PART A

Scientific Council Meeting, 1-15 June 2000

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Participants at Scientific Council Meeting, 1-15 June 2000 (Bottom to top – left to right):

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REPORT OF SCIENTIFIC COUNCIL MEETING

1-15 June 2000

Chairman: W. B. Brodie Rapporteur: T. Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 1-15 June 2000, to consider the various matters in its agenda.

Representatives attended from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), Estonia, European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Russian Federation and United States of America. The Assistant Executive Secretary was in attendance. An observer from the Netherlands, two ICES representatives and an invited speaker from Norway were present for short periods.

The Executive Committee met prior to the opening session of the Council, and the Provisional Agenda, plan of work and other related matters were discussed.

The opening session of the Council was called to order at 1015 hours on 1 June 2000.

The Chairman welcomed everyone to Dartmouth and to this new venue for the June Meeting. The Assistant Executive Secretary was appointed rapporteur.

The Assistant Executive Secretary informed Council that authorization had been received for proxy votes from Estonia, Latvia and Norway to record their abstentions during any voting procedures.

In the review of the Provisional Agenda, the Chairman noted one modification was needed to include stock monitor of witch flounder in Div. 2J and 3KL. In addition, it was noted that each Standing Committee may include some changes. The Council agreed each Standing Committee should review and report on the previous year's recommendations. The Council **adopted** the agenda with the proposed revision (see Agenda I, Part D, this volume).

The Chairman recalled that E. J. Molenaar, University of Utrecht, who had requested to attend the Scientific Council as an observer, was due to come some time during the course of this meeting.

It was noted W. Melle, Institute of Marine Research, Norway, was the invited speaker in the STACFEN sessions.

In the review of the work plan, the Council noted this year different criteria for providing advice would apply, since some stocks will only be monitored. The Council agreed Designated Experts would address these as needed.

The Council welcomed E. Trippel (Canada) to present the Chairman's update on the progress of the Working Group on Reproduction Potential (see Section XI below).

The Chairman noted an election was needed to the Chair of STACFEN to take office at the end of the NAFO Annual Meeting in September 2000 (see Section XII below).

In accordance with the new Rules of Procedure for STACPUB membership, the Council noted the appointment of members for 3-year periods was needed. Noting that A. Vazquez (Spain) would not be attending the June 2000 Meeting, the Council appointed C. Darby (EU-United Kingdom) to replace him on an interim basis. The Council invited C. Darby to consider continuing as a STACPUB member in subsequent meetings.

Having reviewed the work plan for each Agenda item, the Opening Session was adjourned at 1200 hours.

The Council reconvened briefly at 1645 hours on 3 June 2000.

Progress reports on two forthcoming Scientific Council Special Sessions were considered (see Section X below), and the meeting was adjourned at 1710 hours.

The Council reconvened at 0905 hours on 6 June 2000.

The Chairman presented a review of meetings in 2000 regarding the Precautionary Approach. There were two meetings; the CWP Intersessional Meeting of the Working Group on Precautionary Approach Terminology, and the Joint Scientific Council and Fisheries Commission Working Group on Precautionary Approach. This was followed by a discussion on future developments on the PA by the Scientific Council, as reported in Section III.1 and 2 below.

The Council then considered the recommendation with respect to the proposed millennium publication "NAFO Century Book" by the Executive Secretary, L. Chepel. Noting STACPUB had discussed this item to some extent, the STACPUB Chairman was requested to inform the Council on the status. The Council was informed that the Executive Secretary had made considerable progress on the compilation on his own accord. The Council agreed to request the Executive Secretary for an update (see Section XIII.4. below).

The session was adjourned at 1030 hours.

The Council briefly convened at 0910 hours on 9 June 2000, to address Agenda items XIII.2. regarding Scientific Council representation at ICES ACFM Meetings. The Council nominated W. R. Bowering (Canada), who is currently a Chairman of an ICES Working Group, to be the NAFO Scientific Council observer at ICES ACFM in autumn 2000. The Council extended its appreciation to W. R. Bowering for undertaking this role. A summary of the meeting of FAO ACFR Working Party on Status and Trends of Fisheries was presented by the Assistant Executive Secretary (see Section XIV.1). The Council then considered a proposal for the September 2002 Symposium (Section X.4), and particularly reviewed the financial implications of such a proposed Symposium as well as other Symposia hosted by the Scientific Council (see Section XIV.5.d below).

The session was adjourned at 0945 hours.

During a session on 10 June 2000, the Council was presented a summary of the Joint NAFO/ICES Working Group on Harp and Hooded Seals (see Section XIV.4).

The Council noted H. Lassen, ICES Scientific Advisor, and Tore Jakobsen, Chairman, ICES ACFM, briefly visited the Council as observers.

Noting that two additional STACPUB members were needed in accordance with STACPUB deliberations on the rotating membership, the Council appointed H. Siegstad (Denmark/Greenland) and D. Maddock Parsons (Canada) as STACPUB members. The Council also noted the STACPUB recommendation that a meeting of the Executive Committee should take place near the end of each June meeting. Accordingly, the Chairman held a meeting of the Executive Committee on 13 June 2000 to consider Scientific Council matters related to NAFO budget. The Council noted the Chairman will submit an itemized budget to the General Council Meeting in September 2000.

The Council met as necessary through 12-14 June 2000.

The concluding session of the Council was called to order at 0900 hours on 15 June 2000.

Outstanding agenda items were addressed. The Council discussed its meeting schedules and future meetings, and considered and **adopted** the Reports of the Standing Committees.

The Council then considered and **adopted** the Report of the Scientific Council of this Meeting of 1-15 June 2000, noting changes as discussed during the reviews would be made by the Chairman and Assistant Executive Secretary.

The meeting was adjourned at 1300 hours on 15 June 2000.

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

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

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

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 1999

The Council noted recommendations made in 1999 pertaining to the work of the Standing Committees would be addressed directly by the Standing Committees, while recommendations pertaining specifically to the Council's work would be considered under each relevant topic of its Agenda.

III. IMPLEMENTATION OF PRECAUTIONARY APPROACH (PA)

1. Review of Results of 1999/2000 Meetings

The Chairman noted that there were two meetings concerning the Precautionary Approach (PA): the CWP Intersessional Meeting of the Working Group on Precautionary Approach Terminology during 14-16 February 2000 at ICES Headquarters, Copenhagen, Denmark (SCS Doc. 00/7), and the Joint Scientific Council and Fisheries Commission Working Group on Precautionary Approach (FC Doc. 00/2) during 29 February-2 March 2000, Brussels, Belgium.

The Scientific Council Chairman, W. B. Brodie, who chaired the CWP Intersessional Meeting: *Working Group on Precautionary Approach Terminology*, presented a summary. Representatives of Fisheries and Agricultural Organization (FAO), International Commission for the Conservation of Atlantic Tunas (ICCAT), International Council for the Exploration of the Sea (ICES), and NAFO attended. NAFO Scientific Council was represented by W. R. Bowering (Canada), D. Rivard (Canada) and K. Patterson (EU), and Assistant Executive Secretary, T. Amaratunga, was in attendance.

The terms of reference for the meeting were 1) Review the terminology and definitions of concepts in use by the different agencies, and 2) Identify where concepts are identical and where these differ; explore consequences of such differences in concepts to the reference points used for providing scientific advice within the PA.

The Working Group produced several detailed comparisons on the terminology and concepts in the PA frameworks that are in use or being developed within the three scientific agencies (NAFO, ICES, ICCAT). The Working Group concluded that although specific interpretations of the United Nations Fish Stock Agreement (UNFSA) guidelines differed, the objectives of these three scientific agencies share these common elements:

Reference points should be chosen in such a way as to allow managers to operate a fishery to take sustainable yields close to the estimated long-term maximum. Reference points should generally lead to stock dynamics, which satisfy these conditions, in order of priority: a) Low probability of recruitment over fishing, b) The choice of thresholds should be made so as to avoid a recruitment collapse or to minimize risk when approaching an area where the stock dynamics are poorly known.

The $_{PA}$ ref. points of ICES, the $_{Buf}$ ref. pts. of NAFO, and the $_{Threshold}$ concept of ICCAT all refer to the same idea, i.e. to provide a buffer or safety margin to ensure that there is a high probability that the $_{Limit}$ ref. points on biomass or fishing mortality will not be reached. There are a number of other initiatives on the PA underway in various organizations and national departments. Thus, even if it were possible, the Working Group concluded that it may be premature to recommend a common approach to the PA. In many cases, work on the PA is very much in the exploratory stage.

Scientific Council noted that the full report of this Working Group was available in SCS Doc. 00/7.

The Scientific Council Chairman, W. B. Brodie, who was the co-chairman of this meeting, along with J. Baird (Canada) appointed by the Fisheries Commission, presented a summary of the *Joint Scientific Council and Fisheries Commission Working Group on Precautionary Approach*, which took place 29 February-02 March 2000, in Brussels, Belgium. This was the third such meeting of this Working Group, and the full report is contained in FC Doc. 00/2. The main agenda items dealt with:

- harmonization of concepts and terminology
- operationalizing the PA into the management plans for three model stocks
- implementation plan for the PA for other NAFO stocks
- consideration of changes or additions to the Fisheries Commission request to Scientific Council to reflect the PA
- consideration of criteria for reopening a fishery in light of the PA
- consideration of additional supportive management measures to complement the application of the PA.

Under harmonization, the joint Working Group concluded that although no formulations of the PA framework had been accepted by international fisheries organizations, including NAFO Fisheries Commission, several elements of the PA have been implemented by various management authorities. There are several broad similarities between the ICES and NAFO versions of the PA, and the Working Group preferred NAFO's B_{buf} term as opposed to B_{pa}.

The WG concluded that determination of harvest control rules is the role of managers. In the NAFO context, it is the Fisheries Commission's responsibility to determine appropriate harvest strategies corresponding to reference biomass levels.

The NAFO Scientific Council framework proposes that F_{lim} should be set no higher than F_{msy}, based on its interpretation of the United Nations Fish Stock Agreement (UNFSA). The ICES framework does not make specific reference to F_{msy}. The Working Group did not reach agreement on which formulation was more appropriate. Differences of opinion may be related to experiences with fish stocks in the Northwest Atlantic as regards to their response to exploitation *vs* the Northeast Atlantic. It was observed much work is happening on PA nationally in many Contracting Parties, and seeking complete harmonization at this time may be premature.

Under operationalizing/implementing the PA, the Working Group noted that the three model stocks were cod in Div. 3NO, yellowtail flounder in Div. 3LNO, and shrimp in Div. 3M, and that ongoing work on the PA for the shrimp stock in Div. 3M would be examined at the Scientific Council Meeting in November 2000. The following is an example (for Div. 3LNO yellowtail flounder, see Annex 7 of FC Doc. 00/2) of an action plan for implementing the PA. Similar plans were proposed by the Working Group for cod in Div. 3NO, and American plaice in Div. 3LNO (the latter as an example of an implementation plan for other NAFO stocks). The proposed plans also included additional supportive management measures to complement application of the PA.

For **Yellowtail Flounder in 3LNO**:

Objectives: The action plan for implementation of a PA should include the eight objectives discussed at the Joint Scientific Council/Fisheries Commission Working Group meeting in May 1999:

1) Maintain harvest levels that will continue to rebuild and maintain the stock biomass above the rebuilt biomass level.
2) Continue with a comprehensive suite of management measures.
3) Ensure a conduct of the fishery in a manner that will not jeopardize recovery of other stocks in the area which are currently under moratorium, specifically cod in Div. 3NO and American plaice in Div. 3LNO.
4) Performance measures of interest to the managers could be expressed in terms of biomass and its trajectory and where it is with respect to the reference level and catch levels. With respect to catch, the performance measure was: cumulated yield, yield trajectories and trends (in particular, to identify declining trends).
5) It was noted that production models do not permit determination of all reference points. It should be ensured that data are available for scientists to move toward using age-structured modeling.
6) Despite these limitations, production modeling is a tool that could be used to start to evaluate real F limits and could be used to provide insight to what will happen if there are lower or higher fishing mortality levels.
7) There is a need to develop "target" biomass levels that could be higher than the biological limits so as to take into account management objectives including economic considerations.

8) Endorse the work of the Scientific Council in its attempts to develop a better understanding of the stock-recruit relationship.

Management Strategies

1) As a management objective, Fisheries Commission should maintain SSB at a level that will continue the probability of good recruitment and maintain the stock at a level that will support a sustainable fishery.
2) Given that the present estimate of F_{buf} is in the same range as the 2/3 F_{MSY} value used in past requests from Fisheries Commission, the value of 11% for exploitation rate could continue to be used by Fisheries Commission as a basis for establishing catch levels until such time as Scientific Council may recommend an alternative.
3) Fisheries Commission requests Scientific Council to give priority to work aimed at calculation of possible biological reference points as appropriate including age-based models and any other applicable stock evaluation methodologies.
4) Fisheries Commission shall, as appropriate, review and revise these management measures and strategies based on any new advice provided by Scientific Council.

Data Collection/Analyses

1) Scientific Council and Fisheries Commission should encourage continuation of multiple annual surveys in support of stock assessment
2) Contracting Parties should ensure that appropriate data are collected and that scientists utilize stock evaluation techniques that allow for estimation of stock size and exploitation rates, risk assessment procedures, and a fuller evaluation of reference points.
3) Scientific Council continues efforts to develop a better understanding of the stock-recruit relationship.
4) Scientific Council and Contracting Parties continue to monitor expansion of the range into Div. 3L.
5) Scientific Council and Contracting Parties continue to monitor recruitment as well as trends in weight-at-age.
6) Scientific Council review and update, as necessary, information on spawning locations and timing.
7) Scientific Council provide updated information to the Fisheries Commission regarding the distribution of juvenile yellowtail flounder in relation to adult distribution.

Supportive Management Measures/Good Practices

1) Fisheries Commission should take steps to minimize the catch of juveniles, and ensure that the total catches of yellowtail flounder are in accordance with the target exploitation rate. Some measures that could be considered to achieve this objective are:
   - Review of current directed fisheries for the determination of specific yellowtail flounder by-catch problems so that remedies can be applied.
   - A revision of conservation and technical measures that only permit by-catch that is truly incidental in nature.
   - Closure of specific areas for specific periods of time identified as: a) nursery areas, and b) areas where high concentrations of juveniles are found.

2) Fisheries Commission explore the utility of closure periods to protect spawners as well as the utility of closures of areas identified as spawning locations.

Under consideration of changes or additions to the Fisheries Commission's request to Scientific Council to reflect the PA, the following points were referred to Scientific Council for consideration at its meeting in June 2000:

1) Many of the stocks in the NAFO Regulatory Area are well below any appreciable level of B_{lim} or B_{buf}. For these stocks, the most important task for the Scientific Council is to inform on how to rebuild the stocks. In this context and building on previous work of the Scientific Council in this area, the Scientific Council is requested to evaluate various scenarios corresponding to recovery plans with time frames of 5 to 10 years, or longer as appropriate. This evaluation should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, including information on the consequences and risks of no action at all. Whenever possible, this evaluation should be cast in terms of risks analyses relating removals from various sources to B_{lim} (B_{buf}) and F_{lim} (F_{buf}).

   References to "risk" and to "risk analyses" should refer to estimated probabilities of stock population parameters falling outside biological reference points.

2) Where reference points are proposed by the Scientific Council as indicators of biological risk, they should be accompanied by a description of the nature of the risk incurred if the reference point is crossed (e.g. short-term risk of recruitment overfishing, loss of long-term yield, etc.)

3) When a buffer reference point is proposed in order to maintain a low probability that a stock, measured to be at the buffer reference point may actually be at or beyond the limit reference point, the Scientific Council should explain the assumptions made about the uncertainty with which the stock is measured, and also the level of 'low probability' that is used in the calculation.

4) Wherever possible, short and medium-term consequences should be identified for various exploitation rates (including no fishing) in terms of yield, stability in yield from year to year, and the risk or probability of moving the stock beyond B_{lim} or B_{buf}. Whenever possible, this information should be cast in terms of risk assessments relating fishing mortality rates to the risks of falling below B_{lim}, the risks of stock collapse and recruitment overfishing, as well as the risks of growth overfishing and the consequences in terms of both short and long-term yields.

5) When providing risk estimates, it is very important that the time horizon be clearly spelled out. By way of consequence, risks should be expressed in time frames of 5, 10 and 15 years (or more), or in terms of other appropriate year ranges depending on stock specific dynamics. Furthermore, in order to provide the Fisheries Commission with the information necessary to consider the balance between risks and yield levels, each harvesting strategy or risk scenario should include, for the selected year ranges, the risks and yields associated with various harvesting options in relation to B_{lim} (B_{buf}) and B_{target} and F_{lim} (F_{buf}) and F_{target}.

Under consideration of criteria for reopening a fishery in light of the PA, the Working Group noted that stocks under moratoria have been characterized by a very low spawning stock biomass and a reduced age-range. There is often a concern that the level of spawner biomass reached corresponds to a level where the chance of producing good year-classes is greatly reduced. Once recovery has begun and spawner biomass has reached a level sufficient to allow consideration of reopening of the fishery, under a Precautionary Approach this reopening must be consistent with a strategy of continued stock rebuilding.

The discussion related to stocks under moratoria has necessarily focused on the strategy to reach the first benchmark to rebuilding, i.e. B_{lim}. In order to monitor the progress of stock rebuilding, milestones should be established so as to permit a review of the stock trajectory in relation to reference points within reasonable time frames. For the stocks currently under moratorium, the other elements of a precautionary approach (i.e. other than B_{lim}), have not received detailed attention. Key considerations in the decision of re-opening include the determination of B_{lim}, the determination of the fishing mortality (F) at re-opening, the probability of continued growth in the stock, the trade-off between yield/probability of growth in the stock and the risks that the stock could actually fall (again) below a pre-determined limit.

The other elements of a PA will need to be defined. Also, any reopening of commercial activity should only be contemplated under specific conditions. In particular, increased focus on additional conservation measures such as limitations on by-catch is required in order to afford the resource the best chance of recovery.

As such, additional technical management measures may be specified including, but not limited to the following:

a) *Protection of Spawners:*

Management should incorporate controls to limit the catch during the main spawning periods in order to ensure the best possible spawning success. Information can be made available from scientists to guide managers in this regard. Scientists can also provide information regarding spawning areas for possible protection as well (see above).

An important conservation objective should be to allow development of a full age-range in the spawner population in order to promote the best possible stability in annual recruitment.

b) *Protection of Pre-recruits (Area Closures):*

Specific areas that have been clearly identified as significant nursery areas should be closed, as appropriate, for a specified time so as to minimize the mortality on small fish. In addition, other management measures to protect small fish should be considered.

c) *Concerns with By-catch:*

Fisheries for other species that might result in by-catch of the species under consideration must be conducted in such a manner so as to keep by-catch at the lowest possible level. This would necessitate careful review of possible management strategies including adequate monitoring.

d) *Concerns with By-catch of Other Species:*

Fisheries for the directed species that might result in by-catch of other species, especially those under moratoria, must be conducted in such a manner so as to keep by-catch at the lowest possible level. This would necessitate careful review of possible management strategies including adequate monitoring.

These were the key points highlighted from the Working Group report. Scientific Council noted that this report (FC Doc. 00/2) would be presented to Fisheries Commission during the Annual Meeting in September 2000.

2. **Future Development**

Further to the meetings on PA during 2000, the Chairman did not anticipate developments on the PA at Scientific Council, and deferred its framework considerations until the Report of the Joint Scientific Council and Fisheries Commission Working Group on Precautionary Approach (29 February-2 March 2000) was reviewed by the Fisheries Commission during the 18-22 September 2000 NAFO Annual Meeting. However, the Scientific Council will structure its advice in the PA format and address PA issues as requested by the Fisheries Commission.

Noting that the Scientific Council has been working with the PA framework since 1997 while the Fisheries Commission has not adopted it, the Council recorded that the structure of the last three meetings of the Joint Scientific Council and Fisheries Commission Working Group was not optimal for discussion of the PA framework. The Council was of the view that less formal and smaller meetings in the form of dialogue between scientists and managers may see progress. It was also suggested that there may be more success if the Scientific Council presented applications of the PA to specific cases.

IV. FISHERIES ENVIRONMENT

The Council **adopted** the Report of the Standing Committee on Fisheries Environment (STACFEN), as presented by the Chairman, M. Stein. The full report of STACFEN is at Appendix I.

The **recommendation** made by STACFEN for the work of the Scientific Council as **endorsed** by the Council is as follows:

1. *NAFO's financial contribution to the Joint ICES/NAFO Symposium on "Hydrobiological Variability During the 1990s", August 2001,Edinburgh, Scotland, include the equivalent of GB 3 500 (approximately CDN $8 000) to cover partial costs of conducting the Symposium.*

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V. RESEARCH COORDINATION

The Council **adopted** the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chairman, R. K. Mayo. The full report of STACREC is at Appendix II.

The **recommendations** made by STACREC for the work of the Scientific Council as **endorsed** by the Council, are as follows:

1. *the Executive Secretary write to the national delegates of the USA and Denmark (in respect of Faroe Islands and Greenland) with reference to their obligations on the submission of data to NAFO.*

2. *the Scientific Council should prepare a document for submission to the General Council and the Fisheries Commission on the adverse effect the absence of the STATLANT 21A and 21B data was having on the work of the Scientific Council.*

3. *the Secretariat should extract from Scientific Council reports the annual estimates of the total catches for each stock for the period from 1985 used by STACFIS in its assessment work and report them alongside the annual STATLANT nominal catches.*

4. *for the fiscal year 2001, the following nominees be supported by the NAFO budget for meeting attendance: i) the Assistant Executive Secretary to the February 2001 meeting of the FAO and Non-FAO Regional Fishery Bodies or Arrangements and the associated CWP Intersessional Meeting at FAO Headquarters, Rome, Italy and ii) the Assistant Executive Secretary and the STACREC Chairman to the CWP 19th Session in Noumea, New Caledonia (9-13 July 2001).*

5. *the comparative fishing in Div. 3NO be continued during future spring surveys conducted by EU-Spain and Canada.*

VI. PUBLICATIONS

The Council **adopted** the Report of the Standing Committee on Publications (STACPUB) as presented by the Chairman, O. Jørgensen. The full report of STACPUB is at Appendix III.

The **recommendations** made by STACPUB for the work of the Scientific Council as **endorsed** by the Council are as follows:

1. *STACREC should consider proceeding with the publication of NAFO Statistical Bulletin for 1994 without the USA data.*

2. *an Executive Committee Meeting be held near the end of the June Meeting to evaluate financial impacts on the NAFO budget which arise from deliberations and decisions made during the course of that meeting,* and

   costs associated with the above activities be enumerated and included in the Scientific Council budget request for 2001.

3. *the Scientific Council Reports and the Reports of the Annual Meeting be included in the contents of the CD-ROM, and the CD-ROM be issued before April of the following year.*

4. *electronic publishing of the Journal begin with the five papers currently awaiting publication in Volume 26.*

With respect to STACPUB deliberations on late submission of SCR/SCS Documents (see Appendix III, Section 9.i), the Council noted the difficulties of not receiving finalized papers by the time the meeting report is finalized, and urged authors to submit the revised papers within the two-week time frame after the meeting.

VII. FISHERIES SCIENCE

The Council **adopted** the Report of the Standing Committee on Fisheries Science (STACFIS) as presented by the Chairman, H.-J. Rätz. The full report of STACFIS is at Appendix IV.

The Council endorsed **recommendations** specific to stock considerations are highlighted under the relevant stock in the STACFIS Report at Appendix IV.

VIII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. Fisheries Commission

For stocks within or partly within the Regulatory Area, the Fisheries Commission requested scientific advice.

a) Request for Advice on TACs and Other Management Measures for Year 2001

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 1999 agreed to consider certain stocks on an alternating basis. This section presents those stocks for which the Scientific Council provided scientific advice for the year 2001.

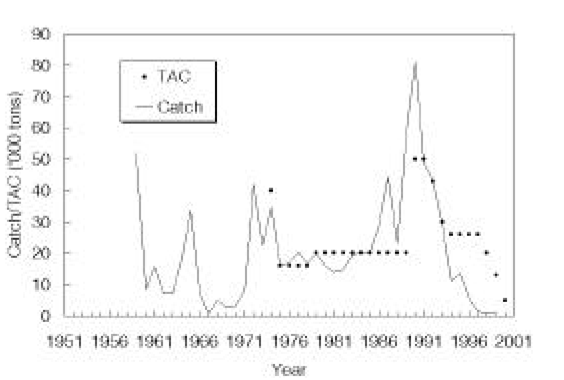
Redfish (Sebastes spp.) in Division 3M

Background: There are 3 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 present assessment evaluates the status of the Div. 3M beaked redfish stock, regarded as a management unit composed of two populations from two very similar species (*Sebastes mentella* and *Sebastes fasciatus*). The reason for this approach is that evidence indicates this is by far the dominant redfish group on Flemish Cap.

Fishery and Catches: The redfish catches in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, falling continuously through 1999, when 1100 tons was reported, mostly as by-catch in the Greenland halibut fishery. The decline in the Div. 3M redfish catches from 1990 to 1999 was related with the simultaneous quick decline of the stock biomass and fishing effort. Despite the fact that since 1995 the redfish by-catch within the shrimp fishery in Div. 3M fell to lower levels, it still constitutes at age 1, on average (1996-99), 20% of the catch in numbers.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	TAC ('000 tons) Agreed
1997	1.5	20	26
1998	1.2	20	20
1999	1.1	10	13
2000		3-5	5

[1] Provisional, including redfish by-catch in the shrimp fishery in Div. 3M.



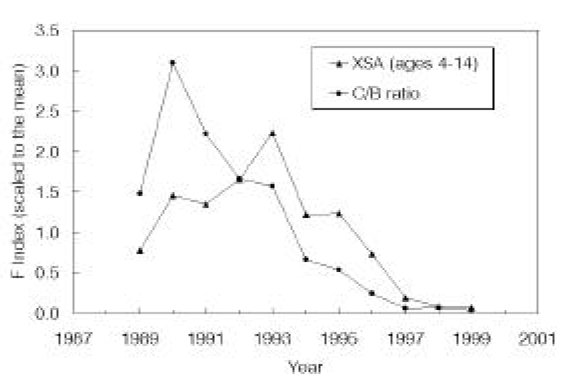
Data: Catch-at-age data were available from 1989-99 including by-catch information from the shrimp fishery.

Catch rate data for 1959-93 were available from the NAFO database.

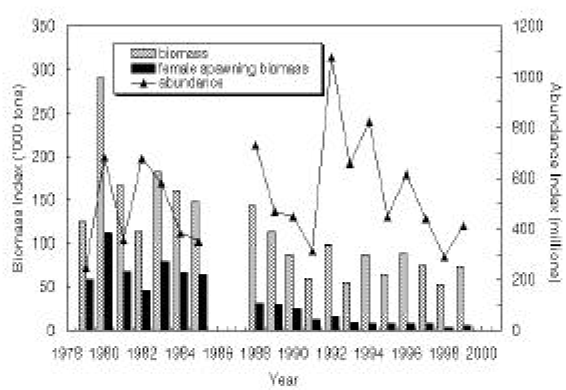
There are three survey series providing bottom biomass indices as well as length and age data for the Flemish Cap redfish stocks; Russia (1983-93 and 1995-96), EU (1988-99) and Canada (1979-85 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic component for the 1988-92 period.

Assessment: Survey bottom biomass and female spawning biomass were calculated from 1979-89 Canadian and 1988-99 EU surveys. A virtual population analysis (XSA) and a surplus production analysis (ASPIC) were carried out for 1989-99, providing estimates of stock biomass and fishing mortality trends.

Fishing Mortality: The ratio of F to F_{msy} was well above 1.0 until 1994. From 1996 onwards this ratio declined to very low levels.

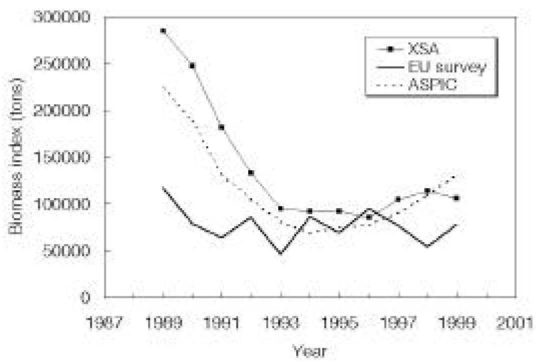


Recruitment: Recruitment at age 4 is fluctuating with no apparent trend in recent years. There has been no strong pulse of recruitment observed since late-1980s, early-1990s.



Biomass: Survey indices and model results indicate a decline of total biomass since the late-1980s. Trends from both XSA and ASPIC models suggested a gradual recent increase in total biomass (1997-99), but that was not seen in the survey results. Spawning biomass has also declined since the late-1980s and from 1994 onwards has remained at a relatively low level.

Over the past 5 years, female spawning stock biomass has been about 10%-15% of the total biomass. During first 5 years of the more recent 1989-99 time period that proportion was about 22-30%.



State of the Stock: Scientific Council concluded that while the decline in stock biomass appears to have halted, it is still unclear as to whether there has been any actual increase. The total stock and spawning stock are currently at a low level compared to the earlier period in the time series. At the current low fishing mortality, and with growth of the relatively strong 1989-90 year-classes, stock and spawning biomass should gradually increase.

Recommendation: The Council was unable to advise on a specific TAC for year 2001, however, in order to maintain relatively low fishing mortalities so as to promote stock recovery, Scientific Council recommends that catch for Div. 3M redfish in year 2001 be in the range of 3 000-5 000 tons.

Reference Points: No updated information on biological reference points was available.

Special Comments: By-catch of juvenile redfish in the shrimp fishery should be kept at the lowest possible level. Redfish by-catches in this shrimp fishery should be closely monitored with information on length distributions and weights and numbers caught being reported on a regular basis to Scientific Council each November during the assessment of shrimp in Div. 3M.

Sources of Information: SCR Doc. 99/96, 00/9, 34; SCS Doc. 009, 16.

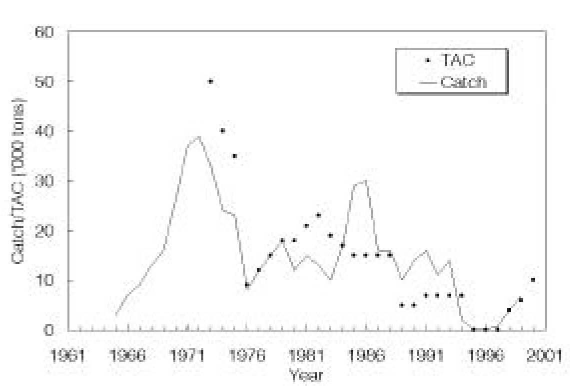
Yellowtail Flounder (Limanda ferruginea) in Divisions 3L, 3N and 3O

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 and a catch of 4 400 tons was taken. In the 1999 fishery a catch of 6 700 tons was taken.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	Agreed
1997	0.8	ndf	0
1998	4	4	4
1999	7	6	6
2000		10	10

[1] Provisional.
ndf No directed fishery.

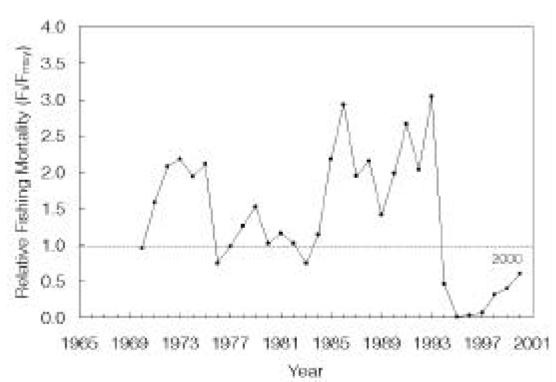


Data: CPUE were available from 1965 to 1999. Limited by-catch sampling data from the Russian, Portuguese and Spanish trawler fleets were available. Abundance and biomass indices were available from: annual Canadian spring (1971-82; 1984-99) and autumn (1990-99) bottom trawl surveys; annual USSR/Russian spring surveys (1972-91); co-operative Canadian Dept. Fisheries and Oceans/Canadian fishing industry surveys (1996-99); and, Spanish surveys in the NAFO Regulatory Area of Div. 3NO (1995-2000).

The analyses of ages were inconclusive due to the unresolved questions about ageing.

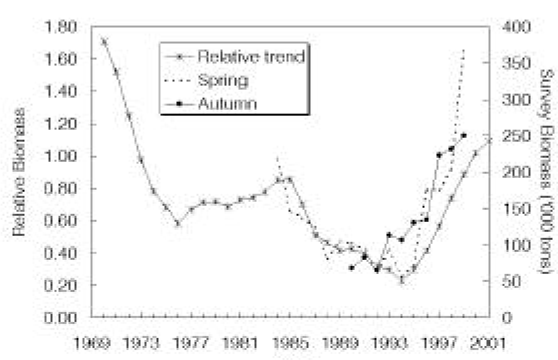
Assessment: An analytical assessment using a stock production model was presented to estimate stock status in 2000.

Fishing Mortality: Has been low since 1994 and is projected to be 61% of F_{msy} in 2000 with an assumed catch of 11 000 tons.



Recruitment: Abundance at length indicated the presence of large numbers of juveniles in the 1999 Canadian autumn survey when compared to other years.

Biomass: The large increase in the survey biomass index in Div. 3LNO in the 1999 Canadian spring survey is indicative of a large change in catchability, i.e. a year effect. Relative biomass from the production model has been increasing since 1994 and is projected to be above the level of B_{msy} in 2001.



State of the Stock: Based on 5 additional surveys since the 1999 assessment, the current view is that the stock size has increased over the past year. The stock biomass is perceived to be at the level of that seen in the mid-1980s.

Recommendation: The TAC for the year 2001 should not exceed 13 000 tons, based on the projection of F= 2/3 F_{msy} and an assumed catch of 11 000 tons in the year 2000.

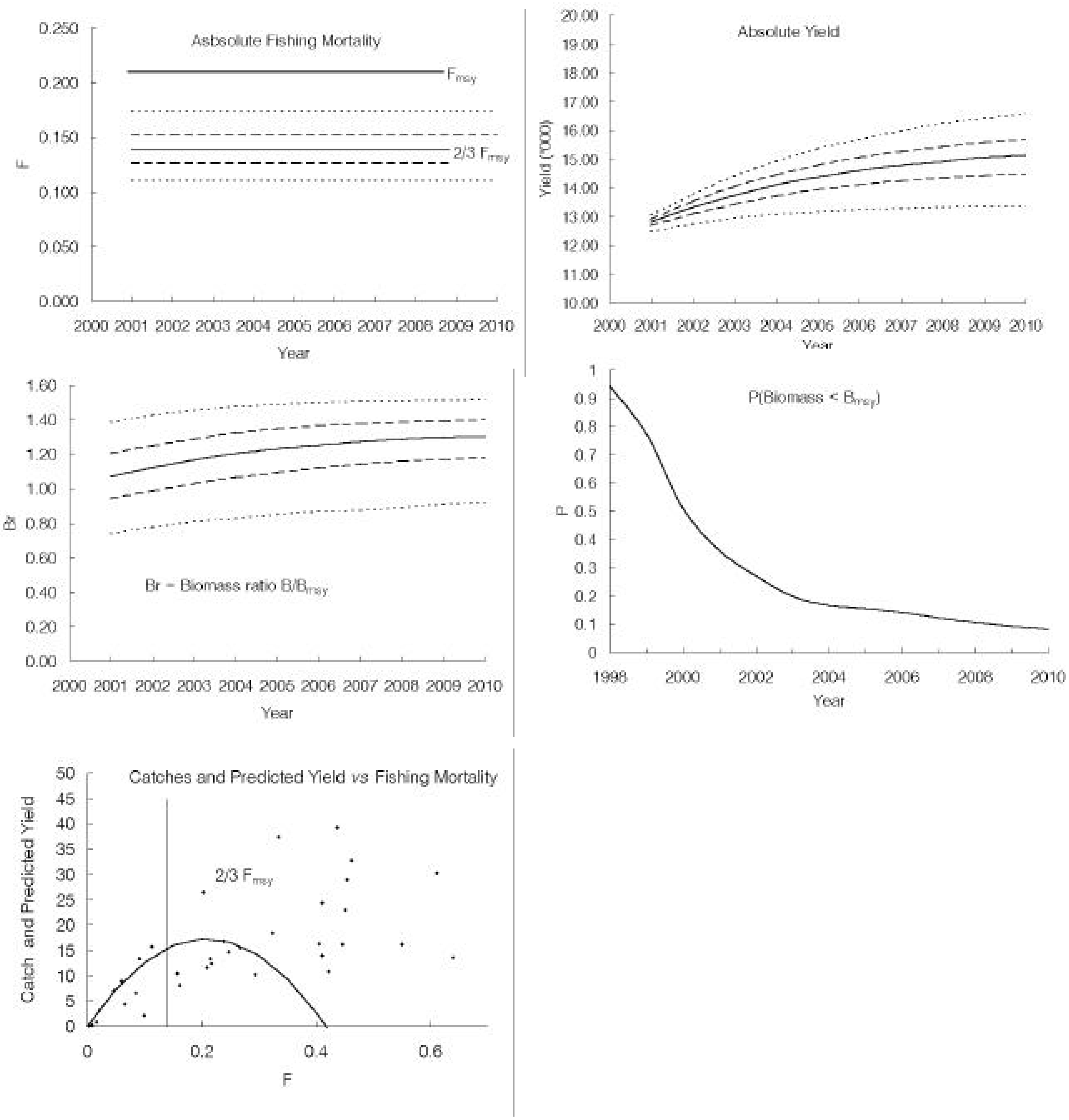
Reference Points: Scientific Council considered 2/3 F_{msy} of 0.139 to be a fishing mortality target but was unable to provide biomass based reference points.

Scientific Council notes it is not in a position to propose age based reference points for this stock at this time and recommends that priority be given to restore the Council's ability to do age-structure analyses on this stock.

Medium Term Considerations: Projections (see Figures below) were made to estimate yield for each year from 2001 to 2010 while constraining F at 2/3 F_{msy}. The results suggest that yield will increase to a maximum of 15 000 tons in the year 2010. The probability of biomass falling below B_{msy} decreases to less than 10% by 2010.

Sources of Information: SCR Doc. 00/35, 42, 44, 46, 50; SCS Doc. 00/9, 16, 20.

Yellowtail flounder in Div. 3LNO: figures show medium-term projections at a constant fishing mortality of 0.66 F_{msy}. The figures show the 5, 25, 50, 75 and 95th percentiles of fishing mortality, yield, potential yield/MSY, biomass and biomass/B_{msy}. The probability of biomass being less than B_{msy} is also given. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 11 000 tons in 2000.



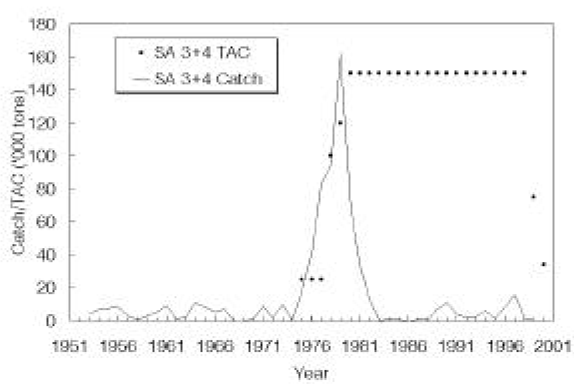
Short-finned Squid (Illex illecebrosus) in Subareas 3 and 4

Background: The northern short-finned squid 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 Subareas 3-6.

Fishery and Catches: Catches in Subareas 3+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 100 tons in 1986, ranged between 600 and 11 000 tons during 1987-95, increased to 15 800 tons in 1997, and declined to 300 tons in 1999. A TAC for Subareas 3+4 was first established in 1975 at 25 000 tons but was increased in 1978, 1979 and 1980. The Subareas 3+4 TAC remained at 150 000 tons during 1980-98 and was set at 75 000 tons for 1999 and 34 000 tons for 2000.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1997	15	na	150
1998	2	na	150
1999	0.3	19-34	75
2000		19-34	34

[1] Provisional.
na No advice provided.

