PART A

Scientific Council Meeting, 3-18 June 1998

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SCIENTIFIC COUNCIL MEETING, 3-18 JUNE 1998

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REPORT OF SCIENTIFIC COUNCIL

3-18 June 1998

Chairman: H. P. Cornus Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada, during 3-18 June 1998, to consider the various matters 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, 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 3 June 1998.

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

In the review of the Provisional Agenda, the Chairman noted some modifications needed to be incorporated under Items IV, V and VI.

The Chairman reported that consequent to the Scientific Council Workshop on the Precautionary Approach (PA) during 17-27 March 1998, and the joint Scientific Council and Fisheries Commission Working Group Meeting during 12-13 May 1998, STACFIS and the Council will address the issue of establishing Reference Points during these stock assessments. The Council then **adopted** the agenda with the proposed revisions.

The Chairman welcomed the observer, M. Perotti, from FAO, Rome, who had been invited to participate in the review of discrepancies between the NAFO and FAO statistical data bases, during (1-6 June 1998) this meeting period.

The Assistant Executive Secretary informed the Council that there was a request from the EU/Venezuela, Columbia, Equador and Peru study team on fishery science and management programs, to send 2 observers to learn about Scientific Council procedures during this meeting. Noting that this would be a learning exercise for the South American group, the Council saw no difficulty accommodating the observers, and requested the Assistant Executive Secretary to extend an invitation on behalf of the Council[a].

With respect to the election of the next Chairman of the Standing Committee on Fisheries Environment (STACFEN), the Council accepted the Chairman's proposal to appoint a Nominating Committee composed of W. R. Bowering (Canada), A. Vazquez (EU-Spain), and F. M. Serchuk (USA) to propose nominations.

In introducing the plan of work, the Chairman described the approach being taken will be such that STACFIS will conduct the assessments, prepare responses to special requests of Fisheries Commission and Coastal States and provide guidance on developing advice. The Council will then address the tasks of developing prognoses on those assessments, determining Reference Points for the PA and providing advice and recommendations.

The Council was informed that the Executive Secretary had received authorization from Estonia, Lithuania and Norway, to record their abstentions during any voting procedures, in respect of Rule 2.3 of the Rules of Procedure.

The Chairman noted the report of the Workshop on PA of March 1998 needed corrections and editorial modifications. It was agreed a small group of Council members, including H. P. Cornus (EU-Germany), D. Rivard (Canada), F. Serchuk (USA) and J. Casey (EU-United Kingdom), will review the report and provide proposals to the Council, during the latter part of this meeting.

[a] The Council subsequently received regrets that travel plan difficulties precluded their attendance.

The Chairman made a presentation as an update on activities since the September 1997 Meeting and a progress report on PA. It was noted that resulting from deliberations on the PA since June 1997, the Council needed to attend to the listed recommendations as well as the responsibilities of the scientists and managers toward developing Reference Points and precautionary measures. It was also observed that globally acceptable terminology for the PA should be developed as soon as possible.

The opening session was adjourned at 1430 hours on 3 June 1998.

The Council reconvened at 0910 hours on 16 June 1998, to consider matters relating to Agenda Item II on the Precautionary Approach. The session was adjourned at 1200 hours. The Council reconvened at 1830 hours again to consider Agenda item VII.

The Scientific Council was pleased with the progress made on both the 1998 Scientific Council Symposium and the 1999 joint NAFO/ICES/PICES Symposium and special appreciation was extended to J. Morgan (Canada) and P. Koeller (Canada), respectively, for their work to date on the Symposia. The session was adjourned at 2000 hours.

The Council reconvened at 0915 hours on 17 June 1998 to consider management advice on various stocks and also provide responses to special requests from the Fisheries Commission and the Coastal States. These discussions and on other outstanding matters on the agenda were continued in sessions through to 18 June 1998, while STACFIS and STACPUB also completed their agenda. At its sessions on 18 June 1998, the Council received the nomination, and elected the Chairman for STACFEN (see Section IX below), and considered its future meetings (see Section VIII below). The Council also particularly focused on facilities and requirements for its meetings, and the lengths of its meetings and structure of the final reports (see Section XI below).

The Council considered and **adopted** the Reports of STACFIS and STACPUB, noting summary texts to these Standing Committee reports will be edited by the Chairman R. K. Mayo (USA) and W. B. Brodie (Canada), respectively. The Reports of STACFEN and STACREC were **adopted** during earlier sessions.

The Council then considered and **adopted** the Report of the Scientific Council of this meeting of 3-18 June 1998, noting the Chairman and the Assistant Executive Secretary will finalize the text after the meeting.

The meeting was adjourned at 1330 hours on 18 June 1998.

The Reports of the Standing Committees are appended as follows: Appendix I. STACFEN, Appendix II. STACFIS, Appendix III. STACREC and Appendix IV. STACPUB.

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

The Council's considerations on the Standing Committee Reports, and other matters addressed by the Council follow in Sections II-X, and the Council endorsed recommendations are given in Part D of this volume.

II. PRECAUTIONARY APPROACH (PA)

1. Review of Report of the Workshop on PA in March 1998

The following terms of reference were give to the Workshop of 17-27 March 1998 by Scientific Council based on its own considerations and on the requests of Fisheries Commission:

- Description of procedures for determining reference point
- Determination of reference points for all stocks under the responsibility of the Fisheries Commission
- Specification of decision rules
- Developing criteria for fisheries re-openings
- Identification of data collection and monitoring activities
- Definition of research requirements
- Indication of time frames and funding

The Workshop was held at NAFO Headquarters, 17-27 March 1998, with Scientific Council Chairman, H. P. Cornus (EU-Germany) as Chairman. Forty seven participants attended from 13 countries. The report of the Workshop after editorial modifications was issued as SCR Doc. 98/76.

The Workshop was structured in two parts. In **Part 1,** a general review of progress to-date of the implementation of Precautionary Approach (PA) in other fora was made. These were from ICES, ICCAT, USA and FAO. Theoretical aspects related to methods for determination of reference points, evaluation of uncertainty, decision rules, re-opening criteria and other aspects of the PA were considered.

The Workshop reviewed methods for calculation of reference points. These were based on general production, yield and SSB per recruit. Also other methods incorporating qualitative criteria or utilizing biological parameters, such as length and growth, were discussed.

Several publications related to the evaluation of uncertainty were reviewed and methods discussed and tested without any preference. It was agreed that a variety of methods were available but no general guidelines for selection of methods could be provided. Quantification of uncertainty was considered important in the context of management actions, but limits established from such measures have to be discussed jointly with the managers.

Six publications covering several aspects of decision rules were discussed. It was agreed that decision rules have to be stock specific and that there is no generic decision rule. It was proposed the Scientific Council should focus on decision rules for providing rebuilding of stocks and re-opening of fisheries, as these are topics of priority in the context of the situation of most stocks in the NAFO area.

There was agreement that there was no need for separate criteria for re-opening of fisheries in the PA context. However, the reproductive dynamics of a stock may be different "on the way up" compared to "on the way down". Therefore there might be the need for different management actions. The "half-way point" criterion (half way between point of closure and long-term average) proposed by the Canadian FRCC (Fisheries Resource Conservation Council) for re-opening of fisheries was considered as a valuable procedure in case of data limitations. It was stressed that the Scientific Council framework is not limited to SSB and F parameters as criteria for re-opening, but that biological parameters should be considered as complementary information.

Other aspects of PA like exploitation pattern, stock age and length composition as well as growth, maturity and mortality, species interactions and technical interactions were discussed.

Exploitation pattern is an important factor in the PA context. For instance, changes in mesh size and selectivity imply changes in reference points. A mesh size decided by the management is an important decision as it determines the survival rate of the youngest year-class entering the fisheries. There is also an optimum mesh size and selectivity related to a management objective.

Stock age and length composition should also be considered as parameters relevant for the PA. Truncated age and length distributions are a common feature in NAFO stocks which have declined drastically in recent years. These declines coincide with age and length at 50% maturity, resulting in fish spawning at smaller sizes and younger ages. This implies different reference points related to historical stock compositions compared to current ones.

Growth, maturity and mortality are critical for evaluation of stock status, estimation of SSB and S/R relationships, as well as determination of reference points.

A very important issue in the context of PA are species interactions. These are important when decision rules are established. Valuable sources of information are the Reports of the ICES Multispecies Assessment Working Group 1997 and the ICES Working Group on Ecosystem Effects of Fishing 1998. The ICES Multispecies Assessment Working Group came to important conclusions. In multispecies systems fishing mortality based reference points may be overestimated by single species methods. Also recovery time may be underestimated by single species methods. Rebuilding predator populations may be detrimental for prey stocks. Multispecies systems exhibit extreme complexity but presently there are no tools to appropriately evaluate single species reference points in multispecies framework. The Working Group found no universal treatment which would be appropriate for all multispecies associations. However, the Working Group stressed that complexity is no excuse to not consider multispecies interactions within a PA framework.

The ICES Working Group on Ecosystem Effects of Fishing also considered important issues in relation to PA. In an ecosystem context additional single species reference points could cover risks on genetic diversity of target stocks, conservation of non-target species, conservation of dependent predatory species and conservation of species due to scavengers on discards and offal. Different modelling approaches indicate that an ecosystem is not at risk if none of the constituent species were at risk. However, it is known that fishing has changed size composition in ecosystems. Changes in predator size composition affects predation pressure on lower trophic

levels. Fishery induced change of numbers of individuals and biomass in different trophic levels affects flux and residency of nutrients in ecosystems. To investigate these effects, programs are required to identify ecosystem properties which require more than just conservation of individual components, which of these properties could be placed at risk by fishing, management measures which are necessary to achieve conservation of such properties and methods to measure and monitor properties potentially at risk from fishing. The NAFO Scientific Council Workshop on PA endorsed the importance of persuing and promoting related investigations.

The Scientific Council Workshop also considered technical interactions in the PA context. The most important issue in this context was the by-catch problem. Well known in existing fisheries, this problem is inevitably expected in new developing fisheries as has been observed when a shrimp fishery quickly developed in recent years on Flemish Cap. It gets a high priority in the context of re-opening fisheries in an area where other stocks are still under moratoria. An actual example in the NAFO area is the yellowtail flounder fishery on the Grand Banks.

Part 2 dealt with NAFO specific issues of the PA. For NAFO stocks precautionary reference points and harvest control rules (decision rules) as well as future development were discussed.

The Workshop agreed to select one stock for detailed consideration and the development of ideas which can be used also to address the other stocks. For all other stocks, attempts were made to determine reference points and propose decision rules as data allowed. Of these, four stocks were also handled in more detail. The American plaice stock in Div. 3LNO was selected as the stock for detailed consideration because the data for this stock were sufficient to apply all considered methods. Other stocks (Greenland halibut in Subarea 2 and Div. 3KLMNO, shrimp in Div. 3M, redfish in Div. 3M and short-finned squid in Subareas 3 to 6) were selected for more detailed discussion because of the problems experienced with the assessments. It was agreed that work be continued between Scientific Council Meetings. The detailed evaluations are available in the workshop report (SCR Doc. 98/76) and elsewhere in this report

For the NAFO stocks, general remarks were made. In the case of poor data the Annex II of the UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks (1995) proposes provisional reference points. It was noted not simply to take the lowest observed biomass from survey series as biomass limit reference point. In the NAFO area those values can be too low to serve as limit reference points. In such a situation thorough investigations are required. A non-parametric PA framework was reviewed which allows to develop a set of rules to adjust catch levels. However, this requires sufficient long time series.

In the case of developing fisheries, conservative caps on fishing capacity and fishing mortality should be installed unless there is a reliable basis of knowledge for increasing the fishery.

If there is a management decision to re-open a fishery, catches should be constrained in a rebuilding phase to guarantee a precautionary development of the re-opened fishery. In addition by-catches of species under closure in the area in which the re-opened fishery operates have to be considered in the management considerations.

There may be a change in production dynamics after a collapsed stock recovered. In such a situation reference points have to be recalculated.

Obvious features in the NAFO area are environmental changes which influence fish stock development. These effects have to be included in the evaluation of precautionary reference points, especially limit reference points, which serve as boundaries of danger zones for stock development.

The Workshop noted that continuation on work on the PA would have financial impacts. There is an identified significant need to reduce the levels of uncertainty around developing reference points for all of the NAFO stocks, and in many cases the levels of uncertainty are broad. These uncertainties, unless narrowed down in a short time frame, may have considerable economic impacts resulting from inappropriate management decisions. The Workshop believed that financial investment toward those research initiatives is an essential commitment in the development of the Precautionary Approach to Management of NAFO Stocks.

The Scientific Council reviewed the Report of the Workshop (SCR Doc. 98/76) and modified it to conform with the views of the Scientific Council during this meeting, and this report is issued as the "Report of Scientific Council on the Development of Precautionary Approach to Fisheries Management" (SCS Doc. 98/1).

2. **Fisheries Commission/Scientific Council Working Group on the PA to Fisheries Management, Copenhagen, Denmark, 12 to 13 May 1998**

As basis for discussion the Working Group started with three presentations. The Chairman of Scientific Council repeated the presentation (abbreviated) of the framework for implemention of the PA in the advice by Scientific Council which he had given at the Fisheries Commission Meeting during the Annual Meeting in September 1997 in St. John's, Newfoundland. The Chairman of the Fisheries Commission added a presentation of his view of the PA.

In the discussion following the presentations a number of different perspectives were put forward. It was noted that a lack of information should not be a reason to not use the PA and that the information gap should be closed as appropriate. The potential role of buffer points (security margins) was emphasized in that they provide warnings before the stock gets to the limit points. It was agreed that where buffer points are reached, remedial actions would be taken but that this may not necessarily imply automatic closures of fisheries. It was suggested that the PA cannot mean conservation at any cost; economic and social aspects need to be considered. It was also noted that although discussion had focussed on reference points and harvest control rules, there were other possible precautionary measures such as closed areas, fish size restrictions, gear regulations and effort controls which may also be implemented. The Working Group agreed that in addition to development and implementation of harvest control rules and reference points, other management tools and concepts need to be identified to enable the wide application of the PA within NAFO. The importance of continued separation of the roles of science and management was emphasized. For example, science should provide managers with explicit expressions of uncertainty associated with the determination of buffer reference points. The importance of consistent terminology between, for example, NAFO and ICES was also stressed.

This was followed by a presentation by the Chairman of Scientific Council of the results of the Scientific Council Workshop on PA held during 17-27 March 1998. Various aspects of the results of this Workshop and again the issue of respective roles of scientists and managers was raised and discussed. It was considered that some specific examples of harvest control rules are needed in order to better understand the meaning of this concept, although these are ultimately the domain of managers. Also, harvest control rules have to be developed carefully and should not be too rigid because it is important that industry and fishermen "buy into" the concepts.

Activities in relation to PA of various Contracting Parties including national and international interactions were then considered.

The Working Group was not in a position to discuss specifically possible management actions or the relationships between management objectives and advice during the meeting. Nonetheless, the Working Group considered it important to clarify the respective roles of scientists and managers in the process of implementation of the PA. The respective roles were discussed and are tabulated below:

Scientific Council	Fisheries Commission
1. Determine status of stocks. 2. Classify stock status with respect to biomass/fishing mortality zones. 3. Calculate limit reference points and security margins. 4. Describe and characterize uncertainty associated with current and projected stock status with respect to reference points. 5. Conduct risk assessments.	1. Specify management objectives, select target reference points, and set limit reference points. 2. Specify management strategies (courses of actions) for biomass/fishing mortality zones. 3. Specify time horizons for stock rebuilding and for fishing mortality adjustments to ensure stock recovery and/or avoid stock collapse. 4. Specify acceptable levels of risk to be used in evaluating possible consequences of management actions.

Generally the managers emphasized the need to be provided by Scientific Council with options of buffer reference points relating to different levels of probability to be off a limit reference point. In addition options of stock specific harvest control rules should be developed. It was agreed that this would be best achieved incorporating managers and scientists together in the developing process.

The Working Group **recommended** to the Fisheries Commisssion that following priority issues be given to the Scientific Council:

- Standardization of concepts/nomenclature/abbreviations/definitions between ICES, NAFO and FAO as appropriate.
- Estimation of limit reference points
  - Biomass, specifically B_{lim} and B_{buf}
  - Fishing mortality, specifically F_{lim} and F_{buf}.

- Calculate limit reference points and security margins which offer a high probability of not approaching established limit reference points.
- Give the information as reflected in Fig. 14b and 15 of the Workshop Report (SCR Doc. 98/76) for as many stocks as possible.
- Review the Harvest Control Rule (HCR) concept provided by the Scientific Council Precautionary Approach Framework (SCS Doc. 97/12, Scientific Council Report 1997, page 35), considering the respective responsibilities of scientists and managers.
- Give additional examples of re-opening simulations for American plaice in Div. 3LNO.
- Continuation of this Working Group as an instrument for a dialogue with the Scientific Council.

3. **Future Development**

Based on the review of the 17-27 March 1998 Scientific Council Workshop, and the results of the Fisheries Commission/Scientific Council Working Group Meeting of 12-13 May 1998, the Council agreed a Scientific Council Special meeting on the PA would be held in spring 1999 (see also Section X.lb). This meeting will be timed and located so as to convey the results to Fisheries Commission Representatives during the intersessional period.

The objective of the Scientific Council Special Meeting will be to develop guidelines for precautionary reference points for NAFO stocks. It was proposed that reference points will be reconsidered, in order to use them in the Scientific Council assessments of stocks. Some methods applied and calculations considered to date need to be critically reviewed, particularly in the context of the specific roles identified for Scientific Council and the Fisheries Commission. A review of decision rules identified as a priority by the NAFO Working Group on Precautionary Approach will also be conducted at this meeting.

The Council will further address this matter during its meeting of 6-18 September 1998 in Lisbon, Portugal.

III. 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's summary of the Committee's deliberations are presented below.

2. **Summary of the Committee Report**

a) **Invited Lecture**

The Council noted that an invited lecture was given by D. Mountain of the National Marine Fisheries Service in Woods Hole, USA, entitled '*Recent Water Property Variability in Subareas 5 and 6*'. Interannual changes in the water properties within the Gulf can result from either variations in properties of the source waters themselves or in the relative amounts of the source waters in the mixture. Observations show that such changes tend to persist for a few years or more. On the Middle Atlantic Bight, the volume of shelf waters has significant interannual variability. Temperature appears to be controlled more by local air-sea heat fluxes while salinity is largely determined by advection, both from the north along the shelf and from the offshore. Recent studies show that temperature anomalies are correlated with the shelf water volume, that is the mean temperature over the entire Bight is determined more by the proportion of water types rather than changes in the temperature of the constituent water types.

b) **Invited Paper**

The Council noted that E. B. Colbourne from the Department of Fisheries and Oceans in St. John's, Newfoundland, Canada, presented an invited paper entitled '*Oceanographic Variability on the Flemish Cap*'. Interannual variability in the temperature and salinity conditions of the Flemish Cap waters were found to be highly correlated to those observed in the inshore branch of the Labrador Current and in other areas of the continental shelves off Newfoundland. Advection of Labrador Current water into the region appears to be the principle cause of hydrographic variability on the Cap. The presence of an anticyclonic gyre over the Cap was confirmed. Based upon repeated summertime surveys, chlorophyll concentrations in the surface layers over the Cap are high relative to those on the Grand Banks.

c) **Marine Environmental Data Service (MEDS) Report**

The Council noted that MEDS has been involved in developing a biological oceanographic database, in distributing data collected during the World Ocean Circulation Experiment (WOCE) including taking the lead in the production of all of the available WOCE data on CD-ROMs, and supporting and co-ordinating the Ships of Opportunity Program (SOOP). MEDS has also been active within the ICES Working Group on Marine Data Management and the Canadian National Data Management Working Group.

d) **Review of Environmental Studies in 1997**

The Council noted that 12 scientific documents dealing with environmental issues were reviewed. Annual air temperatures over Greenland were generally above normal. These conditions contributed to below normal sea ice cover and above normal subsurface ocean temperatures. Based upon a harmonic model, it was argued that the recent warming is expected to be temporary and that the long-term trend into the 21st century will remain one of declining temperatures. A significant drop in salinity in the upper 300 m and in the Irminger Water is believed to be signaling the beginning of a new "Great Salinity Anomaly". The NAO index was below normal in the winter of 1996/97, a condition that is generally associated with milder air in the Greenland area.

Hydrographic data collected in the summer off West Greenland revealed very low temperatures in 1997 on Fyllas Bank although air temperatures were quite warm. This may indicate a strong inflow of Polar water from East Greenland. Low salinities were also observed on Fyllas Bank and to the north during 1997 and in 1996. This is further support for the idea that another "Great Salinity Anomaly" may be underway.

Hydrographic measurements made on Flemish Cap in July 1997 revealed coldest waters to be observed on the western side of the Cap. Geostrophic current estimates showed the presence of an anticyclonic gyre on the Cap, consistent with historic measurements. The data also suggested the possibility of smaller eddies on the Cap with adjacent upwelling and downwelling areas. It was noted that shrimp were found in the coldest areas of the Cap.

Research into the hydrographic conditions on the Scotian Shelf and adjacent areas suggested that there has been an increase in the transport of Labrador waters into the cold intermediate layer of the Scotian Shelf. Warmer slope water was advected into the deeper basins of the Scotian Shelf during the summer and autumn compared to 1996. A surface temperature anomaly of +1K around Sable Island was suggested as a possible cause of the anomalously abundant year-class of silver hake.

Warm slope waters that have traditionally occupied the continental slope off the Scotian Shelf and Gulf of Maine over the past 30 years were displaced by colder, fresher Labrador slope water in the autumn of 1997.

Temperature measurements in the Middle Atlantic Bight revealed below normal conditions at the surface and in the near bottom layer. These both were warmer than in 1996, however. Surface salinity anomalies were also low, and continued the trend of low salinities observed in 1996. Near surface temperatures across the Gulf of Maine transect were near normal, but the near bottom water was slightly above normal.

e) **Interdisciplinary Studies**

The Council noted that interdisciplinary studies were reviewed. Near-bottom temperatures during groundfish surveys off East and West Greenland showed high geographical coherence with cold conditions during 1982-84, warmer conditions in 1985-86, a decreasing trend in 1987-89 and a warming since then. Warmer temperatures, as found during recent years, are favourable for fish growth and reproduction.

A study on the effects of the North Atlantic Oscillation (NAO) on cod recruitment off Greenland was presented. The first objective was to outline the causal mechanisms through which the NAO may affect recruitment. It was suggested that this occurs through the NAO's influence upon air and subsequently, sea temperatures. The second objective was to discuss the necessity of incorporating environmental variability effects into the fish stock assessment process.

f) **Overview of Environmental Conditions in 1997**

The Council was pleased that the annual overview paper was presented containing information on several long-term oceanographic and meteorological data sets. The overview presentation reported that annual air temperatures were above normal in 1997 in the Labrador Sea region but down from their 1996 levels. Along the Atlantic coast, air temperature sites revealed colder-than-normal conditions. Opposite air temperature anomaly trends over the Labrador Sea and the Middle Atlantic Bight have been observed in most of the past 30 years.

The atmospheric circulation pattern weakened resulting in the anomaly of the NAO index being negative. This was the second consecutive year with a below normal NAO index.

Off Newfoundland and Labrador ice left early by more than a month but in much of the Gulf of St. Lawrence the ice remained later-than-normal. Ice conditions were more severe than in 1996 but less than during the early-1990s.

Temperatures in 1997 throughout most of the water column off Newfoundland were below normal, except near bottom where they were slightly above normal. Temperatures were generally cooler than in 1996.

The volume extent of the CIL water off Newfoundland during the summer was near its lowest value on record, similar to 1996.

Deep water temperatures on the Scotian Shelf (Emerald Basin) and in the Gulf of Maine remained high during 1997 while in the Cabot Strait they remained near or slightly above normal. 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.

Cold Labrador slope waters replaced warm slope water along the shelf edge off the Scotian Shelf during the autumn. This water did not penetrate onto the Shelf during 1997.

Both the shelf/slope front and the north wall of the Gulf Stream were seaward of the their long-term mean positions.

g) **Recommendations and Conclusions**

Scientific Council endorsed the STACFEN **recommendation** that NAFO co-sponsors, along with ICES, the Joint ICES/NAFO Decadal Symposium to be held in August 2001 in Edinburgh. Given that both NAFO and ICES would be proposing to hold similar symposia on a review of the 1990s early in the next decade, the Council feels that a single symposium is more efficient.

The Council recognized the need to incorporate environmental information into fisheries management, and felt that increased effort is required to establish more of the links between fisheries and oceanographic variability.

The Council suggested analysis of possible effects of the recently observed low salinities in the Newfoundland region by examining the fisheries responses to past low salinity events.

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

1. **Opening**

The Council accepted the report of STACFIS as presented by Chairman, R. K. Mayo (USA). 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 stock-by-stock review of catches and fishing activities 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 were 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 X of this report, along with the other special advice with 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. **Research Activities**

a) **Review of NAFO/ICES Working Group on Harp and Hooded Seals**

The Council extended it appreciation to G. Stenson (Canada), Chairman of the Working Group, for preparing an informative report, and to D. B. Atkinson (Canada) for the detailed presentation of the report of the Working Group meeting which was held in Copenhagen, Denmark during 28 August-3 September 1997. The Council noted and endorsed several recommendations of the Working Group as they pertain to seals in the NAFO Area.

The Council confirmed that the Chairman of the NAFO/ICES Working Group on Harp and Hooded Seals should routinely present information pertinent to the Council, in time for consideration at the June Meeting of the Scientific Council.

b) **Report on Comparative Fishing Studies**

i) **Between Campelen survey trawl and Spanish survey gear**

The Council noted STACFIS considered a proposal for comparative fishing trials between Spanish and Canadian research vessels, to allow comparisons of results of bottom trawl surveys conducted independently by each country. It was proposed that this work should commence in spring 1999 and be repeated in subsequent years to develop an acceptable database.

ii) **Between the Campelen survey trawl and trawls used in the industry-sponsored surveys**

The Council noted that no specific actions have been taken to develop comparative fishing trials between the Canadian Department of Fisheries and Oceans trawl and trawls used in the industry-sponsored surveys.

iii) **Between Japan and Greenland surveys on Greenland halibut**

The Council noted that comparative fishing trials between Japan and Greenland research vessels were not carried out during 1997.

c) **Ageing Studies**

The Council noted STACFIS will review the report on age validation of roughhead grenadier (SCR Doc. 98/33) during its September 1998 Meeting, although it was presented and briefly reviewed at this meeting.

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

1. **Opening**

The Council welcomed the report of STACREC as presented by the Chairman V. Shibanov (Russia), observing that the matters referred by the Council were addressed.

2. **Fishery Statistics**

a) **Progress report on Secretariat activities in 1997/98**

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

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 tabulations prepared by STACREC of data that have not been received, the Council endorsed the STACREC **recommendation** and agreed to submit the text of the STACREC report regarding this matter to the Fisheries Commission.

ii) **Publication of statistical information**

The Council noted that *NAFO Statistical Bulletin* No. 43 was published in December 1997, but noted that publication of Bulletins 44 and 45 containing 1994 and 1995 data have not been completed since data for 1994 from the United States and data for 1995 from the Faroe Islands and the United States were still outstanding. Noting that STACREC was informed that the data from the USA would be forthcoming by the end of 1998, the Council agreed to await the submission of these data before publishing *NAFO Statistical Bulletin* Vol. 44 and 45.

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

With respect to establishing a website to facilitate the dissemination of STATLANT and other statistical data, the Council noted the progress that had been made at the Secretariat. With respect to security of scientific data and information, the Council endorsed the **recommendation** of STACREC that online access to data on the NAFO website be at the STATLANT 21A level and that access to 21B data should be *via* restricted FTP accounts.

The Council also agreed with the STACREC request that the Secretariat checks that all hardware and software are year 2000 compliant, and that the database modifications and further developing of the Secretariat capabilities be addressed.

iv) **Inter-agency data harmonization (NAFO/FAO)**

The Council was pleased the Assistant Executive Secretary, T. Amaratunga and STACREC Chairman, V. Shibanov, had attended meetings with FAO and EUROSTAT to address NAFO/FAO data harmonization and noted that inter-Secretariat collaboration had eliminated many of the discrepancies between the FAO and NAFO catch databases. The Council also noted that there were some serious discrepancies still remaining and that the NAFO and FAO Secretariats should be contacting national authorities for advice in certain cases.

The Council recognized the value of this work in safeguarding the credibility of the databases and endorsed the STACREC **recommendation** that inter-agency statistical data harmonization be continued as a regular procedure in order that the discrepancies be detected at as early a stage as possible. The Council also endorsed the STACREC **recommendation** that national authorities should be encouraged to submit statistics with a maximum of detail with regard to the species composition of the catch, in order to minimize one of the main causes of inter-agency discrepancies.

b) **The CWP 18th Session**

i) **Report on Intersessional Meeting of 25-27 February 1998**

The Council was pleased the Assistant Executive Secretary T. Amaratunga and STACREC Chairman, V. Shibanov (Russia) had attended the CWP Intersessional Meeting (ISM) in Rome. The Council noted that its concerns on harmonizing inter-agency data were addressed at the ISM and that these issues will be continued in subsequent CWP Meetings.

The Council also noted the discussions at the ISM on dissemination of statistics (reaffirmation of the principle that regional agencies were trustees rather than owners of statistical data, and the use of the WWW for data dissemination), conversion factors, the request from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) for improved availability of data on catches of elasmobranchs and the work on eliminating discrepancies between agency databases.

ii) **Considerations for CWP 18th Session, Luxembourg, July 1999**

The Council noted the STACREC comments on the CWP-18 Provisional Agenda compiled by the ISM and agreed with STACREC that in addition to the agenda items for which NAFO had already been requested to make contributions, inter-agency data harmonization and elasmobranch statistics should also be the subject of inputs from NAFO.

The Council also agreed with STACREC that there was a need for a harmonization among international agencies of the concepts and definitions used in the application of the Precautionary Approach and endorsed the proposal of STACREC that, the advice of the CWP be sought under the agenda item "Statistical Implications of the Precautionary Approach".

The Council endorsed the STACREC **recommendation** that the Scientific Council be represented at the CWP 18th Session in Luxembourg during 5-9 July 1999 (including a pre-meeting session on 5 July) by the Assistant Executive Secretary and the STACREC Chairman.

The Council also noted that it could include a representative from a NAFO Contracting Party in its representation at the CWP, and invited interested national participants to declare their interest at the September 1998 Meeting of the Council.

3. **Biological Sampling**

a) **Report on Activities in 1997/98**

The Council noted that the Secretariat, in accordance with its June 1997 recommendation, had prepared the listings of biological sampling data for 1996 and 1997 received by 30 May 1998. Data from commercial

fisheries pertinent to stock assessments were also tabulated and National Representatives reported their sampling programs for the 1997 commercial fisheries to STACREC.

The Council endorsed the STACREC **recommendation** that the Secretariat examine the various datasets compiled by NAFO, which may be available electronically in the future, and consider appropriate codes and abbreviations in order to develop means of cross referencing the information easily.

The Council noted the request from Canada regarding the inclusion of a new country component code for Canada, Central and Arctic and endorsed the STACREC **recommendation** that the Secretariat make provision for a new code for Canada - Central and Arctic.

4. **Biological Surveys**

a) **Review of Survey Activities in 1997**

The Council noted that an inventory of biological surveys conducted in 1997 was compiled by the Secretariat and that more detailed accounts of survey data for 1997 were tabled by National Representatives and Designated Experts for the stocks for which they have responsibility.

b) **Surveys Planned for 1998 and Early-1999**

The Council noted an inventory of biological surveys planned for 1998 and early-1999, 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 that a paper describing the skate fishery and survey results in Div. 3NO was reviewed and noting the increasing world-wide interest in elasmobranchs, endorsed the STACREC **recommendation** that analyses on the distribution and abundance of elasmobranchs and other non-traditional species be carried out and the results presented to STACREC at the earliest opportunity.

b) **Report on the CITES Meeting on the Co-ordination of Shark Data Collection**

The Council noted the CITES resolution requesting regional fishery agencies to improve the collection of data on shark catches and the responses by ICES and by ICCAT. The Council also noted that the CITES resolution had been discussed at the CWP 17th Session. The CWP had highlighted that identification of some elasmobranch species could be problematic, and the Council endorsed the STACREC **recommendation** that NAFO encourage training in identification and reporting of elasmobranchs.

c) **Report on Northwest Atlantic/Gulf/Caribbean Regional Shark Management Workshop**

The Council was pleased that as recommended by the Council, F. M. Serchuk (USA) attended the Northwest Atlantic, Gulf of Mexico and Caribbean Sea Regional Strategy Development Workshop for the Conservation and Management of Sharks held on 4-5 December 1997 at the Mote Marine Laboratory, Sarasota, Florida, USA, as a NAFO observer, and gave a presentation on the history and mandate of NAFO.

The Council noted that the information developed at the Workshop was subsequently used in preparing background documents for the meeting of the FAO Technical Working Group (TWG) on the Conservation and Management of Sharks held 23-27 April 1998 in Tokyo, Japan. The principal remit of the TWG meeting was to (1) formulate guidelines for the conservation and management of sharks (including data and research needs) at the national and regional levels; and (2) develop a global Plan of Action for the conservation and management of sharks.

The Council noted that NAFO was not represented at the FAO TWG on the Conservation and Management of Sharks held 23-27 April 1998 in Tokyo, Japan, and that a global Plan of Action for the conservation and management of sharks is to be reviewed at an October 1988 FAO Consultation on the Plans of Action and

considered for adoption at the 23rd Session of the FAO Committee on Fisheries (COFI) during 15-19 February 1999. The Council endorsed the STACREC **recommendation** that the Secretariat approach FAO requesting that a Scientific Council representative be invited to attend the October 1998 FAO Consultation on the Plans of Action for the conservation and management of sharks.

The Council noted that NAFO had received an invitation from FAO to attend the preparatory meeting of COFI "Meeting of FAO and non-FAO Regional Fishery Bodies" during 11-12 February 1999, dealing with various inter-agency activities focusing on promotion of code of conduct for responsible fisheries within different agencies. This meeting will be a preparatory meeting for the above-mentioned COFI Meeting. The Scientific Council **recommended** that *NAFO accept the invitation and endorsed the STACREC recommendation that the Scientific Council nominate a representative to participate, noting also that this would be a suitable forum for discussion of harmonization of terminology in relation to the Precautionary Approach*.

The Council further noted that FAO is also developing a plan of action on the incidental capture of seabirds in longline fisheries and a plan of action on managing fishing capacity and endorsed the STACREC **recommendation** that the NAFO Secretariat inform FAO of its interest in these initiatives and request that FAO keep NAFO informed of any progress.

d) **Catch-data Collection of Elasmobranchs**

In response to the CITES resolution on shark data collection, the Council endorsed the STACREC **recommendation** that an expanded list of individually identified species of elasmobranchs be included on the STATLANT 21A questionnaire and that the national authorities be requested to submit catch statistics with a maximum degree of detail.

The Council also noted that catch data on elasmobranchs from the NAFO Convention Area by Subarea from 1992 to 1996 summarized by the Secretariat indicated that substantial catches were reported.

6. **Species Breakdown of Grenadier Fisheries Statistics**

The Council noted that in Subarea 3 south of Div. 3K, the catch composition of grenadiers is 80%-90% roughhead grenadier, whereas catches are reported as roundnose grenadier. Noting that accurate reporting of catches is of paramount importance to stock assessments, the Council endorsed the STACREC **recommendation** that identification of grenadiers should be publicized, and that Scientific Council consider for 1999 that members with data on roughhead grenadier bring such data to its June 1999 Meeting to attempt an assessment on this species.

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

The Council noted that four documents were reviewed.

8. **Other Matters**

a) **Tagging Activities**

The Council noted that the Secretariat had compiled a list of tagging activities carried out in 1997 (SCS Doc. 98/4).

b) **Scientific Data from Pilot Observer Program**

The Council noted that a meeting of the Standing Committee on International Control (STACTIC) had taken place during May 1998 and that the report of that meeting showed no knowledge of the Council's detailed protocol developed for the Pilot Observer Program at the June 1997 Meeting and the subsequent document (FC WP 97/8) presented to STACTIC, and that STACTIC had requested the same details again.

The Council endorsed the STACREC **recommendation** that the Fisheries Commission be informed that the information being requested had previously been furnished.

c) **Conversion Factors**

The Council noted that the information being compiled by EUROSTAT and FAO on the factors used to convert landings data to the live weight equivalent, may soon be published together with the factors used by FAO in the compilation of food balance sheets for fishery products and reports on two studies on conversion factors commissioned by FAO.

Noting the importance of conversion factors in compiling catch statistics, the Council welcomed the advances made in this work.

d) **Description of Fishing Effort**

The Council noted a new proposal for recording fishing effort for boat seines (Danish seine, etc.) was suggested. The Council endorsed the STACREC **recommendation** that the following definition of fishing effort for boat seines (Danish, etc.) should be referred to the CWP to determine its suitability for global definitions: Boat seines (Danish seine etc.). Effort measure: hours fishing per day. Definition: number of times the gear was set or shot per day times the estimated mean set or shot duration.

e) **Other Business**

i) The Council noted that a pair trawl survey using escape window and codend covers to analyse selectivity of sorting grids on bottom trawls in fisheries directed to groundfish in Subarea 3 will be conducted by EU-Spain over a 2-week period towards the end of 1998.

ii) The Council noted the progress made by the STACREC *Ad hoc* Working Group dealing with desirability of storing biological information on a common database, and agreed with the suggestion that the Working Group it be reconvened during at the September 1998 Meeting of Scientific Council.

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

1. **Opening**

The Council welcomed the STACPUB report as presented by the Chairman W. B. Brodie (Canada). The Council's summary of the Committee's deliberations and the recommendations as proposed by the Committee are presented below.

2. **Summary of the Committee Report**

Scientific Council was pleased to note the progress on scientific publications since the June 1997 meeting. The Council also noted the discussions on budgetary issues, particularly with respect to mailing costs and computer expenditures. In this regard, the Council endorsed the STACPUB **recommendations** that the Executive Committee of the Scientific Council be more directly involved in the budgetary process of NAFO, and that the Scientific Council form an *Ad hoc* Working Group to review current and future computer needs. As well, the Scientific Council **recommended** that *its reports be made available to the public through the FTP-server of the NAFO internet, and any cost-savings related to this should be reinvested in the NAFO website and FTP-server.*

Finally, the Council endorsed the **recommendations** that authors be encouraged to bring a copy of their papers to the 1998 NAFO Symposium, and that a collection of abstracts from this Symposium be made available to all participants.

VII. ARRANGEMENTS FOR SPECIAL SESSIONS

1. **Progress Report on the Special Session in 1998**

Symposium on 'Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish' (co-convenors: E. Aro, J. Burnett and J. Morgan): The Council was informed by co-convenor, J. Morgan (Canada), that plans for Symposium were proceeding well. There are in total 35 Abstracts received, in addition to the 4 invited papers received to date. It is likely that there will be 2 additional papers. Authors of 17 papers had indicated they wish their papers be considered for publication in the Journal of Northwest Atlantic Fishery Science, while the others did not wish to publish.

The invited papers are: Kjesbu, O. '*Factors affecting reproductive output in groundfish*', Trippel, E. A. *'Parent-progeny relationships: challenges for groundfish stock assessments*', Dutil, J.-D., M. Castonguay, Y. Lambert, and D. Gilbert. '*Growth, condition and mortality relationships in Atlantic cod: should we factor in latitudinal and temporal variations in stock productivity?*', and Serchuk, F. M., and S. Murawski. '*Implications of variations in maturation, growth, condition and spawning stock biomass production on groundfish management strategies: some real world examples*'.

The Symposium will consist of both oral presentations and posters. A discussion of the implications of changes in maturation, growth, condition and spawning stock biomass production for stock assessment is also planned.

The Council noted the announcement and related information is given in the NAFO website: www.nafo.ca.

The Council expressed its appreciation to J. Morgan and the co-convenors for the considerable progress made. The Council believes this Symposium which will be held during 9-11 September 1998 in conjunction with the Annual Meeting at the Hotel Altis, Lisbon, Portugal, will make valuable scientific contributions, particularly for the Council's work.

2. **Progress Report on the Special Session in 1999**

Joint NAFO/ICES/PICES Symposium on 'Pandalid Shrimp Fisheries - Science and Management at the Millennium' (co-convenors: P. A. Koeller, J. Boutillier and S. Tveite): Since the last report in September 1997, official approval of co-sponsorship was received by NAFO from ICES and PICES. A meeting website was established with links from the NAFO, ICES and PICES sites and to Nova Scotia and Halifax-Dartmouth tourism sites, with periodic updates as plans progress. Participants can pre-register using an e-mail form, submit tentative titles or abstracts, and obtain information on key dates, program, submitted titles, accommodations, social events, etc. The information is in websites http://www.mar.dfo-mpo.gc.ca/shrimp and at NAFO's website (www.nafo.ca).

Invitations to 5 keynote speakers have been extended (replies pending), and funding support has been pledged from a number of member countries and industry. In addition to the usual mail-outs from the sponsoring agencies, a brochure has been designed and will be mailed out shortly to known shrimp researchers, managers and industry members. About a dozen tentative titles have been received, including a number from the Pacific Coast.

The meeting is scheduled for 8-10 September 1999, to be held in conjunction with the NAFO Annual Meeting, in Dartmouth, Nova Scotia, Canada. The Council extended its appreciation to co-convenor P. Koeller (Canada) for his initiatives in developing this Symposium.

3. **Proposals for Special Session in 2000**

This item was deferred to the September 1998 Meeting.

4. **Proposal for Special Session in 2001**

The progress of the proposed Joint ICES/NAFO Decadal Symposium in August 2001 was presented by M. Stein (EU-Germany). Information from J. Meincke, who is one of the convenors, suggested that as a result of the ICES Working Group on Oceanic Hydrography (OHWG, 27-29 April 1998, Santander, Spain), the General Secretary of ICES will contact NAFO and ask for co-sponsorship of NAFO. As for the local preparation (done

by R. Dickson, CEFAS), the Lecture Theatre in Edinburg has been provisionally booked from 8-10 August 2001 and the Great Hall of the Royal Scottish Museum has been booked on 9 August 2001 for the Symposium banquet. The Chief Executive CEFAS and the Director SOAFD Laboratory Aberdeen have agreed to contribute to the cost. A Steering Committee has been set up by the OHWG, and in a letter from ICES General Secretary, invitations have been sent to M. Stein (EU-Germany) to be a member of the Steering Committee and K. Drinkwater (Canada) to be in the Scientific Editorial Committee.

The Council noted that this proposed Symposium would be of good value to the Scientific Council, considering that it also undertakes the decadal review of environmental conditions in the Northwest Atlantic. However, it was noted that the proposed dates will not coincide with NAFO Meetings and, as a result, usual NAFO participants may not be able to attend the Symposium.

VIII. FUTURE SCIENTIFIC COUNCIL MEETINGS

1. **Annual Meeting and Symposium, September 1998**

The Scientific Council will next meet at the Annual Meeting of NAFO in September 1998, at the Hotel Altis, Lisbon, Portugal.

The Council reconfirmed to meet during 6-8 September 1998, which includes Sunday, 6 September, to address the Assessment of Shrimp in Div. 3M and the special request on Shrimp in Div. 3LNO. The rest of the Agenda for the September 1998 Scientific Council Meeting will be addressed during 14-18 September 1998.

The Scientific Council Symposium on *'Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish*' will be held during 8-11 September 1998, at the Hotel Altis, Lisbon, Portugal.

2. **Shrimp Assessment Meeting in November 1998**

The Council reconfirmed its plan to conduct its meeting for the assessment of Shrimp in Subareas 0 and 1, and Shrimp in Denmark Strait, during 6-10 November 1998 in Copenhagen, Denmark.

3. **Precautionary Approach Meeting in Spring 1999**

The Council will conduct a meeting on the Precautionary Approach in spring 1999. The venue and dates will be discussed during the Council Meeting in September 1998.

4. **Scientific Council Meeting in June 1999**

The Council reconfirmed its agreed dates of 2-17 June 1999. It was, however, noted that these June assessment meetings are long. It was agreed that the Council will review the timing, contents and logistic of the June 1999 Meeting, at its meeting in September 1998. It was also agreed meeting facilities and computer requirements would be discussed at that time.

5. **Annual Meeting and Symposium in 1999**

The Council agreed on the provisional dates of 5-7 September 1999 for its meeting on the assessment of Shrimp in Div. 3M, and 13-17 September 1999 for the rest of its Annual Meeting agenda.

The Scientific Council Symposium on '*Pandalid Shrimp Fisheries - Science and Management at the Millennium*' is scheduled for 8-10 September 1999, in conjunction with the Annual Meeting.

6. **Scientific Council Meetings in Year 2000**

It was tentatively noted that the June Meeting of the Council would be during 7-22 June 2000, however, it was noted that the Scientific Council will at its September 1998 Meeting review the structure and duration of June Meetings.

The Council also noted the tentative date for the Annual Meeting for year 2000 would be 10-12 September for Shrimp in Div. 3M, and 18-22 September 2000 for the rest of the agenda, while the proposed Special Session dates would be 13-15 September 2000.

IX. NOMINATION AND ELECTION OF OFFICERS

1. **Chairman STACFEN**

At its meeting on 3 June 1998, the Chairman's proposal to appoint a Nominating Committee composed of W. R. Bowering (Canada), A. Vazquez (EU-Spain) and F. Serchuk (USA) was accepted.

On 18 June 1998, the Chairman requested the Nominating Committee to present its proposed nominations. The Nominating Committee, having consulted representatives, nominated M. Stein (EU-Germany) for another term of office.

Noting that the appointment would be for a two-year term beginning at the end of the September 1998 Annual Meeting of the Scientific Council, the Chairman called for any further nominations, if any, and election.

For the office of Chairman of STACFEN, the Council elected M. Stein (EU-Germany) by unanimous consent. The Council extended its gratitude to M. Stein for accepting to continue in the Chair for another term in office.

X. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. **Fisheries Commission** (see Agenda I, Annex 1 in Part D, this volume)

a) **Advice for TACs for 1999**

For stocks within or partly within the Regulatory Area as requested by the Fisheries Commission, the following are the responses. The Council agreed to conduct the assessment of Shrimp in Div. 3M and the special request on Shrimp in Div. 3LNO at its Annual Meeting during 6-18 September 1998.

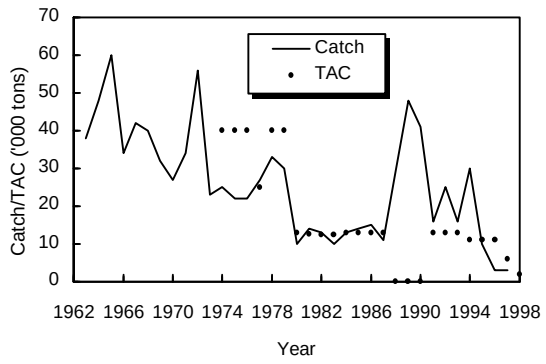
Cod (Gadus morhua) in Division 3M

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 since 1995. 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 and 1997 fisheries were very small compared with previous years. Most of the fleets traditionally directing for Div. 3M cod did not participate. Half of the 1997 catch was taken by vessels from non-Contracting Parties.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	10	ndf [2]	11
1996	3		11
1997	3	ndf	6
1998		ndf	2

[1] Provisional.
[2] TAC in the vicinity of 1995 TAC.
ndf No directed fishery and by-catch of cod kept at lowest possible. level.



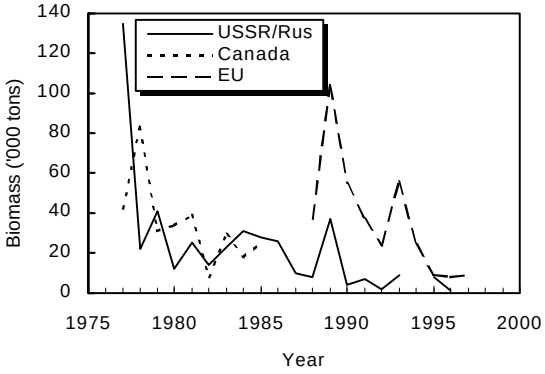
Data: Length and age composition of the 1997 catch were available for Portuguese trawlers from only one sample. Data were also available from the EU bottom-trawl survey which covers the whole distribution area of the stock.

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 were heavily exploited in 1994. The 1992 to 1995 year-classes appear to be weak and were the lowest in the EU time series.

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



State of the Stock: The stock has collapsed. The total stock biomass in 1996 and 1997 are the lowest on record. Recruitment at age 3 was poor from 1995 to 1997 and it is expected to be even poorer in 1998 and 1999. 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 1999. 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 continuation of fisheries contrary to the advice of Scientific Council has contributed to the critical condition of this stock. Part of this overall problem is due to continued fishing by non-Contracting Parties. Continued fishing by these fleets will not allow rebuilding.

Sources of Information: SCR Doc. 98/30, 52, 58; SCS Doc. 98/11, 13.

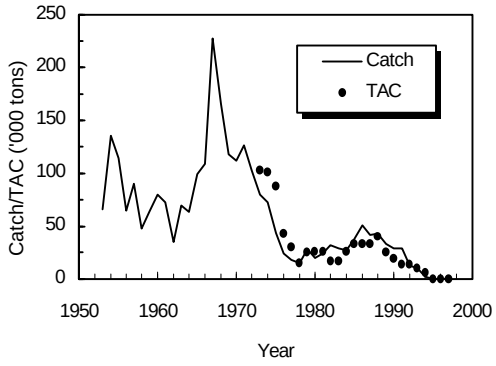
Cod (Gadus morhua) in Divisions 3N and 3O

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
1995	0.2	nf	0
1996	0.2	ndf	0
1997	0.4	ndf	0
1998	-	ndf	0

[1] Provisional.
nf No fishing.
ndf No directed fishery and by-catches of cod in fisheries targeting. Other species should be kept at the lowest possible level.

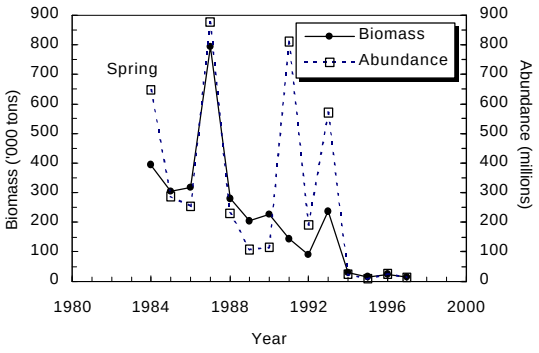


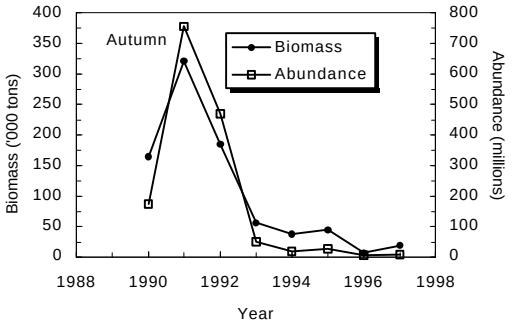
Data: No biological sampling data were available from by-catches of cod in 1997. Canadian spring and autumn survey data provided abundance, biomass and age structure information. Spanish spring survey data provided abundance and biomass information. Russian research survey data were available up to 1993.

Assessment: An analytical assessment was presented based on historical catch data up to 1995.

Recruitment: Most recent surveys suggest that all year-classes are at a low level.

Biomass: The 1997 biomass is estimated to be at an extremely low level.





State of the Stock: The stock remains close to its historical low with weak representation from all year-classes.

Recommendation: There should be no directed fishing for cod in Div. 3N and 3O in 1999. By-catches of cod in fisheries targeting other species should be kept at the lowest possible level.

Sources of Information: SCR Doc. 98/48, 65, 68; SCS Doc. 98/13,15.

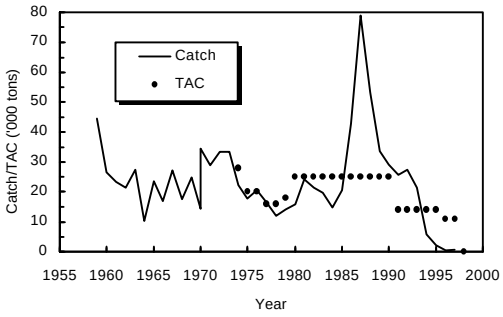
Redfish (Sebastes spp.) in Divisions 3L and 3N

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 1997 catch was about 600 tons, the second lowest historically. This was only the fourth consecutive year since 1985 that the TAC was not exceeded. Catches declined rapidly from high levels that peaked in 1987 at 79 000 tons. 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
1995	2	14	14
1996	0.5	14	11
1997	0.6	14	11
1998		ndf	0

[1] Provisional.
ndf No directed fishing and by-catch kept at current low level.



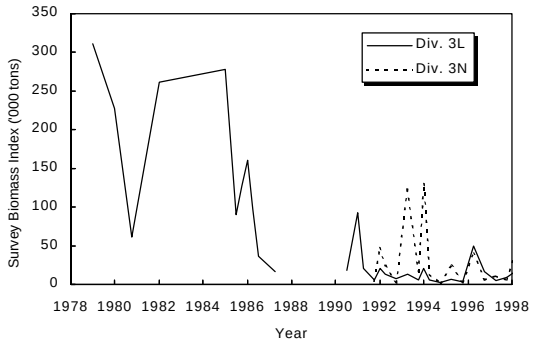
Data: Bottom trawl surveys conducted by Russia from 1984 to 1994, and by Canada from 1978 to 1998 are the bases for the assessment of stock status.

Assessment: No analytical assessment was possible.

Fishing Mortality: Unknown, but assumed to have declined due to reduced effort since 1994. 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.

Biomass: Based on survey results biomass has declined since the mid-1980s.



State of the Stock: Based on the available data, the stock appears to be at a very low level. There are indications of some increase in Div. 3N due to growth of the relatively strong 1986-87 year-classes.

Recommendation: No directed fishing for redfish in Div. 3LN in 1999, and by-catches be at the lowest possible level.

Special Comments: The continuing uncertainties regarding the relationship between redfish in Div. 3LN and Div. 3O have important impacts on interpretation of available data.

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.

Assessments of Div. 3LN redfish would be improved by data on the size of the pelagic component of this stock. Appropriate research is needed to eliminate this gap.

Sources of Information: SCR Doc. 98/71, 74; SCS Doc. 98/6, 13.

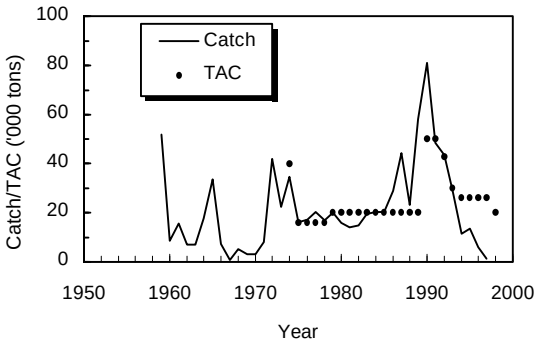
Redfish (Sebastes spp.) in Division 3M

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: The redfish fishery in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, falling continuously through 1997, when a catch of only 1 300 tons was reported, mostly as by-catch in the Greenland halibut fishery. The decline in the Div. 3M redfish catches from 1990 to 1997 is related to the reduction of fishing effort.

	Catch[1]	TAC ('000 tons)	
		Recommended	Agreed
1995	13	20	26
1996	6	20	26
1997	1.3	20	26
1998		20	20

[1] Provisional.



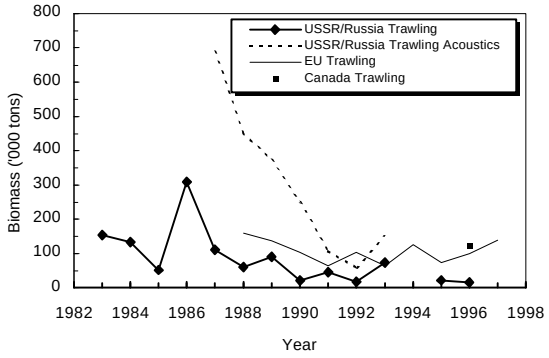
Data: Length and age data and observed CPUE data were available for Portuguese bottom trawlers. Another CPUE series, standardized with catch and effort STATLANT 21B data for most of the components of the fishery (1959-93), was also available.

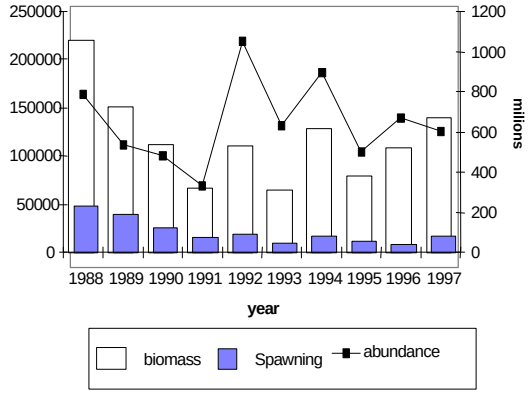
There are three survey series providing bottom biomass indices as well as length and age structure of the Flemish Cap redfish stocks, one from Russia (1983-93 and 1995-96) and the others from EU (1988-97) and Canada (1979-85 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic component for the 1988-92 period.

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

Fishing Mortality: Fishing mortality declined since 1991 and is at present at a very low level.

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





Biomass: Since 1991 total biomass index show no apparent trend. The spawning biomass index has not recovered from the decline suffered during the late-1980s and early-1990s, remaining at a low level since 1992.

State of the Stock: The stock declined as a result of high catches during the late-1980s and early-1990s. The spawning stock biomass is currently at a low level.

Recommendation: To allow the recovery of the Div. 3M redfish spawning biomass through the survival and maturity of fish from the abundant 1990 to 1992 cohorts, Scientific Council advises that it would not be prudent to increase the exploitation of redfish from the recent low level. Therefore, Scientific Council recommends a TAC for redfish in Div. 3M in 1999 significantly below (in the order of 50%) the current TAC of 20 000 tons.

Scientific Council also recommends that by-catch of juvenile redfish in the shrimp fishery should be kept at the lowest possible level

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

Sources of Information: SCR Doc. 98/ 15, 29, 30, 53; SCS Doc. 98/ 13.

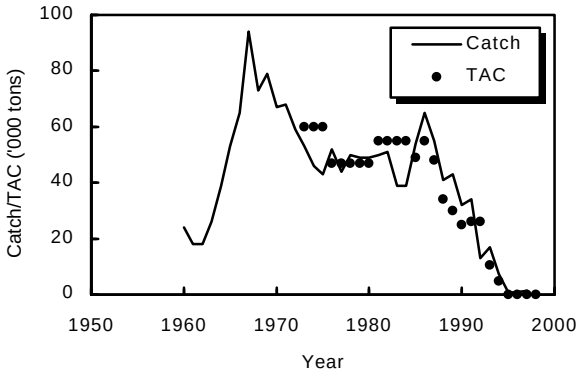
American plaice (Hippoglossoides platessoides) in Divisions 3L, 3N and 3O

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 1998.

		TAC ('000 tons)	
Year	Catch[1] ('000 tons)	Recommended	Agreed
1995	0.6	nf	0
1996	0.9	nf	0
1997	1.4	nf	0
1998		nf	0

[1] Provisional.
nf No fishing.

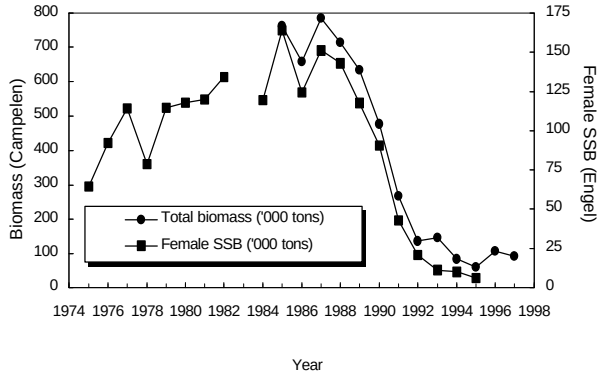


Data: Biomass and abundance data were available from several surveys. Limited sampling data from by-catch by Portuguese and Spanish vessels were available.

Assessment: No analytical assessment possible due mainly to uncertainties with catch and catch-at-age data, and lack of sampling in some years.

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. Total mortality remains high and the stock is composed mainly of fish that are less than 7 years old. Biomass is not increasing, and abundance continues to decrease.

Recommendation: No fishing on American plaice in Div. 3LNO in 1999.

Special Comments: Scientific Council cautions that by-catches of American plaice have more than doubled since 1995. Most of this increase is due to by-catches in the Greenland halibut fishery and unregulated skate fishery. There will also be a by-catch in the reopened yellowtail flounder fishery.

Sources of Information: SCR Doc. 98/48, 69, 70; SCS Doc. 98/11, 13.

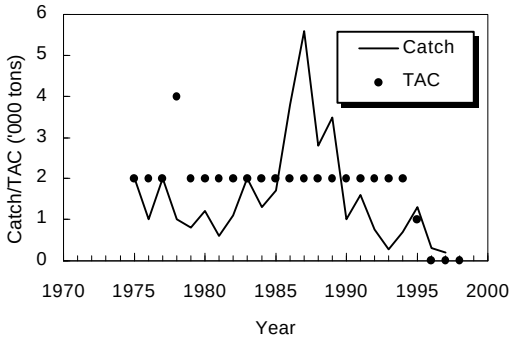
American Plaice (Hippoglossoides platessoides) in Division 3M

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 1997.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	1.3	1	1
1996	0.3	0	0
1997	0.2	0	0
1998		ndf	0

[1] Provisional.
ndf No directed fishing and by-catch kept at lowest possible level.

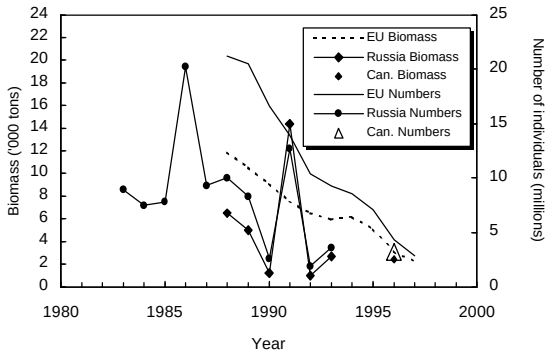


Data: Abundance and biomass indices from surveys were available from USSR/Russia (1983-93), EU (1988-97).

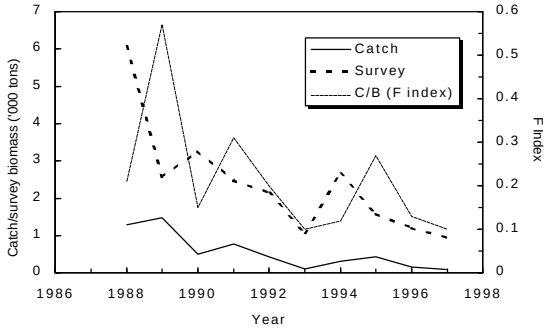
Assessment: No analytical assessment was possible. A comparison of catch levels with EU survey biomass indicated that the exploitation level decreased between 1988 and 1993, after which it remained at that level.

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 index in 1997 was the lowest observed (25% of the 1988 level).



State of the Stock: The stock is at a very low level. It is anticipated that SSB will decrease in the near future because of recent poor recruitment.

Recommendation: There should be no directed fishery on American plaice in Div. 3M in 1999. By-catch should be kept at the lowest possible level.

Sources of Information: SCR Doc. 98/30,51; SCS Doc. 98/13.

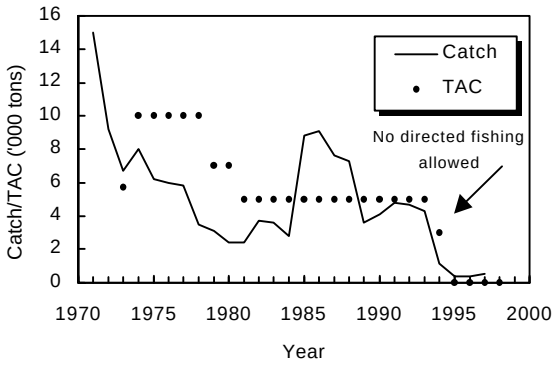
Witch Flounder (Glyptocephalus cynoglossus) in Divisions 3N and 3O

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 1995 and 1996 were 300 tons and 400 tons, respectively, including unreported catches. Estimated catch in 1997 was about 500 tons.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	0.3	nf	0
1996	0.4	nf	0
1997	0.5	nf	0
1998	-	nf	0

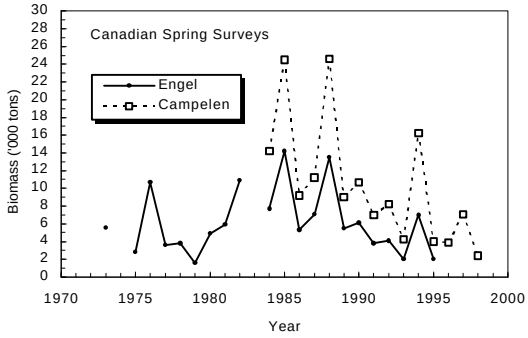
[1] Provisional.
nf No fishing.



Data: Abundance and biomass data were available from Canadian spring surveys during 1971-98 and autumn surveys during 1990-97 as well as Spanish surveys during spring 1995-98.

Assessment: No analytical assessment was possible with current data.

Biomass



State of the Stock: Stock appears to remain at a low level. The most recent data from the longest time series trend suggests the stock may be continuing to decline. The 1998 value is the lowest observed.

Recommendation: No fishing on witch flounder in 1999 in Div. 3N and 3O to allow for stock rebuilding. By-catches be kept at the lowest possible level.

Special Comments: No ageing data were available since 1993 and none are anticipated in the near future.

Sources of Information: SCR Doc. 98/48, 49, 50.

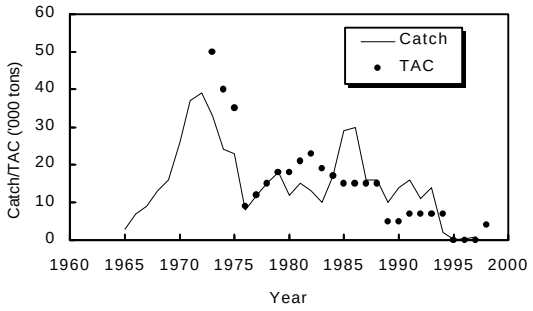
Yellowtail Flounder (Limanda ferugina) in Divisions 3L, 3N and 3O

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 has been a moratorium on directed fishing from 1994 to 1997. Small catches were taken as by-catch in other fisheries. Prior to the moratorium, TACs had been exceeded each year from 1985 to 1993. The fishery was re-opened for 1998.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	0.1	ndf	0
1996	0.3	ndf	0
1997	0.8	ndf	0
1998		4	4

[1] Provisional.
ndf No directed fishery.



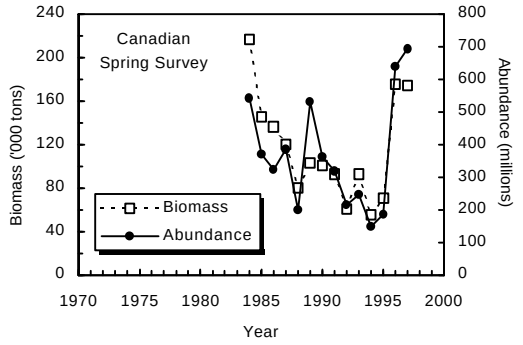
Data: Catch-at-age and CPUE were available from 1965 to 1993. Limited by-catch sampling data from the Spanish trawler fleet were available. Abundance and biomass indices were available from: annual Canadian spring (1984-98) and autumn (1990-97) bottom trawl surveys; co-operative Canadian Dept. Fisheries and Oceans/Canadian fishing industry seasonal surveys (1996-98); and, Spanish surveys in the NAFO Regulatory Area of Div. 3NO (1995-98).

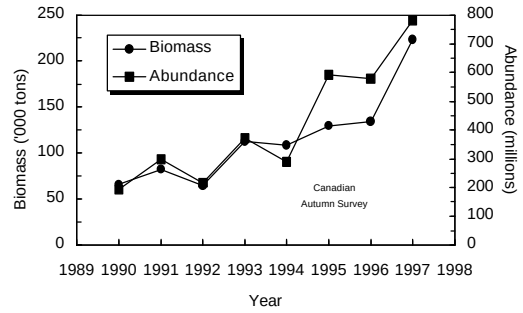
Assessment: No analytical assessment possible.

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

Recruitment: The 1996-97 surveys show the 1992 and 1993 year-classes to be well above the long-term average.

Biomass





State of Stock: Based on 7 additional surveys since the 1997 assessment, the current view is that the stock size has increased over the past year. The stock is perceived to be at a level close to that of the mid-1980s.

Recommendation: The stock should be able to sustain a fishery in 1999. Scientific Council noted that any directed fishery for yellowtail flounder would result in a by-catch of American plaice and cod. A precautionary approach would be to limit the size of yellowtail flounder fishery to minimize by-catches. Therefore, Scientific Council recommends that the exploitation rate in the yellowtail flounder fishery in 1999 in Div. 3LNO not exceed that advised for 1998.

Taking the average estimate of fully recruited age 7+ biomass index from the spring and autumn surveys of 1997 together with the lowest exploitation rate (6%) calculated from the commercial fishery, Scientific Council recommends that the TAC for 1999 not exceed 6 000 tons. Scientific Council further recommends that this fishery should be carefully monitored. 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. 98/27, 42, 48, 60, 66, 72, 73; SCS Doc.98/11.

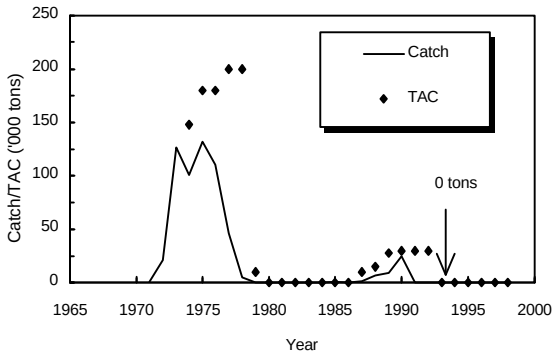
Capelin (Mallotus villosus) in Divisions 3N and 3O

Background: Within the NAFO Regulatory Area, the capelin 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	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	-	ndf	0
1996	-	ndf	0
1997	-	na	0
1998	-	na	0

ndf No directed fishery.
na No advice possible.



Data: No recent data available.

Assessment: No assessment was possible.

Recommendation: No advice possible.

Sources of Information: No SCR and SCS Documents.

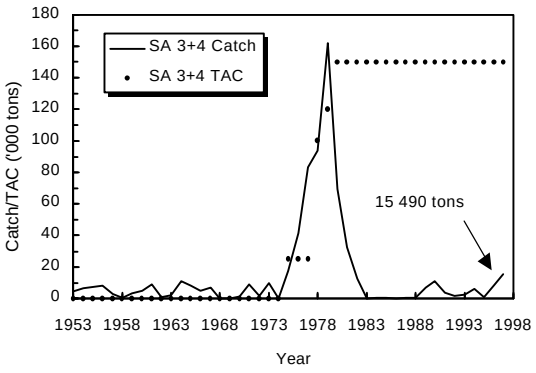
Short-finned Squid (Illex illecebrosus) in Subareas 3 and 4 (see also Fisheries Commission request in Agenda I, Annex I, Item 7 in Part D, this volume)

Background: The northern short-finned squid (*Illex illecebrosus*) is an annual species (1-year life cycle) that is considered to comprise a unit stock throughout its range in the northwest Atlantic Ocean, from Newfoundland to Florida including NAFO Subareas 3-6.

Fishery and Catches: Catches in Subareas 3 and 4 increased during the late-1970s, averaging 81 000 tons during 1976-81, and peaking at 162 000 tons in 1979. Catches in Subareas 3+4 declined to 111 tons in 1986, ranged between 600 and 11 000 tons during 1987-95, and increased to 8 700 tons in 1996 and to 15 500 tons in 1997. A TAC for Subareas 3+4 was first established in 1975 at 25 000 tons but was increased in 1978, 1979 and 1980. Since 1980, the Subareas 3+4 TAC has remained at 150 000 tons.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	1	na	150
1996	9	na	150
1997	15	na	150
1998	-	na	150

[1] Provisional.
na No advice provided.

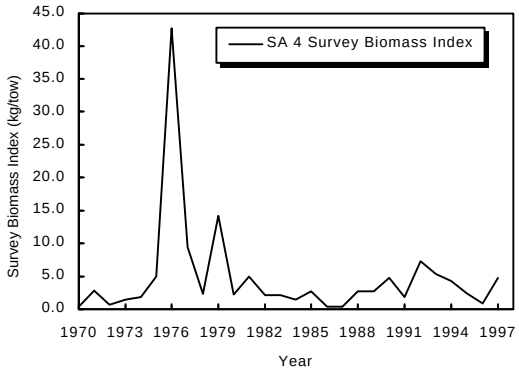


Data: Relative biomass and abundance indices were available from annual Canadian bottom trawl surveys conducted in Subarea 4 in July (1970-97). Survey indices are assumed to reflect relative stock size at the beginning of the fishing season. Size composition data were available from the inshore Newfoundland commercial jig fishery in Subarea 3.

Assessment: Absolute biomass and recruitment estimates for the short-finned squid resource in SA3+4 are not available.

Fishing Mortality: Relative fishing mortality rates increased in the mid-1970s and peaked during 1977-82. During 1983-97, relative fishing mortality rates have been very much lower, about 10% of the average during the peak period.

Biomass: Survey biomass indices reached peak levels during the late-1970s indicating that this was a period of high squid productivity. Since 1983, survey biomass indices have been markedly lower indicative of low squid productivity.



State of the Stock: Based on the survey data, the squid resource in Subareas 3+4 has remained at a low level. Increased catches in 1996 and 1997 may be indicative of some recent increase in abundance or availability.

Recommendation: The Scientific Council is unable to advise on a specific level of catch for 1999. However, based on available information (including an analysis of the upper range of yields that might be expected under the present low productivity regime), the Council advises that the TAC for 1999 for squid in Subareas 3+4 be set between 19 000 tons and 34 000 tons.

The advised TAC range (19 000-34 000 tons) is applicable only in periods of low productivity. In periods of high productivity, much higher catches and TAC levels are appropriate.

Special Comments: It is important to note that short-finned squid in Subareas 3-6 (and further south to Florida) are considered to comprise a unit stock, and that the current assessment only applies to part of the area.

Research Recommendation: Given the life cycle of this species, the Council recommended additional research on the factors that affect recruitment and that would assist, if taken into consideration, in forecasting the onset of high productivity period.

Sources of Information: SCR Doc. 98/54, 55, 59, 75; SCS Doc. 98/5, 12, 15.

Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 2 and Divisions 3KLMNO

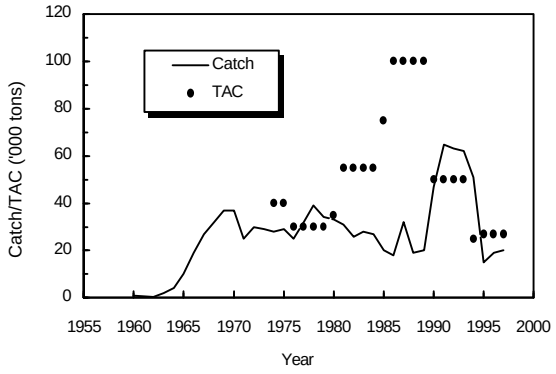
Background: The Greenland halibut stock in Subarea 2 and Div. 3KLMNO is considered to be part of a biological stock complex which includes Subareas 0 and 1.

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 to 20 000 tons per year in 1995 to 1997 as a result of lower TACs under management measures introduced by the Fisheries Commission. Catches have been well below TACs in 1995-97.

Catches show best estimates.

	Catch[1]	TAC[2] ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	15	<40	27
1996	19	-	27
1997	20	-	27
1998		-	27

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



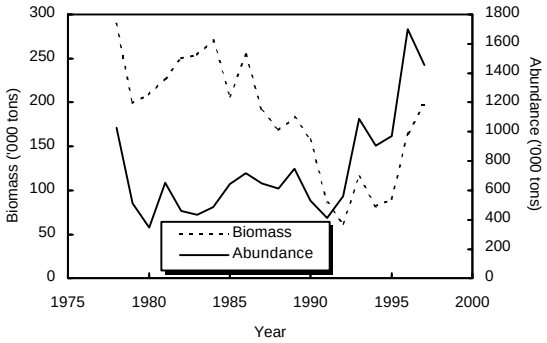
Data: CPUE data were available from otter trawl fisheries in Canadian zone and the Portuguese otter trawl fishery in the Regulatory Area of Div. 3LMN. Abundance and biomass indices were available from research vessel surveys of Canada (1978-97), EU (1988-97), EU-Spain (1995-98), and USSR/Russia (1986-96). The Canadian autumn surveys in 1996 and 1997 covered most of the stock distribution, including Div. 2GH.

Assessment: Analytical assessments are not available.

Fishing Mortality: Not precisely known, but believed to be above sustainable levels during 1990-94. Sharp declining trend since 1994 as a result of significant reductions in fishing effort.

Recruitment: The 1990 and 1991 year-classes were estimated to be better than average. Data from several surveys suggest that the 1992-95 year-classes are also above average. However, additional estimates at older ages are necessary to establish additional confidence in the most recent year-classes.

Biomass:



State of the Stock: Above average recruitment is indicated for all year-classes from 1990 to 1995. Indices of fishable biomass were below average in 1997, but should increase in 1998-99 as some of these year-classes recruit to the fishable stock.

Recommendation: With the substantial reduction in F experienced in 1995-97, and low level anticipated in 1998, combined with improved recruitment prospects, the fishable stock should continue to increase. While the Council is unable to advise on a specific TAC for Greenland halibut in Subarea 2 and Div. 3KLMNO for 1999, an increase in catch from 1996-97 levels (20 000 tons) to about 30 000 tons should not impede recovery.

The Council again recommends that measures be considered to reduce, as much as possible, the exploitation of juvenile Greenland halibut in all fisheries, including the use of exclusion devices (grates) in the shrimp fishery. Measures should also be taken to reduce the by-catch of American plaice in the Greenland halibut fishery.

Special Comments: 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, and that such exploitation results in foregoing much potential yield. It was also noted that a large increase in the Canadian shrimp fishery in Div. 3K was projected for 1998 over 1997 levels, and that this fishery was likely to occur in areas where small Greenland halibut are distributed.

Sources of Information: SCR Doc. 98/13, 29, 30, 47, 48, 63; SCS Doc. 98/10, 11, 13.

b) **Precautionary Approach**

Introduction

Progress was made in the course of this June 1998 Meeting of the Scientific Council on the development and evaluation of a framework for Div. 3LNO yellowtail flounder, Div. 3LNO American plaice and Div. 3NO cod. For other stocks, such as Div. 3M redfish, Div. 3M cod, and Subarea 2+ Div. 3KLMNO Greenland halibut, the available data were analyzed with the view of identifying possible candidates for reference points and suggestions were made for further investigations. Suggestions have been made on a stock-by-stock basis in the STACFIS report on specific analyses that should be undertaken in the immediate future to assist in the determination of possible limit reference points in the context of the NAFO framework.

From the analyses done at this June 1998 Meeting, it appears that it will be possible to express some reference points in terms of observed survey indices and to establish Precautionary Approach frameworks directly based on such indices. As analytical assessments are not available for many stocks in the NAFO Regulatory Area, establishing the feasibility of survey index-based frameworks is a crucial step in the implementation of the Precautionary Approach.

Generally, the Scientific Council noted that there are three basic steps in the determination of a Precautionary Approach framework:

1. selection of possible reference points in terms of biomass and fishing mortality,
2. identification of actual limits and thresholds that could be used in the framework (usually selected from the first step), and
3. identification of decision rules that could be applied in the context of the specific stock.

While each of the steps are important, they must evolve and be taken together as the end goal as an integrated framework which will allow an evaluation of various management actions. The frameworks are simply tools enabling managers to evaluate the performance of the "system" in relation to the management objectives (either explicit, or implicit from past actions). In case of diverging views on the basis for the framework, the Scientific Council **recommended** that *more than one framework be put forward for testing. For the above to work, it is very important that scientists and managers work together closely.*

A more thorough investigation of methods applicable for assessments of the various stocks has been a welcome by-product of the Precautionary Approach initiatives. For many stocks, additional assessment methods have been introduced and applied, opening the possibility of new approaches for the assessments. The initiative has also fostered discussions on fundamental biological questions, such as mechanisms regulating recruitment and their impact on stock productivity.

In order to maintain the current momentum in the development of Precautionary Approach frameworks, the Scientific Council encouraged representatives to carry on activities in this area and **recommended** that *a Special Scientific Council Meeting be held during the spring of 1999 to review progress on Precautionary Approach initiatives in preparation for the June 1999 Meeting.* The venue and agenda will be developed during the September 1998 Meeting of the Scientific Council (see also Section II.3 above).

Cod in Division 3M

Reference Points

Attempts were made to evaluate the relationship between spawning stock biomass and recruitment. Results from two former VPAs from different earlier periods were reviewed, although those analyses had not been accepted due to inadequacy of the sampling in some years. Doubts on the reliability of catch estimated have also been repeatedly expressed. Spawning stock biomass deduced from the VPAs was in some years more than 10 times higher than the present level of about 20 000 tons (Fig. PA-1). STACFIS decided to defer determining SSB and fishing mortality reference points for this stock until these uncertainties can be resolved.

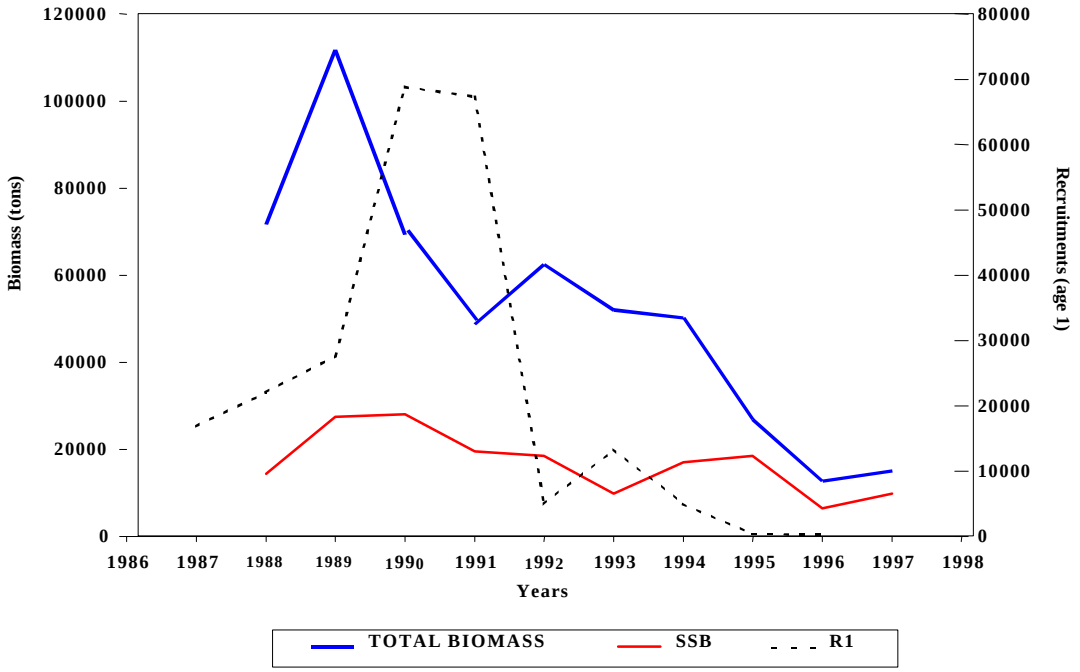


Fig. PA-1. Cod in Div. 3M: total biomass, spawning stock biomass (SSB) and abundance of recruitment at age 1 according to XSA results.

Cod in Divisions 3NO

Reference Points

A first attempt was made this year to calculate provisional reference points for cod in Div. 3NO. An approach similar to that of Evans and Rice (*1998, ICES J. Cons., 44*) was applied to the VPA results from the 1995 assessment to describe the relationship of recruitment of spawner stock biomass (SSB). There are two discernible inflection points (65 000 tons, 90 000 tons) in the smoother through the scatter of points in the stock recruitment plot (Fig. PA-2a and b). Once SSB drops below 65 000 tons there is low recruitment. This level of SSB was chosen as B_{lim}. Recruitment increased steadily when SSB was greater than 65 000 tons to a four fold increase when SSB is greater than 90 000 tons SSB. This was chosen as B_{buf}. The Scientific Council **recommended** that *more investigations into the calculations of other reference points for cod in Div. 3NO be conducted.*

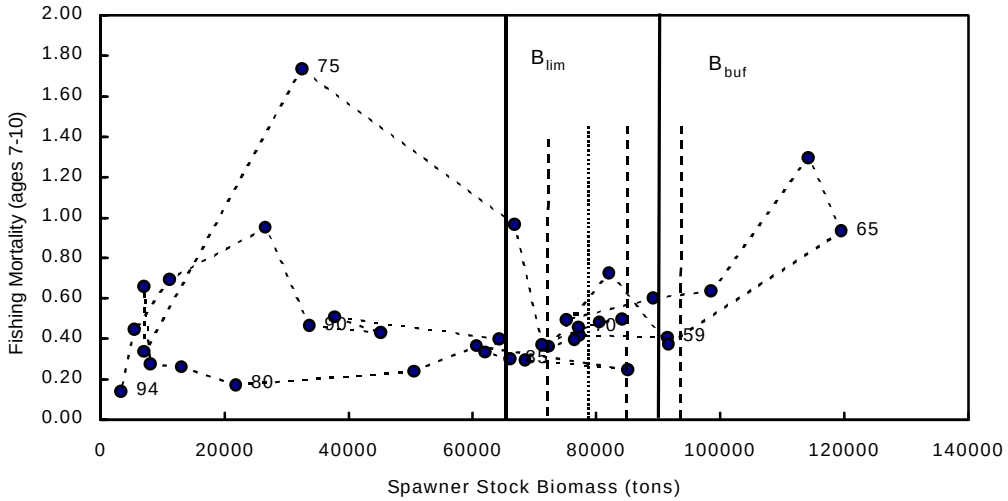


Fig. PA-2a. Cod in Div. 3NO: a schematic of possible implementation of precautionary reference points. Fishing mortality is the average of ages 7-10.

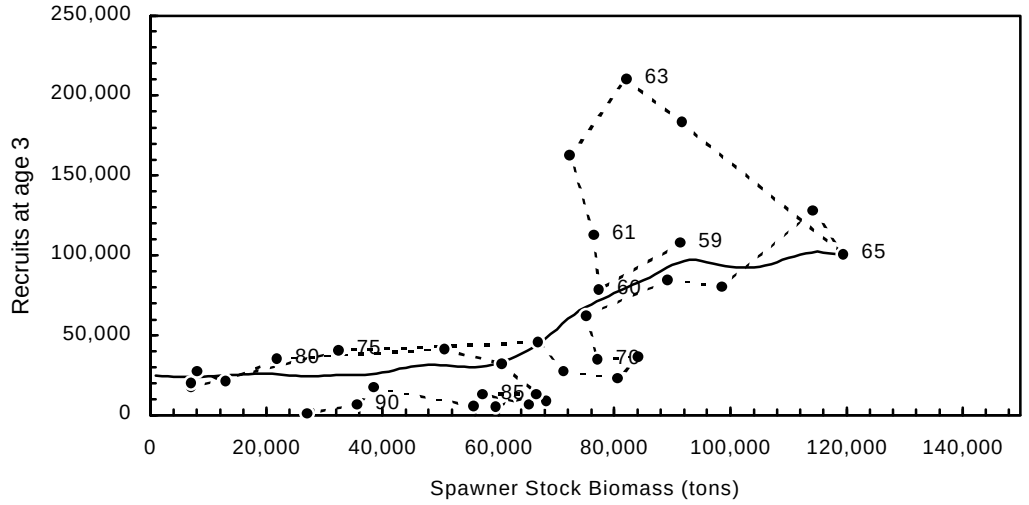


Fig. PA-2b. Cod in Div. 3NO: recruits *vs* SSB scatter plot. SSB for 1992-94 are shown without corresponding recruitment estimates of age 3.

American Plaice in Division 3M

Reference Points

Only 8 data points were available to evaluate spawning stock and recruitment relationship, but as can be seen in Fig. PA-3, only very poor recruitment appears at an SSB less than 5 500 tons, as estimated by the EU survey. However, it is difficult to assess the effect of the environment on recruitment failures. The results from the yield-per-recruit analysis provide estimates of F_{max} = 0.40, and an $F_{0.1}$ = 0.20 (Fig. PA-4). At this stage no limit reference points can be considered.

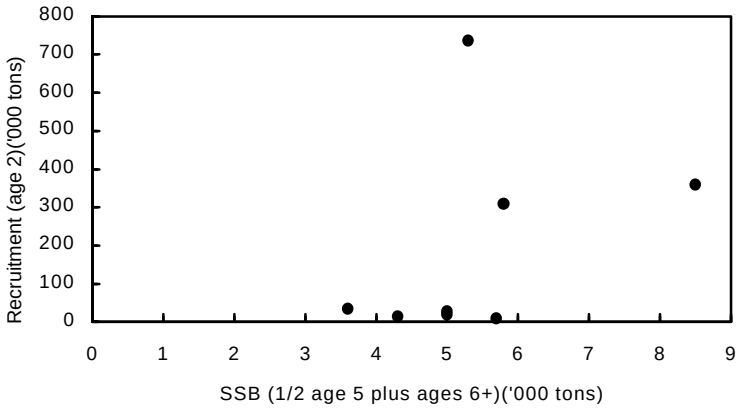


Fig. PA-3. American plaice in Div. 3M: SSB-Recruitment scatter plot.

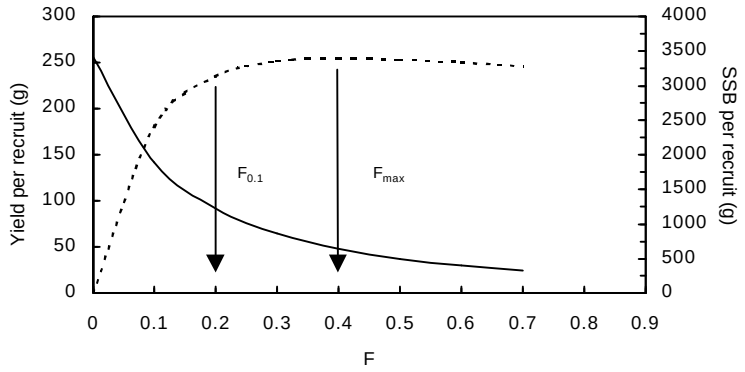


Fig. PA-4. American plaice in Div. 3M: yield-per-recruit.

American Plaice in Divisions 3LNO

Reference Points

At the Scientific Council PA Workshop in March 1998, data from this stock were chosen for use in the various models employed at that meeting (see Section II, of this Report). It was tentatively agreed that a B_{lim} value of 150 000 tons of SSB was reasonable for this stock. Calculations were largely based on data from a sequential population model used in the 1993 assessment. Although SPA models are no longer used for this stock, the low level of SSB estimated for 1992 coupled with declining trends in survey biomass since that time, indicate that the stock size is far below this B_{lim} value at present (Fig. PA-5). There was no clear agreement on how to define limit reference points for fishing mortality for this stock. It was argued that an F_{lim} of 0.25 was too high for this stock, although perhaps not for the largest stock sizes. The stock size was relatively stable for an extended period in the 1970s and 1980s with Fs around 0.25 to 0.3 (PA-6), although the stock declined rapidly after then. Future work should focus on estimation of biomass and F-based reference points with available survey data, and ways to link these analyses with those conducted to date. The suitability of various reference points based on biomass and fishing mortality will continue to be evaluated.

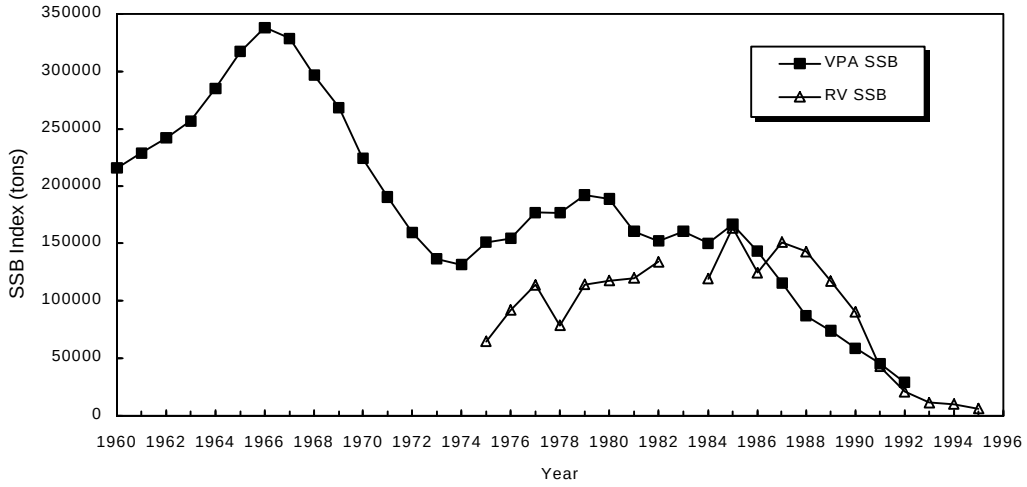


Fig. PA-5. American plaice in Div. 3LNO: comparison of SSB estimates from VPA (1993 assessment) and RV surveys (from 1997 assessment). Data from VPA are 9+ (male + female), data from surveys are female SSB calculated with annual maturity ogives.

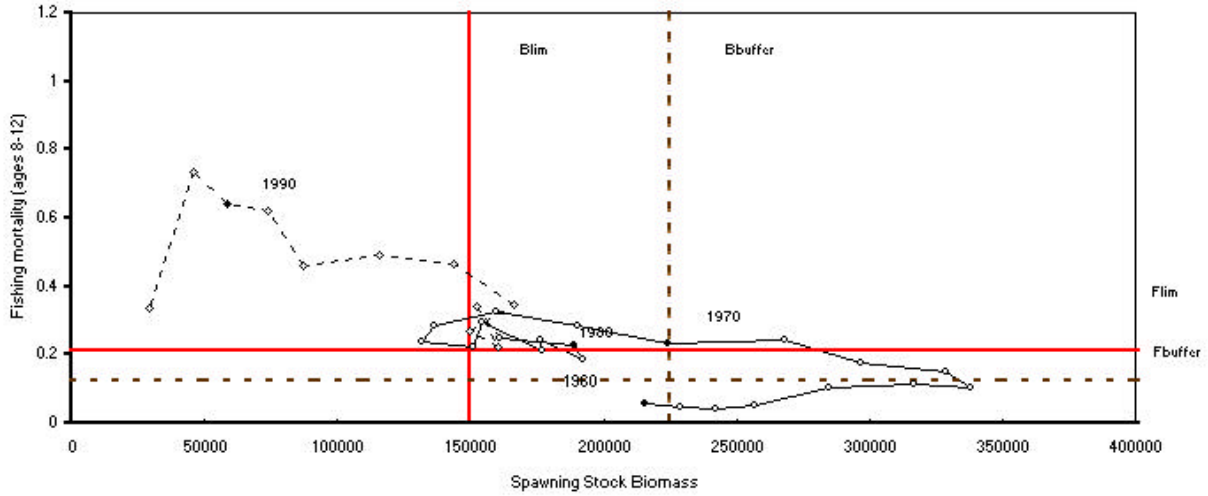


Fig. PA-6 American plaice in Div. 3LNO: schematic of a possible implementation of precautionary reference points.

Yellowtail Flounder in Divisions 3LNO

Reference Points

Several age aggregated and disaggregated models were used to analyze commercial catch and CPUE data and survey data. Various estimates of biological and fishing mortality reference points were made, many of which involved using the 'old standard' survey time series from 1975-95, and were presented for illustrative purposes. Given that revisions are ongoing with the conversion to the 'new standard' time series, Scientific Council considered it to be pre-mature to recommend any of these parameter estimates as reference points and noted that further analyses are forthcoming.

Witch Flounder in Divisions 3NO

Reference Points

Attempts were made to investigate potential reference points by examining historic commercial catch-effort data from 1974-92 using CEDA (Catch Effort Data Analysis) software (SCR Doc. 98/49). A range of trial runs were conducted to evaluate the sensitivity of the analysis to model choice, error structure and input parameters. It was concluded that under equilibrium conditions, the MSY may be in the order of about 5 000 tons with an associated F_{msy} of about 0.25. The MSY value was most robust in all analyses that were considered reasonable, however, other potential reference points were much more sensitive to changes in the input parameters. It was proposed, therefore, that a more thorough examination of the data including survey trends as covariates be carried out before arriving at more firm conclusions on the values of reference points.

Redfish in Division 3M

Reference Points

All biological information used was for deep-sea redfish (*Sebastes mentella*).

Yield-per-recruit analyses were conducted using the mean weights-at-age in the Portuguese commercial catch, mean weights-at-age in the stock (as well as in the female component) from the EU survey data together with the female proportion-at-age. Natural mortality was assumed to be constant at 0.1. The histological analysis of gonads collected during the 1991-94 EU surveys provided the data for calculating the maturity ogive-at-age. Partial recruitment was estimated from Z calculations in two ways; using survey data, and comparisons of commercial catch-at-age and research abundance-at-age.

From the yield, biomass and spawning biomass-per-recruit curves, different levels of reduction of spawning and total biomass were determined for corresponding levels of fishing mortality. With the assumption of constant recruitment, the results indicated a reduction of between 65-70% of the female spawning biomass from its unexploited level when fishing at $F_{0.1}$.

Fishing mortality corresponding to a fishery where the mean length in the catch is above the mean length-at-maturity, estimated using the method of Die and Caddy (1997, *Fish. Res., 32*) and first reviewed during the March 1998 Workshop was lower than $F_{0.1}$, implying an associated SSB more than 40-55% of the non-fishing level.

Various formulations of a logistic surplus production model which does not use the equilibrium assumption (ASPIC) was applied with the 1959-97 catch estimates and the various commercial and survey bottom biomass indices. STACFIS considered that further investigations are necessary before there can be confidence in the reference points suggested by the outputs.

STACFIS did note, however, that fishing mortality higher than $F_{0.1}$ observed through the 1989-93 period was most likely responsible for the present low SSB. Therefore as a first approximation, $F_{0.1}$ might be considered a limit reference F.

Redfish in Divisions 3LN

Reference Points

A non-equilibrium production model (ASPIC) was run using various combinations of Portuguese logbook CPUE, Canadian survey data and Russian survey data. However, no acceptable results were achieved.

Various yield-per-recruit analyses have been conducted (NAFO Sci. Coun. Rep., 1996, p. 68; SCR Doc. 98/76). While the estimates of $F_{0.1}$ and F_{max} were similar between studies, the estimated yields at these reference points were different. It is believed that these differences are due, in a large part, to differences in ageing methodologies; scales *versus* otoliths.

This type of difficulty with redfish, caused by differences in age reading methodology and interpretation, is a continuing problem and hampers use of age based analyses to develop meaningful reference points. Work is continuing to examine the use of length based information. At present however, it is not possible to determine limit or other reference points for either fishing mortality or biomass for Div. 3LN redfish.

Greenland Halibut in Subareas 2 and 3

Reference Points

When analytical assessments are available, reference points can be defined in terms of biomass or fishing mortality. For Greenland halibut in NAFO Subareas 2+3, there exists little information on the absolute estimate of biomass. However, historic data from research surveys and on the historic catch levels do exist, and both may be used to derive estimates of total mortality. Scientific Council reviewed (SCR Doc. 98/76) on various ways to utilize these data in the determination of limit reference points for this resource, using equilibrium yield- and biomass-per-recruit calculations.

SCR Doc. 98/76 also proposed a model which may be used to obtain the expected recruitment to the SSB in an equilibrium situation (assuming average recruitment). It was suggested that a Precautionary Approach framework should recognize the particular characteristic of population dynamics for this stock by setting up limit reference points allowing "sufficient" escapement through the immature age groups. This approach may be useful to set the Precautionary Approach reference points if there is some way to evaluate what is the proper level of escapement.

When developing a Precautionary Approach framework for Greenland halibut in Subarea 2 and Div. 3KLMNO, other aspects of the life history of the species should be taken into consideration. For instance, there is an apparent differential natural mortality rate between the males and the females starting at about the age of first maturity for males. This particularity complicates the calculation of certain reference points. In recent years, some analyses have assumed a constant mortality rate for all ages and both sexes (M = 0.15 to 0.2), while others have assumed a differential mortality rate between males and females (M = 0.15 for all ages for females; for males, M = 0.15 from ages 3 to 6 and M = 1.05 thereafter). In addition, in the absence of a VPA, there are some questions on the partial selection pattern that best describes the fishery (e.g. the degree to which there is a dome in the partial selection). As these aspects of life history and fishing patterns could have a major impact on the calculation of reference points, they must be addressed before a Precautionary Approach framework can be finalized for this stock.

Capelin in Divisions 3NO

Potential Reference Points

It is quite difficult to determine precautionary reference points for capelin in Div. 3NO. The historical database (both biological and fisheries statistics) began in the early-1970s but has not been updated since 1992. The main problems are related to the biological peculiarities of capelin, such as short life span and the high post-spawning mortality.

During the history of management by ICNAF and NAFO, the important role capelin play in the food chain in the Northwest Atlantic has been recognized. Early quotas were based on surplus production estimates after feeding had been accounted for. During the mid- to late-1970s, there was consideration that exploitation should not exceed 20% of the mature biomass. During the 1980s, after review, the practice of not harvesting more than 10% of the mature biomass was agreed upon, in full recognition of the importance of capelin as a food for many other species (see e.g. NAFO Sci. Coun. Rep., 1981, p. 18). This low harvest rate policy has been maintained to the present. Scientific Council considered this low target exploitation rate to be precautionary.

There are currently no surveys directed to capelin in the Div. 3NO. Without this information, it is not possible to evaluate the status of this stock. There is also a problem of stock mixing (with the Div. 2J and 3KL stock) in Div. 3L during the feeding period. This mixing has hampered estimates of historic stock size. Additional work should also be carried out examining the trophic relationships of capelin to other species, especially the value of capelin consumption by the main predators in relation to their stock size.

Squid in Subareas 3 and 4

Reference Points

Attempts were made to apply a stock production model using, as input parameters, Subareas 3-6 landings, Subareas 5+6 autumn survey kg/tow and Subarea 4 July survey kg/tow. However, concerns were raised regarding reliability of results due to unknown suitability of the model for this annual species. Using this approach, it was not possible to select reliable reference points at this time.

To estimate the upper range of yields that might be expected from Subareas 3 and 4 under the recent low productivity regime, catches during the high productivity period (1976-81) were adjusted by the ratio of the relative survey biomass indices from the high and low productivity periods (SCR Doc. 98/75). This approach assumes that the peak relative fishing mortality rates estimated during the high productivity period (10 × higher than at present) are appropriate during the current low productivity period. The results indicate an upper range of catches between 18 000 and 34 000 tons. If the high landings taken in the late-1970s were responsible for the subsequent declines in the resource in the early-1980s, then the estimated range of yields might best be considered as limits.

c) **Other Requests for Management Advice**

The following are the Scientific Council responses to the Fisheries Commission special requests.

i) **Cod in Divisions 2J+3KL** (see Agenda I, Annex 1, item 5 in Part D, this volume)

The Fisheries Commission with the concurrence of the Coastal State requested the Council 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 tagging and 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, other distinct populations in the offshore, and relationships with adjacent stocks if they exist. The ability to identify distinct elements of the stock complex and relationships with adjacent stocks 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 1997 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 equivalence. 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 and rose to 8.5% in 1997. The 1997 spring survey estimate was 2.2% 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	Years RV survey conducted	Range of percentage of Div. 3L biomass occurring in the Regulatory Area (1997 value in brackets)	Average proportion (%)
Winter	1985-86	23.8-26.8	25.3
Spring	1977-97	0.4-63.1 (2.2)	10.3
Autumn	1981-97	0.2-9.7 (8.5)	3.1

The percentages 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 (Div. 2J, 3K and 3L) by Canada from 1981 to 1997, 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% increased in recent years to 5.17% in 1993 and were 4.4% in 1994. In 1997 the proportion of the Div. 2J+3KL stock in the Regulatory Area was 5.2%. However the total offshore 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 percentage of Div. 2J+3KL autumn biomass 1981-97	Percentage of Div. 2J+3KL biomass 1997 autumn
2J	29	22
3K	33	22
3L	38	56

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) **Witch flounder in Divisions 2J+3KL** (see Agenda I, Annex 1, item 6 in Part D, this volume)

The Fisheries Commission with the concurrence of the Coastal State requested: *the Scientific Council review available information, including any Canadian assessment documentation on the stock status, and provide advice on catch levels for the Div. 2J+3KL witch flounder resource. Any information pertaining to the relative distribution of the resource within the stock area, as well as changes in this distribution over time should also be provided.*

The Scientific Council evaluated the status of the resource based on Canadian assessment and converted survey data. 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 by 1995 had reached a level of biomass less than 2% of the 1981-84 average when the stock was stable. The 1995-97 average biomass is about 4 % of the 1981-84 average.