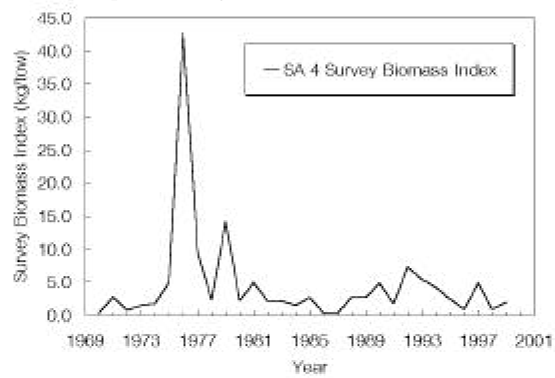


Data: Relative biomass and abundance indices were available from annual Canadian bottom trawl surveys conducted in Subarea 4 in July on the Scotian Shelf (Div. 4VWX, 1970-99) and in September in the southern Gulf of St. Lawrence (Div. 4T, 1971-99). The July survey indices are assumed to reflect relative stock size at the beginning of the fishing season. Size composition data were available from the Subarea 4 survey in July.

Assessment: Absolute biomass and recruitment estimates for the short-finned squid resource in SA 3+4 were not available.

Fishing Mortality: Relative fishing mortality rates increased in the mid-1970s and peaked during 1977-82. During 1983-99, 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 1982, survey biomass indices have been markedly lower indicative of low squid productivity.



State of the Stock: Based on the survey data, the short-finned squid resource in Subareas 3+4 has remained at a low level.

Recommendation: The Scientific Council is unable to advise on a specific level of catch for year 2001. 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 year 2001 for short-finned 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.

Reference Points: Scientific Council is not in a position to propose reference points at this time.

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.

Sources of Information: SCR Doc. 98/75, 00/36, 37. SCS Doc. 00/8, 14, 21.

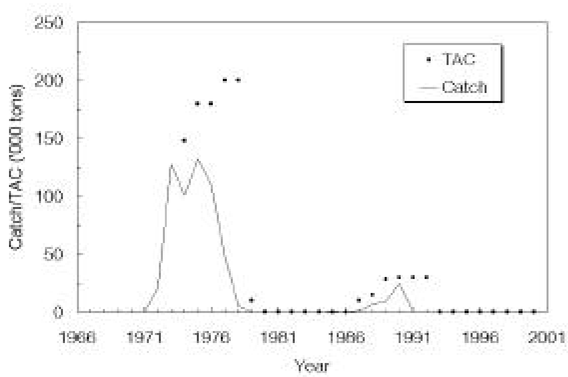
Capelin *(Mallotus villosus)* in Divisions 3N and 3O

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[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1997	-	na	0
1998	-	na	0
1999	-	na	0
2000	-	na	

na No advice possible.



Data: No recent data available. Scientific Council was informed that some recent research survey data were collected by Canada, but these have not been reviewed by Scientific Council.

Assessment: No assessment was possible.

For several years, the Scientific Council was not in a position to provide advice for capelin Div. 3NO due to absence of data. The Scientific Council proposes that it will give no advice until appropriate data are available.

Recommendation: No advice possible.

Special Comments: Scientific Council recommends to present all data available related to capelin in Div. 3NO for the 2001 June Meeting.

In the absence of new data Scientific Council will not be able to provide any advice for this stock in 2001.

Source of Information: SCS Doc. 00/21.

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

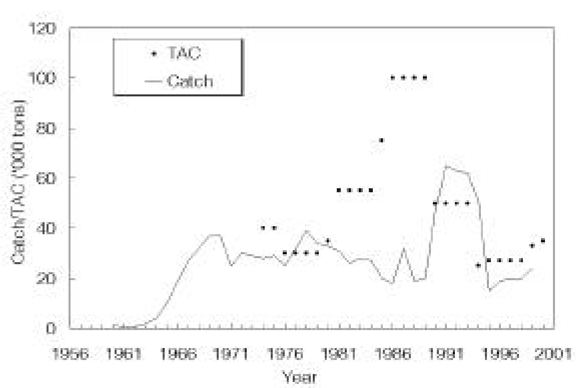
Background: The Greenland halibut stock in Subarea 2 and Div. 3KLMNO is considered to be part of a biological stock complex, which includes Subareas 0 and 1.

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 during 1995 to 1998 as a result of lower TACs under management measures introduced by the Fisheries Commission. The catch in 1999 was estimated to be 24 000 tons, the highest since 1994. Catches have been well below TACs during 1995-99.

Catches in the following table are best estimates.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1997	20		27
1998	20		27
1999	24	~30	33
2000	-	~30	35

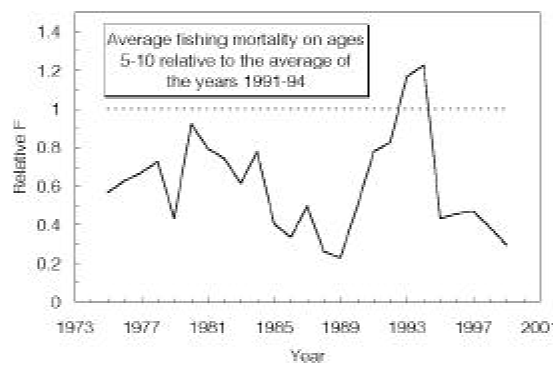
[1] Provisional.
[2] Established autonomously by Canada in 1993-94 and by the Fisheries Commission in 1995-2000.



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 (1978-99), EU (1988-99), and EU-Spain (1995-2000). The Canadian autumn surveys in 1996 to 1999 covered most of the stock distribution, including Div. 2GH. International commercial catch-at-age data were updated from 1989-99 providing a series from 1975-99.

Assessment: An analytical assessment using several calibration models was reviewed to estimate population numbers in 2000. The various estimation procedures led to biomass estimates for year 2000 that covered a wide range of values and methods that produced high estimates of biomass also produced low estimates of fishing mortality for 1999.

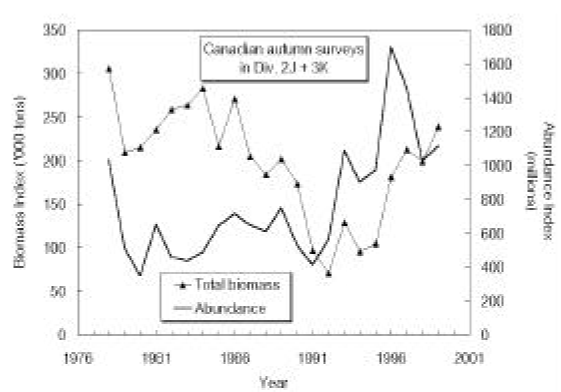
Fishing Mortality: While the levels of fishing mortality implied from these analyses were different, all methods indicated a fishing mortality level for 1999 that is relatively low in comparison to the early-1990s.



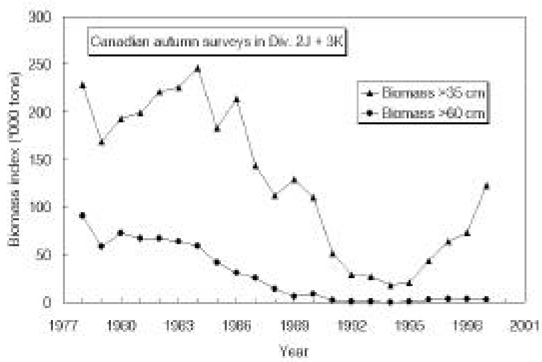
Recruitment: Above average recruitment indicated for the 1990-95 year-classes. The 1996 to 1998 year-classes appear to be average to below average. However, the comparability of the estimates may be significantly influenced by the change in survey gear in 1995.

Biomass: As the dynamics of the population are still uncertain, it is not possible to determine which method provides the best absolute estimate of biomass.

Most survey indices of biomass increased from 1996 to 1999.



Indices of fishable biomass since 1995 (greater than 35 cm) continued to increase as good year-classes recruit to the fishable stock. However, the biomass index of fish greater than 60 cm remains at a low level.



Portuguese CPUE increased in 1997-99 due mainly to recruitment of the 1990-92 year-classes.

State of the Stock: The stock appears to be recovering due to good recruitment and low fishing mortality but the biomass of fish over 60 cm is still low.

Catch Forecast: Short and medium term projections indicate that there should be scope for catches to increase up to 44 000 tons in 2001 without increasing fishing mortality. See Figures below.

Recommendation: The current assessment is considered uncertain. There is a high level of uncertainty associated with the estimates of the 1994 and 1995 year classes, and these year-classes are not yet represented in the catches. In addition, the high exploitation of immature fish and the low abundance of sexually mature fish (>60 cm) is indicative of a situation of significant biological risk, although this risk cannot be quantified at present. In the light of these uncertainties, Scientific Council recommends a stepwise approach to increasing the TAC. For 2001, Scientific Council recommends the catch should not exceed 40 000 tons. Future steps to increase the TAC should be considered on re-evaluation of the contribution of the 1994 and 1995 year-classes to the catches in 2000 during the 2001 assessment. This approach is consistent with considerations raised below under 'reference points'.

The Council again recommends that measures be considered to reduce, as much as possible, the exploitation of juvenile Greenland halibut in all fisheries.

Reference Points: The current assessment results are not considered sufficiently reliable to allow estimation of formal reference points in quantitative terms. Until such reference points can be provided, Scientific Council advises that :

- Fishing mortality should be maintained, with high probability, below the average level estimated for the period 1991 to 1994.

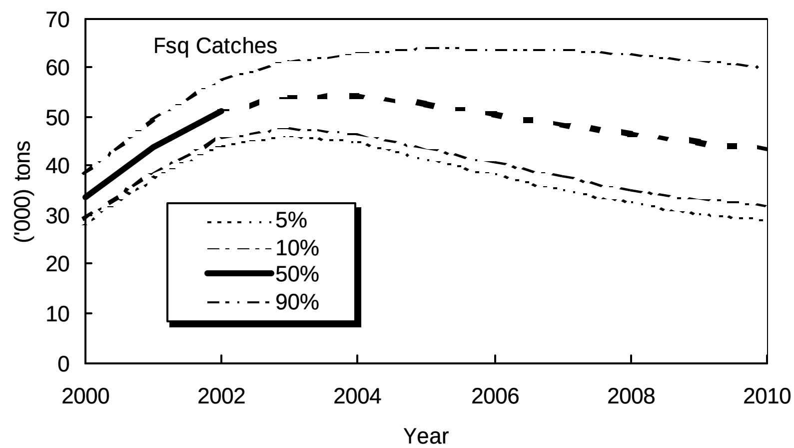
This approach is advised in order to maintain a low risk that the stock will enter regions of unknown dynamics, which are considered to have unacceptable levels of risk.

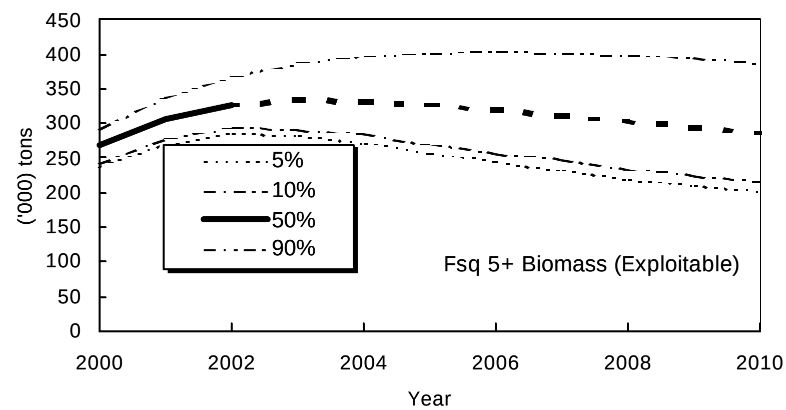
Special Comments: The Council reiterates its concern that the catches taken from this stock consist mainly of young, immature fish of ages several years less than those at which sexual maturity is achieved, and that such exploitation results in foregoing much potential yield.

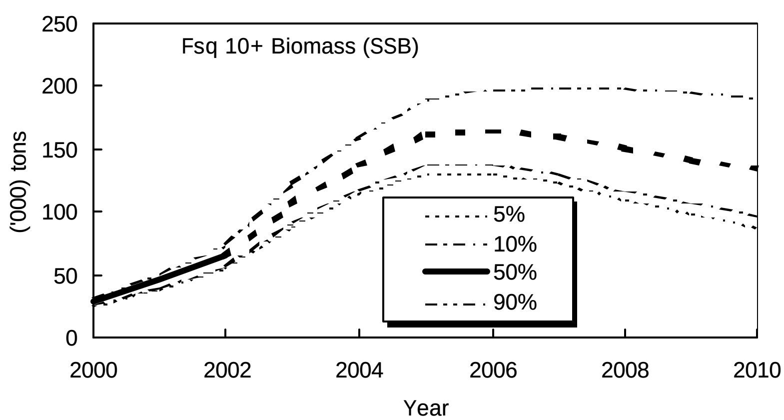
During previous assessments, Scientific Council has noted that fishing effort should be distributed in a similar fashion to biomass distribution in order to ensure sustainability of all spawning components. Application of this approach becomes increasingly important as the overall TAC is increased.

Scientific Council is also concerned that increased catches of Greenland halibut will result in increased catches of other species, some of which are currently under moratorium. It is strongly recommended that Fisheries Commission take steps to ensure that any by-catches of other species during the Greenland halibut fishery are true and unavoidable by-catches.

Sources of Information: SCR Doc. 00/6, 9, 12, 17, 24, 43, 46, 53, 54; SCS Doc. 00/9, 16, 19, 20.







Figures show the medium-term projections for Greenland halibut in Subarea 2 and Div. 3KLMNO.

b) **Request for Advice on TACs and Other Management Measures for the Years 2001 and 2002**

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 1999 agreed to consider certain stocks on a alternating basis. This section presents those stocks for which the Scientific Council provided scientific advice for the years 2001 and 2002.

Cod (Gadus morhua) in Division 3M

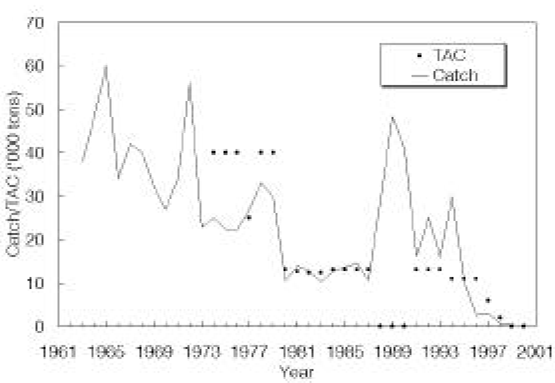
Background: The cod stock on Flemish Cap is considered to be a discrete population.

Fishery and Catches: Catches exceeded the TAC from 1988 to 1994, however, were below the TAC fom 1995 to 1998. 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 fisheries since 1996 were very small compared with previous years. In 1999 the fshery was closed, virtually all the catch was taken by vessels from non-Contracting Parties.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	Agreed
1997	2.9	ndf	6
1998	0.7	ndf	2
1999	0.4	ndf	0
2000		ndf	0

[1] Provisional.

ndf No directed fishery and by-catch of cod kept at lowest possible level.

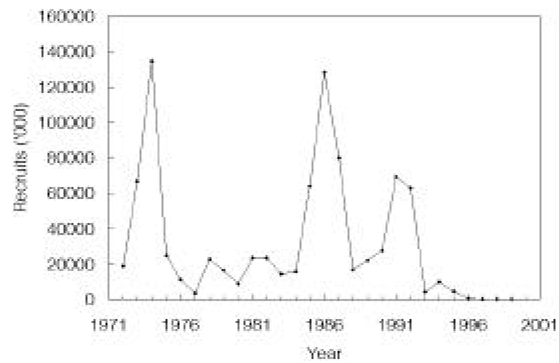


Data: Length and age composition of the 1999 catch was available for Portuguese trawlers. Data were also available from the EU bottom-trawl survey, which covers the whole distribution area of the stock.

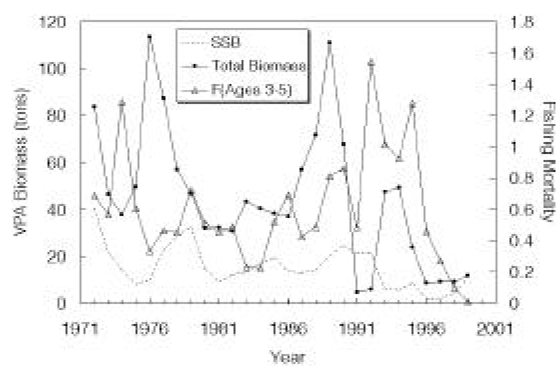
Assessment: An analytical assessment was presented.

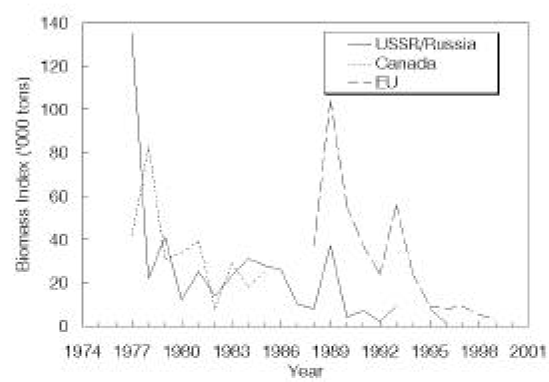
Fishing Mortality: Declined since 1996 as fishing effort and catches did.

Recruitment: The 1985 and 1991 year-classes were the most abundant in recent years. The 1992 to 1995 year-classes appear to be weak and, according to EU survey results, the 1996 to 1999 year-classes are even poorer.



Biomass: The stock biomass and spawning stock biomass at the beginning of 2000 remain at a very low level and is mainly composed by fish 6 and 7 years old. Fish younger are scarce due to the lower recruitment in last four years.





State of the Stock: The stock remains at a very low level.

Recommendation: No directed fishery for cod in Div. 3M in the years 2001 and 2002. Also, by-catch of cod in fisheries directed to other species on Flemish Cap should be kept at the lowest possible level.

Reference Points: There are uncertainties about the precision of the SSB and recruitment estimates. Nevertheless, the SSB-recruitment plot from the VPA shows that there was reduced recruitment at SSB below 14 000 tons, and this value might be considered as a preliminary estimate of B_{lim}.

Special Comments: The next Scientific Council assessment of this stock will be in 2002.

Sources of Information: SCR Doc. 00/9, 40; SCS Doc. 00/16.

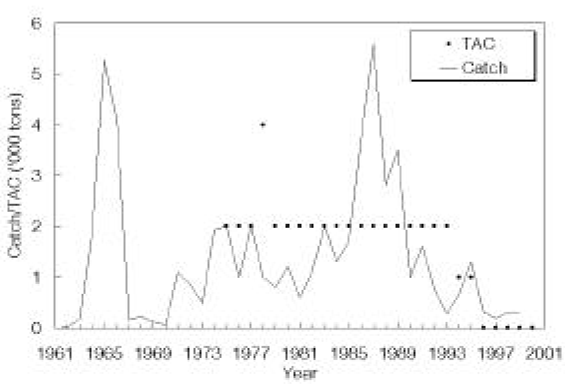
American Plaice (Hippoglossoides platessoides) in Division 3M

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.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1997	0.2	0	0
1998	0.3	ndf	0
1999	0.3	ndf	0
2000		ndf	0

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

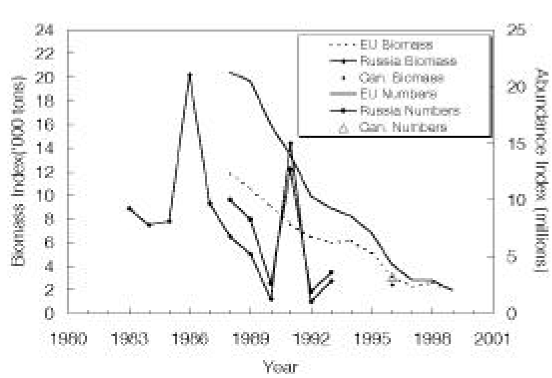


Data: Abundance and biomass indices from surveys were available from USSR/Russia (1983-93), EU (1988-99) and Canada (1996).

Assessment: No analytical assessment was possible.

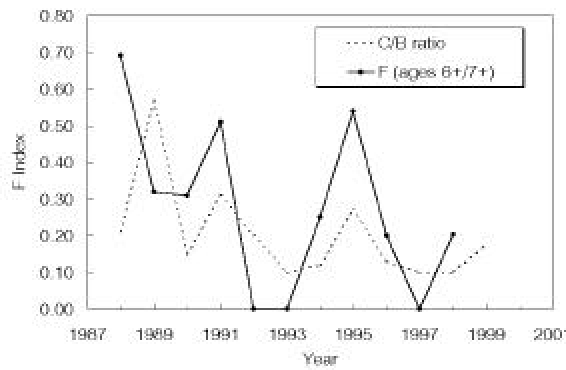
Recruitment: Only weak year-classes have been observed since 1990.

Biomass and Abundance:



The SSB index reached the maximum in 1988, remained more or less stable during 1990-94 and has been declining since 1995. The index in 1999 was at the lowest level observed (18% of the 1988 level).

Fishing Mortality: 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. Average Z estimated for ages 6 plus showed a decreasing trend during the 1990s.



State of the Stock: The stock biomass and the SSB are at a very low level and there is no sign of recovery, due to the consistent year to year recruitment failure since the beginning of the 1990s.

Recommendation: There should be no directed fishery on American plaice in Div. 3M in years 2001 and 2002. By-catch should be kept at the lowest possible level.

Reference Points: The Scientific Council is not in a position to propose reference points at this time.

Special Comments: Average recruitment per unit of SSB has been low since 1990.

The next Scientific Council assessment of this stock will be in 2002.

Sources of Information: SCR Doc. 00/9, 25; SCS Doc. 00/9.

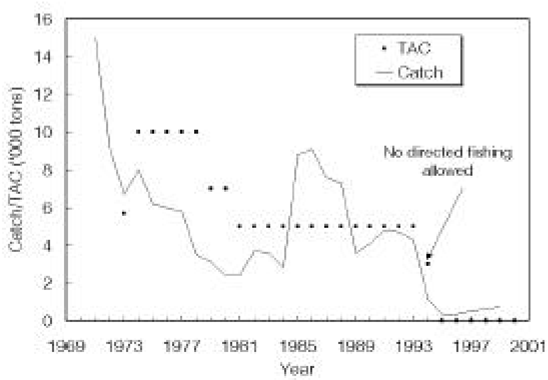
Witch Flounder (Glyptocephalus cynoglossus) in Divisions 3N and 3O

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

Fishery and Catches: Catches exceeded the TAC by large margins during the mid-1980s. The catches during 1995-98 ranged between 300-600 tons including unreported catches. The 1999 catch was 800 tons, the highest since 1994.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1997	0.5	nf	0
1998	0.6	nf	0
1999	0.8	nf	0
2000	-	nf	0

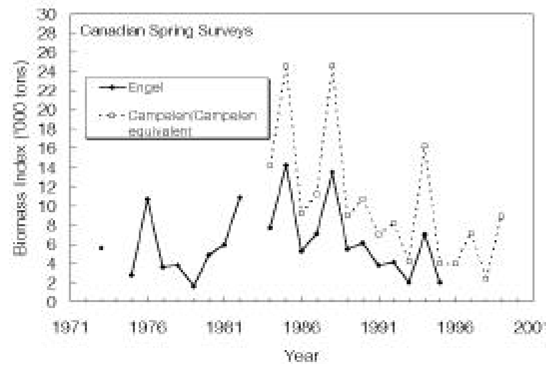
[1] Provisional.
nf No fishing.



Data: Converted abundance and biomass data were available from Canadian spring surveys during 1984-99 and autumn surveys during 1990-99 as well as Spanish surveys during spring 1995-2000.

Assessment: No analytical assessment was possible with current data.

Biomass: Survey biomass indices have trended downwards since the mid-1980s and the 1998 value is the lowest observed. The apparent increase in 1999 is considered to be a year effect similar to spikes observed in some earlier years.



Recruitment: No information.

State of the Stock: Stock remains at a low level.

Recommendation: No directed fishing on witch flounder in the years 2001 and 2002 in Div. 3N and 3O to allow for stock rebuilding. By-catches in fisheries targeting other species should be kept at the lowest possible level.

Reference Points: Scientific Council is not in a position to propose reference points at this time.

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

The next Scientific Council assessment of this stock will be in 2002.

Sources of Information: SCR Doc. 00/14, 46; SCS Doc. 00/9, 16.

c) **Special Requests for Management Advice**

i) **Precautionary Measures**

The Council noted this matter was discussed before under Agenda item III.

ii) **Request on Squid (*Illex*) in Subareas 3 and 4**

The Fisheries Commission requested the Scientific Council to: *develop an in-season indicator of productivity level based on results from the annual July survey of the Scotian Shelf and any other source of data.* If it is not considered possible to develop an in-season indicator, the Scientific Council is requested to: *comment on the research that would be required to develop such an indicator.* The Scientific Council is also requested to: *review the protocol outlined in FC Working Paper 99/18 and to advise on possible modifications to ensure its applicability on the long term, including a level of TAC which would be applicable during the high productivity regime* (see Part D, Agenda 1, Annex 1, Item 3f for complete request).

Scientific Council noted in 1999 that it may be possible to identify the onset of a new productivity regime based on marked changes in (a) survey abundance and biomass indices; (b) the average size of squid in the population; and (c) environmental conditions which persist for two or more years. For an in-season predictive model to be of practical value it should be based on early-season indices that are simple and readily available.

An initial exploratory analysis was presented which used July research vessel abundance and size indices, fishery CPUE indices and an environmental index to predict annual SA 3+4 squid catches (SCR Doc. 00/36). While the results of this analysis were promising, further research and developmental work is required before a reliable in-season indicator of short-finned squid productivity is available. Considerable resources will be required to accomplish this work.

Scientific Council was unable to advise on any modification to the protocol for determining productivity of the short-finned squid resource in NAFO Subareas 3+4 to ensure its applicability on the long term. Furthermore the Scientific Council is not in a position to advise on a specific level of TAC which would be applicable during the high productivity regime.

iii) **Information on Catches and/or Discards of Juvenile Fish in the Various NAFO Fisheries** (SCR Doc. 99/96, SCR Doc. 00/46)

The Fisheries Commission requested the Scientific Council to: *compile and review all information on catches and/or discards of juvenile fish in the NAFO fisheries*, and *describe and evaluate the effectiveness of additional technical management measures arising at reducing catches of juvenile fish and male shrimp in various NAFO fisheries* (see Part D, Agenda 1, Annex 1, Item 8) .

The Scientific Council commented as follows:

a) **Introduction**

As the distribution of demersal species often overlaps, a directed fishery hardly ever avoids by-catches completely. Also, as fishing aggregations often include fish of all sizes, the capture of small, immature fish has been inescapable given the current gear configurations and fishing practices.

A preliminary inquiry was carried out among Designated Experts to collect information on relevant catch statistics, biology etc. for the considered stocks. As a result of the sporadic research effort in this area there is a relatively large number of cases with no available information. Information from NAFO observers program should be of great benefit in providing information on by-catches and discards.

The number and weight of juveniles were calculated as numbers in the size distribution less than L_{50} for maturity of females.

b) **Catches of Juveniles**

The result of the inquiry with quantitative catches are presented by stock units for 1999 are listed in Table 1.

c) **By-catches in the Shrimp Fishery**

By-catch rates of Greenland halibut in Subareas 2 and 3 in Canadian shrimp vessels greater than 500 GRT calculated for combined grates (22 and 28 mm) in 1997, 1998, 1999 was 12.5, 9.9 and 5.9 kg/hr, respectively. Indication from analysis of age disaggregation shows that no more than 1.5% of any cohort was removed by the offshore shrimp fleet in this period. Theoretical losses computed from yield-per-recruit analysis showed that total loss due to shrimp by-catch mortality in this fishery in 1997, 1998, 1999 were 449 tons, 275 tons and 202 tons, respectively. The loss for each year will be distributed over the 17-year life span of the fish.

d) **By-catches – Technical Measures**

No specific technical management measures aimed at reducing catches of juvenile fish were evaluated. A number of examples were discussed during the assessments of various stocks (mesh size, exclusion grates, etc.). Scientific Council noted that a document on codend mesh selection studies was presented (SCR Doc. 00/49), and that there was a considerable amount of valuable information contained in this paper. As well, Scientific Council noted that research vessel surveys should provide useful data in delineating distributions of species, including juveniles. In addition, the data could also be used to delineate areas where by catches would probably occur, and areas where such by-catches would be unlikely. An example using Canadian autumn survey data in Div. 3LNO suggested that by-catches of yellowtail flounder in a fishery for Greenland halibut would be expected to be extremely low, given that there is very little overlap in the depth distribution of these species.

Table 1. Overview of catch, by-catch, discard, by-catch of juveniles, discards of juveniles of relevant fish species and squid in the NAFO area for 1999 if not otherwise stated.

Stocks	Size limits		Directed fishery									By-catch in other fisheries							
	A	B	C	D	E	F	G	H	I	J		K	L	M	N	O	P	Q	R
	Length at 50% mature female (L50), cm	Minimum landing size, cm	Total catch, t	Total catch in numbers ('000)	Catch of juveniles, t	Catch of juveniles in numbers ('000)	Discarded catch, t	Discarded catch in numbers ('000)	Discarded juveniles, t	Discarded juveniles in numbers ('000)	Fleet	Total bycatch, t	Total bycatch in numbers ('000)	Juveniles in bycatch, t	Juveniles in bycatch in numbers ('000)	Discarded by-catches, t	Discarded by-catches in numbers ('000)	Discarded juveniles in by-catch, t	Discarded juveniles in by-catch in numbers ('000)
American plaice in Div. 3LNO	33	25	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	163	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											Yellowtail flounder	212	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											Skate/Greenland halibut	1,243	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											TOTAL	1,618	2,898	84	338	N/A	N/A	N/A	N/A
American plaice in Div. 3M	34	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut/Redfish	255	280	1	3	N/A	N/A	N/A	N/A
Capelin in Div. 3NO	14-16	N/A	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cod in Div. 2J3KL	about 43	N/A	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cod in Div. 3M	43-47	45	353 2)	189 2)	13 2)	14 2)	N/A	N/A	N/A	N/A	Redfish	3	2	0	0	N/A	N/A	N/A	N/A
Cod in Div. 3NO	N/A	41	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Skate	584	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											Other	325	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											TOTAL	909	60	16	15	N/A	N/A	N/A	N/A
Thorny skate	55	None	10,374	N/A	~500	N/A	433	N/A	N/A	N/A		<662 3)	N/A	N/A	N/A	117	N/A	N/A	N/A
Greenland halibut in Div. 1A, inshore	N/A	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Greenland halibut in SA 0+1	57	None	9,067	6,185	5,290	5,038	~0	~0	~0	~0	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Greenland halibut in SA 2+3KLMNO	74.1-81.7	35	24,232	23,702	21,973	23,406	N/A	N/A	N/A	N/A	Shrimp	85	N/A	85	N/A	N/A	N/A	N/A	N/A
Other finfish in SA 1	N/A	None	4,983	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Redfish in Div. 3LN	28.30	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	2,300	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Redfish in Div. 3M	29	0	1100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Shrimp	55	1,434	55	1,434	N/A	N/A	N/A	N/A
Redfish in SA 1	35	None	98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roughhead grenadier in SA 2+3	26	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	7,052	13,078	5,149	12,560	N/A	N/A	N/A	N/A
Roundnose grenadier in SA 0+1	N/A	None	10	N/A	N/A	N/A	~0	~0	~0	~0	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roundnose grenadier in SA 2+3	N/A	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	83	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Squid in SA 3+4	N/A	None	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Silver hake	294	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Witch flounder in Div. 2J3KL	40	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Witch flounder in Div. 3NO	44-46	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	800	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yellowtail flounder in Div. 3LNO	34	25	5,413	N/A	N/A	4)	N/A	N/A	N/A	N/A	Greenland halibut	96	N/A	N/A	2%	N/A	N/A	N/A	N/A
											Greenland halibut/Redfish	300	N/A	N/A	2%	N/A	N/A	N/A	N/A
											Skate	752	N/A	N/A	8%	N/A	N/A	N/A	N/A
											TOTAL	1,148	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not available. NDF: No directed fishery. NCP: non-contracting parties.
1) All data for 1998 2) NCP 3) Canada by-catches <50 t 4) 0.4% fro Canada

iv) **Elasmobranchs in Subareas 0-6**

The Fisheries Commission requested the Scientific Council to: *summarize all available information from the Convention Area on catches of elasmobranches by species and by the smallest geographic scale possible*, and to *review available information from research vessel surveys on the relative biomass and geographic distribution of elasmobranchs by species, and to quantify the extent of exploitation on these resources*. Further, the Scientific Council was requested to: *initiate work leading to the development of precautionary reference points* (see Part D, Agenda 1, Annex 1, Item 6).

In a recent paper [McEachran, J. D. and K. A. Dunn, 1998. Phylogenetic analysis of skates, a morphologically conservative clade of elasmobranchs (*Chondrichthyes: Rajidae*). *Copeia*, 2: 271-290], changes to the genus names of the following skates species were proposed:

Common name	Old Scientific name	Proposed (new) scientific name
Little Skate	*Raja erinacea*	*Leucoraja erinacea*
Arctic Skate	*Raja hyperborea*	*Amblyraja hyperborea*
Barndoor Skate	*Raja laevis*	*Dipturus laevis*
Winter Skate	*Raja ocellata*	*Leucoraja ocellata*
Spinytail Skate	*Raja spinicauda*	*Bathyraja spinicauda*
Thorny Skate	*Raja radiata*	*Amblyraja radiata*
Smooth Skate	*Raja senta*	*Malacoraja senta*

It is anticipated that these proposed scientific names will be accepted as the official names of these species by the American Fisheries Society (AFS) Names of Fishes Committee, and will be published in the 2000 edition of the AFS publication, "Common and Scientific Names of Fishes from the United States and Canada".

Geographic Distribution

Subareas 0+1. Thorny skate (*Amblyraja radiata*), Arctic skate (*Amblyraja hyperborea*) and Greenland shark (*Somniosus microcephalus*) are the common elasmobranchs distributed throughout Subareas 0 and 1. A survey in Div. 0A in October 1999 showed thorny skate were distributed primarily at depths <751m in the area of Davis Strait and Arctic skate was distributed primarily at depths >501m throughout Davis Strait and Baffin Bay.

Subarea 2. No information is available for this area.

Subarea 3. Thorny skate are distributed throughout Subarea 3 and perform seasonal migrations, tending to move into deeper water along the shelf edge during winter-spring. Analyses of distribution of thorny skate in the Canadian bottom trawl surveys (Div. 3LNO and Subdiv. 3Ps) suggest that in the past a greater abundance of skates was distributed further to the north in Div. 3K and 3L than is currently found. Recent Canadian surveys indicate that about 20% of the overall biomass in Div. 3LNO and Subdiv. 3Ps is found in the NAFO Regulatory Area. The information from commercial catches indicates that barndoor skate (*Dipturus laevis*) may be more widely distributed than reflected by research survey data and perhaps continuously distributed along deep slope waters of the Northwest Atlantic. Apparent changes in abundance as observed from research surveys may in part reflect periods of expansion and contraction in to and out of the shallower waters within its range.

Subarea 4. No information is available for this area.

Subareas 5+6. Bottom trawl research surveys in Subareas 5+6 have documented 33 species of elasmobranchs including large and small sharks and stingrays. Of the 12 species examined for patterns in distribution, 11 exhibited large seasonal shifts in distribution from south to north or offshore to inshore as water temperatures warmed. The exception to this was chain dogfish (*Scyliorhinus retifer*) that generally remained in deep slope waters year round.

Winter skate (*Leucoraja ocellata*) are most abundant in the Georges Bank and Southern New England offshore regions, with few fish caught in the Gulf of Maine or Mid-Atlantic regions. Little skate (*Leucoraja erinacea*) are abundant in the inshore and offshore areas in all regions of the northeast USA coast, but are most abundant on Georges Bank and in the Southern New England region.

Barndoor skate are most abundant in the Gulf of Maine, Georges Bank, and Southern New England offshore regions, with very few fish caught in inshore (<27m depth) waters or the Mid-Atlantic region. Historically barndoor skate were found in inshore waters to the tide-line, and in depths as great as 400m off Nantucket.

Thorny skate and smooth skate (*Malacoraja senta*) are most abundant in the Gulf of Maine and Georges Bank offshore regions, with very few fish caught in inshore (<27m depth) areas, and in the Southern New England and Mid-Atlantic regions. Clearnose skate (*Raja eglanteria*) and rosette skate (*Raja garmani*) are most abundant in the Mid-Atlantic region, with very few fish caught in Southern New England and no fish caught in other regions.

Spiny dogfish (*Squalus acanthius)* migrate from offshore southern waters (south of Georges Bank) to the Gulf of Maine and into Canadian waters as far north as Newfoundland in the summer and autumn.

Relative Biomass

Absolute biomass and recruitment estimates for elasmobranch species are not available for any Subarea. However, relative biomass and abundance indices were available for Subareas 3, 5 and 6. Survey biomass indices for thorny skate showed increasing trends in recent years in Subarea 3 but has declined to historic lows in Subareas 5+6.

For the aggregate skate complex in Subareas 5 and 6, biomass remained relatively constant from 1963 to 1980, then increased significantly to peak levels in the mid-to late-1980s. The index of skate complex biomass then declined steadily until 1994, but recently began to increase again. The large increase in skate biomass in the mid- to late-1980s was dominated by winter and little skate. The biomass of large-bodied skates (>100 cm maximum length; barndoor, winter, and thorny) has steadily declined since the mid-1980s and the recent increase in aggregate skate biomass has been due to an increase in small-bodied skates (<100 cm maximum length; little, clearnose, rosette, and smooth). All large-bodied skates (winter, barndoor, and thorny) and all primary skate species in the Gulf of Maine (thorny and smooth) are currently at low biomass.

Biomass of spiny dogfish in Subareas 5+6 increased from the late-1970s to the early-1990s, but has declined over the past 5 years. This change is largely due to a decline in mature female (>80 cm) biomass.

Fishery and Catches

There are directed fisheries for skate in Subareas 3, 4, 5 and 6. An unregulated non-Canadian directed fishery outside 200 miles began in Div. 3N in 1985 and a regulated directed Canadian fishery began inside 200 miles in Div. 3LNO and Subdiv. 3Ps in 1994. Thorny skate is the targeted species in Subarea 3 with total catches in the order of 9 000 to 12 000 tons since 1997.

Thorny, winter skate and porbeagle (*Lamna nasus*) are fished in Div. 4V. This fishery is regulated through quota controls established by Canada.

A number of skate species are harvested in Subareas 5 and 6. Composition varies by area but catches are primarily dominated by winter skates and little skates in most areas. Average catches in the mid-1980s increased to 5 000 tons, mostly due to by-catch in USA fisheries. In the late-1980s, an unregulated directed fishery for skates (primarily large skate wings) developed and catches increased to 13 000 tons. Total catches for the skate complex in Subareas 5 and 6 reached a peak in 1998 at 17 000 tons due to a demand for bait and were comprised mainly of smaller bodied species.

Catches of spiny dogfish in Subareas 2-6 increased from very low levels in the early-1960s to an average of 24 000 tons in the 1970s. Catches then declined to by-catch levels in the mid-1980s, but increased sharply, reaching 28 300 tons in 1996 before declining through the late-1990s. The fishery directed towards spiny dogfish in Subareas 5 and 6 is presently under regulation.

Elasmobranchs such as thorny skate, Arctic skate, barndoor skate, Greenland shark, and black dogfish (*Centroscyllium fabricii*) are also taken as by-catch in other fisheries in Subareas 0 to 6.

Exploitation

Exploitation rates could not be determined for any elasmobranch species in Subareas 2-4. In Subareas 5 and 6, fishing mortality on winter skate increased coincident with the onset of the directed fishery, and was estimated to be 0.4 in 1999. Fishing mortality on little skate also increased in recent years and is estimated to be 0.3 in 1999. Fishing mortality on large female spiny dogfish ranged from 0.35-0.5 during 1997-99.