An evaluation of distribution patterns indicated that during the late-1970s and early-1980s witch flounder were widely distributed throughout the continental shelf 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 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. Similar observations were made for the 1997 survey data.

Based on the data examined here, the Scientific Council advises that there should be no fishing for witch flounder in Div. 2J+3KL in 1999.

iii) **Squid (*Illex*) in Subareas 3 and 4** (see Agenda I, Annex 1, item 7 in Part D, this volume)

The Fisheries Commission requested the Scientific Council to: *undertake a review of the historical and current status of Illex squid in Subareas 3 and 4, and in Subareas 5 and 6, and to describe the major aspects of the biology and population dynamics of the species in these regions.* The Council was further requested to: *describe the Illex fisheries in these regions and review the basis for considering Illex in Subareas 3, 4, 5 and 6 as a unit stock.*

Life Cycle, Biology and Population Dynamics

This species has a 1-year life cycle and is broadly distributed throughout the Northwest Atlantic Ocean, ranging from central Florida to southern Labrador. It is commercially fished between Cape Hatteras, North Carolina and Newfoundland (NAFO Subareas 3-6). Spawning occurs south of Cape Hatteras throughout most of the year, with the main spawning peak usually occurring in winter. Spawning occurs in close proximity to the Gulf Stream, which serves as the transport mechanism for egg balloons and larvae. Small juveniles are concentrated in the Gulf Stream Front, whereas larger juveniles become dispersed throughout Slope Water to the Shelf Water-Slope Water Front. Movement onto the continental shelf in spring between Cape Hatteras and the Grand Bank begins slightly earlier to the south. Temporal and spatial distribution patterns, as well as annual recruitment levels are related to environmental factors and vary greatly. Seasonal recruitment patterns are complex and population structure in fishery areas changes considerably over the season due to continuous recruitment and emigration. Males, the smaller of the sexes, mature throughout summer-autumn, whereas females remain immature. Mature females have very seldom been caught in any Subarea. The diet changes throughout the season from reliance on crustaceans to fish to cannibalism. A seasonal decline in prevalence of males is often seen, which may be related to earlier maturation and emigration of males or higher natural mortality of males due to size-related cannibalism. Growth is rapid and approximately linear during summer-autumn. Growth rate is under-estimated by modeling trends in length because of dynamic changes in the exploited population due to continuous recruitment and emigration. The prominent seasonal increase in cannibalism likely represents another source of bias. An off-shelf movement is evident in late autumn, presumably related to a spawning migration.

Fishery Trends

Spatial and Seasonal Trends. The directed fisheries occur during summer through autumn. Fisheries are prosecuted at Newfoundland (Subarea 3) and, rarely, at Labrador (Subarea 2), on the Scotian Shelf (Subarea 4), and on the continental shelf of the United States, between the Gulf of Maine and Cape Hatteras, North Carolina (Subareas 5 and 6). Temporal and spatial fishing patterns are related to distribution patterns. Consequently, the timing of peak landings differs slightly among Subareas, although some commercial fishing occurs during July-November in all Subareas. Peak landings in the Middle Atlantic fishing area (Subarea 6) generally occur during July or August. In Subarea 3, squid are not available to the Newfoundland inshore fishery until at least July and the peak varies between August and October. Historically, the Subarea 4 offshore fishery has occurred during April-November, with peak catches occurring between late July and early September.

Annual Landings Trends. Total landings in Subareas 3-6 ranged between 800 and 11 000 tons during 1953-67 and were primarily from the directed inshore jig fishery at Newfoundland (Subarea 3). Landings have been recorded in Subarea 2 in only six years since 1953, with a maximum of only 30 tons. Distant water trawl fisheries developed in Subareas 4 and 5+6 during 1968-70. Landings peaked at 179 000 tons in 1979, with 162 000 tons derived from Subareas 3+4. Landings subsequently declined to a low of 6 800 tons in 1985. During 1982-96, Subareas 5+6 landings were higher than those in Subareas 3+4. Since about 1982 the Subareas 5+6 fishery has been exclusively a domestic bottom trawl fishery, whereas Subarea 4 landings have been mostly by-catch in the silver hake fishery. Total landings increased from 15 000 tons in 1995 to 29 000 tons in 1997, due primarily to increases in Subareas 3+4 (from 1 000 tons in 1995 to 15 000 tons in 1997).

Trends in Abundance and Biomass

Relative abundance and biomass indices are available from research vessel surveys in Subareas 4 and 5+6. Mean weight (kg) and number per tow from Canadian bottom trawl surveys conducted on the Scotian Shelf (Subarea 4) during July (1970-97) are assumed to represent relative biomass and abundance levels at the start of the fishing season. Mean weight and number per tow from USA autumn bottom trawl surveys, conducted in Subareas 5+6 (1967-97), are assumed to represent relative biomass and abundance levels near the end of the fishing season. Standardized landings-per-unit-effort (LPUE) data also exist for the Subareas 5+6 domestic trawl fishery (1982-93).

Survey biomass indices are positively correlated between Subareas 4 and 5+6, and are also correlated with landings trends. Trends in landings and survey indices reflect a period of high productivity during 1975-81, followed by a recent period of low productivity. Increased catches in 1996 and 1997 in Subareas 3+4 may suggest some recent increase in abundance or availability.

Stock Structure

This species is considered to constitute a unit stock throughout its range from Newfoundland to central Florida. Although conclusive genetic stock identification studies have not been conducted, several factors lend support to the unit stock concept. The distribution and timing of the occurrence of larval and juvenile stages between Newfoundland and south of Cape Hatteras suggest a spawning site south of Cape Hatteras, with a Gulf Stream dispersal mechanism which transports young stages as far north as Newfoundland. In all Subareas, the first occurrence on the shelf is along the shelf-edge during spring. This distribution pattern suggests a single stock which recruits to all fishery areas simultaneously from offshore. Similarity among the landings trends and survey indices for all Subareas also suggests the existence of a single stock throughout Subareas 3-6 with recruitment variability increasing to the north.

Precautionary Approach

To estimate the upper range of yields that might be expected from Subareas 3+4 under recent low productivity regime, catches during the high productivity period (1976-81) were adjusted by the ratio of the relative survey biomass indices from the high and low productivity periods (SCR Doc. 98/75). This approach assumes that the peak relative fishing mortality rates estimated during the high productivity period (10 × higher than at present) are appropriate during the current low productivity period. The results indicate an upper range of catches between 19 000 and 34 000 tons. If the high landings taken in the late-1970s were responsible for the subsequent declines in the resource in the early-1980s, then the estimated range of yields might best be considered as limits.

iv) **Mesh size of Greenland halibut** (see Agenda I, Annex 1, item 9 in Part D, this volume)

The Fisheries Commission requested the Scientific Council to: *evaluate the impact, in terms of changes in spawning biomasss-per-recruit and yield-per-recruit, as well as the implication on effort in the short-term and long-term resulting from the use of a mesh size of 155 mm versus 130 mm for the Subareas 2+3 Greenland halibut stock in the NAFO Regulatory Area.*

In order to assess the relative change in the trawl fishery for Greenland halibut in the NAFO Regulatory Area by introducing a 155 mm mesh size from the current 130 mm mesh size, two long-term projection scenarios were conducted as follows:

Scenario 1) assuming the same natural mortality for both sexes (M = 0.15).
Scenario 2) assuming different natural mortality for males and females (M = 0.15 for all females and males < age 7 and M = 1.05 for males age 7 and older).

Selection factor and selection range of 130 mm and 155 mm mesh size are assumed to be the same. Both exercises assume a dome-shaped exploitaiton pattern (from selectivity studies by Jørgensen *et al*., 1995), and no escapement mortality. The SSB was calculated for females only.

The results were as follows:

Scenario 1)	**M = 0.15 for Male and Females**			
	Mesh size	**F_{max}**	**B at F_{max}**	**Y at F_{max}**
Actual	130	0.34	952	389
New	155	0.45	918	447
Difference	+19%	+32%	-4%	+15%
	Mesh size	**$F_{0.1}$**	**B at $F_{0.1}$**	**Y at $F_{0.1}$**
Actual	130	0.23	1695	371
New	155	0.30	1674	426
Difference	+19%	+30%	-1%	+15%

Scenario 2)	**M = 0.15 for Females** **M = 0.15 for Males < age 7 and M = 0.15 for Males >= age 7.**			
	Mesh size	**F_{max}**	**B at F_{max}**	**Y at F_{max}**
Actual	130	0.47	489	284
New	155	0.63	479	306
Difference	+19%	+34%	-2%	+8%
	Mesh size	**$F_{0.1}$**	**B at $F_{0.1}$**	**Y at $F_{0.1}$**
Actual	130	0.24	1617	256
New	155	0.28	1820	265
Difference	+19%	+17%	+13%	+4%

Conclusions

Scenario 1)

For M=0.15 for both sexes a 15% increase in yield at both $F_{0.1}$ and F_{max} can be expected when increasing the mesh size from 130mm to 155mm, however, the equilibrium SSB would decrease by 4% for F_{max} and 1% for $F_{0.1}$.

Scenario 2)

Assuming substantial difference in natural mortality by sex as illustrated above would result in much smaller increases in yield between the respective mesh sizes (8% at F_{max} and 4% at $F_{0.1}$). SSB would decrease by 2% at F_{max} but increase by 13% at $F_{0.1}$.

It must be emphasized that these calculations are very sensitive to changes in the input parameters as illustrated by the examples cited and must be treated with some caution.

2. **Coastal States** (see Agenda I, Annexes 2 and 3 in Part D, this volume)

a) **Advice for TACs for 1999 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.

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 6-10 November 1998.

Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 2 and 3 [including information on Roughhead grenadier (Macrourus berglax)]

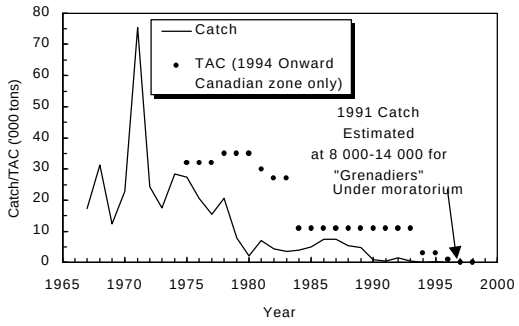
Background: Roundnose grenadier are found throughout Subareas 2 and 3 although the request for advice applies only to that portion of the resource lying within Canada's 200-mile economic zone. It is believed that only one stock occupies the entire area including the Regulatory Area although there are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

Fishery and Catches: Catches by EU-Portugal (1986-92) and EU-Spain (1992-96) reported to NAFO as roundnose grenadier from directed Greenland halibut fisheries in the Div. 3LMN area were primarily roughhead grenadiers. The following description of these fisheries takes account of these misclassifications.

Roundnose Grenadier: The traditional fishery prior to 1990 occurred in Canadian waters in Div. 2GH and 3K. Catches since 1991 have been taken as by-catch in Greenland halibut fisheries. About 50 tons were reported for 1996 and 1997.

	Catch[1] ('000 tons)	TAC[2] ('000 tons)
1995	0.2	3
1996	+	1
1997	+	0[3]
1998		

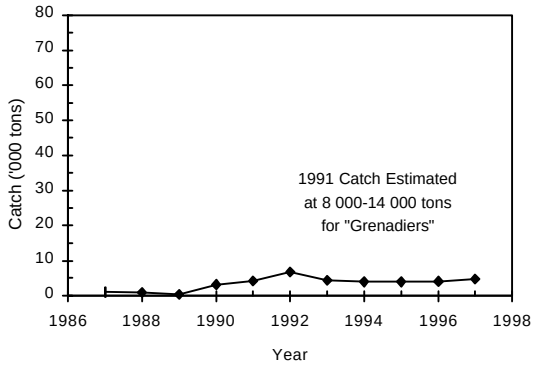
1 Provisional reported catches, <50 tons for 1996-97.
2 Canadian zone only.
3 Under moratorium.



Roughhead Grenadier: The average catch since 1990 has been about 4 000 tons taken primarily by EU-Portugal and EU-Spain as by-catch in the Div. 3LMN Greenland halibut fishery.

	Catch[1] ('000 tons)
1995	4
1996	4
1997	5

1 Provisional.



Data: Surveys conducted by Canada (Div. 2G to Div. 3O) from 1996-97, Japan (Div. 2GH) in 1996 and Russia Div. 2GH from 1987 to 1992.

Assessment: Because of limited time series, limited coverage and various vessel/gears conducting these surveys, the information is of limited value in determining resource status. It is not possible to provide an estimate of the absolute size of the stock.

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

Recommendation: Not possible to provide any advice for roundnose grenadier in Subareas 2 and 3 for 1999.

Special Comments: It has been reported that roughhead grenadier is a long-lived species. Catches of roughhead grenadier have averaged about 4 000 tons since 1992 as by-catch primarily in the Div. 3LMNO Greenland halibut fishery. Roughhead grenadier is an unregulated species and the impact of this catch level should be investigated.

The reason for the misclassification of roughhead grenadier being reported as roundnose grenadier for EU-Portugal (1986-92) and EU-Spain (1992-96) is because roundnose grenadier is the only name that appears on the statistical data reporting forms.

Sources of Information: For Roundnose grenadier: SCR Doc. 98/14, 28, 57; SCS Doc. 98/10.

For Roughhead grenadier: SCR Doc. 98/30, 31, 33, 43; SCS Doc. 98/11, 13.

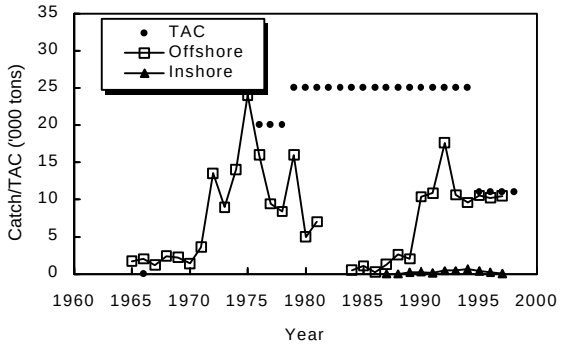
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 0 + Division 1A Offshore and Divisions 1B-1F

Background: The Greenland halibut stock in Subarea 0 + Div. 1A offshore and 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 from 2 000 tons in 1989 to 18 000 tons in 1992 and have remained at about 10 500 tons annually since.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Autonomous
1995	11	11	11
1996	10	11	11
1997	11	11	11
1998		11	

[1] Provisional.



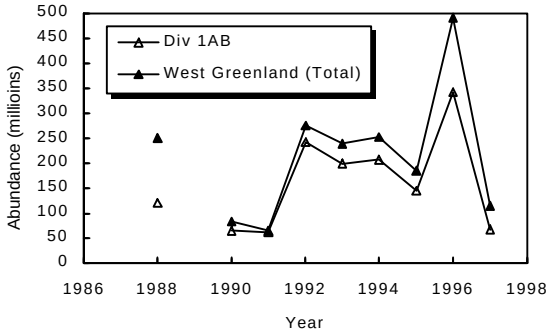
Data: Catch-at-age data were available for assessment from Div. 0B and Div. 1CD. Standardized and unstandardized catch rates were available from Div. 0B and Div. 1CD. Biomass estimates were available from Div. 1CD. Recruitment data were available from Div. 1AB from 1989-97.

Assessment: No analytical assessment could be performed. Standardized catch rates have been stable in Div. 0B during 1990-97. Standardized catch rates have increased slightly since 1994 in Div. 1CD.

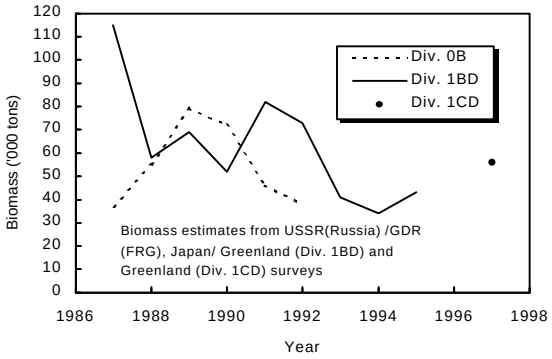
Fishing Mortality: Level not known.

Recruitment: Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated at age 1 to be the highest in the time series, but at age 2 estimated at below average. The 1996 year-class is at the level of the relatively low 1990 year-classes.

Abundance:



Biomass: The biomass in Div. 1CD increased from 1995 to 1997. The estimates are, however, based on two different surveys, and the interpretation is difficult.



State of the Stock: The age composition in the catches has been stable in recent years. The decline in the stock observed until 1994 seems to have stopped and the stock has apparently stabilised at a lower level compared to the late-1980s and early-1990s.

Recommendation: The TAC for 1999 should not exceed the current level of 11 000 tons for Greenland halibut in Subarea 0 + Div. 1A (offshore) + 1BCDEF, based on the relative stability of the stock.

Sources of Information: SCR Doc. 98/25, 39, 40, 41, 56; SCS Doc. 98/7, 14, 15.

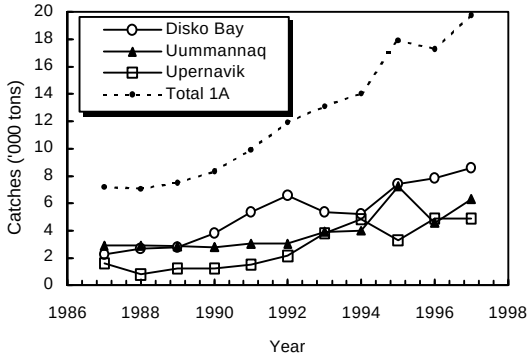
Greenland Halibut (Reinhardtius hippoglossoides) in Division 1A, inshore

Background: The inshore stock is dependent for recruitment on immigration from the offshore nursery grounds and the spawning stock in Davis Strait. Only sporadic spawning seems to occur in the fjords, hence the stock is not considered self-sustainable. The fish remain in the fjords, and do not contribute back to the offshore spawning stock. This connection between the offshore and inshore stock implies that reproductive failure in the offshore spawning stock for any reason will have severe implications for the recruitment to the inshore stock.

Fishery and Catches: The fishery is mainly conducted with longlines and to a varying degree gillnets. Effort has increased in all areas. There was no offshore catch in 1996 or 1997.

	Catches ('000 tons)[1,2]			
	1995	1996	1997	TAC 98
Disko Bay	7.4	7.8	8.6	-
Uummannaq	7.2	4.6	6.3	-
Upernavik	3.3	4.8	4.9	-
Total 1A	17.9	17.3	19.8	-

[1] Provisional.
[2] No TAC advised.



Data: Catch-at-age data were available for years 1988-97 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 2 were available from trawl survey. Catch rates and mean lengths were available from inshore longline surveys.

Assessment: The recent level of fishing mortality could not be estimated.

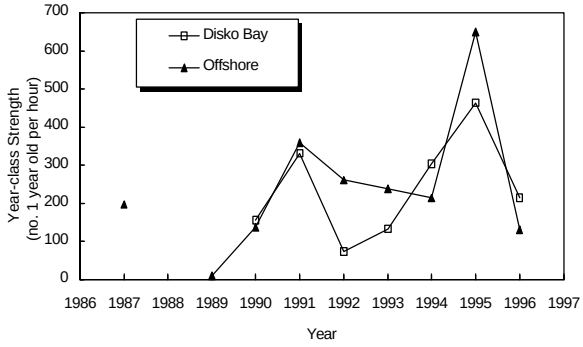
The stock component in Disko Bay is composed of younger and smaller individuals than in the other two areas. In spite of the increasing catches, age and length composition in both the commercial and survey catches have not changed dramatically in recent years.

In Uummannaq survey results since 1993 do not indicate any major changes in abundance. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age groups.

In Upernavik survey results in 1994 and 1995 suggested a decrease in total abundance. Age and length compositions in commercial and survey catches have also decreased.

Recruitment: Recruitment of the 1996 year-class was below average. The 1995 year-class that has been identified as the highest on record as age 1, was also found to be the highest in the time series as 2 years old in the inshore areas. However, in the offshore area this year-class has decreased in strength and was estimated to be below average in 1997.

State of the Stock: The stock components in all three areas consist of a large number of age groups. However, age compositions of the catches appear to be shifting towards younger age groups.



Disko Bay: The stock is still considered growth overfished.

Uummannaq: There is indication of growth overfishing of the stock.

Upernavik: Data are insufficient to determine the status of the resource.

Recommendation: Landings have continually increased, and there is concern that the presumed associated increase in effort will incur the risk of a significant reduction of the available stock.

Scientific Council still considers that separate TACs are appropriate for each of the three areas. In order to prevent escalating effort it is recommended that a TAC for each inshore area for 1999 should not

exceed the average of the catches for 1995-97; Disko Bay 7 900 tons, Uummannaq 6 000 tons and Upernavik 4 300 tons. This gives a total TAC of 18 200 tons in Div. 1A inshore.

Special Comments: The continuing increase in total landings generates concern, especially because lack of effort data from the commercial fishery impedes the assessment of the stocks.

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

Sources of Information: SCR Doc. 98/40, 41, 44; SCS Doc. 98/14.

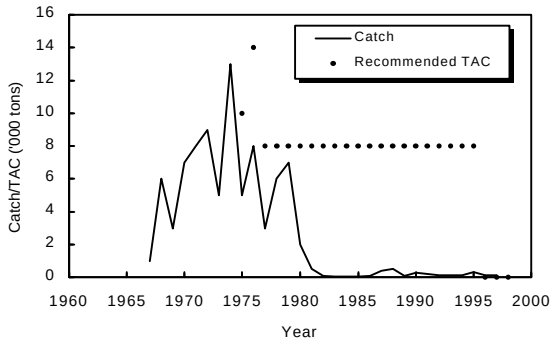
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 0 + 1

Background: The roundnose grenadier (*Coryphaenoides rupestris*) 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 Subareas 0 and 1 showed that most of the biomass generally was found in Subarea 1.

Fishery and Catches: Recommended TACs have been at 8 000 tons in the period 1977-95. The advice since 1996 has been 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. An unknown proportion of the reported catches are roughhead grenadier (*Macrourus beglax*).

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Autonomous[2]
1995	0.3	8.0	5.5
1996	0.1	ndf	3.4
1997	0.2	ndf	3.4
1998		ndf	3.4

[1] Provisional.
[2] Set by Greenland for Subarea 1.
ndf No directed fishing, catches restricted to by-catch in other fisheries.

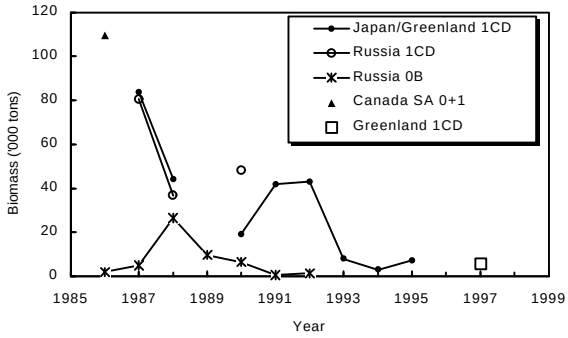


Data: Biomass estimates of roundnose grenadier from surveys in Div. 0B during the period 1986-92, from Div. 1CD during the period 1987-95 and from 1CD in 1997 were available.

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 of roundnose grenadier for the entire stock area. In 1997 the biomass of roundnose grenadier was estimated at 5 700 tons for Div. 1CD. In the same Divisions the biomass of roughhead grenadier was estimated at 2 300 tons.



State of the Stock: The stock of roundnose grenadier seems to be at a very low level.

Recommendation: There should be no directed fishing for roundnose grenadier in Subareas 0 and 1 in 1999. Catches should be restricted to by-catches in fisheries targeting other species.

Sources of Information: SCR Doc. 98/25; SCS Doc. 98/7, 14.

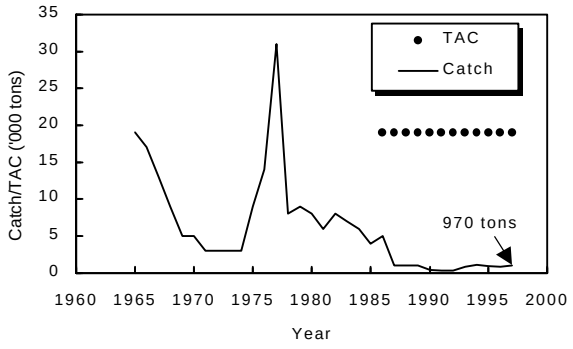
Redfish (Sebastes spp.) in Subarea 1

Background: There are two species of commercial importance in Subarea 1 golden redfish (*Sebastes marinus*) and deep-sea redfish (*Sebastes mentella*). 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 golden redfish and deep-sea redfish were included in the catch statistics since no species specific data were available. Recent catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp. For July-August 1997 the discard of redfish in the shrimp fishery was assessed to 30 million individuals (870 tons).

	Catch[1]	TAC (000 tons)	
	('000 tons)	Recommended	Autonomous
1995	0.9	ndf	19
1996	0.9	ndf	19
1997	1	ndf	19
1998		ndf	19

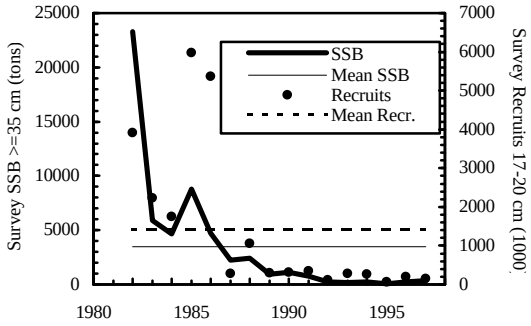
[1] Provisional.
ndf No directed fishing, by-catch be at the lowest possible level.



Data: No data on commercial CPUE were available. Spawning stock biomass and recruitment indices were calculated based on EU-German groundfish surveys.

Assessment of Golden Redfish: No analytical assessment of *Sebastes marinus* was possible.

Recruitment: Recent recruitment indices have decreased drastically and have remained significantly below the average level since 1989.

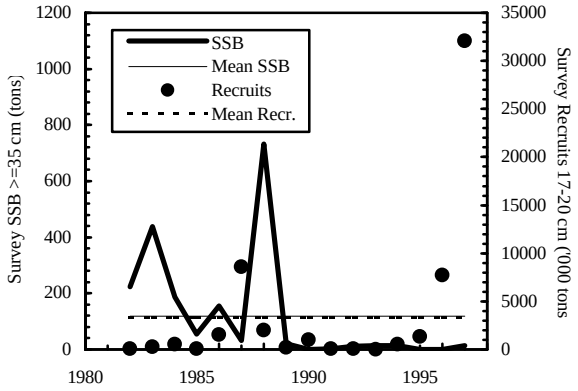


SSB: SSB indices decreased drastically from 1982 and have remained at the historical low since 1989.

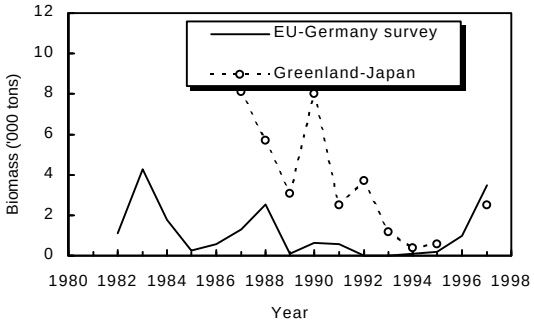
State of the Golden Redfish Stock: The stock of golden redfish in Subarea 1 remains severely depleted. There are indications that the probability of future recruitment is reduced at the current low SSB. Short term recovery is very unlikely.

Assessment of Deep Sea Redfish: No analytical assessment of *Sebastes mentella* was possible.

Recruitment: Variation in recruitment indices is high and the 1996-97 estimates were above average, the latter one representing the maximum of the time series.



SSB: SSB indices remained at the historical low level since 1989.



Biomass: Total stock biomass indices increased in 1996-97 but the stock is composed of mostly immature fish.

State of the Deep Sea Redfish Stock: The spawning stock of deep sea redfish in Subarea 1 remains severely depleted and an increase is unlikely in a short term.

Recommendation for Golden and Deep Sea Redfish Stocks: No directed fishery should occur on redfish in Subarea 1 until the stocks have recovered substantially. By-catches in the shrimp fisheries should be at the lowest possible level.

Special Comments: The probability of recovery of the redfish stocks in Subarea 1 should increase if the by-catches taken by the shrimp fishery are reduced.

Due to a lack of appropriate data, limit or target reference points for fishing mortality or spawning stock biomass of the golden and deep sea redfish stocks in Subarea 1 could not be proposed. Nevertheless, the recently depleted spawning stocks as derived from survey results are considered far below appropriate levels of B_{lim}.

Sources of Information: SCR Doc. 98/21, 25, 40, 41, 67; SCS Doc. 98/7, 14.

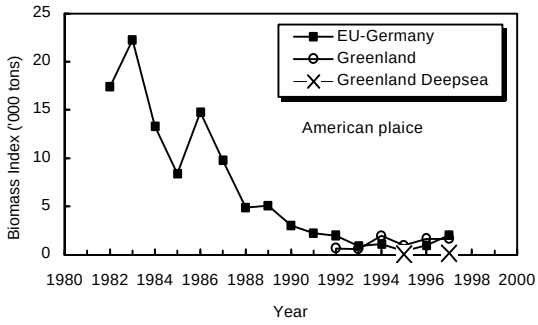
Other Finfish in Subarea 1

Background: The resources of other finfish in Subarea 1 are mainly Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffishes (*Anarhichas lupus* and *A. minor*), starry or thorny skate (*Raja radiata*), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus hippoglossus*) and sharks.

Fishery Development and Catches: Greenland cod are taken inshore by directed fisheries. Other species are mainly taken as by-catch offshore in trawl fisheries directed to shrimp, cod, redfish and Greenland halibut. In 1997, reported catches of other finfishes amounted to 4 246 tons representing an increase by 26 %, compared to the 1996 catch (3 367 tons). The catch figures do not include the weight of fish discarded by the trawl fisheries directed to shrimp.

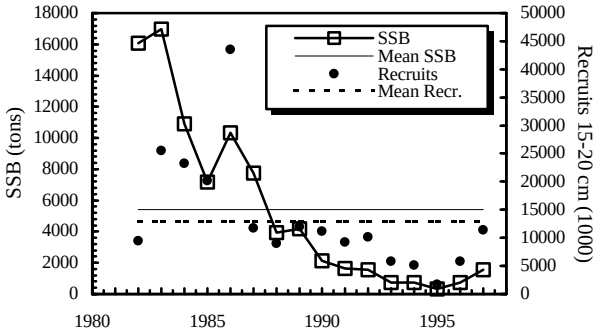
Data: No data on CPUE, length and age composition of the catches were available. Length frequencies were derived from the Greenland bottom trawl surveys. Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland. Spawning stock biomass and recruitment indices for American plaice and Atlantic wolffish were derived from EU-German survey data.

Assessment of American plaice: No analytical assessment was possible.



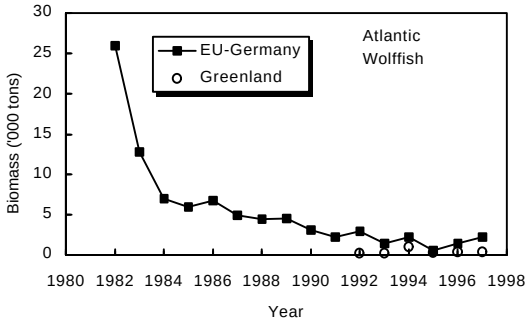
Recruitment: Recruitment indices have been low since late-1980s but had increased in 1997 to the average level.

SSB: Since 1983 the SSB index decreased drastically to historical low in 1995 but showed a slight increase in 1997.



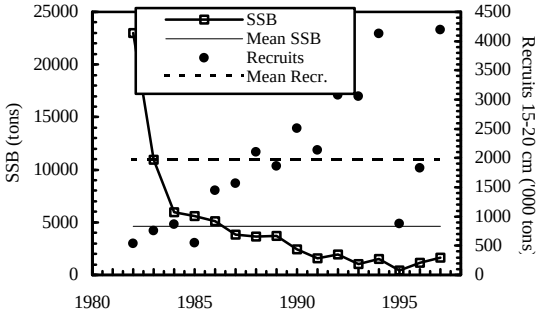
State of the American plaice stock: The stock remains severely depleted with an indication of increased recruitment.

Assessment of Atlantic wolffish: No analytical assessment was possible.



Recruitment: Indices increased almost continuously over the time series. Apart from 1995 the recruitment estimates were at or above the average level since the early-1990s.

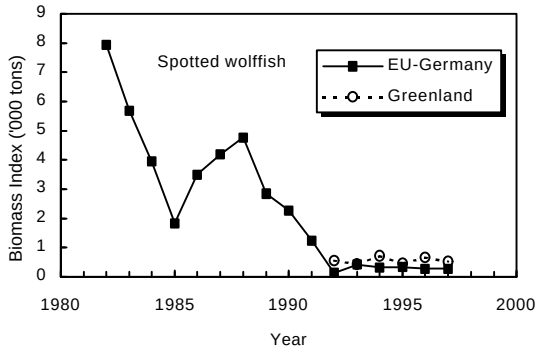
SSB: Since 1982, the SSB indices have decreased drastically to a historic low in 1995 but showed a slight increase in 1997.

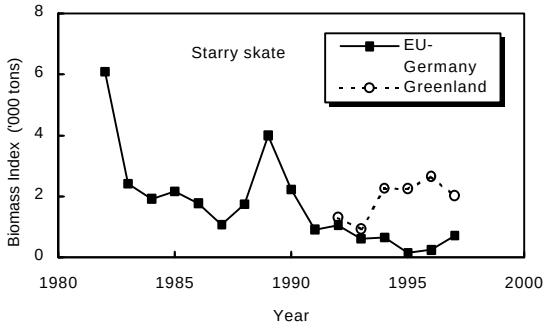


State of the Atlantic wolffish stock: The stock remains severely depleted although recruitment has increased almost steadily since the early-1980s. This suggests ongoing high mortality prior to maturation.

Assessment of spotted wolffish and starry or thorny skate: No analytical assessment was possible.

Biomass Indices: Survey results revealed dramatic declines for spotted wolffish and starry or thorny skate to a very low level.





State of the stocks of spotted wolffish and starry or thorny skate: The stocks of spotted wolffish and starry or thorny skate remain severely depleted.

Recommendation for the stocks of American plaice, Atlantic wolffish, spotted wolffish and starry or thorny skate: No recommendations can be made for Greenland cod, lumpsucker, Atlantic halibut and sharks. No directed fishery in Subarea 1 for American plaice, Atlantic wolffish, spotted wolffish and starry or thorny skate should occur until the stocks have recovered substantially. By-catches of these species in the shrimp fisheries should be at the lowest possible level.

Special Comments: The probability of stock recovery should increase if the by-catches taken by the shrimp fishery are reduced.

Due to a lack of appropriate data, limit or target reference points for fishing mortality or spawning stock biomass of the stocks American plaice, spotted wolffish and starry or thorny skate in Subarea 1 could not be proposed. Nevertheless, the recently depleted spawning stocks as derived from survey results are considered far below appropriate levels of B_{lim}.

Sources of Information: SCR Doc. 98/21, 25, 40, 41, 45; SCS Doc. 98/7, 14.

b) **Special Requests for Scientific Advice from Coastal States**

i) **Responses to Requests from Canada**

a) Canada with the concurrence of Denmark (Greenland) requested the Council to*: advise on appropriate TAC levels for Greenland halibut throughout Subareas 0-3, separately for Subareas 0+1, for Subarea 2+ Div. 3K and for Div. 3LMNO, and to make recommendations on the distribution of fishing effort within each of these three geographic areas.* The Council was asked also to: *provide information on present harvest patterns in terms of yield-per-recruit and on distributional variation of the resource in recent years* (see Agenda I, Annex 2, item 1 in Part D, this volume).

Scientific Council was able to provide some information on the distribution of the resource. The Canadian autumn surveys in 1996-97 covered almost all the stock range in Subareas 2 and 3. The survey results indicated that about 81% of the surveyed biomass was located in Subarea 2 + Div. 3K, and about 19% in Div. 3LMNO with only slight differences between 1996 and 1997. About two-thirds of the estimated biomass was comprised of fish smaller than 36 cm in both years.

b) The Council was requested by Canada to: *provide information on the application of the precautionary approach for Greenland halibut in Subareas 0 + 1 and Roundnose grenadier in Subareas 0 +1* (see Agenda I, Annex 2, item 2 in Part D, this volume).

Greenland halibut Subareas 0 and 1 (Div. 1A inshore)

A yield-per-recruit analysis could not be used to estimate reference points owing to lack of reliable input data. An XSA was presented in 1996 but was considered to be unsuitable for assessment, and hence for estimating reference points, owing to high log-catchability residuals and standard errors and a systematic shift in the residuals. Runs in 1997 and 1998 (not presented) showed no significant improvement in the outcome of the analysis. An attempt to estimate MSY and F_{msy} by a production model (ASPIC) was not successful probably because there was a small range in the input data. This lack of contrast due to small range in CPUE and biomass estimates also hampered estimation of precautionary reference points based on CPUE and biomass.

Roundnose grenadier (Subareas 0 and 1)

The trawlable biomass was in the order of 100 000 tons in Div. 1CD in 1986-87. Since the fishery has been at a very low level since the late-1970s, the stock could in 1986-87 be considered as virgin. Under this assumption, current trawlable biomass is about 5% of virgin stock size. Trial runs of a surplus production analysis were done using commercial catch and effort data from 1968 to 1978, but the results were considered unrealistic. Although it was not possible to estimate a limit biomass level, it is most probable that any limit biomass would be substantially greater than 5% of the virgin level, the current situation as suggested by the survey data. Therefore it is considered that the current stock size is well below the limit biomass.

c) The Council was requested by Canada to: *review the status of the cod stock in Div. 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, Annex 2, item 3 in Part D, this volume).

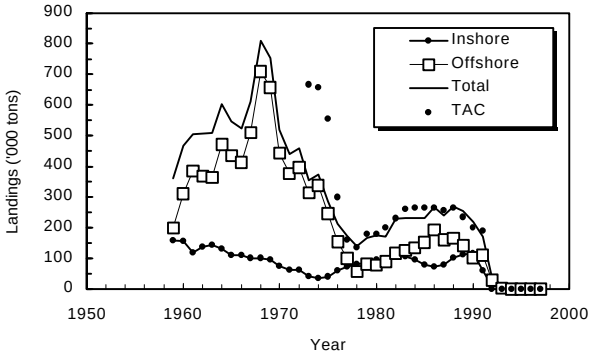
Cod (Gadus morhua) in Divisions 2J, 3K and 3L

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 over-winter 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, 1994 and 1996 but not in 1995 and 1997.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1995	0.3	nf	0
1996	1.5	nf	0
1997	0.5	nf	0
1998	-	nf	0

[1] Provisional.
nf No fishing.



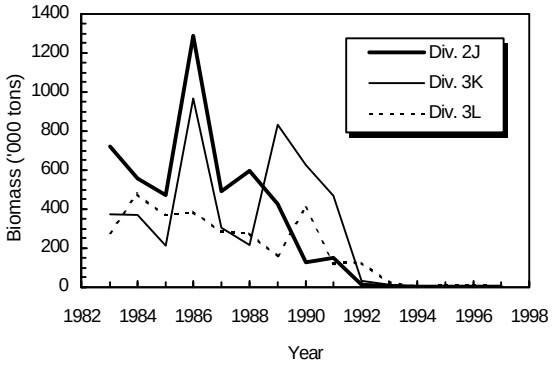
Data: Abundance and biomass indices were available from several surveys. Removals at age were available from the limited by-catch and the sentinel survey. Data on growth and maturity were also available.

Assessment: Stock status was estimated based on research vessel abundance indices, sentinel survey data and biological data. No acceptable analytical assessment could be provided.

Fishing Mortality: Based on previous SPAs, 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. Total mortality in recent years was estimated to be high based on research vessel data. The cause for this has not been determined but may be attributable in part to seal predation and illegal removals.

Recruitment: The number of 3-year-olds estimated by previous SPAs 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. Survey data have continued to indicate very low recruitment in recent years. The 1996 year-class appears to be extremely weak. Pelagic juvenile surveys indicated the 1997 year-class to be intermediate between the values in 1995 and 1996.

Biomass: Autumn research vessel survey index of biomass in Div. 2J+3KL declined abruptly in the early-1990s. The 1997 estimate is slightly lower than the previous year and therefore remains extremely low. Biomass in the spring research vessel survey was the highest since 1992, but remains at an extremely low level.



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. Even under the moratorium, in place since 1992, total mortality is estimated to be high. Given low recruitment and high mortality, the spawner biomass could decline further in 1998. While a number of factors appear to contribute to the high mortality their relative contribution is unknown.

Sources of Information: SCR Doc. 98/38, 46.

d) Canada in concurrence of Denmark (Greenland) requested the Council to*: describe the spawning times and locations as well as nursery areas for Greenland halibut in Subareas 0+1 and the relationships with the Greenland halibut resources in the southern areas.* (see Agenda I, Annex 2, item 4a in Part D, this volume).

Greenland halibut is widely distributed in the Northwest Atlantic from 78°N in the north to the Gulf of Maine in the south, and is considered to constitute a single spawning complex. The main spawning area is believed to be located at great depth (up to 2 000 m) in the central part of the Davis Strait, although spawning has also been observed along the Canadian continental slope and in the Flemish Pass. Based on observations of pelagic eggs and larvae, and on maturity development during the year, the spawning time in the Davis Strait has been inferred as winter and early spring. Studies suggest that the eggs and larvae drift with currents along the West Greenland and Canadian coasts, and post-larvae settle on the slopes of the banks off Greenland and Canada. Greenland halibut then gradually move towards deeper water and the presumed spawning area as they grow, reaching the spawning area as mature fish. The main nursery area in Subarea 1 is on the northern part of the 'Store Hellefiske Banke' (the northern part of Div. 1B) and the southern part of 'Disko Banke' (the southern part of Div. 1A). Although small Greenland halibut have been observed throughout its range of distribution, no other major nursery areas have been identified.

e) Canada with concurrence from Denmark (Greenland) requested the Council to: *quantify the by-catch of Greenland halibut (by size and age) from the shrimp fishery in the nursery areas of Davis Strait and describe the potential loss in both yield and contribution to the spawning stock.* The Scientific Council was also asked to: *comment on the measures that could be taken to eliminate or reduce substantially these by-catches* (see Agenda I, Annex 2, item 4b in Part D, this volume).

Although only two major nursery areas have been identified, small Greenland halibut have been found throughout the range of Greenland halibut distribution. Therefore, any shrimp fishery within this range may impact the Greenland halibut resource.

Based on survey data in 1997 the by-catch of Greenland halibut offshore at West Greenland in July-August was estimated at 287.8 tons or 3.3 million fish. A further 304.1 tons (4.5 million) were estimated from by-catch in Disko Bay for the same period; it is however unknown whether those fish would eventually have recruited to inshore or offshore stocks. The offshore by-catch was largest in Div. 1C in terms of weight (0.090 kg Greenland halibut per kg shrimp), but largest by numbers in the nursery area in Div. 1B (1.1 fish per kg shrimp). In the nursery area the by-catch was comprised almost exclusively of fish < 20 cm, probably 1 or 2 years old.

The by-catch in the shrimp fishery in Div. 0A and Div. 0B was estimated at 42 tons (0.45 % of the shrimp catches) in 1997. Lengths ranged from 6 to about 40 cm. In Div. 0A two modes were seen around 7 and 20 cm, while the length distribution was dominated by a single mode at 18 cm in Div. 0B. Separator grates with a bar separation of 22 mm have been mandatory since 1997 in the shrimp fishery in Subarea 0.

The potential loss in yield and contribution to the spawning stock due to by-catch could not be estimated because the annual total by-catch of Greenland halibut and the age distribution in the by-catch is not known.

Separator grates appear to be effective in reducing the by-catch of Greenland halibut in the shrimp fishery in Subarea 0. Separator grates with a bar separation of 22 mm will be mandatory in the offshore shrimp fishery in Subarea 1 in the near future.

f) Canada with concurrence from Denmark (Greenland) requested the Council to: *comment on the research required to adequately answer these and related questions regarding the status of the stock of Greenland halibut throughout the Davis Strait area*. (see Agenda I, Annex 2, item 4c in Part D, this volume).

During the period 1987-95 joint Japan/Greenland surveys were conducted in Subarea 1. Former USSR and GDR conducted surveys covering parts of Subareas 0 and 1 in the late-1980s and 1990. The most recent survey to cover Subareas 0 and 1 extensively, was conducted by Canada in 1986. In 1997 Greenland initiated a survey series covering Div. 1CD (where the commercial offshore fishery in Subarea 1 takes place). (The nursery areas for Greenland halibut are covered by the Greenland shrimp trawl survey). In order to get an overall view of the stock status in Subareas 0 and 1, and to estimate trawlable biomass and its distribution among the Subareas, it is necessary to survey the whole area, preferably using the same vessel and gear throughout. A survey will also give information about size and age distribution in the stock. To follow developments in the stock, the survey should be conducted annually in order to establish a time series.

g) Canada with concurrence from Denmark (Greenland) requested the Council to: *comment on the research required to allow the Council to provide advice on TAC levels for Roundnose grenadier in Subareas 0 and 1* (see Agenda I, Annex 2, item 5 in Part D, this volume).

Roundnose grenadier is widely distributed in the Davis Strait south of 67°N. There is now no commercial fishery for roundnose grenadier. Historically the fishery took place in Div. 0B and 1CD. In order to advise on TAC levels at least a survey estimate of biomass is needed. This area was surveyed in 1986 by Canada, but there have since been no surveys covering the entire area where the commercial fishery took place. To estimate the trawlable biomass and its distribution between the two Subareas and to get information on size and age distribution in the stock, it is necessary to survey the whole area, preferably using the same vessel and gear throughout. To follow developments in the stock, the survey should be conducted annually in order to establish a time series. A survey designed for Greenland halibut in Subareas 0 and 1 would cover most of the distribution area of roundnose grenadier.

ii) **Response to Request by Denmark (Greenland)**

Denmark (Greenland) made a special request with respect to Greenland halibut in Subareas 0 and 1. (see Agenda I, Annex 3, item 2 in Part D, this volume). The Council was asked to: *provide further information on following topics:*

a) allocation of TACs to appropriate Subareas (Subareas 0 and 1), and
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 on Greenland halibut Subarea 0 + Div. 1B-F and NAFO Sci. Coun. Rep., 1994, p. 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 the inshore areas of Div. 1A.

Scientific Council considers that separate TACs are appropriate for each of the three areas. In order to prevent escalating effort it is **recommended** that *a TAC for each inshore area for 1999 should not exceed the average of the catches for 1995-97; Disko Bay 7 900 tons, Uummannaq 6 000 tons and Upernavik 4 300 tons. This gives a total TAC of 18 200 tons in Div. 1A inshore* (see also Summary Sheet).

XI. OTHER MATTERS

The Chairman noted there were items of specific importance raised at this current meeting which should be addressed. In particular, the Council noted that there were the following 3 items:

a) **Harmonizing Inter-agency Terminology on the PA**

The Council noted that there was an identified need to harmonize the Precautionary Approach (PA) terminology among different agencies, e.g. NAFO, ICES, FAO.

The Council agreed that the FAO Committee on Fisheries (COFI) is the suitable forum to address this task. It was agreed that the Scientific Council Chairman should look at an appropriate approach for NAFO. The Council also **recommended** that *NAFO accept the invitation to attend the FAO and non-FAO international agency meeting prior to the COFI Meeting in February 1999 and bring forward the issue of harmonizing the PA terminology.*

b) **Protocol for Data Collection in the Pilot Observer Program**

The Council was concerned that the detailed protocol developed by the Scientific Council in June 1997 (NAFO Sci. Coun. Rep., 1997, p. 163-166) and submitted to the Fisheries Commission as a Fisheries Commission Document (FC WP 97/8) had not been addressed by the Fisheries Commission. The Council agreed that the Scientific Council Chairman should address this matter with the Fisheries Commission Chairman to ensure better communications.

c) **Place and Duration of June Meetings**

Place. There was consensus in the Council that the meeting facilities at its present venue, Keddy's Dartmouth Inn, were not suitable for the Scientific Council June Meeting.

The Council agreed the Executive Committee will prepare a report to provide guidelines for the meeting facilities, including the general computer requirements.

The Council agreed that the Chairman should address this matter with the Executive Secretary.

Duration. With respect to the length of the June meetings, the Council agreed the Executive Committee, in consultation with national representatives and Designated Experts, prepare a proposal for discussion during the September 1998 Meeting of the Council. While noting the importance of timely submission of scientific advice to the Fisheries Commission, it was recognized that this proposal should also include aspects such as data availability and the effectiveness of the present long demanding commitment required from the scientists.

The Council agreed to review this proposal at its September 1998 Meeting, and address any matters as needed with the Fisheries Commission.

XII. ADOPTION OF REPORTS AND RECOMMENDATIONS

The Council during the course of the meeting received summary presentations on the STACFEN and STACREC Reports from the respective Chairs. Having considered each recommendation, and also the text of the reports, the Council **adopted** the reports of STACFEN and STACREC.

At its concluding session on 18 June 1998, the Council received summary presentations by the Chairmen of STACFIS and STACPUB. Having addressed each recommendation, the Council **adopted** the reports of STACFIS and STACPUB, noting that some text insertions and modifications as discussed at plenary will be incorporated later by the Chairman and the Assistant Executive Secretary.

The Council noted that the list of recommendations will be annexed (see Annex 1) to this Scientific Council Report, ahead of the Appendices.

XIII. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 18 June 1998, the Council considered the draft report of this meeting, and **adopted** the report of this meeting, with the understanding that the Chairman and the Assistant Executive Secretary will incorporate later the text insertions and modifications as discussed at plenary.

XIV. ADJOURNMENT

There being no further business, the Chairman thanked all the participants for their patience and long working hours. Special thanks were extended to the Designated Experts and the Chairmen of the Committees who had to carry extra burdens of work through the meeting, particularly the STACIFS Chairman. Thanks were extended to the Nominating Committee. Congratulations were extended to the Chairman of STACFEN along with the Council's appreciation for undertaking this task for a further term. With a special thanks to the Assistant Executive Secretary and the Secretariat staff, the meeting was adjourned.

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

Chairman: M. Stein Rapporteur: K. F. Drinkwater

The Committee met at the Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada, on 4 and 17 June 1998, 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 Greenland), European Union, Japan, Russia and the United States of America.

The Committee reviewed the following documents: SCR Doc. 98/17, 18, 20, 21, 22, 23, 24, 32, 35, 36, 37, 38; SCS Doc. 98/6, 7 and 12.

1. **Opening**

The Chairman welcomed the members to the annual June meeting of STACFEN. He noted, with pleasure, the attendance of S. Narayanan (MEDS) who is the present Chairman of the ICES Ocean Hydrography Working Group. The Committee hoped her attendance would promote closer co-operation between ICES and NAFO on environment related matters.