Sources of Information: SCR Doc. 00/15, 18, 19, 27, 31, 46; SCS Doc. 00/9, 20.

d) **Monitoring of Stocks for Which Multi-year Advice was Provided in 1999**

During the 1999 assessments, the Scientific Council provided 2-year advice (for 2000 and 2001) for cod in Div. 3NO, redfish in Div. 3LN, American plaice in Div. 3LNO and witch flounder in Div. 2J+3KL. The Scientific Council reviewed the status of these stocks at its June 2000 Meeting and found no significant change in status for any of the stocks. Therefore, the Scientific Council has not provided updated/revised advice for 2001 for these stocks. The next Scientific Council assessment of these stocks will be in 2001.

2. **Coastal States**

a) **Request by Canada for Advice**

i) The Scientific Council was requested by the Coastal State Canada to provide advice on stock status for cod in Div. 2J+3KL and impact of by-catch on yellowtail flounder resource in Div. 3LNO. This section provides the Scientific Council advice.

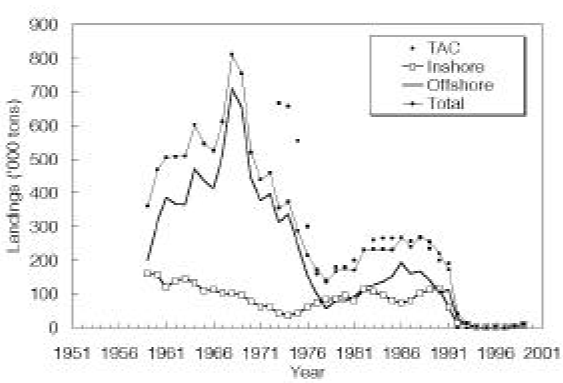
Cod (Gadus morhua) in Divisions 2J, 3K and 3L

Background: Cod in these Divisions are considered a single stock complex. However, there is considerable evidence of sub-stock structure. Historically, many of the cod migrated between the offshore and the inshore. There are at present very few cod in the offshore compared to any time prior to 1993. Denser aggregations exist in the inshore from southern Div. 3K to the southern boundary of the stock. Tagging studies indicate that the inshore of Div. 3KL is inhabited by at least two groups of cod; a northern resident group that inhabits southern Div. 3K and northern Div. 3L and a migrant group that moves into southern Div. 3L from Subdiv. 3Ps from spring to autumn.

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. A food/recreational fishery was permitted in 1992-94, 1996, 1998 and 1999 but not in 1995 and 1997. Catches also came from sentinel surveys in 1995-99 and an index or test fishery in 1998. The commercial fishery was reopened in 1999 with a TAC of 9 000 tons for the inshore only.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended[2]	Autonomous
1997	0.5		0
1998	4.5		0
1999	8.5		9

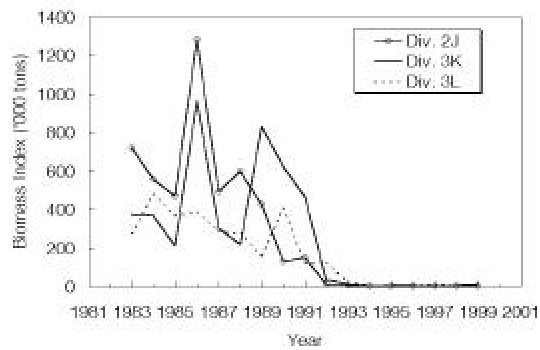
[1] Provisional.
[2] Advice not requested.



Data: Abundance and biomass indices were available from bottom-trawl surveys in autumn and spring (Div. 3L only). Removals-at-age in 1999 were available from the limited by-catch, the sentinel survey, a food/recreational fishery and the commercial fishery. Exploitation rates were derived from inshore tagging studies. Data on growth and maturity were also available.

Assessment: Stock status was estimated based on research vessel indices, sentinel survey data, acoustic studies in limited areas and a mark-recapture study in the inshore. An analytical assessment was not attempted.

Biomass: The biomass index for the offshore area from the autumn research vessel survey in Div. 2J and 3KL declined abruptly in the early-1990s. The 1999 estimate is very low compared to the 1980s.



The biomass index from the spring research vessel survey in Div. 3L in 1999 is also very low compared to the 1980s.

In the inshore, exploitation rates calculated from tag return data indicate a biomass of at most 55 000 tons in Div. 3K and northern Div. 3L in 1999. An unquantified additional biomass was available in southern Div. 3L, but much of this migrated seasonally from Subdiv. 3Ps. Acoustic studies of Smith Sound (northern Div. 3L) in winter of 2000 when cod are aggregated produced estimates of about 22 000 tons. No additional large aggregations were found in northern Div. 3L and southern Div. 3K during this survey.

Standardized catch rates calculated from limited fishing throughout the inshore of Div. 2J and Div. 3KL with commercial gears (the sentinel surveys) revealed patterns that differed with gear; in gillnets there was an increase from 1995 to 1998 and a decline in 1999, whereas in line trawls there was an increase from 1995 to 1997 and a decline to 1999.

Mortality: Total mortality, as calculated from research vessel data, has remained well above 0.2 since declaration of the moratorium in 1992. The cause for this has not been determined. Predation by harp seals may be an important contributor. Exploitation rates for the first and second openings in the inshore fishery in 1999 were estimated to have been at least 19% and 13% in Div. 3K and 2.3% and 3.8% in northern 3L.

Recruitment: Recruitment has been extremely low during the 1990s and recent year-classes are uncertain.

State of the Stock: The stock as a whole remains at a very low level. Year-classes recruiting in the 1990s have been extremely weak.

In the offshore there are no signs of recovery. The biomass is very small with few mature fish.

In the inshore, the biomass in Div. 3K and northern Div. 3L was estimated from mark-recapture experiments to be at most 55 000 tons. Additional biomass exists in southern Div. 3L, but much of this migrates seasonally into Div. 3L from Subdiv. 3Ps.

Sources of Information: SCR Doc. 00/33.

ii) **By-catch of Yellowtail flounder in Div. 3LNO**

Canada made a special request: *noting the increase in by-catch of Div. 3LNO yellowtail flounder, in particular the skate fishery, the Scientific Council is requested to comment on the potential impacts of these by-catches on the long term sustainability of the yellowtail flounder resource.*

Scientific Council noted that total catches have been 9% above TACs in both the 1998 and 1999 fisheries. In providing its TAC advice, Scientific Council notes that the advice applies to all removals (directed plus by-catch). To the extent that the total catch exceeds the advised catch, fishing morality will be higher than intended and if maintained could have an impact on the long term sustainability of the resource.

Sources of information: SCR Doc. 00/45.

b) **Request by Denmark (Greenland) for Advice**:

During the 1999 assessments, the Scientific Council provided 2-year advice (for 2000 and 2001) for redfish in Subarea 1 and other finfish in Subareas 0+1, while 3-year advice (for 2000-2002) was provided upon the request of both Canada and Denmark (Greenland) for roundnose grenadier in Subareas 0+1.

The Scientific Council reviewed the status of these stocks at its June 2000 Meeting and found no significant change in status for any of the stocks. Therefore, the Scientific Council has not provided updated/revised advice for 2001 for these stocks.

c) **Request by Canada and Denmark (Greenland) for Advice on TACs and Other Management Measures**

The Scientific Council was requested by the Coastal States to provide advice for certain stocks. This section presents the stock for which the Scientific Council provided advice for the year 2001.

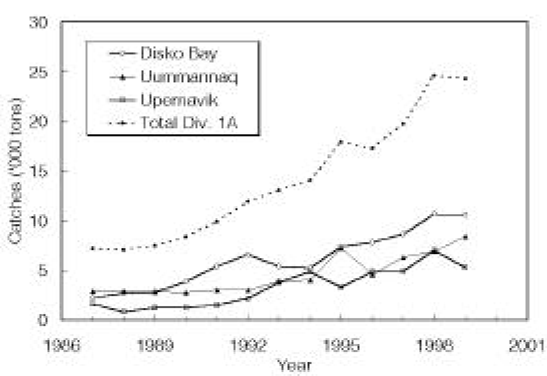
Greenland Halibut (Reinhardtius hippoglossoides) in Division 1A, inshore

Background: The inshore stock is dependent for recruitment on immigration from the offshore nursery grounds in Div. 1A and 1B 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 appear to 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.

Fishery and Catches: The fishery is mainly conducted with longlines and to a varying degree gillnets. Effort has increased in all areas. The offshore fishery has not been conducted since 1996.

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended		Agreed
Disko Bay	8.6	10.7	10.6	7.9
Uummannaq	6.3	6.9	8.4	6.0
Upernavik	4.9	7.0	5.3	4.3
Total Div. 1A	19.8	24.6	24.3	-

[1] Provisional.
[2] No TAC advised before 1999.



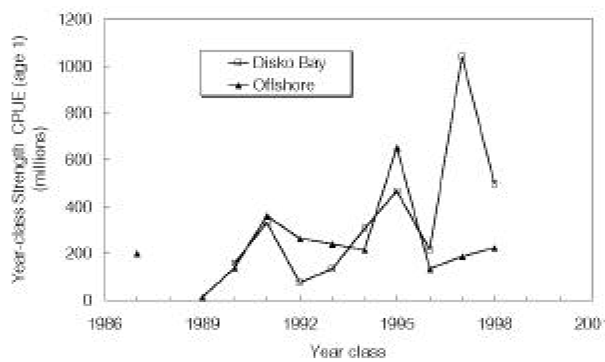
Data: Catch-at-age data were available for years 1988-99 at Disko Bay, and for most years in this period at Uummannaq and Upernavik. Data on mean length in commercial catches were available. A recruitment index for age 1, 2 and 3+ was available from trawl survey. Catch rates and mean lengths were available from inshore longline surveys.

Assessment: The stock component in Disko Bay is composed of younger and smaller individuals than in the other two areas. Survey results since 1993 do not indicate any major changes in abundance. Mean length composition in survey has not changed and in the commercial fishery an increase in mean length has been observed the latest 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, but have stabilized during latest years.

In Upernavik survey results since 1993 do not indicate any major changes in abundance. Mean length compositions in both commercial and survey catches have decreased, especially in the commercial winter-fishery. New fishing grounds in the northern part of the district have been exploited only recently. Little information exists from these areas, and the stock components are considered virgin.

Fishing mortality: There is indication of an increase in fishing mortality in all three stock components.



Recruitment: Offshore and inshore in Disko Bay the numbers of one-year-olds from the 1998 year-class were above average in 1999. In Disko Bay it was the second highest on record. The 1997 year-class that was very strong inshore at age one was still above average at age 2.

State of the Stock: The stock components in all three areas consist of a large number of age groups.

Disko Bay: indices of abundance have been relatively stable since 1993.

Uummannaq: indices of abundance have been relatively stable since 1993.

Upernavik: There is indication of growth over-fishing of the stock components in the traditional fishing areas around Upernavik and up to 73.45°N (Giesecke Ice fjord). In the northern parts of the district, where new fishing grounds are exploited, data are insufficient to determine the status of the resource.

Recommendation: Scientific Council still considers that separate TACs are appropriate for each of the three areas.

Assessments indicate that there has been no improvement in stock status in any of the three areas. Therefore, Scientific Council concludes that there be no change in the TACs recommended for 2000. The TAC for 2001 for each of the inshore areas are therefore recommended to be: Disko Bay 7 900 tons, Uummannaq 6 000 tons, and Upernavik 4 300 tons.

Reference Points: Scientific Council is not in a position to propose reference points.

Special Comments: The increase in landings in recent years 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. 00/22, 29, 47; SCS Doc. 00/22.

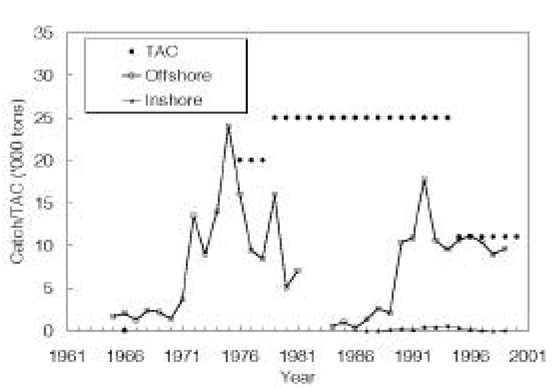
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 0 + Division 1A Offshore and Divisions 1B-1F

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 10 000 tons annually since.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Autonomous
1997	11	11	11
1998	9	11	11
1999	10	11	11
2000		11	

[1] Provisional.



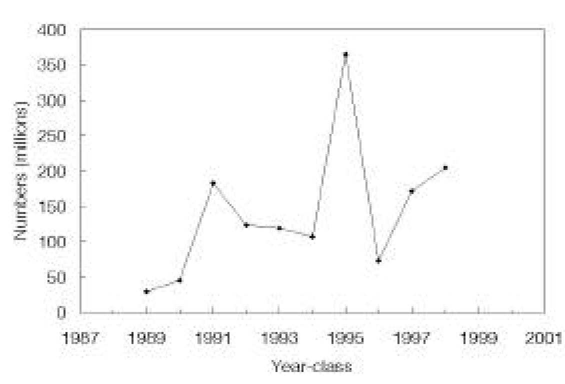
Data: Catch-at-age data were available for assessment from Div. 0B and Div. 1CD. Standardized and unstandardized catch rates were available from Div. 0B and Div. 1CD. Biomass estimates were available from Div. 1CD and 0A. Recruitment data were available from Div. 1A-1F from 1989-99.

Assessment: No analytical assessment could be performed. Combined standardized catch rates for Div. 0B + Div. 1CD have been stable during 1990-99.

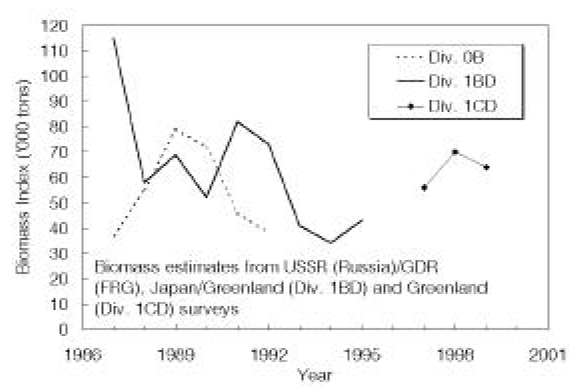
Fishing Mortality: Level not known.

Recruitment: Recruitment of the 1998 year-class at age one was slightly above the estimate of the 1997 year-class and the second largest in the time series.

Abundance (age one):



Biomass: The biomass in Div. 1CD increased from 1997 to 1998 but decreased again in 1999. A new survey in Div. 0A resulted in a biomass estimate of 83 000 tons.



State of the Stock: The age composition in the catches in Div. 0B and 1B-1F, where most of the fishery takes place, has been stable in recent years. Although the survey series from Subarea 1 in 1987-95 is not directly comparable with the series from 1997-99, the decline in the stock observed in Subarea 1 until 1994 has stopped and the stock seems to be back at the level in the late-1980s and early-1990s. The relationship between Greenland halibut in both Div. 0A (offshore) and 1A (offshore), and remaining areas is unknown and needs to be thoroughly investigated.

Recommendation: The TAC for year 2001 should not exceed 11 000 tons for Div. 0B and 1B-1F where the fishery primarily has taken place since it began.

Special Comments. Until the relationship between Greenland halibut in Div. 0A + 1A (offshore) and the remaining areas have been resolved and given the estimated biomass in Division 0A, it is suggested that an additional TAC be implemented for the offshore areas of Div. 0A and 1A that would generate a low fishing mortality. This could be achieved by a catch in 2001 not exceeding 4 000 tons.

Reference Points: Scientific Council is not in a position to propose reference points at this time.

Sources of Information: SCR Doc. 00/6, 7, 10, 22, 26, 31, 38; SCS Doc. 00/ 9, 11, 22.

3. **Scientific Advice from Scientific Council on its Own Accord.**

The Scientific Council on its own accord considered roughhead grenadier in Subareas 2 and 3 and the following Summary Sheet was prepared.

Roughhead Grenadier (Macrourus berglax) in Subareas 2 and 3

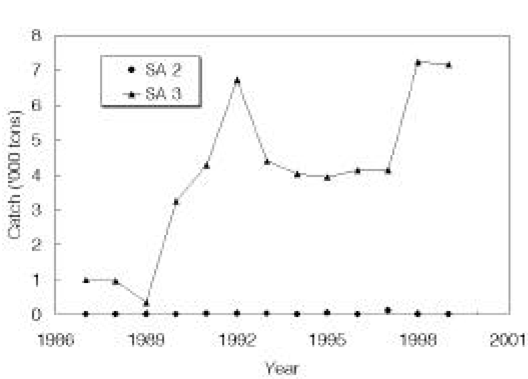
Background: Roughhead grenadier are distributed throughout Subareas 2 and 3 in depths between 300 and 2 000 m. This is an unregulated species.

Fishery and Catches: There is no directed fishery for roughhead grenadier and most of the catches are taken as by-catches in the Greenland halibut fishery in Subareas 2 and 3. Roughhead grenadier is taken mainly in Div. 3LMN Regulatory Area. At the beginning of the Greenland halibut fishery in Subarea 3 of the Regulatory Area in 1988, the grenadier catches were systematically misreported as roundnose grenadier. Since 1997 the roughhead catches have been correctly reported, but the mis-reporting problem is not still solved in the statistics prior 1996. The level of catches remains uncertain in Subareas 2 and 3 before the start of the Greenland halibut fishery in the Regulatory Area.

Catches since 1997 are as follows:

	Catch ('000 tons)
1997[1]	4.7
1998[1]	7.2
1999[1]	7.2

[1] Provisional.



Data: Biomass indices were derived from: the Canadian stratified bottom trawl autumn surveys in Div. 2GHJ and 3KL since 1978, the Canadian stratified random bottom trawl spring surveys in Div. 3LN since 1971, the Canadian stratified deepwater bottom trawl surveys in Div. 3KLMN in 1991, 1994 and 1995, the Spanish stratified bottom trawl spring survey in Div. 3NO Regulatory Area since 1995, and the EU (Spain and Portugal) stratified bottom trawl summer survey in Div. 3M since 1988. The EU (Spain-Portugal) longline deepwater survey in Div. 3LMN in 1995 provided information on the roughhead grenadier depth distribution. It is not known how well trends in these surveys reflect the state of the stock.

A female maturity curve based on histological analysis of fish from Div. 3LMN has been obtained. A selectivity curve for 130-mm diamond mesh is available. Data on length distribution (1995-99) and catches-at-age (1997–99) are available from Portuguese, Russian and Spanish trawl catches.

Assessment:

Fishing mortality: Not known

Biomass: Because of limited time series, limited coverage and various vessels/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.

Recruitment: Not known.

State of the Stock: The state of the stock is not known.

Reference Points: Scientific Council is not in a position to propose reference points at this time

Special Comments: It should be noted that immature fish constituted 80% of the catch in 1997 and 82 % in 1998 and 1999.

Scientific Council in future will monitor this stock and attempt to assess the stock status and provide advice on the state of the stock if possible.

In particular it is recommended that work in age-structured production modelling be continued.

Sources of information: SCR Doc. 00/9, 30, 39; SCS Doc. 00/9, 16, 20.

IX. FUTURE SCIENTIFIC COUNCIL MEETINGS 2000 AND 2001

1. Scientific Council Meeting and Special Session, September 2000

The Council reconfirmed its dates for the Annual Meeting, 18-22 September 2000 to be held at Back Bay Hilton in Boston, MA, USA. The Scientific Council Special Session, the Workshop on Assessment Methods, will be held 13-15 September 2000 at the same venue.

2. Scientific Council Meeting in November 2000

The Council reconfirmed that its meeting for the assessments of northern shrimp in Div. 3M, in Subareas 0 and 1 and in Denmark Strait, will be held during 8-15 November 2000 in Copenhagen, Denmark

The Council noted that this includes an additional day to address matters pertaining to shrimp in Div. 3LNO as well as considerations on shrimp in Div. 3M.

3. Scientific Council Meeting, June 2001

The Council agreed the Scientific Council Meeting will be held from Thursday 31 May 2001 to Thursday 14 June 2001. The Council agreed the facilities and services at the present meeting venue at Alderney Landing, Dartmouth, were quite suitable for its June Meeting, and proposed the same venue for the meeting of 2001. The Secretariat was requested to look into audio systems to enhance the acoustics of the meeting room.

4. Scientific Council Meeting and Symposium, September 2001

The Scientific Council noted the Annual Meeting will be held 17-21 September 2001 in Havana, Cuba. The Scientific Council Special Session, the Symposium on "Deep-sea Fisheries", will be held during 12-14 September 2001 at the same venue.

5. Scientific Council Meeting, November 2001

The Council had preliminary discussions on advancing the dates of the meeting in order to promote participation by ICES shrimp scientists. The Council agreed to finalize the dates for the November 2001 Meeting for shrimp assessments during its November 2000 Meeting. The meeting will be held in Dartmouth, Nova Scotia, Canada.

X. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Progress report on Special Session in 2000: Workshop on Assessment Methods

At its session on 3 June 2000, the Council was presented a progress report and proposed Agenda for the 13-15 September 2000 Workshop on Assessment Methods, by the co-conveners: D. Rivard (Canada) and C. Darby (EU-United Kingdom).

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This Workshop has been designed to provide an opportunity for the members of the NAFO Scientific Council to explore assessment techniques and the various tools available for their application. In particular, the Workshop would focus on tools to perform age-structured analyses and stock abundance estimation, calculate reference points in the context of the Precautionary Approach and carry out risk analyses.

Each session will begin with a brief comment on the theory and common practices. This will be followed by demonstrations or tutorials making use of a common data set. Then, a working session will invite the participants to apply these tools to specific data sets.

To facilitate the planning of this Workshop, the Council agreed a list of potential participants should be prepared during this June 2000 Meeting. A preliminary list of about 35 participants was prepared.

The Council noted that a comprehensive Agenda was proposed for the meeting and agreed this would be an attachment to the Provisional Agenda of the Scientific Council Meeting of 18-22 September 2000. The Council thanked the co-conveners for the work to date, and saw the great value of a Workshop of this nature.

The Council noted an information booklet would be published in the *NAFO Scientific Council Studies*.

2. **Progress Report on ICES/NAFO Symposium on Hydrobiological Variability in August 2001**

The Council noted that STACFEN was presented an update on the Symposium (see STACFEN Report). The Council welcomed the update.

3. **Progress report on Special Session in September 2001: Symposium on "Deep Sea Fisheries"**

At its session on 3 June 2000, the Council Chairman presented a progress report submitted by the co-convener J. Moore (USA). The Council endorsed the view that International Council for the Exploration of the Sea (ICES) and Commonwealth Scientific and Industrial Research Organization (CSIRO) be invited to co-sponsor this Symposium with J. Gordon (ICES/EU-United Kingdom) and T. Koslow (CSIRO/Australia) as co-conveners. The Council Chairman agreed to forward letters of invitation for co-sponsorship.

The Council noted that a worldwide trend exists towards increasing exploitation of deepwater fishery resources, including within the North Atlantic. This has raised a number of issues concerning both the biology and management of these resources.

The purpose of this Symposium will be to discuss the available biological information and the issues in the management of deepwater fisheries. Some possible topics include:

- age, growth and reproduction of target species
- life histories and estimates of production
- identification of stocks
- impacts of fisheries on the target populations
- by-catch and impacts of fisheries on habitats
- techniques and fishing methods used in deepwater fisheries
- deep-sea crustacean and cephalopod fisheries
- policy and management of deep-sea resources, especially in international waters
- sustainability of deep-sea fisheries

It was noted the Symposium will incorporate both traditional and non-traditional species. It was also proposed environmental considerations should be included, especially using global databases, which are available in the Worldwide Web and on CD-ROM issues.

An announcement and 'Call for Papers' will be issued shortly for contributed papers and posters. Papers will be selected on the basis of their relevance to the topic and scientific suitability. It is anticipated that the proceedings of this Symposium will be published in the *Journal of Northwest Atlantic Fishery Science*.

The Council thanked J. Moore for the work to date and was pleased to announce this Symposium to be held in conjunction with the NAFO 23rd Annual Meeting in Havana, Cuba. The Symposium will be co-convened by J. Gordon, (Scotland), T. Koslow (Australia), and J. Moore (USA), and organized by the NAFO Secretariat.

The Council noted the level of success of this Symposium will be related to the possibility of attracting eminent scientists to it, and agreed that financial support is required to invite key speakers, and **recommended** that *NAFO's financial contribution to the Symposium on "Deep-sea Fisheries" in 12-14 September 2001 should be CDN $8 000*. The Council also **recommended** that *ICES and CSIRO as co-sponsors should also be requested to contribute CDN $8 000 each*.

4. **Topic for Special Session in 2002**

At its session on 9 June 2000, the Council received a suggestion that the September 2002 Scientific Council Special Session should be a Symposium on elasmobranchs fisheries perhaps with the title "Elasmobranch Fisheries". The Council considered this topic would be timely, particularly noting the likely progress on the subject within NAFO, and the level of interest internationally.

The Council welcomed F. M. Serchuk (USA) with the assistance of D. Kulka (Canada), the Designated Expert for elasmobranchs, to pursue this matter further and provide a progress report at the 18-22 September 2000 Meeting of the Council.

XI. REPORT OF THE WORKING GROUP ON REPRODUCTIVE POTENTIAL

The Terms of Reference and the proposed work plan for the Working Group was presented by the Chairman, E. A. Trippel (Canada).

The Council recalled the growth in research activity on the reproductive biology of marine fishes was clearly recognized during the Symposium organized by the Scientific Council on "Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish" was in Lisbon, Portugal, September 9-11, 1998. An outcome of that meeting was the **recommendation** of the establishment of a Working Group to further explore and record important data and methodology in this field.

By November 1999, a Working Group had been formed comprised of 18 members (representing 9 countries) to undertake the challenges of completing the Terms of References set out by the Scientific Council. By April 2000, a draft work plan for each Term of Reference was established indicating key participants and tentative completion dates. These work plans were presented for input and possible revision.

Based on comments received from the Scientific Council during this meeting, the Working Group members will begin to undertake their activities in June 2000. A meeting is planned for 10-13 October 2000 in San Sebastian, Spain to assist with data collection and completion of work in an integrated manner. Work includes providing accepted protocols to estimate reproductive potential of fish stocks using data from both wild and captive fish and exploring its integration into conventional stock assessment methodology.

It was clear that the work will be limited to documenting methodology and using some case studies to illustrate the recommended techniques for finfish. The Working Group will not evaluate whether "new" estimates of reproductive potential would improve the ability to predict recruitment for a given stock. If Working Group members are interested in exploring water temperature data in relation to stock reproductive potential, there are certain databases currently obtainable (details can be provided by STACFEN). Work will likely extend to September 2001, but this will be discussed at the September 2000 Meeting of Scientific Council. The Working Group members and work progress will be available to the Council through e-mail communications.

XII. NOMINATION AND ELECTION OF OFFICERS

1. **Chairman STACFEN**

The Council noted that the election of a Chairman for STACFEN to take office at the end of the Annual Meeting in September 2000, should be considered during this meeting. The Council Chairman, recalling that all other elections of the Scientific Council officers will take place in June 2001, proposed that the present Chairman of STACFEN, M. Stein (EU-Germany) be requested to continue for one more year. The Council agreed to this proposal, and M. Stein agreed to continue, with the understanding that an election will take place in June 2001 to replace him.

The Council accordingly elected M. Stein to continue as Chairman of STACFEN for one more year, and extended its appreciation to him for undertaking this task.

XIII. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOLS

1. **Adapting the Form of Advice to PA Requirements**

The Council noted that several points were referred to Scientific Council from the Joint Scientific Council and Fisheries Commission Working Group on Precautionary Approach Meeting of 29 February-2 March 2000 held in Brussels, Belgium. These are reported under Section III above. Scientific Council agreed to formulate its advice in these terms wherever possible.

2. **NAFO Scientific Council Observership at ICES ACFM Meetings**

In accordance with the Scientific Council decision of September 1999, the Council had nominated Scientific Council observers to ICES ACFM Meetings on an *ad hoc* basis.

The Council was informed that W. R. Bowering (Canada) was currently the Chairman of the ICES Working Group on Arctic Fisheries and regularly attended ICES Meetings. The Council expressed its appreciation to W. R. Bowering for offering to attend other ACFM meetings in autumn 2000 as an observer, and appointed him as the Scientific Council observer for that period. The Chairman will write to the General Secretary of ICES of this appointment.

3. **STACPUB Membership: Elections**

The Council at its meetings in 1999 established new Rules of Procedures for STACPUB membership (SCS Doc. 00/4). It was agreed to appoint STACPUB members for terms, in order to maintain a rotating membership.

The Council noted the progress made by STACPUB in this new membership scheme, and appointed C. Darby (EU-Kingdom United), D. Maddock Parsons (Canada) and H. Siegstad (Denmark/Greenland) as STACPUB members to fulfil the new rotating membership. Appreciation was extended to the new members for accepting this additional commitment.

4. **Review of Proposed NAFO Millennium Publication "NAFO Century Book"**

The Chairman of the Scientific Council discussed this matter with the Executive Secretary, L. Chepel, and reminded him of previous Scientific Council recommendations to review "*NAFO Century book – Northwest Atlantic Fisheries in the 20th Century*". It was noted that the book was not yet complete. The Executive Secretary noted the potential benefits of a review by Scientific Council and was not opposed to it.

XIV. OTHER MATTERS

1. **Report on FAO ACFR Working Party on Status and Trends of Fisheries, November/December 1999**

The Assistant Executive Secretary, in accordance with the June 1999 Scientific Council **recommendation**, attended the FAO ACFR Working Party on Status and Trends of Fisheries Meeting during 29 November-3 December 1999 at FAO Headquarters, Rome, Italy. The summary of the meeting proceedings was presented to the Council (SCS Doc. 00/15) noting the background, objectives, and the results and conclusions.

2. **Report on NAFO Intersessional Meetings**

With respect to two intersessional meetings, the Chairman announced that some Scientific Council members participated in the CWP Intersessional Meeting in February 2000 in Copenhagen, Denmark, and the Joint Scientific Council and Fisheries Commission Working Group on Precautionary Approach Meeting during 29 February-2 March 2000, in Brussels, Belgium.

The Council also noted there were other intersessional meetings of Standing Committees of other NAFO Constituent Bodies:

> Fisheries Commission Working Group on Quota and Shrimp held during 27-30 March 2000 in Washington, DC
>
> STACFAC Dispute Settlement Procedures held during 29-31 May 2000 in Copenhagen, Denmark.

3. **Participation at ICES ACFM Meetings 1999-2000**

The Council expressed thanks to M. Kingsley (Denmark-Greenland), who represented NAFO Scientific Council as an observer at the ICES ACFM Meeting held October-November 1999 at ICES in Copenhagen. The Council reviewed his report, noting the information on the Precautionary Approach and provision of advice. Scientific Council was not able to send an observer to the May-June 2000 Meeting of ACFM due to the overlap with this 1-15 June 2000 Scientific Council Meeting.

4. **Joint NAFO-ICES Working Group on Harp and Hooded Seals**

At its last meeting in 1998, the Joint ICES/NAFO Working Group on Harp and Hooded Seals concluded that a 1999 meeting was not necessary, and work proceeded by correspondence. Research activities included continued analysis of the data on pup production of White Sea harp seals and a survey of Northwest Atlantic harp seal pup production. Preliminary discussions were held to determine the objectives and contents of the proposed Workshop on Population Modeling of Pinnipeds. The Working Group will meet next at ICES headquarters in Copenhagen in 9-13 October 2000. The terms of reference of the meeting include:

1. Complete the assessment of stock size and pup production of harp seals in the White Sea/Barents Sea and hooded seals in the Greenland Sea;
2. Assess the sustainable yield at present stock sizes and provide catch options for these two stocks;
3. Agree on objectives and plan the forthcoming Workshop on Population Modeling of Pinnipeds;
4. Develop an approach for determining biological reference points for Pinnipeds under the precautionary principle.

The Council was presented with a status report on the Northwest Atlantic Harp Seals by G. Stenson (Canada). An assessment of the status of harp seals in the Northwest Atlantic was carried out by the National Marine Mammal Peer Review Committee (Canada) in April 2000. Marine Mammal scientists from Canada, the United States and Greenland participated. The Committee reviewed recent data on removals, reproductive rates and estimates of pup production obtained from surveys carried out in 1999. They also reviewed the results of a population model that incorporated information from all of these sources to estimate population trajectories for the period 1960-2000.

Northwest Atlantic harp seals are harvested in Canadian and Greenland waters. After a period of reduced catches during 1983-95, reported Canadian catches increased significantly to between 240 000 and 280 000 since 1996. Greenland catches have increased steadily since the mid-1970s and are currently estimated to be over 100 000. Total removals of harp seals was estimated by including reported catches, estimates of by-catch in the Newfoundland lumpfish fishery and estimates of seals killed but not recovered during the harp seal hunts in Canada and Greenland. Total removals have been relatively stable since 1997, at around 465 000 seals annually.

Pregnancy rates of harp seals in the Northwest Atlantic have varied considerably since the 1950s. The percentage of mature females that were pregnant increased from the mid-1950s (85%) to the mid-1960s (95%). It then dropped from approximately 90% in the early-1980s to only 70% during the early-1990s. It appears to have increased slightly (72%) in the mid-1990s. The age at which females become sexually mature has also changed. In the early-1950s the average age at which they matured was 5.8 years, whereas in the early-1980s it was 4.6 years. By the mid-1990s it had increased to approximately 5.6 years.

The most recent estimate of harp seal pup production in the Northwest Atlantic was obtained from surveys conducted by Canada in March 1999. Extensive reconnaissance flights were carried out to find the whelping concentrations and monitor their movements. Both visual and photographic surveys were conducted to estimate pup production. The total number of pups born was estimated to be approximately 998 000 ± 200 000.

The population model indicates that the harp seal population declined during the 1960s, reached a minimum of less than 2 million in the early-1970s, and then increased steadily until 1996. Due to the large harvests in recent years, the population has been stable since then at the highest values in the time series. The total population in 2000 was estimated to be approximately 5.2 million with a 95% C.I. of 4.0- 6.4 million). The uncertainty associated with the estimates of pup production are accounted for in the confidence intervals. Additional uncertainty associated with the reproductive rates, total removals and the age of catches have not been included, and therefore these confidence intervals are underestimates of the total uncertainty.

Although an increase in pup production is apparent in both the model and survey estimates since the early-1980s, the population size has stabilized over the past four years due to large catches of young animals. The impact of these catches on pup production is expected to become apparent in coming years.

Estimates of prey consumption by harp seals in Div. 2J+3KL were presented to the June 1999 Meeting of the Scientific Council. Although consumption has not been recalculated using the new population estimates, it is not likely to differ significantly, since the recent estimates of population size are very close to the estimates used previously.

Following the presentation, there was some discussion in the Scientific Council about the recent results. There were no requests to the NAFO/ICES Working Group from the Scientific Council at this time.

5. Other Business

The Council considered 4 items.

a) Reporting of Assessment Results and Documentation

The Council discussed the value of standardizing the reporting of assessment results and documentation methods. The Council agreed this should be discussed further during the September 2000 Meeting of the Council.

b) Meeting Summaries on the Website

The Council noted the value of releasing information about meeting accomplishments on the website, soon after each Scientific Council Meeting.

The Council agreed to set up a working group including STACPUB Chairman, at the beginning of the June 2001 Meeting to prepare such a report. It was agreed this should be a very short informative note.

The Council noted these and other developments on the website should be reviewed by Scientific Council members through the Working Group set up by STACPUB. Such developments should be coordinated through the Chairman of STACPUB.

The Council took the opportunity to congratulate the Secretariat on the progress made to date in developing a user friendly and practical website for NAFO.

c) Technology at Meetings

The Council considered the LAN System used at this meeting and noted it functioned quite effectively for most of the work. There were, however, minor technological considerations such as the interactions with the printers and communication links, that should be considered for the next meeting.

d) **Costs Associated with Council Symposia**

The Council noted most Symposia charge registration fees to offset costs of running them, for example, sponsoring invited speakers, and considered the value of introducing the practice to Scientific Council Symposia. Noting the diverse views of Council members, it was agreed this matter would be further considered during the September 2000 Meeting.

XV. ADOPTION OF COMMITTEE REPORTS

The Council, during the course of the meeting, received summary presentations of the Standing Committee Reports, with focus on the recommendations. Having considered each recommendation and also the text of the reports, the Council during the concluding session on 15 June 2000 **adopted** the reports of STACFEN, STACREC, STACPUB and STACFIS. It was noted that some text insertions and modifications as discussed at the Council plenary will incorporated later by the Chairman and the Assistant Executive Secretary.

XVI. SCIENTIFIC COUNCIL RECOMMENDATIONS TO GENERAL COUNCIL AND FISHERIES COMMISSION

A. The Council considered its **recommendations** from this meeting, and referred the following to the **General Council** as they have financial and administrative implications:

1. The Scientific Council **recommended** that *NAFO's financial contribution to the Joint ICES/NAFO Symposium, August 2001, include the equivalent of GB 3 500 (approximately CDN $8 000) to cover partial costs of conducting the Symposium.*

2. Regarding the September 2001 Symposium, the Scientific Council noted the level of success of this Symposium will be related to the possibility of attracting eminent scientists to it, and agreed that financial support is required to invite key speakers, and **recommended** that *NAFO's financial contribution to the Symposium on "Deep-sea Fisheries" in 12-14 September 2001 should be CDN $8 000*. The Scientific Council also **recommended** that *the ICES and CSIRO as co-sponsors should also be requested to contribute CDN $8 000 each*.

3. The Scientific Council noted that no volumes of *NAFO Statistical Bulletin* had been published since Volume 43, with 1993 data. Volume 44 was still delayed by the absence of data from the USA for 1994 and Volumes 45-48 were delayed by the absence of data for 1995-98 from the Faroe Islands and the USA. The situation on the submission of the data for 1994-98 is shown in the following table.

List of countries that have not submitted STATLANT 21A and 21B data through 1994-98.

STATLANT 21A					STATLANT 21B				
1994	1995	1996	1997	1998	1994	1995	1996	1997	1998
USA	USA	USA	USA	Faroe Is. USA	USA	Faroe Is. USA	Faroe Is. USA	Faroe Is. USA	Faroe Is. USA

The Scientific Council regretted this situation, noting the work of the Scientific Council is seriously jeopardized and the publication of the Statistical Bulletin is seriously delayed, and **recommended** that *the Executive Secretary write to the national delegates of the USA and Denmark (in respect of Faroe Islands and Greenland) with reference to their obligations on the submission of data to NAFO*, and further **recommended** that *the Scientific Council should prepare a document for submission to the General Council and the Fisheries Commission on the adverse effect the absence of the STATLANT 21A and 21B data was having on the work of the Scientific Council.*

4. The Scientific Council **recommended** that *for the fiscal year 2001, the following nominees be supported by the NAFO budget for meeting attendance: i) the Assistant Executive Secretary to the February 2001 meeting of the FAO and Non-FAO Regional Fishery Bodies or Arrangements and the associated CWP Intersessional Meeting at FAO Headquarters, Rome, Italy and ii) the Assistant Executive Secretary and the STACREC Chairman to the CWP 19th Session in Noumea, New Caledonia (July 2001).*

5. There was considerable discussion on additional work to be applied to the Website, and the Council specifically suggested to:

   scan in Journals No. 1-21 (within next year), Studies (thereafter) and make them available from the Website (preliminary considerations suggest that the costs for this project amount to about $27 000 for the Journals, and $24 000 for the Studies)

   Scientific Council further **recommended** that *costs associated with the above activities be enumerated and included in the Scientific Council budget request for 2001.*

   The Scientific Council also noted the following meetings with respect to financial implications in 2001:

   31 May-14 June 2001 Scientific Council Meeting
   12-14 September 2001 Special Session Symposium
   17-21 September 2001 Annual Meeting
   November 2001 Shrimp Meeting

6. The Scientific Council **recommended** that *the Scientific Council Reports and the Reports of the Annual Meeting be included in the contents of the CD-ROM, and the CD-ROM be issued before April of the following year.*

B. The Council noted the following **recommendations** relate to the **Fisheries Commission** considerations:

1. The Scientific Council noted that no volumes of *NAFO Statistical Bulletin* had been published since Volume 43, with 1993 data. Volume 44 was still delayed by the absence of data from the USA for 1994 and Volumes 45-48 were delayed by the absence of data for 1995-98 from the Faroe Islands and the USA. The situation on the submission of the data for 1994-98 is shown in the following table.