2. **Chairman's Introduction; Report on Activities**

The Chairman informed the Committee on activities in preparing for the June 1998 Meeting of STACFEN. This was mostly correspondence with the Invited Speakers, but also included activities in regard of results from the ICES Ocean Hydrography Working Group (OHWG). A summary on climatic issues in the North Atlantic Hemisphere as provided by the ICES OHWG was made available to the Committee.

3. **Invited Lecture**

The Chairman introduced D. Mountain of the National Marine Fisheries Service in Woods Hole, USA, who presented a talk entitled *Recent Water Property Variability in Subareas 5 and 6*. The following is a summary.

The temperature, salinity characteristics of the waters within the Gulf of Maine fall along a line joining its two constituent water masses; relatively cold, fresh waters from the Scotian Shelf and warm, salty waters from the offshore slope region. Interannual changes in the water properties within the Gulf can result from either variations in the properties of the source waters themselves or in the relative amounts of the source waters in the mixture. Observations show that such changes tend to persist for a few years or more. Lower-than-normal salinities observed since 1995 in the Gulf have been caused by an increase in the transport of low salinity waters from the Scotian Shelf and a corresponding decrease in the higher salinity slope waters that enter through the Northeast Channel.

On the Middle Atlantic Bight, the volume of shelf waters as defined by salinities less than 34 PSU, has significant interannual variability. The anomaly or deviation from the mean of the volume of shelf water is strongly coupled to the salinity anomaly of the shelf waters but not to their temperature. Temperature appears to be controlled more by local air-sea heat fluxes while salinity is largely determined by advection, both from the north along the shelf and from the offshore. In past studies attempting to relate fishery-related indices to temperature, the mean temperature over the entire Middle Atlantic Bight has most often been used. Recent studies show this temperature anomaly is correlated with the shelf water volume, that is the mean temperature over the entire Bight is determined more by the proportion of water types rather than changes in the temperature of the constituent water types.

4. **Invited Paper**

E. B. Colbourne from the Canadian Department of Fisheries and Oceans in St. John's, Newfoundland, Canada, presented an invited paper entitled *Oceanographic Variability on the Flemish Cap* (SCR Doc. 98/35), co-authored with K.D. Foote, a brief summary of which follows.

Interannual variability in the temperature and salinity conditions of the Flemish Cap waters were found to be highly correlated to those observed in the inshore branch of the Labrador Current and in other areas of the continental shelves off Newfoundland. These include relatively warm waters during the 1950s and 1960s followed by three colder and fresher than normal periods; in the early-1970s, the mid-1980s and the early-1990s. The coldest conditions appeared during 1993 when temperature anomalies were 2K below normal in the

upper layers over the Cap and 0.5K below normal near bottom. Advection of Labrador Current water into the region appears to be the principle cause of hydrographic variability on the Cap. Examination of recent acoustic Doppler current measurements during summer, as well as geostrophic current estimates from detailed hydrographic measurements, confirm the presence of an anticyclonic gyre over the Cap but with high interannual variability in its structure and strength. Based upon repeated summertime surveys, chlorophyll concentrations in the surface layers over the Cap are high relative to those on the Grand Banks.

5. Review of Environmental Conditions

a) Marine Environmental Data Service (MEDS) Report for 1997 (SCR Doc. 98/22)

The inventory of oceanographic data obtained by MEDS during 1997 was presented along with information on several new initiatives.

i) Hydrographic Data Collected in 1997

Data from 6 851 oceanographic stations collected in the NAFO area were sent directly to MEDS in 1997, including data from net-mounted CTDs of which 3 348 have been archived and the remainder are awaiting to be archived. An additional 5 253 stations were received through IGOSS (Integrated Global Ocean Service System). The number of stations received directly by MEDS increased by approximately 68% from that obtained in 1996 while the number of stations obtained through IGOSS increased by 13%.

ii) Historical Hydrographic Data Holdings

Data from 30 174 oceanographic stations collected prior to 1997 were obtained during the year, over 20 times the number of those stations received in 1996. Most of the data came from Canada.

iii) Drift-buoy Data

A total of 158 drift-buoy tracks were received by MEDS during 1997 representing over 398 buoy months. The total number of buoys was an increase of 29 over 1996 but the number of buoy months was down by 10%.

iv) Wave Data

In 1997, 75 379 wave spectra were processed, mostly from the permanent network of moored wave buoys in the area. This represents a decrease of over 23 000 compared to 1996.

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 are derived from the CHS active permanent water level network. A total of 57 stations were processed during 1997, a decrease of 8 stations from 1996.

vi) Recent Activities

MEDS has been active in three other recent initiatives. They have been involved, along with others, in (1) developing a biological oceanographic database; (2) distributing data collected during the World Ocean Circulation Experiment (WOCE) including taking the lead in the production of all of the available WOCE data on CD-ROMs, and (3) supporting and co-ordinating the Ships of Opportunity Program (SOOP). In addition, the Atlantic Zone Monitoring Program described last year has been approved. MEDS has also been active within the ICES Working Group on Marine Data Management and the Canadian National Data Management Working Group. These groups, respectively, provide a forum for co-operation and co-ordination of data and data management issues, internationally and national.

b) **Review of Environmental Studies in 1997**

i) **Results from physical oceanographic studies**

Subareas 0 and 1 (SCR Doc. 98/23, 24, 36; SCS Doc. 98/7)

During the annual EU-German groundfish survey (SCS Doc. 98/7) CTD measurements were taken at 45 fishing stations and along 2 NAFO standard sections off West Greenland (Cape Desolation and Fyllas Bank).

Monthly air temperature anomalies at three sites in Greenland and changes in the ice cover in the northern North Atlantic during 1997 were described (SCR Doc. 98/36). Annual air temperatures over Greenland were generally above normal, however, exceptions included very cold conditions from February to April over West Greenland. The annual above normal air temperatures are similar to those recorded in 1996. These conditions contributed to below normal sea ice cover and above normal subsurface ocean temperatures. Based upon a simple harmonic model, it was argued that the recent warming is expected to be temporary and that the long-term trend into the 21st century will remain one of declining temperatures. A significant drop in salinity in the upper 300 m and in the Irminger Water layer (200-300 m) was observed on the Cape Desolation Section. This is believed to be due to a major export of sea ice from the North Polar Sea and may be signaling the beginning of new "Great Salinity Anomaly". The NAO index was below normal in the winter of 1996/97, a condition which is generally associated with milder air in the Greenland area.

Hydrographic data collected by Denmark in the summer off West Greenland reveal very low temperatures in 1997 on Fyllas Bank although air temperatures were quite warm (SCR Doc. 98/23). This may indicate a strong inflow of Polar water from East Greenland. Low salinities were also observed on Fyllas Bank and to the north during 1997 and in 1996. This is further support for the idea that another "Great Salinity Anomaly" may be underway. High inflow of pure Irminger Water was observed, with these waters observed north of the Frederikshaab section.

A high NAO index from the early-1980s until recently resulted in generally cold, dry conditions over Greenland (SCR Doc. 98/24) Two periods of extreme cold air were 1982-84 and 1989-94. These cold atmospheric conditions were reflected in the waters off Southwest Greenland by below-normal temperatures in the top 40 m as well as by a southward extension of the edge of first year ice in Baffin Bay (Westice). Several times during the past 15 years, the Westice merged with the multiyear ice carried to West Greenland by the East Greenland Current (Storis) around Julianehaab Bight, a relatively unusual event.

Subareas 2, 3 and 4 (SCR Doc. 98/32, 37; SCS Doc. 98/6)

A presentation was made based upon hydrographic measurements made during EU-Spanish fisheries surveys of Flemish Cap in July 1997 (SCR Doc. 98/32). The coldest waters were observed on the western side of the Cap. Temperatures decreased with depth, with no subsurface temperature minimum. Geostrophic current estimates based upon the density data from the survey showed the presence of an anticyclonic gyre on the Cap, consistent with historic measurements. The data also suggested the possibility of smaller eddies on the Cap with adjacent upwelling and downwelling areas. It was noted that shrimp were found in the coldest areas of the Cap.

Research into the hydrographic conditions on the Scotian Shelf and adjacent waters were briefly discussed (SCS Doc. 98/6). It was suggested that there has been an increase in the transport of Labrador waters into the cold intermediate layer of the Scotian Shelf. Warmer slope water was advected into the deeper basins of the Scotian Shelf during the summer and autumn compared to 1996. A +1K surface temperature anomaly around Sable Island was suggested as a possible cause of the anomalously abundant year class of hake.

Warm slope waters that have traditionally occupied the continental slope off the Scotian Shelf and Gulf of Maine over the past 30 years, were displaced by colder, fresher Labrador Slope water in the autumn of 1997 (SCR Doc. 98/37). It was first observed off Banquereau Bank in northeastern Scotian Shelf in September and gradually moved southward along the shelf edge to at least the Great South Channel by March 1998, consistent with a speed of 4 to 10 km d^{-1}. The Labrador Slope Water penetrated into Emerald Basin on the Scotian Shelf but not until 3-4 months after its arrival in the adjacent offshore area. Temperatures dropped by over 3K and 0.5 in salinity in the Basin between

mid-December and mid-April. The recent T,S properties in the lower layers of Emerald Basin are similar to those observed during the 1960s and the coldest in approximately 30 years.

Subareas 5 and 6 (SCR Doc. 98/17; SCS Doc. 98/12)

Monthly monitoring of surface and bottom temperatures on a transect across the Middle Atlantic Bight revealed below normal values with annual average anomalies of -1.6K at the surface and -0.4K near bottom. These both are warmer than in 1996, however. Surface salinity anomalies were also low (0.76 PSU below the 1978-92 mean) and continued the trend of low salinities observed in 1996. Near surface temperatures across the Gulf of Maine transect were near normal (-0.1K anomaly) but the near bottom water was 0.6K above normal. Relatively warm near bottom temperatures were also observed in 1996.

A paper (SCS Doc. 98/12) on the recent hydrographic conditions obtained from the transects across the Middle Atlantic Bight and the Gulf of Maine in addition to the data series (1978-92) will soon appear in the *Journal of Northwest Atlantic Fishery Science*.

ii) **Interdisciplinary Studies** (SCR Doc. 98/20, 21)

Near-bottom temperatures during groundfish surveys off East (ICES Subarea XIV) and West Greenland (Div. 1B-1F) from 1982 to 1997 show high geographical coherence with cold conditions during 1982-84, warmer in 1985-86, a decreasing trend in 1987-89 and warming since then (SCR Doc. 98/21). The 1996 measurements were the highest of the past 16 years. The warm conditions continued into 1997 although temperatures decreased slightly relative to 1996. The temperature pattern matches that observed in air temperature and sea temperatures along standard sections off West Greenland. Warmer temperatures, as found during recent years, are favourable conditions for fish growth and reproduction.

A study on the effects of the North Atlantic Oscillation (NAO) on cod recruitment off Greenland was presented (SCR Doc. 98/20). The first objective was to outline the causal mechanisms through which the NAO may affect recruitment. It was suggested that this occurs through the NAOs influence upon air and subsequently, sea temperatures. The second objective was to discuss the necessity of incorporating environmental variability effects into the assessment process.

A discussion on how to include information on environmental variability into fisheries assessments followed the presentation of SCR Doc. 98/20. The process was seen as having two stages. The first stage is finding correlations or developing models linking environmental variables to fisheries and the second stage is quantitatively incorporating these into the assessments, such as is presently being done in the case of walleye pollack in the Northeast Pacific. It was noted that the ease with which environmental data could be incorporated will depend upon the management system. The present system used within NAFO makes this difficult but it was generally agreed that promotion of, and work towards, the goal of incorporating environmental information into assessments is very important. With the advent of the Precautionary Approach to management, different reference points may be established depending upon the environmental conditions. Thus for example, recruitment could be made a function of not only spawning stock biomass as is presently done, but also of the environment. The difficulties of obtaining good relationships between recruitment and the environment because of poor quality fisheries data was also noted. The lack of predictability of the environment was discussed. Even if there is a strong relationship between an environmental variable and recruitment, since the environment can not be predicted then how useful is it for annual assessments? First, it was recognized that fisheries events occur at both short (year-to-year) time scales and long (multi-year) time scales. While it may be unlikely to accurately predict year-to-year variations, for some environmental variables better success of prediction will be found at the multi-year time scale. For example, there has been strong decadal scale oscillations in several environmental variables in the North Atlantic since the 1960s. These may be used to predict general long-term environmental trends, and subsequently, the response of the fish stocks. Thus, environmental information can be helpful in longer-term fisheries management issues. Second, the scientific understanding of the physical systems continues to improve and short- and long-term predictions are being set as the goals of major international programs and nations. Although initial success may be limited, as it was when weather prediction services were first set up, it is expected that better models will be developed over time and that predictions will improve. From the fisheries perspective, scientists need to be in a position to take advantage of improved environmental predictions, when they do occur. Third, it is important to realize that for most environmental variables it will only be possible to accurately predict trends or tendencies, not absolute values. Such information, however, could be easily used within the Precautionary Approach, for example

fisheries management strategies would vary depending upon the predicted environmental trend. It was also felt that increased knowledge of environmental effects may help to explain fishery events, even if this only occurs after the fact. Such explanations would enhance the credibility of science in the eyes of managers and the public. Other international groups such as GLOBEC and ICES, through its Working Group on Cod and Climate Change, are wrestling with these same issues. Any activities planned on this subject within NAFO should be cognisant of the efforts and results from these groups. A special theme session or workshop on this issue was discussed but no specific time was set. It was finally noted that the very low stock size due to the collapse of the groundfish in much of the NAFO area helps in the evaluation of reference points as part of the Precautionary Approach to management.

c) **Overview of Environmental Conditions in 1997** (SCR Doc. 98/38)

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 1997 in the Labrador Sea region but down from their 1996 levels. In spite of this, late winter and early spring temperatures were anomalously cold. Along the Atlantic coast, air temperature sites revealed colder-than-normal conditions. Opposite air temperature anomaly trends over the Labrador Sea and the Middle Atlantic Bight have been observed in most of the past 30 years.

ii) The atmospheric circulation pattern was weaker than usual resulting in the anomaly of the North Atlantic Oscillation (NAO) index being negative. This was the second consecutive year with a below normal NAO index but it has been above the 1996 value.

iii) Due to warm air temperatures and weaker winds, ice formed late in 1997 off southern Labrador, Newfoundland and in the Gulf of St. Lawrence. Due to cold air temperatures during the latter half of January through March, the areal extent of ice was near normal. Off Newfoundland and Labrador ice left early by upwards of a month but in much of the Gulf the ice remained later-than-normal. Ice conditions were more severe than in 1996 but less than during the early-1990s.

iv) During 1997, the number of icebergs to reach south of 48^{o}N increased relative to 1996. It was considered to be an above average iceberg year.

v) Temperatures in 1997 throughout most of the water column off Newfoundland were below normal, except near bottom where they were slightly above normal. Temperatures were generally cooler than in 1996.

vi) The volume extent of the CIL water off Newfoundland during the summer was near its lowest value on record, similar to 1996. The below normal area of CIL water was observed off southern Labrador and off northern Newfoundland but not across the Grand Bank, where it was slightly above normal.

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. Conditions continue to moderate as evidenced by the increase in temperatures and the decrease in the area of the Magdalen Shallows by temperatures <0 and <1^{o}C.

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 and 1996.

ix) Deep water temperatures on the Scotian Shelf (Emerald Basin) and in the Gulf of Maine remained high during 1997 while in Cabot Strait they remained near or slightly above normal. The high temperatures on the Scotian Shelf and in the Gulf of Maine are related to the influence of warm slope waters penetrating onto the shelf.

x) Cold Labrador Slope waters replaced Warm Slope water along the shelf edge off the Scotian Shelf during the autumn. This water did not penetrate onto the Shelf during 1997.

xi) Cold waters were observed near-bottom and at intermediate depths over the northeastern Scotian Shelf and off southwestern Nova Scotia, continuing a trend that began in the mid- to late-1980s. The slow warming observed in 1996 is continuing.

xii) Both the shelf/slope front and the north wall of the Gulf Stream were seaward of the their long-term mean positions.

6. **Recommendations and Conclusions**

STACFEN **recommended** that *NAFO co-sponsors, along with ICES, the Joint ICES/NAFO Decadal Symposium to be held in August 2001 in Edinburgh*. The co-convenors are J. Meincke (Germany) and R. R. Dickson (UK). The joint sponsorship is supported by the ICES Hydrography Working Group, which has recommended that the Chairman of the STACFEN, M. Stein, sit on the Steering Committee for the Symposium and that K. Drinkwater (Canada) be on the editorial board for publication of the symposium proceedings. Given that both NAFO and ICES would be proposing to hold similar symposia on a review of the 1990s early in the next decade, STACFEN feels that a single symposium is more efficient. In addition to allowing the traditional regional focus that separate symposium would foster, it would provide the opportunity to place both the ICES and NAFO areas into a larger-scale perspective through comparisons of different areas around the North Atlantic.

STACFEN recognized the need to incorporate environmental information into fisheries management. The Committee felt that increased effort is required to establish more of the links between fisheries and oceanographic variability. In addition, work needs to begin on methods of how best to use this information within the fisheries assessment and management strategies. This includes the Precautionary Approach to fisheries management. STACFEN encouraged scientists to bring forth new ideas and working papers on this subject, and STACFEN would like the Scientific Council to consider the possibility of these topics being the focus of a future Workshop and/or Symposium. STACFEN felt that such activities would likely follow the proposed 2001 Symposium.

It was suggested that STACFEN examine the possibility of effects of the recently observed low salinities in the Newfoundland region by examining the fisheries responses to past low salinity events. If the environmental conditions are likely to delay the recovery of the groundfish stocks off Newfoundland and elsewhere, then we need to alert management and the public.

The Chairman will approach R. R. Dickson, from the Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft, to give the invited lecture for the June 1999 STACFEN Meeting. R. R. Dickson has recently been working on the NAO variability and its biological consequences.

7. **National Representatives**

The Committee was informed that S. Narayanan will be replacing G. Glenn as the Canadian national representative responsible for submitting oceanographic data to MEDS. She joins the other representatives: R. Dominguez (Cuba), E. Buch (Denmark), A. Battaglia (France), F. Nast (Germany), H. Okamura (Japan), R. Leinebo (Norway), A. J. Paciorkowski (Poland), J. Pissarra (Portugal), J. Gil (Spain), F. Troyanovsky (Russia), L. J. Rickards (United Kingdom) and G. Withee (USA).

8. **Report on the Russian/German Data Evaluation Project** (SCR Doc. 98/18)

The Chairman reported that the Joint Russian/German Oceanographic Data Evaluation project has been given funding to begin a new phase entitled "*Assessment of short-time climatic variations in the Labrador Sea*". The first workshop under this new phase was held on 20-25 April 1998 in Hamburg, Germany. Analysis to detect the relationship of the NAO index to ice cover in the Labrador Sea was undertaken. Significant positive correlations were found for the ice months of January, February and April as well as for the mean for the entire ice season. The next workshop within this project is scheduled for 24-31 August 1998 in Murmansk, Russia.

9. **Other Matters**

There being no other business, the Chairman closed the meeting by thanking the participants for their contributions and co-operation. Special thanks were addressed to the NAFO Secretariat for their valuable help in providing the SCR Documents in due time for consideration in STACFEN.

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

Chairman: R. K. Mayo Rapporteurs: Various

I. OPENING

The Committee met at the Keddy's Dartmouth Inn, Dartmouth, Nova Scotia, Canada during 3-17 June 1998, 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, Russian Federation and the United States of America. Various scientists assisted in the preparation of the reports considered by the Committee.

The Chairman, R. K. Mayo (USA), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The Chairman noted there were additional considerations on the Precautionary Approach reference points, which will be addressed within each section of the report. The agenda was accordingly **adopted** as presented in the Provisional Agenda (see Agenda I in Part D, this volume).

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 1997. 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 reviews in 1996 and 1997, differences in the estimation of the catches were resolved with little difficulty.

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 the NAFO area were inspected at the landing site in 1997. Results from the EU-Observer Program in 1997 indicated good agreement with the officially reported landings for EU member countries fishing in the NAFO area.

III. STOCK ASSESSMENTS

1. **Cod (*Gadus morhua*) in Division 3M** (SCR Doc. 98/30, 52, 58; SCS Doc. 98/11, 13)

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 have also been 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 nill 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 variation between years. Reported catches declined after 1980, when a TAC of 13 000 tons was established, but the 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. 1.1), including non-reported catches and catches from non-Contracting Parties.

The fishery in 1996 and 1997 was at a very low level compared with previous years: most of the fleets traditionally targeting cod in Div. 3M didn't participate, particularly Portuguese gillnetters, Faroese longliners and Spanish pair-trawlers. One Spanish pair-trawler began a fishery but redirected to other target species after experiencing very low catch rates. Most of the reported catches were taken by Portuguese trawlers during a directed cod fishery mostly in December. A catch of 1 500 tons was estimated for vessels from non-Contracting Parties, based on Canadian Surveillance reports.

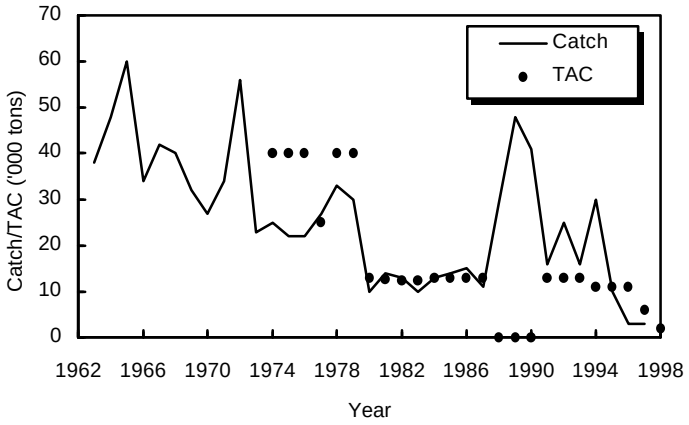


Fig. 1.1. Cod in Div. 3M: reported catches and TACs. Catch figures include estimates of misreported catches since 1988.

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	0	0	0	13	13	13	11	11	11	6	2
Catch	29[1]	48[1]	41[1]	16[1]	25[1]	16[1]	30[1,2]	10[1,2]	3[1,2]	3[1,2]	

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

b) **Input Data**

i) **Commercial fishery data**

Length and age composition samples for 1997 catches were only available for Portuguese trawlers for May. Sampling was too low to adequately represent the whole catch. Mean weights-at-age in the catch were low in comparison with previous years. Ages 3 and 4 dominated the sampled catch.

ii) **Research survey data**

Biomass and abundance estimates were available from research vessel bottom trawl surveys conducted by USSR/Russia from 1977 to 1996, with the exception of 1994 (Fig. 1.2), and from a concurrent acoustic survey from 1985 to 1993. The estimates of bottom trawlable biomass in the most recent period showed a maximum of 37 000 tons in 1989, and a minimum of 2 500 tons in 1992. Biomass estimates declined from 8 300 tons in 1995 to 700 tons in 1996.

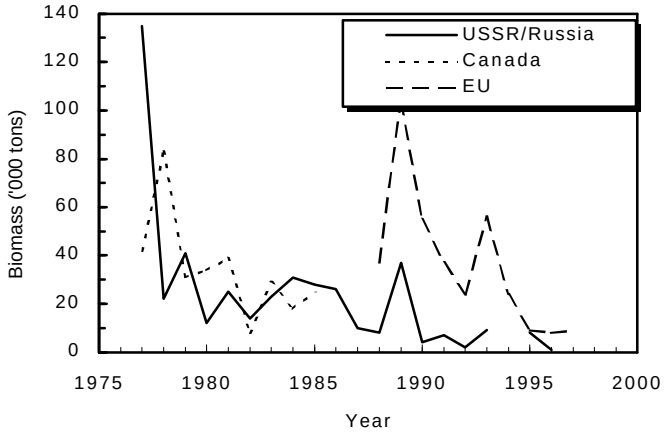


Fig. 1.2. Cod in Div. 3M: total biomass estimates from surveys.

Stratified-random bottom trawl surveys were conducted by the EU from 1988 to 1997. This survey also showed a decline in 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, a decrease to 8 800 tons in 1995 and about the same level in 1996 (8 200 tons), and 1997 (9 100 tons). Surveys indicate poor recruitment of the 1992 and subsequent year-classes, particularly the 1995 year-class at ages 1 and 2 and the 1996 year-class at age 1.

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 the Canadian survey and the EU-survey in 1996.

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

c) **Estimation of Parameters**

A sequential population analysis (XSA) was carried out for ages 1 to 8+ from 1988 to 1997. Catch-in-number data correspond to the estimates of total annual catch. Natural mortality was set at 0.2. The analysis was tuned with the results of the EU survey for ages 1 to 7 from 1988 to 1997.

The analysis showed a reasonably good fit, given the uncertainties associated with catch-at-age matrix. A retrospective analysis also indicated an acceptable pattern. However, owing to the short time series used in the analysis and the above mentioned uncertainties in the catch-at-age matrix, 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 projection.

d) **Assessment Results**

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, and fishing mortalities on these cohorts remained at a relatively high level in 1994 and 1995 (Fig.1.3). The low fishing mortality in 1996 and 1997 is consistent with the decrease in fishing effort and catch in those years. However, the decreased abundance observed throughout the EU surveys implies that fishing mortality in the most recent years was higher than that calculated by sequential population analysis.

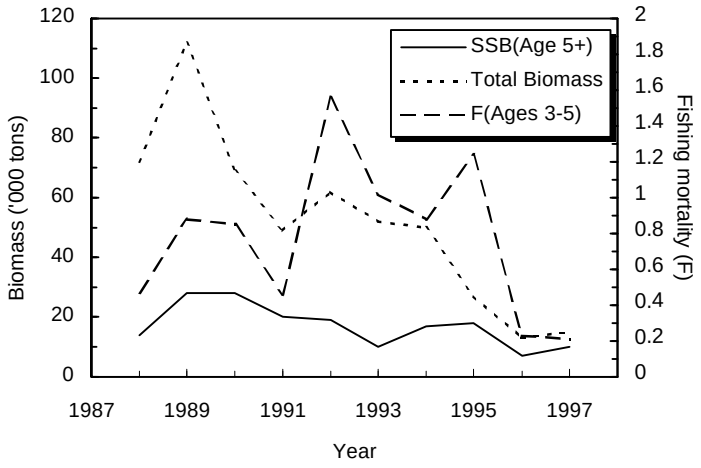


Fig 1.3. Cod in Div. 3M: results from Sequential Population Analysis.

Total biomass decreased during this period from a peak value in 1989 and reached a minimum in 1996 as indicated by both Russian and EU survey results. The XSA also confirms the relative strength of the 1985 and 1990-91 year-classes and the weakness of those from 1992 to 1995.

The stock is now composed of few year-classes. Fish older than 6 years are scarce, much less abundant than in the 1960s, when ages 5 and 6 dominated the fishery and fish older than 10 years were common. At present, ages 3 and 4 dominate the catch.

Limited data from the shrimp fisheries in Div. 3M indicate low by-catch of cod. However, by-catch data from several fleets fishing shrimp are unavailable.

The possibility of a concentration of the majority of the population in dense shoals was previously noted (NAFO Sci. Coun. Rep., 1997, p. 83-84) for this stock. This behaviour could induce an increase in catchability, and therefore the fishery would be able to maintain high catch-rates, even at the lowest stock biomass levels, and at the expense of high fishing mortality.

e) **Reference Points**

Attempts were made to evaluate the relationship between SSB and recruitment. Results from two former VPAs from different earlier periods were reviewed, although those analyses had not been accepted due to inadequacy of the sampling in some years. Doubts about the reliability of estimated catch have also been repeatedly expressed. SSB deduced from the VPAs was high, greater than 500 000 tons in some years, and well above the present level of about 20 000 tons. STACFIS decided to defer setting SSB reference points for this stock until these uncertainties could be resolved.

f) **Research Recommendations**

STACFIS **recommended** that *research effort be directed to rebuild past catch-at-age information and abundance indices to link all partial series, and to carry out further sequential population analysis in a common framework.*

2. **Cod (*Gadus morhua*) in Divisions 3N and 3O** (SCR. Doc. 98/68, 48, 65; SCS Doc. 98/13, 15)

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. 2.1). Directed fisheries on this stock ceased about mid-year in 1994. This suspension continued through 1998.

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Recommended TAC					Same as agreed						
Agreed TAC	40	25	18.6	13.6	13.6	10.2	6	nf	ndf	ndf	ndf
Reported Catches	43	33	18	17	10.1	9	1.9[1]	0.17[1]	0.17[1]		
Non-reported Catches	-	-	11	12	2.5	0.7	0.8	0	0		
Total Landings	43	33	29	29	12.6	9.7	2.7[1]	0.17[1]	0.17[1]	0.42[1]	

[1] Provisional.
nf No fishing
ndf No directed fishery and by-catches of cod in fisheries targeting other species should be kept at the lowest possible level.

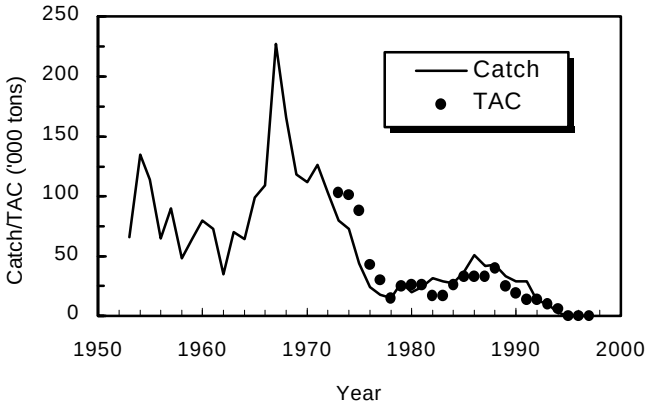


Fig. 2.1. Cod in Div. 3NO: catches and TACs.

Catches during 1997 totaled approximately 442 tons. All reported catches were by-catch mainly from Canadian otter trawl and gill net fisheries (329 tons) and EU (113 tons).

b) **Input Data**

i) **Commercial fishery data**

Catch rates. There was no 1997 catch rate information since there were no directed fisheries for cod.

Catch-at-age. No biological sampling data were available from by-catches of cod. Consequently, an estimate of the total removals-at-age could not be derived. STACFIS **recommended** that *length and age data from by-catches of cod in Div. 3NO be presented in June 1999.*

ii) **Research survey data**

Canadian spring surveys. Stratified-random research vessel surveys have been conducted in spring by Canada in Div. 3N for the 1971-97 period, with the exception of 1983, and in Div. 3O for the years 1973-97 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. The survey time series was converted to Campelen equivalents from 1984 to spring 1995. 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 1997, estimates declined to very low levels. Abundance estimates for Div. 3NO suggested similar trends to those observed for biomass (Fig. 2.2).

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 cohorts. All year-classes were at low levels in the 1996 and 1997 surveys.

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 2.3).

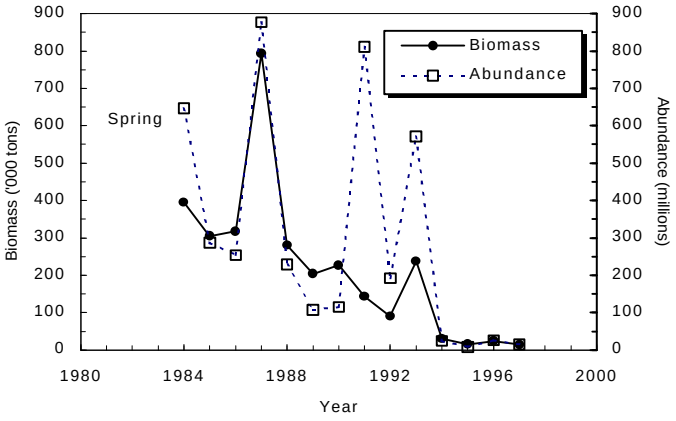


Fig. 2.2. Cod in Div. 3NO: abundance and biomass estimates from Canadian spring surveys.

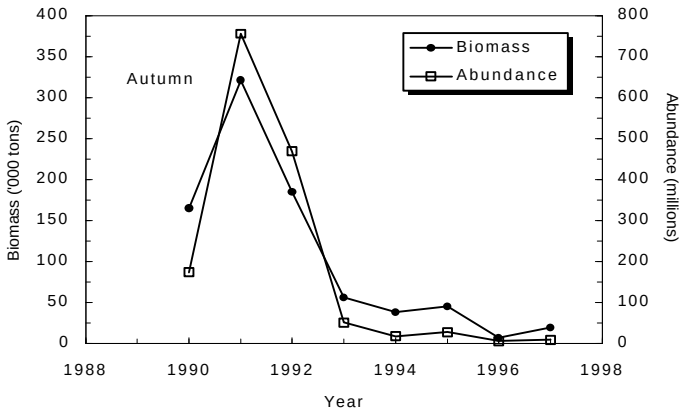


Fig. 2.3. Cod in Div. 3NO: abundance and biomass estimates from Canadian autumn surveys.

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

Spanish surveys. Stratified random surveys have been conducted by EU-Spain during spring since 1995 in the Regulatory Area of Div. 3NO. A concentration of cod was observed on the slope in Div.

3N but scarce elsewhere. The biomass estimate from this survey was not considered to be representative of the stock due to its high variance.

Russian surveys. USSR/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)**

In the absence of recent catch-at-age data, STACFIS decided that for this assessment it would be useful to estimate the current spawner biomass directly from the spring and autumn 1997 surveys by dividing the indices at age by their respective catchabilities at age estimated from an SPA. This required that survey catchabilities at age from the spring and autumn Campelen index be estimated. An ADAPT was therefore applied to the spring and autumn converted survey data, and estimates of spawner biomass for spring and autumn in 1997 were 2 900 tons and 3 424 tons, respectively.

d) **Assessment Results**

Estimates of recent year-class sizes from survey data indicates that recruitment has been almost non-existent since the 1990 year-class. Estimates of total mortality for the moratorium period (since February 1994) from survey data indicate that the current *Z* is substantially higher than the assumed natural mortality value used in the SPA. Low spawner biomass, low recruitment and high total mortality point to poor prospects for this stock in the medium term. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

e) **Reference Points**

A first attempt was made this year to calculate provisional reference points for cod in Div. 3NO. An approach similar to that of Evans and Rice (*1998, ICES J. Cons., 44*) to describe the relationship of recruitment to SSB was applied to the VPA results from the 1995 assessment. There were two discernible inflection points (65 000 tons, 90 000 tons) in the smoother through the scatter of points in the stock recruit plot (Fig. 2.4). Once SSB dropped below 65 000 tons there was low recruitment. This level of SSB was chosen as B_{lim}. Recruitment increased steadily when SSB was greater than 65 000 tons to a four fold increase when SSB was greater than 90 000 tons SSB . This was chosen as B_{buf}. STACFIS **recommended** that *more investigations into the calculations of other reference points for cod in Div. 3NO be conducted.*

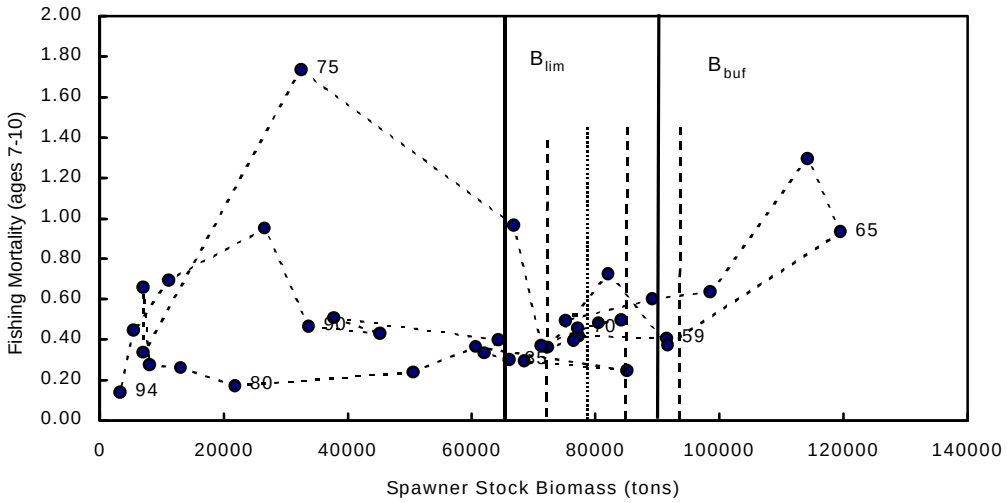


Fig. 2.4a. Cod in Div. 3NO: a schematic of possible implementation of precautionary reference points. Fishing mortality is the average of ages 7-10.

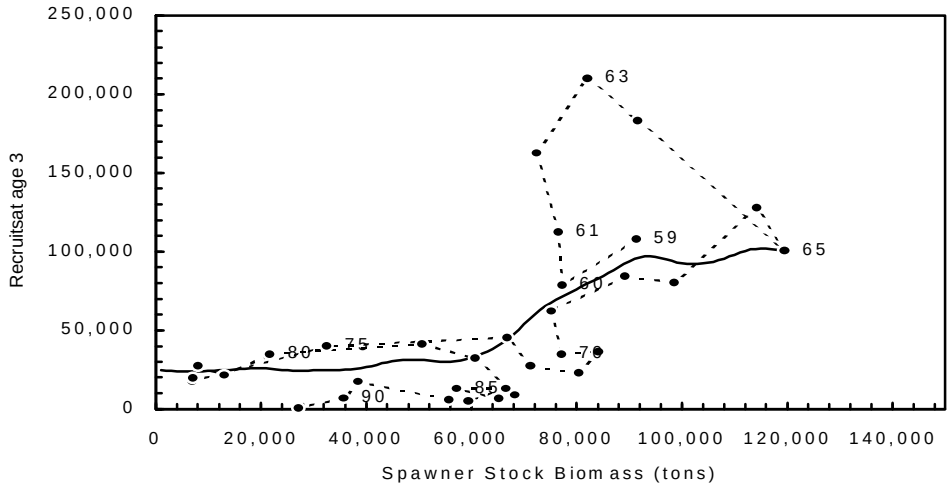


Fig. 2.4b. Cod in Div. 3NO: recruits *vs*. SSB scatter plot (lower panel). SSB for 1992-94 are shown with corresponding recruitment estimates of age 3.

3. **Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N** (SCR Doc. 98/71, 74, 76; SCS Doc. 98/6, 13)

a) **Introduction**

There are two species of *Sebastes* that have been commercially fished in Div. 3LN; the deep sea redfish (*Sebastes mentella)* and the Acadian redfish (*Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics.

Surveillance sources indicate that spatial fishing patterns changed from one that concentrated in the vicinity of the Div. 3N and Div. 3O border and the slope edge in Div. 3L in the early-1980s, to one that predominated in an area southwest of the Flemish Cap at the border of Div. 3LNM in the 1990s.

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. Catches increased sharply from about 21 000 tons in 1985, peaked at an historical high of 79 000 tons in 1987 then declined steadily to about 500 tons in 1996. The provisional catch for 1997 is 600 tons.

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 and continued high catch in 1987 and 1988 was due to new entrants, primarily EU-Portugal and various non-Contracting Parties (NCP), most notably South Korea, Panama and Caymen Islands. These countries began to fish in the Regulatory Area and accounted for a catch of about 24 000 tons. In the period from 1988 to 1994 NCPs took between 1 000 tons and 19 000 tons annually; however, NCPs have not fished fish in Div. 3LN since 1994.

Cuba has not fished since 1993 and the Baltic States have not directed for redfish since 1994. EU-Portugal has targeted Div. 3O redfish and other species in the NAFO Regulatory Area since 1994. Russia also reduced its directed effort in 1996.

The reasons for reduced effort in recent years has 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 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.

The fishery occurred during the first half of the year in Div. 3L but mostly from April to September in Div. 3N. The bottom trawl was the predominant gear in the fishery in the 1980s. The fleets fishing the Div. 3LMN border on the "Beothuk Knoll" probably accounted for most of the midwater trawl catch.

From 1980 to 1990 the TAC each year was 25 000 tons. The TAC was reduced to 14 000 tons for 1991 and maintained at that level through 1995. The TAC was reduced again in 1996 to 11 000 tons and maintained at that level in 1997. The Fisheries Commission agreed on a moratorium for this stock in 1998. In the 12-year period since 1986, TACs have been exceeded in all but the last four years. In some years catches have been twice (1988) and even three times (1987) the agreed TAC.

Recent nominal catches and TACs ('000 tons) are as follows (Fig. 3.1):

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	25	25	25	14	14	14	14	14	11	11	0
Catch[1]	53	34	29	26	27	21[3]	6[2,3]	2[2,3]	0.5[2]	0.6[2]	

[1] Includes catch estimated by STACFIS.
[2] Provisional.
[3] STACFIS could not precisely estimate the catch. Figures are midpoint of range of estimates.

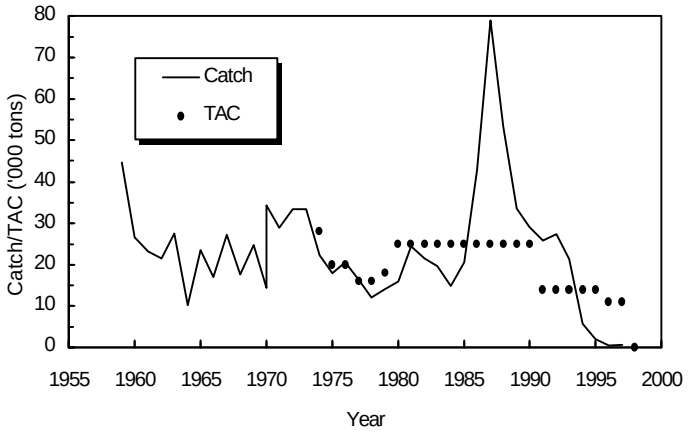


Fig. 3.1. Redfish in Div. 3LN: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

STACFIS reiterated its point of view that the commercial CPUE data are not reflective of year to year changes in population abundance (NAFO Sci. Coun. Rep., 1996, p. 72), although they may be indicative of trends over longer periods of time. The annual update for the standardized catch rate series provided little new information because of low catches in recent years. These indices of abundance are of little value in determining current stock status.

Limited sampling of redfish by-catch from the 1997 Portuguese trawl fishery in Div. 3L in March, April, May and October suggested the catches were dominated by lengths between 25 and 33 cm with two modes at 26 cm and 30 cm (mean length of 29.5 cm). Sampling of the 1997 Div. 3N Portuguese trawl fishery in January and February indicated that dominant lengths of redfish in the catches were between 29 to 34 cm with a mode at 33 cm.

ii) **Research survey data**

Stratified-random surveys have been conducted by Canada in Div. 3L in various years and seasons from 1978 to 1998 during which strata down to a maximum depth of 732 m (400 fathoms) were sampled. Until the autumn of 1995 these surveys were conducted with an Engels 145 high lift otter trawl. Starting in the autumn 1995 survey, Campelen 1800 survey trawl was used. The Engel data were converted into Campelen equivalent units for this assessment. A comparison of the generated data with the original Engel data suggested overall trends in abundance were the same.

Results of bottom trawl surveys for redfish in Div. 3L indicated a considerable amount of variability. This occurred between both seasons and years. Although it is difficult to interpret year to year changes in the estimates, in general, the data suggest that the survey biomass index (Fig. 3.2) from spring 1992 to spring 1995 was at a very low level (average 8 400 tons) relative to the time period prior to 1986 (average 179 000 tons). With the exception of the relatively high autumn 1995 survey estimate that was influenced by one large set, all survey indices from autumn 1995 to 1997 have also been low relative to pre-1986 surveys, ranging from 4 700 tons to 19 500 tons.

Canadian surveys have also been conducted in spring (1991-98) and autumn (1991-97) in Div. 3N. These surveys also utilized the Campelen survey trawl beginning in the autumn of 1995. The Engel data prior to autumn 1995 were converted into Campelen equivalents as above. Survey biomass and abundance estimates were generally higher in Div. 3N than in Div. 3L, but there was greater between survey variability than in Div. 3L. The source of this variability is unclear but is likely due to availability to the trawl gear or migrations between Div. 3N and 3O rather than real changes in population abundance.

The average survey biomass index in Div. 3N for the converted data in the 1991 to spring 1995 period is about 35 000 tons. The average Campelen survey biomass index from autumn 1995 to spring 1998 is about 25 000 tons. About 28 000 tons of the autumn 1995 estimate of 41 000 tons occurred in a single stratum due to one large catch. The increase in the autumn index between 1996 and 1997 in Div. 3N was a result of larger catches in the eastern slope area rather than near the Div. 3N/3O boundary.

There have been no Russian surveys conducted in Div. 3L since 1994 or in Div. 3N since 1993. A comparison of the Canadian and Russian bottom trawl surveys in Div. 3L indicated a similar decline in biomass estimates from 1984 to 1990 and both indices have remained at this relatively low level through 1994. It was noted, however, that the 1994 Russian survey did not cover the entire Div. 3L area. The Canadian index continued to be relatively low through autumn 1997 except for an increase in the index in the autumn of 1995.

In Div. 3N, the Russian surveys indicated a relatively stable biomass from 1989-91 followed by an increase 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.

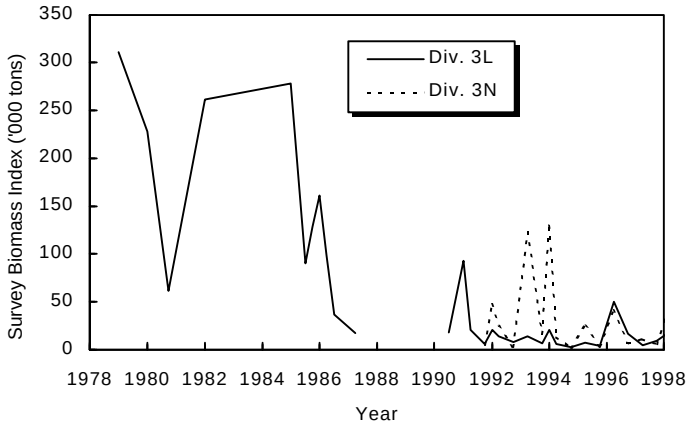


Fig. 3.2. Redfish in Div. 3LN: survey biomass indices from Canadian surveys in Div. 3L and Div. 3N in Campelen equivalent units prior to autumn 1995.

iii) **Recruitment**

Length distributions from the regular spring and autumn Canadian surveys in Div. 3L indicated there has been relatively poor recruitment for very many years. The autumn 1997 survey indicated the presence of some fish in the 10 cm range even though numbers caught were very low compared to numbers found during the late-1970s.

Length distributions from spring and autumn Canadian surveys in Div. 3N from 1991-98 generally showed smaller fish compared with Div. 3L. There was a relatively good pulse of recruitment (1986-87 year-classes) first detected during the 1991 autumn survey in the range of 12-14 cm that were tracked through to the 1998 spring survey. There is no sign of any good year-classes subsequent to this in the surveys.

c) **Assessment Results**

In 1997, Scientific Council concluded that the Div. 3LN redfish stock appeared to be "at a very low level." (NAFO Sci. Coun. Rep., 1997 p. 19).

Interpretation of available data remains difficult for this stock. The surveys demonstrate considerable inter-annual variability, the changes frequently being the result of single large catches being taken in different years. Estimates from recent surveys are considerably lower than those from the 1980s indicating a reduced and low stock size. There are indications of some increase in Div. 3N due to growth of the relatively strong 1986-87 year-classes.

Poor recruitment has persisted in Div. 3L since the late-1970s. The last good recruitment in Div. 3N was from the 1986-87 year-classes. These year-classes are now available to the commercial fleets but have not resulted in a turn around in catch levels, which remain low. This is interpreted as another sign of low overall stock sizes.

d) **Reference Points**

A non-equilibrium production model (ASPIC) was run using various combinations of Portuguese logbook CPUE, Canadian survey data and Russian survey data. However, no acceptable results were achieved.

Various yield-per-recruit analyses have been conducted (NAFO Sci. Coun. Rep., 1996, p. 68; SCR Doc. 98/76). While the estimates of $F_{0.1}$ and F_{max} were similar between studies, the estimated yields at these reference points were different. It is believed that these differences are due, in a large part, to differences in ageing methodologies; scales *versus* otoliths.

This type of difficulty with redfish, caused by differences in age reading methodology and interpretation, is a continuing problem and hampers use of age based analyses to develop meaningful reference points. Work is continuing to examine the use of length based information. At present however, it is not possible to determine limit or other reference points for either fishing mortality or biomass for Div. 3LN redfish.

e) **Future Studies**

No new information was available to address an outstanding recommendation concerning the relationship between Div. 3LN and Div. 3O redfish. STACFIS was informed that work on redfish stock discrimination continues within Canada to address questions related to stock structure and migration of redfish. These studies have included Div. 3O, Div. 3LN and areas north of Div. 3L, and results will be presented at a Workshop to be held in Canada in October 1998.

STACFIS regards this stock issue to be as important as the continuing uncertainties regarding the relationship between redfish in Div. 3O and Div. 3LN have important impacts on interpretations of available data. STACFIS again **recommended** that *(1) redfish 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*. In addition, STACFIS would welcome presentation of any results of the Canadian Workshop pertaining to the Div. 3LN/Div. 3O redfish issue during the June 1999 meeting of Scientific Council.

4. Redfish *(Sebastes mentella, Sebastes marinus* and *Sebastes fasciatus)* in Division 3M (SCR Doc. 98/ 15, 29, 30, 53; SCS Doc. 98/ 13)

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 difficulties with identification and separation, all three species are reported together under 'redfish' in the commercial fishery. Each of the three species of redfish has both a pelagic and demersal behaviour producing wide inter annual shifts in their concentrations between the Flemish Cap bank and other Div. 3M fishing grounds in the vicinity of this bank. All redfish species are long lived with slow and very similar growth. Sexual maturity is reached at a median length of 26.5 cm for Acadian redfish, 30.1 cm for deep-sea redfish and of 33.8 cm for golden redfish.

i) Description of the fishery

Redfish catches in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990 (Fig. 4.1), but declined continuously through 1997, when a catch of only 1 300 tons was reported, mostly as by-catch in the Greenland halibut fishery. The decline in the Div. 3M redfish catches from 1990 to 1997 is related to the reduction in fishing effort deployed in this fishery by fleets responsible for the high level of catches from the late-1980s and early-1990s (former USSR, former GDR and Korean crewed non-Contracting Party vessels). For the remaining fleets, such as the Portuguese trawlers, Div. 3M redfish is a secondary target compared to cod or American plaice and, more recently, Greenland halibut.

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

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	20	20	20	50	50	43	30	26	26	26	26	20
Catch	44.4	23.2	58.1[1]	81.0[1]	48.5[1]	43.3[1]	29.0[1]	11.3[1,2]	13.5[1,2]	5.8[1,2]	1.3[1,2]	

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

The Div.3M redfish stocks have been exploited in the past both by pelagic and bottom trawls. The majority of the bottom commercial catches are composed of beaked redfish. The species composition of the pelagic redfish catches, which dominated the fishery in the early nineties, remains unknown. However, based on bottom survey results, *S. mentella* and *S. fasciatus* together represented most of the abundance and biomass of Div. 3M redfish. It is assumed that therefore, these pelagic catches in the commercial fishery were also dominated by beaked redfish.

b) Input Data

i) Commercial fishery data

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

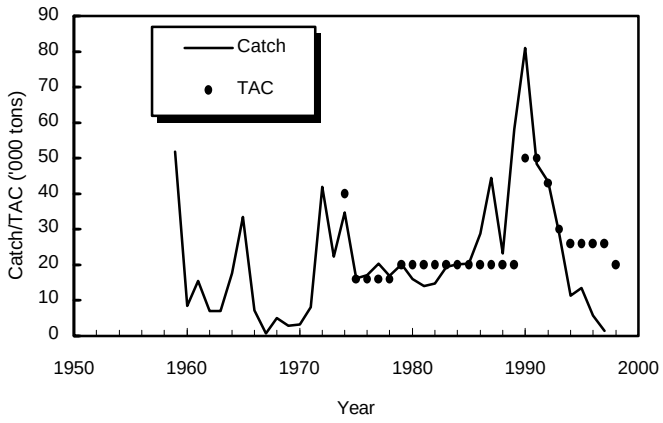


Fig. 4.1. Redfish in Div. 3M: catches and TACs.

The relatively small sample of Div. 3M beaked redfish in 1997 came from the by-catch in the Portuguese Greenland halibut fishery. The length composition shows a mode at 25-26 cm and the proportion of 27-36 cm length groups increased in the 1997 catch compared to the previous year, coupled with an increase in the mean fish length and weight in the catch. The 1989, 1990 and 1991 year-classes dominated the 1997 commercial beaked redfish catches. Ages 9 to 14 were also well represented, but older ages were of low abundance in the 1997 catch.

Redfish by-catch in the shrimp fishery. Redfish has been the largest component in the by-catch of the Div. 3M shrimp fishery. The rapid decline of 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 be related to the small size of recent year-classes.

Based on available information from the Icelandic Div. 3M shrimp fishery, in terms of weight, the redfish by-catch was around 1.5% in 1996 and 1997. The redfish by-catch in the Canadian and Norwegian shrimp fisheries was estimated to be 1% in 1996 and 0.6% in 1997. The 1997 redfish by-catch in the latter two fisheries combined was estimated to be 198 tons corresponding to 4.8 million fish. From the Icelandic data on length composition of redfish by-catch from January 1996 to March 1998, the 1995 year-class should have dominated the 1996 and 1997 redfish by-catch. The spatial analysis of the Canadian and Norwegian shrimp and redfish by-catch data suggested a considerable overlap in the concentration of commercial shrimp and redfish small enough to pass through the grate spacing currently in use.

Updated yield-per-recruit analysis (NAFO Sci. Coun. Rep., 1997, p. 92) 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.

CPUE data. Schooling behaviour and changes in the 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 in the stock over a time period of several years rather than providing information on interannual changes.

The standardized CPUE series from the Portuguese trawl fleet, based on data taken only from monitored vessels and only from fishing days directed at Div. 3M redfish, has not been updated since no directed fishing took place in 1997. This CPUE series showed good agreement with the EU survey biomass series over the 1990-96 period.

Another CPUE series, standardized with STATLANT 21B catch and effort data for most of the components of the fishery (1959-93), is also available. This CPUE series also showed good agreement with the EU biomass series over the overlapping period of both series.

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 Spain and Portugal (EU) (Fig. 4.2). The Russian survey was conducted annually in April-May as a bottom trawl survey down to the 731m depth contour from 1983 to 1996, with an interruption in 1994. This survey was complemented with an acoustic estimate of the overall pelagic component for the three redfish stocks from 1988 to 1993. The bottom biomass estimates are available for golden and beaked redfish separately since 1987. The Russian survey was not conducted in 1997.

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 (<21 cm) were also separated as an independent category. From 1991 forward all 3 species and juveniles were separated in each haul catch. The ability to identify redfish smaller than 21 cm by species has increased with time, contributing to the decreasing proportion of small redfish classified as juvenile during the most recent years.

A Canadian bottom trawl survey series on the Flemish Cap was conducted from 1979 to 1985 in January-February and abundance estimates for Div. 3M beaked redfish were found to be within the same range as those derived from the more recent EU series. A bottom trawl survey was also conducted by Canada on Flemish Cap during autumn 1996, the first one since 1985. Comparing only strata to the 400 fathom depth contour, there was reasonably good agreement between the biomass estimates from the Canadian survey and the EU survey for both golden and beaked redfish.

Total biomass and female spawning biomass of Div. 3M beaked (*S. mentella* plus *S. fasciatus*) and golden (*S. marinus*) redfish were calculated based on abundance at length from Canadian and EU bottom trawl surveys for the periods 1979-85 and 1988-97, respectively.

Survey results. Biomass indices from all surveys are presented in the following table:

	EU						
Year	*S. marinus*	*Sebastes* spp.	Beaked redfish	*S. Mentella*	*S. fasciatus*	Juveniles	Total
1983	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-
1988	154.289	142.933	-	-	-	-	158.222
1989	22.958	113.675					136.633
1990	14.699		72.893			16.601	104.193
1991	4.093		55.751	50.071	5.680	4.001	63.846
1992	4.130		77.118	71.810	5.308	23.229	104.477
1993	4.173		29.481	25.056	4.425	28.935	62.589
1994	33.240		43.539	35.710	7.829	49.233	126.011
1995	9.042		64.364	59.332	5.032	0.235	73.641
1996	11.293		88.922	77.897	11.025	0.329	100.544
1997	64.847		73.564	56.093	17.471	0.830	139.241

	Canada			Russia			
Year	*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	690.100
1988	-	-	-	14.400	47.000	61.400	452.600
1989	-	-	-	6.800	83.300	90.100	372.700
1990	-	-	-	3.000	17.700	20.700	249.400
1991	-	-	-	0.100	45.400	45.500	107.800
1992	-	-	-	0.300	18.200	18.500	58.600
1993	-	-	-	2.800	69.800	72.600	149.100
1994	-	-	-	-	-	-	-
1995				0.900	20.700	21.600	-
1996	10.8	112.687	123.487	5.900	10.000	15.900	-
1997	-	-	-	-	-	-	-

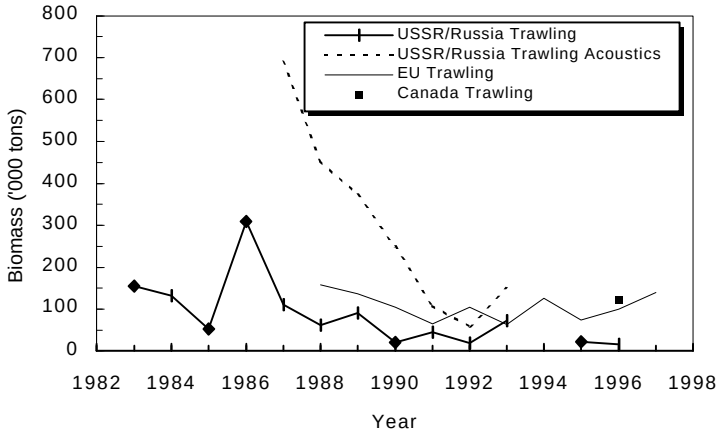


Fig. 4.2. Redfish in Div. 3M: biomass indices.

Bottom biomass and spawning biomass. During the period 1979-85 (Fig. 4.3), covered by the Canadian surveys, both bottom biomass and spawning biomass of beaked redfish were stable, with female spawning biomass averaging about 42% of the total bottom biomass. During the more recent period of 1988-97, covered by EU surveys, there was a continuous decline in the bottom biomass through 1991 followed by a period of stability, due to survival and growth of the abundant year-classes of 1990-92. Bottom spawning biomass, however, has gradually declined since 1988 and for the more recent period of 1994-97 female spawning biomass represented on average just 10% of the total bottom biomass.

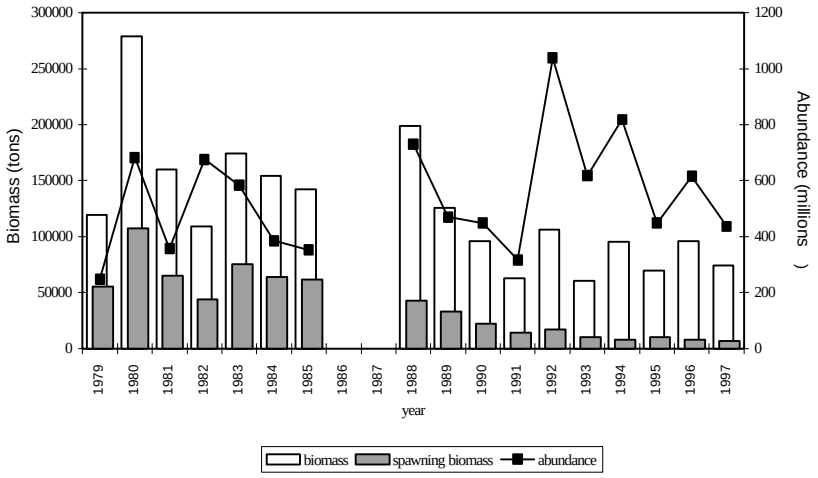


Fig. 4.3. Beaked Redfish in Div. 3M: bottom biomass, female spawning biomass and abundance from Canadian (1979-85) and EU (1988-97) surveys.

Both bottom total biomass and spawning biomass of golden redfish declined from 1989 to 1991, remaining at the lowest level of the EU survey series until 1993. Bottom total biomass showed peaks in 1994 and 1997 although these increases are probably due at least in part to interannual changes in availability to the survey gear. Overall, there does appear to have been some increase due to improved recruitment. Spawning biomass showed the same overall interannual changes, with a maximum in 1997. However in 1997 the proportion of female spawning biomass of the total bottom biomass was only 16%, compared to 1988-90 when it averaged 25%.

Overall, the combined Div. 3M redfish stocks experienced a decline in bottom total biomass from 1988 to 1991, followed by an intermediate period of no apparent trend and an apparent increase during the last two years. The anomalously high bottom total biomass estimate of golden redfish in 1997 was responsible for the recent increase however, and so the present apparent overall increasing trend needs to be confirmed by future surveys. The bottom spawning biomass has not recovered from the decline suffered during the late-1980s and early-1990s, remaining at a low level since 1992. The average proportion of female spawning to bottom total biomass declined from 23% to 12% from the earlier (1988-91) to the recent period (1994-97) of the EU survey series.

Pelagic biomass. The only acoustic estimates of the pelagic component of the redfish stocks were provided from Russian surveys between 1987 and 1993. These acoustic results have been revised recently, with separation by size (≤15 cm, >15 cm) and distribution (pelagic and bottom).

Based on these surveys pelagic redfish biomass declined gradually from 1987 to 1990. A major drop was recorded in 1991 and the pelagic biomass of Div. 3M redfish remained low to 1993. Even taking into account the high catches observed between 1989 and 1991 it is difficult to explain the drop in the range of acoustic biomass estimates from the 1987-90 period to the 1991-93 period. Redfish 15 cm and smaller dominated the pelagic redfish abundance in 1987-88 and in 1991-92.

c) **Estimation of Parameters**

Total Div. 3M redfish biomass was estimated as the sum of EU bottom and Russian acoustic indices for the 1988-90 period. For the 1991-97 period, total biomass was estimated by adjusting the bottom biomass of the EU survey, using a mean ratio between the EU bottom biomass and the total biomass (EU bottom and Russian acoustic combined) for the overlapping years of these survey series.

In order to estimate the fishing mortality trend over the past ten years, the ratio between annual Div. 3M redfish catch and total survey biomass was taken as an index of fishing mortality. This index quickly rose to a peak in 1991 but gradually fell since then, reaching a level near zero in 1997.

d) **Assessment Results**

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The Div. 3M redfish stocks experienced a continuous decline in overall biomass from 1988 to 1991 due to a sharp increase of fishing mortality that peaked in 1991. Since then fishing mortality declined rapidly, allowing the survival of three consecutive strong year-classes from the early-1990s that appeared in each of the Flemish Cap redfish populations. The survival and growth of these year-classes appears to have halted the decline and may have contributed to an apparent increase in the biomass since 1995 although the magnitude of any increase still needs to be confirmed.

The observed levels of fishing mortality, that brought about the decline in the Div. 3M redfish stocks primarily affected the larger length groups in each population. This produced a decline in spawning stock biomass to a low level from which these stocks have not yet recovered.

In the near future, recovery of the Div. 3M redfish spawning biomass will be dependent on the survival and maturation of fish from the abundant 1990 to 1992 cohorts.

STACFIS noted that the method of presentation of Div. 3M redfish by-catch information from the shrimp fishery continues to be variable. It is **recommended** that *in future the estimated numbers caught as well as tables showing their size distribution be presented*. 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 information on redfish in Div. 3M should also be provided to enable easier comparisons.*

e) **Reference Points**

All biological information was derived for deep-sea redfish (*S. mentella*). Natural mortality was assumed to be constant at 0.1.

Yield-per-recruit analyses were conducted using the mean weights-at-age in the Portuguese commercial catch, mean weights-at-age in the stock (as well as in the female component) from the EU survey data together with the female proportion at age. The histological analysis of gonads collected during the 1991-1994 EU surveys provided the data for calculating the maturity ogive-at-age. Partial recruitment was estimated from Z calculations in two ways; using survey data, and comparisons of commercial catch-at-age and research abundance-at-age.

From the yield, biomass and spawning biomass per recruit curves, different levels of reduction of spawning and total biomass were determined for corresponding levels of fishing mortality. With the assumption of constant recruitment, the results indicated a reduction of between 65-70% of the female spawning biomass from its unexploited level when fishing at $F_{0.1}$

Fishing mortality corresponding to a fishery where the mean length in the catch is above the mean length at maturity, estimated using the method of Die and Caddy (1997, Fish. Res., 32) and first reviewed during the March Workshop (SCR Doc. 98/76) was lower than $F_{0.1}$, implying an associated SSB more than 40-55% of the non-fishing level.

Various formulations of a logistic surplus production model which does not use the equilibrium assumption (ASPIC) was applied with the 1959-97 catch estimates and the various commercial and survey bottom biomass indices. STACFIS considered that further investigations are necessary before there can be confidence in the reference points suggested by the outputs.

STACFIS did note however that fishing mortality higher than $F_{0.1}$ observed through the 1989-93 period was most likely responsible for the present low spawning stock biomass. Therefore as a first approximation, $F_{0.1}$ might be considered a limit reference F.

5. **American Plaice (*Hippoglossoides platessoides*) in Divisions 3L, 3N and 3O** (SCR Doc. 98/48, 69, 70; SCS Doc. 98/11, 13)

a) **Introduction**

This fishery was under moratorium in 1997. Total catch in 1997 was 1 407 tons, mainly taken in the Regulatory Area (Fig. 5.1), and represented an increase of about 50% from 1996. Canadian catch in 1997 was about 114 tons, and catches by EU-Portugal and EU-Spain were 336 and 951 tons, respectively.

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	40[1]	30.3	24.9	25.8	25.8	10.5	4.8[2]	0	0	0	0
Catch	41[3,4]	44[3,4]	32[3,4]	34[4]	13[4]	17[5]	7[6]	0.6[6]	0.9[6]	1.4[6]	

[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] Catch may be as high as 19 400 tons.
[6] Provisional.

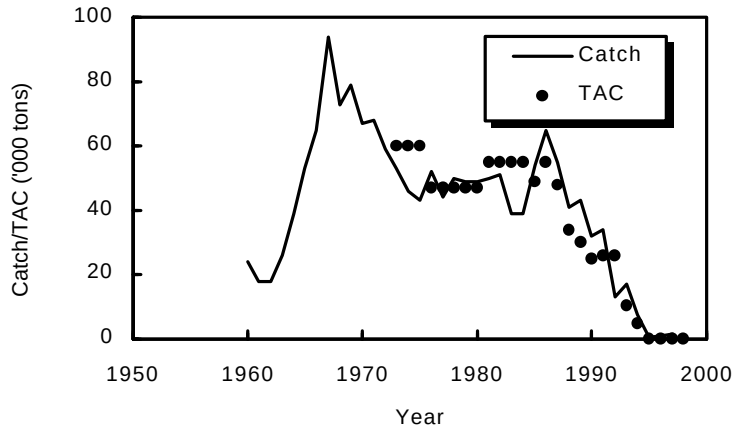

Fig. 5.1. American plaice in Div. 3LNO: catches and TACs.

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 sampling of by-catch in the Portuguese and Spanish fisheries. In the Portuguese catch in Div. 3L there was a mode at about 32-36 cm while in Div. 3N the mode was 34 cm (SCS Doc. 98/13). Mean length in the catch in Div. 3N declined from 40 cm in 1996 to 34 cm in 1997. The catch of the Spanish trawler fleet showed a mode of 30-39 cm in Div. 3L and of 36-41 cm in Div. 3N (SCS Doc. 98/11).

ii) **Research survey data**

Canadian stratified-random groundfish surveys. Surveys were done with the Yankee 41.5 trawl from 1971-82, the Engel trawl from 1983-95, and the Campelen trawl from autumn 1995 onward. Comparisons are possible between the first and second series, as well as the second and third series, but not directly between the first and third. Conversions between the Engel and Campelen trawls were presented using the length based method tabled in 1997 (SCR Doc. 97/68). The Campelen trawl is much more efficient at catching small fish, requiring a high conversion factor at smaller sizes in the Engel length frequency data (SCR Doc. 98/70). There is more uncertainty in the conversion factors at smaller sizes (less than 24 cm) than for larger fish, and the converted values at these smaller lengths are probably underestimates.

Data from **spring surveys** in Div. 3L, 3N and 3O were available, with some exceptions, from 1971 to 1997. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 1997, 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 which is only about 3% of the 1985-88 mean value. Surveys in 1996 and 1997 indicated that the biomass has continued to decline (SCR Doc. 98/69).

In Div. 3NO, the trawlable biomass index also showed a decline in recent years, with 1994 and 1995 being the lowest points by far in the 1971-95 series in both Divisions. Biomass remained stable from 1996 to 1997, and again to 1998 (preliminary results) in both Divisions.

For Div. 3LNO combined, biomass estimates in 1996 and 1997 are about 20% of values in the mid-1980s (comparing Campelen equivalents). These values in the mid-1980s were about 25% lower than peak values in the late-1970s.

The trawlable abundance was generally highest in the late-1970s and early-1980s (Fig. 5.2) as the strong year-classes of the early-1970s dominated survey catches. The total abundance index for 1995 was the lowest estimate in the 1971-95 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, from about 85% in 1986-89 to about 35-45% in 1993-97.

Abundance declined by 41% between the spring 1996 survey and the spring 1997 survey. The same 4 year-classes (1989-93) dominated survey catches in both years, but their combined abundance in 1997 was only 57% of the 1996 value. Fish aged 9 years and older comprised only 3.8% of the abundance index in 1996, and 7.4% in 1997.

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 which was less than 3% of the estimates in the early-1980s. Since 1990, autumn surveys were also carried out in Div. 3NO (maximum depth of 731 m since 1993). The estimates from Div. 3LNO combined indicated that biomass dropped sharply from 1990-94, and has remained stable at this low level since then, around 150 000 tons.

The estimates of abundance continued to decline, by 22% from 1995 to 1996, and by 17% from 1996 to 1997. In both 1995 and 1996, less than 5% of the abundance was made up of fish age 9 years and older. No age compositions were available from the autumn 1997 survey at this time, and numbers at age from the Engel surveys in 1990-94 have not been converted to Campelen equivalents.

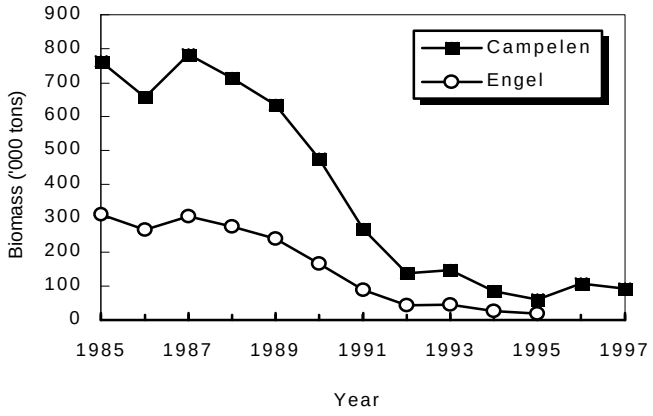

Fig. 5.2. American plaice in Div. 3LNO: abundance from spring surveys.

Since the autumn surveys began in 1990, estimates of abundance and biomass have been higher in the autumn than in the spring surveys of the same year, although both surveys showed similar declining trends in this period (Fig. 5.3)

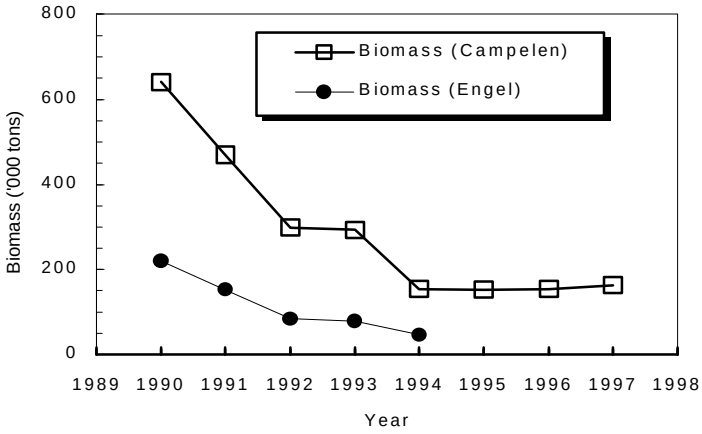

Fig. 5.3. American plaice in Div. 3LNO: biomass from autumn surveys.

Survey by EU-Spain. Surveys have been conducted annually from 1995 to 1998 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 462 m (in 1998). The biomass index of American plaice in strata surveyed in all 4 surveys showed a large increase in 1996, a large decrease in 1997, and a large increase in 1998 to the highest value in the 4-year series. Most of the biomass (41%) in 1998 was found in stratum 360, depth 57-92 m, in Div. 3N. Modal size of males was 30-33 cm, and 36-39 cm for females.

iii) **Biological studies**.

In the previous assessment of this stock, 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 substantially 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.

An index of female spawning stock biomass was available (SCR Doc. 97/60) from the Canadian spring Engel surveys from 1975 to 1995. This index was relatively stable until the late-1980s when it began a precipitous decline (Fig. 5.4). The 1995 estimate of 6 000 tons is 95% less than estimates from the mid-1980s. This index was not updated with Campelen data at this time.

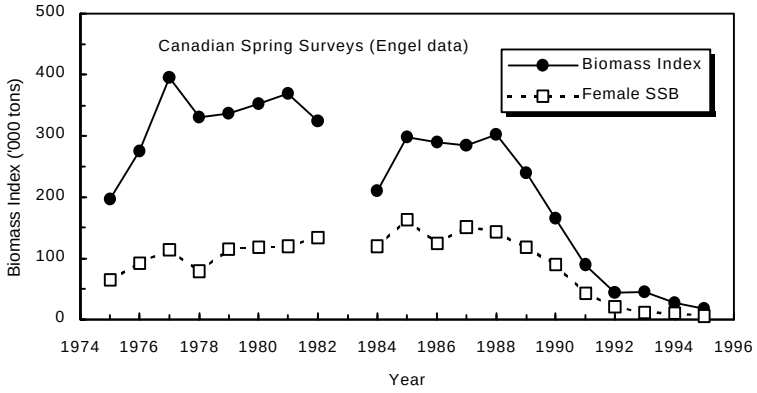

Fig. 5.4. American plaice in Div. 3LNO: estimates of biomass from Canadian spring surveys.

Relative cohort strengths and mortalities were estimated from the Canadian spring groundfish surveys from 1975 to 1996 in the 1997 assessment. 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 over time could affect the estimates of relative cohort strength.

There was a trend of increased mortality at almost every age from 1 to 16 over the time period, as indicated in the 1997 analysis. Examination of total mortality from the spring and autumn survey data indicated that mortality on fish aged 9 and above was at high levels throughout the 1990s, and remains high in recent years despite the moratorium in effect since 1995.

c) **Assessment Results**

The Canadian spring and autumn surveys show a very large decline in abundance and biomass since about the late-1980s. Recent surveys show the biomass to be stable at this low level, but abundance still appears to be declining. The EU-Spain survey in the Regulatory Area of Div. 3NO showed a large increase in biomass and abundance between 1995 and 1996, a large decrease between 1996 and 1997, and a large increase in 1998. 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, and the stock is composed mainly of fish less than 7 years old. Most of the indicators evaluated suggest that the stock remains at a very low level.

d) **Comments on Reference Points and Precautionary Approach**

At the NAFO PA Workshop in March 1998, data from this stock were chosen for use in the various models employed at that meeting (see Section II, of Scientific Council Report). It was tentatively agreed that a B_{lim} value of 150 000 tons of SSB was reasonable for this stock (Fig. 5.5). Calculations were largely based on data from a sequential population model used in the 1993 assessment. Although SPA models are no longer used for this stock, the low level of SSB estimated for 1992 coupled with declining trends in survey biomass since that time, indicate that the stock size is far below this B_{lim} value at present (Fig. 5.6). There was no clear agreement on how to define limit reference points for fishing mortality for this stock. It was argued that an F_{lim} of 0.25 was too high for this stock, although perhaps not for the largest stock sizes. The stock size was relatively stable for an extended period in the 1970s and 1980s with Fs around 0.25 to 0.3, although the stock declined rapidly after then. Future work should focus on estimation of biomass and F-based reference points with available survey data, and ways to link these analyses with those conducted to date. The suitability of various reference points based on biomass and fishing mortality will continue to be evaluated.

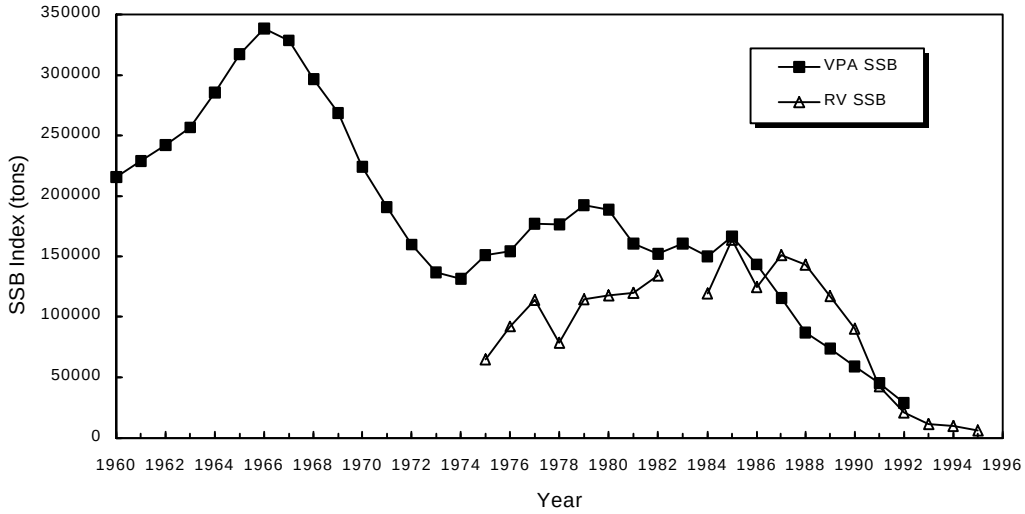

Fig.5.5. American plaice in Div. 3LN: comparison of SSB estimates from VPA (1993 assessment) and RV surveys (from 1997 assessment). Data from VPA are 9+ (male + female), data from surveys are female SSB calculated with annual maturity ogives.

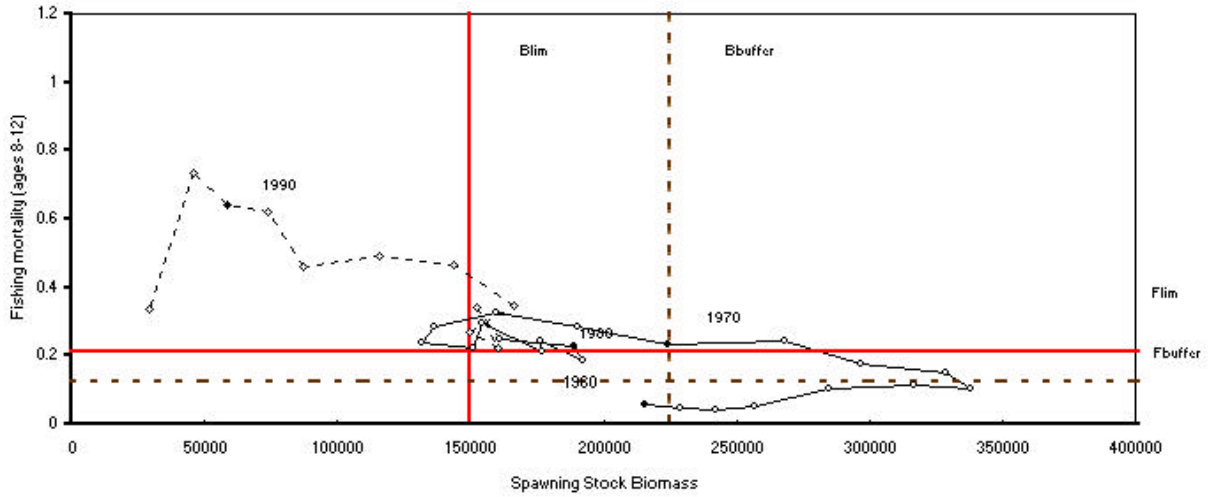

Fig. 5.6 American plaice in Div. 3LNO: schematic of a possible implementation of precautionary F.

6. American Plaice (*Hippoglossoides platessoides*) in Division 3M (SCR Doc. 98/30, 51; SCS Doc. 98/13)

a) Introduction

On Flemish Cap the stock mainly occurs at depths shallower than 600 m. Catches of Contracting Parties are mainly as by-catches in trawl fisheries directed to other species in this Division.

Since 1974, when this stock became regulated, catches ranged from 600 tons (1981) to 5 600 tons (1987). After that catches declined to 275 tons in 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. Catch for 1997 was estimated to be 208 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 agreed for 1994 and 1995 and a moratorium was agreed to thereafter (Fig. 6.1).

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
TAC	2	2	2	2	2	2	1[1]	1[1]	0	0
Catch	2.8	3.5	0.8	1.6	0.8	0.3	0.7[2]	1.3[2]	0.3[2]	0.2[2]

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

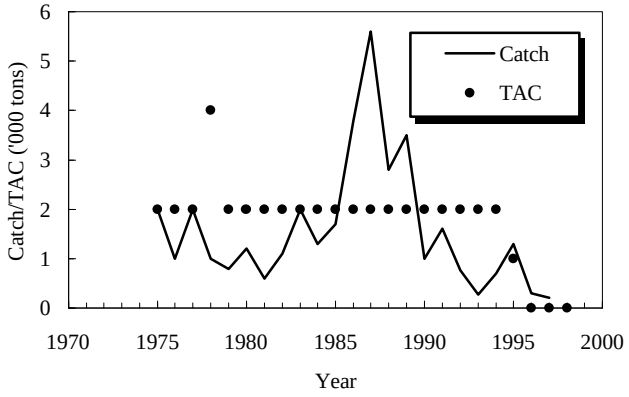

Fig. 6.1. American plaice in Div. 3M: nominal catches and agreed TACs.

b) **Input Data**

i) **Commercial fishery data**

EU-Portugal provided length composition data of the trawl catches for the second quarter of the year, but these represented only 2 samples and a total of 102 individuals measured. This information was used to estimate the length composition for the total catch (208 tons). The 1990 and 1986 year-classes (ages 7 and 11 in 1997) appear as the most abundant ones.

Mean weight-at-age in the catch shows a slight decreasing trend since 1993 for ages older than 8.

ii) **Research survey data**

The series of research surveys conducted by the EU since 1988 was continued in July 1997. The USSR-Russian survey series started in 1983 but was terminated in 1994. There was a survey carried out by Canada in 1996, not in 1997. Results of the 1996 survey are not comparable with the former Canadian series (1978-85) due to changes in survey gear and timing.

A continuous decreasing trend in both indices of abundance and biomass was observed since the beginning of the EU survey series. The USSR-Russian survey series, although more variable, also showed a decreasing trend between the 1986-93 period (Fig. 6.2).

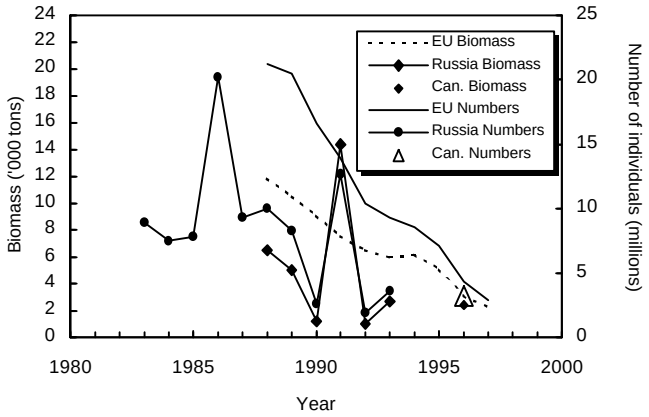

Fig. 6.2. American plaice in Div. 3M: trends in biomass and abundance in the surveys.

During the survey series the age reader was changed three times, and age compositions of the survey may reflect different criteria. As in the commercial catches, ages 7 and 11, corresponding to the 1986 and 1990 year-classes, are the best represented. Since 1991, a series of very poor year-classes has recruited to this fishery as shown by EU survey indices in successive years.

The spawning stock biomass (50% of that in age 5 plus age 6 and older), as estimated from the EU surveys, increased in 1993 to a value close to 1991, but decreased after 1995 (Table 6.1). The level in 1997 was only 25% of the 1988 level, the lowest point observed in the survey series (1988-97). This decreasing trend is expected to continue as long as no strong year-classes recruit to the SSB in the near future.

Table 6.1. Evolution of SSB EU survey index during the period 1988-97.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
SSB	8.5	5.8	5.3	5.7	3.6	5.0	5.0	4.3	2.9	2.1

c) **Estimation of Parameters**

Taking into account the deficiencies in the data base, only an approximation of the trend in exploitation was obtained, by comparing the catch and survey biomass ratio for ages fully recruited to the fishery (ages 8-11). For 1997 the index was 0.1, reaching the lowest in the series (Fig. 6.3). This index could be affected by unreported catches. Another estimation of F could be obtained by the log of the ratio between ages 6+ in one year, and 7+ the next year, minus 0.2 (natural mortality). The results demonstrate a considerable amount of interannual variability but suggest that the overall F during the 1988-97 period was in the range between 0.2 and 0.6 (Fig. 6.3; 6.4).

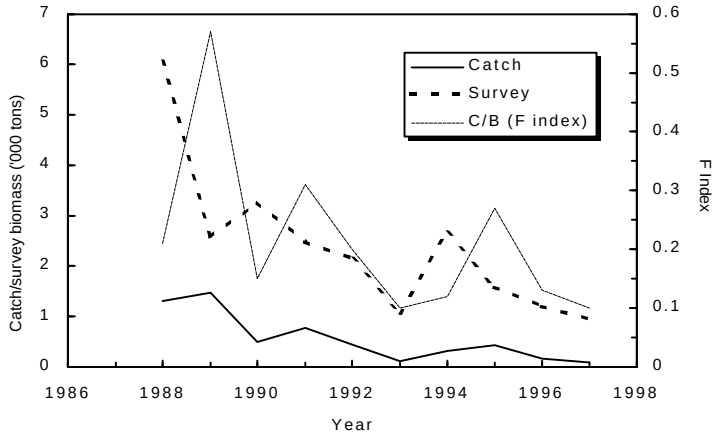

Fig. 6.3. American plaice in Div. 3M: trends in catch (C) and survey biomass (B) index, and trends in C/B index.

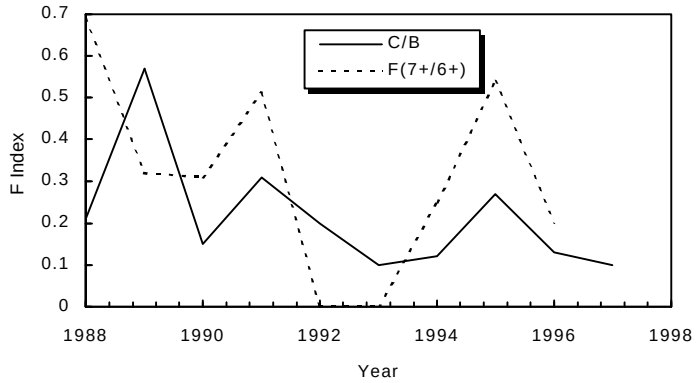

Fig. 6.4. American plaice in Div. 3M: comparison between the trends shown by two indices of F.

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 the 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.

e) **Reference Points**

Only 8 points are available to evaluate a spawning stock and recruitment relationship, but as can be seen in Fig. 6.5, only very poor recruitment appears at an SSB less than 5 500 tons, as estimated by the EU survey. However, it is difficult to assess the effect of the environment on recruitment. The results from the yield-per-recruit analysis, give an F_{max} = 0.40 and an $F_{0.1}$ = 0.20 (Fig. 6.6). At this stage no limit reference points can be considered.

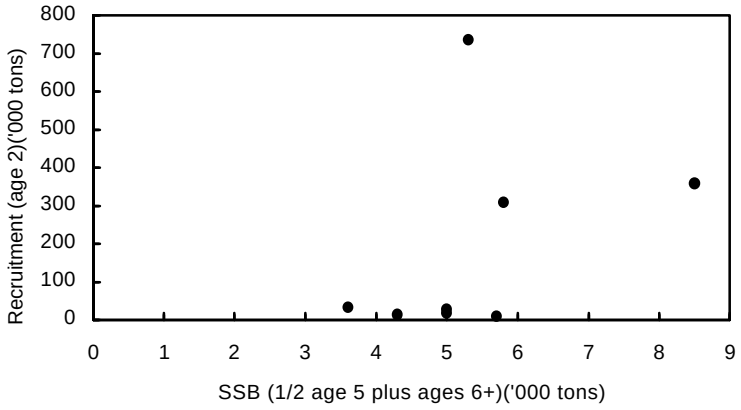

Fig. 6.5. American plaice in Div. 3M: SSB-Recruitment scatter plot.

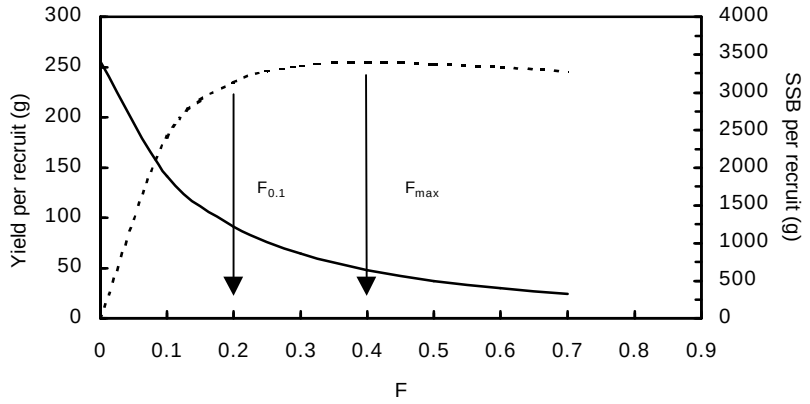

Fig. 6.6. American plaice in Div. 3M: yield-per-recruit analysis.

7. **Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 3N and 3O** (SCR Doc. 98/48, 49, 50)

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. 7.1). 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:

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	5	5	5	5	5	3[1]	0	0	0	0
Catch	4	4	5	5	4	1[2]	0.3[2]	0.4[2]	0.5[2]	

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

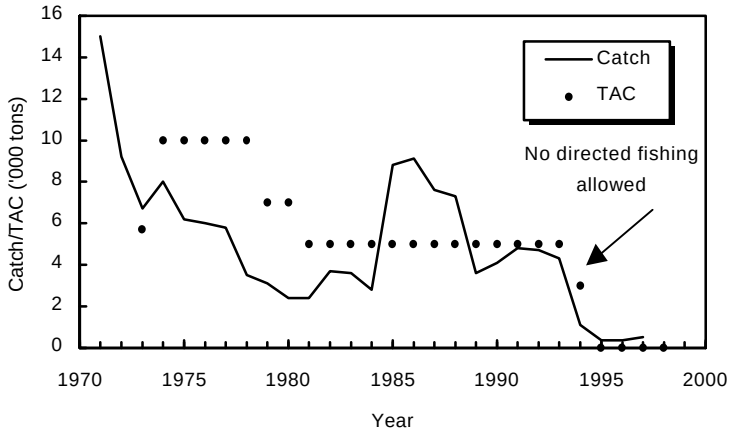

Fig. 7.1. Witch flounder in Div. 3NO: catches and TACs.

In 1987 and 1988, the total catch was about 7 500 tons, declining to between 3 700 and 4 900 tons from 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, with the 1997 catch just over 500 tons.

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 very small amounts of by-catch by Canada were taken since then due to the moratorium. 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**

No data for 1997.

ii) **Research survey data**

Biomass estimates. Canadian survey data were converted to reflect Campelen equivalent catches (SCR Doc. 98/50). Biomass estimates from Canadian converted spring surveys (SCR Doc. 98/49) in Div. 3N have been at very low levels during 1984-98 and in most years were less than 1 000 tons. For Div. 3O the estimates of biomass fluctuated annually, on average between 8 000 and 24 000 tons in the late-1980s. It was observed that despite the fact that survey coverage in Div. 3NO during 1991-98 has been the most complete in the time series, including much deeper water, there was a declining trend since about 1984 with the 1998 value the lowest observed (Fig. 7.2). Canadian autumn surveys from 1990-97 showed little or no trend during this period.

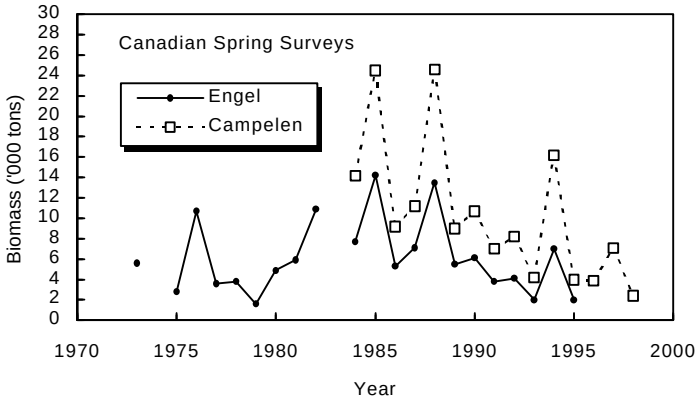

Fig. 7.2. Witch flounder in Div. 3NO: estimates of biomass.

Annual surveys have been conducted by EU-Spain in May since 1995 in the Regulatory Area of Div. 3NO (SCR Doc. 98/48). The survey was extended from a maximum depth of 730 m in 1995 to 1 100 m in 1996 and 1 400 in 1997-98. The biomass index was about the same between 1996 and 1997 at about 4 000 tons but increased sharply to 14 000 tons in 1998. Given the stability in the size composition for these years and the unexplained increases in biomass indices for other species, STACFIS believed there was a strong year effect in the recent data.

c) **Assessment Results**

Based on the most recent data, the stock appears to remain at a very low level with no apparent improvement.

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. Although STACFIS was informed that this problem is unlikely to be resolved in the near future, it was **recommended** nevertheless that *wherever possible the most up to date catch-at-age data for witch flounder from the surveys in Div. 3NO be made available.*

e) **Reference Points** (SCR Doc. 98/49)

Attempts were made to investigate potential reference points by examining historic commercial catch-effort data from 1974-92 using CEDA (Catch Effort Data Analysis) software (SCR Doc. 98/49). A range of trial runs was conducted to evaluate the sensitivity of the analysis to model choice, error structure and input parameters. It was concluded that under equilibrium conditions the MSY may be in the order of about 5 000 tons with an associated F_{msy} of about 0.25. The MSY value was most robust in all analyses that were considered reasonable, however, other potential reference points were much more sensitive to changes in the input parameters. It is proposed, therefore, that a more thorough examination of the data including survey trends as covariates be carried out before arriving at more firm conclusions on the values for reference points.

8. **Yellowtail Flounder (*Limanda ferruginea*) in Divisions 3L, 3N and 3O** (SCR Doc. 98/27, 42, 48, 60, 66, 72, 73; SCS Doc. 98/11)

a) **Introduction** (SCR Doc. 98/72)

Catches decreased from around 2 000 tons in 1994 to about 280 tons in 1996 and increased to 800 tons in 1997 (Fig. 8.1). Catches exceeded the TACs in each year from 1985 to 1993. In 1995-97, 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:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	15	5	5	7	7	7	7[1]	0[1]	0[1]	0[1]	4
Catch	16[2]	10[2]	14[2]	16[2]	11[2]	14[2]	2[1,3]	0.1[2,3]	0.3[1,3]	0.8[1,3]	

[1]No directed fisheries permitted.
[2]Includes estimates of misreported catches.
[3]Provisional

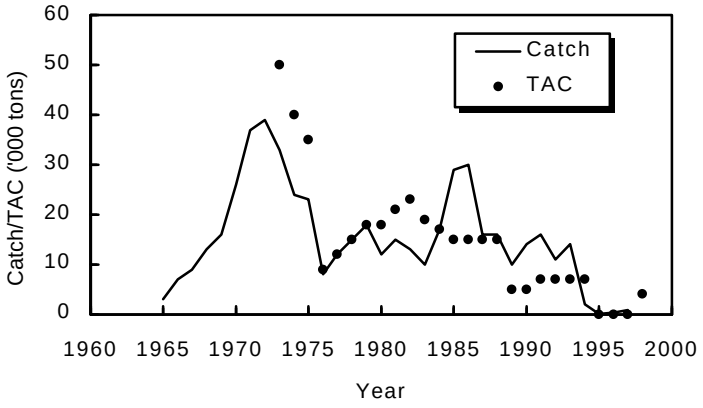

Fig. 8.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data** (SCS Doc. 98/11;SCR Doc. 98/73)

There were no catch-at age data from the commercial catch in 1997. There was limited sampling of yellowtail flounder from by-catches in an EU-Spain skate fishery in the Regulatory Area of Div. 3N. The length frequency of yellowtail flounder in the catches ranged in size from 12 to 56 cm, peaking at 30 cm. Twenty-six (26) percent of the total catch in the fishery was below 28 cm. Catch rate analysis of data from the 1996-98 cooperative Department of Fisheries and Oceans (DFO) and the Canadian fishing industry seasonal 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**

Conversion factors (SCR Doc. 98/60). In the fall of 1995, a new survey trawl was introduced. A Campelen 1800 shrimp trawl with rockhopper footgear replaced the 'old standard' Engel 145 otter trawl. Based upon the results of comparative fishing experiments between the two trawls presented to STACFIS in 1997 (SCR Doc.97/68), length based conversion factors were developed and accepted to convert the historic spring-time series of biomass and abundance of yellowtail flounder from 1984-95 to Campelen trawl units (Fig.8.2). The time series from 1971-82 have not been converted because a different survey gear was used. The 1990-94 Engel trawl autumn survey series was also converted with the same conversion factors (Fig. 8.3).

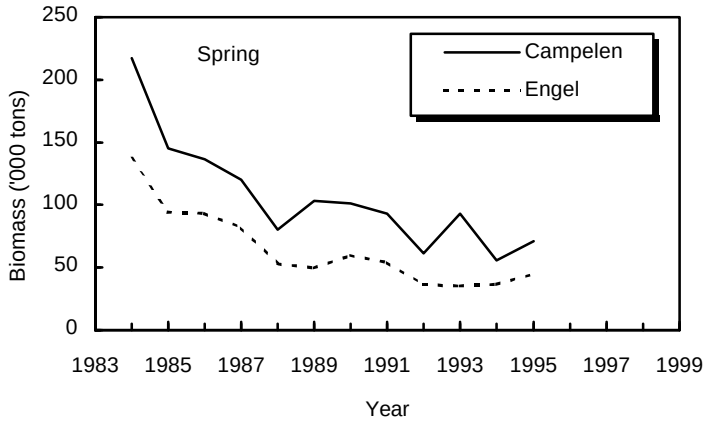

Fig. 8.2. Yellowtail flounder in Div. 3NO: comparison of biomass indices derived by converting the Engel trawl survey series to Campelen trawl units, spring 1984-95.

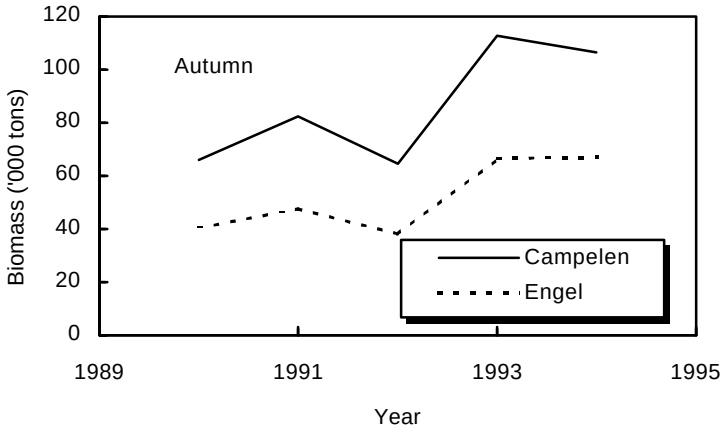

Fig. 8.3. Yellowtail flounder in Div. 3NO: comparison of biomass indices derived by converting the Engel trawl survey series to Campelen trawl units, autumn 1990-94.

Canadian stratified-random spring surveys (SCR Doc. 98/72). These surveys covered depths from 42 to 731 m. In 1997, most of the trawlable biomass of this stock continued to be found in Div. 3N, where the index has declined from 167 700 tons in 1984 to 57 900 tons in 1995 and then increased to an average biomass of 112 600 tons in 1996-97. A preliminary estimate for 1998 puts the biomass index at 147 000 tons. In Div. 3L, the index of trawlable biomass declined steadily from about 21 000 tons in 1984-85 to zero in 1995; the average biomass in 1996-97 was 800 tons. In Div. 3O, the biomass index was relatively stable around 26 000 tons from 1984 to 1991, however, the 1992 and 1994-95 values were around 9 000-13 000 tons, compared to 42 000 tons in 1993. In 1996-97, the average biomass estimates had increased to about 62 000 tons and in 1998 a preliminary estimate of 57 000 tons was calculated (Fig. 8.4).

In 1997, the total trawlable biomass index in Div. 3LNO was estimated to be 174 000 tons (Fig. 8.4). The survey catches have been usually dominated by yellowtail flounder aged 6-7 years, however, in 1996 and 1997 the catches were dominated by ages 4-7. In 1996-97, the 1992-93 year-classes appear stronger than preceding year-classes. Age 7+ biomass index was estimated to be 100 000 tons, representing 54% of the survey estimate.

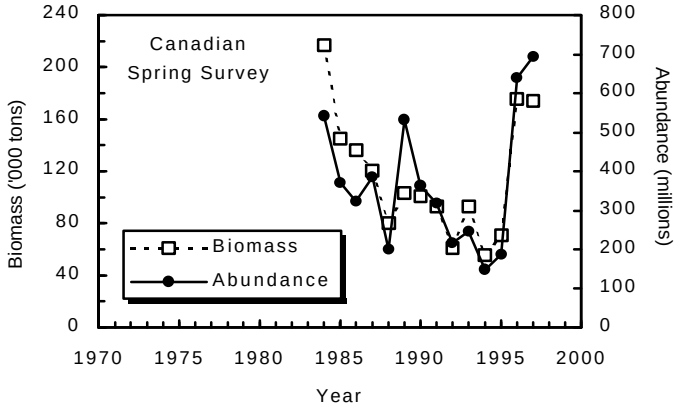

Fig. 8.4. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian spring surveys.

Canadian stratified-random autumn surveys (SCR Doc. 98/72). These surveys covered depths from 42 to 731 m. The index of trawlable biomass for Div. 3LNO yellowtail flounder has increased steadily from 66 000 tons in 1990 to 215 000 tons in 1997 (Fig. 8.5). Most of this biomass was found in Div. 3NO; Div. 3L had a biomass estimate of 1 000 tons. The survey catches were dominated by yellowtail flounder aged 4-5 years in 1996 and 5-6 years in 1997. The 1992-93 year-classes at age 4 were the strongest year-classes in the time series. In 1997, the age 7+ biomass index decreased slightly from 109 000 to 100 000 tons, representing 52% of the survey estimate.

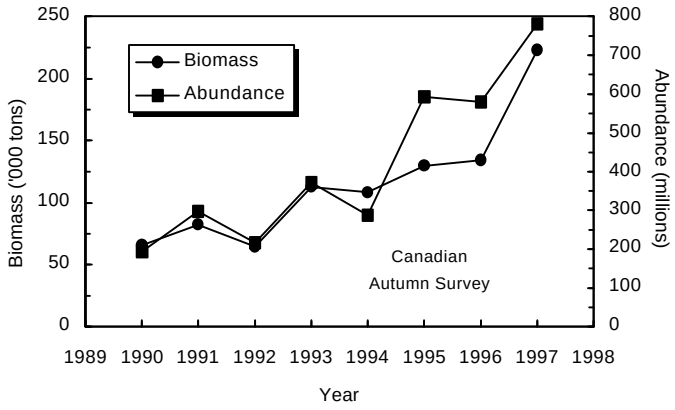

Fig. 8.5. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian autumn surveys.