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USA	USA	USA	USA	Faroe Is. USA	USA	Faroe Is. USA	Faroe Is. USA	Faroe Is. USA	Faroe Is. USA

   The Scientific Council regretted this situation, noting the work of the Scientific Council is seriously jeopardized and the publication of the Statistical Bulletin is seriously delayed, and **recommended** that *the Executive Secretary write to the national delegates of the USA and Denmark (in respect of Faroe Islands and Greenland) with reference to their obligations on the submission of data to NAFO,* and further **recommended** that *the Scientific Council should prepare a document for submission to the General Council and the Fisheries Commission on the adverse effect the absence of the STATLANT 21A and 21B data was having on the work of the Scientific Council.*

2. The Scientific Council noted that further to its 1999 recommendation that: *the (Scientific Council) ad hoc Working Group on Protocol for Scientific Data Collection should work intersessionally to define the type of data from the Observer Program needed for Scientific Council assessment work as requested by STACTIC during the Joint STACTIC/Scientific Council Meeting at the Annual Meeting, 1998, and develop a complete package of observer collection protocols, data forms, instructions and codes, for presentation to Scientific*

Council at the September 1999 Meeting. The Scientific Council during this meeting prepared and submitted Scientific Council Summary Document (SCS Doc. 00/23) to STACTIC for consideration at its June 2000 Meeting.

3. The Scientific Council **recommended** that *the comparative fishing in Div. 3NO be continued during future spring surveys conducted by EU-Spain and Canada.*

4. All stock-by-stock scientific advice and recommendations will be submitted by the Scientific Council Chairman to the Fisheries Commission during the 18-22 September 2000 Annual Meeting.

XVII. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 15 June 2000, the Council considered the Draft Report of the 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 related to plenary sessions of 14-15 June 2000 and other modifications as discussed at plenary.

XVIII. ADJOURNMENT

The Chairman expressed his gratitude to the Council members for their co-operation during the meeting. He was especially pleased to note the excellent co-operative efforts on a number of stocks, resulting in improved assessments. Special thanks were extended to the Designated Experts and the Standing Committee Chairs for their commitment and for carrying out an extra workload during the meeting.

The Secretariat was congratulated for its fine efforts and support during the meeting, and for providing an excellent LAN at the new meeting site. The Chair also extended thanks to the administrative staff at the Alderney Landing meeting site for their support.

There being no further business, the Chairman wished everyone a safe trip home and closed the meeting.

The members of the Scientific Council extended a special thank you to the Council Chairman for a well-conducted and productive meeting.

Chairman of Standing Committees of Scientific Council:

M. Stein (Chairman STACFEN), W. B. Brodie (Chairman Scientific Council), H.-J. Rätz (Chairman STACFIS), O. A. Jørgensen (Chairman STACPUB) and R. K. Mayo (Chairman STACREC).

STACFIS members in session during the 1-15 June 2000 Meeting.

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

Chairman: M. Stein Rapporteur: K. Drinkwater

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 2 June 2000, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), Estonia, European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Russia and United States of America.

1. Opening

The Committee noted the following documents would be reviewed: SCR Doc. 00/1, 2, 5, 8, 10, 11, 20, 21; SCS Doc. 00/9, 11, 14. K. Drinkwater (Canada) was appointed rapporteur.

2. Chairman's Introduction and Intersessional Report

The Chairman welcomed the members to the annual June meeting of STACFEN. He noted, with pleasure, the attendance of Dr. Webjørn Melle, who will present the invited lecture. The Chairman reported that his primary work between sessions was involved in preparing for the annual meeting, securing a speaker and setting the agenda.

3. Invited Lecture

The Chairman introduced Dr. Webjørn Melle (Institute of Marine Research, Bergen, Norway) who presented a talk entitled "Climate-plankton-fisheries interactions". The following is a brief summary:

Pelagic fish catches (mainly herring and blue whiting) increased significantly from the early- to late-1990s in the Greenland and Norwegian Seas. Demersal catches, on the other hand, have been low and relatively stable, a result primarily related to the large depth of the Nordic seas. Krill, amphipods, and shrimps are prevalent zooplankton in the region and the southern Norwegian Sea is a center of distribution for *Calanus finmarchicus. Calanus glacialis* and *Calanus hyperborius* are also found in the Nordic Seas. Climatologically, the meteorological and oceanographic variability is strongly linked to changes in the NAO (North Atlantic Oscillation) index. High NAO lead to strong SW winds over Norwegian Sea and increasing temperatures and decreasing salinities in northern waters. The latter is believed to be a result of the narrowing of the Atlantic inflow along the coast.

Previous studies in the region have established links between climate and fisheries. For example, there is a positive correlation between temperature from the Kola section and the spawning stock size of the Norwegian spring spawning herring. Also, condition (as measured by weight/length relationship) and the temperature anomaly at weather station Mike are related, although the positive correlations are weak.

Dr. Melle described a positive relationship between *Calanus finmarchicus* and herring. Two hypotheses were proposed to account for this relationship: (1) through the timing of the annual production cycles (match/mismatch) or (2) through the size of annual zooplankton production (food availability).

In the early spring, the herring inhabit the coastal regions feeding on euphausiids. By April they begin to migrate out towards the Norwegian and Greenland Seas and by July tend to be located along the Arctic front. The importance of Calanus in the diet of herring generally increases during the summer. Those herring that reach Arctic type waters feed almost exclusively on Calanus.

In the Norwegian Sea, *C. finmarchicus* release their eggs prior to the peak of the spring bloom in contrast to other regions where they tend to be released during the peak of the bloom. Observational studies in the Norwegian Sea have shown that in spite of the large interannual variability in the timing of the spring bloom, the copepods match closely the timing of the plankton. This has lead to the rejection of the first hypothesis.

Based upon approximately 3000 CTD profiles, five separate water types were identified from their temperature and salinity properties- coastal, Atlantic water east, Atlantic water west, Arctic water, and mixed Arctic/Atlantic water. The bloom occurs in April along the Norwegian coast, later in Atlantic waters and but slightly earlier than Atlantic waters in Arctic waters. The latter is believed to be due a bloom associated with melting ice. Depletion of NO_3, however, occurs first at the coast, then in the Atlantic and lastly in the Arctic waters.

ICES coordinated surveys in the Norwegian and Icelandic Seas in May showed similar temporal patterns in zooplankton abundance in the Arctic and Atlantic waters but slightly different than in coastal waters. A relationship between *C. finmarchicus* abundance during these surveys and overwintering biomass of herring was found. In addition, the condition index of the herring from 1991 to 1999 was related to zooplankton biomass. This stimulated strong interest by the ICES working group responsible for herring assessments. While there are few years of data and hence relationships are not statistically significant, the herring assessment group is looking at providing prognoses for herring biomass from zooplankton and environmental indices. They are exploring the use of the zooplankton abundance indices from the May surveys and the NAO index.

Following questions and discussion of the presentation, the Chairman thanked the speaker for a very interesting lecture.

4. Review of Environmental Conditions

a) Marine Environmental Data Service (MEDS) Report for 1999 (SCR Doc. 00/16)

The inventory of oceanographic data obtained by MEDS during 1999 was presented along with information on several new initiatives.

i) Hydrographic Data Collected in 1998

Data from 5 208 oceanographic stations collected in the NAFO area sent in delayed mode to MEDS in 1999 have been archived, of which 4 040 were CTDs, 1011 were XBTs and 157 were bottles. An additional 882 stations were received directly by MEDS but are not yet archived. A total of 5 191 stations were received through IGOSS (Integrated Global Ocean Service System) and have been archived. The number of stations received directly by MEDS was similar to 1998 while the number of stations obtained through IGOSS decreased by over 12%.

ii) Historical Hydrographic Data Holdings

Data from 18 414 oceanographic stations collected prior to 1999 were obtained during the year, close to the number received in 1998.

iii) Thermosalinograph Data

A number of ships have been equipped with thermosalinographs to collect surface temperature and salinity data while the vessels are under way. These are transmitted as station data via satellite with over 8 802 stations in the NW Atlantic being received during 1999, an increase over 1998 in excess of 53%.

iv) Drift-buoy Data

A total of 138 drift-buoy tracks were received by MEDS during 1999 representing over 407 buoy months. The total number of buoys increased by 29 over 1998 and the number of buoy months is up by over 34%.

v) Wave Data

In 1999, 106 172 wave spectra were processed, originating mostly from the permanent network of moored wave buoys in the area. This represents almost a 35% increase compared to 1998.

vi) **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 31 stations were processed during 1999, a decrease of 16 stations from 1998 and 26 less than in 1997.

vii) **Recent Activities**

MEDS reported on three recent initiatives. (1) since 1998, MEDS has been acquiring and archiving data from the profiling buoys, known as PALACE floats. (2) three CD-ROMs will be produced in the near future. The set of CD-ROMs containing WOCE data will be issued in September 2000, the second in the series. A CD that includes positional drift buoy data from the Arctic from 1979 to 1999 will be ready by June 2000. Data acquired during the Canadian Joint Global Ocean Flux Study (JGOFS) will also be published on a CD. The data are presently being acquired by MEDS. (3) MEDS continues to be involved with the Canadian Atlantic Zone Monitoring Program (ZMP) and has assumed the responsibility for leading the data management team. A website displaying indices also allows easy access to the data.

b) **Review of Environmental Studies in 1999**

i) **Subareas 0 and 1** (SCR Doc. 00/1, 00/10, 00/11; SCS Doc. 00/11)

A survey of oceanographic stations along the West Greenland standard sections by Danish scientists was carried out from 1-10 July 1999 (SCR Doc. 00/01). At Fyllas Bank, near surface temperatures were below the record set in 1998 but still were well above normal. Near surface salinities at Fyllas Bank decreased slightly from the 1998 value but remained slightly above the long-term mean. Cold, low salinity surface layer waters were observed south of Fyllas Bank in the inshore areas from Cape Farewell north to 63ºN. These are thought to be Polar Waters from the East Greenland Current. Polar waters were absent at Fyllas Bank for the second consecutive year. In the subsurface layers, a weak inflow of pure Irminger Water was found in 1999, reaching only as far north as the Cape Desolation section. Temperatures in this core were higher-than-normal. Modified Irminger water was observed almost as far north as Holsteinsborg.

The German Research Report (SCS Doc. 00/11) noted that during the 1999 German groundfish survey off Greenland conducted from 4 October to 18 November, 102 CTD stations were occupied in addition to the 4 standard sections off Cape Desolation, Fyllas Bank, Little Halibut Bank and Holsteinsborg.

Examination of atmospheric conditions around Greenland (SCR Doc. 00/11) showed that mean air temperatures at Nuuk were slightly below normal in 1999 due primarily to a cold winter and one month in spring (May). Temperatures during the last half of the year were all above the climatic normal, however. Ice conditions in 1999 were relatively light. Sea-surface temperatures off Greenland in the autumn cooled relative to the very high values of 1998 but still were one of the warmest years since observations began in 1963. Subsurface ocean temperatures at this time were warmer-than-normal along the standard sections off West Greenland with warm Modified Irminger water (4.93°C, $34.88 < S < 34.95$) located as far north as Holsteinsborg.

During a survey for Greenland halibut in Div. 1C-1D from 21 September to 6 October 1999, bottom temperatures were recorded (SCR Doc. 00/10). These ranged from 1.5ºC averaged over depths of 601-800 m in Div. 1C to 4.7ºC in depths of 401-600 m in Div. 1C.

ii) **Subareas 2, 3 and 4** (SCR Doc. 00/8; SCS Doc. 00/9)

Hydrographic conditions on Flemish Cap were described from a CTD survey (116 stations) conducted during July 1999 (SCR Doc. 00/8). As in past years, the warmest waters were found over the central region of the Cap and the coldest tended to be on its northern flank. Four distinct water masses were identified based upon their T-S properties. These were cold, low saline Labrador Water (LW), Anticyclone Gyre Water (ACW) formed from LW through solar heating and evaporative processes, Modified Labrador Water (MLW) through mixing and has higher salinities than LW and no subsurface temperature minimum, and North Atlantic Current Water (NACW) with relatively high temperatures and salinities. In 1999, MLW was predominant and no NACW was found.

Sea-surface temperatures off Labrador, Newfoundland, the Scotian Shelf and adjacent areas during 1999 were reported (SCS Doc. 00/9). Data were averaged over 5-degree squares. Off Labrador and Newfoundland, including the Labrador Sea, surface temperatures were warmer-than-normal, continuing a trend that started in 1996. Warm temperatures were also observed over the Scotian Shelf, conditions favourable for silver hake recruitment.

iii) **Subareas 5 and 6** (SCS Doc. 00/14)

The United States Research Report listed several ongoing programs. The Narragansett Laboratory during 1999 occupied their standard sections across the Middle Atlantic Bight south of New York and across the Gulf of Maine from Boston to Cape Sable. Several papers based upon the historical data collected along these sections are in preparation including one on the temperature and salinity variability during the 1990s. The GLOBEC studies on Georges Bank completed its fifth and final year of field studies. This program has provided extensive hydrographic coverage of the entire Gulf of Maine during the past five years in addition to concentrated process studies on stratification and front exchange on the Bank.

iv) **Interdisciplinary Studies** (SCR Doc. 00/20)

Near-bottom temperatures and their anomalies over the Grand Banks (Div. 3LNO) during 1990-99 were compared to the spatial distributions of cod catches obtained during spring and autumn surveys. Large interannual variations in the near-bottom thermal habitat for cod were observed from the cold sub-zero degree conditions of the early-1990s to the relatively warm waters of the late-1990s. The percentage of bottom covered by water warmer than 2ºC changed from around 20% in the early-1990s to over 60% by 1999. Over this time there was a significant increase in the number of cod caught per tow in the survey sets in Div. 3NO with more fish being found in the shallower warmer waters on top of the Grand Bank. The cause of the improved catches over the Bank was unclear. In Division 3L there was no significant increase in cod catches.

c) **Overview of Environmental Conditions in 1999** (SCR Doc.00/21)

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

i) Annual air temperatures throughout the Northwest Atlantic were above normal in 1999 with new record highs set in the region from southern Labrador to the Gulf of Maine, including Newfoundland and the Gulf of St. Lawrence.

ii) The atmospheric circulation intensified in 1998 with the largest changes occurring over the eastern side of the Atlantic. This resulted in a relatively high North Atlantic Oscillation (NAO) index and a large increase over 1998 levels. The index was similar to the values of the early-1990s.

iii) While ice formed on schedule or slightly later-than-usual, the warm temperatures during the winter resulted in an early disappearance and shorter ice duration in 1999 than normal off southern Labrador, Newfoundland and in the Gulf of St. Lawrence. Little to no ice reached the Scotian Shelf.

iv) During 1999, the number of icebergs to reach south of 48°N decreased dramatically relative to 1998 (from 1 384 to 22) and was the lowest number of icebergs in over 20 years.

v) Temperatures off Newfoundland and Labrador during 1999 were warmer than normal throughout most of the water column.

vi) The area of CIL (Cold Intermediate Layer) water was below normal from southern Labrador to the Grand Bank. This resulted in the CIL volume during the summer and autumn of 1999 being the lowest on record.

vii) The CIL waters in the Gulf of St. Lawrence warmed significantly during 1999 but the core temperature still remained below normal. Further evidence of the warming in 1999 was supplied by the decrease in the bottom area of the Magdalen Shallows covered by temperatures <0 and <1°C. Cause of the warming was believed related to decreased winter cooling.

viii) Annual coastal sea surface temperatures (SSTs) at Boothbay Harbor and St. Andrews were above average, a pattern similar to the previous four years. Halifax SSTs were about normal, representing a decline over 1998 levels.

ix) Deep-water temperatures on the Scotian Shelf (Emerald Basin) increased by upwards of 2-3°C from 1998 levels. Temperature increases were also recorded in Georges Basin in the Gulf of Maine and the southwestern Scotian Shelf. The warm temperatures in the deep basins on the Scotian Shelf and in the Gulf of Maine were due to the on-shelf penetration of Warm Slope water from the shelf break region.

x) The cold Labrador Slope water observed in 1998 along the shelf edge off the Scotian Shelf retracted to its normal position around the Laurentian Channel. Along the Middle Atlantic Bight and Scotian Shelf it was replaced by Warm Slope water and represents a return to conditions that have generally persisted since the 1970s.

xi) Warmer-than-normal waters were observed over substantial portions of the bottom and at intermediate waters over the northeastern Scotian Shelf for the first time since the mid-1980s.

xii) Density stratification on the Scotian Shelf continued high during 1999.

xiii) Both the shelf/slope front and the north wall of the Gulf Stream moved northward during 1999. While the Stream still remained south of its long-term mean, the Shelf/Slope front moved north of its climatological mean position.

5. Recommendations Based on Environmental Conditions in 1999

A discussion followed the presentation of the environmental conditions for 1999. It initially focused upon the possible effect of temperatures on catchability and whether this could explain the improved cod catches on the Grand Banks that were reported in SCR Doc. 00/20. Opinions were divided but it was noted that the number of cod collected was still very low. It was suggested that a similar analysis comparing bottom-temperatures and distributions should be performed with yellowtail flounder since they have been very abundant in recent years. It was stated that when the yellowtail flounder abundance was low, they were confined to the Southeast Shoal of the Grand Bank but have been spreading into the southern areas of Div. 3L. It was also noted that temperature might effect not only distribution or catchability, but also growth. This had been discussed in a previous NAFO meeting in regards to warming around Iceland. No specific recommendations were felt to be required at this time, however.

The Chairman reminded STACFEN members the importance of ensuring that their environmental data are submitted to MEDS for archiving, and in a timely manner. Again, no specific recommendation to Council was felt to be required at this time.

6. **Environmental Indices** (implementation in the assessment process)

No new information was available to the Committee.

7. **Russian/German Project Data Evaluation** (SCR Doc. 00/2, 00/5)

The Chairman presented the Fourth and Fifth Reports on the Joint Russian/German Project "Assessment of short-time climatic variations in the Labrador Sea". A Workshop was held on 23-30 August 1999 in Murmansk, Russia. Using historical data, the interannual variability of the slope trapped boundary currents along the Seal-Island-Cape Farewell Section, as well as the temporal changes of sea-surface temperature (SST) and the North Atlantic Oscillation (NAO) Index correlation patterns in the Labrador Sea region were analyzed. A second Workshop was held on 10-14 April 2000 in Hamburg, Germany. The relationship between physical variables (air temperatures, winds and SSTs) and cod recruitment off West Greenland and Iceland were analysed. Results included a significant relationship between wind and recruitment of West Greenland cod. During April, northerly winds off southern Greenland and easterly winds in the Denmark Strait favour higher recruitment. During summer, easterly winds west of Iceland favour good recruitment. The next workshop within this project is scheduled for 6-10 November 2000 in Murmansk, Russia.

8. **ICES/NAFO Symposium on Hydrobiological Variability**

In 1998, STACFEN recommended that NAFO co-sponsor, along with ICES, the planned Symposium on Hydrobiological Variability during the 1990s to be held in 2001 in Edinburgh, Scotland. The co-convenors are to be Jens Meincke (Germany) and Bob Dickson (UK). The ICES Oceanic Hydrography Working Group has supported the joint sponsorship. The Chairman of the STACFEN, M. Stein, was appointed to the Steering Committee for the Symposium and K. Drinkwater is on the editorial board for publication of the symposium proceedings. Given that both NAFO and ICES have been proposing to hold similar symposia on the review of the 1990s early in the next decade, a single symposium was felt to be more efficient. In addition to allowing the traditional regional focus that separate symposium would foster, the joint meeting will 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.

At the 1999 meeting of STACFEN, the Committee proposed a recommendation that NAFO's financial contribution to the Joint ICES/NAFO Symposium include the equivalent of GBP 3 500 to cover the cost of the art exhibition. This recommendation was presented to the Standing Committee on Finance and Administration (STACFAD). STACFAD had concerns with the amount of the contribution considering NAFO's emphasis on budget restraints. There were also concerns with the appropriateness of NAFO funding the transportation of artwork to the Symposium. STACFAD was, however, not opposed to providing a contribution to the joint ICES/NAFO Symposium in August 2001 and requested that the Scientific Council review its request in light of the foregoing concerns for reference back to STACFAD at the next Annual Meeting in 2000. STACFEN agreed the Chairman should present the new recommendation below, which was accepted by the Committee.

STACFEN **recommended** that *NAFO's financial contribution to the Joint ICES/NAFO Symposium on "Hydrobiological Variability During the 1990s", August 2001, Edinburgh, Scotland, include the equivalent of GB 3 500 (approximately CDN $8 000) to cover partial costs of conducting the Symposium.*

9. **National Representatives**

STACFEN noted the national representatives responsible for hydrographic data submission to MEDS are: E. Valdes (Cuba), E. Buch (Denmark), A. Battaglia (France), F. Nast (Germany), H. Okamura (Japan), R. Leinebo (Norway), A.J. Paciorkowski (Poland), J. Pissarra (Portugal), F. Troyanovsky (Russia), L.J. Rickards (United Kingdom) and K.J. Schnebele (USA).

The issue of whether new representatives such as the Baltic States should have national representatives responsible for hydrographic data submission was raised but no decision was made.

10. **Other Matters**

The Chairman noted that he has been in the office for sixteen years and will be stepping down after the Annual Meeting in 2001. STACFEN agreed that at the June 2001 Meeting, a new Chairman will have to be elected, and anyone wishing to assume the Chair or wishing to nominate someone to the position should contact the present Chair or the NAFO Secretariat intersessionally.

11. **Acknowledgements**

The Chairman closed the meeting by thanking the participants for their contributions and co-operation, the Invited Speaker for his interesting lecture, the rapporteur for taking the minutes, and the NAFO Secretariat for providing the scientific papers in due time and excellent quality on the NAFO Website, and in printed version.

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

Chairman: R.K. Mayo Rapporteur: D. G. Cross

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 1-15 June 2000, to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), Estonia, European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Russian Federation and United States of America. The Assistant Executive Secretary was in attendance.

1. Opening

The Chairman opened the meeting by welcoming the participants. D. Cross (EU) was appointed rapporteur.

2. Review of Recommendations in 1999

a) From the June 1999 Meeting

i) STACREC had recommended that *the Chairman of the Scientific Council interact with the Chairmen of the General Council and the Fisheries Commission in establishing a cooperative and integrated approach to ensure the continued development and enhancement of the NAFO Website.*

STACREC noted several major enhancements to the NAFO website, including the availability of 1960-99 21A data-files.

ii) STACREC had recommended that *the (error) detection exercise should be repeated at short intervals at the discretion of the NAFO and FAO Secretariats.*

STACREC noted this exercise has been included in Secretariat's program of work particularly in relation to developing the STATLANT 21 database on the NAFO website.

iii) STACREC had recommended that *STACFIS consider appointing a Designated Expert for elasmobranch species.*

STACFIS accepted and acted upon this recommendation at the June 1999 Meeting with the nomination of D. Kulka (Canada) as Designated Expert.

iv) STACREC had recommended that *the ad hoc Working Group on Protocol for Scientific Data Collection should work intersessionally to define the type of data from the Observer Program needed for Scientific Council assessment work as requested by STACTIC during the Joint STACTIC/Scientific Council Meeting at the Annual Meeting, 1998, and develop a complete package of observer collection protocols, data forms, instructions and codes, for presentation to Scientific Council at the September 1999 Meeting.*

The Working Group reported to STACREC at its September 1999 Meeting (page 24, 1999 Sci. Coun. Rep., 1999, p. 24) and the topic was further discussed during this meeting (see Section 6 below).

b) From the September 1999 Meeting

v) STACREC had recommended that *the Working Group on NAFO Observer Protocol communicates by email with STACREC members during development of the coding and sampling procedures in order to ensure concurrence with the recommendation tabled by STACTIC for consideration during the proposed STACTIC intersessional meeting in 2000.*

See STACREC Section 6 below for discussion.

vi) STACREC had recommended that *noting that STACTIC will call an intersessional meeting in 2000 on Observer Protocol, M. Showell (Canada) and D. Kulka (Canada) should represent Scientific Council at that meeting.*

It was noted that the STACTIC Meeting is scheduled for 26-30 June 2000. D. Kulka (Canada) will represent Scientific Council (see STACREC Section 6).

vii) STACREC had recommended that *the Assistant Executive Secretary and STACREC Chairman attend the 19th Session of CWP in Noumea, New Caledonia in July 2001.*

The Council accepted this recommendation. Further discussions are reported in STACREC Section 3.b.ii. below.

viii) STACREC had recommended that *the Assistant Executive Secretary and the STACREC Chairman attend the CWP intersessional meeting in Copenhagen, Denmark in February 2000 and report proceedings to the Scientific Council in June 2000.*

The Assistant Executive Secretary attended the CWP intersessional meeting in Copenhagen in February 2000. See STACREC Section 3b.i. below.

ix) STACREC had recommended that *the Designated Expert for cod in Div. 3NO complete the spreadsheet as proposed by the Working Group on Biological Database Exchange using the data for this stock and present it to the Scientific Council Meeting in June 2000.*

See STACREC Section 5 below.

3. Fishery Statistics

a) Progress Report on Secretariat Activities in 1999/2000

i) Acquisition of STATLANT 21A and 21B Reports for Recent Years

The Assistant Executive Secretary outlined the status of the STATLANT data submissions for recent years. The following table shows the dates STATLANT 21A and 21B submissions were received at the Secretariat up to June 2000.

Country/ Component	STATLANT 21A (deadline, 15 May) 1997	1998	1999	STATLANT 21B (deadline, 30 June) 1997	1998	1999
BGR	-	-	-	-	-	-
CAN-M	22 Jun 98	10 May 99	12 May 00	12 Jan 99	30 Nov 99	-
CAN-N	02 Jun 98	14 Jul 99	18 May 00	14 Jul 99	25 Feb 00	-
CAN-Q	15 May 98	10 May 99	-	02 Sep 98	04 Nov 99	-
CUB	10 Aug 99	10 Aug 99	01 Jun 00	10 Aug 99	10 Aug 99	01 Jun 00
EST	27 May 98	17 May 99	03 May 00	27 May 98	21 Oct 99	03 May 00
E/DNK	02 Feb 99	07 Jun 99	17 May 00	23 Mar 99	27 Mar 00	-
E/FRA-M	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
E/DEU	23 Mar 98	23 Apr 99	04 May 00	23 Mar 98	27 Apr 99	-
E/NLD	No fishing	No fishing	-	No fishing	No fishing	-
E/PRT	24 Apr 98	26 Apr 99	16 May 00	14 Sep 98	27 Aug 99	-
E/ESP	14 Sep 98	01 Jun 99	29 May 00	14 Sep 98	07 Sep 99	-
E/GBR	30 Mar 99	11 May 99	No fishing	30 Mar 99	29 Mar 00	No fishing
FRO	03 Feb 99	-	-	-	-	-
GRL	28 May 98	28 May 99	-	03 Feb 99	26 Oct 99	-
ISL	24 Jul 98	07 Jun 99	26 May 00	12 Nov 98	23 Nov 99	-
JPN	14 Apr 98	29 Apr 99	11 Apr 00	14 Apr 98	14 Apr 99	11 Apr 00
KOR	No fishing	No fishing	-	No fishing	No fishing	-
LVA	22 Apr 98	14 May 99	12 May 00	04 Jun 98	14 May 99	12 May 00
LTU	17 Feb 98	29 Nov 99	-	29 Nov 99	29 Nov 99	-
NOR	20 Nov 98	25 May 99	09 May 00	21 Jun 99	-	-
POL	-	10 May 99	-	-	14 Oct 99	-
ROM	-	-	-	-	-	-
RUS	02 Apr 98	01 Jun 99	04 May 00	08 Jul 98	01 Jun 99	-
USA	-	-	-	-	-	-
FRA-SP	29 Jan 99	02 Jun 99	04 May 00	29 Jan 99	02 Jun 99	11 May 00
HND*	-	-	-	-	-	-
VEN*	-	-	-	-	-	-

* Non-Contracting Party.

ii) **Publication of Statistical Information**

The Assistant Executive Secretary reported that no volumes of the *NAFO Statistical Bulletin* had been published since Volume 43, with 1993 data. Volume 44 was still delayed by the absence of data from the USA for 1994 and volumes 45-48 were delayed by the absence of data for 1995-98 from the Faroe Islands and the USA. The situation on the submission of the data for 1994-98 is shown in the following table.

List of countries that have not submitted STATLANT 21A and 21B data through 1994-98.

STATLANT 21A 1994	1995	1996	1997	1998	STATLANT 21B 1994	1995	1996	1997	1998
USA	USA	USA	USA	Faroe Is. USA	USA	Faroe Is. USA	Faroe Is. USA	Faroe Is. USA	Faroe Is. USA

STACREC regretted this situation, noting the work of the Scientific Council is seriously jeopardized and the publication of the Statistical Bulletin is seriously delayed. Thus STACREC **recommended** that *the Executive Secretary write to the national delegates of the USA and Denmark (in respect of Faroe Islands and Greenland) with reference to their obligations on the submission of data to NAFO.* STACREC further **recommended** that *the Scientific Council should prepare a document for submission to the General Council and the Fisheries Commission on the adverse effect the absence of the STATLANT 21A and 21B data was having on the work of the Scientific Council.*

STACREC reviewed SCS Doc. 00/12 ("Historical Nominal Catches for Selected Stocks") and noted that, while it was useful, the tabulations were of the official STATLANT 21A data and were not necessarily the data used in the STACFIS assessment work. It was considered that the latter data should be documented and, accordingly, STACREC **recommended** that the *Secretariat should extract from Scientific Council reports the annual estimates of the total catches for each stock for the period from 1985 used by STACFIS in its assessment work and report them alongside the annual STATLANT nominal catches.*

iii) **Considerations on Internet Site for Statistical Data**

D. Cross (EU) reported on collaboration between NAFO, EUROSTAT and FAO in reformatting the NAFO STATLANT 21A data files for preparing a user-friendly database for consultation on the NAFO website. The FAO FISHSTAT Plus software was used to demonstrate a preliminary version of the software which, when fully developed, would be made available for down-loading from the NAFO internet site. STACREC welcomed this development which was considered to be a useful extension of services to data users and thanked EUROSTAT and FAO for their collaboration in this work.

iv) **Interagency Data Harmonization (NAFO/FAO)**

The Assistant Executive Secretary reported that although in the last year there had been no formal exercise to detect discrepancies between the NAFO and FAO databases, the close collaboration between the two organisations and the exchange of data between them has contributed significantly to the harmonisation of the data. The development of the FISHSTAT Plus database is also enhancing this process

v) **Elasmobranch Species**

STACREC reviewed the list of Elasmobranch species for which catch statistics are to be requested from national authorities on the STATLANT questionnaires. It was agreed that four additional species should be added to the list, which then is as follows.

Code	Short name	Common name	Scientific name	Abbreviation	Category
452	Spiny dogfish	Spiny (picked) dogfish	*Squalus acanthias*	DGS	3
460*	Sand tiger	Sand tiger shark	*Odontaspis taurus*	CCT	3
462	Porbeagle	Porbeagle	*Lamna nasus*	POR	3
464	Shortfin mako	Shortfin mako shark	*Isurus oxyrinchus*	SMA	3
470	Sharpnose shark	Atlantic sharpnose shark	*Rhizoprionodon terranovae*	RHT	3
467*	Dusky shark	Dusky shark	*Carcharhinus obscurus*	DUS	3
468*	Blue shark	Great blue shark	*Prionace glauca*	BSH	3
473	Boreal shark	Boreal (Greenland) shark	*Somniosus microcephalus*	GSK	3
472	Black dogfish	Black dogfish	*Centroscyllium fabricii*	CFB	3
474	Basking shark	Basking shark	*Cetorhinus maximus*	BSK	3
480	Little skate	Little skate	*Leucoraja erinacea*	RJD	3
482*	Arctic skate	Arctic skate	*Amblyraja hyperborea*	RJG	3
484	Barndoor skate	Barndoor skate	*Dipturus laevis*	RJL	3
487	Winter skate	Winter skate	*Leucoraja ocellata*	RJT	3
490	Spinytail skate	Spinytail (Spinetail) ray	*Bathyraja spinacauda*	RJQ	3
488	Thorny skate	Thorny skate (starry skate)	*Amblyraja radiata*	RJR	3
489	Smooth skate	Smooth skate	*Malacoraja senta*	RJS	3

* Additions since 1999.

b) **CWP Sessions 2000/2001**

i) **Report on the CWP Intersessional Meeting, Copenhagen, 10-16 February 2000**

STACREC noted that the CWP Intersessional Meeting consisted of two Working Groups (the Working Group on Publication of Integrated Catch Statistics for the Atlantic, 10-11 February 2000, and the Working Group on Precautionary Approach Terminology, 14-16 February 2000), held at ICES Headquarters, Copenhagen, Denmark.

D. Cross (EU, CWP Chairman) reported on the discussions in the Working Group on Publication of Integrated Catch Statistics for the Atlantic. The following organisations were represented: ICCAT, ICES, EUROSTAT, FAO and NAFO, the latter in the persons of W. Brodie and the NAFO Assistant Executive Secretary. The discussions centred on a proposal from the CWP 18th Session to produce a CD-ROM of Integrated Catch Statistics using the FAO FISHSTAT Plus software. It was agreed that this CD-ROM would integrate the STATLANT A data (or their equivalent) from Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), Fisheries Committee for the Eastern Central Arctic (CECAF), Fisheries and Agriculture Organisation (FAO), General Fisheries Council for the Mediterranean (GFCM), International Commission for the Conservation of Atlantic Tunas (ICCAT), International Council for the Exploration of the Sea (ICES) and NAFO and that, in selecting data for this integrated data file, priority would be given initially to ICCAT data (for tuna species), then regional agency data and finally to FAO data. As well as the integrated data-file the CD-ROM would contain the individual data-bases of the agencies. It was anticipated that the draft CD-ROM version would be available in time for the NAFO Annual Meeting in September 2000, for review and comments by NAFO members.

STACREC noted that the Working Group on Precautionary Approach Terminology was chaired by W. R. Brodie (Chairman of the Scientific Council) and that the report of that meeting would be addressed by the Scientific Council (see Scientific Council Section III.1).

ii) **CWP 19th session, July 2001**

The preliminary list of topics to be included in the agenda for the CWP 19th session proposed at the intersessional meeting (see SCS Doc. 00/7) were noted. STACREC was informed that the agenda for the CWP 19th session would be finalised at another CWP intersessional meeting at FAO Headquarters (Rome) in February 2001 immediately prior to or following the Second Meeting of FAO and Non-FAO Regional Fishery Bodies or Arrangements.

STACREC discussed the attendance of Scientific Council nominees at CWP sessions as well as at important meetings of other international organisations. It was noted that the attendance of the Assistant Executive Secretary at such meetings was usually financed from the NAFO budget but that other nominees, particularly key officers of the Scientific Council had no financial support from the NAFO budget. STACREC was concerned that the STACREC Chairman was unable to attend the CWP Intersessional Meeting in February 2000 due to lack of financial support.

STACREC reiterated its view that participation by Secretariat officers as well as Scientific Council officers nominated to attend important meetings of international organizations such as CWP should be supported by the NAFO budget. Accordingly STACREC **recommended** that *for the fiscal year 2001, the following nominees be supported by the NAFO budget for meeting attendance: i) the Assistant Executive Secretary to the February 2001 meeting of the FAO and Non-FAO Regional Fishery Bodies or Arrangements and the associated CWP Intersessional Meeting at FAO Headquarters, Rome, Italy, and ii) the Assistant Executive Secretary and the STACREC Chairman to the CWP 19th Session in Noumea, New Caledonia (9-13 July 2001).*

4. Research Activities

a) Biological Sampling

i) Report of Activities in 1999/2000

STACREC noted and reviewed the listings of Biological Sampling Data prepared by the NAFO Secretariat. These listings (SCS Doc. 00/10) include biological sampling data for 1999 reported to the Secretariat prior to the present meeting.

ii) Report by National Representatives on Commercial Sampling

Cuba: Samples were obtained in the shrimp fishery in Div. 3M in December 1999. Length composition of shrimp samples were obtained by one observer on board the vessel.

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. Div. 3M: the fishery for shrimp in Div. 3M was not sampled in 1999.

EU-France: Data on catch rates, length composition of catches were made available for the French trawl fishery of Greenland halibut in Div. 2J, 3L and 3M.

EU-Germany: No fishing in 1999.

EU-Portugal: Data on catch rates, length and age composition were obtained from trawl catches for Greenland halibut (Div. 3LMNO). Data on length and age composition of the catch were obtained for cod (Div.3M) and redfish (Div. 3M). Data on length composition of the catch were obtained for cod (Div.3NO), redfish (Div. 3LNO), American plaice (Div. 3LNO), yellowtail flounder (Div. 3NO), roughhead grenadier (Div. 3LMN) and witch flounder (Div. 3LNO).

EU-Spain: Length composition samples obtained from observers on-board the freezer trawl and pair-trawl fleet were available for Greenland halibut in Div. 3LMNO, roughhead grenadier in Div. 3LM, roundnose grenadier in Div. 3LM, witch flounder in Div. 3LMNO, American plaice in Div. 3LNO, yellowtail flounder in Div. 3N, thorny skate in Div. 3N, cod in Div. 3N and redfish in Div. 3LNO. In addition, data on age composition of the catch were obtained for Greenland halibut in Div. 3LMNO and roughhead grenadier in Div. 3LM.

Russia: Samples were obtained from commercial bottom trawl fishery directed to Greenland halibut in Div. 3LMNO and 1D. The length, age data of Greenland halibut, roughhead grenadier, redfish, American plaice, other flatfishes, sharks and skates were collected by observers on-board the trawlers during January-December 1999 (in Subarea 3) and during September-October (in Div. 1D). Data on catch rates were taken as well.

iii) 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 were prepared with inputs from Designated Experts.

Table 1. Available data from the commercial fisheries related to stock assessment (1999). (+ is data available).

			Biological Sampling					
Stock	Country[1]	Catch	CPUE	Sex	Length	Age	Individual Wt.	Maturity
Cod in 2J3KL	CAN	+	+	+	+	+	+	+
Cod in 3M	EU/PRT	+			+	+		
Cod in 3NO	EU/PRT	+			+			
	EU/ESP	+			+			
	CAN	+		+	+	+		
Redfish in SA1	GRL	+						
Redfish in 3M	EU/PRT	+		+	+	+		+
	EU/ESP	+						
	JPN	+						
	RUS	+		+	+			
	NCP	+						
Redfish in 3LN	CAN	+						
	JPN	+						
	EU/FRA	+						
	EU/PRT	+			+			
	EUESP	+			+			
	RUS	+		+	+	+	+	
American Plaice in 3M	RUS	+		+	+			
	JPN	+						
	EU/PRT	+						
	EU/ESP	+						
	FRO	+						
American Plaice in 3LNO	CAN-M	+						
	CAN-N	+			+	+		
	RUS	+						
Witch flounder in 3NO	CAN	+						
	EU/ESP	+						
	EU/PRT	+			+			
	RUS	+			+			
Yellowtail flounder in 3LNO	CAN	+	+	+	+			
	EU/ESP	+		+	+			
	EU/PRT	+			+			
	RUS	+			+			
Greenland halibut in SA0 + 1B-F	EU/DEU	+	+					
	RUS	+	+	+	+	+	+	
	CAN	+	+			+	+	
	GRL	+	+		+			
	NOR	+	+					
Greenland halibut in 1A	GRL	+		+	+	+	+	+

Table 1 (Continued).