Cooperative DFO/fishing industry seasonal surveys (SCR Doc. 98/73). Cooperative surveys in Divisions 3NO between DFO and the Canadian fishing industry were carried out using a commercial fishing gear without a codend liner. These surveys indicate drastic changes in catch rate and distribution of yellowtail flounder and other species in March of 1997 and 1998 compared with surveys at other times of the year. CPUE observed in the 4 other cooperative surveys was relatively high compared to historic CPUE data from the fishery. The similarity in CPUE estimates from the remaining grid surveys, and the low CPUE of other species in the March surveys, suggested that

catchability in the grid area during March is lower than that found in other seasons. The length range of yellowtail flounder in these surveys ranged from 30-45 cm and only 10% of the catch in any one trip was less than 30 cm. Ages 6-8 dominated the catch. These surveys also pointed to the difficulty of directing a fishery for yellowtail flounder without incurring large by-catches of American plaice and cod whose fisheries are under moratoria.

Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO (SCR Doc. 98/48)**.** Beginning in 1995 EU-Spain has conducted stratified-random surveys for groundfish in the Regulatory Area of Div. 3NO. These surveys cover a depth range of approximately 45 to 1 300 m. The biomass index increased between 1995 (27 704 tons) and 1996 (129 642 tons), decreased in 1997 (115 728 tons) and then increased in 1998 (425 375 tons). STACFIS noted that it was difficult to put this survey in context with the Canadian spring surveys because of lack of data on the differences in catchability of both sampling trawls and because the Spanish surveys do not cover the entire stock area.

Modal length of the 1995-97 catches was 24 cm and in 1998 it was 27 cm. Using the mean-length-at age from the Canadian survey, the peak in the 1997 catch represents age 4 and in 1998 age 5, i.e. 1993 year-class which has been identified as a strong year-class in the Canadian spring and autumn surveys in 1996-97.

Stock distribution (SCR Doc. 98/72). The 1995-97 spring and autumn surveys showed the stock to be mainly concentrated in Div. 3NO and appeared to be more concentrated in the autumn surveys than the spring surveys. Some expansion of the range into Div. 3L may be taking place.

Biological studies (SCR Doc. 98/27,42,72). Mean length at age in both the Canadian spring and autumn surveys showed a significant linear relationship in growth with no differences between the sexes. However, there is a difference in weight at age in males and females beginning at age 6, with females being heavier than males at the same age.

Length at 50% maturity (L_{50}) was calculated for males and females, separately, from samples collected during the 1995-97 Spanish surveys in the Regulatory Area. A large decrease in 50% maturity was seen in females and to a lesser extent in males in 1997, however, the samples did not contain many older fish. Spawning appeared to be near completion in July 1996 and in July 1997 it was completed. Diel patterns in feeding intensity were examined. Peak fullness occurred at nightfall indicating that yellowtail are daytime feeders, feeding mainly on small crustaceans and sand lance.

Stock-recruitment relationships (SCR Doc. 98/72). An investigation of a stock-recruitment relationship used the age 7+ biomass as a proxy for SSB from the 1975-95 Canadian spring survey data together with combined age 3 + 4 cohort abundance. The results suggested that the SSB index was below the long-term average from 1988-95, however, there has been an increase in SSB during 1996 and 1997 to levels comparable with the mid-1980s. The large 1992 and 1993 year-classes were produced when the SSB was below the long-term mean.

Total mortality (SCR Doc. 98/72). Estimates of total mortality (Zs) from the 1984-97 Canadian spring survey data for similar cohorts between ages 6 and 9 showed Z-values for ages 6 and 7 were being affected by lack of full recruitment to the survey gear. The high estimates (Zs>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. Given the continuing inadequacies with the catch and sampling data, and still-unresolved questions about the natural mortality at age for this stock, it remains impossible to estimate the level of fishing mortality in the recent years before the moratorium

Sampling gear studies (SCR Doc. 98/66). Data from the 1996 comparative fishing trials between the Yankee 41 shrimp trawl, used in annual Canadian juvenile groundfish surveys from 1986-94, and the Campelen 1800 shrimp trawl now used in annual spring and autumn groundfish surveys were examined. Although the number of paired tows was low, the catches were very high in many pairs. No differences were found in the size selectivity of both sampling trawls and differences in trawling efficiency were related to differences in tow duration. STACFIS **recommended** that *conversion factors be derived for re-calculating the Yankee trawl survey time series into Campelen trawl units.*

c) **Assessment Results**

Surveys in 1996-97 have shown the stock is more widely distributed than in the early-1990s but not as extensively as prior to the mid-1980s. The Canadian spring and autumn surveys and the Spanish surveys in the Regulatory Area show that stock abundance and biomass has been increasing in recent years. The increase in biomass is related to both an increase in growth and recruitment. 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 indices in 1996 and 1997. The SSB is at a higher level in recent years relative to the mid-1980s and the relative cohort strength in 1995-97 surveys is above average as measured in the 1984-97 spring surveys and 1990-97 autumn surveys. The mean weights at age have also remained stable. Based on 7 additional surveys since the 1997 assessment, the current view is that the stock size has increased since 1994. However, STACFIS recognizes that a fishery for yellowtail flounder on the southern Grand Bank will result in by-catch of American plaice and cod whose fisheries are under moratoria, as well as juvenile yellowtail flounder in the nursery area.

d) **Reference Points**

Several age aggregated and disaggregated models were used to analyze commercial catch and CPUE data and survey data. Various estimates of biological and fishing mortality reference points were made, many of which involved using the 'old standard' survey time series from 1975-95, and were presented for illustrative purposes. Given that revisions are ongoing with the conversion to the 'new standard' time series, STACFIS considers it to be pre-mature to recommend any of these parameter estimates as reference points and notes that further analyses are forthcoming.

9. **Capelin (*Mallotus villosus*) in Divisions 3N and 3O** (No SCR Doc.)

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 the former 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 1998 (Fig. 9.1).

Nominal catches and TACs ('000 tons) for the recent period are as follows:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Advised TAC	10	18	30	30	30	ndf	ndf	ndf	ndf	na	na
TAC	15	28	30	30	30	0	0	0	0	0	0
Catch	7	9	25	+	+	+	0[1]	0[1]	0[1]	0[1]	

[1] Provisional.
ndf - no directed fishery
na - no advice possible

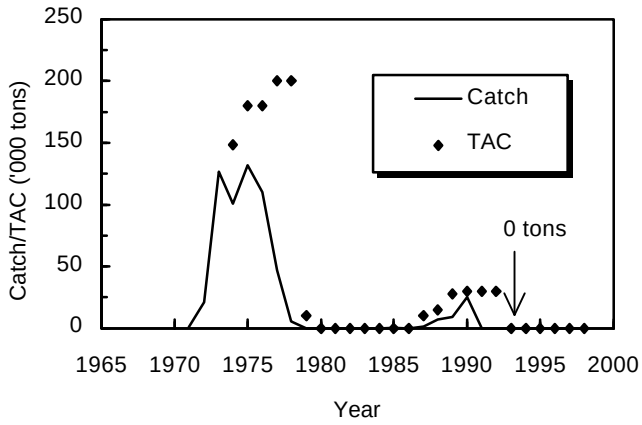

Fig. 9.1. Capelin in Div. 3N and 3O: catches and TACs.

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 1997.

During the beginning of 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.

STACFIS has no data on Div. 3NO capelin on which the current status of that stock can be evaluated.

c) **Potential Reference Points**

It is quite difficult to determine precautionary reference points for capelin in Div. 3NO. The historical database (both biological and fisheries statistics) began in the early-1970s but has not been updated since 1992. The main problems are related to the biological peculiarities of capelin, such as short life span and the high post-spawning mortality.

During the history of management by ICNAF and NAFO, the important role capelin play in the food chain in the Northwest Atlantic has been recognized. Early quotas were based on surplus production estimates after feeding had been accounted for. During the mid- to late-1970s, there was consideration that exploitation should not exceed 20% of the mature biomass. During the 1980s, after review, the practice of not harvesting more than 10% of the mature biomass was agreed upon, in full recognition of the importance of capelin as a food for many other species (see e.g. NAFO Sci. Coun. Rep., 1981, p. 18). This low harvest rate policy has been maintained to the present. STACFIS considers this low target exploitation rate to be precautionary.

There are currently no surveys directed to capelin in the Div. 3NO. Without this information, it is not possible to evaluate the status of this stock. There is also a problem of stock mixing (with the Div. 2J+3KL stock) in Div. 3L during the feeding period. This mixing has hampered estimates of historic stock size. Additional work should also be carried out examining the trophic relationships of capelin to other species, especially the value of capelin consumption by the main predators in relation to their stock size.

10. Short-finned squid (*Illex illecebrosus*) in Subareas 3+4 (SCR Doc. 98/54, 55, 59, 75; SCS Doc. 98/5, 12, 15)

a) **Introduction**

i) **Description of the fisheries**

In Subareas 3+4 a TAC of 150 000 tons has been in place since 1980. Occasionally very small landings from Subarea 2 are included with Subarea 3 for convenience. Subareas 3+4 landings declined from 162 000 tons in 1979 to only 100 tons in 1986 but subsequently increased to 11 000 tons in 1990. Landings ranged between 1 000 tons and 6 000 tons during 1991-95 before increasing to 8700 tons in 1996 and 15 500 tons in 1997.

Since this annual species is now considered to constitute a single stock throughout Subareas 2-6 (see Section X.1b and c above), trends in Subareas 3+4 must be considered in relation to those in Subareas 5+6. Subareas 5+6 landings have ranged between 2 000 tons and 25 000 tons since 1970 (Fig. 10.1).

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

	1988	1989	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998
TAC SA 3+4	150	150	150	150	150	150	150	150	150	150	150
Catch SA 3+4	0.80	7.00	11.00	4.00	2.00	2.67	5.97	1.03	8.73	15.49	
Catch SA 5+6	1.96	6.80	11.67	11.91	17.83	18.01	18.35	14.06	16.97	13.63	
Catch SA 3-6	2.76	13.80	22.67	15.90	19.83	20.69	24.32	15.09	25.70	29.11	

[1] Provisional catches.

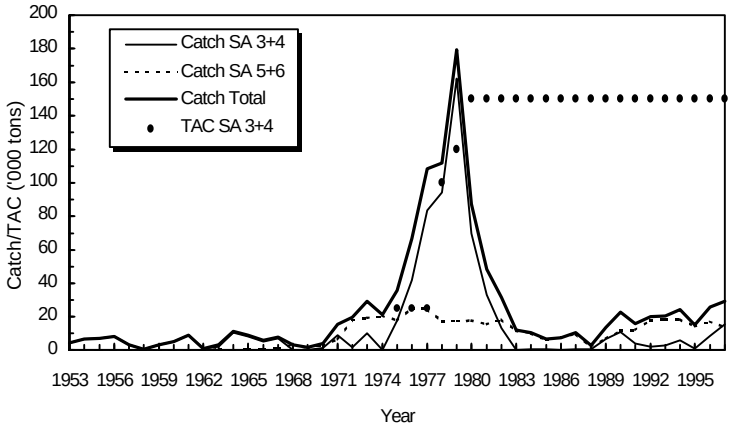

Fig. 10.1. Short-finned squid in Subareas 3+4: landings during 1953-98 with TAC.

b) **Input Data**

i) **Commercial fishery data**

Estimates of total annual landings were available for Subareas 3+4 during 1953-97, and for Subareas 5+6 during 1963-97. Subareas 5+6 landings prior to 1976 may not be accurate since distant-water fleets did not report all squid landings by species. The accuracy of landing estimates for Subareas 3+4 is unknown, especially for early years.

Standardized landings per unit effort (LPUE) data were available for 1982-93 from the Subareas 5+6 USA trawl fishery.

The Subarea 3 fishery during 1994-97 was described and it was noted that seasonal variation in size composition of the catch could not be attributed to growth alone (SCR Doc. 98/55).

ii) **Research survey data**

Stratified random bottom trawl surveys have been conducted on the Scotian Shelf (Subarea 4) during July of 1970-97 and in Subareas 5+6 during September-November of 1967-97. Mean weight (kg) and number-per-tow indices are assumed to represent relative biomass and abundance levels at the start of the fishing season in Subarea 4 and near the end of the fishing season for Subareas 5+6.

Survey biomass indices were positively correlated between Subareas 4 and 5+6 (Fig 10.2). These indices were also positively correlated with catch trends from all Subareas.

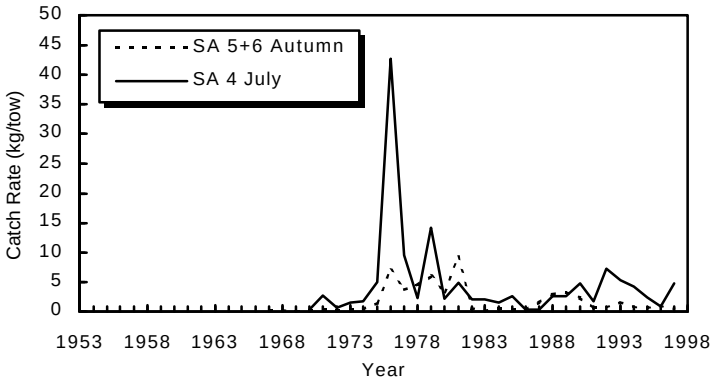

Fig 10.2. Short-finned squid in Subareas 3+4: research survey biomass indices for Subarea 4, 1970-97 and Subareas 5+6, 1967-97.

iii) **Biological studies** (see Section X.1b and c above)

Several papers contributed information on biological characteristics and environmental relationships. SCR Doc. 98/59 provided a review of the life cycle, distribution, biology, and population dynamics of the species. SCR Doc. 98/54 showed that landing trends in Subareas 3 and 4 are related to broad-scale environmental variation.

c) **Assessment Results**

Trends in the fisheries and in the research vessel survey data indicate that the recent past included a period of high productivity during 1976-81 which was followed by a period of much lower productivity during 1983-97. STACFIS was unable to determine if the decline was a direct result of high catches, as in 1979, or whether there was also an environmental component involved.

Survey biomass indices remain low. However increased catches in the past 2 years suggest some increase in abundance. There is currently no basis for reliably predicting recruitment for this annual species.

d) **Precautionary Reference Points**

Attempts were made to apply a surplus production model using, as input parameters, Subareas 3-6 landings, Subareas 5+6 autumn survey kg/tow and Subarea 4 July survey kg/tow However concerns were raised regarding reliability of results due to unknown suitability of the model for this annual species . Using this approach, it was not possible to select reliable reference points at this time.

To estimate the upper range of yields that might be expected from Subareas 3 and 4 under the recent low productivity regime, catches during the high productivity period (1976-81) were adjusted by the ratio of the relative survey biomass indices from the high and low productivity periods (SCR Doc. 98/75). This approach assumes that the peak relative fishing mortality rates estimated during the high productivity period (10 times higher than at present) are appropriate during the current low productivity period. The results indicate an upper range of catches between 18 000 and 34 000 tons. If the high landings taken in the late-1970s were responsible for the subsequent declines in the resource in the early-1980s, then the estimated range of yields might best be considered as limits.

e) **Research Recommendations**

For short-finned squid in Subareas 3+4, STACFIS **recommended** that:

i) The suitability of surplus production models for this annual species be investigated through simulation studies.

ii) In order to evaluate effects of annually variable effort levels, data on effective fishing effort should be collected in all Subareas.

11. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO** (SCR Doc. 98/13, 29, 30, 47, 48, 63, 77; SCS Doc. 98/11, 13)

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. 11.1). 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. Beginning in 1995, TACs for the resource were established by the Fisheries Commission, and the catch declined to just over 15 000 tons in 1995, a reduction of about 75% compared to the average annual catch of the previous 5 years. The catch accepted for 1996 was about 19 000 tons, increasing slightly to almost 20 000 tons in 1997. The major participants in the fishery in the Regulatory Area in 1997 were EU-Spain (7 900 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. EU-Portugal, EU-Spain 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, declined annually to 2 300 tons in 1995, but increased in 1996-97 to about 6 000 tons in each year.

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. In 1996-97 gillnet catches increased to around 5 000 tons in each year. 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 each of 1996 and 1997 was just over 1 000 tons by this fleet component.

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC[1]	100	100	50	50	50	50	25	27	27	27	27
Catch[2]	19	19	47	55-75	63	42-62	51[3]	15[3]	19[3]	20	

[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.

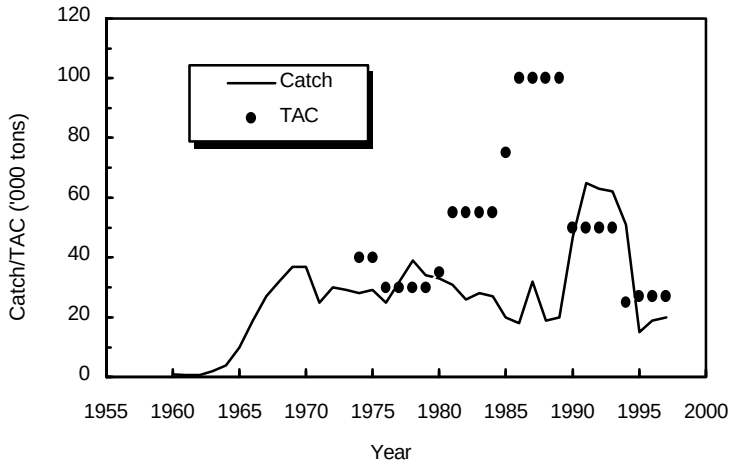

Fig. 11.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch and effort. An analysis of otter trawl catch rates from many fleets, but mostly from Canadian vessels, indicated a declining trend since about the mid-1980s, and stabilized at a low level from 1991 to 1996. The standardized catch rate increased in 1997 to a level similar to that of the late-1980s, although there was a large variance associated with the 1997 data. Data from the most recent years were very limited as a result of low effort, due to the poor catch rates in many years (SCR Doc. 98/47). Standardized effort in 1997 was among the 5 lowest values in the time series.

A catch-rate analysis of Portuguese otter trawlers fishing in the NAFO Regulatory Area of Div. 3L from 1988-97 was also reviewed. The CPUE declined sharply from 1989 to 1991, and remained around this low level until 1994. CPUE has gradually increased since then, and in 1997 it was about double the low values in 1991-94, but still below the CPUE in 1988-90. Directed effort on Greenland halibut in Div. 3N accounted for only 2% of the observed effort from the Portuguese trawl fishery, and no trend in catch rates for this Division could be detected. Data were available from only 4 years in Div. 3M (1990, 1995-97), and CPUE was highest in 1997. The combined CPUE index for all 3 Divisions increased gradually from 1994 to 1997, but remained below the 1988-90 levels.

By-catch data for Greenland halibut in the Icelandic shrimp fishery in Div. 3M in 1997 and early 1998 were available (SCR Doc. 98/29). The by-catches were around 0.2% (by weight) in 1997, compared to 0.3% in 1996. The 1997 data indicated about 17 Greenland halibut were caught per ton of shrimp in this fishery. No length compositions were available.

Size and age data were available from the 1997 Canadian fisheries (SCR Doc. 98/47). Sampling data was from the catches of Canada in 1997 and indicated that the gillnet catch in 1997 was comprised mainly of fish aged 7 to 12 years, compared to mainly 6 to 8 in the otter trawl catch. The gillnet catch-at-age was bimodal, with peaks at ages 7 and 11, reflecting catches by the different mesh sizes used. Overall, ages 7 to 11 comprised the bulk of the catch, with a peak at age 7. Mean weights-at-age were similar to recent values.

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. 98/47). No trends were seen in the mean weights over the period 1988-97.

The commercial catch-at-age data for 1997 from EU-Portugal was similar to 1996 and indicated low numbers (about 11%) 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 6 and 7 in (SCS Doc. 98/13), which were the 2 year-classes that comprised most of the catch in this fishery in 1996 as well. These 2 year-classes were also the most abundant in Spanish catches (SCR Doc. 98/11). The length and age composition of the French catch was similar to the Canadian otter trawl catch (SCS Doc. 98/10).

ii) **Research survey data**

STACFIS noted once again that 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 and 1997 the Canadian survey covered almost the entire geographical range of the Greenland halibut stock in Subarea 2 and Div. 3KLMNO, giving estimates of stock abundance and biomass. Unfortunately, there is no single survey series prior to 1996 with which the total results of the 1996 and 1997 surveys can be compared.

Canadian stratified-random survey in Div. 2G and 2H (SCR Doc. 98/47). During September-October 1997, a stratified random survey of Div. 2GH was carried out by Canada on the R/V *Teleost,* in depths from 200 to 1 382 m. The biomass estimate for Div. 2GH combined was about 54 000 tons, and was similar to the 1996 biomass estimate of 48 000 tons, when coverage of Div. 2G was incomplete. In both Divisions, the 1995-97 year-classes were predominant in both surveys. The age composition in both Divisions was dominated by small fish, with ages 1 and 2 being the most abundant in catches. Estimates of biomass and abundance from the surveys in Div. 2GH in 1996-97 are not directly comparable with estimates from previous surveys in this area, but suggested that biomass is lower 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. Length based conversion factors were developed and accepted by STACFIS in 1996 and 1997 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. 11.2). To date, these conversions have been used for the data in Div. 2J and 3K, from 1978 to 1994.

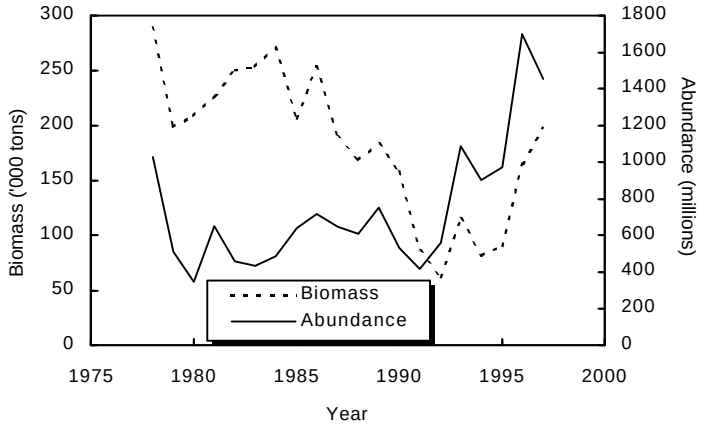

Fig. 11.2. Greenland halibut in Div. 2J and 3K: estimates of biomass and abundance from Canadian surveys.

The results indicated that the biomass index for Div. 2J and 3K combined generally increased from the late-1970s to peak around 270 000 tons in 1984. The index then declined steadily to around 160 000 tons in 1990. There was a sharp decrease by about 50% between 1990 and 1991, and the index reached its lowest level observed by 1992 at about 62 000 tons. The 1992 value was only about 20% of the peak values observed in the late-1970s and early-1980s. The estimates have increased since then, with the 1995 value about the same as that of 1991 (around 90 000 tons). The 1996 value was about 80% higher than the 1995 point, although coverage was incomplete in 1995. The 1997 point (approximately 200 000 tons) was about 15% higher than the 1996 value, and was similar to the levels observed in the mid-1980s, but below the peak values observed in the late-1970s and early-1980s. Increases in 1997 were observed in almost all depths over 300 m throughout Div. 2J and 3K. It should be noted that the 1995 to 1997 surveys were actually conducted with the new survey trawl and are not converted values. Biomass of fish less than 36 cm has increased substantially in recent years, and 1997 appears to be the highest point in the series. However, comparisons at these sizes are heavily dependent on the accuracy of conversion factors applied to the small fish in the Engel surveys. Biomass of fish greater than 35 cm was lowest in 1994, and has increased steadily since then, but is still only about one-quarter of peak values in the early-1980s.

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 lowest point observed in 1994. Abundance has increased at these ages since 1994, but remains well below average levels. Ages 10+ declined since at least the early-1980s and remained at a low level throughout the 1990s. Abundance at ages 10+ in 1996 and 1997 was less than 10% of the estimates in the mid-1980s. 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 index for ages 3-5 has generally remained above the long-term average since 1989 and reached a maximum in 1993. The index declined in 1994 and 1995 but increased again in 1996 and 1997. The 1997 estimate was similar to the 1993 value. The relatively high index of ages 3-5 in recent years is a result of high indices of abundance of the 1990-94 year-classes.

Estimates of total mortality from the survey data indicate an increase to very high levels ($Z > 1.0$) in the early-1990s as catches from the stock increased sharply. Mortality values are relatively low as measured by surveys since 1995, which corresponds to the period of reduced catches.

EU stratified-random surveys in Div. 3M (SCR Doc. 98/30). 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 has increased in each year since then, to reach a maximum value of 15 800 tons in 1997. Much of the increase in biomass is due to improved recruitment. 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). In 1997, the peak abundance was at age 6, and ages 3-7 comprised the bulk of the catches in the survey. The 1994 year-class had the highest values in the time series at ages 1, 2, and 3. Few fish older than age 10 were encountered in any of these surveys, probably because no depths greater than 730 m were fished.

Russian surveys in Flemish Cap (SCR Doc. 98/13). A stratified-random survey was conducted in part of Flemish Cap in Div. 3M during April-May 1996 to a depth of 914 m. The abundance index was 2.8 million fish and the biomass index was 1 200 tons. Data from these surveys from 1987-96 varied without trend. The peak biomass occurred in 1989, and the low point was in 1991. The biomass in 1996 was below the average value but the abundance was above the average of the time series.

Spanish stratified-random surveys in Div. 3NO Regulatory Area (SCR Doc. 98/48). During April-May of 1995 to 1998, stratified-random bottom trawl surveys were conducted by EU-Spain in the Regulatory Area of Div. 3NO to a depth of 730 m in 1995, 1 100 m in 1996, 1 275 m in 1997, and 1 460 m in 1998. The estimated biomass (comparable strata from 1996-98 only) was about 35 000 tons in 1995, 45 000 tons in 1996, and 85 000 tons in 1997. The total biomass estimated in 1998, including the deep strata not surveyed previously, was 148 000 tons. In 1998, the size composition was dominated by fish in the 28 to 39 cm range, with peaks at 30-31 and 36-37 cm. Few fish above 60 cm were caught, consistent with previous surveys.

Canadian stratified-random survey in Div. 3LMNO (SCR Doc. 98/47). As part of the annual Canadian autumn survey (September to December), coverage in 1996-97 was extended to Div. 3M, and to a few 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. In 1996, a full survey of Div. 3M was done, but in 1997 only the strata greater than 730 m in the Flemish Pass and Sackville Spur areas were covered. Biomass estimated in Div. 3L increased from 36 000 tons in 1996 to 49 000 tons in 1997. Biomass in Div. 3MNO combined was at the same level in each year, although not enough deep water strata were fished in Div. 3NO in each year to consider these surveys as reliable indicators of Greenland halibut biomass in these Divisions. Fish greater than 36 cm made up the bulk of the biomass in Div. 3L, unlike the situation in Div. 2J and 3K. Overall, biomass in Div. 3LMNO comprised about 19% of the total biomass estimated from the Canadian autumn surveys in 1996 and 1997, although deep strata in Div. 3NO were poorly sampled in each year.

iii) **Recruitment indices**

In the past several 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 and 1997. In Subarea 2 and Div. 3K, the 1990 year-class was predominant in commercial catches.

Surveys in Div. 2J and 3K suggested that the 1992 and 1993 year-classes may also be above average abundance. The 1995-97 Canadian surveys in Div. 2J and 3K and the EU survey in Div. 3M in the same years estimated the 1994 and 1995 year-classes to be the largest observed. These two year-classes dominated catches in the Canadian survey Subarea 2 and Div. 3KLMNO in both 1996 and 1997. The 1994 year-class was also strong in the 1998 survey of Div. 3NO (NRA) by EU-Spain, based on length frequency data. For the Canadian surveys, STACFIS again cautions that comparisons of year-class strengths in the 1995-97 surveys with data prior to 1995 are very sensitive to the length conversion factors for small fish between the two survey series. More confidence in the strength of these year-classes will be developed over the next 1-2 years' surveys, before these cohorts recruit to the fishery. Little can be said about the strength of the 1996 year-class, except that it does not appear to be as large as the 1995 year-class when the 1996 and 1997 surveys are compared.

c) **Assessment Results**

In the 1997 assessment of this stock, STACFIS concluded that following a decline in the fishable stock up to 1995, there had been improvement in most indices of abundance, although the biomass of older fish clearly remained at a low level. As well, there were repeated indications from various surveys of good recruitment from the year-classes of the early- and mid-1990s. STACFIS cautioned, however, that estimates of these cohorts at older ages need to be obtained in future surveys to confirm the relative strengths more confidently.

The year-classes of 1990 and 1991 have recruited to most fisheries, and all CPUE indices increased somewhat in 1997, although fishable biomass still remains below average. Estimates of SSB for this stock, based on surveys, are uncertain due to variable survey coverage and variations in the maturity ogive available for this stock. Surveys in 1997 confirmed the abundance of year-classes previously thought to be strong.

A simulation exercise was carried out (SCR Doc. 98/63) by projecting forward the population estimates from the 1997 Canadian survey in Div. 2J3K. The model used a bootstrapping technique, and was based on observed survival rates at age between the 1996 and 1997 surveys. The analysis indicated that fishable biomass (and the estimate of the mature biomass) could increase substantially in 1998-99 under current levels of exploitation. Although it may be sensitive to the relatively high survival rates between 1996 and 1997, the analysis confirmed the expectations of increasing stock size under status quo levels of exploitation, which are the second lowest in the time series.

There was a significant reduction in catches from a range of 50 000 to 70 000 tons in the early-1990s, to between 15 000 to 20 000 tons in 1995-97. Based on the available information STACFIS again concluded that the stock continues to show signs of recovery. Fishable biomass is still at a relatively low level (about half of long-term average from surveys in Div. 2J3K), but should continue to increase in 1998-99, if current levels of exploitation are maintained.

d) **Reference Points**

When analytical assessments are available, reference points can be defined in terms of biomass or fishing mortality. For Greenland halibut in Subareas 2 and 3, there exists little information on the absolute estimate of biomass. However, historic data from research surveys and on the historic catch level do exist, and both may be used to derive estimates of total mortality. STACFIS reviewed SCR Doc. 98/77 on various ways to utilize these data in the determination of limit reference points for this resource, using equilibrium yield and biomass per-recruit calculations.

SCR Doc. 98/76 also proposed a model which may be used to obtain the expected recruitment to the spawning stock biomass in an equilibrium situation (assuming average recruitment). They suggest that a Precautionary Approach Framework should recognize the particular characteristic of population dynamics for this stock by setting up limit reference points allowing "sufficient" escapement through the immature age-groups. This approach may be useful to set the Precautionary Approach reference points if there is some way to evaluate what is the proper level of escapement.

When developing a Precautionary Approach framework for Greenland halibut in Subarea 2 and Div. 3KLMNO, other aspects of the life history of the species should be taken into consideration. For instance, there is an apparent differential natural mortality rate between the males and the females starting about at the age of first maturity for males. This particularly complicates the calculation of certain reference points. In recent years, some analyses have assumed a constant mortality rate for all ages and both sexes (M = 0.15 to 0.2), while others have assumed a differential mortality rate between males and females (M = 0.15 for all ages for females; for males, M = 0.15 from ages 3 to 6 and M = 1.05 thereafter). In addition, in the absence of a virtual population analysis, there are some questions on the partial selection pattern that best describes the fishery (e.g. the degree to which there is a dome in the partial selection). As these aspects of life history and fishing patterns could have a major impact on the calculation of reference points, they must be addressed before a Precautionary Approach framework can be finalized for this stock.

12. **Roundnose Grenadier (*Coryphaenoides rupestris*) in Subareas 2 and 3** (SCR Doc. 98/14, 28, 57; SCS Doc. 98/10)(with information on roughhead grenadiers (*Macrourus berglax*) SCR Doc. 98/30, 31, 33, 43 SCS Doc. 97/11, 13)

a) **Introduction**

It has been recognized for a number of years that recent catches of grenadiers by EU-Portugal and EU-Spain reported to NAFO as roundnose grenadier from directed Greenland halibut fisheries in the Div. 3LMN area were primarily roughhead grenadiers. EU-Portugal reported that all of their catch of grenadiers since 1988 has been roughhead grenadier and this has been changed in the NAFO catch statistics. Grenadier catches by EU-Spain for 1992-96 are also mostly roughhead grenadier. The reason for this misclassification is because roundnose grenadier is the only name that appears in the statistical data reporting forms. This misclassification has not been resolved in the official statistics for 1992-96 but the species has been reported correctly for 1997.

The first reported catch of roundnose grenadier in NAFO Subareas 2 and 3 was 17 000 tons in 1967. Until 1977 nominal catches were on average about 23 000 tons with the exception of the largest recorded catch of 75 000 tons in 1971. Catches declined rapidly to 8 000 tons in 1979, averaged about 5 000 tons up to 1989 and dropped to 800 tons in 1990. The 1991 catch could not be estimated precisely but the total 1991 estimate for both roundnose and roughhead grenadier is thought to be in the range of 8 000 tons to 14 000 tons. From 1992 to 1995 catches of roundnose grenadier were between 100 tons and 500 tons. The 1996 and 1997 catches were about 50 tons (Fig. 12.1).

Over most of the years of the directed roundnose grenadier fishery, the bulk of the catch came from Div. 3K with the exception of 1971 when over 50 000 tons was reported from Div. 2G. This traditional fishery was conducted by the former USSR and former GDR during the second half of the year. These fleets fished before the establishment of the 200-mile limit in 1977 and under bilateral arrangements with Canada afterward. Beginning in 1993 there have been no allocations to non-Canadian vessels inside the Canadian 200-mile zone.

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 combined have been taken primarily as bycatch during the first half of the year corresponding to the period of the most effort for Greenland halibut.

A TAC was first imposed on roundnose grenadier at 32 000 tons in 1974, increased marginally to 35 000 tons in 1977 and reduced to 27 000 tons by 1982. A reduction to 11 000 tons occurred for 1983 and the TAC was maintained at this level to 1993. From 1994 to 1995 a 3 000 ton TAC was in effect for the Canadian 200-mile zone only. This was reduced to 1 000 tons for 1996. Currently there is a moratorium on the directed fishery imposed within the Canadian 200-mile zone.

Nominal catches and TACs ('000 tons) for roundnose grenadier in the recent period are as follows:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
TAC	11	11	11	11	11	11	3	3	1	0	0
Catch[1]	5	5	1	8-14[2]	1	0.4	0.1[3]	0.2[3]	+[3]	+[3]	

[1] Based on revised catch statistics for EU-Portugal and estimates for EU-Spain
[2] Estimate for grenadiers, the amount and proportion of roundnose grenadier could not be determined precisely.
[3] Provisional data.

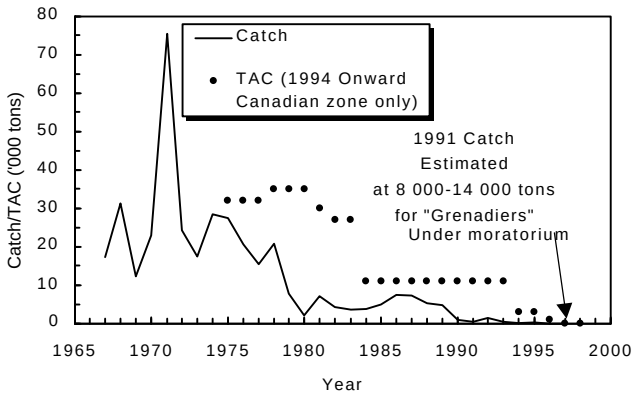

Fig. 12.1. Roundnose grenadier in Subareas 2+3: catch and TACs.

Revised catches for roughhead grenadiers since 1987 ranged from 300 tons to 7 500 tons, with the exception of 1991 when the catch could not be precisely estimated (Fig. 12.2). The average catch since 1990 has been about 4 000 tons taken primarily by EU-Portugal and EU-Spain. Roughhead grenadier is an unregulated species. Catches of roughhead grenadiers in the Regulatory Area ('000 tons) have been estimated to be:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Catch[1]	1	0.3	3	8-14[2]	7	4	4	4[3]	4[3]	5[3]

[1] Based on revised catch statistics for EU-Portugal and estimates for EU-Spain
[2] Estimate for grenadiers, The amount and proportion of roughhead grenadier could not be determined precisely.
[3] Provisional data.

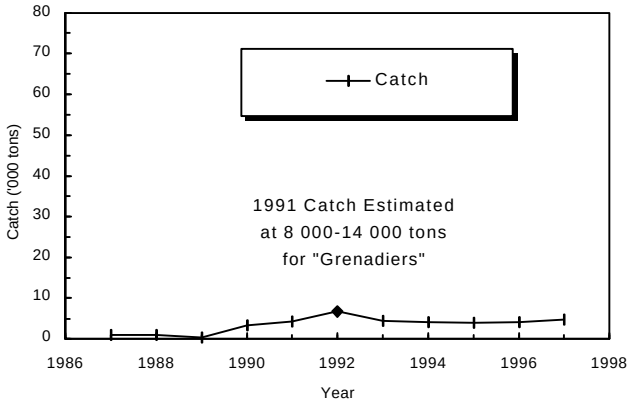

Fig. 12.2. Roughhead grenadier catch in Subareas 2+3.

b) **Input Data**

i) **Commercial fishery data**

Roundnose grenadier. There was no sampling information available for the 1997 roundnose grenadier by-catches. Information available for 1996 (NAFO Sci. Coun. Rep., 1997, p. 121) from the discarded by-catch of the Spanish trawler fleet suggested the bulk of the roundnose grenadier by-catch in Div. 3L was composed of sizes between 6.5 cm and 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.

Roughhead grenadier. In 1997, commercial catches from the Spanish trawler and pair-trawler fleet were sampled by national scientific observers. In both fleets the roughhead grenadier is caught as the main by-catch in the Greenland halibut fishery. The roughhead grenadier length distributions and catches at age in those two fleet components have been recorded. The modal length (pre-anal fin length) ranged between 19 cm-20 cm in Div. 3M and 16 cm-17 cm in Div. 3L and 3N. Most of the commercial catches from both fleets are composed of ages between 6 and 11 with the mode at age 7.

Commercial catches from the Portuguese trawler fleet sampled as by-catch in the Greenland halibut fishery by national scientific observers indicate the annual length composition (pre-anal fin length) in Div. 3L and Div. 3M were similar with a modal peak at 11 cm. In contrast, based on limited sampling in Div. 3N, the modal peak was at 18 cm.

Both the Portuguese and Spanish fleets fish deeper than 700 m in Div. 3L and Div. 3M but the differences in peak modal length is striking suggesting that the Portuguese fleet generally fishes shallower compared to the Spanish fleet.

ii) **Research survey data**

Roundnose grenadier. Canada conducted a stratified-random multi-species bottom trawl survey in 1996 and 1997 from September to December in Subareas 2 and 3 with the exception of Div. 3P. Coverage of strata was complete down to 1 500 m in Div. 2J+3KL in both years and in Div. 2H in 1997. Div. 3M was covered from 730 m to 1 500 m in the north and west strata of Flemish Cap in Div. 3M. Div. 2G was only partially covered in 1997 from 400 m-1 250 m with even less coverage

(<500 m) in 1996. Div. 3N was covered from 367 m-732 m and similar depth strata were incomplete in Div. 3O but abundance was scarce in these areas. Overall, highest abundance occurred in strata beyond 900 m and in Div. 2H and Div. 3K. In 1996 roundnose grenadier were most abundant in Div. 2H and Div. 3K. The survey biomass estimates ranged from 2 600 tons in Div. 3L to 26 000 tons in Div. 2H. The total 1996 survey biomass index amounted to about 68 000 tons. The 1997 survey showed a reduction in abundance and biomass in Div. 2H, Div. 2J and Div. 3K with an increase in estimates for Div. 3L and Div. 3M. The total 1997 survey biomass index for the area surveyed amounted to 34 000 tons despite increased coverage in 1997.

Size distributions of roundnose grenadier (using pre-anal fin length measurements) from the Canadian survey by year and Division indicated a smaller size range and predominantly smaller fish in the southern Divisions, at least for Div. 3LM, compared to the northern Div. 2HJ and 3K. The substantial decrease in Div. 2HJ and 3K occurred over most of the size ranges that were observed in 1996 (5 cm to 15 cm) indicating a possible year effect. The increase for Div. 3L in 1997 occurred in the larger sizes (6 cm to 11 cm) compared to the 1996 distribution. In Div. 3M the increase occurred in the same dominant size range (5 cm to 8 cm) that was sampled in 1996. There were too few fish captured in Div. 3NO to indicate possible trends.

Japan conducted a stratified-random trawl survey in Div. 2GH in August 1996. The survey covered strata from 201 m to 1 500 m and utilized the same stratification scheme as the Canadian survey. Tow duration was 30 minutes at 3.5 knots. The gear used had 140 mm mesh codend with a 30 mm liner. The survey biomass estimate for roundnose grenadier was 2 250 tons for Div. 2G and 2 736 tons for Div. 2H.

Russia conducted stratified-random trawl surveys in Div. 2GH from 1987 to 1992 directed to Greenland halibut. The surveys covered depths to 1 250 m during 1987-89 and to 1 500 m from 1990-92. Division 2H was not surveyed in 1990. The surveys were conducted with a 12 mm liner in the codend and tows were of one hour duration. Coverage was incomplete in most years. The survey biomass index for roundnose grenadier ranged from 5 800 tons (1988) to 67 200 tons (1989) in Div. 2G and from 1 500 tons (1992) to 14 000 tons (1989) in Div. 2H.

Roughhead grenadier. Information on roughhead grenadier (*Macrourus berglax*) is collected during the EU annual bottom trawl survey carried out on Flemish Cap (Div. 3M) since 1988. In addition to detailed results from the 1997 survey, a review was presented to STACFIS on roughhead grenadier information recorded during the last seven EU surveys (1991-97) on Flemish Cap. The survey was considered not to cover the main depths of roughhead grenadier distribution. Survey catches were usually dominated by ages 6-8. The 1986-87 cohorts dominated the catches during the early years. The 1982 cohort also appeared abundant. The importance of these year-classes has declined during 1994 to 1997, and the 1990 cohort dominates survey catches in the most recent years, including 1997. Age and length composition of the survey catches showed clear differences between sexes. The proportion of males declined at larger sizes, and were absent at the very largest sizes. Females grow faster than males for ages older than 8 years. In addition, females reach older ages. The oldest male found in the EU survey was 14 years old, while the oldest female was 18 years old. Total mortality (Z) by sex was calculated from survey catch curves. Both sexes are fully recruited to the survey gear at age 7. A different mortality was obtained for females (0.3) and for males (0.4). The same mortality differences between sexes were noted in the Spanish commercial fishery in the NAFO Regulatory Area, with practically identical values of Z. Roughhead grenadier shows a long life span, a multiaged population structure with sexual differences in growth and mortality and a relatively slow growth.

It was reported previously (NAFO Sci. Coun. Rep., 1997, p. 121) that length at first maturity for females of this species (L_{50}) was about 67 cm total length, or, 26 cm pre-anal fin length corresponding to about 15 years old in Div. 3LMN. This study covered a wide range of lengths based on sampling from a longline survey and a trawl selectivity survey in addition to the EU Flemish Cap survey.

c) **Assessment Results - Roundnose Grenadiers**

There has been very limited commercial data since the cessation of fishing within the Canadian 200-mile zone in 1993. The Canadian surveys indicated a substantial decline in the survey biomass index between 1996 and 1997 in the Divisions where the traditional directed fishery occurred (Div. 2HJ and 3K) although this decline may be a year effect since it occurred over all fish sizes. The 1996 and 1997 Canadian surveys are not directly comparable to the data from 1991 and 1994-95 Greenland halibut directed Canadian surveys because a different gear was used. For the same reasons, the 1996 survey by Japan and the 1987-92 surveys by Russia are not comparable to the surveys by Canada.

Although these surveys cover depths to 1 500 m for most of the area it is known from other investigations that roundnose grenadier inhabit waters down to 3 000 m. It is also well known that grenadier size increases with depth so intuitively the surveys will be unable to track the full life cycle. STACFIS cannot determine the status of the current stock compared with the historical period when a directed fishery occurred.

d) **Reference Points - Roundnose Grenadier**

It is not possible to determine limit or target reference points based on spawning stock biomass or fishing mortalities. The only readily available source of data were commercial catch rate data that showed relationships between standardized CPUE and effort were inconclusive (NAFO Sci. Coun. Rep., 1988, p. 70) and therefore these data were not evaluated any further in a production model.

13. **Greenland Halibut (*Reinhardtius hippoglossoides)* in Subarea 0 and Division 1A offshore and Divisions 1B-1F** (SCR Doc. 98/25,39, 40,41,56; SCS Doc. 98/7,14,15)

a) **Introduction**

The annual catches in Subarea 0 and Div. 1A offshore and Div. 1B-1F were below 2 600 tons from 1984 to 1988. From 1989 to 1990 catches increased from 2 200 tons to 10 500 tons, remained at that level in 1991 and then increased to 18 100 tons in 1992. In 1993 catches decreased to 10 957 tons and have remained near that level since. The catch in 1997 was 10 540 tons. In Subarea 0 catches peaked in 1992 with 12 400 tons, declined to 4 300 tons in 1994 and increased gradually to 5 700 tons in 1997. The catches offshore in Div. 1A have been negligible. Catches in Div. 1B-1F have fluctuated between 900 and 1 600 tons during the period 1987-91. After then catches increased to about 5 500 tons where they have remained until 1995. In 1996 catches decreased to 4 600 tons and increased to 4 800 tons in 1997 (Fig. 13.1).

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

	1988	1989	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998
Recommended TAC[2]	25	25	25	25	25	25	25	25	11	11	11
SA 0	1	1	9	8	12	7	4	5	6	6	
SA 1 excluding Div. 1A inshore	2	1	1	2	5	4	6	6	5	5	
Total	3	2	10	10	18	11[3]	10[4]	11[5]	10[6]	11[7]	

[1] Provisional.
[2] In the period 1986-94 the TAC included Div. 1A inshore.
[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.
[7] Including 4 128 tons non-reported.

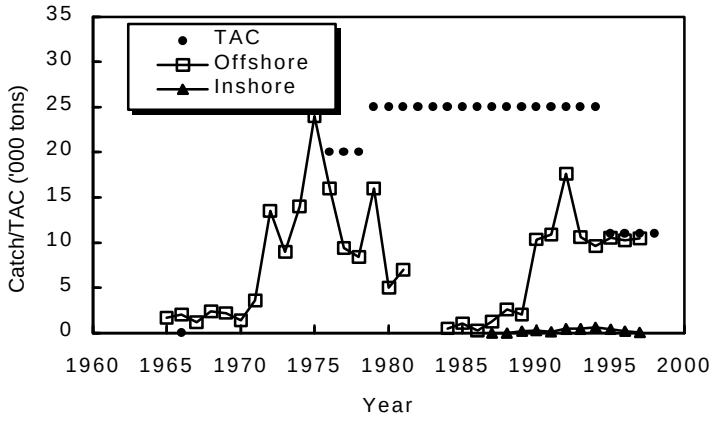

Fig. 13.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

The fishery in Subarea 0. Before 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 entered the fishery. Catches were about 12 400 tons in 1992 but have decreased to 5 740 tons in 1997. In 1995 a Canadian gillnet fishery began. In 1997 trawlers took about 4 000 tons while the Canadian effort, mostly gillnets, took 1 700 tons.

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 decreased through 285 tons in 1995 to 60 tons in 1996 and 66 tons in 1997, owing to lack of ice cover.

An exploratory trawl fishery by Canada in Div. 0A in 1996 resulted in a catch of 295 tons. The fishery continued in 1997 with a catch of 240 tons, which was the only catch reported from this area.

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 remained at that level until 1995, but decreased to 4 800 tons in 1997. Offshore, 3 703 tons were taken by mainly Norwegian and Greenlandic trawlers while 1 090 tons were taken by Norwegian and Greenlandic longliners. Inshore catches amounted to 7 tons. Almost all the fishery takes place in Div. 1D in the second half of the year.

b) **Input Data**

i) **Commercial fishery data**

For 1997 catch-at-age and weight-at-age data were available from the offshore trawl fishery and the gillnet longline fishery (combined) in Div. 0B. Length-frequency data were available from the trawl fishery in Div. 1D. In previous years, fish age 7 were the most abundant in the overall catches closely followed by age 8. This was reversed in 1997 because of a dominance of age 8 fish in the Subarea 1 trawl fishery. In 1995 and 1996 the 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 resulted in a shift towards larger fish in the overall catches. In 1997 there was an apparent decline in the numbers of large fish. This was probably due to the absence of samples from the longline catches in Div. 1CD (1 090 tons) which in previous years were dominated by older fish than the Canadian gillnet longline catches. (SCR Doc. 98/56).

Standardized annual catch rates were calculated for the trawl fishery in Div. 0B for 1990-97 based on observer data. The catch rates have been relatively stable during the period with a weak (statistically insignificant) increasing trend (SCR Doc. 98/39).

Standardized CPUE indices (Fig. 13.2) were calculated for the trawl fishery in Div. 1CD for 1987-97 from available logbook data, Norwegian CPUE data from 1991-97 and German data from 1997 (SCS Doc. 98/7). The standardized CPUE index fluctuated and showed an all time low in 1994. From then on the index has shown a weak increasing trend but the CPUE is still below the average for the period. Average catch rates from the Norwegian trawl fishery in Div. 1CD decreased from 1991 to 1993, stabilized between 1993 and 1994, and decreased further in 1995. The CPUE remained at the 1995 level in 1996, but decreased slightly again in 1997. Catch rates for a longliner in Subarea 1 were available for the period 1994-97. They increased 36% between 1994 and 1995, but were back at the 1994 level in 1996 and decreased further in 1997 to about 50% of the level in 1995.

The by-catch of Greenland halibut in the Canadian shrimp fishery in Subarea 0 was estimated to be between 0.45 and 2.1% of the shrimp catches for the period 1995-97. The by-catches ranged between 42 and 174 tons per year. Separator grates were introduced in the fishery in 1993, and were increasingly used and were made mandatory in 1997. Spacing between bars has been reduced from 28 to 22 mm. The by-catch in 1997 was estimated to be 0.45 % of the shrimp catches (42 tons), and was mainly taken in Div. 0B.

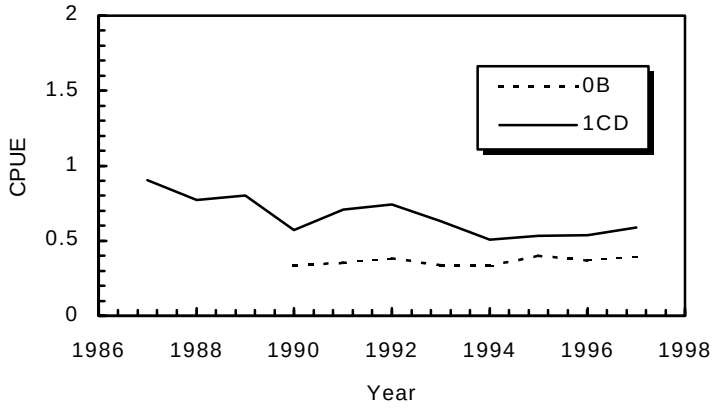

Fig. 13.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): Standardized CPUE. Div. 0B is re-transformed to actual catch figures. Div. 1CD index is not re-transformed.

ii) **Research survey data**

During 1987-95 bottom-trawl surveys have been conducted in Subarea 1 jointly by Japan and Greenland. (The survey area was restratified and the biomass estimates were recalculated in 1997 (SCR Doc. 97/21)). In 1997 Greenland initiated a new survey series covering Div. 1CD. The trawlable biomass in Div. 1CD was estimated to be 56 000 tons compared with 38 000 tons in the same area in 1995. (Fig. 13.3).

Biomass estimates ('000 tons) from USSR(Russia)/GDR(FRG) surveys, Japan/Greenland and Greenland surveys for the years 1987-97 in Subareas 0 and 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	-
1996	-	-	-	-	-
1997	-	-	56[4,5]	-	-

[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] Div. 1CD only.
[5] Greenland survey.
- No survey.

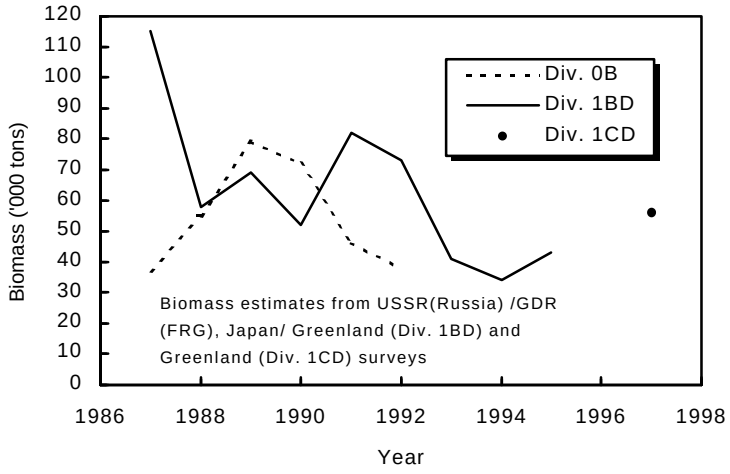

Fig. 13.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from surveys.

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 Greenland halibut catches in 1997 consisted mainly of one-and two-year old fish and the abundance was estimated at 115 million which is a decrease from 491 million in 1996 and only slightly above the low levels (83-65 million) in 1990-91. In the nursery area (Div. 1A and B), which is a subset of the survey area, the abundance was estimated at 67 million which is a decrease from 342 million in 1996 (SCR Doc. 98/40) (Fig. 13.4).

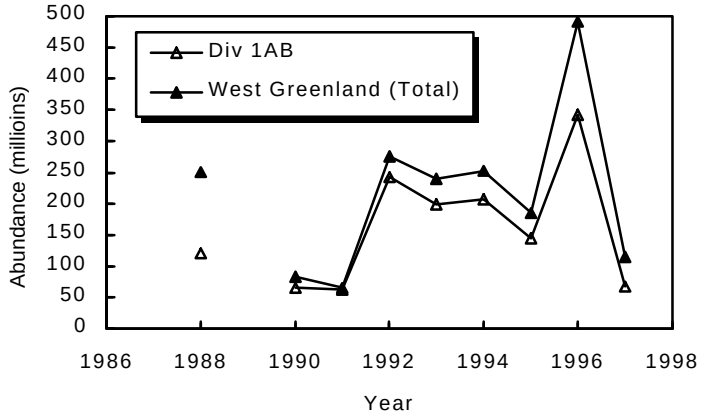

Fig. 13.4. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): offshore abundance from shrimp trawl surveys.

c) **Estimation of Parameters**

An ASPIC production model was run using standardized CPUE data from Div. 0B and 1CD and biomass estimates from Div. 1CD together with catch data as input in order to estimate MSY and F_{msy}. The CPUE data from Div. 1CD fitted the model best, but the estimates of a number of essential parameters were associated with very wide confidence intervals. This was probably because the data series was relatively short and the ranges of both catch and CPUE data were small. The estimation of MSY and F_{msy} was not considered precise enough to be used.

d) **Assessment Results**

Catches peaked at 18 000 tons in 1992 but have been stable around 10 500 tons since then. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was in 1997 estimated as 56 000 tons which is an increase from the 38 000 estimated for the same area in the Japan/Greenland survey. The two surveys were, however, conducted with different vessels and gear.

Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 year-class was estimated to be below the 1991-95 year-classes but at the level of the 1990 year-class. The presumably good 1991 year-class was partly recruited to the trawl fishery in 1997, but the catches of 6-year-old fish were actually a little below average.

A standardized CPUE index from Div. 0B has been stable during 1990-97 with a weak increasing trend. A standardized CPUE index from Div. 1CD has shown a weak increasing trend since 1994. An unstandardized Norwegian CPUE index from Div. 1CD. has been declining since 1991, was stable in 1995 and 1996, and decreased further in 1997.

Although data for 1997 are limited they do not indicate changes in the stock compared to the latest years, i.e. the decline in the stock observed in Subarea 1 until 1994 seems to have stopped and the stock has apparently stabilized at a lower level compared with the late-1980s and early-1990s.

e) **Precautionary Reference Points**

A yield-per-recruit analysis could not be used to estimate reference points owing to lack of reliable input data. An XSA was presented in 1996 but was considered to be unsuitable for assessment, and hence for estimating reference points, owing to high log-catchability residuals and standard errors and a systematic shift in the residuals. Runs in 1997 and 1998 (not presented) showed no significant improvement in the outcome of the analysis. An attempt to estimate MSY and F_{msy} by a production model (ASPIC) was not successful probably because there was a small range in the input data. This lack of contrast due to the low range in CPUE and biomass estimates also hampered estimation of precautionary reference points based on CPUE and biomass.

f) **Research Recommendations**

Although Greenland initiated a new trawl survey series in 1997 covering 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 prevent any linkage between the two. As a result, it will take a few years before trends in stock size can be established with any confidence using the new 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 Subarea 0 and Subarea 1 should be conducted in order to allow for a more complete evaluation of the Greenland halibut stock status*.

The question of whether the Cumberland Sound Greenland halibut stock contributes to the Subareas 0 and 1 stock needs to be resolved. STACFIS **recommended** that *the tagging program in Cumberland Sound should be continued in 1999 to ascertain whether Greenland halibut move into Davis Strait.*

STACFIS **recommended** that *the investigations of the by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued*.

STACFIS **recommended** that *the standardized catch rates from Div. 0B and Div. 1CD should be combined to get a better overall view of the Greenland halibut stock.*

14. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Division 1A** (SCR Doc. 98/40, 41, 44; SCS Doc. 98/14)

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 have increased steadily since, and were almost 20 000 tons in 1997 (Fig. 14.1). Catches were rather evenly distributed over the year but with a tendency toward higher catches in July and August.

The inshore stock is dependent for recruitment on immigration from the offshore nursery grounds and the spawning stock in Davis Strait. Only sporadic spawning seems to occur in the fjords, hence the stock is not considered self-sustainable. The fish remain in the fjords, and do not contribute back to the offshore spawning stock. This connection between the offshore and inshore stocks implies that reproductive failure in the offshore spawning stock for any reason will have severe implications for the recruitment to the inshore stocks.

Catches ('000 tons) in Div. 1A are as follows:

	1989	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]
Disko Bay[2]	2.8	3.8	5.4	6.6	5.4	5.2	7.4	7.8	8.6
Uummannaq	2.9	2.8	3.0	3.1	3.9	4.0	7.2	4.6	6.3
Upernavik	1.3	1.2	1.5	2.2	3.8	4.8	3.3	4.8	4.9
Offshore	-	-	-	-	+	+	+	-	-
Unknown[3]	0.6	0.5	+	0.1	-	-	-	-	-
Total	7.5	8.3	9.9	11.9	13.1	14.0	17.9	17.3	19.8
Officially reported	7.5	7.5	9.2	11.9	-	-	-	--	

[1] Provisional.
[2] Formerly named Ilulissat.
[3] Catches from unknown areas within Div. 1A.

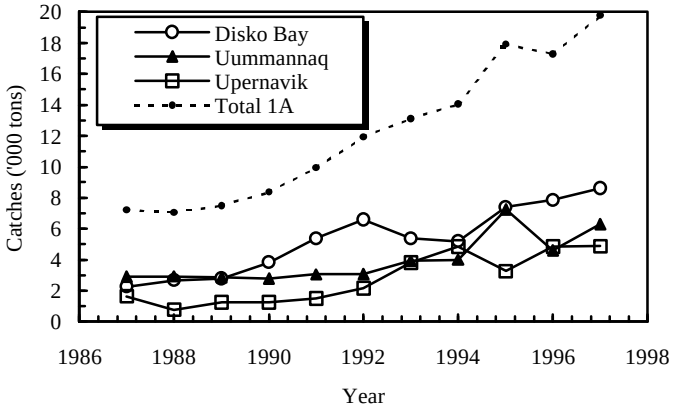

Fig. 14.1. Greenland halibut in Div. 1A: catches by area.

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 1996-97.

The inshore fisheries in Div. 1A. This fishery is mainly a traditional fishery, typically in the inner parts of the ice fjords at depths between 500 to 800 m. Longlines are set from small boats below 20 GRT, or in winter through the ice. In the middle of the 1980s 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 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 led to an increased proportion of longline catches. Gillnets will be banned in year 2000. The minimum mesh size allowed is 110 mm (half meshes). There are no regulations on longline fisheries. Longline catches comprised 74% of the total in 1996 and 76% in 1997. There are no quota regulations on the fishery, but from 1998 a license is required to land commercial catches.

Commercial processors pay more for 'large fish' (over 3.3 kg), so 'small fish' are sometimes discarded. Size composition data from the landed catch are therefore biased with respect to the fishable stock.

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's northernmost settlement, Qaannaq (77°) were 25.3 tons in 1997.

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 have increased from about 2 300 tons in 1987 to an historic high level of 8 601 tons in 1997. Longline catches comprised 61% of the total in 1997.

Uummannaq. The area is a large system of ice fjords where the fishery is conducted. The main fishing ground is in the southwestern part of the fjord system. Initially Qarajaq Ice fjord was the main fishing area but in recent years the fishery has moved further north to Sermilik and Itivilliup Ice fjords. Gillnets are prohibited in the inner parts of the fjords in Uummannaq.

Catches have been increasing from a level of 2 000 tons before 1987 to a record high in 1995 of 7 000 tons. The catch in 1997 was 6 294 tons. The longline catches comprised 76% of the total in 1997.

Upernavik. The northernmost area consists of a large number of ice fjords. The main fishing grounds are Upernavik and Giesecke ice fjords. New fishing grounds around Kullorsuaq in the northern part of the area have recently been exploited. Use of gillnets is prohibited in Upernavik.

The catches in the Upernavik area have increased steadily from about 1 000 tons in the late-1980s to about 3 000 to 4 000 tons in 1993 to 1995 (Fig. 14.1). In 1996 and 1997 the total catch was almost 5 000 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. Where otolith sampling was missing or inadequate, age-length keys were applied from adjacent years or areas. In 1997 the fishery was conducted on age groups 5 to 18 years with 74% of the catch being 10 years or younger, compared with 61% in 1996.

Generally there has been a small downward trend in the proportion of 'large fish' in landings from all areas.

Length measurements from the commercial longline landings from 1993 to 1997 in Disko Bay, Uummannaq and Upernavik indicated that the fishery is taking place on smaller sub-components of the stock, as size differences were observed between summer and winter. A decline in mean length was observed in Upernavik and Uummannaq while mean length has fluctuated in Disko Bay in the latest years.

Catch curve analyses could not be performed because the necessary assumptions were not met, i.e. the fishery is expected to exploit different age-components in the different seasons and localities.

ii) **Research survey data**

Before 1993 various longline exploratory fisheries were conducted with research vessels. Owing 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 the three areas in rotation, with approximately 30 fixed stations in each area. In July 1997 the research longline vessel *Adolf Jensen* covered the fjord areas of Disko Bay. A total of 25 longline sets employed 37 025 hooks.

CPUE values (kg/100 hooks) from longline surveys conducted in Div. 1A inshore areas.

Area	1962	1985	1987	1993	1994	1995	1996	1997
Disko Bay		8.3	16.5	3.1	3.1	-	3.9	4.4
Uummannaq	4.6	-	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	1997
Disko Bay	-	62.4	53.5	62.2	55.9	56.5	-	53.6	57.0
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, during the period 1993 to 1997, a statistically significant decline is not evident.

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 included. Standardized recruitment indices based on the survey in 1997 were presented as catch-in-numbers per age per hour, for both the offshore and inshore nursery areas (Fig. 14.2). Offshore, the number of one-year-olds from the 1996 year-class was below average. The 1995 year-class that appeared very strong as one year olds had declined in strength, as the numbers of two-year-olds were not above average. Inshore recruitment from the 1996 year-class also seemed to be below average, but here the numbers of 2-year-olds from 1995 year-class was still the highest in the time series.

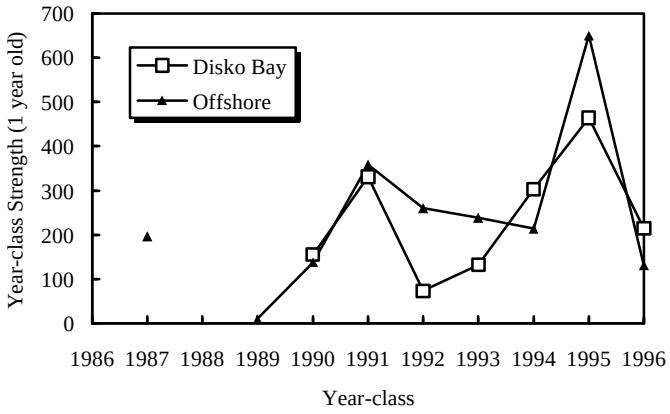

Fig. 14.2. Greenland halibut in Div. 1A: recruitment of age one on nursery grounds.

iii) **Biological studies**

Inshore tagging of Greenland halibut in Div. 1A was continued in 1997. No fish tagged in the fjords have yet been caught outside the tagging area (unpublished data). Therefore the assumption that the stocks in the three main areas are considered to be separate units can be maintained (SCR Doc. 98/44).

Sexual maturity of Greenland halibut was estimated from samples collected in August 1997 and showed that most fish were immature. A study on maturity covering the entire year was initiated in March 1998. This study may clarify the extent of the inshore spawning.

c) **Assessment Results**

The recent level of fishing mortality could not be estimated.

The stock in all three areas consists of a large number of age groups, and the age structure of the stock does not show signs of collapse, but there is an apparent shift towards younger age groups.

Disko Bay. Catches have been increasing continuously in the past 10 years from about 2 000 tons to 8 601 tons in 1997. Survey results since 1993 do not indicate any major changes in abundance. The stock component in Disko Bay is composed of younger and smaller individuals than in the other two areas. In spite of the increasing catches, age and length composition in both the commercial and survey have not changed dramatically in recent years. However, the stock is still considered growth overfished.

Uummannaq. Catches have been increasing from a level of 2 000 tons before 1987 to a record high in 1995 of 7 000 tons. The catch in 1997 was 6 294 tons. Survey results since 1993 do not indicate any major changes in abundance. Catch composition in the commercial fishery has changed significantly since the 1980s towards a higher exploitation of younger age-groups, indicating growth overfishing. The stock component in Uummannaq is thus affected by the increasing fishery.

Upernavik. Catches have been increasing from a level of 1 000 tons before 1992 to about 5 000 tons in recent years. Survey results in 1994 and 1995 suggest a decrease in total abundance. Age and length compositions in commercial and survey catches have also decreased. The increasing fishery thus affects the stock component in Upernavik.

d) **Reference Points**

As the fishing mortality could not be estimated, precautionary reference points could not be given. Instead the "precautionary traffic light" (SCR. Doc. 98/8) approach as reviewed at the Scientific Council Workshop on the Precautionary Approach to Fisheries Management (17-27 March 1998) was applied. The checklist of 29 questions indicated 12 items in the red zone primarily related to the fishery. This raises cause for concern about the sustainability of the fishery under the current management regime.

e) **Research Recommendations**

The continuing increase in total landings of Greenland halibut in NAFO Div. 1A inshore generates concern, especially because lack of effort data from the commercial fishery impedes the assessment of the stocks. Therefore 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 *investigations of by-catch of juvenile Greenland halibut in Div. 1A in the commercial shrimp fishery should be continued.*

STACFIS **recommended** that *the discard rate of 'small Greenland halibut' in Div. 1A be investigated.*

15. **Roundnose Grenadier (*Coryphaenoides rupestris)* in Subareas 0 and 1** (SCR Doc. 98/25; SCS Doc. 98/7, 14)

a) **Introduction**

A total catch of 151 tons was reported for 1997 compared to 127 tons for 1996 (Fig. 15.1).

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Recommended TAC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	0	0	0
Catch	0.52	0.08	0.29	0.19	0.12	0.14	0.12[1]	0.31[1,2]	0.13[1,3]	0.15[1,4]	

[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.
[4] Includes 27 tons roughhead grenadier from Div. 1A misreported as roundnose grenadier and 39 tons taken by a longliner and hence must be roughhead grenadier.

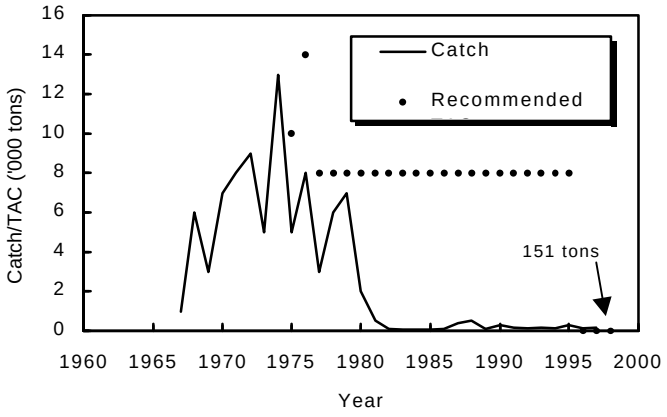

Fig. 15.1. Roundnose grenadier in Subareas 0+1: catches and TACs

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 by-catch in the Greenland halibut fishery. No update of the catch/effort analysis which was presented previously (NAFO Sci. Coun. Rep., 1985, p. 72) was possible. Some of the reported catches are a mixture of roundnose grenadier and roughhead grenadier (*Macrourus berglax*). The proportion of roughhead grenadier is not known.

ii) **Research survey data**

Rroundnose grenadier. In 1986 Canada conducted a survey that covered Subareas 0 and 1 down to 1 250 m. 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 m from then on. The surveys took place in October-November. In September/October 1997 Greenland conducted a survey covering Div. 1CD at depths between 400 and 1 500 m. The trawlable biomass ('000 tons) was estimated as follows (Fig. 15.2):

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Canada												
0B	11.1											
1CD	99.9											
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[1]	3.1[4]	7.2[4]		
Greenland 1CD												5.7

[1] June/July. Biomass at depth >1 000 m estimated by an ANOVA (47%),
[2] September/October,
[3] April/May,
[4] August/September.

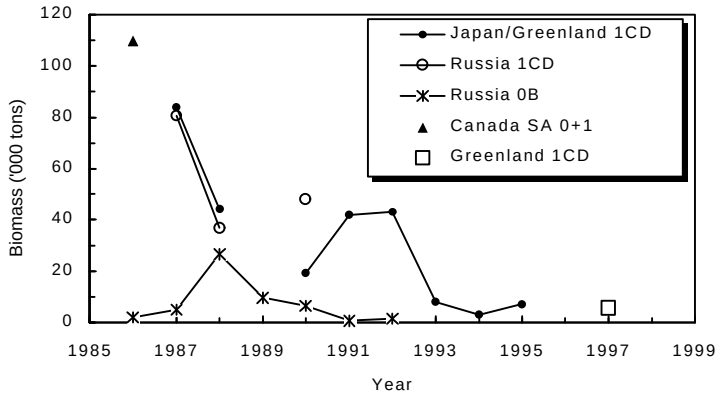

Fig. 15.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland and Greenland surveys in Div. 0B and Div. 1CD.

In the 1997 survey the abundance and biomass was estimated at 32.4 million and 5 687 tons, respectively. As in previous years almost all the roundnose grenadier was found at depths >1 000 m in Div. 1D and the fish were generally small, between 5 and 10 cm pre-anal fin length.

Roughhead grenadier. The abundance and biomass of roughhead grenadier in Div. 1CD was in 1997 estimated at 4.6 million and 2 258.6 tons, respectively, by the Greenland survey. The abundance and biomass was greatest at depth between 1 000 and 1 200 m in Div. 1A. The length ranged from 2.0 to 20 cm, pre-anal fin length, with a mode near 8 cm.

c) **Assessment Results**

In the Greenland survey in 1997 the biomass in Div. 1CD was estimated at 5 687 tons and the biomass has remained at the very low level observed since 1993.

d) **Reference Points**

The trawlable biomass was in the order of 100 000 tons in Div. 1CD in 1986-87. Since the fishery has been at a very low level since the late-1970s, the stock could in 1986-87 be considered as virgin. Under this assumption, current trawlable biomass is about 5% of virgin stock size. Trial runs of a surplus production analysis were done using commercial catch and effort data from 1968 to 1978, but the results were considered unrealistic. Although it was not possible to estimate a limit biomass level, it is most probable that any limit biomass would be substantially greater than 5% of the virgin level, the current situation as suggested by the survey data. Therefore it is considered that the current stock size is well below the limit biomass.

16. **Redfish (*Sebastes* spp.) in Subarea 1** (SCR Doc. 98/21, 25, 40, 41, 67; SCS Doc. 98/7, 14)

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 long lining or jigging and offshore by shrimp fisheries only. There are also substantial numbers of juveniles discarded in the shrimp fishery.

Both redfish species, golden redfish (*Sebastes marinus* L.) and deep sea redfish (*Sebastes mentella* Travin) are included in the catch statistics since no species specific data are available. Other data suggest that until 1986, landings were 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 are believed to be deep sea redfish.

In 1977, total reported catches peaked at 31 000 tons (Fig. 16.1). 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 this offshore fishery in 1987, catches decreased further to 1 200 tons, and remained at that low level. The catch figure for 1997 was 970 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:

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Catch	1	1	0.4	0.3	0.3	0.8	1[1]	0.9[1]	0.9[1]	1[1]
TAC	19	19	19	19	19	19	19	19	19	19

[1] Provisional

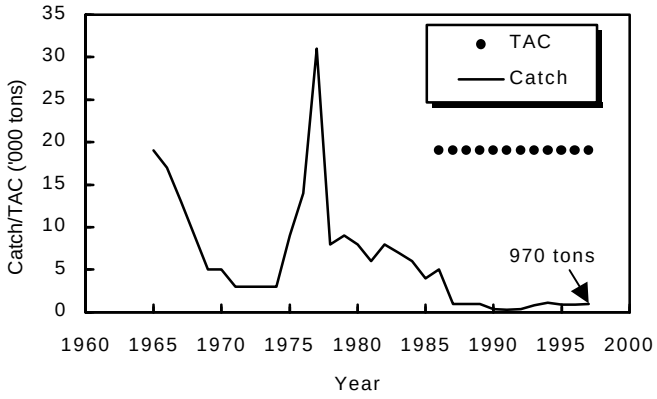

Fig. 16.1. Redfish in Subarea 1: catches and TAC.

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. There are no data available to estimate the size composition of historical catches of deep sea redfish.

Converted length frequencies derived from the Greenland shrimp survey revealed that the commercial shrimp gear selected a significant proportion of fish <10 cm and all fish sizes >10 cm. For July-August 1997 the by-catch and discard of redfish in the shrimp fishery was assessed to 30 million individuals and 870 tons. Given uncertainties related to the estimation method and likely seasonal changes, the assessment of annual discard rates is impossible.

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 interannual variation in 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. Nonetheless, the survey results indicated that both abundance and biomass estimates of golden redfish (≥17 cm) decreased by more than 90 % until 1990 and remained at that low level since then (Fig. 16.2). Estimates for deep sea redfish (≥17 cm) varied without a clear trend but have frequently been extremely low since 1989 (Fig. 16.3). However, the 1997 estimate indicated a significant biomass increase due to recruitment. Unspecified redfish <17 cm were found to be very abundant, especially in 1986, 1991, and 1996-97 (Fig. 16.4). Reappearing peaks at 6, 10-12 and 15-16 cm might indicate annual growth increments and represent the age groups 0, 1 and 2 years.

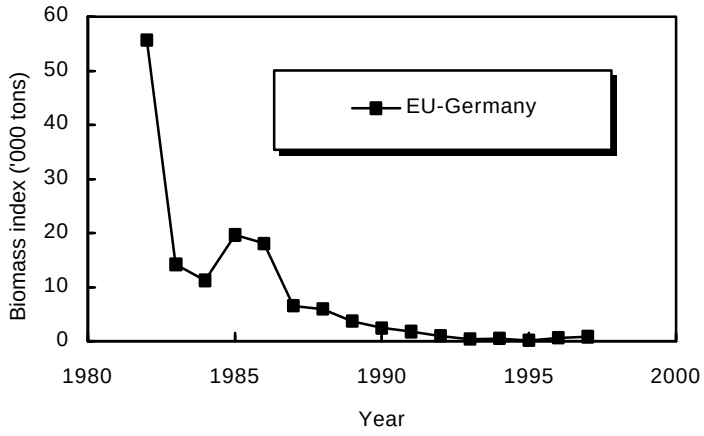

Fig. 16.2. Golden redfish in Subarea 1: survey biomass index.

Greenland-Japan and Greenland groundfish surveys. 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 and 1 500 m. This Greenland-Japan deep water survey was discontinued in 1996 but conducted again in 1997 by Greenland with another vessel and changed gear. Deep sea redfish were mainly caught at depths less than 600 m. Recent increases in stock abundance and biomass are consistent with other survey information (Fig. 16.3). Length measurements revealed that the size composition of the stock is presently dominated by individuals <30 cm.

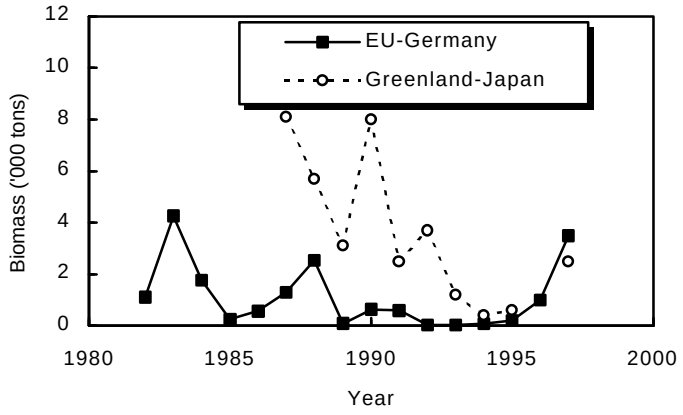

Fig. 16.3. Deep Sea redfish in Subarea 1: survey biomass indices.

Greenland bottom trawl survey using a shrimp gear. Since 1988, a shrimp survey has been conducted 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 only since 1992. Redfish was found to be most abundant in the northern Div. 1B. Abundance and biomass indices varied without a clear trend but indicated juvenile redfish to be very abundant, especially in 1997 (Fig. 16.4). During the entire survey series, catches were composed almost exclusively of redfish smaller than 15 cm.

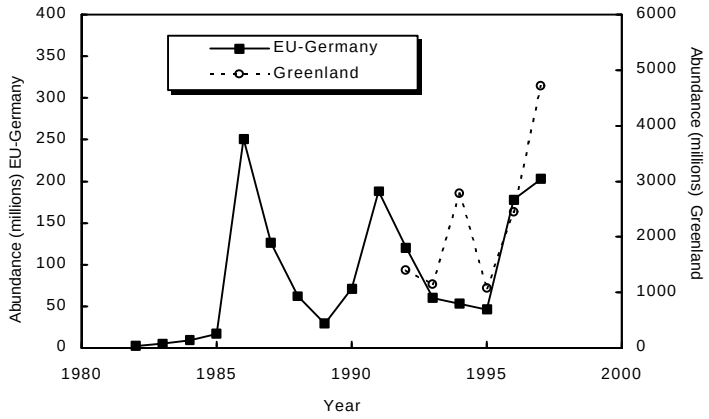

Fig. 16.4. Juvenile redfish in Subarea 1: survey abundance indices.

c) **Estimation of Parameters**

The golden redfish SSB was assessed assuming knife edge maturity at 35 cm as observed in East Greenland applied to the length disaggregated abundance indices derived from the EU-Germany groundfish survey. The length groups 17-20 cm were chosen as recruitment indices and correspond approximately to age group 5. SSB and recruitment indices decreased drastically from 1982 and have remained significantly below the average level since 1989 (Fig. 16.5). Taking into account the recent very low SSB and the recruitment failure together with the absence of golden redfish in the Greenland surveys, the stock of golden redfish in Subarea 1 is considered to be severely depleted with no signs of recovery. There are indications that the probability of future recruitment is reduced at the current low SSB (Fig. 16.6).

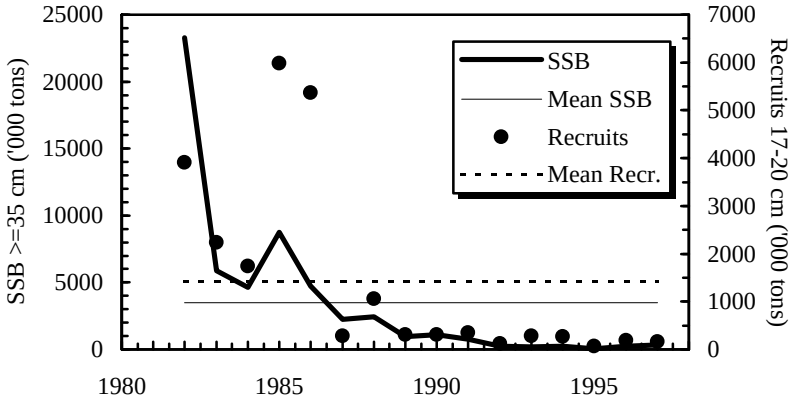

Fig. 16.5. Golden redfish in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

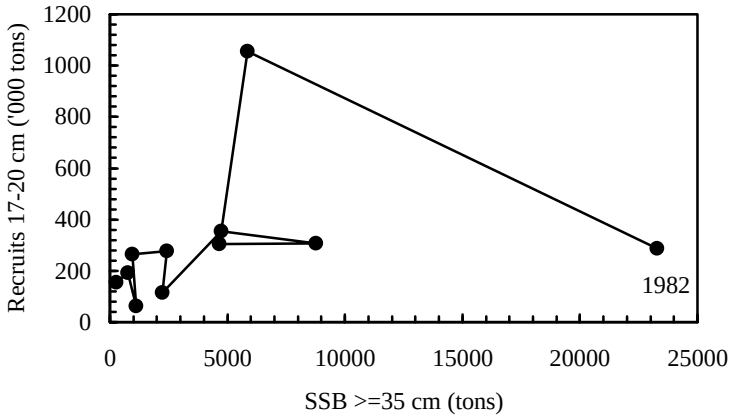

Fig. 16.6. Golden redfish in Subarea 1: SSB-recruitment plot as derived form the EU-Germany groundfish survey.

The German survey biomass of fish ≥35 cm and the abundance of length groups 17-20 cm were taken as proxies for deep sea redfish SSB and recruitment at age 5. No clear trend can de derived from these estimates but SSB has been below average since 1989 (Fig. 16.7). The recently depleted status of the SSB is confirmed by the lack of adult fish in the Greenland deep water survey. Recruitment variation is high and the 1996-97 estimates were above average, the latter one representing the maximum of the time series (Fig. 16.8).

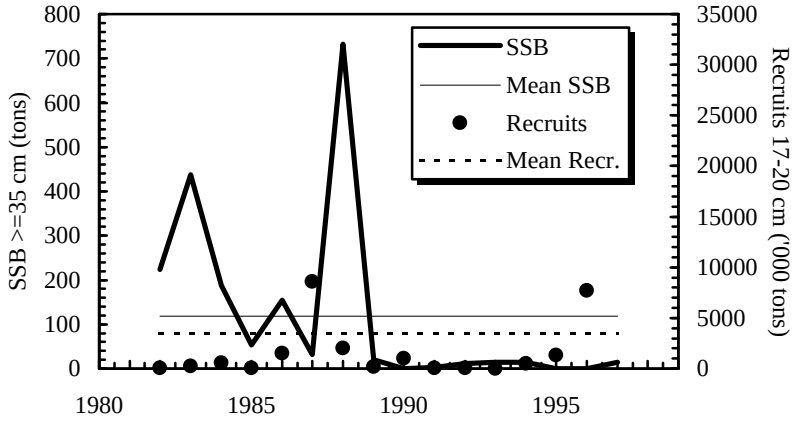

Fig. 16.7. Deep sea redfish in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

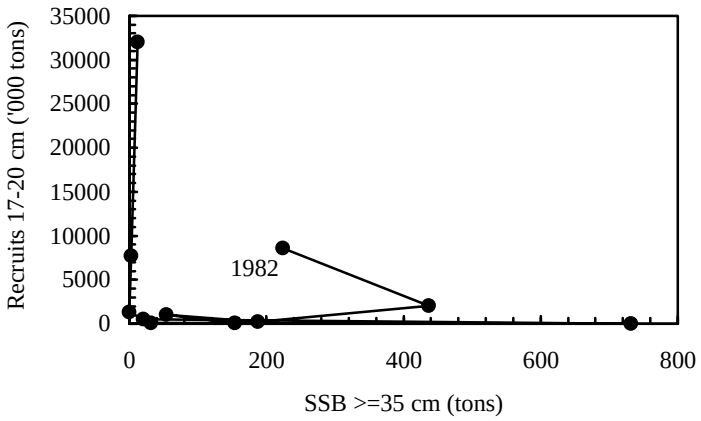

Fig. 16.8. Deep sea redfish in Subarea 1: SSB-recruitment plot as derived form the EU-Germany groundfish survey.

d) **Assessment Results**

In view of dramatic declines in survey 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 short-term recovery although pre-recruits (<17 cm) were found to be very abundant as indicated in the surveys.

Substantial numbers of redfish are caught and discarded in the shrimp fishery, and concern must be expressed about the continuing failure of the juveniles to rebuild the pre-mature and mature stock components. Considering the depleted SSBs, the recruitment potential of the very abundant early life stages at an age of 0-2 years to the Subarea 1 stocks remains unclear. The probability of recovery of the redfish stocks in Subarea 1 should increase if the by-catches taken in the shrimp fishery are reduced to the lowest level possible.

e) **Reference Points**

Due to a lack of appropriate data, STACFIS was unable to propose any limit or target reference points for fishing mortality or SSB for the stocks of golden and deep sea redfish stocks in Subarea 1. Nevertheless, the recently depleted spawning stocks as derived from survey results are considered far below appropriate levels of B_{lim}.

f) **Research Recommendation**

STACFIS **recommended** that *the monitoring of redfish by-catch taken by the shrimp fishery in Subarea 1 based on the Greenland bottom trawl survey results reflecting the catch composition of a commercial shrimp trawl on the shrimp fishing grounds should be continued and that the results should be presented at the June Meeting in 1999 on a length disaggregated basis*.

17. **Other Finfish in Subarea 1** (SCR Doc. 98/21, 25, 40, 41, 45; SCS Doc. 98/7, 14)

a) **Introduction**

Historically, catches of Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*A. minor*), starry or thorny skate (*Raja radiata*), lumpsucker, Atlantic halibut (*Hippoglossus hippoglossus*) and sharks were mainly taken by offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut. Fisheries have also been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. In 1997, reported catches of other finfishes amounted to 4 246 tons representing an increase by 26%, compared to the 1996 catch (3 367 tons). This was due to increased catches of lumpsucker and non specified finfish. Most recent catches of other finfishes were dominated by Greenland cod (41%), lumpsucker (27 %) and the category of non-specified finfish (30%).

The catch figures do not include the weight of fish discarded by the trawl fisheries directed to shrimp.

Nominal reported catches (tons) are as follows:

Species	1993	1994[1]	1995[1]	1996[1]	1997[1]
Greenland cod	1 896	1 854	2 526	2 117	1 729
Wolffishes	157	100	51	47	68
Atlantic halibut	43	38	23	34	22
Lumpsucker	246	607	447	425	1 158
Sharks	10	34	46	135	
non-specified finfish	411	643	618	609	1 269
Total	2 763	3 276	3 711	3 367	4 246

[1] Provisional.

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 shrimp survey revealed that the shrimp trawl was capable of catching all predominant fish sizes. Estimates of discarded by-catches for July-August 1997 did not exceed 50 tons or 1 million individuals of American plaice, Atlantic wolffish, spotted wolffish, and starry or thorny skates, respectively. This is likely due to the recent decline in the species rather than changes in the selectivity of the gear. Given uncertainties related to the estimation methodology and likely seasonal changes, the assessment of annual discard rates is impossible.

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. After severe declines until 1991 some stocks showed first and very slight indications of stock recovery due to improved recruitment but no significant increases in mature biomass, i.e. American plaice, Atlantic wolffish (Fig. 17.1-17.5).

Greenland-Japan and Greenland groundfish surveys. 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 and 1 500 m. This Greenland-Japan deep water survey was discontinued in 1996 but in 1997 a Greenland survey was initiated with another vessel and different gear. However, 1997 estimates of abundance and biomass indices for American plaice were very low and amounted to 830 000 individuals and 137 tons, respectively (Fig. 17.1).

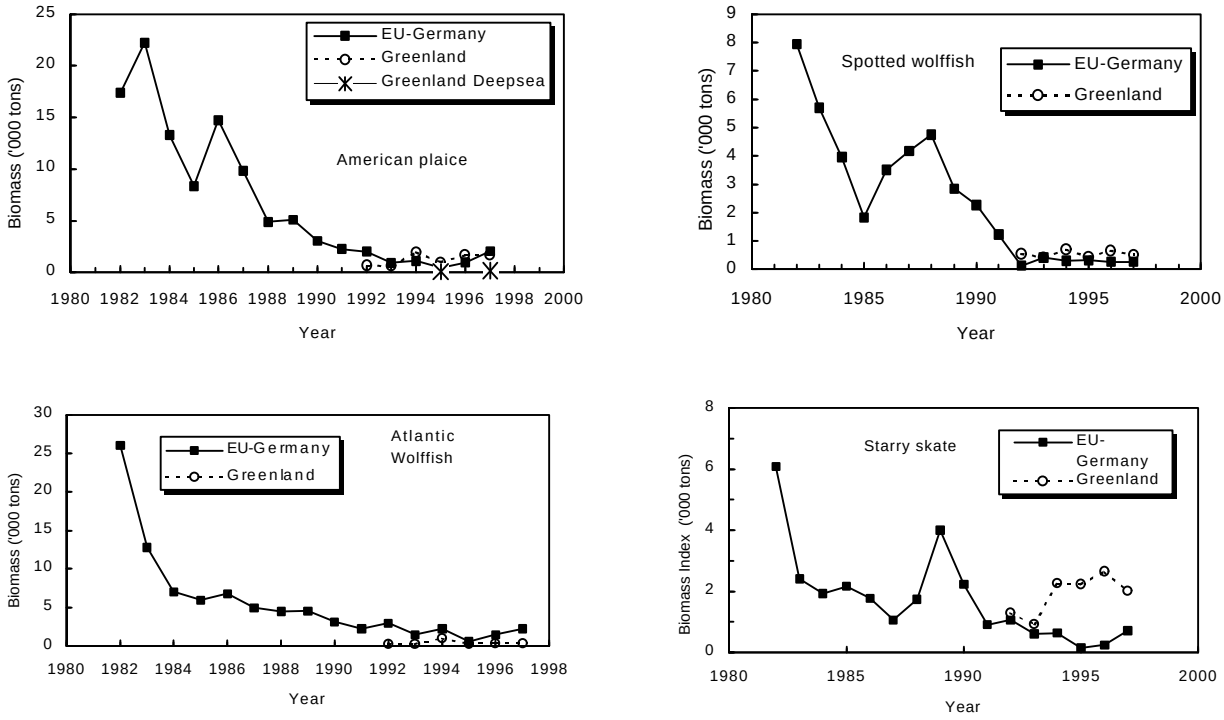

Fig. 17.1. Finfish in Subarea 1: survey biomass indices of various finfish species.

Greenland bottom trawl survey using a shrimp gear. Since 1988, a shrimp survey was conducted 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 only since 1992. Abundance and biomass indices of American plaice, Atlantic wolffish, and spotted wolffish were very low (Fig. 17.1). Starry or thorny skates were mainly distributed in northern strata with big areas causing higher abundance and biomass estimates. The stocks mentioned were dominated by juveniles as derived from length measurements.

c) **Estimation of Parameters**

American plaice SSB was derived from EU-Germany length disaggregated abundance indices to which a length-maturity ogive was applied. During 1982-91, the SSB decreased drastically to depletion but showed a slight increase in 1997 (Fig. 17.2). Recruitment is presented as abundance of small fish 15-20 cm representing age group 5 and is indicated to be below average since 1989. In 1997, a first indication of stock recovery was based on increased recruitment at the level of the long-term average. Despite the average recruitment in 1997 (1992 year-class), indications for reduced probability of recruitment at low SSB can be derived from the recruitment-SSB plot (Fig. 17.3).

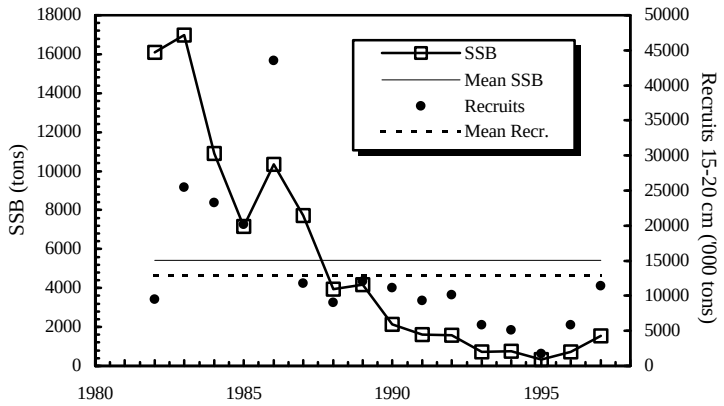

Fig. 17.2. American plaice in Subarea 1: SSB and recruitment indices as derived from the EU-German groundfish survey.

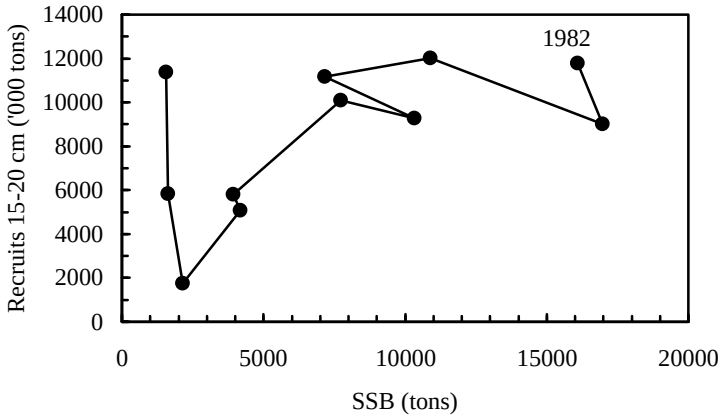

Fig. 17.3. American plaice in Subarea 1: SSB-recruitment plot.

The estimation of Atlantic wolffish SSB and recruitment was performed in the same manner as for American plaice, i.e. using a length-maturity ogive and fish of 15-20 cm representing 5 year old recruits. Since 1982, the SSB decreased drastically and remained severely depleted since the early-1990s (Fig. 17.4). In contrast, recruitment increased almost continuously over the time series. Apart from 1995 the recruitment estimates are at or above the average level since the early-1990s. However, the abundant recruits did not contribute significantly to the SSB yet and there is no recruitment-SSB relation derivable (Fig. 17.5).

d) **Assessment Results**

Despite increased recruitment the SSB of American plaice and Atlantic wolffish remains depleted. In view of dramatic declines in survey biomass indices since 1982 to very low levels (Fig. 17.1) and simultaneous decreases in individual fish weight by more than 80% it was concluded that the stocks of spotted wolffish and starry or thorny skates in Subarea 1 are severely depleted.

Taking the poor stock status of American plaice, Atlantic wolffish, spotted wolffish and starry or thorny skate into account, even low amounts of fish taken and discarded presently by the shrimp fishery might be substantial and concern must be expressed about possible reductions in the recovery potential. The probability of stock recovery should increase if pre-recruitment mortality caused by discarding of finfish in the shrimp fishery in Subarea 1 is reduced to the lowest level possible.

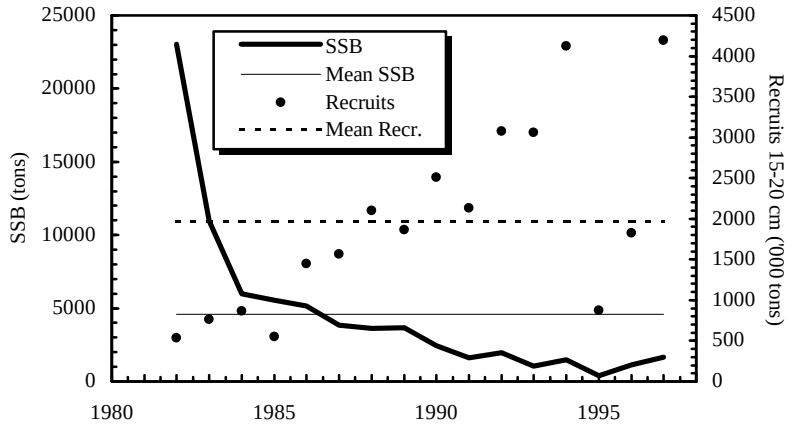

Fig. 17.4. Atlantic wolffish in Subarea 1: SSB and recruitment indices as derived from the German groundfish survey in the given years.

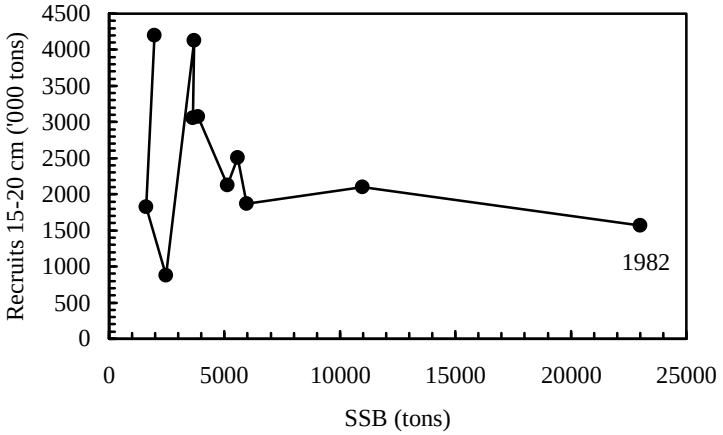

Fig. 17.5. Atlantic wolffish in Subarea 1: SSB-recruitment plot.

e) **Reference Points**

Due to a lack of appropriate data, STACFIS was unable to propose any limit or target reference points for fishing mortality or SSB for American plaice, Atlantic wolffish, spotted wolffish, and starry or thorny skate in Subarea 1. Nevertheless, the recently depleted spawning stocks as derived from survey results are considered far below proper levels of B_{lim}.

f) **Research Recommendation**

STACFIS **recommended** that *the monitoring of finfish by-catch taken by the shrimp fishery in Subarea 1 based on the Greenland bottom trawl survey results reflecting the catch composition of a commercial shrimp trawl on the shrimp fishing grounds should be continued and that the results should be presented at the June Meeting in 1999 on a species by species, as well as a length disaggregated basis.*

18. **Cod (*Gadus morhua*) in Divisions 2J, 3K, and 3L** (SCR Doc. 98/38, 46)

a) **Introduction**

In the 1997 assessment of the stock, STACFIS determined that the stock continued to remain at an extremely low level. The 1997 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 pre-recruit surveys.

b) **Description of the Fishery**

Prior to the 1960s the Div. 2J and 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. 18.1). 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, 1994 and 1996 but not in 1995 and 1997. A limited fishery for scientific purposes (sentinel survey) caught 163 tons in 1995, 397 tons in 1996 and 346 tons in 1997. The sentinel survey catches together with by-catch gave a total catch of 505 tons in 1997 (Fig. 18.2). There is evidence of removals from the inshore in excess of the sentinel survey catches and legal by-catches but the magnitude of these removals cannot be estimated.

No catch was reported in the Regulatory Area in Div. 3L in 1997.

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

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Fixed Gear Catch	102	103	117	61	12	9	1.3[1]	0.3[1,2]	1.5[1]	0.5[1]	
Offshore Catch	167	151	103	111[2]	29[2,3]	2[2]	0.5[1,2]	0[1]	0[1]	0[1]	
Total Catch	269	254	220	172	41	11	1.4[1]	0.3[1]	1.7[1]	0.5[1]	
TAC	266	235	199	190	120[4]	0[4]	0[4]	0[4]	0[4]	0[4]	0

[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.

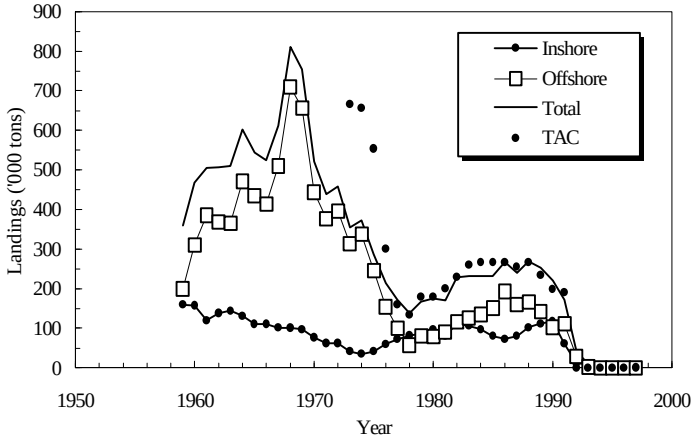

Fig. 18.1. Cod in Div. 2J+3KL: inshore and offshore landings and TACs.

c) **Oceanographic Environment**

The relatively warm conditions that were first observed in 1996 have generally continued. Time series of temperatures at Station 27 shows values ranging from 0.0 to 0.5 K above normal for the winter months over most of the water column. By mid-April a strong negative surface temperature anomaly developed, reaching nearly 1 K below normal by mid-May. These colder than normal temperatures appear to have propagated deeper into the water column reaching 100 m by October. Autumn temperatures in the upper layer were about normal while bottom temperatures throughout the year were near normal (SCR Doc. 98/38).

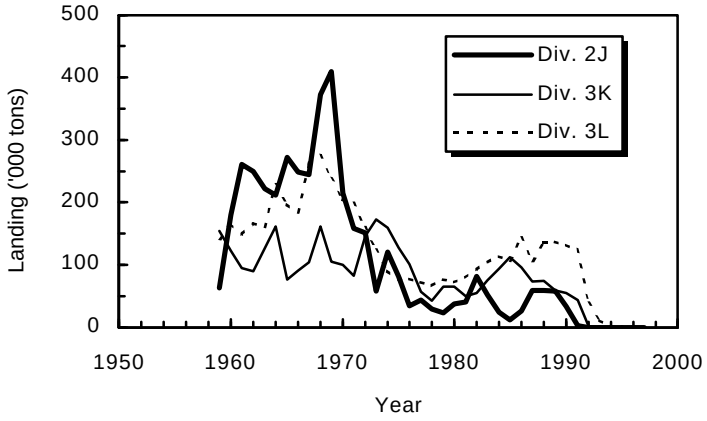

Fig. 18.2. Cod in Div. 2J+3KL: landings by Division.

d) **Biomass Trends** (Fig. 18.3)

The Canadian research trawl surveys switched from the Engel trawl to the Campelen trawl from the autumn of 1995.

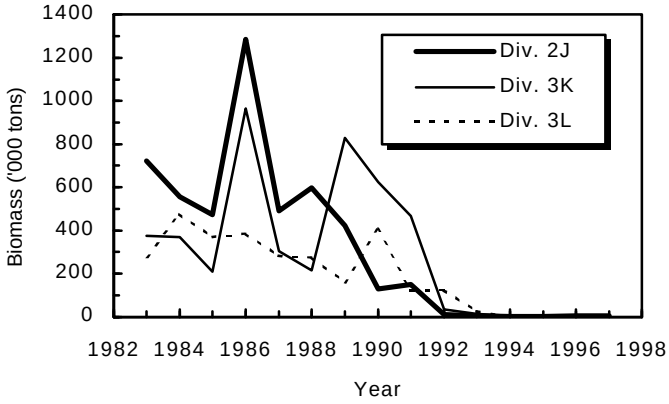

Fig. 18.3. Cod in Div. 2J+3KL: biomass estimates from surveys.

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 1997 were similar to those in 1996 except that some of the new inshore strata were modified and one new stratum was added.

Autumn research vessel survey estimates of biomass in Div. 2J and 3KL declined abruptly in the early-1990s. The 1997 estimate (excluding new inshore strata) is slightly lower than the previous year and therefore remains extremely low. Biomass in the spring research vessel survey was the highest since 1992, but remains at an extremely low level.