Stock	Country[1]	Catch	CPUE	Sex	Length	Age	Individual Wt.	Maturity
				Biological Sampling				
Greenland halibut in SA 2+3	CAN	+	+		+	+		
	EU/PRT	+	+	+	+	+		
	EU/ESP	+		+	+	+	+	+
	JPN	+						
	RUS	+	+	+	+	+		+
	FRA	+	+	+	+	+		
Roundnose grenadier SA 0+1	RUS	+						
	GRL	+						
Roughhead grenadier SA 2+3	EU/ESP	+	+	+	+	+	+	+
	EU/PRT	+	+		+		+	
	RUS	+		+	+	+		+
Capelin in 3NO	No data available							
Elasmobranchs	EU/ESP	+						
	RUS	+						
	CAN	+						
	USA	+						
Squid in SA 3+4	CAN	313	+		+			
Other Finfish in SA1	GRL	+						
Shrimp in 3L		+	+	+	+	+		+
Shrimp in 3M								
Shrimp in SA 0+1	GRL	+	+	+	+			
Shrimp in Denmark Strait	EU/DNK	+	+					
	FRO	+	+					
	GRL	+	+	+	+			+
	ISL	+	+	+	+			+
	NOR	+						

[1] Country or Component abbreviations as found in *NAFO Statistical Bulletin*; 'NCP' refers to estimates of non-Contracting Parties `who did not report catches to NAFO.

b) **Biological surveys**

i) **Review of Survey Activities in 1999**

An inventory of biological surveys conducted in 1999 as submitted by National Representatives and Designated Experts was prepared by the Secretariat

Table 2. Inventory of biological surveys conducted in the NAFO Area during 1999. ([1]Country or Component abbreviations as in *NAFO Statistical Bulletin*)

Subarea	Division	Country [1]	Month	Type of survey	No. of sets
				Stratified-random Surveys	
0	A	CAN-C+A	10	Greenland halibut deep-sea trawl	66
1	A	GRL	5-6	Snow crab	50 (12)
	B		5-6	Snow crab	66 (12)
	A-F		7-9	Shrimp and groundfish trawl	230
	C-D		7-8	Greenland halibut deep-sea trawl	38
	BCDEF	EU/DEU	10, 11	Demersal fish	67
2+3	GHJ+ KLMNO	CAN-N	9-12	Groundfish/shellfish trawl	821
3	LNO		4-6	Groundfish/Shellfish trawl	315
	NO	EU/ESP	5	Groundfish	134
	M	EU/ESP&PRT	7	Groundfish	135
	P	CAN-N	4	Groundfish/Shellfish trawl	171
3+4	Pn+RST	CAN-Q	8-9	Summer multidisciplinary survey in the Estuary and Gulf of St. Lawrence	246
4	X	USA	3,4	Spring bottom trawl	27
	X		6	Ecosystem monitoring	9
	X		8,9	Ecosystem monitoring	8
	X		10,11	Autumn bottom trawl	39
	X		11	Ecosystem monitoring	8
5	YZ		3,4	Spring bottom trawl	189
	YZ		6	Ecosystem monitoring	50
	YZ		7,8	Northern shrimp	61
	YZ		8,9	Ecosystem monitoring	68
	YZ		10,11	Autumn bottom trawl	242
	YZ		11	Ecosystem monitoring	66
	Z		2	Winter bottom trawl	53
	Z		7	Surf clam/ocean quahog	136
	Z		8	Sea scallops	210
6	ABC		2	Winter bottom trawl	94
	ABC		3	Spring bottom trawl	192
	ABC		5	Ecosystem monitoring	23
	ABC		7	Sea scallops	194
	ABC		9,10	Autumn bottom trawl	199
	ABC		6,7	Surfclam/Ocean Quahog	470
	ABC		11	Ecosystem monitoring	33
	BC		5	Apex predators	24
				Other Surveys	
1	A	GRL	7-8	Longline, inshore Greenland halibut	36
	D		6-7	Gillnets, inshore juvenile cod	72
2	J	CAN-N	1	Cod acoustic	171
2+3	J+KLM		7	Physical/biological oceanography	
	J+KLMNO		8	0 group cod/capelin trawl	149
3	LMNO	EU-ESP	4	Selectivity	62
	K	CAN-N	9	White Bay pre-recruit snow crab	
	K		9	Snow crab comparative fishing and selectivity	
	KL		5	Capelin acoustic/trawl	
	KL		11-12	Inshore cod and herring acoustics	
	L		4-5	Inshore cod acoustics	
	L		6	Juvenile cod habitat acoustics	
	L		6	Bonavista Bay and Northeast Avalon snow crab trap/trawl	

Table 2. Continued.

Subarea	Division	Country [1]	Month	Type of survey	No. of sets
				Other Surveys	
3	L		8	Bonavista Bay cod habitat and acoustics	
	L		9-10	Conception Bay snow crab trap. trawl	
	LNO		11	Physical and biological oceanography	
	Ps		3-4	St. Mary's/Placentia Bay herring acoustics	
	Ps		4	Inshore pre-spawning cod trawl/acoustics	
	Ps		4	Inshore cod tagging	
	Ps		6	Post spawning cod	
4	R		9	Iceland scallops	
	R	CAN-Q	10	Newfoundland west coast herring acoustic survey	
	R		11	Study of the cod movements in LaPoile Bay, Newfoundland	
	RST		6	Water and fish	105
	S		5	Population dynamics of snow crab in Sainte-Marguerite Bay	28
	S		6-7	Growth and natural mortality of the Iceland scallop off the Middle North Shore	
	ST		5-10	Abundance, distribution and growth of juvenile shrimp in the Estuary and Gulf of St. Lawrence	
	ST		7-8	Snow crab survey research survey in the Estuary and northeastern Gulf of St. Lawrence	
	ST		8-9	Zooplankton biomass assessment in the Estuary and Gulf of St. Lawrence	60
	T		2-3	Sampling of young grey seals	
	T		4	Sampling of pelagic and benthic species near Les Escoumins wharf	
	T		5	Inter-annual variations of the larvae production by redfish females	12
	T		5-10	Monitoring of the planktonic communities (zoo and phyto) and the marine enivironment in the Laurentian Channel	
	T		6	Fish sampling – Le Bassin, Havre Aubert	
	T		6	Sampling of live cod and varous benthic organisms	40
	T		7-8	Acoustic mapping of the grounds off Magdalen Islands using the EM-1000 echosounder	
	T		7	Hypoxic areas – Chenal Saguenay	
	T		8	Distribution, abundance and biology of scallops off Magdalen Islands	102
	T		9	Abundance assessment of the lobster and rock crab of Îles-de-la-Madeleine	77
	T		9	Characterization of the exploited urchin aggregations	
	T		10	Sampling of live cod, shrimp and other groundfish	
	X		6	Mackerel eggs and larvae in St.. Margarets Bay	27
	X	USA	7-9	Northern right whale	
5	Y		6,7	Gulf of Maine cod closed area	17
	YZ		7-9	Northern right whale	
	YZ		9,10	Herring hydroacoustics	
	Z		1	GLOBEC broad scale	80
	Z		2	GLOBEC broad scale	79
	Z		3	GLOBEC broad scale	78
	Z		3	Essential fish habitat	
	Z		3	ESDIM gear comparison	
	Z		3,4	Harbor porpoise and hydroacoustic	
	Z		4	GLOBEC broad scale	81
	Z		5	GLOBEC broad scale	83
	Z		6	GLOBEC broad scale	41
	Z		6	Closed Area II benthic habitat	
	Z		7	Closed Area I benthic habitat	
6	AB		3,4	Harbor porpoise & hydroacoustic	
	AB		7-9	Northern right whale	
	ABC		2	Deepwater systematics	

ii) **Surveys Planned for 2000 and Early-2001**

An inventory of biological surveys planned for 2000 and early-2001 as submitted by National Representatives and Designated Experts was prepared by the Secretariat.

Table 3. Biological surveys planned for the NAFO Area in 2000 and early-2001.([1] Country or Component abbreviations from *NAFO Statistical Bulletin*)

Area/Div.	Country[1]	Type of Survey	Dates
		Stratified-random Surveys - 2000	
1A-B	GRL	Snow crab	May-Jun
1C-D	GRL	Greenland halibut deep-sea trawl	Sep-Oct
1BCDEF	EU-DEU	Demersal fish	Sep-Oct
2J+3KLMNO	CAN-N	Multi-species trawl	10 Oct-12 Dec
3LNO	CAN-N	Multi-species trawl	4 May-29 Jun
3NO	EU-ESP	Groundfish	May
3M	EU-ESP&PRT	Groundfish	Jul
3OP	CAN-N	Redfish trawl	11-28 Aug
3Ps	CAN-N	Multi-species trawl	7 Apr-2 May
3+4	CAN-Q	Summer multidisciplinary survey in the Estuary and Gulf of St. Lawrence	3 Aug-2 Sep
4R	CAN-N	Scallop	22-31 Aug
4X+	5YZ	Ecosystem monitoring	20-27 Jan
4X+5YZ+ 6ABC	USA	Spring bottom trawl	15 Mar-5 May
4X+5YZ+ 6ABC	USA	Autumn bottom trawl	5 Sep-27 Oct
4X+5YZ+ 6ABC	USA	Ecosystem monitoring	22 May-9 Jun
4X+5YZ+ 6A	USA	Ecosystem monitoring	21 Aug-1 Sep
4X+5YZ+ 6ABC	USA	Ecosystem monitoring	30 Oct-17 Nov
5YZ	USA	Northern shrimp	24 Jul-5 Aug
5Z+6ABC	USA	Winter bottom trawl	9 Feb-1 Mar
5Z+6ABC	USA	Sea scallops	6 Jul-4 Aug
6BC	USA	Apex predators	17 Apr-May
		Other Surveys - 2000	
1A	GRL	Longline, inshore Greenland halibut	Jul-Aug
1B-F	GRL	Gillnets, inshore juvenile cod	Jun-Jul
2J+3KL	CAN-N	Offshore cod tagging	5-16 Jun
3K	CAN-N	Harp seal	24 Apr-3 May
3K	CAN-N	White/Notre Dame Bay snow crab trap/trawl	8-24 Sep
3KL	CAN-N	Capelin acoustic/trawl	9-28 May
3L	CAN-N	Bonavista Bay cod habitat and acoustics	13 Mar-3 Apr
3L	CAN-N	Bonavista Bay cod habitat and acoustics	15 Jan-1 Feb
3L	CAN-N	Avalon snow crab trawl/trap	19 May-3 Jun
		Bonavista Bay snow crab trap/trawl	30 Jul-11 Aug
		Conception Bay snow crab trap/trawl	24 Sep-6 Oct
3L	CAN-N	Predator/Prey	17 Jul-1 Aug
3LMNO	CAN-N	Physical and biological oceanography	22 Apr-7 May 14-30 Jul
3Ps	CAN-N	St. Mary's Bay/Placentia Bay herring acoustics	13 Mar-3 Apr
3Ps	CAN-N	Cod tagging	31 Mar-10 Apr
3Ps	CAN-N	Inshore cod tagging	25 Apr-10 May
3Ps	CAN-N	Cod tagging/tagging mortality	1-14 Nov
4S	CAN-Q	Snow crab assessment	7-17 May

Table 3. Continued

Area/Div.	Country[1]	Type of Survey	Dates
		Other Surveys - 2000	
4S	CAN-Q	Scallop assessment – North Shore	10-14 Jun
		Scallop assessment – Mingan Archipelego	5-17 Jul
4ST	CAN-Q	Snow crab research survey in the Estuary and northeastern Gulf of St. Lawrence	18 Jul-15 Aug
4T	CAN-Q	Validation of the data gathered during the winter sportfishing in the Saguenay Fjord	24-30 Apr
4T	CAN-Q	Prerecruitment of the northern shrimp	1-6 May
4T	CAN-Q	Monitoring of the interannual variations of the number of larvae produced by redfish females	18-24 May
4T	CAN-Q	Sampling of live wolffishes	25-19 May
4T	CAN-Q	Sampling of live cod	30 May-9 Jun
4T	CAN-Q	Urchin assessment – St. Lawrence Estuary	12-17 Jun
4T	CAN-Q	Mackerel egg sampling survey	14 Jun-5 Jul
4T	CAN-Q	Prerecruitment of the northern shrimp	15-26 Jun
4T	CAN-Q	Mackerel assessment by trawling – Magdalen Islands	27 Jun-4 Jul
4T	CAN-Q	Lobster grounds mapping using the EM-1000	Aug
		Rock crab assessment – Chaleur Bay	mid-Aug
		Sampling of live wolffishes	16-23 Aug
		Scallop assessment – Magdalen Islands	24 Aug-4 Sep
		Lobster assessment – Magdalen Islands	5-16 Sep
		Sampling of live fish and invertebrates	11-15 Oct
		Prerecruitment of the northern shrimp	17-21 Oct
4VWX+5YZ	USA	Northern right whale	5 Jul-18 Aug
4VWX+5YZ	USA	Northern right whale	8 Aug-1 Sep
4X	CAN-Q	Sampling of live wolffishes	30 Oct-3 Nov
4X+5Y	USA	CMER – GLOBEC plankton	20-25 Feb
4X+5Y	USA	Porbeagle shark tagging	1-18 Aug
4X+5YZ	USA	Herring hydracoustic	5-29 Sep
5Y	USA	Gear testing	7-17 Feb
5Y	USA	Harbor porpoise/hydroacoustic	28 Feb-17 Mar
5Z	USA	Benthic habitat	19-29 Jun
			30 Oct-9 Nov
5Z+6A	USA	Fishing power	20 Mar-14 Apr
5Z+6ABC	USA	Deep water systematics	27 Nov-8 Dec

5. Report on Biological Information Database Exchange for Divisions 3NO Cod

STACREC received a report on the development of a template for biological information exchange for Div. 3NO Cod and a report of the ICES experience in developing similar data exchange mechanisms. STACREC agreed to a one-year trial of the Div. 3NO Cod template and it was proposed that the STACFIS assessments could be used to indicate where a wider application of this template might be appropriate.

6. Report of the Working Group on NAFO Observer Protocol

STACREC reviewed progress made by the Working Group since the September 1999 Scientific Council Meeting. Forms for recording catch, effort and biological data were developed and reviewed by STACREC. A subgroup was appointed to review additional forms and coding instructions developed by the EU. It was noted that, aside from some additional summary forms, data elements contained on the EU forms essentially overlapped those on the draft NAFO Observer forms. It was decided that the NAFO Observer forms, augmented by additional data elements from the EU forms and a set of coding instructions, would be presented to STACTIC at its June 2000 Meeting by D. Kulka (Canada). It was proposed that an SCS Document using the subgroup compilation (SCS Doc. 00/23) be presented.

7. Review of SCR and SCS Documents

a) The results of silver hake young-of-the-year feeding research in the Scotian Shelf Area based on long-term data (1982-91) were presented (SCR Doc. 00/3). Feeding peculiarities in relation to fish growth, inter annual variations of food compositions and feeding rate for autumn-winter were shown. The attempt was made to assess food supply by year. The research show that the young silver hake survival from July-August to October-November was affected by feeding conditions as indicated with food consumption and condition indices. Cannibalism of pelagic young silver hake seemed to increase in the years with unfavourable food condition as well as in the case of appearance of strong year-classes.

b) An analysis of silver hake stock dynamics had been carried out for the period from 1962 to 1996 (SCR Doc. 00/4). An attempt was made to obtain an idea of the general trends in silver hake stock state during earlier years starting from 1920s when no systematic research of the latter was performed. The results obtained show that in 1960s, the late-1970s, the late-1980s to early-1990s the stock size was at the level "worse and much worse than average", while in the late-1960s, the first half of 1970s, the first half of 1980s and probably in the second half of 1990s, it was at the level "better and much better than average". Results of extrapolation allow to suppose that strong and rather regular fluctuations of silver hake abundance took place also in period from 1920s to 1960s.

c) The United States Research Report (SCS Doc. 00/14) was presented. The status of 19 stocks in Subareas 5 and 6 was updated, including the status of *Illex illecebrosus*, for which the US autumn 1999 survey biomass index was among the lowest observed. The presentation included information about ongoing studies on the effects of mobile gear, variables affecting the quality of nursery habitat, bay scallops, many species of finfish, lobster, marine mammals, food web dynamics, aging studies, and observer operations.

8. Other Matters

a) Tagging Activities

STACREC reviewed the list of tagging activities carried out in 1999 (SCS Doc. 00/5) compiled by the Secretariat, and requested national representatives to up-date the list during this meeting

A 5-year tagging program directed at yellowtail flounder on the Grand Bank (Divisions 3LNO) was begun in May 2000. The project is designed to study and measure movements, stock size, exploitation, mortality, longevity, and growth rates. Each May from 2000-2004, a 12-day trip is planned onboard a Canadian commercial trawler to tag at least 5000 yellowtail flounder with Petersen disc tags and 200 fish with archival electronic tags (data storage tags or DSTs). As done in 2000, Petersen discs of 2 different colors and reward values (red $20 and pink $100) will be applied, some as single tags and some as double, to allow estimates of tag loss and recapture reporting rates.

The tagging program is designed to provide estimates of exploitation, and therefore stock size if catches are known, to be used in annual stock assessments. Estimates of tagging mortality, tag loss and return rates will be available from the Petersen discs and associated laboratory/field work, and will be necessary to calculate exploitation rates. The Petersen disc tags will also provide information on movement, longevity, and age and growth. At present, the growth and longevity of this species is in question, largely as a result of tag returns from experiments in the early-1990s. DST will provide insight into seasonal movements of yellowtail flounder, by allowing information on the depth, temperature, and salinity of water occupied by tagged fish to be collected. These data can be matched to known oceanographic conditions and models to deduce fish movements (horizontal as well as vertical), and address questions on the substantial differences observed in seasonal distribution and abundance.

b) Conversion Factors

There was no progress to report in the work on conversion factors.

c) **Comparative Fishing Between Canada and EU-Spain**

Canada and EU-Spain have conducted spring surveys in Div. 3NO (1971-2000 for Canada, 1995-2000 in the NAFO Regulatory Area for EU-Spain), using a stratified random approach. To examine differences in results between these 2 survey series, side-by-side comparative fishing was conducted during May 23-24, 2000, at positions chosen from both the Spanish and Canadian surveys. Fourteen comparative sets were carried out on the southern Grand Bank (Div. 3N), at depths less than 90 m.

The Spanish vessel *Playa de Menduiña*, using a Pedreira trawl, caught substantially more fish than the Canadian vessel *Wilfred Templeman*, using a Campelen trawl. For the most abundant species in the catches (yellowtail flounder, American plaice and thorny skate), the Spanish vessel caught more of each species on every set than the Canadian vessel. For yellowtail flounder, the mean ratio of catch (Spanish vessel to Canadian vessel) was 9.3 for numbers and 9.9 for weights. For American plaice, the ratios of catch numbers and weights were 10.5 and 13.3. The corresponding values for thorny skate were 12.1 for both catch numbers and weights.

Length frequency data were collected but have not yet been analysed. Noting the differences in catches observed in the comparative fishing in 2000, and the potential impact on interpretation of indices of abundance from the Canadian and Spanish surveys, STACREC **recommended** that *the comparative fishing in Div. 3NO be continued during future spring surveys conducted by EU-Spain and Canada.*

d) **Other Business**

The Chairman thanked the participants, especially the rapporteur, for their valuable contributions and cooperation. He extended special thanks to the Assistant Executive Secretary and other members of the NAFO Secretariat for their considerable assistance in document preparation and distribution. There being no other business, the chairman closed the June 2000 STACREC Meeting.

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

Chairman: O. A. Jørgensen Rapporteur: M. Stein

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 5, 7, 8, 10 June 2000. In attendance were C. Darby (EU-UK), O. A. Jørgensen (Denmark in respect of Greenland), M. J. Morgan (Canada), V. A. Rikhter (Russian Federation), F. M. Serchuk (USA), M. Stein (EU-Germany), 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 Recommendations in 1999

Recommendations in June

i) STACPUB had recommended that *Rule 5.1.c).(ii). of the Rules of Procedure for the Scientific Council be revised to eliminate the words "be chaired by the [Scientific Council] Vice-Chairman, and*". STACPUB had also recommended that *a STACPUB chairperson be elected by the Scientific Council to serve for a term of two years and shall be eligible for re-election.*

STACPUB noted that Scientific Council endorsed these recommendations (see SCS Doc. 00/4).

ii) STACPUB did not reach consensus on a proposal that STACPUB conduct its business in the future in open plenary sessions (as done in STACFEN, STACFIS and STACREC) with Committee membership open to all Scientific Council members. It had therefore recommended that *the issue of STACPUB membership be elevated to the Scientific Council for discussion and resolution.*

Scientific Council had discussed and resolved this item. Accordingly, every STACPUB meeting is open to members of the Scientific Council.

iii) To facilitate the dissemination process STACPUB had recommended that *Scientific Council Research Documents be submitted with an abstract of 250 words or less as described in the instructions for authors*. SCR documents with "white" cover will be available on the NAFO website only for internal purposes. STACPUB had recommended that *the final SCR documents ("yellow" cover) be made available to the public through NAFO website.* Authors were requested to check that their final manuscripts sent to NAFO are error free.

STACPUB noted that there has been significant progress in authors submitting SCR Documents with abstract, and in circulating SCR Documents through the website.

iv) STACPUB had recommended *that NAFO Journals 22, 23 and 24 be made available through the web as soon as possible, and that access to the Journal be highlighted on the main page of NAFO website.* Further to that STACPUB had recommended that *NAFO Journals prior to No. 22 be accessible through the web provided they are available on electronic means.*

Journal Volumes 22 to 25 have been placed on the web, and attempts are being made to scan earlier issues.

v) STACPUB noting that further development of the website had been requested, had recommended that *Scientific Council request a cost accounting from the NAFO Secretariat on the costs involved in maintaining and operating the NAFO website and FTP server.*

A summary had been presented to STACPUB, noting that most website development was done within the Secretariat work.

vi) STACPUB emphasized that information on other bodies of NAFO (General Council, Fisheries Commission) should also be accessible through the NAFO web. STACPUB therefore had recommended that *Scientific Council Chair discuss with the NAFO Executive Secretary the inclusion on the website of the General Council and Fisheries Commission Reports.* There was further discussion on the distribution and dissemination of NAFO science through hyperlinks from the homepages of individual NAFO scientists. STACPUB therefore had recommended that *an ad hoc Working Group of Scientific Council be formed to explore computer requirements, improvement of the NAFO website and software links to enhance external awareness of the activities of NAFO and NAFO Scientific Council.*

The matter was brought to the attention of General Council and Fisheries Commission by the Chairman of Scientific Council.

An *ad hoc* Working Group of STACPUB members was formed, which worked intersessionally by e-mail.

Recommendations in September

vii) STACPUB had recommended that *the final issue of Scientific Council Studies using the present criteria for selection of papers, should include papers of the June 1999 Meeting selected by STACPUB, and the paper selection using the new criteria come into effect thereafter.*

STACPUB noted that this recommendation has come into effect.

viii) STACPUB had recommended that *the Assistant Executive Secretary take the lead in drafting editorial guidelines for Journal papers, and that STACPUB members and editors should provide input.*

The Assistant Executive Secretary informed the Committee that work was in progress according to this recommendation.

ix) With regard to increased use of the NAFO Website and putting documents into an appropriate format (e.g. pdf files), STACPUB had recommended that *additional resources be made available to the Secretariat, or technical support obtained in the form of service contracts, to develop the website for access to NAFO Journal publications.*

STACPUB considered this issue under agenda item 6 c) of this June 2000 meeting.

x) STACPUB had recommended that *the blue covered SCS documents (i.e. final) containing meeting reports are distributed to Designated Experts and national representatives of the Scientific Council, in addition to the current mailing list and website circulation*

STACPUB was informed that blue covered SCS documents have been circulated accordingly.

xi) STACPUB had endorsed the idea of a rotating membership, and had recommended that *Scientific Council consider a change in its Rules of Procedure to accommodate the format of rotating membership of STACPUB.*

This issue was discussed in Scientific Council during the 1999 Meetings and the Rules of Procedure were changed. (see also Section 3 below)

xii) Regarding STACPUB membership, noting that the present Rule 5.1.(c).(ii), after the modifications made in June 1999 reads "consist of five other members appointed by the Scientific Council", STACPUB had recommended that *the following change to the Rules of Procedure be incorporated:*

Rule 5.1.(c).(ii): "consist of six other members appointed by the Scientific Council. Members would serve 3-year terms."

It was noted that a new NAFO Convention (the former NAFO Handbook) with changed Rules of Procedures is in the process of publication (see also SCS Doc. 00/4).

xiii) STACPUB had been informed that a publication was being prepared by the Executive Secretary, L. I. Chepel, for publication by 2001. STACPUB had recommended that *any material related to ICNAF and NAFO scientific information being incorporated in the "NAFO Century book – Northwest Atlantic Fisheries in the 20th Century", should be reviewed by the Scientific Council prior to publication, and that this book when completed should be placed on the NAFO website*.

STACPUB suggested that the Executive Secretary of NAFO, Dr. L. I. Chepel, be invited to the Committee to consider the review process on the "NAFO Century book Northwest Atlantic Fisheries in the 20th Century". The Chairman, after having addressed Dr. L.I. Chepel on this matter, reported that Dr. Chepel appreciates input by the Scientific Council on scientific issues in the planned book. He indicated, however, that there will be no formal review process initiated.

STACPUB found that it would be desirable to have a Publications Committee, which considers publications of the three Constituent Bodies of NAFO, and requested the Scientific Council Chairman to share this view with the Chairmen of General Council and Fisheries Commission to find a means to address this.

3. **Review of STACPUB Membership**

STACPUB noted that the Chairman, O. A. Jørgensen, was elected by the Scientific Council during the June 1999 Meeting for a term of two years beginning at the end of the September 1999 Annual Meeting.

In accordance with the new STACPUB Rules of Procedure, incoming STACPUB members will be designated for a term of three years. STACPUB was informed that A. Vazquez (EU-Spain) who was not able to attend the meeting will step down from his STACPUB membership. STACPUB extended its appreciation to him for his long-standing valuable contributions. STACPUB welcomed C. Darby (EU-United Kingdom), who was nominated by Scientific Council to replace A. Vazquez. STACPUB invited C. Darby to continue as a member.

There was considerable discussion on how to accommodate the new rotating scheme for STACPUB membership. Based on the wishes of the present members, STACPUB prepared a roster noting the terms of membership will end at the end of the Annual Meeting in the given year as follows:

M. J. Morgan (Canada), 2000
V. A. Rikhter (Russian Federation), 2001
M. Stein (EU-Germany), 2001
C. Darby (EU-UK), 2002
F. M. Serchuk (USA), 2002

It was noted the following new members were appointed by the Council during this meeting, and the year their terms end are shown:

H. Siegstad (Greenland), 2003
D. Maddock Parsons (Canada), 2003

4. **Review of Scientific Publications since June 1999**

a) **Journal of Northwest Atlantic Fishery Science**

STACPUB was informed that:

Journal Volumes 22-25 were placed on the NAFO website www.nafo.ca, where individual papers can be downloaded separately, or entire volumes retrieved.

Volume 25 containing the Report of the Symposium and Symposium Presentations (19 papers) and 4 notices (233 pages) presented at the 1998 Symposium on "Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish", held during 9-11 September 1998 in Lisbon, Portugal, was published with a publication date of October 1999.

Volume 26 containing 5 miscellaneous papers is in the final galley stage. This issue is expected to be complete by mid-2000.

Volume 27 containing papers presented at the 1999 Symposium on "Pandalid Shrimp Fisheries – Science and Management at the Millennium", held in Dartmouth, Canada, is in various stages of the editorial process. This issue is expected to be complete by the end of year 2000. STACPUB noted the process is on schedule and hoped the publication will meet the proposed time frame.

There are presently 7 miscellaneous papers in Secretariat files for future Journal issues.

b) **NAFO Scientific Council Studies**

STACPUB was informed Studies Numbers 31 and 32 will be placed on the NAFO website in the near future.

Studies Number 32, containing 8 miscellaneous papers and 3 notices (133 pages) was published with a publication date of April 1999.

Studies Number 33 containing 7 miscellaneous papers is in the galley stage of the editorial process. This issue is expected to be published within the next month.

There are presently 2 papers in Secretariat files for future Studies issues.

c) **NAFO Statistical Bulletin**

STACPUB observed catch data by country, species and division were available on the NAFO website as text files for 1960 to 1998. Information is the most up-to-date information available at the Secretariat and is updated, as new information becomes available.

STAPUB noted the last publication of NAFO Statistical Bulletin was Vol. 43 with 1993 data, published with a publication date of December 1997. Noting the deadline for submission of STATLANT 21B reports for 1994 to 1998 was 30 June of each subsequent year, STACPUB was informed data are still outstanding from USA for 1994 to 1998 and Faroe Islands for 1995 to 1998, and therefore these Bulletin publications have been seriously delayed.

STACPUB **recommended** that *STACREC should consider proceeding with the publication of NAFO Statistical Bulletin for 1994 without the USA data.*

d) **NAFO Scientific Council Reports**

STACPUB noted NAFO Scientific Council Reports are available on the NAFO website for 1998 and 1999.

Only about l/4 of 1998 SCR/SCS Documents are in electronic form. All 1999 SCR/SCS Documents are available on NAFO website. All 2000 SCR/SCS Documents submitted (as of 30 May) are on a special directory on the web, and these will be placed in the public domain at the end of this meeting.

The volume (327 pages) containing reports of the 1999 meetings of the Scientific Council in April, June, September and November was published and distributed on schedule in January 2000. STACPUB was informed CD-ROM copies were also available on request.

e) **Index and Lists of Titles**

The provisional index and lists of titles of 116 research documents (SCR Doc.) and 24 summary documents (SCS Doc.) which were presented at the Scientific Council Meetings during 1999 were compiled and presented in SCS Doc. 00/3 for the June 2000 Meeting. The last 5-year compilation for 1990-94 was published in November 1995 and the 5-year compilation for 1995-99 is scheduled to be issued by mid-2000.

f) **Others**

There were no other publications considered.

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

a) **Review of Costs and Revenues**

STACPUB considered the total number of Scientific Council publications being printed at the Secretariat. It was noted this was 250 copies at present. The question whether 200 copies would be enough, was discussed. The Assistant Executive Secretary gave an overview on printing costs for the Journal, the Studies and the Scientific Council Report. After trimming down the different distribution lists, it was felt that 250 copies were an appropriate quantity. According to a query sent out by the Secretariat, STACPUB was informed that about 35-40 recipients of the Scientific Council publications preferred to receive CD-ROM versions instead of printed copies.

b) **Consideration of Publication of 2000 Special Session Papers**

STACPUB observed that there are at present no plans to publish a manual for the Special Session of September 2000, as programs due to be used in the Workshop are documented and published in the different publicly available forms (e.g. Info. Tech. Ser., CEFAS, Lowestoft, 1, 85 p.). STACPUB, however, supported the idea of a publication of a workbook, and accordingly requested the co-conveners to consider documentation in the *NAFO Scientific Council Studies* series.

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

a) **Invitational Paper**

The invited paper by V. A. Rikhter on "Silver Hake of Scotian Shelf" is ready for publication in Journal 26. The invited paper by Sv. A. Horsted on "Review of cod fisheries after WWII" is in the editorial process. The editor reported to the Committee that there was some further work needed and it was agreed this will be expedited with assistance of the Assistant Executive Secretary working with the author.

STACPUB felt it suitable to have the Invited Lectures in STACFEN be considered for publication in the NAFO publication series. The Chairman of STACFEN will make this proposal to the invited speaker at this meeting and to future invited speakers.

b) **Abstracts from Research Documents**

STACPUB noted there was progress made in requesting authors to include abstracts in their SCR Documents. Virtually all had responded to the required formats, and that Research Documents contain abstracts.

c) **NAFO Website**

STACPUB noted that Journals No. 22-25 were mounted to the NAFO Website. There was considerable discussion on additional work to be applied to the Website. Accordingly, it was suggested to:

i) make the Website more user friendly
ii) mount a search engine on the Website
iii) scan in Journals No. 1-21 (within next year), Studies (thereafter) and make them available from the Website (preliminary considerations suggest that the costs for this project amount to about $27 000 for the Journals, and $24 000 for the Studies)
iv) have individual e-mail addresses available for each NAFO staff member
v) have the information on updates available at the Website (home.htm)
vi) implement modern software for designing the website
vii) insert date of update with a new button on front page

Realizing that there may arise financial impacts on the NAFO budget as a result of June meeting deliberations, STACPUB **recommended** that *an Executive Committee Meeting be held near the end of the June Meeting to evaluate financial impacts on the NAFO budget which arise from deliberations and decisions made during the course of that meeting.*

STACPUB further **recommended** that *costs associated with the above activities be enumerated and included in the Scientific Council budget request for 2001.*

d) **Scientific Citation Index (SCI)**

Further to the previous STACPUB Chairman's communications with ISI, the Assistant Executive Secretary had sent a letter to the Institute for Scientific Information (ISI) on 15 November 1999 to promote the Journal through registration with ISI. However, no answer has been received to date. STACPUB suggested the Assistant Executive Secretary telephones ISI on this matter. If this approach is not successful, the Committee deemed it wise to close this matter.

e) **CD-ROM Versions of Reports, Documents**

STACPUB considered the issue of CD-ROM versions of reports and **recommended** that *the Scientific Council Reports and the Reports of the Annual Meeting be included in the contents of the CD-ROM, and the CD-ROM be issued before April of the following year.*

f) **New Initiatives for Publications**

Assistant Executive Secretary presented a proposal on new initiatives for publication of Journal papers, other than those of Symposia proceedings. Fast publication and circulation is needed, and it was suggested to establish "electronic publication" as follows:

i) Establish a Journal publication schedule of one volume per calendar year.

ii) Each paper be e-published (on web) as soon as possible after edit, by assigning a Journal Vol. Number and pagination, so that it can be cited (e.g. Scientist *et al*., 2000. Title. *J. Northw. Atl. Fish. Sci*., **28**(1): 1-23).

iii) These citable papers be collated one after another on e-publication for the year (in the event that more papers come in, the Journal issue can be every 6 months).

iv) At the end of the year, publish the printed and bound Journal Volume (and CDs) and circulate in the usual fashion. [Only author's reprints and incidental specific requests for hard copies of a paper will be entertained until then].

Specific Advantage:
- early release of citable papers
- quick turn-around
- fixed publication schedule

For promotion, it was proposed to announce this new method of fast publication with an e-mail flyer saying "NAFO Journal goes to electronic publication" that can be circulated worldwide.

STACPUB agreed with the above proposal and **recommended** that *electronic publishing of the Journal begin with the five papers currently awaiting publication in Volume 26.*

7. Editorial Matters Regarding Scientific Publications

a) Review of Editorial Board

STACPUB was informed that the Associate Editors G. Krause (Biological Oceanography) and A. Richards (Invertebrate Fisheries Biology) have stepped down from the Editorial Board of NAFO. It was agreed that STACPUB Chairman would continue discussions intersessionally and decisions made as soon as possible.

b) Progress Review of Publication of 1999 Symposium

STACPUB noted the editorial process of the 26 papers from the 1999 Symposium on Pandalid Shrimp for Journal Volume No. 27 are at present more or less on schedule and it is hoped the publication will be completed by the end of 2000.

8. Papers for Possible Publication

a) Review of Proposals Resulting from the 1999 Meetings

i) Papers Nominated by STACPUB

At its meetings since 1980, STACPUB has nominated a total of 681 research documents. This includes 10 documents nominated at the June 1999 Meeting and 29 papers from the 1999 Symposium. Since 1980, a total of 579 papers have been published in the Journal (277) and Studies (302). [It is noted some are papers submitted independent of the research document series.]

Of the 10 papers nominated at the June 1999 Meeting, 1 paper has been submitted for the Journal and 4 papers have been submitted for the Studies series. The authors of the remaining 5 papers did not respond.

In addition, 1 paper from outside of the STACPUB nomination process was submitted for the Journal since June 1999.

ii) Up-date Since June 1999

A total of 39 papers were published or are in their final stage of galley preparation (24 in the Journal and 15 in Studies) since June 1999.

b) **Review of Contributions to the June 2000 Meeting**

The list of SCR Documents was distributed in STACPUB containing 3 notifications by authors. There was considerable discussion on how to handle these papers. STACPUB concluded to follow option (2) of the 1999 September STACPUB report (Scientific Council Reports 1999, p. 243 3 (2)). Accordingly, Assistant Executive Secretary will inform the authors on the new publication policies of STACPUB, and invite them to consider publication in the Journal if they wish so.

Regarding the review of SCR Documents for possible publication, STACPUB members decided to share their views intersessionally by e-mail with the Chairman. Possible authors would be informed by the Assistant Executive Secretary of STACPUB decisions.

9. **Other Matters**

a) **Late Submission of SCR/SCS Documents**

Chairman informed the Committee that there are few instances where a research paper is presented at a Scientific Council Meeting, but the revised SCR Document is not submitted within about 2 weeks after the meeting.

This results in many difficulties e.g.:

The document is referred to in the meeting report and listed in the SCR/SCS series, but there is no document to back it up.

- All documents related to the meeting report are to be placed on the web, and the meeting report is issued within about 2 weeks after the meeting.
- There are often requests for documents, but there are no documents to send.
- The Scientific Council Report is printed at the end of the year, and there is the dilemma of how to address this issue.
- CDs are burned to contain the Scientific Council Report and all related SCR and SCS Documents, at the end of the year.

STACPUB noted these are of course very difficult issues from the point of view of authors as well as they have very demanding time-schedules.

STACPUB agreed the possible solution would be:

- To inform Scientific Council members about the problem
- Set a cut off date. STACPUB proposes the date of release of the meeting Report (i.e. 2 weeks after the meeting ends).
- If the cut off date is exceeded, authors will be asked whether the version of the paper that was presented at the meeting may be used. If this is not accepted, all references to the paper will be removed from the meeting Report (i.e. treated as working papers).

b) **Considerations on Future Symposia**

STACPUB noted that a proposal for the 2002 Annual Meeting, a Symposium on "Elasmobranchs" was considered by Scientific Council. STACPUB discussed the proposal and supported it.

c) **Other Business**

There being no other business the Chairman closed the meeting by thanking the participants for their contributions and co-operation, the rapporteur for taking the minutes, and the NAFO Secretariat for their assistance.

APPENDIX IV. REPORT OF STANDING COMMITTEE ON FISHERIES SCIENCE (STACFIS)

Chairman: H.-J. Rätz Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 1-15 June 2000, 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 attended from Canada, Cuba, Denmark (in respect of Faroe Islands and Greenland), Estonia, European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Russian Federation and United States of America. Various scientists assisted in the preparation of the reports considered by the Committee.

The Chairman, H.-J. Rätz (EU-Germany), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The Chairman noted that there were new agenda items, *viz* VII.3a Elasmobranchs in Subareas 0-6, and VII.3a the provision of information on catches and/or discards of juvenile fish in the various NAFO fisheries. The provisional agenda with these modifications was accordingly **adopted**.

II. GENERAL REVIEW

1. Review of Recommendations in 1999

STACFIS reviewed the recommendations from 1999 during considerations of each relevant stock.

2. 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 1999. Estimates of catches from various sources were considered along 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. Differences in the estimation of the catches were resolved for almost all stocks with minimum 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 in NAFO area were inspected at the landing site in 1999. These provided other sources of catch data.

Structure of STACFIS Report. The present STACFIS report is based on four geographic regions similar to the revision done in 1999. The region based structure of the report enables a quick comparison of the status and trends of biomass and exploitation of resources inhabiting the same or adjacent areas. It was agreed that introductory short overviews of the environment and fishery trends will not be included in this report. STACFIS requested that such overviews be written by Designated Experts over the upcoming year be included in the year 2001 STACFIS report.

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III. STOCK ASSESSMENTS

A. STOCKS OFF GREENLAND AND IN DAVIS STRAIT

1. Greenland Halibut (*Reinhardtius hippoglossoides)* in Subarea 0 and Division 1A Offshore and Divisions 1B-1F (SCR Doc. 00/6, 7, 10, 22, 26, 31, 38; SCS Doc. 00/9, 11, 22)

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 about 11 000 tons and have remained near that level up to 1998 when the catch declined to 9 000 tons to increase again to 9 667 tons in 1999. In Subarea 0 catches peaked in 1992 at 12 400 tons, declined to 4 300 tons in 1994 and increased to 6 700 tons in 1996, and decreased to 4 400 in 1998. In 1999 catches were 4 567 tons. Catches from 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 that catches increased to about 5 500 tons where they have remained until 1995. In 1996 catches decreased to 4 600 tons and have since remained at that level until 1998. In 1999 catches increased to 5 100 tons (Fig. 1.1).

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

	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]	2000
Recommended TAC[2]	25	25	25	25	25	11	11	11	11	11
SA 0	9	12	7	4	5	7	6	4	5	
SA 1 excluding Div. 1A inshore	2	6	4	6	6	5	5	5	5	
Total	11	18	11	10	11[3]	11	11[4]	9[5]	10[6]	

[1] Provisional.
[2] In the period 1991-95 the TAC included Div. 1A inshore.
[3] Including 3 018 tons non-reported.
[4] Including 1 935 tons non-reported.
[5] Including 559 tons non-reported.
[6] Including 131 tons non-reported.

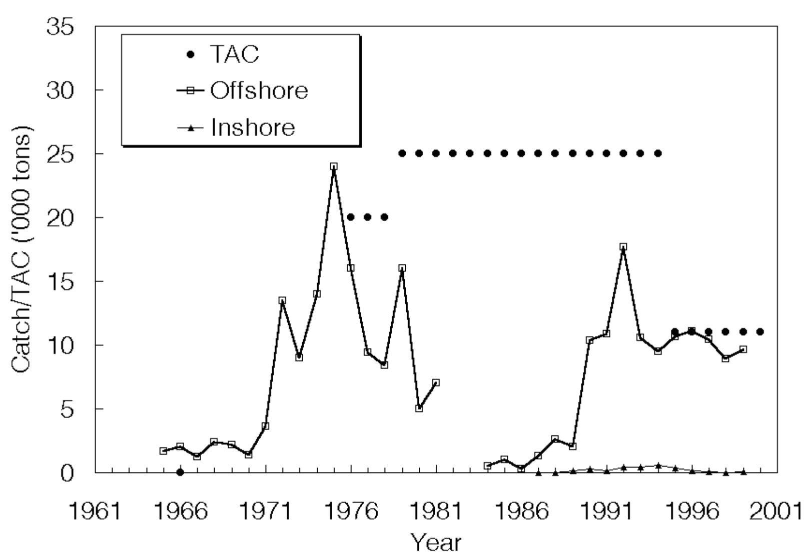

Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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 Faeroe Islands and Norway. In the beginning of the 1990s catches taken by these two countries increased and Canada, Russia and Japan entered the fishery. In 1995 a Canadian gillnet fishery began. In 1997 and 1998 only Faeroe Island and Canada conducted a fishery in the area and in 1999 Canada was the only country fishing in the area. In 1999 trawlers took about 1 900 tons while gillnetters and longliners took 1 900 tons and 400 tons, respectively. Catches on 300 tons were not allocated to gear. Almost all the fishery takes place in the second half of the year.

In 1987 a longline fishery started inshore in Cumberland Sound. The catches gradually increased to 400 tons in 1992 where they remained until 1994. Catches decreased to 285 tons in 1995. Since the catches have been below 100 tons. The decrease in catches in recent years is due to decrease in effort.

There was no exploratory fishery in Div. 0A in 1999. Catches in the commercial trawl fishery were, however, taken both in Div. 0B and 0A.

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 5 700 tons. Catches remained at that level until 1995, but decreased to 4 600 tons in 1996, and catches have been at that level until 1998. In 1999 catches increased to 5 100 tons. Almost all catches were taken offshore. Trawlers from Greenland, Norway, Russia and EU-Germany took 4 220 tons. A longline fishery started in 1994 and longliners from Greenland caught 744 tons in 1999. Inshore catches amounted to 5 tons. Further 131 tons taken on longlines were not reported. Almost all the fishery takes place in Div. 1D in the second half of the year.

b) **Input Data**

i) **Commercial fishery data**

Information on the catch-at-age and length composition of commercial catches in the Russian fishery for Greenland halibut in Div. 1D in September-October was available for 1999 (SCR Doc. 00/07). Males dominated the catches at depths down to about 1300 m and fish length increased with depth. Fish age ranged between 4 and 19 yeas, with age 6 as the most abundant. Further, length compositions were available from the Greenland trawl fishery in Div. 1D. Catch-at-age and weight-at-age data were available from the trawl fishery and the gillnet and longline fishery (combined) in Div. 0B. Age 7 fish dominated the trawl catches. Age 9 dominated in the combined gillnet and longline catches. The age distribution was based on samplings from the longline fishery only (SCR Doc. 00/38).

Combined standardized annual catch rates were calculated for the trawl fishery in Div. 0B for 1990-99 and from Div. 1CD for 1987-99 based on available logbooks (SCR Doc. 00/38). The combined catch rates showed a decrease from 1987-89 (one large vessel with high catch rates) to 1990, but has remained stable since (Fig. 1.2). Due to the frequency of fleet changes in the fishery both in Div. 0B and Div. 1CD, the index of CPUE should, however, be treated with caution. (SCR Doc. 00/26,38).

Catch rates for a longliner fishing in Subarea 1 were available for the period 1994-99. The catch rates increased 36% between 1994 and 1995, but declined to the 1994 level in 1996 and have been decreasing since and was in 1999 28% of the catch rates in 1995. The 1999 data represents, however, only 37% of the catches.

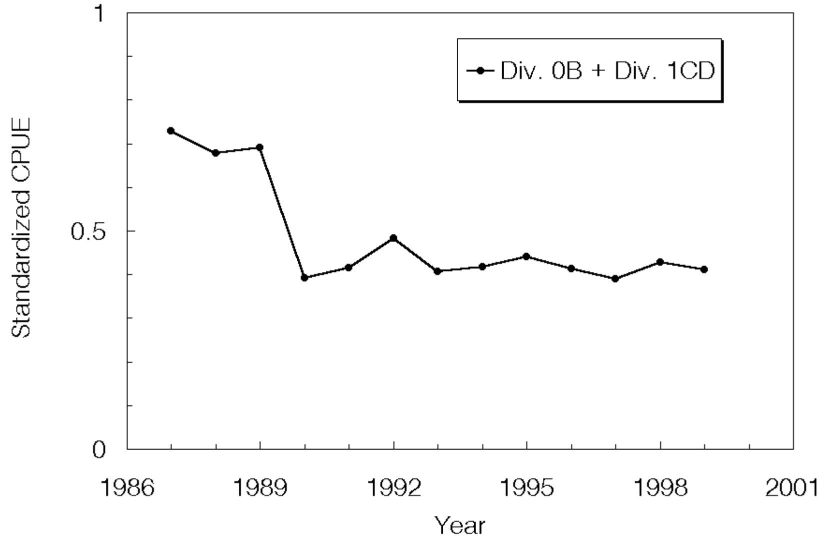

Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): combined standardized CPUE from Div. 0B and Div.1CD.

ii) **Research survey data**

Deep-sea surveys. During the period 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 64 000 tons in 1999 compared to 70 000 tons in 1998 (1.3).

In October 1999 a joint Canada/Greenland survey was carried out in Div. 0A using the same vessel and gear as the survey in Div. 1CD. The survey was conducted as a stratified-random bottom trawl survey covering depths between 400 and 1 500 m. The biomass and abundance was estimated at 83 000 tons and 141 million individuals, respectively. The highest densities were found at 1 000-1 250 m throughout both the Davis Strait and Baffin Bay. Length ranged from 6 to 94 cm with a broad mode around 38 cm.

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:

	USSR(Russia)/GDR(FRG)		Japan/Greenland		Greenland	Total
Year	0B	1BCD	1BCD	1ABCD[1]	1CD	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	-
1998	-	-	-	-	70	-
1999	-	-	-	-	64	-

[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.
- No survey.

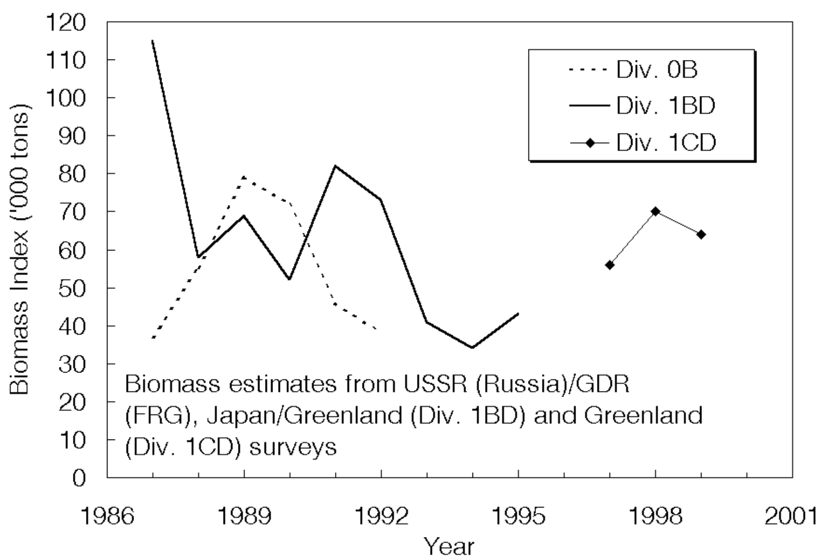

Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from surveys.

Greenland shrimp survey. 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 1999 consisted mainly of one-year-old fish. The number of one year old fish in the total survey area including Disko Bay was estimated at 205 million in 1999, which is an increase from 172 million in 1998. The estimate from 1999 is the second largest in the time series. The high index in is caused by a combination of a high percentage of one year old fish and good recruitment in both the Disko Bay, the traditional offshore nursery area (Div. 1A(southern) + 1B) and Div. 1A (northern)). (SCR Doc. 00/22) (Fig. 1.4).

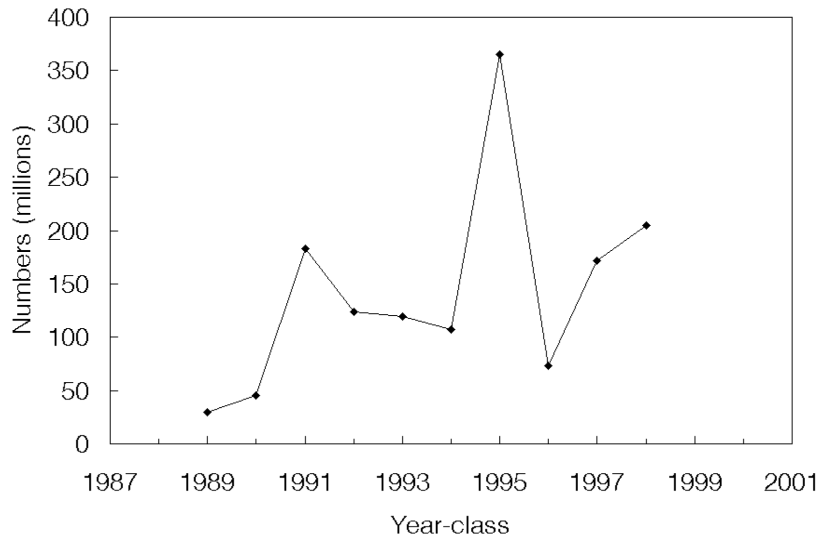

Fig. 1.4. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1989 and 1990.

In the Div. 0A survey a majority of fish (72%) were less than 42 cm and 96% less than eight years of age, hence the majority of the fish in that area are well below the established age of maturity for Greenland halibut. The length distribution from the three surveys may suggest that Div. 0A could act as recruitment area for Div. 1CD and probably also Div. 0B (Fig. 1.5)

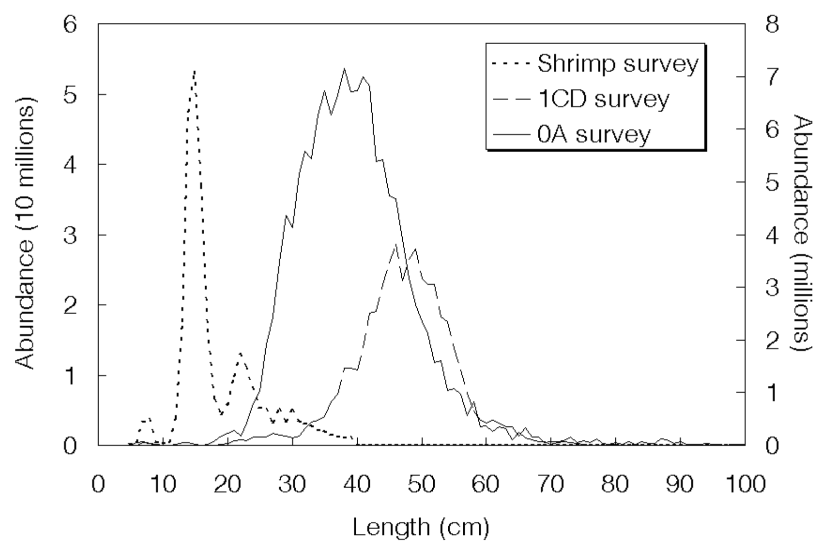

Fig. 1.5. Greenland halibut in Subareas 0+1: length composition from three different surveys (Greenland halibut in the Greenland shrimp survey (left y-axis), the Greenland deep-sea survey in Div. 1CD and the Canadian deep-sea survey in Div. 0A (right y-axis)).

iii) **Biological studies**

A study of maturity-at-age and size of Greenland halibut and geographic distribution of spawning fish (SCR Doc. 00/06) showed, for adult females sampled in Div. 0B in the period 1993-95, that 32% were spent and 68% were maturing for the next year. This was very similar to results from Div. 2GH. For the period 1996-99 15% was spawning, 57% was spent and 28% were maturing for the present year. This is also more or less similar to what was observed in Div. 2GH but different from the rest of the area studied (Div. 2J+3KLMNO).

Further, information on length-weight, age-weight and age-length by sex from the Russian trawl fishery in Div. 1CD was presented (SCR Doc. 00/7).

c) **Estimation of Parameters**

A separable VPA was attempted but the outcome was not considered to be precise enough to be used (SCR Doc. 00/38).

d) **Assessment Results**

The survey biomass index in Div. 1CD was estimated as 64 000 tons in 1999, which is slightly below the estimate on 70 000 tons in 1998, but above the estimate from 1997 on 56 000 tons.

Recruitment of the 1998 year-class at age one was slightly above the estimate from 1997 and the second largest in the time series, but well below the good 1995 year-class.

A combined standardized trawl CPUE index from Div. 0B and Div. 1CD has been stable during 1990-99. An unstandardized CPUE from the longline survey in Div. 1CD showed a steady decrease since 1995.

Although the survey series from 1987-95 not is directly comparable with the series from 1997-98, the decline in the stock observed in Subarea 1 until 1994 has stopped and the stock seems to be back at the level of the late-1980s and early-1990s.

The results of a survey to Div. 0A in 1999 resulted in biomass and abundance estimates of 83 000 tons and 141 million fish, respectively. At present it remains uncertain how the resource in this area relates to that in the other areas of SA0+1. A survey of Div. 0B is planned for 2000. Once this survey is completed, careful analysis of information from all 3 offshore survey areas (Div. 1CD, 0A and 0B) as well as the inshore area of Div. 1A will be necessary in order to better describe the status and distribution of this resource, as well as possible relationships between fish in the different areas.

e) **Precautionary Reference Points**

A yield-per-recruit analysis could not be used to estimate reference points owing to lack of reliable input data. A Sequential Population Analysis (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 1999 showed no significant improvement in the outcome of the analysis. A Separable VPA was attempted this year, but the outcome of the analysis was not considered useful for further use. In 1999 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. Input data changed only very little in 1999. 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**

STACFIS **recommended** that *the investigations of the by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued*.

2. Greenland Halibut (*Reinhardtius hippoglossoides*) in Division 1A Inshore (SCR Doc. 00/22, 29, 47; SCS Doc. 00/22)

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 and have increased until 1998 where the catch was almost 25 000 tons. In 1999 the catch was at the same level at 25 000 tons (Fig. 2.1).

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. Based on available tagging data the fish remain in the fjords, and do not appear to 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 on the recruitment to the inshore stocks.

Catches ('000 tons) in Div. 1A are as follows:

	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]	2000
Disko Bay[2]	5.4	6.6	5.4	5.2	7.4	7.8	8.6	10.7	10.6	
Recommended TAC									7.9	7.9
Uummannaq	3.0	3.1	3.9	4.0	7.2	4.6	6.3	6.9	8.4	
Recommended TAC									6.0	6.0
Upernavik	1.5	2.2	3.8	4.8	3.3	4.8	4.9	7.0	5.3	
Recommended TAC									4.3	4.3
Offshore	-	-	-	+	+	+	-	-	-	
Unknown[3]		+	0.1	-	-	-	-	-	-	
Total	9.9	11.9	13.1	14.0	17.9	17.3	19.8	24.6	24.3	
Officially reported	9.2	11.9	13.1	14.0	17.9	17.3	19.8	18.8	-	

[1] Provisional.
[2] Formerly named Ilulissat.
[3] Catches from unknown areas within Div. 1A.

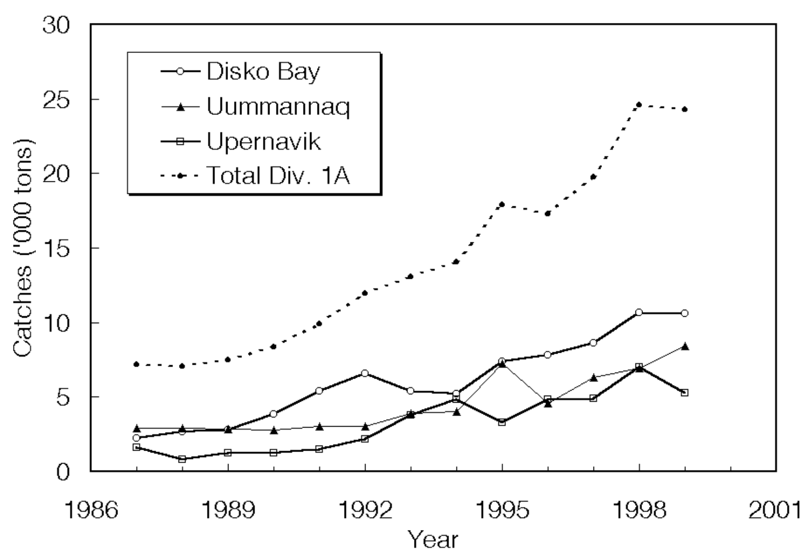

Fig. 2.1. Greenland halibut in Div. 1A: catches by area.

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 Greenland longliner, in 1995 13 tons by a Japanese trawler. No fishing was carried out in the area in 1996-99.

The inshore fisheries in Div. 1A. This fishery take place 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. A total ban for gillnets has been in force from year 2000 however, many exemptions have been given to this ban. The minimum mesh size allowed is 110 mm (half meshes). There are no regulations on landings, but from 1998 a fishery licence has been required to land Greenland halibut. The total number of licenses in 1999 was around 1200.

The inshore fishery in Div. 1A is mainly located in three areas: Disko Bay (69°N-70°N), Uummannaq (70°30N-72°N) and Upernavik (72°30N-75°N).

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, Torssukattaq, north of Ilulissat.

The catches in Disko Bay have increased from about 2 300 tons in 1987 to an historic high level of about 10 500 tons in 1998. Catches in 1999 were at the same level as last year. Longline catches comprised 38% of the total in 1999.

Uummannaq. The area consists of a large system of ice fjords where the fishery is conducted. The main fishing ground is in the south-western 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.

Catches have been increasing from a level of 2 000 tons before 1987 to a record high in 1999 of 8 425 tons. The longline catches comprised 94% of the total in 1999.

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.

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. 2.1). The total catch in 1998 was the highest on record, 7 000 tons. In 1999 the catch was 5 258 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.

The age composition in the stock has been moving towards fewer and younger age groups, but seems to have stabilized in Disko Bay and Uummannaq in recent years.

Length measurements from the commercial longline landings from 1993 to 1999 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.

In Uummannaq, a negative trend in mean length is seen for the summer fishery, while mean lengths was stable in winter fishery. In Upernavik a variable mean length without trend is seen for the summer, while for the winter fishery, mean length decreases significantly. Disko Bay showed an overall positive trend in mean length except for winter 2000. The traditional ice fishery was impossible for most of the winter 2000 due to unusual sea-ice conditions, with no fast ice formed. Instead an open-water fishery developed at alternative fishing grounds.

Logbooks are not mandatory in the fishery. However, in 1999 logbooks was introduced on a voluntary basis and information from these are at present very scarce and could not be used in the present assessment. Earlier attempts to estimate fishing effort has shown a significant correlation between effort (expresses as fishing days) and landings.

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-August 1999 the research longline vessel *Adolf Jensen* covered the fjord areas of Uummannaq and Disko Bay.

CPUE values (kg/100 hooks) from longline surveys conducted in Div. 1A inshore areas.

Area	1993	1994	1995	1996	1997	1998	1999
Disko Bay	3.1	3.1	-	3.9	4.4	-	3.6
Uummannaq	2.8	-	6.6	4.5	-	6.1	8.2
Upernavik	-	5.2	3.9	-	-	4.2	-

Mean length (cm) from catches taken in Div. 1A inshore longline surveys.

Area	1993	1994	1995	1996	1997	1998	1999
Disko Bay	55.9	56.5	-	53.6	57.0	-	56.7
Uummannaq	57.5	-	57.8	59.5	-	61.2	61.5
Upernavik	-	64.6	60.8	-	-	57.1	-

In the standardized surveys from 1993 to 1999 mean length in Disko Bay has been stable. In Uummannaq mean length has increased while in Upernavik it has decreased. Analyses of length distribution showed that Disko Bay had a very stable mode around 60 cm, while in Uummannaq the mode have shifted from around 55 to 65 cm. In Upernavik larger fish have become less abundant.

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 1999 were presented as catch-in-numbers per age per hour, for both the offshore and inshore nursery areas (Fig. 2.2). Both offshore and in Disko Bay the numbers of one-year-old from the 1998 year-class were above average. In Disko Bay it was the second highest on record. The 1997 year-class that was very strong inshore was still above average at age 2.

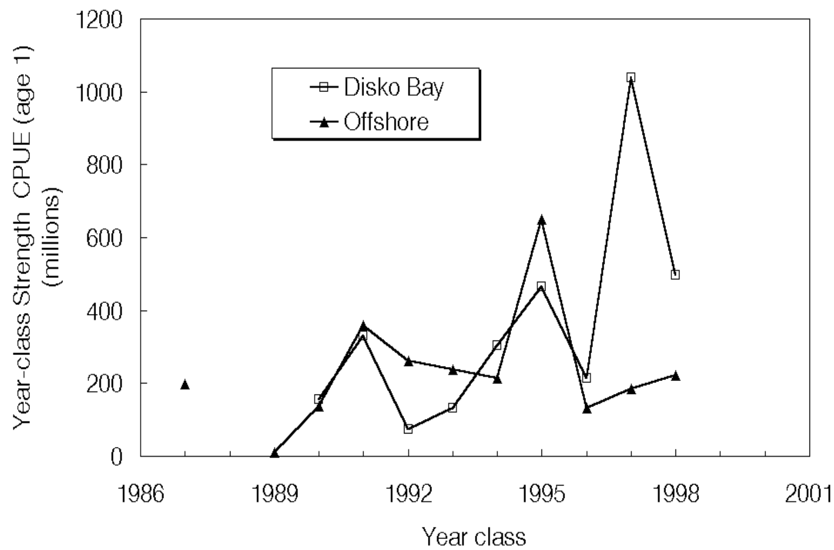

Fig. 2.2. Greenland halibut in Div. 1A: recruitment at age 1 on nursery grounds.

iii) **Biological studies**

A review of the tagging experiments in West Greenland in the period 1986-98 was carried out during the 1999 assessment. Tagging of inshore Greenland halibut in Div. 1A was continued in 1999, but data were not available for review.

Estimation of sexual maturity of Greenland halibut continued in the summer 1999 and confirmed earlier studies, which showed that about 90% of the males and 60% of the females are immature. A study on Greenland halibut collected from the fishery on maturity covering the entire year was initiated in 1998 and may clarify the extent of the inshore spawning.

iv) **Others studies**

Methodological aspects of the Greenland halibut longline survey ongoing since 1993 was reviewed in detail (SCR Doc. 00/29). The study examined the different factors that could influence catch rate of Greenland halibut and analysed the variability in catch rates both with regard to time and space. Variability in catch rates was found to be just as high within stations as between stations. Within station variance was analysed by examining repeated settings and settings with subdivided lines. Of the other factors that influenced the catch rate of Greenland halibut was Subarea and year. By means of cluster analysis, some areas showed consistent higher catch rates than others, The presence of other species did not influence catch rate, neither did bigger Greenland halibut seem to have an effect on smaller ones. Analyses of the CPUE in relation to time of day pointed to that Greenland halibut was equally active feeding at night- as at day-time. For the present STACFIS believed that caution should be taken when analyzing trends in CPUE from the longline survey.

c) **Assessment Results**

Disko Bay. A separable VPA was carried out for the Disko Bay area. The output of the separable VPA was considered to be indicative of trends in fishing mortality and stock size but was not considered to be sufficiently reliable to estimate current fishing mortality. Estimate of fishing mortality has shown a generally increasing trend from late-1980s to present.

Survey results from 1993 onwards do not indicate any major changes in abundance. Mean length composition in the survey has not changed and an increase in mean length was observed in the commercial fishery in recent years.

Uummannaq. Survey results from 1993 onwards 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, but has stabilized during the latest years.

Upernavik. Survey results from 1993 onwards do not indicate any major changes in abundance. Mean length compositions in both commercial and survey catches have decreased, significantly in the winter fishery. In the traditional fishing areas around Upernavik younger and fewer age groups are caught. New fishing grounds in the northern part of the district have been exploited only recently. Little information exists from these areas and the stock components are considered virgin.

d) **Reference Points**

As fishing mortality could not be estimated, precautionary reference points could not be given.

e) **Research Recommendations**

The high catch level of Greenland halibut in Div. 1A inshore generates concern, especially because the lack of effort data from the commercial fishery impedes the assessment of the stocks. Logbooks were introduced in 1999 and STACFIS **recommended** that *for the Greenland halibut commercial fishery in Div. 1A action should be continued to obtain measures of effort from the commercial fishery.*

STACFIS **recommended** that *studies of the longline survey in Div. 1A should be continued to investigate if the observed variation in CPUE is caused by natural behaviour of the Greenland halibut or if it is due to survey design.*

STACFIS **recommended** that *investigations of by-catch of juvenile Greenland halibut in the commercial shrimp fishery in Subareas 0+1 should be continued.*

STACFIS **recommended** that *the discard rate of 'small Greenland halibut' in Div. 1A be investigated.*

3. **Roundnose Grenadier (*Coryphaenoides rupestris*) in Subareas 0 and 1** (SCR Doc. 00/10, 31; SCS Doc. 00/9, 11, 22)

a) **Interim Monitoring Report**

A total catch of 10 tons, taken as by-catch in the fishery for Greenland halibut, was reported from 1999 compared to 29 tons in 1998 (Fig. 3.1).

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Recommended TAC	8.0	8.0	8.0	8.0	8.0	0	0	0	0	0
Catch	0.19	0.12	0.16	0.12[1]	0	.24[1,2]	0.12[1,3]	0.15[1,4]	0.03[1,5]	0.01[1]

[1] Provisional.

[2-5] Includes roughhead grenadier from Div. 1A misreported as roundnose grenadier: [2]: 24 tons, [3]: 30 tons, [4]: 27 tons, [5]: 3 tons.

[4] Also includes 39 tons taken by a longliner and hence must be roughhead grenadier.

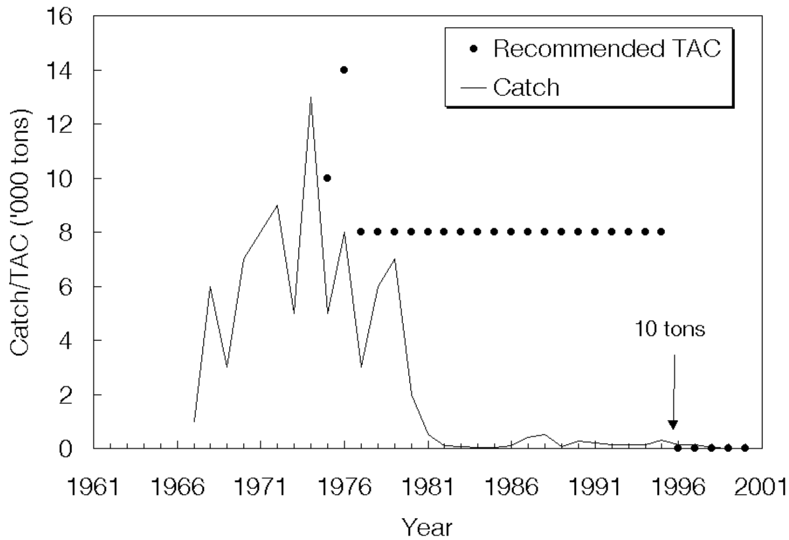

Fig. 3.1. Roundnose grenadier in Subareas 0+1: catches and TACs

In the Greenland survey in 1999 the biomass in Div. 1CD was estimated at 2 772 tons, which is a decrease from 7 263 tons in 1998 and the lowest on record (Fig. 3.2). In a new survey covering Div. 0A only one roundnose grenadier was observed.

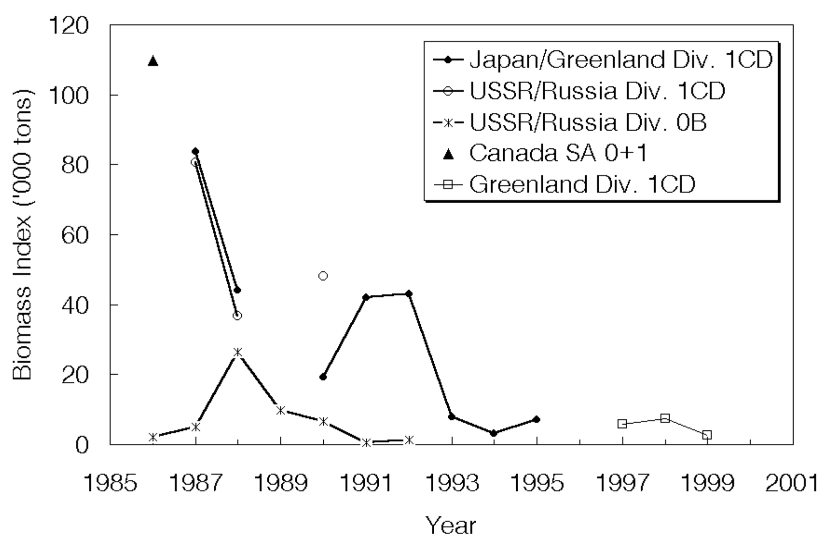

Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from USSR/Russian, Japan/Greenland and Greenland surveys in Div. 0B and Div. 1CD.

The stock of roundnose grenadier is still at a very low level observed since 1993.

Exploitation level is considered to be low in recent years.

4. **Redfish (*Sebastes* spp.) in Subarea 1** (SCR Doc. 00/28, 00/22, 00/10; SCS Doc.00/11,00/22)

a) **Interim Monitoring Report**

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. Both redfish species golden redfish and deep-sea redfish were included in the catch statistics since no species-specific data were available.

Reported catches of redfish in Subarea 1 has been less than 1 000 tons since 1987. The total estimated catch for 1999 was 252 tons. Greenland reported 98 tons landed redfish and for the first time EU-Germany reported catches from a pelagic fishery of oceanic redfish of a total of 154 tons.

Recent catches ('000 tons) are as follows (Fig. 4.1):

	1991	1992	1993	1994	1995	1996	1997	1998[1]	1999	2000
TAC	19	19	19	19	19	19	19	19	19	19
Catch	0.3	0.3	0.8	1[1]	0.9[1]	0.9[1]	1[1]	0.9	0.3[2]	

[1] Provisional.
[2] Estimated.

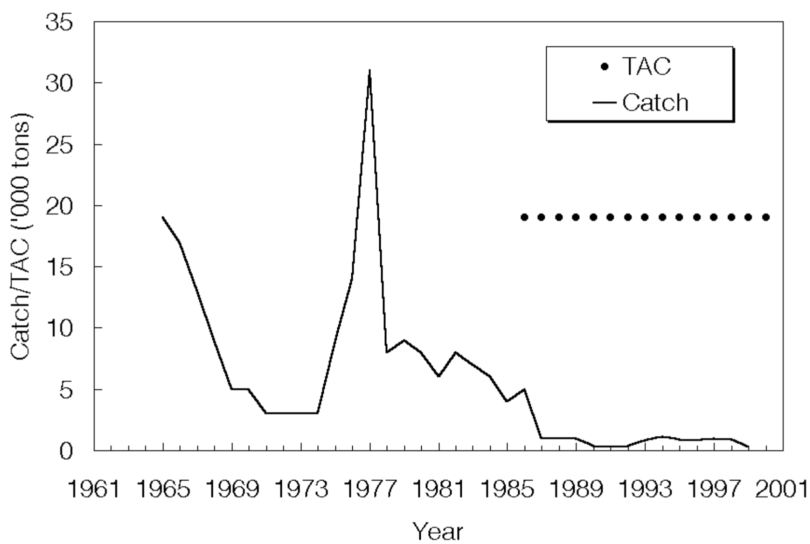

Fig. 4.1. Redfish in Subarea 1: catches and TAC.

In view of dramatic declines in survey biomass indices (Fig. 4.2) of golden redfish and deep-sea redfish (≥17 cm) to an extremely low level along with significant reduction in fish sizes, it was concluded that the stocks of golden and deep-sea redfish in Subarea 1 (Fig. 4.3) remain severely depleted and there were no signs of any short-term recovery although pre-recruits (<17 cm) were found to be very abundant as indicated in the surveys.

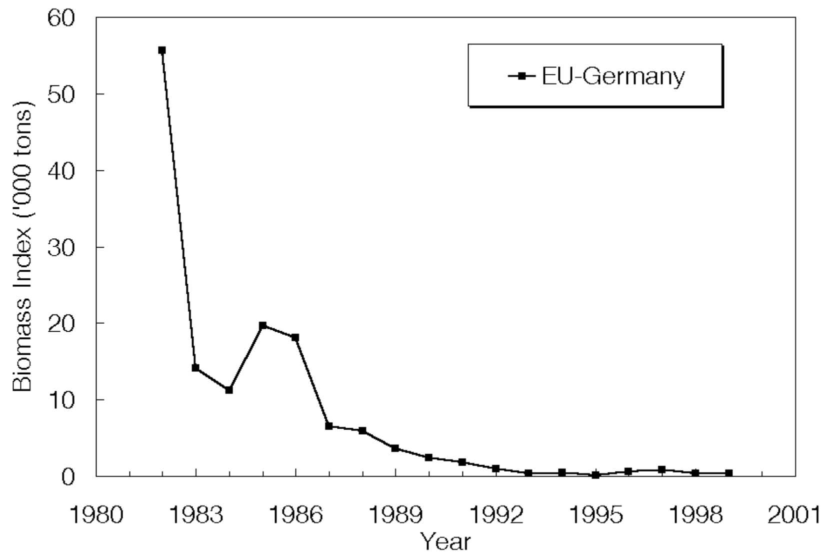

Fig. 4.2. Golden redfish in NAFO Subarea 1: survey biomass index.

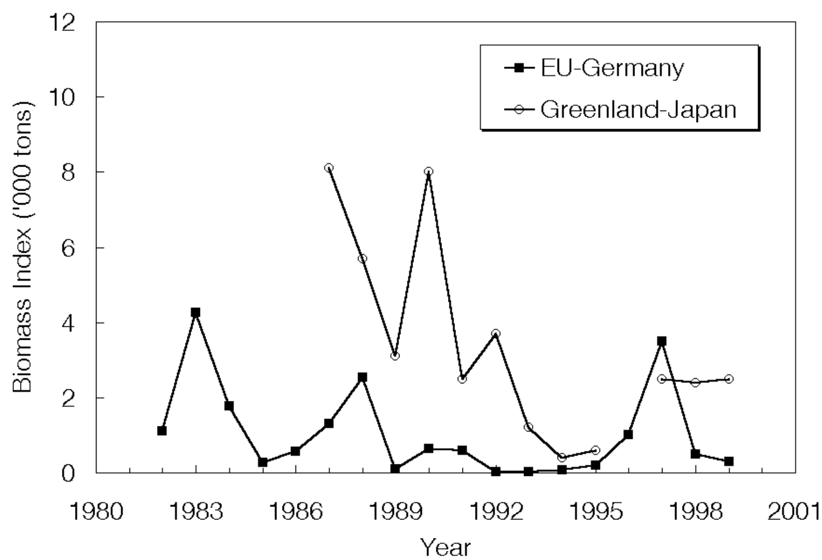

Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass index.

b) **Research Recommendation**

STACFIS **recommended** that *monitoring of redfish by-catch taken by the shrimp fishery in Subarea 1 should be conducted and that the results should be presented at the June 2001 Scientific Council Meeting on a length disaggregated basis*.

STACFIS **recommended** that *study on maturation and reproduction of redfish in Subarea 1 be carried out.*

5. **Other Finfish in Subarea 1** (SCR Doc. 00/28, 00/22, 00/10; SCS Doc.00/22)

a) **Interim Monitoring Report**

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*), thorny skate (*Raja radiata*) (Fig. 5.1), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus hippoglossus*) and sharks. No assessment can be made for Greenland cod, lumpsucker, Atlantic halibut and sharks.

Nominal reported catches (tons) are as follows:

Species	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999 [2]
Greenland cod	1 896	1 854	2 526	2 117	1 729	1 717	1899
Wolffishes	157	100	51	47	68	30	26
Atlantic halibut	43	38	23	34	22	22	<1
Lumpsucker	246	607	447	425	1 158	2 143	3057
Sharks	10	34	46	135			
Non-specified finfish	411	643	618	609	1 269	588	no data
Total	2 763	3 276	3 711	3 367	4 246	4 500	4983

[1] Provisional
[2] Estimated catches

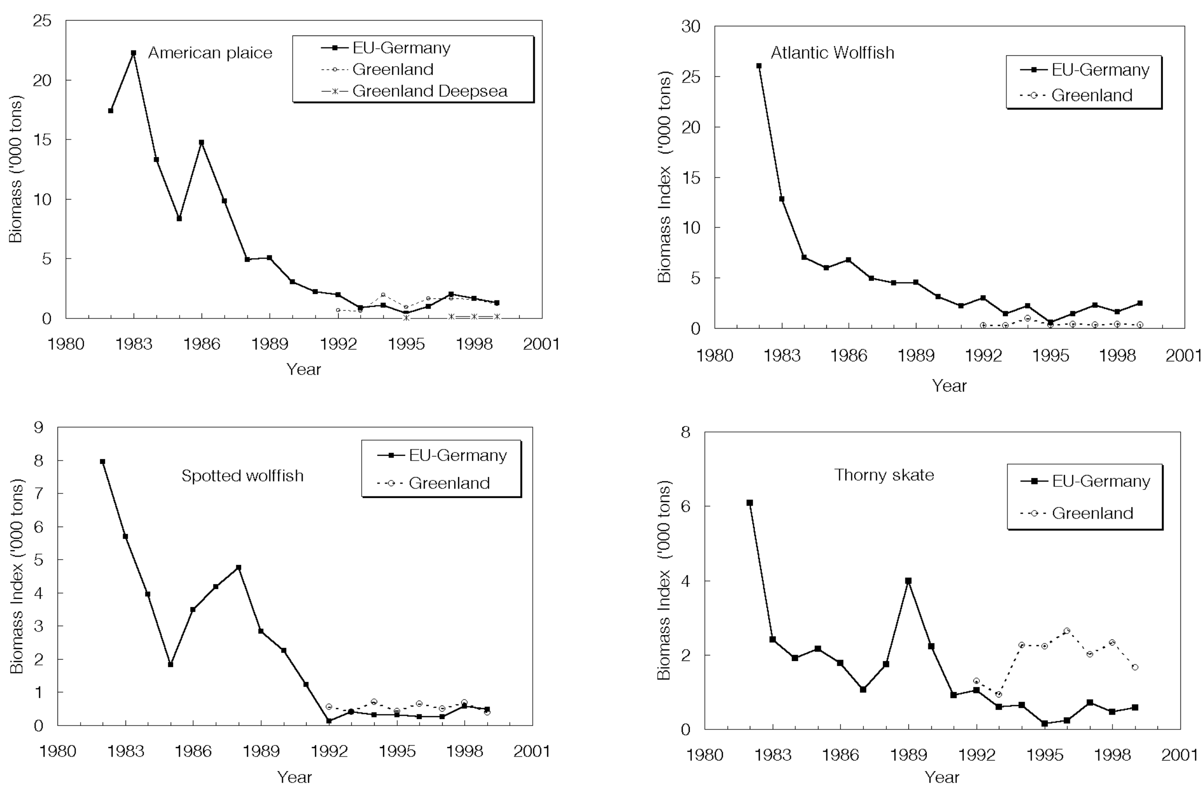

Fig. 5.1. Finfish in Subarea 1: survey biomass indices of various finfish species.