Despite the poor fit of the SPA model to the data, the general trends in estimated biomass are considered to be broadly reflective of the population, with current biomass estimated to be at an extremely low level.

e) **Spatial Patterns of Abundance and Distribution**

Bottom-trawl surveys in Div. 3L in spring 1997 and in Div. 2J and 3KL in autumn 1997 found very low abundance levels of cod throughout the survey area. However, densities in the range of one or two cod per set were quite widespread throughout the survey area.

A dense aggregation of cod was first found in Smith Sound, Trinity Bay (Div. 3L) in spring 1995. Acoustic surveys of this Sound have produced biomass estimates of 17 000 tons in May 1995, 200 tons in April 1996 and 21 000 tons in April 1997. Surveys in other areas of western Trinity Bay in April 1997 and southern Bonavista Bay in June 1997 detected relatively small quantities of fish, giving a total biomass from the surveyed areas in spring of 23 000 tons.

An intensive acoustic survey of waters landward of the research vessel bottom trawl survey from the southwestern limit of Div. 3L to northern Div. 3K in October-December 1997 gave a biomass estimate of 18 000 tons, 60% of which was in Trinity and Bonavista Bays.

f) **Changes in Lengths, Weights and Maturity**

Mean weights-at-age of 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 showed a strong decline in lengths-at-age and weights-at-age in Div. 2J, a lesser decline in Div. 3K, and little or no decline in Div. 3L. The trend of decreasing mean lengths-at-age and weights-at-age during the 1980s appears to have been reversed in recent years.

The age of 50% maturity of females declined from 1986 to 1994 but increased in 1995 and 1996. There was an apparent decline again in 1997 but it must be noted that sample sizes, particularly of older fish, have been low in recent years.

g) **Recruitment Trends**

Mean catches at age per tow during the autumn bottom-trawl survey have revealed very weak recruitment in the 1990s. The 1994 year-class at age 1 was relatively large compared with catches of earlier year-classes with the Engel trawl, but it looks very weak compared to previous year-classes following conversion of the earlier data to Campelen equivalent abundances. Data from two juvenile surveys are in agreement with the data from the bottom-trawl survey in indicating that the 1994 year-class was strong relative to the adjacent weak year-classes. All three surveys indicate that the 1996 year-class may be exceptionally weak.

h) **Sentinel Survey**

The inshore sentinel survey in NAFO Div. 2J and 3KL was initiated in 1995 to provide indices of cod abundance in coastal waters during the period of the moratorium. It has been conducted primarily with gillnets and linetrawls, but also with handlines and cod traps. Catch rates in southern Div. 3K and in Div. 3L are considered by participants in the fishery to have been good. Although data are collected from both fixed sites and varying sites, only the fixed site data have been analyzed. Comparison with commercial catch rates before the moratorium from logbooks filled out by skippers of vessels 35 ft and greater in length indicate that mean gillnet catch rates are lower in the sentinel survey while those for linetrawls are higher. For both gillnets and linetrawls the median catch rates in the sentinel survey are lower than in the commercial fishery. Because of the differences in the nature of the commercial fishery and sentinel survey, it is difficult to draw any conclusions from these comparisons. Given the present lack of understanding of the relationship between sentinel survey catch rates and the size of the Div. 2J and 3KL

cod stock (either the inshore component alone or the entire stock), it is not possible to infer stock status from these data.

i) **Seal Consumption**

There is no update of seal consumption or population size for 1997. Previous estimates have indicated that consumption of fish by seals in the stock area has been increasing in recent years. The total estimate for Div. 2J and 3KL in 1996 is 2.5 million tons. This is estimated to include 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) **Survey Estimates of Total Mortality**

Research vessel survey data were used to calculate total mortality. Although there was a marked decrease in the total mortality after the declaration of the moratorium, current values for most ages appear to be higher than the assumed value of total mortality of 0.2 in the absence of fishing mortality. The estimate of average total mortality in 1995 and 1996 for ages 2 to 7 is 0.77.

k) **Assessment Results**

The Div. 2J and 3KL cod stock has not experienced a detectable increase in the offshore since the declaration of a moratorium in July 1992. Indices of abundance and biomass from the spring and autumn surveys continued to decline after directed commercial fishing was closed.

Recent levels of recruitment have been extremely low. While the 1994 year-class appeared initially to be slightly less weak, the 1996 year-class may be exceptionally weak. Total mortality calculated from recent (1995-97) surveys is extremely high. Very few fish are surviving beyond age 5, especially offshore in Div. 2J and 3K.

There is no reliable information from which stock abundance can be determined for the inshore. Acoustic surveys have indicated some large aggregations but an overall low biomass. Sentinel survey catch rates have indicated dense aggregations in some areas at times but cannot be used to infer stock status at present.

Factors that may be contributing to the apparent lack of recovery include predation by harp seals and unreported removals. Given the estimates of low recruitment and high mortality, the spawner biomass may decline further in 1998 even in the absence of a fishery.

IV. RESEARCH ACTIVITIES

1. **Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals** (SCS Doc. 98/16)

STACFIS reviewed the report arising from the 28 August through 3 September 1997 Meeting of the Joint Working Group as it pertained to harp and hooded seals in the Northwest Atlantic.

Results of stock identity work using the cytochrome B gene of harp seals supported previous studies indicating a separation between eastern and western Atlantic groups. Seals in the Gulf of St. Lawrence and at the "front" were closely related.

The Canadian catch had increased to about 242 362 and 261 043 animals in 1996 and 1997, respectively, and these numbers were about four times higher than the average take over the previous 10 years. The nature of the hunt has also changed with a significant increase in the number of pups taken. Revised estimates from Greenland also indicated increased take in recent years (67 158 in 1995). Current combined catches from Canada and Greenland are about 300 000 animals; approximately the replacement yield.

The take of hooded seals in Greenland waters was somewhat higher than that during the 1980s (7 330 in 1995), but comparable to the trend shown since the 1950s. Catches in Canadian waters have been variable in recent years (25 754 in 1996; 7 058 in 1997). It appears that the 1996 catch exceeded the replacement yield.

No new population estimates for either species were available during the meeting. Work is continuing to investigate predator-prey relationships as well as movements and migrations through the use of tags. The Davis Strait whelping patch of hooded seals was located during 1997, and work is ongoing to investigate reproductive parameters of females of this species. A model of prey consumption is also under development.

STACFIS was pleased that the Working Group will be examining various population models in the future, and supports their **recommendation** that a special workshop be held to evaluate the performance of the various models available. Of the seven **recommendations** arising from the meeting of the Working Group (SCS Doc. 98/16, p. 14), six pertain to seals in the Northwest Atlantic, and STACFIS endorsed all of these.

STACFIS **recommended** that *the Chair of the Joint Working Group provide a detailed update of information on harp and hooded seals in the Northwest Atlantic to the Scientific Council for its consideration at the June 1999 Meeting*.

2. **Report on Comparative Fishing Studies**

i) **Between Campelen survey trawl and Spanish survey gear**

STACFIS noted that a comparative fishing study between the Canadian Campelen trawl and the Spanish survey gear was proposed to take place in Div. 3NO beginning in the spring of 1999. It is proposed that at least two days be set aside during future Canadian and Spanish spring surveys to conduct the comparative fishing experiments. This work should be repeated in subsequent years to develop an acceptable database to allow comparisons between vessels.

ii) **Between Campelen survey trawl and DFO/fishing industry trawl**

STACFIS noted that no progress could be reported on this proposed comparative fishing experiment.

iii) **Between Japan and Greenland surveys on Greenland halibut**

Canada and EU-Spain have conducted spring surveys in Div. 3NO (1971-98 for Canada, 1995-98 for EU-Spain), using the same stratified random approach. To address differences in trawl efficiency and size selectivity for most species between the two surveys, STACFIS **recommended** that *at least two days be set aside during future Spanish and Canadian spring surveys to conduct comparative fishing between the vessels, beginning in 1999*. This work should be repeated in subsequent years to develop an acceptable database to allow comparisons between the vessels.

3. **Ageing Studies**

STACFIS noted that a review of an age validation study of roughhead grenadier (SCR Doc. 98/33) will be reviewed at the September 1998 Meeting.

4. **Other Matters**

There being no other business, the Chairman thanked the participants for their contributions, and in particular the Designated Experts and the Secretariat for their work during the meeting.

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

Chairman V. N. Shibanov Rapporteur: J. Casey

The Committee met at Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada on 6, 9 and 11 June 1998, to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives from Canada, Cuba, Denmark (in respect of the Faroe Islands and Greenland), European Union, Japan, the Russian Federation and United States of America were present. The Assistant Executive Secretary was in attendance.

1. **Opening**

The Chairman opened the meeting welcoming everyone. J. Casey (EU-United Kingdom) was appointed rapporteur. It was agreed that recommendations from the 1997 meetings would be addressed under the appropriate agenda items.

2. **Fishery Statistics**

a) **Progress report on Secretariat Activities in 1997/98**

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

The Chairman reminded the Committee of the June 1997 recommendation of STACREC, that the 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. The Assistant Executive Secretary drew attention to Rule 4.4 of the Rules of Procedure of the Scientific Council concerning the deadline dates for submission of STATLANT data for the preceding year. STATLANT 21A data should be submitted by 15 May and STATLANT 21B data by 30 June. STACREC once again stressed the importance of these data and their timely submission, since they are used extensively by the Scientific Council for stock assessments and other scientific investigations.

The Assistant Executive Secretary outlined the status of STATLANT data submissions for recent years. The following table shows the dates of receipt of STATLANT 21A and 21B submissions for 1995-97 received by the Secretariat up to 1 June 1998

	STATLANT 21A (deadline, 15 May)			STATLANT 21B (deadline, 30 June)		
Country	1995	1996	1997	1995	1996	1997
BGR	-	-	-	-	-	-
CAN-M	04 Jul 96	20 May 97	-	26 Feb 96	04 Mar 98	-
CAN-N	31 May 96	16 May 97	-	21 Apr 97	-	-
CAN-Q	14 May 96	20 Jun 97	12 May 98	02 Jul 97	26 Aug 97	-
CUB	30 May 97	30 May 97	27 May 98	30 May 97	30 May 97	-
EST	16 Sep 97	17 Sep 97	-	16 Sep 97	17 Sep 97	27 May 98
E/DNK	15 Aug 96	-	-	15 Aug 96	-	-
E/FRA-M	-	-	-	-	-	-
E/DEU	No fishing	04 Jun 97	23 Mar 98	No fishing	24 Jun 97	18 Mar 98
E/NLD	No fishing	No fishing	-	No fishing	No fishing	-
E/PRT	12 May 96	14 May 97	24 Apr 98	04 Sep 96	04 Sep 97	-
E/ESP	05 Sep 96	04 Jun 97	-	11 Sep 96	-	-
E/GBR	No fishing	16 Jul 97	-	No fishing	-	-
FRO	24 Oct 97	24 Oct 97	-	-	-	-
GRL	20 Aug 96	06 Jun 97	28 May 98	09 Oct 96	-	-
ISL	27 May 96	16 May 97	-	-	12 Jun 97	-
JPN	02 Apr 96	14 Apr 97	14 Apr 98	02 Apr 96	24 Apr 97	14 Apr 98
KOR	No fishing	-	-	No fishing	-	-
LVA	21 May 96	17 Apr 97	22 Apr 98	21 May 96	17 Apr 97	-
LTU	17 Feb 98	17 Feb 98	17 Feb 98	17 Feb 98	17 Feb 98	-
NOR	31 May 96	22 May 97	-	27 Jun 96	-	-
POL	No fishing	-	-	No fishing	-	-

	STATLANT 21A (deadline, 15 May)			STATLANT 21B (deadline, 30 June)		
Country	1995	1996	1997	1995	1996	1997
ROM	-	-	-	-	-	-
RUS	23 May 96	22 Jul 97	02 Apr 98	14 Jul 96	-	-
USA	-	-	-	-	-	-
FRA-SP	18 Jul 96	06 Mar 97	-	12 Sep 96	06 Mar 97	-
HND*	-	-	-	-	-	-
VEN*	-	-	-	-	-	-

* Non-Contracting Party.

ii) **Publication of statistical information**

STACREC noted that NAFO *Statistical Bulletin*, Vol. 43, containing 1993 data was published in December 1997.

STACREC noted that publication of NAFO *Statistical Bulletin* Vol. 44 and 45 containing 1994 and 1995 data has not been completed since data for 1994 from the United States and data for 1995 from the Faroe Islands and the United States are still outstanding.

The following table lists the countries/components that have not submitted data through 1994-96 (N.B. Bulgaria and Romania have not reported any fishing in recent years.):

STATLANT 21A			STATLANT 21B		
1994	1995	1996	1994	1995	1996
USA	Faroe Islands USA	Denmark Great Britain Faroe Islands	USA	Faroe Island USA	Canada-N Denmark Faroe Islands Greenland Korea Norway Poland Spain Great Britain USA

STACREC was informed that the United States had made a commitment that by the end of 1998, data for 1994 and 1995 would be made available. STACREC agreed to await the submission of data from the United States before publishing *Statistical Bulletin* Vol. 44 and 45.

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

The Chairman reminded the Committee of its recommendation from the June 1997 Meeting of STACREC that a NAFO website be established to facilitate the dissemination of STATLANT and other statistical data. The Assistant Executive Secretary outlined the progress that had been made with respect to the establishment of the website, and pointed out that a thorough review of the computing facilities within the Secretariat had also been undertaken. STACREC noted the considerable progress that had been made and thanked the Secretariat for the effort.

STACREC considered the issue of security of scientific data and information on the website and suggested that access to the website could be on different levels; full access to Scientific Council members and restricted access to the general public. STACREC recalled previous discussions on this topic that STATLANT data were to be regarded as public domain and can be set up for direct access by the general public, whereas other data e.g. hail data will require a restricted FTP coded access

method. STACREC noted that EUROSTAT had considered that online consultation at the STATLANT 21A level was feasible, but that STATLANT 21B data is too detailed for such access. STACREC **recommended** that *online access to data on the NAFO website be at the STATLANT 21A level and that access to 21B data should be via restricted FTP accounts*.

Regarding data on the website, some problems still need to be addressed. It was noted that staff in the Secretariat needed further training. Also, data are currently stored using Microsoft Access, but other possibilities exist. Whether the current database can be modified to be year 2000 compliant needs to be addressed, since the current database uses a 2-digit code for the year. STACREC requested that the Secretariat checks that all hardware and software is year 2000 compliant, and that the database modifications and developing the Secretariat capabilities be addressed.

iv) **Interagency data harmonization (NAFO/FAO)**

STACREC was pleased the Assistant Executive Secretary and STACREC Chairman had attended meetings with FAO and EUROSTAT to address NAFO/FAO data harmonization.

STACREC reviewed the progress in the detection and elimination of discrepancies between the FAO and NAFO catch databases made at the CWP Inter-Sessional Meeting (Rome, 23-24 February 1998) and at a session immediately preceding the current Scientific Council Meeting (1-6 June 1998). It noted that inter-Secretariat collaboration had eliminated many of these discrepancies but there were some serious ones still remaining and that the NAFO and FAO Secretariats should be contacting national authorities for advice in certain cases.

The main causes of these discrepancies were considered to be

- different sources of data within countries (e.g. regional agencies, federal agencies),
- variation in the way data are allocated between capture fisheries and aquaculture,
- different ways in which data are pooled across species items,
- different rules for assigning catches to countries, and
- different status of records (provisional or final).

STACREC recognized the value of this work in safeguarding the credibility of the databases and **recommended** that *inter-agency statistical data harmonization be continued as a regular procedure in order that the discrepancies be detected at as early a stage as possible.* STACREC also **recommended** that *national authorities should be encouraged to submit statistics with a maximum of detail with regard to the species composition of the catch, in order to minimize one of the main causes of inter-agency discrepancies*.

b) **The CWP 18th Session**

i) **Report on intersessional meeting of 23-27 February 1998**

STACREC was pleased the Assistant Executive Secretary and STACREC Chairman attended the CWP Intersessional Meeting (ISM) in Rome. STACREC was pleased with the results of the ISM (as presented to STACREC in the ISM Report), where the Scientific Council's concerns on harmonizing inter-agency data were addressed. STACREC noted these issues will be continued in subsequent CWP Meetings.

STACREC noted the discussions at the ISM on dissemination of statistics, reaffirmation of the principle that regional agencies were trustees rather than owners of statistical data, the use of the WWW for data dissemination, conversion factors, the request from CITES for improved availability of data on catches of Elasmobranchs and the work on eliminating discrepancies between agency databases.

ii) **Considerations for CWP 18th Session, Luxembourg, July 1999**

STACREC reviewed the CWP-18 Provisional Agenda compiled by the ISM and noted that, in addition to the agenda items for which NAFO had already been requested to make contributions,

interagency data harmonization and Elasmobranch statistics should also be the subject of inputs from NAFO.

STACREC noted that there was a need for a harmonization among international agencies of the concepts and definitions used in the application of the Precautionary Approach and proposed that, the CWPs advice be sought under the agenda item "Statistical Implications of the Precautionary Approach".

STACREC **recommended** that *the Scientific Council be represented at the CWP-18 session in Luxembourg in July 1999 by the Assistant Executive Secretary and the STACREC Chairman*. It was noted that the Scientific Council could include representatives from a NAFO Contracting Party in its representation and STACREC invited interested national participants to declare their interest at the September 1998 STACREC Meeting.

3. **Biological Sampling**

a) **Report on Activities in 1997/98**

STACREC noted and reviewed the listings of Biological Sampling Data prepared by the NAFO Secretariat in accordance with the June 1997 recommendation of Scientific Council, (NAFO Sci. Coun. Rep., 1997, p.156). The listings (SCS Doc. 98/9) include biological sampling data for 1996 and 1997 received by 30 May 1998.

STACREC discussed the possibility of making these data available on the NAFO website and agreed that the ability to cross reference information with fishery data was highly desirable. STACREC **recommended** that the *Secretariat examine the various datasets compiled by different NAFO Committees, which may be available electronically in the future, and consider appropriate codes and abbreviations in order to develop means of cross referencing the information easily.*

STACREC also noted that there is presently no country component code for Central and Arctic under Canada, and Canada had requested the inclusion of such a code due to the developing interest in the inshore fishery for Greenland halibut in Subarea 0. STACREC **recommended** that *the Secretariat make provision for a new code for Canada - Central and Arctic.*

b) **Report by National Representatives on Commercial Sampling Conducted**

Cuba - Samples were obtained from commercial bottom trawl catches from the silver hake fishery in Div. 4WX. Additional sampling was carried out on some by-catch species (haddock, pollock, cod and squid). Length compositions of the catches were estimated by scientific observers on-board the vessels during July-September 1997.

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 landings.

Division 3M: The fishery for shrimp in Div. 3M was not sampled in 1997.

EU-France: Sampling was carried out in 1997 and covered the cod fishery in Subdiv. 3Ps (length and age composition of trawl, gillnet and longline catches), the Greenland halibut fishery in Div. 3L and 3M (length composition of trawl catches), and the Iceland scallop fishery in Subdiv. 3Ps (length composition of catches).

EU-Portugal: Samples were obtained for trawl catches only. Data on catch rates and length compositions of cod, redfish (*S. mentella*), American plaice, roughhead grenadier, Greenland halibut and witch flounder were take from January to November from Subarea 3.

c) **Report on Data Availability for Stock Assessments (by Designated Experts)**

Available data from commercial fisheries relevant for stock assessment on a stock by stock basis was prepared with inputs from Designated Experts (Table 1).

Table 1. Available data from the commercial fisheries related to stock assessment (1997). (+ is data available).

				Biological Sampling				
Stock	Country[1]	Catch	CPUE	Sex	Length	Age	Individual Wt.	Maturity
2J3KL Cod	CAN-N	+	+	+	+	+	+	+
3M Cod	E/PRT	*	+		+	+		
	OTHERS	+						
3NO Cod	CAN	+			+	+		
	EU/PRT	+			+	+		
SA 1 Redfish	GRL	+						
3M Redfish	E/PRT	+	+	+	+	+	+	
	RUS	+						
	JPN	+						
	NCP	+						
3LN Redfish	CAN	+						
	JPN	+						
	E/PRT	+			+			
	E/ESP	+						
	RUS	+						
3M American plaice	EU/PRT	+			+	+	+	
	EU/ESP	+						
3LNO American plaice	CAN-M	+						
	CAN-N	+						
	E/PRT	+			+			
	E/ESP	+			+			
3NO Witch flounder	E/ESP	+						
	CAN	+						
	E/PRT	+						
3LNO Yellow-tail	CAN	+	+	+	+	+		+
	E/ESP	+		+	+			+
SA 0 + 1B-F Greenland halibut								
SA 1A Green-land halibut	GRL	+		+	+	+	+	+
SA 2+3 Green-land halibut	CAN	+	+	+	+	+	+	+
	E/PRT	+	+	+	+	+		
	E/ESP	+		+	+	+	+	+
	JPN		+	+				

Table 1. Continued.

Stock	Country[1]	Biological Sampling						
		Catch	CPUE	Sex	Length	Age	Individual Wt.	Maturity
SA 0+1 Roundnose grenadier								
SA 2+3 Roundnose grenadier	CAN	+						
	JPN	+						
	E/ESP	+						
	E/PRT	+						
	E/FRA	+						
SA 2+3 Rough-head grenadier								
3NO Capelin		NO DATA AVAILABLE						
SA 3+4 Squid	CAN	12 616	+	+	+			+
SA 1 Other finfish	GRL	+						
3M Shrimp		to be provided at the September 1998 Meeting of the Scientific Council.						
SA 0+1 Shrimp		to be provided at the November 1998 Meeting of the Scientific Council.						
Denmark Strait Shrimp		to be provided at the November 1998 Meeting of the Scientific Council.						

[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 1997**

An inventory of biological surveys conducted in 1997 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 1997 in relation to the stocks for which they have responsibility.

Table 2. Inventory of biological surveys conducted in the NAFO Area during 1997.

Subarea	Division	Country	Month	Type of survey	No. of sets
				Stratified-random Surveys	
1	A	GRL	5-6	Snow crab	360
	A-F		7-8	Trawl survey for shrimp & groundfish	190
	A-F		7-8	Deep-sea trawl survey for Greenland halibut	63
	B		5-6	Snow crab survey	840
	B-F	E/DEU	10-11	Groundfish, oceanography	45
	C	GRL	9-10	Snow crab	1020
	D	GRL	9-10	Snow crab survey	708

Table 2. Continued.

Subarea	Division	Country	Month	Type of survey	No. of sets
				Stratified-random Surveys	
2+3	GH+KLMNO	CAN-N	9-12	groundfish & shellfish trawl	821
	J+KLMNO		8	0-group cod/capelin trawl	149
3	KL		10-12	inshore cod and herring acoustics	-
	LNO		4-6	groundfish	315
	M	E/ESP+E/PRT	7+8	groundfish	117
	NO	E/ESP	4+5	groundfish	128
	P	CAN-N	1	Fortune Bay herring acoustics	-
			4	groundfish	171
3+4	OPR	CAN-N	7+8	unit 2 redfish trawl survey	133
4	T	CAN-M	7	lobster	150
			7	scallop	121
			9	groundfish/oceanography	214
			9	lobster	100
			10	lobster	15
	Vn	CAN-M	5	ichthyoplankton	38
	VsW		3	groundfish	132
	VW		7	groundfish/oceanography	96
	WX		7	groundfish/oceanography	112
	X		6	scallop	259
			6	scallop	120
			6	scallop	65
			7	scallop	75
5	Z	CAN-M	2	groundfish	96
				Other Surveys	
1	A	GRL	7-8	longline, inshore G. halibut	25
	B-C		6-7	gillnet, inshore juvenile cod	146
2+3	JKLM	CAN-N	7	physical/biological oceanography	-
2+3+4	JK+LK+W	CAN-M	5	oceanography/plankton	269
3	K	CAN-N	9	White Bay pre-recruit snow crab	-
		CAN-M	11	air sea interaction/remote sensing	
	L	CAN-N	4-5	inshore cod acoustics	-
			8+9	larval fish feeding	-
			6	juvenile cod habitat acoustics	-
			7	effects of environmental variability on catchability of groundfish	-
			8	Bonavista Bay and Northeast Avalon snow crab trap/trawl	-
			9+10	Conception bay snow crab trap/trawl	-
	LN		7	Iceland scallops	-
	LNO		5	physical and biological oceanography	-
	Ps		4	inshore pre-spawning cod trawl/acoustics	-
3+4	L+VW	CAN-M	10	benthic habitat trawl impact	374
	P+RSTV		1	cod stock mixing	104
	P+TVn		4	cod stock mixing	8
	O+VW		12	oceanography	-

Table 2. Continued.

Subarea	Division	Country	Month	Type of survey	No. of sets
				Other Surveys	
4	R	CAN-N	9	Iceland scallops	-
	RS		4	redfish/cod mortality	-
	T	CAN-M	5	crab tagging/epibiont sampling	-
			7	Lobster	-
			7	crab tagging/epibiont sampling	-
			9	herring spawning bed	-
			10	herring acoustic	35
			11	specimen sampling	-
	TVn		10	herring acoustic	35
	Vn		6	juvenile cod	53
	Vn		9	juvenile cod	18
			10	juvenile cod	5
	VsW		5	fish disease	60
	VWX		4	oceanography/plankton	46
			10	oceanography	185
	W		4	oceanography	25
			9	benthic habitat & trawl impact	14
			10	oceanography	25
			11	oceanography	50
	WX		8	larval lobster	168
			10	silver hake	160
	X		6	benthic habitat	130
			11	redfish high priority	22
			11	herring	107
			11	scallop	14
4+5	T+Z	CAN-M	6	oceanography	51
	X+Y		11	oceanography	-

Recalling its recommendation from its September 1997 meeting (NAFO Sci. Coun. Rep., 1997, p. 156), STACREC noted that only one Contracting Party will conduct shrimp surveys in 1998, but reiterated the importance of co-ordination with other Contracting Parties in planning such surveys.

b) **Surveys Planned for 1998 and Early-1999**

An inventory of biological surveys planned for 1998 and early-1999 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 1998 and early-1999.

Area	Country	Type of Survey	Dates
		Stratified-random Surveys - 1998	
1A-B	GRL	snow crab	May-Jun
1A-F		trawl survey for shrimp and groundfish	Jul-Sep
1B-F		Deep-sea trawl survey for Greenland halibut	Sep-Oct
1B-F	E/DEU	groundfish, oceanography	Oct-Nov
1E	GRL	snow crab	Sep-Oct
2J+3KLMNO	CAN-N	groundfish / shellfish trawl	14 Oct-19 Dec
3L	CAN-N	Bonavista/Trinity Bay herring acoustics	9 Nov-11 Dec
3LNO	CAN-N	groundfish trawl	11 May-26 Jun

Table 3. Continued.

Area	Country	Type of Survey	Dates
3LMNO	RUS	groundfish	Jun-Oct
3M	EU/ESP+EU/PRT	groundfish	Jul-Aug
3NO	EU/ESP	groundfish	Apr-May
3P	CAN-N	Placentia/St. Mary's Bay herring acoustics	2-31 Mar
3Ps		groundfish trawl	10 Apr-7 May
3P+4T	CAN-N	Unit 2 redfish trawl	4-21 Aug
4T	CAN-M	lobster	May
		sea scallop	Jul
		groundfish	Sep
		lobster	Oct
4T	CAN-M	lobster	Nov
4Vn		cod	May
4VW		groundfish	Jul
4WX		groundfish	Jul
4X		scallop	Jun
		scallop	Aug
		scallop	Sep
5Z	CAN-M	groundfish	Feb
		Other Surveys - 1998	
SA0	CAN-M	oceanography	May
		Lobster vidio	Jul
		oceanography	Sep
		oceanography	Oct
		plankton	Nov
1A	GRL	longline, inshore juvenile Greenland halibut	Jul-Aug
1E-F		gillnets, inshore juvenile cod	Jun-Jul
1F+2GHJ+3K	CAN-N	Atlantic salmon smolt distribution	19 Sep-6 Oct
2J+3K	CAN-N	harp seal foraging selectivity	21-30 Jan
2J+3KL		0-group cod/capelin trawl	24 Aug-11 Sep
2J+3KLMN		physical and biological oceanography	17 Jul-2 Aug
2J+3KLPs		post-spawning cod acoustics research	08-26 Jun
2J+3P		cod acoustics	5-16 Jan
2HJ+3KL +4X	CAN-N	oceanography/plankton	Jun
3K	CAN-N	snow crab comparative fishing and selectivity	7-17 Sep
		White/Notre dame bay snow crab trap/trawl	7-17 Sep
3L		larval feeding and growth research	20 Jul-5 Aug
		Avalon snow crab trawl/trap	19-29 May
		Bonavista Bay snow crab trap/trawl	3-14 Aug
		Juvenile cod habitat/acoustics	24 Oct-6 Nov
3LMNO		physical and biological oceanography	23 Apr-2 May
3LP		effect of environmental variability on catchability	22 Jan-24 Feb
3OP		redfish acoustics	27 Mar-3 Apr
3P		redfish and cod acoustics	3-14 Mar
		Iceland scallops	29 Jun-10 Jul

Table 3. Continued.

Area	Country	Type of Survey	Dates
		Other Surveys	
3P	CAN-N	inshore cod tagging and acoustics	10-21 Oct
		redfish acoustics target strength	5-16
3Ps		offshore cod tagging	1-9 Apr
		inshore cod research	1-20 Apr
		inshore cod tagging	22 Apr-4 May
4T	CAN-M	snow crab habitat	Jun
		lobster habitat	Jul
		sea urchin	Aug
		snow crab collection	Aug
		herring acoustic	Sep
		snow crab collection	Nov
4TVW		trawl impact study	Jun
4V		shrimp	Feb
4VsW		snow crab	May
		fish disease	Jun
4VW		oceanography/plankton	Apr
4VWX		oceanography/plankton	Sep
4W		benthic sampling	Apr
		trawl impact studies	Jun
		oceanography/plankton	Jul
4WX		oceanography/plankton	Sep
4X		fish food collection	May
		live fish sampling	May
		herring	Jun
		scallop	Jul
		larval lobster tracking	Aug
4X		live fish sampling	Sep
		scallop	Sep
		live fish sampling	Oct
4X+5Z	CAN-M	larval herring	Oct
		larval herring	Nov
		Surveys Planned for Early-1999	
2J+3K	CAN-N	harp seal moulting	22 Apr-8 May
3K		harp seal moulting	22 Apr-8 May
3P		redfish acoustics target strength	5-16 Jan

5. Non-traditional Fishery Resources in the NAFO Area

a) Distribution Data from Surveys

Noting the recommendation from its June 1997 Meeting, (NAFO Sci. Coun. Rep., 1997, p. 162), STACREC reviewed a paper describing the skate fishery and survey results in Div. 3NO (SCR Doc. 98/26). The paper presented results of commercial fishing activity by EU-Spain, and the results of a research survey. Since 1993 a significant increase in the skate catches by trawlers from EU-Spain has been reported. The main exploited species was the thorny skate (starry ray), *Raja radiata.* According to data from observers, this species showed a marked pattern of seasonal aggregation in shallower waters, which occurred mainly in the summer months. Accordingly, the majority of catches occurred in depths less than 100 m. The results of the EU-Spain bottom trawl survey in Div. 3NO in 1995-97 showed that in late-spring, skate were distributed all over the surveyed area to a depth of 1 400 m. However, the largest

concentrations were found in the shallowest (<200 m) and the deepest (>1 000 m) strata, and were much less abundant at intermediate depths.

STACREC noted the increasing interest in elasmobranchs worldwide and **recommended** that *analyses on the distribution and abundance of elasmobranchs and other non-traditional species be carried out and the results presented to STACREC at the earliest opportunity.*

b) **Report on the CITES Meeting on the Co-ordination of Shark Data Collection**

STACREC noted the CITES resolution requesting regional fishery agencies to improve the collection of data on shark catches and the responses by ICES (the addition, at the request of the ICES Study Group on Elasmobranchs, of 37 species on the STATLANT 27A questionnaire) and by ICCAT (the request that national authorities submit to ICCAT data on shark by-catches in tuna-fisheries and on catches by tuna-vessels targeting sharks). STACREC noted that this resolution was discussed at the CWP 17th Session, which **recommended** that CWP Agencies include individually identified elasmobranchs in their list species. Recognizing that identification of some species would be problematic the CWP **recommended** that *CWP agencies give guidance to National Authorities in species identification*.

STACREC agreed with the CWP that identification of elasmobranchs could be problematic and **recommended** that *NAFO encourage training in identification and reporting of elasmobranchs.*

c) **Report on Northwest Atlantic/Gulf/Caribbean Regional Shark Management Workshop**

STACREC noted the Northwest Atlantic, Gulf of Mexico and Caribbean Sea Regional Strategy Development Workshop for the Conservation and Management of Sharks was held 4-5 December 1997 at the Mote Marine Laboratory, Sarasota, Florida, USA. A total of five countries participated in the Workshop. As recommended by the Scientific Council, F. M. Serchuk (USA) attended the Workshop as the NAFO Observer, and gave a presentation on the history and mandate of NAFO. Information on the catches of skates, dogfish and other sharks in the NAFO Convention Area was presented, as well as a summary of activities by NAFO in determining the distribution, abundance and status of elasmobranchs.

The aim of the Workshop was to: (1) develop information on the status of elasmobranch fisheries in the region, (2) review current national/regional arrangements for the management of elasmobranchs, (3) identify regional issues and problems related to the biology, assessment, exploitation, and management of elasmobranchs, (4) identify general principles to be used in formulating a regional strategy for the conservation and management of chondrichthyan resources, and (5) develop a regional strategy that addresses both general and fisheries specific short-term and long-term needs and tasks for the conservation and management of elasmobranchs.

A draft report of the Workshop was distributed to STACREC.

The information developed at the Workshop was subsequently used in preparing background documents for the meeting of the FAO Technical Working Group (TWG) on the Conservation and Management of Sharks held 23-27 April 1998 in Tokyo, Japan. The principal remit of the TWG Meeting was to: (1) formulate guidelines for the conservation and management of sharks (including data and research needs) at the national and regional levels, and (2) develop a global Plan of Action for the conservation and management of sharks, which will reviewed at an October 1998 FAO Consultation on the Plans of Action and considered for adoption at the 23rd Session of the FAO Committee on Fisheries (COFI) in February 1999.

A summary report of the TWG Meeting, as well as copies of: (1) the draft conservation and management guidelines, (2) the draft report of the shark management TWG subgroup, and (3) the draft Plan of Action were distributed to STACREC.

STACREC noted that NAFO was not represented at the FAO Technical Working Group (TWG) on the Conservation and Management of Sharks held 23-27 April 1998 in Tokyo, Japan, and that a global Plan of Action for the conservation and management of sharks is to be reviewed at an October 1998 FAO

Consultation on the Plans of Action and considered for adoption at the 23rd Session of the FAO Committee on Fisheries in February 1999. STACREC **recommended** that *the Scientific Council consider asking the Secretariat to approach FAO requesting that a Scientific Council representative be invited to attend the October 1998 FAO Consultation on the Plans of Action for the conservation and management of sharks.*

The Assistant Executive Secretary informed STACREC of an invitation from FAO to NAFO to attend the Meeting of FAO and non-FAO Regional Fishery Bodies (during 11 and 12 February, 1999), which will be a preparatory meeting of COFI (FAO Committee on Fisheries), dealing with various inter-agency activities focusing on promotion of the code of conduct for responsible fisheries within different agencies, to be held at FAO Headquarters, Rome, 15-19 February, 1999.

STACREC **recommended** that *NAFO accept the invitation from FAO to attend the preparatory meeting of FAO and non-FAO Regional Fisheries Bodies to be held in Rome on 11-12 February, 1999, and that this would also be a suitable forum for discussion of harmonization of terminology in relation to the Precautionary Approach.*

STACREC noted that FAO is also developing a plan of action on the incidental capture of seabirds in longline fisheries and a plan of action on managing fishing capacity. STACREC **recommended** that *the NAFO Secretariat inform FAO of its interest in these initiatives and request that FAO keep NAFO informed of any progress.*

d) **Catch-data Collection of Elasmobranchs**

In response to the CITES resolution on shark data collection STACREC **recommended** that *an expanded list of individually identified species of elasmobranchs be included on the STATLANT 21A questionnaire and that the national authorities be requested to submit catch statistics with a maximum degree of detail.* However it was recognised that precise identification of elasmobranch species might present difficulties for the fishermen and the national authorities.

STACREC also noted that catch data on elasmobranchs from the NAFO Convention Area by Subarea from 1992 to 1996 summarized by the Secretariat indicated that substantial catches were reported.

6. **Species Composition of Grenadier Fisheries Statistics**

STACREC reviewed a paper on the species composition of grenadier fisheries catch statistics for Subarea 3 (SCR Doc. 98/28). In Subarea 3, catches of grenadiers are composed of 80-90% of roughhead grenadier, although this fact is obscured since catches are reported as roundnose grenadier.

STACREC **recommended** that *identification of grenadiers should also be publicized, and that Scientific Council consider for 1999 that members with data on roughhead grenadier in SA 2+3 bring such data to its June 1999 meeting to attempt an assessment on this species.* STACREC noted that landings of grenadiers in 1997 by EU-Spain and EU-Portugal were exclusively roughhead grenadier.

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

a) The diet of *Centroscyllium fabricci* from Div. 3M was investigated (SCR Doc. 98/34). 151 stomachs from were collected and analyzed on board commercial freezer trawlers targeting Greenland halibut in Div. 3LM in 1992. Three length groups were established to study variations in diet with length. The most important prey items were waste products (offal) from fish processing and other fish. It was observed that diet varies with length, the smaller individuals feeding mainly on molluscs and crustaceans, with offal and other fish becoming increasingly important as diet items in larger individuals.

b) The results of Russian investigations on the distribution of deepwater redfish (*Sebastes mentella*) between 0-800 m depth in the Irminger Sea were presented (SCR Doc. 98/16). Mean length and sex ratio was studied at different depths. Mean length of both males and females decreased at depths down to between 400 and 600 m depth, but increased again at greater depths. Fish maturing for the first time were observed at all depths. Similar observations were made for both the Irminger Sea and off Northern Newfoundland.

c) Length-weight growth rate and bathymetric distribution of *Macrourus berglax* off Bear Island and in the Northwest Atlantic was reviewed (SCR Doc. 98/19). Catches were taken by bottom trawl in the directed fishery for Greenland halibut and did not exceed 5% of the total catch. Mean length of males and females increased with increasing trawling depth. Growth rate of males and females from the region of Bear Island was lower than those observed for the Northwest Atlantic.

d) The feeding of American plaice (*Hippoglossoides platessoides*) and yellowtail flounder (*Limanda feruginea*) on the Grand Bank (Div. 3N) was reviewed (SCR Doc. 98/42). A total of 970 American plaice and 1999 yellowtail flounder were sampled from sixty hauls carried out over a 24 hour period. The main prey of yellowtail flounder was gammaridae (19.5%), *Ammodytes dubius* (10.1%), Annelidae (6.3%), Mycidacea (6%) and Antozoa (6%). The predominant prey of American plaice were *A. dubius* (72.3%), followed by Mysidacea (8.5%) and *Echinus parma* (6.1%). Significant difference in the average fullness index between hauls was observed for both species. Over a 24-hour period peak stomach content weight occurred at nightfall (2100 hours) for yellowtail, while for American plaice peak fullness occurred at dawn. Both species fed less intensively during the night. The feeding behaviour may have an influence on the different catchabilities observed during the day and night.

8. **Other Matters**

a) **Tagging Activities**

The Secretariat compiled a list of tagging activities carried out in 1997 (SCS Doc. 98/4).

b) **Scientific Data from Pilot Observer Program**

The Chairman drew attention to the detailed protocol developed for the Pilot Observer Program by STACREC at its June 1997 Meeting (NAFO Sci. Coun. Rep., 1997, p. 163), and presented at the meeting of the Fisheries Commission in September 1997 (FC WP. 97/8).

STACREC, however, noted that a meeting of a Standing Committee on International Control (STACTIC) had taken place on 12-13 May 1998 and that the report of that meeting showed no knowledge of the protocol presented by the Scientific Council and had requested the same details again.

STACREC **recommended** that *the Scientific Council inform the Fisheries Commission that the information on protocol for data collection by the Pilot Observer Program being requested has already been furnished to the Fisheries Commission.*

c) **Conversion Factors**

The EU (EUROSTAT) representative reported on the continuance of its work with FAO compiling the information on the factors used to convert landings data to the live weight equivalent. It was hoped that these data would soon be published together with the factors used by FAO in the compilation of food balance sheets for fishery products and with two studies on conversion factors commissioned by FAO.

Noting the importance of conversion factors in compiling catch statistics, STACREC welcomed the advances made in this work.

d) **Description of Fishing Effort**

STACREC noted that no submissions of fishing effort data had been submitted to the Secretariat. However, as a result of recent initiatives by D. Power (Canada) in accordance with the June 1997 recommendation (NAFO Sci. Coun. Rep., 1997, p. 166), a new proposal for recording fishing effort for boat seines (Danish seine, etc.) was suggested. STACREC agreed that the following new proposal would be a more appropriate measure of effort for these gears:

> Boat seines (Danish, etc.). Effort measure: hours fishing per day. Definition: number of times the gear was set or shot per day times estimated mean set or shot duration.

STACREC **recommended** that *its proposed definition of fishing effort for boat seines (Danish, etc.) should be referred to the CWP to determine its suitability for global definitions.*

e) **Other Business**

i) STACREC noted that a pair trawl survey using escape window and codend covers to analyze selectivity of sorting grids on bottom trawls in fisheries directed at groundfish in SA 3 will be conducted by EU-Spain over a 2-week period towards the end of 1998.

ii) In accordance with the September 1997 Meeting of STACREC, a report from an *Ad hoc* Working Group (convened by E. de Cárdenas, EU-Spain) dealing with desirability of storing biological information on a common database was received by STACREC. The group suggested that a standard file format for transmission of fisheries data in preparation for Scientific Council meetings would be a useful start, and proposed that members bring forward suggestions for file formats for discussion at the September 1998 Meeting of Scientific Council.

STACREC noted the progress made by the *Ad hoc* Working Group and agreed that it should reconvene at the September 1998 Meeting of the Scientific Council.

There being no further business, the Chairman expressed his thanks to the Secretariat, the rapporteur and meeting participants for their fruitful assistance in compiling the information necessary for the meeting.

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

Chairman: W. B. Brodie Rapporteur: M. Stein

The Committee met at Keddy's Dartmouth Inn, 9 Braemar Drive, Dartmouth, Nova Scotia, Canada on 8, 10, 13 and 17 June, 1998. In attendance were W.B. Brodie (Canada), D.B. Atkinson (Canada) for J. Morgan (Canada), V. A. Rikhter (Russian Federation), F. M. Serchuk (USA), M. Stein (EU-Germany), A. Vazquez (EU-Spain) and the Assistant Executive Secretary (T. Amaratunga).

1. **Opening**

The Chairman welcomed the Committee. The agenda as presented in the Provisional Agenda was **adopted**. M. Stein was appointed rapporteur.

2. **Review of STACPUB Membership**

The Scientific Council was informed that J. Morgan (Canada) was unable to attend this June Meeting, and Canada proposed that D. B. Atkinson (Canada) should attend STACPUB on her behalf. STACPUB was pleased to welcome D. B. Atkinson to this meeting. There was no change in STACPUB membership.

3. **Review of Scientific Publications Since June 1997**

a) **Journal of Northwest Atlantic Fishery Science**

Volume 22, containing 25 papers presented at the 1995 Joint NAFO/ICES Symposium on "The Role of Marine Mammals in the Ecosystem", Report of Symposium, List of Participants and Documents, and 2 notices (387 p.) was published with a date of December 1997.

Volume 23, containing 16 papers presented at the 1997 Symposium on "What Future for Capture Fisheries" is in the final review of galley stage. This issue is expected to be completed by mid-1998.

Volume 24. An invitational paper and 2 other papers are ready for publication in this volume. STACPUB agreed that this volume should be completed by mid-1998, when 1 or 2 further papers are received from the Associate Editors.

b) **NAFO Scientific Council Studies**

Studies Number 30, containing 9 miscellaneous papers and 2 notices (117 p.) was published with a date of December 1997.

There are presently 14 outstanding Studies papers being processed at the Secretariat for Studies issues 31 and 32.

c) **NAFO Statistical Bulletin**

STACPUB was pleased that the outstanding STATLANT 21B data from the USA for 1993 had been submitted to the Secretariat, thereby allowing *NAFO Statistical Bulletin* Vol. 43 to be published in December 1997. It was noted, however, that although the deadline for submission of STATLANT 21B reports for 1994 was 30 June 1995, and for 1995 was 30 June 1996, as of May 1998, data were still outstanding from USA for 1994, and from Faroe Islands and USA for 1995. This has consequently delayed the publication of the Statistical Bulletin Vol. 44 and 45. As of May 1998, data for 1996 were still outstanding from Canada-N, Denmark, Faroe Islands, Greenland, Korea, Norway, Poland, Spain, United Kingdom and USA, for publication of *NAFO Statistical Bulletin* Vol. 46.

d) **Index and Lists of Titles**

The provisional index and lists of titles of 108 research documents (SCR Doc.) and 19 summary documents (SCS Doc.) which were presented at the Scientific Council Meetings during 1997 were compiled and presented in SCS Doc. 98/8 for the June 1998 Meeting. The last 5-year compilation (1990-94) was published in November 1995.

STACPUB noted the large number of publications completed by the Secretariat since its last June 1997 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 discussed during the 1997 STACPUB Meeting, the Secretariat had contacted universities and public institutions, to explore the option of offering complete sets of these archived NAFO publications free of charges, provided they cover the mailing cost. STAPUB believed this might disseminate the scientific work of NAFO more widely, and improve the profile of both the Journal and the Studies. Several requests from these institutions and individuals were fulfilled.

There was considerable discussion on the free mailing list. STACPUB felt that before reducing the free mailing list, it should be explored as to whether the money saved by this activity could be used for the benefit of the Scientific Council's work. In particular the question of funding invited speakers to Scientific Council Sessions, and improving facilities for Scientific Council Meetings were mentioned. STACPUB therefore **recommended** that *the Executive Committee of the Scientific Council be more directly involved in the budgetary process of NAFO.*

b) **Proposal for Publications of 1998 Symposium Proceedings**

With respect to the scientific papers to be presented at the Symposium on "Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish", 9-11 September 1998, in Lisbon, Portugal, STACPUB was informed that 21 papers including 4 invited papers will be submitted for consideration for the Journal. The editorially-selected manuscripts will be published in a single publication of the *Journal of Northwest Atlantic Fisheries Science*. STACPUB therefore **recommended** that *all authors be encouraged to bring a copy of their papers to the session to enable the Secretariat to keep a complete record of papers presented at the Symposium*. A collection of abstracts of all papers will be made available to the participants of the Special Session, if possible.

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

a) **Invitational Papers**

STACPUB had received the manuscript of the invitational paper by Sv. Aa. Horsted on an update and evaluation of catch statistics for West Greenland cod. In a letter to the Assistant Executive Secretary the author indicated that further work on the manuscript will be done by him provided time permits such additional work.

STACPUB noted that the invitational paper by D. G. Parsons on Flemish Cap shrimp will be published in Journal Vol. 24.

STACPUB was pleased to receive the invitational paper by E. B. Colbourne on a 5-year review of the Flemish Cap oceanography. The Committee was also pleased to receive the invitational paper by V. A. Rikhter on silver hake, which is now in the editorial review process.

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

STACPUB was informed that NAFO Secretariat prepared abstracts of SCR Documents, starting with 1997 and working backwards. The Secretariat plans to provide an annual publication of abstracts of SCR Documents, Studies and Journals. These collated abstracts will go to the FTP-server linked to the NAFO website. STACPUB expressed its views that NAFO Secretariat no longer be required to prepare abstracts, and that there is no need to continue to print the Index and List of Titles. This issue should also be made available through electronic media. Agencies like ASFA should be informed on the availability of these products. STACPUB **recommended** that *NAFO Secretariat change the forms and announcements for paper submissions at the Scientific Council Meetings to incorporate abstracts in the SCR Docs*.

c) **New Initiatives for Publications**

There were no new items raised at this meeting.

d) **NAFO Website**

STACPUB **recommended** *that Scientific Council reports be made available to the public through the FTP-server*. There will be two versions of reports: The "Blue covered SCS Doc." and the "Redbook" versions. The "Blue cover" versions will be loaded to the server as soon as they are available. When the "Redbook" version is available, this report will replace the previous "Blue cover" versions. The use of electronic media for dissemination of information should reduce production and shipping costs considerably. STACPUB accordingly **recommended** that *any savings of funds be used for hiring and training of personnel as necessary for maintenance of the Website and FTP server.*

e) **Scientific Citation Index (SCI)**

STACPUB noted that it would be appropriate to include the Journal into the Scientific Citation Index. STACPUB was informed by the Assistant Executive Secretary that no costs are involved to have the Journal in SCI, however, the SCI undertakes its own review of suitable Journals to be included in its citation index. It was agreed that the STACPUB Chairman will write to SCI to recommend the Journal for inclusion in the index.

6. **Editorial Matters Regarding Scientific Publications**

a) **Review of Editorial Board**

STACPUB noted that there were no changes in the Editorial Board.

b) **Progress Report of Publication on Shrimp in Division 3M**

STACPUB noted this matter was discussed under Section 5a above.

It was the unanimous decision of STACPUB that future invitational papers should go through normal peer review process as practiced by the Journal.

c) **Considerations for Publishing Symposium Proceedings**

STACPUB reaffirmed that co-convernors of Symposia should normally serve as editors of the proceedings publications. STACPUB also reiterated that the Symposium convenors have the responsibility for expediting the publication process of the Symposium proceedings. It was agreed that such editorial work be closely coordinated with the Assistant Executive Secretary to ensure publication of the Symposium volume within one year. Effective with the 1999 Shrimp Symposium, guidelines will be established to expedite the editorial process.

d) **Progress Review of Publication of 1995 Symposium**

The 1995 Symposium proceedings were published in Journal Vol. 22 with a date of December 1997.

STACPUB commended the Assistant Executive Secretary for having undertaken the large workload required to finalize the 1995 Symposium proceedings.

e) **Progress Review of Publication of 1997 Symposium**

The 1997 Symposium proceedings are in the final galley stage, and are expected to be published by mid-1998. STACPUB acknowledged the valuable work done by the Assistant Executive Secretary in doing the entire review of the Symposium contributions.

7. **Papers for Possible Publication**

a) **Review of Proposal Resulting from the 1997 Meetings**

STACPUB noted that a total of 54 papers were published or are in the final stage of galley preparation (45 in the Journal and 9 in the Studies) since June 1997.

b) **Review of Contributions to the March 1998 Workshop on Precautionary Approach**

There were no papers in the March 1998 Workshop that would require a Special Publication on Precautionary Approach issues. It was noted that 2 papers submitted during the June 1997 Meeting related to the Precautionary Approach have already been accepted for publication in Studies.

c) **Review of Contributions to the June 1998 Meeting**

There was considerable discussion on STACPUB's responsibilities in proposing SCR Documents for submission to either the Studies or the Journal. STACPUB concluded that the proposal procedure be continued, and papers which arrive during the June Meeting, but after the STACPUB meetings, be considered during the following September Meeting.

STACPUB considered the SCR Documents suggested by authors as well as 1 SCR Document suggested by STACPUB members and 3 SCR Documents suggested by Designated Experts, and nominated the following 12, including the standard papers on overview of environmental conditions: SCR Doc. 98/15, 16, 17, 24, 32, 33, 34, 35, 36, 37, 38 and 42.

At its meetings since 1980, STACPUB has nominated a total of 600 research documents as potential for publication in the NAFO Journal and Studies. This includes 12 documents nominated at the June 1998 Meeting. Since 1980, a total of 544 papers have been published, in the Journal (258) and Studies (286).

8. **Other Matters**

STACPUB noted the increased importance of computers to the work of the Scientific Council and **recommended** that *Scientific Council form an Ad hoc Working Group to review current and future needs.*

The Chairman thanked the participants for their valuable contributions, and in particular the Assistant Executive Secretary and the NAFO Secretariat for preparation of documentation, and the rapporteur for compiling the report. There being no further business, the meeting was adjourned.