Despite gradually increasing recruitment since the 1980s, no increase in Atlantic wolffish SSB has been observed. The recent increase in recruitment of American plaice has not yet resulted in any increase in SSB. Both spotted wolffish and thorny skates have exhibited declines since the 1980s and are at or near record low levels. Based on the above, STACFIS has concluded that these stocks remain severely depleted.

Taking the poor stock status of American plaice, Atlantic wolffish, spotted wolffish and thorny skate into account, even low amounts of fish taken and discarded by the shrimp fishery might be sufficient to retard the recovery potential of these stocks. The continued failure of the recruits to rebuild the spawning stocks indicates high mortality rates in excess of the sustainable level. The probability of stock recovery would be enhanced by minimising the by-catch of finfish in Subarea 1 to the lowest possible level.

b) **Research Recommendation**

STACFIS **recommended** that *monitoring of finfish by-catch taken by the shrimp fishery in Subarea 1 should be conducted and that the results should be presented at the June 2001 Scientific Council Meeting on a species by species, as well as a length disaggregated basis*.

B. STOCKS ON THE FLEMISH CAP

6. Cod (*Gadus morhua*) in Division 3M (SCR Doc. 00/9, 00/40; SCS Doc. 00/16)

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 has 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 as 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 variations between years. Reported catches declined after 1980, when a TAC of 13 000 tons was established, but Scientific Council regularly expressed its concern about the reliability of some catches reported in the period since 1963, particularly those since 1980. New estimates of the annual total catch since 1988 were made available in 1995 (Fig. 6.1), including non-reported catches and catches from non-Contracting Parties.

In 1999 the fishery was closed and catches were estimated as 353 tons: 3 tons reported as by-catches from Portuguese trawlers and 350 tons estimated from non-Contracting Parties based on Canadian Surveillance reports.

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	13	13	13	11	11	11	6	2	0	0
Catch	16.2[1]	25.1[1]	15.9[1]	29.9[1,2]	10.3[1,2]	2.6[1,2]	2.9[1,2]	0.7[1,2]	0.4[1,2]	

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

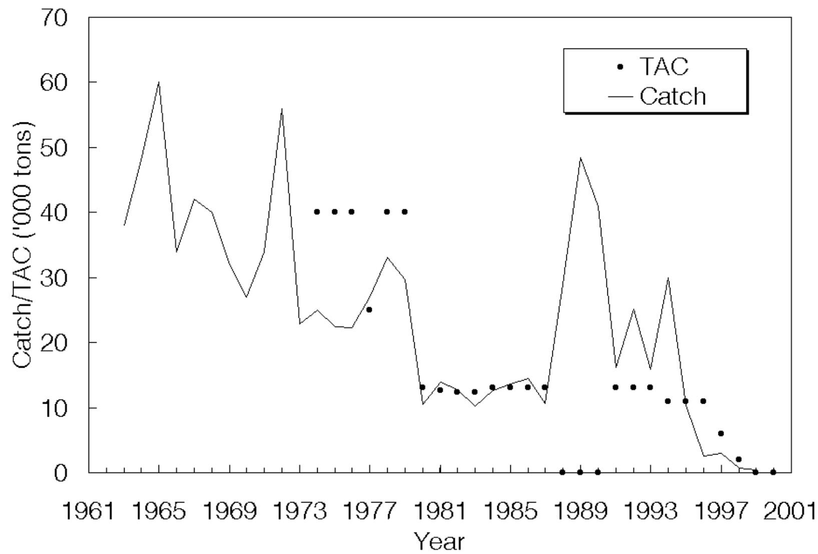

Fig. 6. 1. Cod in Div. 3M: catches and TACs. Catch figures include estimates of misreported catches since 1988.

b) **Input Data**

i) **Commercial fishery data**

Length and age compositions of 1999 catches were available from Portuguese trawlers. This information was not used in the present assessment due to the size of the sample, which only had 27 fish.

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

ii) **Research survey data**

Biomass and abundance estimates were available from bottom trawl surveys conducted by Canada from 1977 to 1985. The estimates of bottom trawlable biomass showed a maximum level of 83 000 tons in 1978 and a minimum of 8 000 tons in 1982.

Biomass and abundance estimates were also available from bottom trawl surveys conducted by USSR/Russia from 1977 to 1996, with the exception of 1994 (Fig. 6.2), and with a concurrent acoustic survey from 1985 to 1993. The estimates of bottom trawlable biomass in the most recent period showed a maximum level of 37 000 tons in 1989, a minimum 2 500 tons in 1992, and a decline from 8 300 tons in 1995 to 700 tons in 1996.

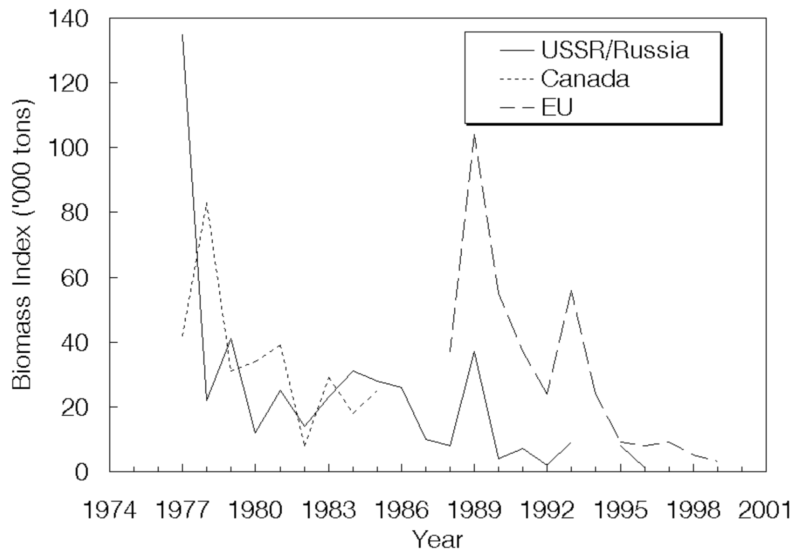

Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

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 EU survey in 1996.

Stratified-random bottom trawl surveys were conducted by the EU from 1988 to 1999. 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 a 8 800-9 000 tons level in the 1995 to 1997 period, and a recent decrease in 1998 with 4 500 tons and 2 500 tons in 1999. Surveys indicate poor recruitment of the 1992 and subsequent year-classes, particularly the 1996, 1997, 1998 and 1999 year-classes at all observed ages.

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 of biomass from 1992 to 1993 was attributed to the contribution of the also abundant 1990 and 1991 year-classes.

c) **Estimation of Parameters**

A sequential population analysis (XSA) was carried out for ages 1 to 8+ and years 1973 to 1999. Catch-in-number data corresponded to the estimates of total annual catch. Catch-at-age was split using EU survey frequencies for ages 3 to 8+, ages 1 and 2 were set to 0. Maturity ogive estimated using data collected in the 1998 EU survey was used. Natural mortality was set at 0.2. The analysis was tuned with the results of the EU survey for ages 1 to 8+ and from 1988 to 1999.

The analysis showed a reasonably good fit in ages 1 to 5 but not in ages 6 and 7. These ages, 6 and 7, presented negative catchability residuals in 1999 leading an overestimation of their abundance.

Table 6.1. Cod in Div. 3M: VPA results. Recruits-at-age 1 ('000), biomass, SSB and landings (tons), and F_{bar} (ages 3-5).

Year	Recruit	Biomass	SSB	Landings	F_{bar}	EU-surveys
1972	18 862	83 839	40 474	57 503	0.689	
1973	66 656	46 551	21 415	22 900	0.569	
1974	134 642	37 830	14 414	24 938	1.289	
1975	24 748	49 619	8 240	22 375	0.606	
1976	11 149	113 367	9 973	22 266	0.334	
1977	3 587	87 522	22 762	27 019	0.465	
1978	22 809	56 866	28 587	33 131	0.453	
1979	16 323	46 632	32 507	29 710	0.725	
1980	8 601	32 025	14 794	10 468	0.510	
1981	23 513	32 258	9 477	13 873	0.452	
1982	23 452	30 799	11 961	12 753	0.487	
1983	14 211	43 283	13 264	10 215	0.233	
1984	15 865	40 544	17 071	12 702	0.226	
1985	64 078	38 376	19 549	13 675	0.525	
1986	128 066	37 125	13 467	14 518	0.692	
1987	79 904	56 875	13 059	10 632	0.424	
1988	16 915	71 673	14 234	28 899	0.489	37 127
1989	22 091	111 086	20 381	48 373	0.813	103 644
1990	27 643	67 798	24 745	40 827	0.862	55 360
1991	69 104	48 410	21 266	16 229	0.485	36 597
1992	63 013	61 080	21 412	25 089	1.543	24 295
1993	4 324	47 532	6 326	15 958	1.016	55 642
1994	9 724	49 481	5 550	29 916	0.925	24 062
1995	4 442	23 938	8 636	10 372	1.281	8 815
1996	182	8 666	2 000	2 601	0.462	8 196
1997	122	9 199	2 109	2 933	0.271	9 063
1998	89	9 259	4 548	705	0.101	4 532
1999	42	11 736	10 408	353	0.010	2 596

d) **Assessment Results**

Estimated fishing mortality was very high throughout the age range of the exploited population from 1988 to 1993. From 1994 to 1997 the exploited population has been mainly restricted to the survivors of the 1991 and 1990 cohorts, and fishing mortalities of these cohorts remained at a relatively high level. The lowest fishing mortality since 1996 is consistent with the decrease of the fishing effort and the catch in those years (Fig. 6.3).

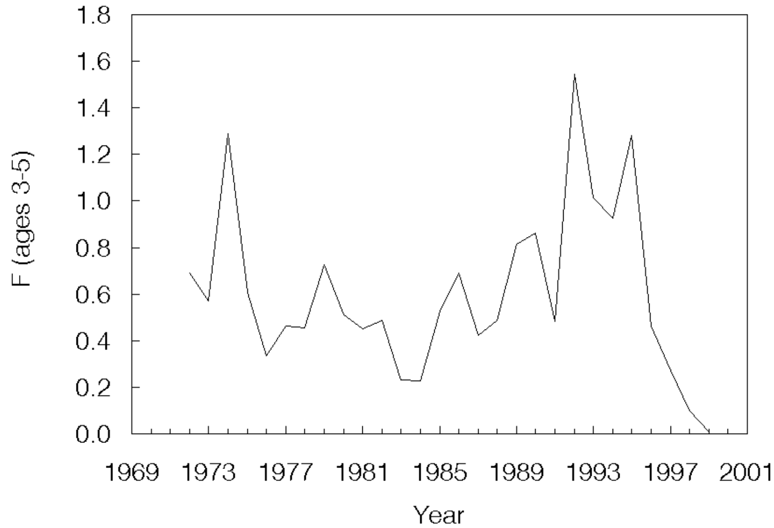

Fig. 6.3. Cod in Div. 3M: fishing mortality from Sequential Population Analysis.

Estimated total biomass remained above 30 000 tons prior to 1995 when it declined to 24 000 tons; since then, biomass has remained at approximately 10 000 tons, with a small increase from 8 666 tons in 1996 to 11 736 tons in 1999. This increase can not be considered realistic due to the overestimation of ages 6 and 7 (60% in total weight). The XSA results also confirms the relative abundance of the 1985, 1990 and 1991 year-classes at age 3 and the weakness of those since 1992 onwards.

The stock biomass and spawning stock biomass at the beginning of 2000 remain at a very low level (Fig. 6.4) and are mainly composed of fish 6 and 7 years old. Fish younger are scarce due to the lower recruitment in last four years (Fig. 6.5).

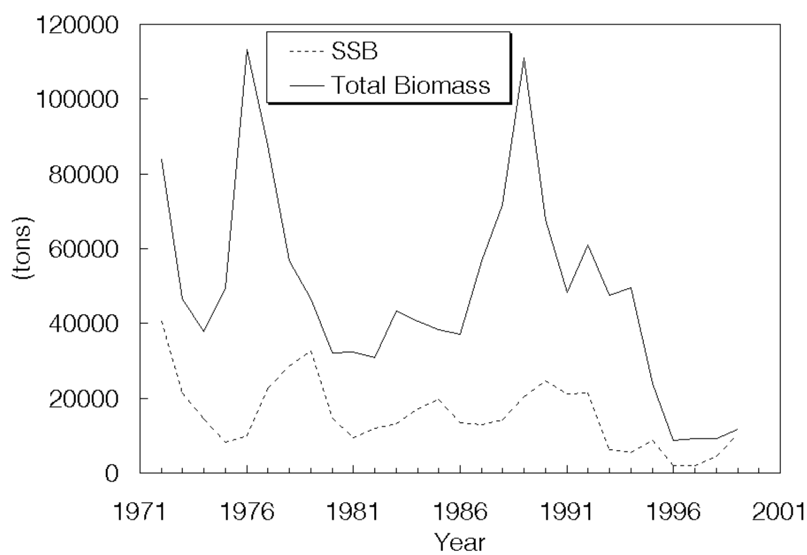

Fig 6.4. Cod in Div. 3M: biomass and SSB from Sequential Population Analysis.

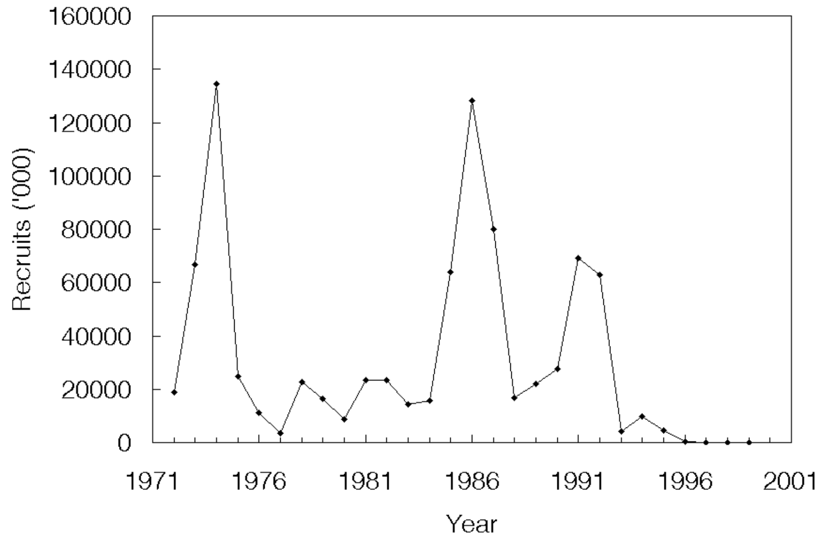

Fig. 6.5. Cod in Div. 3M: recruits at age 1 from Sequential Population Analysis.

e) **Reference Points**

Attempts were made to evaluate the relationship between SSB and recruitment. The SSB calculated based on SPA results suffer from the inadequacy of the maturity sampling in some former years and from the lack of reliability of some catch estimates. Recruitment was considered at age 3 to avoid the effect of possible unreported discards on the reliability of the time series of recruitment abundance. The SSB/recruitment plot (Fig. 6.6) shows that there were reduced recruitments at SSB below 14 000 tons, and this value might be considered as an initial B_{lim}.

Reference points for F are not available.

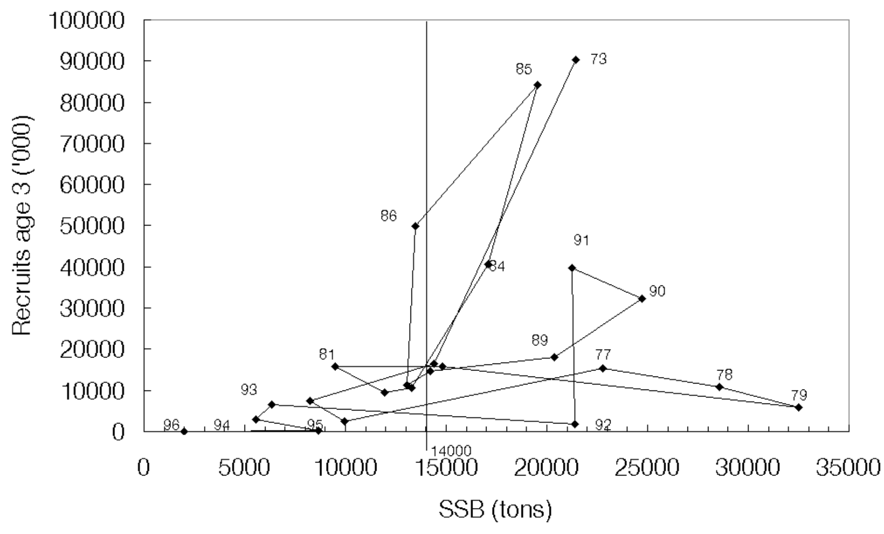

Fig. 6.6. Cod in Div. 3M: SSB and recruitment plot at age 3.

7. Redfish *(Sebastes mentella* and *Sebastes fasciatus)* in Division 3M (SCR Doc. 99/96, 00/9, 34; SCS Doc. 00/9, 16)

a) Introduction

There are three species of redfish that 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. All stocks have both pelagic and demersal concentrations as well as a long recruitment process to the bottom, extending to lengths up to 30-32 cm. All redfish species are long lived with slow and very similar growth. Female sexual maturity is reached at a median length of 26.5 cm for Acadian redfish, 30.1 cm for deep-sea redfish and 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, falling continuously since then until 1998, when a minimum catch of only 970 tons was recorded. The drop of the Div. 3M redfish catches from 1990 onwards was related both with the simultaneous quick decline of the stock biomass and fishing effort deployed in this fishery, caused by the vanishing from the NAFO Regulatory Area of the fleets responsible for the high level of catches in the late-1980s and early-1990s (former USSR, former GDR and Korean crewed non-Contracting Party vessels). The EU (Portugal and Spain) and the Japanese trawlers remained the major players in the present fishery, with 280 tons and 320 tons respectively recorded in 1999, most as by-catch of the Greenland halibut fishery. Also in 1999 Russia appeared again in Flemish Cap with a nominal catch of 168 tons, the same occurring with non-Contracting Party trawlers with an estimated Div. 3M redfish catch of 300 tons.

The rapid expansion, beginning in 1993, of a shrimp fishery on Flemish Cap led to high levels of redfish by-catch in 1993-94. Despite the fact that since 1995 this by-catch fell to lower levels, it is still accounting for an important portion of the catch in numbers for the most recent years. This by-catch at age 1 constitutes, on average (1996-99), 20% of the catch in numbers.

Recent TACs catches and by-catch ('000 tons) are as follows (Fig. 7.1):

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	50	43	30	26	26	26	26	20	13	5
Catch	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]	0.97[2]	1.07[2]	
By-catch[3]		11.97	5.90	0.37	0.55	0.16	0.22	0.06		
Total catch		41.0	17.2	13.9	6.4	1.5	1.2	1.1		

1 Includes estimates of non-reported catches from various sources
2 Provisional
3 In shrimp fishery (SCR Doc. 99/96)

The Div. 3M redfish stocks have been exploited in the past both by pelagic and bottom trawls. The majority of the bottom commercial catches were composed of beaked redfish. The species composition of the pelagic redfish catches, which dominated the fishery in the early-1990s, remains unknown. However, based on bottom survey results, on average *S. mentella* and *S. fasciatus* together represent most of the abundance and biomass of Div. 3M redfish. It is assumed therefore that the pelagic catches in the commercial fishery were also dominated by beaked redfish.

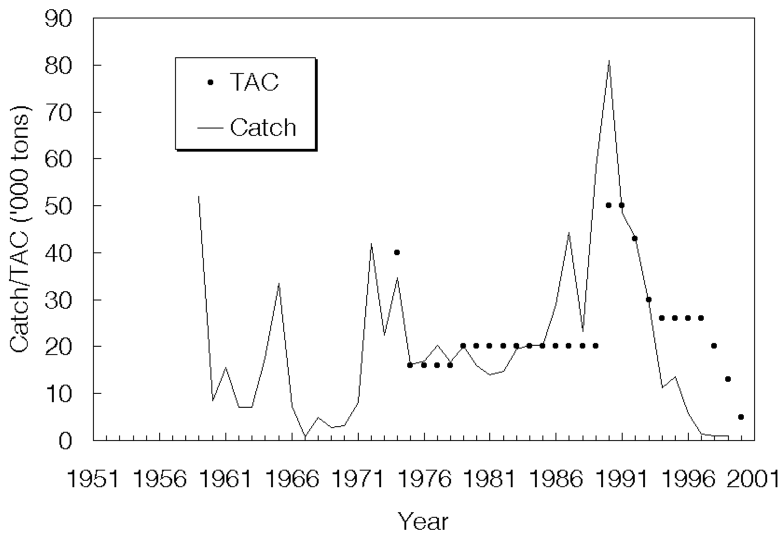

Fig. 7.1. Redfish in Div. 3M: catches and TACs.

b) **Input Data**

The present assessment evaluates the status of the Div. 3M beaked redfish stock, regarded as a management unit composed of populations of two very similar species. The reasons for this approach were the dominance of this group in the Div. 3M redfish commercial catches and respective CPUE series, corresponding also to the bulk of all redfish bottom biomass survey indices available for the Flemish Cap bank. Finally any recovery of the Div. 3M redfish fishery from its present minimum will be basically supported by the *S. mentella* plus *S. fasciatus* biomass.

i) **Commercial fishery and by-catch data**

Sampling data. Most of the commercial sampling data available for the Div. 3M redfish stocks since 1989 were from the Portuguese fisheries. For 1999 length composition of the 1999 Russian pelagic catches were also available, but due to their very recent availability have not been included in the present assessment. The 1989-99 length compositions from the Div. 3M redfish Portuguese trawl catch were used, together with the Div. 3M beaked redfish length-weight relationship from 1989-99 EU survey data, to estimate the catch in numbers at length of the Div. 3M redfish commercial catch for the same period.

Redfish by-catch in numbers at length for the Div. 3M shrimp fishery were available for 1993-97 based on data collected on board of Canadian and Norwegian vessels. These numbers at length were recalculated in order to fit by-catch in weight with the annual length weight relationships derived from EU survey data. The 1998 and 1999 by-catch length frequencies were assumed to be equal to the average of the two previous years and were used to generate corresponding by-catch numbers at length.

The commercial and by-catch length frequencies were then summed to establish the total removals at length. These were converted to removals at age and for determination of mean weights-at-age using the *S. mentella* age-length keys from the 1990-98 EU surveys. The 1990 year-class followed by that of 1989 continued to dominate catches in 1999.

CPUE data. Two CPUE series were available, the observed CPUE series from monitored Portuguese trawlers (1988-96) and the STATLANT 21B CPUE series incorporating catch and effort data for most of the components of the fishery (1959-93). The second series was used in a surplus production analysis carried out in this assessment.

ii) **Research survey data**

The Russian bottom trawl survey has not been conducted since 1997. Due to the low correlation with other available biomass indices observed during previous assessments, the Russian survey beaked redfish bottom biomass index was not included this year in the production analysis.

Survey bottom biomass and survey female spawning biomass of Div. 3M beaked (*S. mentella* plus *S. fasciatus*) redfish were calculated based on the abundance at length from Canadian and EU bottom trawl surveys for the periods 1979-85 and 1988-99 respectively, and based on the Div. 3M beaked redfish length weight relationship from 1989-99 EU survey data. Female spawning biomass was calculated applying length maturity ogives derived from data collected during the 1992-94 surveys.

Age composition for the 1989-99 Div. 3M beaked redfish EU survey stock and mature female stock, as well as the respective mean weights-at-age, were obtained using the *S. mentella* age length keys from the 1990-99 EU surveys with both sexes combined, and the corresponding annual length weight relationships.

Survey results. Biomass indices (swept area method) from EU surveys are presented in the following table ('000 tons):

Year	Beaked redfish	*S. Mentella*	*S. fasciatus*	Juveniles
1988	143.0	-	-	-
1989	113.7	-	-	-
1990	87.6	-	-	14.7
1991	59.3	50.1	5.7	3.5
1992	97.6	71.8	5.3	20.5
1993	55.0	25.1	4.4	25.6
1994	87.0	35.7	7.8	43.5
1995	64.6	59.3	5.0	0.2
1996	89.2	77.9	11.0	0.3
1997	74.3	56.1	17.5	0.7
1998	52.8	45.4	6.4	1.0
1999	73.4	65.3	8.0	0.2

Bottom biomass and spawning biomass. During the earlier period (1979-85), covered by the Canadian surveys, both bottom biomass and female spawning biomass of beaked redfish were stable, with female spawning bottom biomass averaging 40% of the total bottom biomass (Fig. 7.2).

The more recent period of 1988-98, covered by EU surveys, started with a continuous decline of bottom biomass until 1991, followed by a period of biomass fluctuation with no apparent trend from 1992 until 1996, then declining further in 1997 and 1998, when the second lowest bottom biomass was recorded. It is however difficult to interpret this last apparent decline from 89 000 tons in 1996 to 53 000 tons in 1998 since catches at the time dropped to very low levels.

Survey bottom biomass increased again in 1999 to 73 000 tons. Bottom spawning biomass declined during the EU survey time series and for the last five years (1995-99) spawning biomass represented on average just 10% of the bottom biomass.

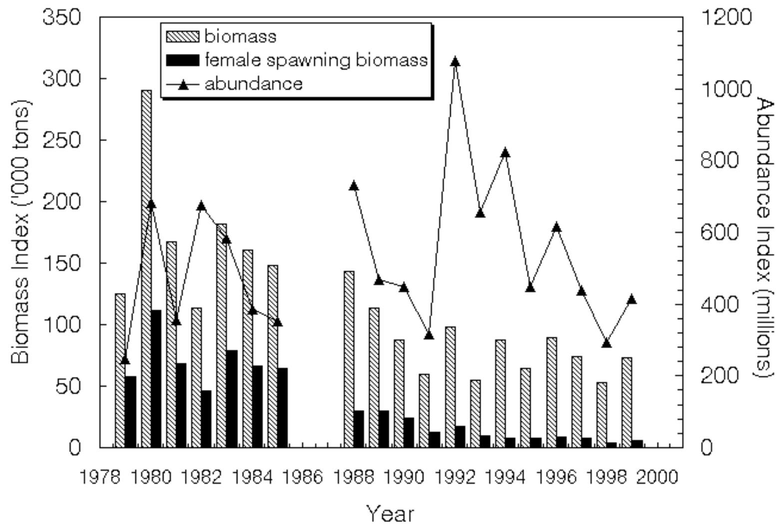

Fig. 7.2. Beaked redfish in Div. 3M: bottom biomass, female spawning biomass and abundance from Canadian (1979-85) and EU (1988-99) surveys.

c) **Estimation of Parameters**

A maturity ogive-at-age for Div. 3M beaked redfish was calculated from the mean proportion of mature females from the survey stock abundance-at-age by a general logistic curve fit to the observed data. This maturity ogive was incorporated in the yield-per-recruit analysis.

A partial recruitment vector for Div. 3M beaked redfish was revised assuming flat topped partial recruitment and adjusting a relative mean index-at-age to a general logistic curve. This index was derived by determining the ratio between the 1989-99 age composition of the total catch, including redfish by-catch in the shrimp fishery, and beaked redfish survey abundance. Both data sets were standardized to numbers-per-thousand prior to analysis.

The ratios between annual STACFIS estimates of Div. 3M redfish catch and by-catch and EU beaked redfish survey bottom biomass were considered to be an index of the mean fishing mortality during the past 12 years.

An Extended Survival Analysis (XSA) (Shepherd, 1999)[1] for the most recent period of 1989-98 was run. Natural mortality was assumed constant at 0.1. The input catch-at-age was as described above as was the female maturity ogive used. The month of peak spawning for Div. 3M *Sebastes mentella*, February, was used for the estimate of the proportion of F and M before spawning. The first age group considered was age 4 and a plus group was set at age 19. EU survey abundance at age was used for calibration.

A logistic surplus production model which does not use the equilibrium assumption (ASPIC) was applied using the 1959-99 STACFIS catch estimates with the standardized STATLANT commercial catch and effort data (1959-93) and the age 4+ EU bottom biomass (1988-99). The selection of these series was made because of their higher correlation, compared with the negative or very low correlation between any other combination of the CPUE and survey series available for Div. 3M redfish. A starting estimate for the intrinsic rate of biomass increase was derived from the $F_{0.1}$ given by the yield-per-recruit analysis. Catchability (q) of the EU survey was fixed based on mean age 4 + survey bottom biomass/XSA stock biomass ratio for the 1992-99 period.

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1 SHEPHERD, J. G., 1999. Extended survivors analysis: an improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci.*, **56**(5): 584-591.

ASPIC was first run to fit for estimates of parameters, together with effort and survey patterns of unweighted residuals as well as the biomass and fishing mortality trends expressed as ratios to B_{msy} and F_{msy} . Effort and survey residuals were finally run through bootstrap analysis in order to derive bias corrected estimates and probability distribution of the parameters.

d) **Assessment Results**

From the F index derived from the ratio of commercial catch to survey biomass, fishing mortality rose to a peak in 1990 then gradually declined. This index has been at very low levels since 1997 (Fig. 7.3).

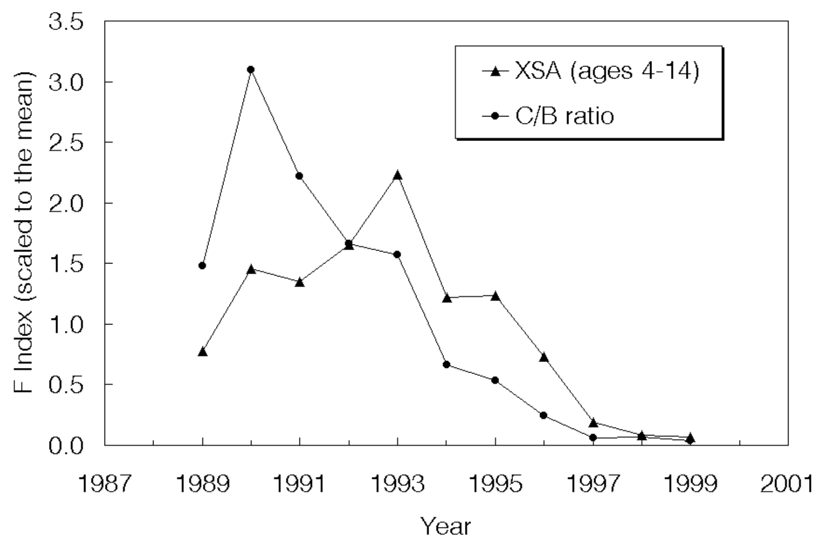


Fig. 7.3. Beaked redfish in Div. 3M: fishing mortality trends: XSA (ages 4 to 14) and catch/biomass EU survey.

Both XSA and ASPIC illustrative analyses indicated that the Div. 3M beaked redfish stock experienced a steep decline from the late-1980s that continued until 1994 (Fig. 7.4). During this former period, fishing mortality is indicated to be well above F_{msy}, due to the extremely high catches in the fishery (1989-93) coupled with a very high level of redfish by-catch in numbers from the Div. 3M shrimp fishery (1993-94). These by-catches primarily affected the above average year-classes of 1989 and 1990 at age 4. From 1996 onwards fishing mortality dropped to values well below natural mortality halting the stock decline.

Recruitment at age 4 is fluctuating with no apparent trend in recent years. There has been no strong pulse of recruitment observed since about 1990.

The apparent gradual increase in biomass suggested by both models for the most recent years (1997-99) was not seen in the survey results.

The observed 1989-95 high level of fishing mortality affected primarily the larger length groups in the *S. mentella* and *S. fasciatus* populations, resulting in a decline of the beaked redfish female spawning biomass to a level much lower than during the late-1970s and early-1980s, when there is evidence, from the Canadian survey bottom biomass series, that the stock experienced a period of relative stability with a proportion of about 40%.

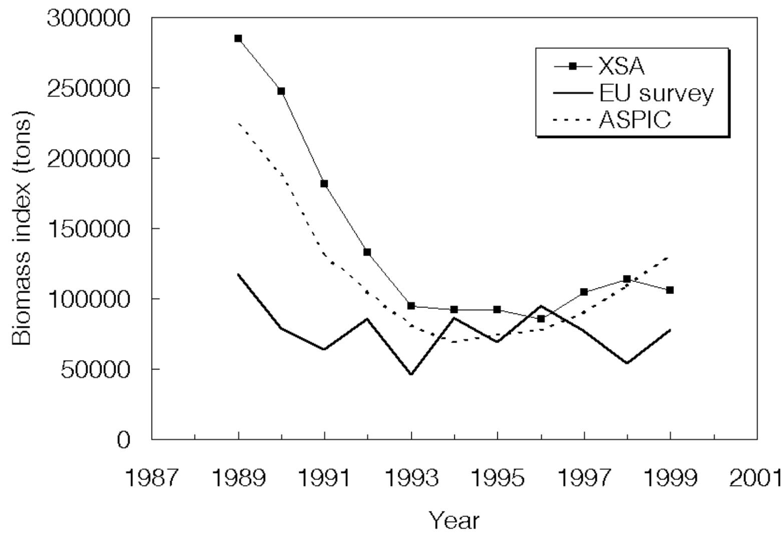


Fig. 7.4. Beaked redfish in Div. 3M: XSA and ASPIC total biomass, and EU survey bottom biomass trends.

STACFIS concluded that while the decline in stock biomass appears to have halted, it is still unclear as to whether there has been any actual increase. The total stock and spawning stock are currently at a low level compared to the earlier period in the time series. At the low fishing mortality level from the most recent years, and with growth of the relatively strong 1989-90 year-classes, stock and spawning biomass should gradually increase.

STACFIS noted that information on Div. 3M redfish by-catch in the shrimp fishery was presented during the November 1999 assessment of shrimp in Div. 3M. STACFIS **recommended** that *an update of the Div. 3M redfish by-catch information be presented on a regular basis during the November assessment of shrimp in Div. 3M, including the estimated weights and numbers of redfish caught annually in the Div. 3M shrimp fishery as well as tables showing their size distribution.*

e) **Reference Points**

No updated information on biological reference points was available.

8. American Plaice (*Hippoglossoides platessoides*) in Division 3M (SCR Doc. 00/09,25; SCS Doc. 99/09)

a) **Introduction**

On the Flemish Cap the stock of American plaice 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 1999 was estimated to be 255 tons.

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. 8.1).

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	2	2	2	1[1]	1[1]	0	0	0	0	0
Catch	1.6	0.8	0.3	0.7[2]	1.3[2]	0.3[2]	0.2[2]	0.3[2]	0.3[2]	

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

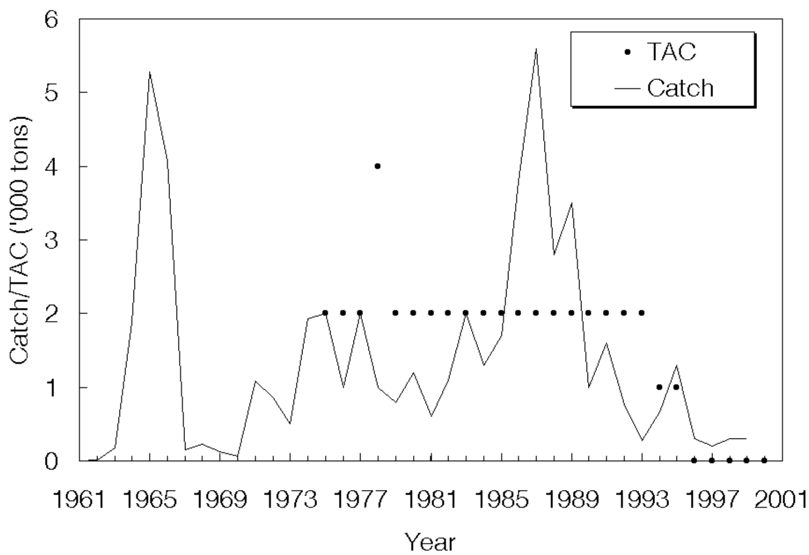


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs.

b) **Input Data**

i) **Commercial fishery data**

Russia provided length composition data for the 1999 trawl catches. This information was used to estimate the length and age compositions for the total catch (255 tons). The 1990 year-class (age 9 in 1999) continues to be the most abundant one.

Mean weights-at-age in the catch showed a slow decreasing trend from 1993 to 1997 for ages older than 8. This trend seems to stop in 1998 but in 1999 the mean weights-at-age decreased again, being actually slightly below the average.

ii) **Research survey data**

The series of research surveys conducted by the EU since 1988 was continued in July 1999. The USSR/Russian survey series started in 1983 ending in 1993. A single Canadian survey was conducted in 1996.

A continuous decreasing trend in abundance and biomass indices was observed since the beginning of the EU survey series. The 1999 abundance and biomass were the lowest of the series. The USSR/Russian survey series, although more variable, also showed a decreasing trend between the 1986-93 period. Both indices from the Canadian survey in 1996 were at the same level of the EU survey (Fig. 8.2).

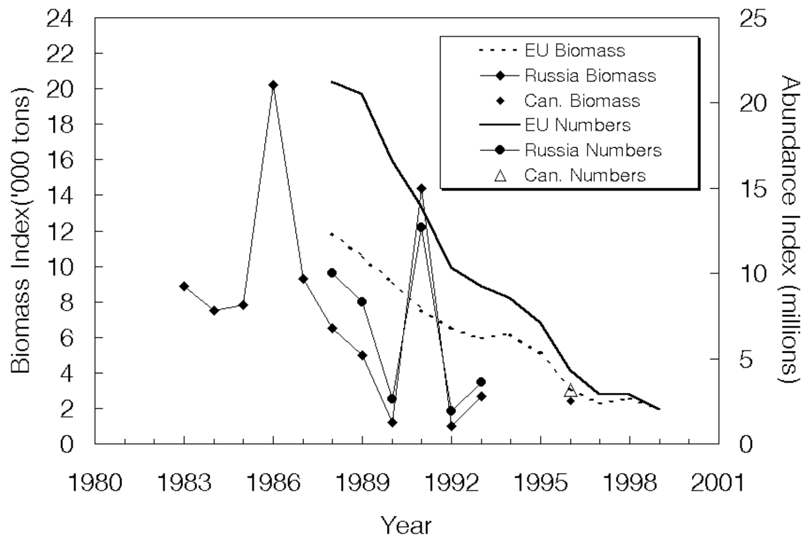


Fig. 8.2. American plaice in Div. 3M: trends in biomass and abundance indices in the surveys.

During the EU survey series the age reader was changed three times, and age compositions of the survey may reflect different criteria. As in the commercial catches age 9, corresponding to the 1990 year-class, was the best represented. Since 1991, all the recruiting year-classes were very poor as shown by EU survey indices.

The EU survey spawning stock biomass (50% of age 5 and 100% of age 6 plus) was in 1994 at the 1989-90 level, but decreased since then (table below). In 1999 SSB dropped to 18% of the 1988 level, being the lowest point observed in the survey series (1988-99).

Evolution of recruits (‘000) and SSB (‘000 tons) EU survey index during the period 1988-99.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1988	1999
SSB	9.9	7.8	6.0	5.8	5.2	5.0	6.4	4.6	2.7	2.1	2.4	1.8
Age 3 recruits	625	6 847	775	911	679	1 365	40	99	103	96	29	20

c) **Estimation of Parameters**

Taking into account the deficiencies in the database, 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). This index reached its lowest value in 1998 (Fig. 8.3), but in 1999 show a little increase though still at a low level (0.2). As this index could be affected by unreported catches, another estimation of F was tried by the log of the ratio between ages 6+ in one year, and 7+ the next year, minus natural mortality (0.2). This last index, although exhibiting a considerable amount of interannual variability, follows the same trend. Recruitment was estimated as the age 3 index from the EU surveys.

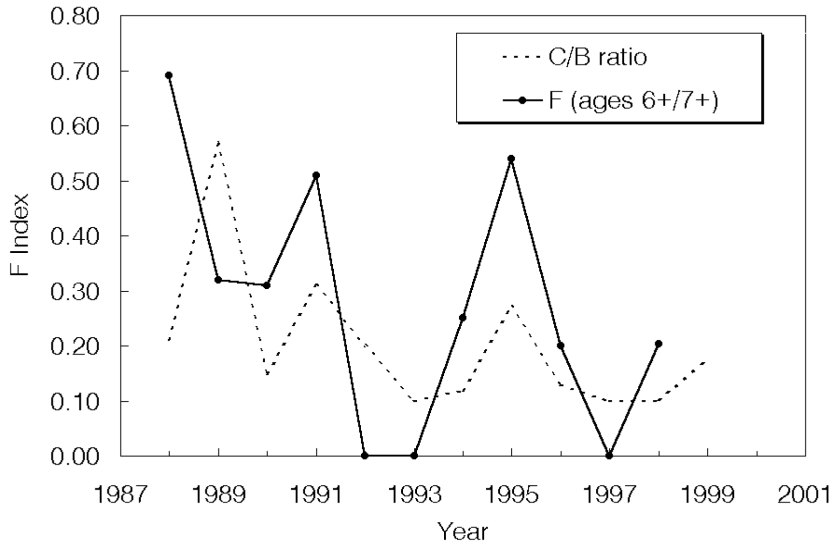


Fig. 8.3. American plaice in Div. 3M: comparison between the trends shown by two indices of F.

d) **Assessment Results**

Recruitment has been poor since the 1990 year-class. 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 and fishing mortality since 1992 appear to be relatively low, survey data indicate that the stock biomass and the SSB are at a very low level and there is no sign of recovery, due to the consistent year to year recruitment failure since the beginning of the 1990s.

e) **Reference Points**

Only 9 points are available to evaluate a spawning stock and recruitment relationship, but only very poor recruitment appears at an SSB less than 6 000 tons, as estimated by the EU survey (Fig. 8.4).

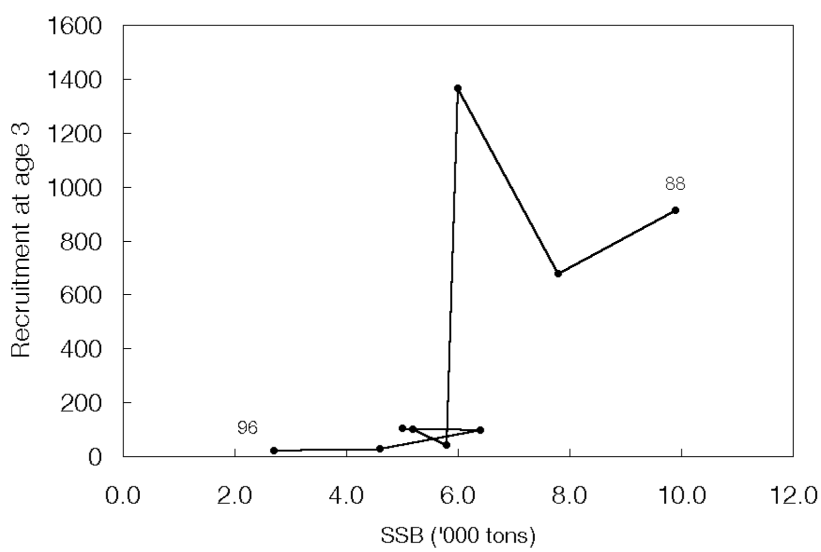


Fig. 8.4. American plaice in Div. 3M: SSB-Recruitment scatter plot.

Figure 8.5 represents an index of age 3 recruitment per unit of SSB obtained as the log of the R/SSB ratio for each year-class. Two different periods can be shown in this figure, one up to 1990 and other one since 1991. In the recent period the amount of recruits surviving per unit of spawning biomass has declined substantially.

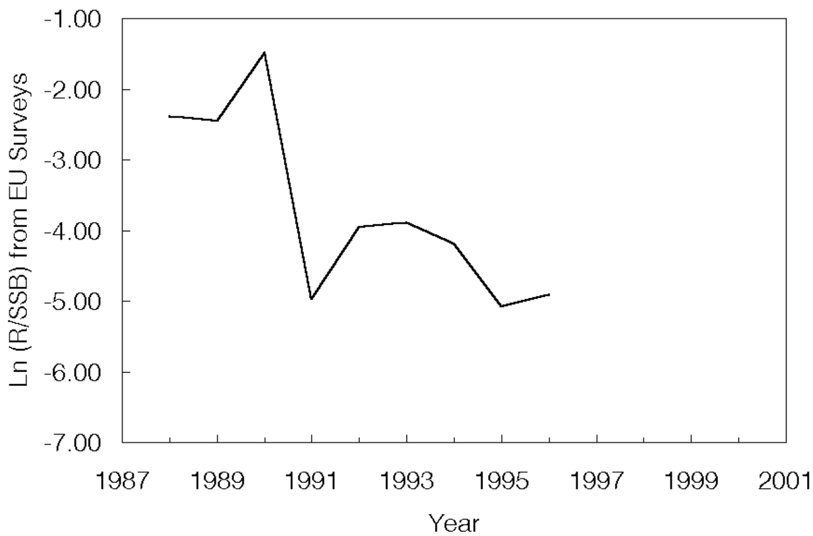


Fig. 8.5. American plaice in Div. 3M: recruits at age 3 produced per kg of SSB index.

The yield-per-recruit analysis is presented with the same parameters from the two last years: M = 0.2; the selectivity pattern coming from Div. 3NO American plaice (SCR Doc. 98/51), the knife edge maturity of 50% of age 5 and 100% of age 6 plus and the average mean weights at age in the catch and the stock for the period 1988-99. This analysis gave a $F_{0.1}$ = 0.28.

f) **Future Studies**

Problems related to age determination were presented as a key obstacle to the use of an analytical approach for American plaice in Div. 3M. STACFIS **recommended** that *current initiatives aiming at reconciling age determination from different age readers be continued in an effort to determine the catch-at-age for this stock.* Also, efforts should be made to establish historical time series of catch-at-age and other biological information at age so that they can be used in analytical assessments. It was noted that, despite these inconsistencies in age determination, the age disaggregated information available appears to be tracking year-classes as well as the information available for many other stocks. Therefore, STACFIS **recommended** that *analytical assessments be attempted in the next assessment of Div. 3M American plaice.*

C. STOCKS ON THE GRAND BANK

9. Cod (*Gadus morhua*) in Divisions 3N and 3O (SCR Doc. 00/20, 33; SCS Doc. 00/9, 16, 20)

a) **Interim Monitoring Report**

The cod stock in Div. 3NO has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. During the last assessment in 1999 of this stock it was concluded that recruitment and spawning stock are extremely low. In 1999 the total by-catch of cod in Div. 3NO was 909 tons (Fig. 9.1). The spring and autumn Canadian research vessel surveys conducted in 1999 indicate an increase in catch rates of juvenile fish (ages 1-3) from recent years in Div. 3N and 3O (Fig. 9.2 and 9.3).

This increase may in part be due to a possible change in catchability resulting from a warming in Div. 3N and 3O. The 1999 indices of biomass suggest no significant increase. The stock size is still much below B_{lim} (Fig. 9.4).

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Recommended TAC				Same as agreed						
Agreed TAC	13.6	13.6	10.2	6	nf	ndf	ndf	ndf	ndf	ndf
Reported Catches	17	10.1	9	1.9[1]	0.17[1]	0.17[1]	0.42[1]	0.50[1]	0.91[1]	
Non-reported Catches	12	2.5	0.7	0.8	0	0	0	0.05		
Total Landings	29	12.6	9.7	2.7[1]	0.17[1]	0.17[1]	0.42[1]	0.55[1]	0.91[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.

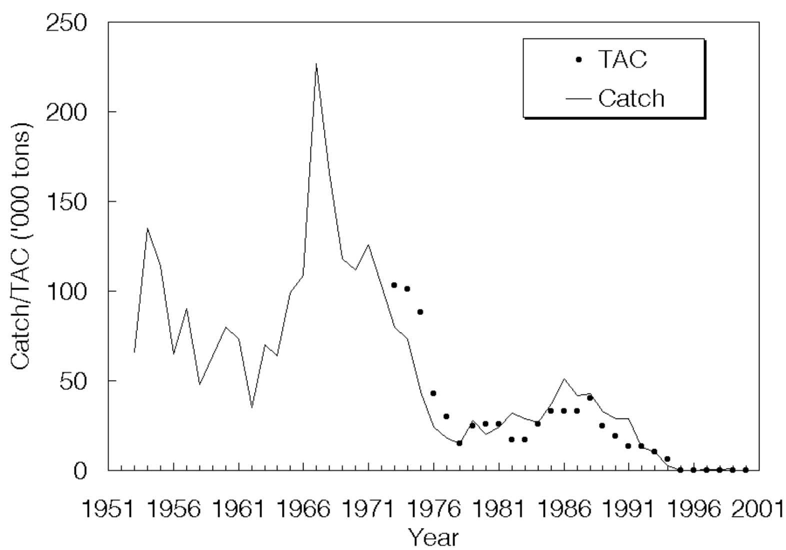


Fig. 9.1. Cod in Div. 3NO: catches and TACs.

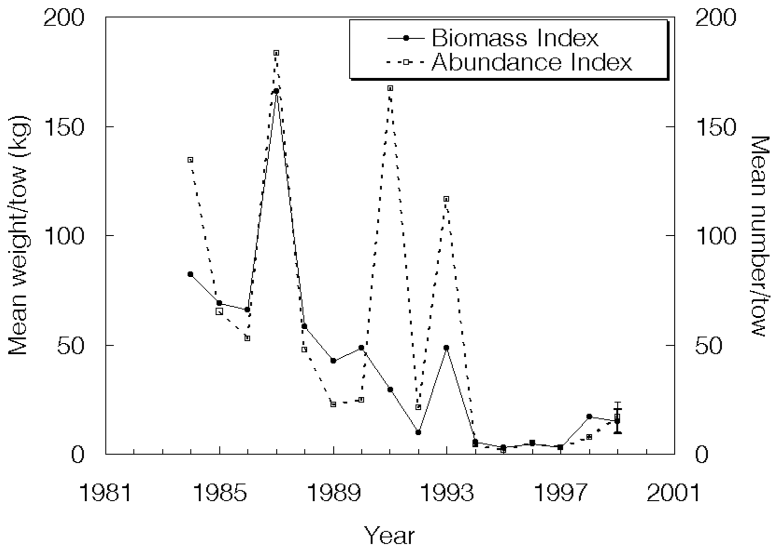


Fig. 9.2. Cod in Div. 3NO: abundance and biomass indices from Canadian spring surveys. 95% confidence intervals are provided for 1999.

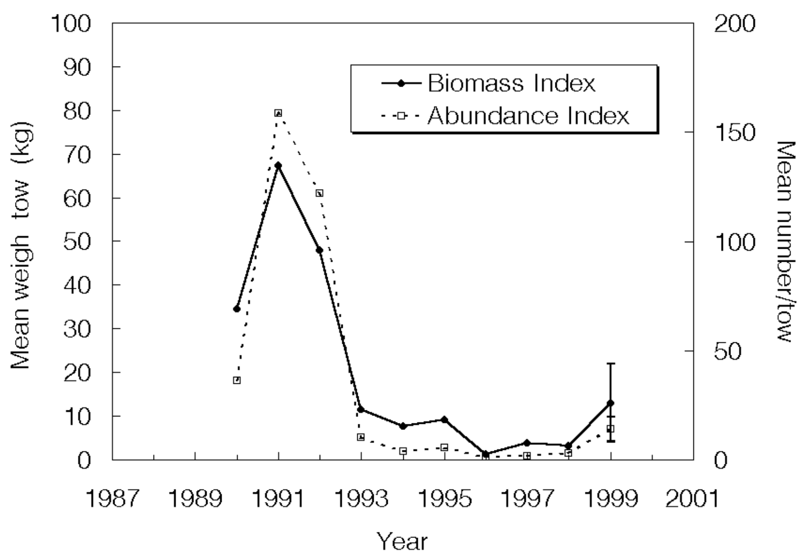


Fig. 9.3. Cod in Div. 3NO: abundance and biomass indices from Canadian autumn surveys. 95% confidence intervals are provided for 1999.

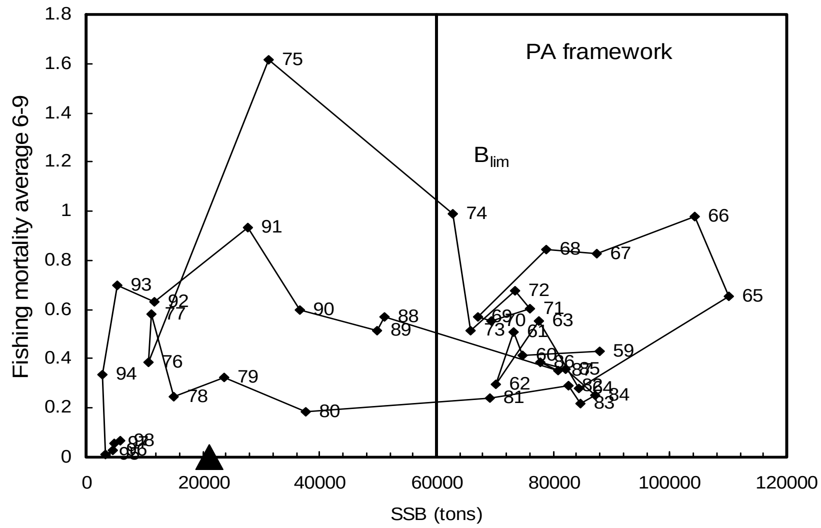


Fig. 9.4. Cod in Div. 3NO: scatter plot of fishing mortality *versus* spawning stock biomass (SSB). The 1999 estimate of spawning stock biomass (Q adjusted) is indicated by the triangle.

10. **Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N** (SCR Doc. 00/48, 52; SCS Doc. 00/6, 9, 16, 20, 16)

a) **Interim Monitoring Report**

A total catch of 2 318 tons was estimated for 1999 compared to 900 tons in 1998 (Fig. 10.1). The catches were taken as by-catch in the Greenland halibut fisheries for various fleets.

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	14	14	14	14	14	11	11	0	0	0
Catch[1]	26	27	21[2]	6[2,3]	2[2,3]	0.5[3]	0.6[3]	0.9[3]	2.3[3]	

[1] Includes catch estimated by STACFIS for 1989-94.
[2] STACFIS could not precisely estimate the catch. Figures are midpoint of range of estimates.
[3] Provisional.

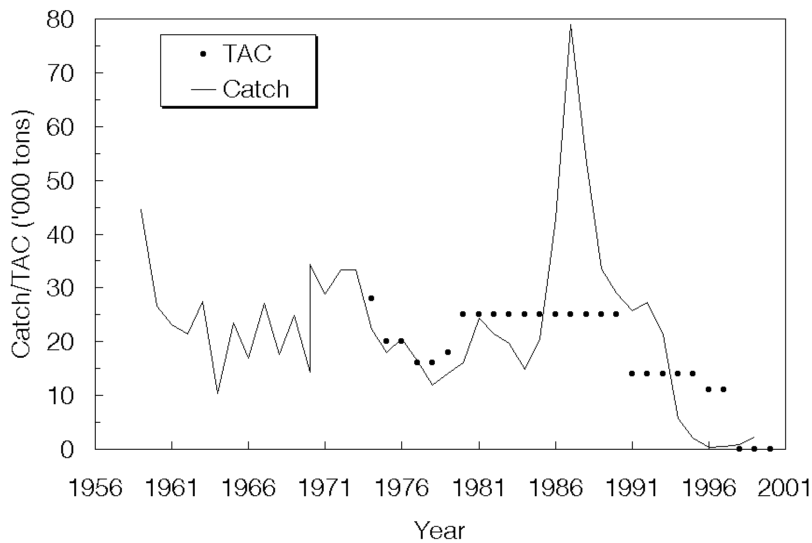


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

Spring and autumn surveys were conducted in Div. 3L and Div. 3N during 1999. The survey estimates (Fig. 10.2) did not alter the perception of STACFIS that the stock biomass remains at a very low level and recruitment has been poor for more than a decade.

b) **Current and Future Studies**

STACFIS noted that preliminary results were available from a study of redfish species distribution and population genetic structure pertinent to the Committee's long standing recommendation on the appropriateness of Div. 3LN and Div. 3O as management units. The study suggests that hybrids of *Sebastes mentella* and *S. fasciatus* exist but are restricted to an area of common overlap that includes Subdiv. 4Rs and Div. 4T (Gulf of St. Lawrence) and Div. 3P and 4V (Laurentian Channel). The study also suggests that within *S. mentella*, no genetic difference could be detected among samples from Div. 3LNO and those from Subarea 2 and Div. 3K. STACFIS was unable to evaluate the results due to the lack of appropriate expertise at the June 2000 Meeting. It was noted that this study will be submitted to a primary journal where the results will be peer reviewed by appropriate expertise. The Committee endorsed continuation of genetic studies at the population level to determine the validity of Div. 3LN and Div. 3O as separate management units. 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.*

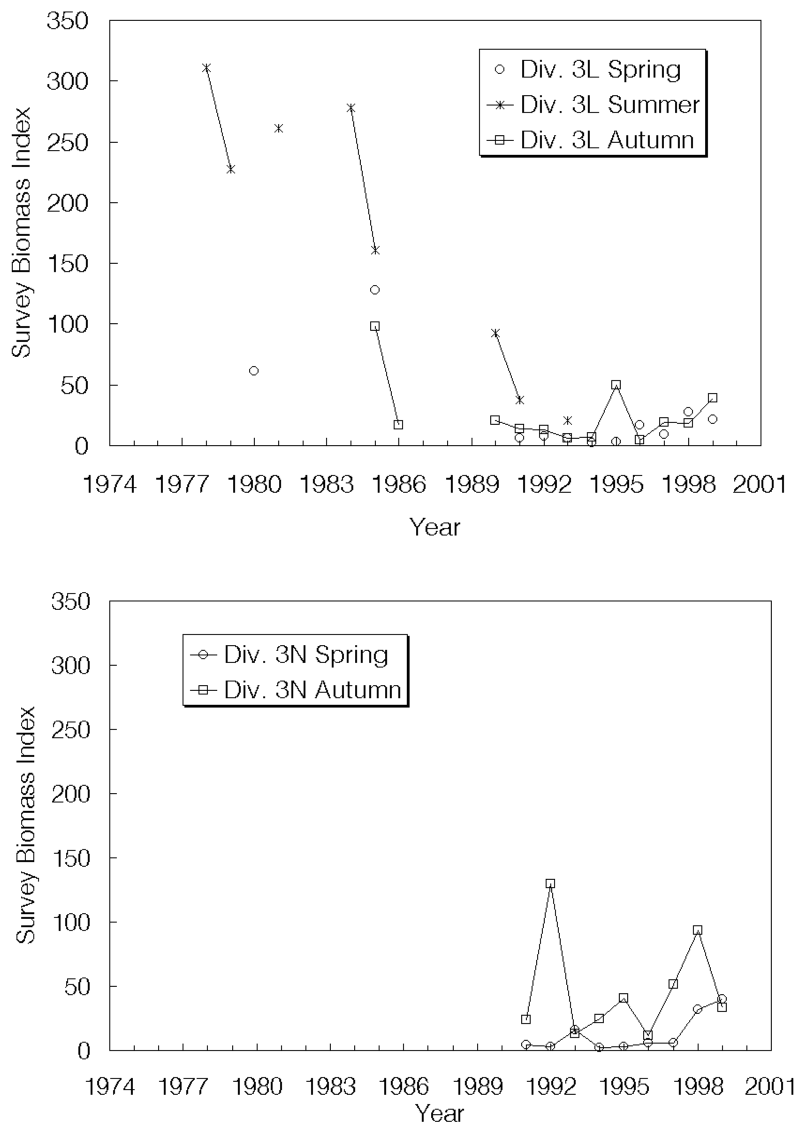


Fig. 10.2. Redfish in Div. 3LN: survey biomass indices from Canadian surveys in Div. 3L and Div. 3N in Campelen equivalent units for surveys prior to autumn 1995.

11. **American plaice (*Hippoglossoides platessoides*) in Divisions 3L, 3N and 3O** (SCR 00/41, 46, SCS 00/9, 16, 20)

a) Interim Monitoring Report

The American plaice stock in Div. 3LNO has been under moratorium since 1995. In 1999 catch of American plaice in Div. 3LNO totaled 2 565 tons up from 1 618 tons in 1998 (Fig. 11.1). Catch was mainly taken in the Regulatory Area and in the Canadian yellowtail flounder fishery.

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	25.8	25.8	10.5	4.8[1]	ndf	ndf	ndf	ndf	ndf	ndf
Catch	34[2]	13[2]	17[3]	7[4]	0.6[4]	0.9[4]	1.4[4]	1.6[4]	2.6[4]	

[1] No directed fisheries allowed.
[2] Includes estimates of misreported catches.
[3] Catch may be as high as 19 400 tons.
[4] Provisional.
ndf No directed fishery.

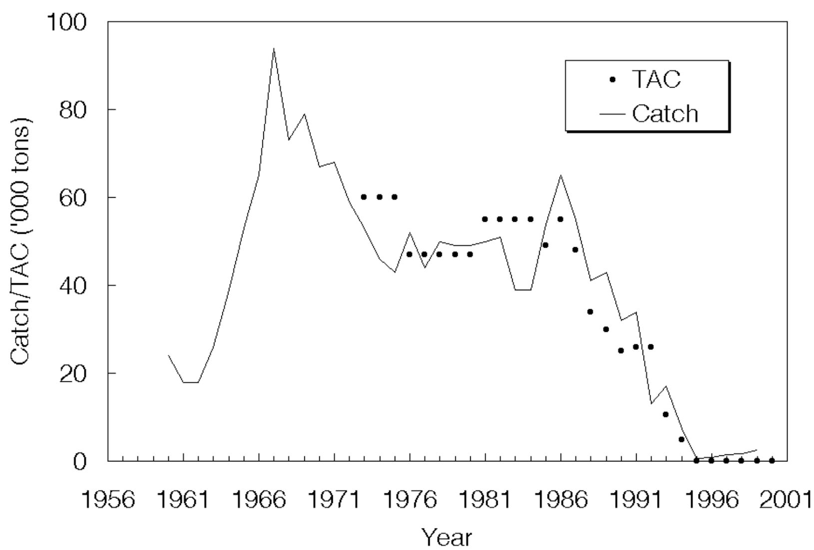


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs.

Spring and autumn Canadian research vessel surveys conducted in 1999 indicate that biomass is still at a low level (Fig. 11.2 and 11.3). The spring survey biomass index in 1999 was 26% of the average level in the mid-1980s while the autumn survey biomass index was 34% of the average level of 1990 and 1991. There was an increase in biomass in the spring survey in 1999 compared to the 1996-98 level but the autumn survey did not increase. The increase in the spring survey may in part be due to a possible change in catchability resulting from a warming in Div. 3LNO.

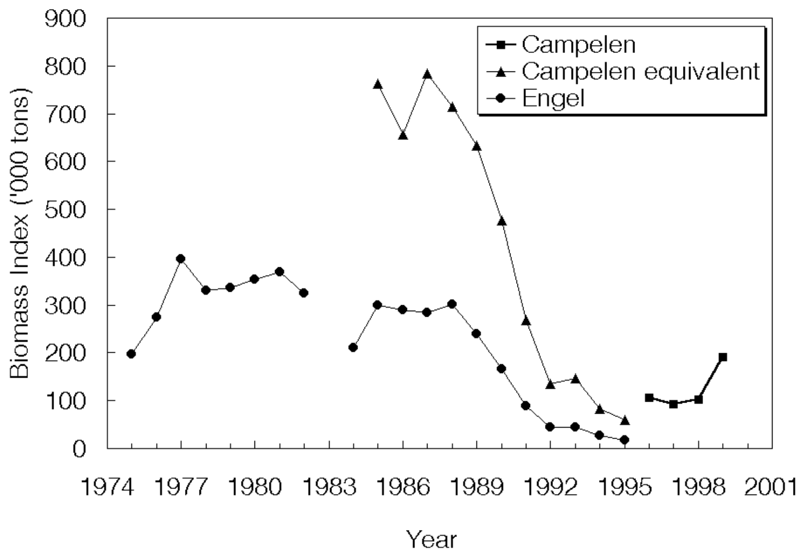


Fig. 11.2. American plaice in Div. 3LNO: biomass from Canadian spring surveys.

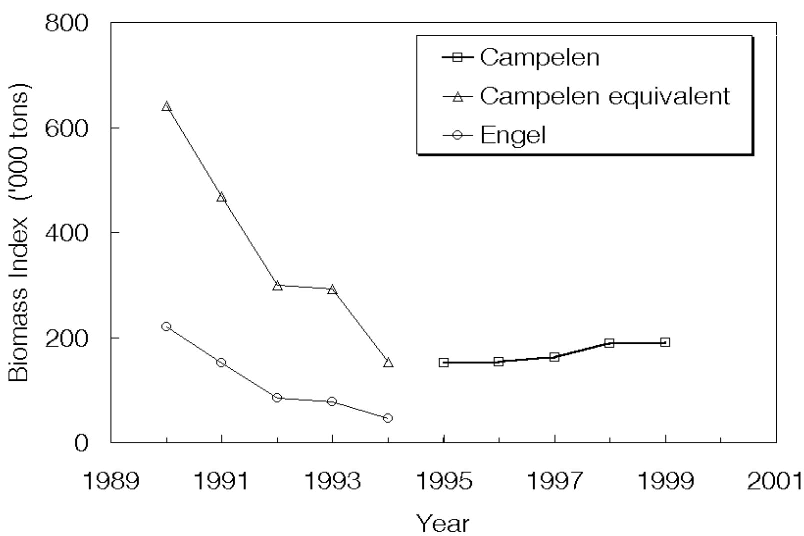


Fig. 11.3 American plaice in Div. 3LNO: biomass from Canadian autumn surveys.

Estimates of abundance and biomass from the surveys, conducted by EU-Spain in the Regulatory Area of Div. 3NO since 1995, have been increasing since 1998.

The 1999 assessment showed that average F was much lower than during the 1970s and 1980s but has shown slight increase since 1995 (Fig. 11.4). Average F on ages 9 to 14 and ages 8 to 12 showed an increasing trend from 1975 to 1992 but has been much lower since 1995. Average F on ages 9 to 14 increased from 0.025 in 1995 to 0.16 in 1998 and on ages 8 to 12 it increased from 0.032 in 1995 to 0.11 in 1998. The high Fs in 1993 and 1994 may be artifacts.

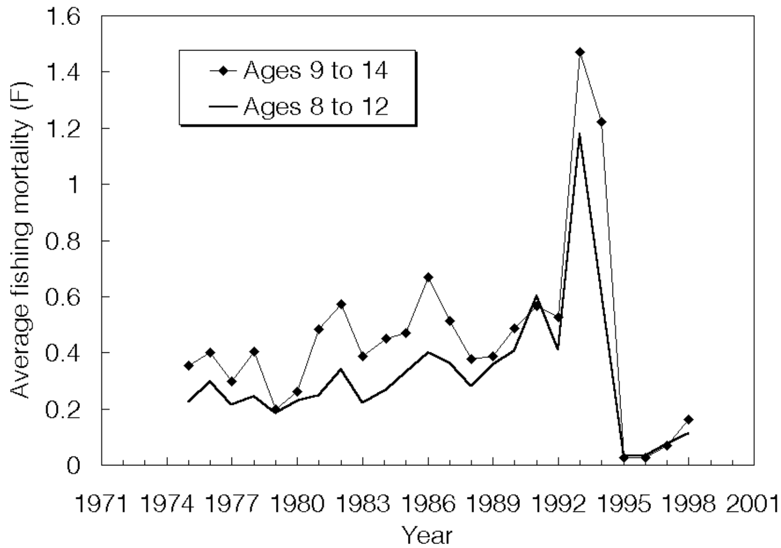


Fig. 11.4. American plaice in Div. 3LNO: average fishing mortality from VPA.

The 1999 VPA included a value for natural mortality that was a large departure from previous models and STACFIS again **recommended** that *for American plaice in Div. 3LNO, the effect of the increase in natural mortality and possible estimation of M be explored.* In recent years catch at older ages was low or nonexistent and therefore, STACFIS again **recommended** that *the number of ages in the catch-at-age matrix of American plaice in Div. 3LNO be reduced and the effect of a plus group in the catch-at-age be explored*. Previous VPAs on this stock had a severe retrospective pattern and STACFIS again **recommended** that *the current VPA of American plaice in Div. 3LNO be examined for a retrospective pattern*. STACFIS again **recommended** that *the stock recruit relationship of American plaice in Div. 3LNO from the VPA should be explored further.* STACFIS **recommended** that *in 2001 the entire time series of abundance, biomass and length frequencies for American plaice from the surveys conducted by EU-Spain in the Regulatory Area of Div. 3NO be presented in a single document.* STACFIS further **recommended** that *in future catch to survey biomass plots for American plaice in Div. 3LNO be presented.*

12. Yellowtail Flounder (*Limanda ferruginea*) in Divisions 3L, 3N and 3O (SCR Doc. 00/19, 32, 35, 42, 44, 45, 46, 50; SCS Doc. 00/9, 16, 20)

a) Introduction

During the moratorium (1994-97), catches decreased from around 2 000 tons in 1994 to about 280 tons in 1996 and increased to 800 tons in 1997, as by-catch in other fisheries (Fig. 12.1). In the 1998 fishery a catch of 4 400 tons was taken, and in the 1999 fishery a catch of 6, 600 tons was taken. Catches exceeded the TACs in each year from 1985 to 1993. In 1998 and 1999 by-catches in the Regulatory Area led to catches exceeding their respective TACs. 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:

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	7	7	7	7[1]	ndf	ndf	ndf	4	6	10
Catch	16[2]	11[2]	14[2]	2[1,3]	0.1[1,2,3]	0.3[1,3]	0.8[1,3]	4[3]	7[3]	

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

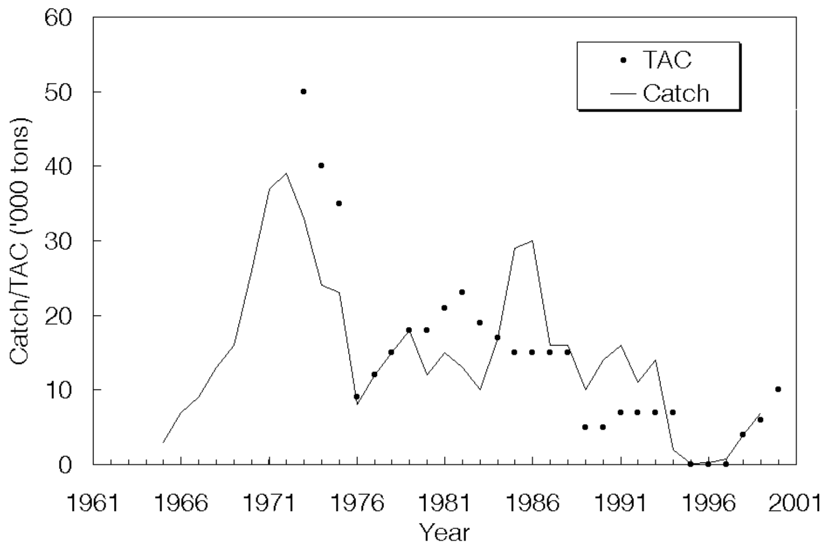


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

There were catch and effort data from the Canadian commercial fishery in 1999, which were included in a multiplicative model to analyze the CPUE series from 1965 to 1999. The index showed a steady decline from 1965 to 1976 and then rose to a relatively stable level from 1980-85 before declining to its lowest level during the 1991-93 time period. The 1998 and 1999 CPUE values are not directly comparable to CPUE indices from previous years because of changes in the 1998 and 1999 fishing patterns. The 1998 and 1999 catch rates are related to the fleet's fishing pattern which because of the 5% by-catch rule resulted in concentrating effort in the area where yellowtail flounder was abundant and the catches of American plaice and cod were expected to be low. This kept the by-catch levels of cod (3%) and American plaice (4%) down. The deployment of an excluder grate also contributed to the low by-catch levels, particularly cod. Juvenile catches were reduced by the use of large mesh sizes (145 mm) in the codend. Modal size of yellowtail flounder in the fishery was 36 cm. Analysis of maturity data indicated that the period of the fishery occurred before and after spawning was finished.

There was limited sampling of yellowtail flounder from by-catches in an EU-Spain skate fishery, EU-Portugal and Russian fisheries in the Regulatory Area of Div. 3NO. The length frequency of yellowtail flounder in the catches ranged in size from 16 to 54 cm, peaking at 34 cm in the Russian catches, 36 cm in the Portuguese catches and 30 cm in the Spanish catches. STACFIS again noted that the yellowtail flounder caught were smaller than might be anticipated with large mesh (220-mm mesh) codends used in the skate fishery. However there is no clear explanation of this observation yet.

ii) **Research survey data**

Sampling gear studies (SCR Doc. 00/19). Preliminary analysis of comparative fishing trials carried out by Canada and EU-Spain in the Regulatory Area of Div. 3N in May of 2000 were presented. Both vessels conducted fourteen side-by-side tows of 15 minute and 30-minute tow duration. Catches (weight) by the Pedreira trawl used by EU-Spain exceeded that of the Campelen trawl used by Canada by a factor of about 10. In the 1999 experiments aboard the Spanish survey vessel, a direct comparison of the catch rates of both trawls was made. By rigging the Campelen trawl with the same long sweeps and trawl doors as used with the Pedreira trawl, the catches of the Pedreira exceeded the Campelen catches by a factor of 3. The huge differences in catchability are partly attributed to the differences in sweep lengths used on both trawls (in excess of 200 m EU-Spain: 46 m Canada) and the smaller footgear used by EU-Spain. STACFIS **recommended** that *a detailed description of the survey design, specifications and geometry of the sampling trawl used in the Spanish survey in the Regulatory Area of Div. 3NO be tabled at the June 2001 Meeting*.

Canadian stratified-random spring surveys (SCR Doc. 00/35). These surveys covered depths from 42 to 731 m. In 1999, 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 sharply to an average biomass of 113 000 tons in 1996-97. In 1998, the estimate puts the biomass index at 144 000 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 1996-98 was 700 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. After increasing to 71 000 tons in 1996, the average biomass estimates dropped to average level of 56 000 tons for 1997-98.

In 1999, the total trawlable biomass index in Div. 3LNO was estimated to be 366 000 tons, a 81% increase since 1998 (Fig. 12.2). Such a huge increase is indicative of a 'year' effect associated with an increase in catchability, which may be related to a warming of bottom temperatures in the survey area.

The analyses of ages were inconclusive due the anomalous 1999 survey and the unresolved questions about ageing older fish.

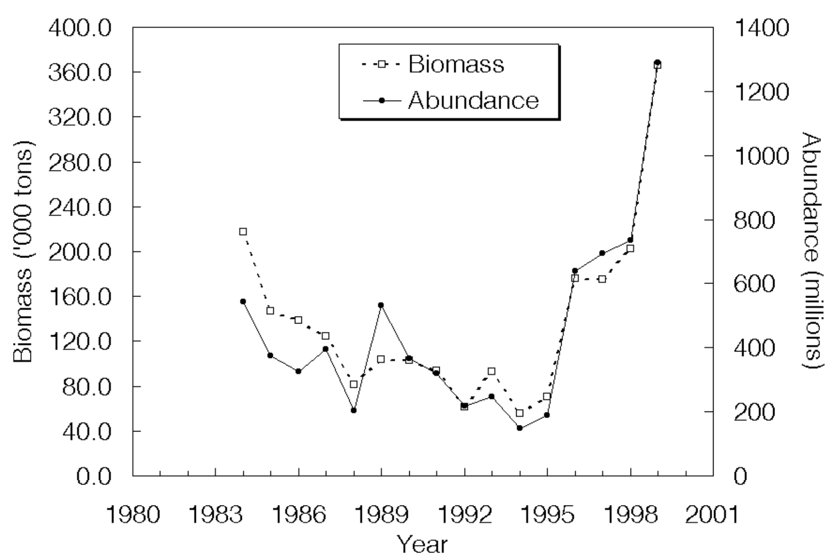


Fig. 12.2. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian spring surveys

Canadian stratified-random autumn surveys (SCR Doc. 00/35). These surveys covered depths from 42 to 1500 m. The index of trawlable biomass for Div. 3LNO yellowtail flounder has increased steadily from 66 000 tons in 1990 to 249 000 tons in 1999 (Fig. 12.3). Most of this biomass was found in Div. 3N; Div. 3L had a biomass estimate of 10 000 tons.

The analyses of ages were inconclusive due to the unresolved questions about ageing, however, abundance at length indicate the presence of large numbers of juveniles when compared to other years.

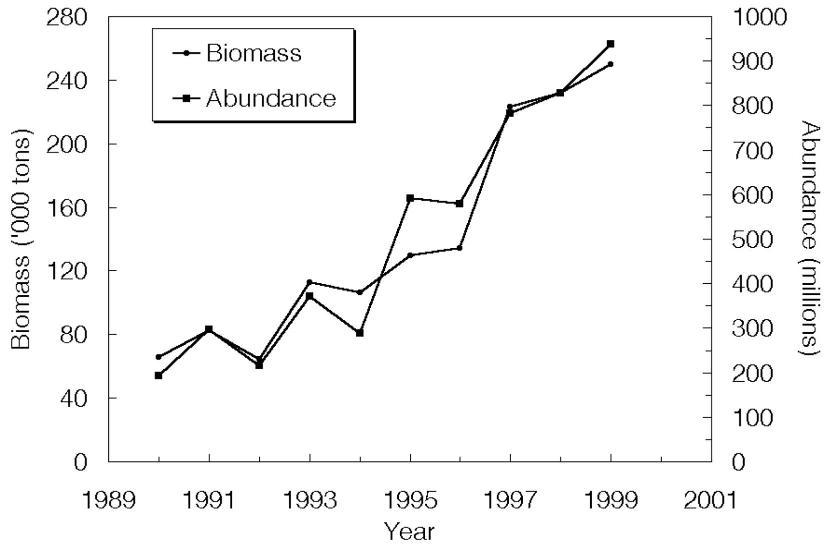


Fig. 12.3. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian autumn surveys.

Cooperative DFO/fishing industry seasonal surveys (SCR Doc. 00/42). Cooperative quarterly surveys between Canadian Department of Fisheries and Oceans (DFO) and the Canadian fishing industry in Div. 3NO were carried out since 1996 using a commercial fishing gear without a codend liner. These surveys indicate very low catch rates of yellowtail flounder and other species in March of 1997, 1998 and 1999 compared with surveys at other times of the year. CPUE observed in the 7 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, although the reason for this is unknown. With the exception of the March survey, the 1999 grid surveys indicate a lower CPUE when compared to previous surveys.

Yellowtail flounder in these surveys ranged from 21-54 cm and only 11% of the catch in any one trip was less than 30 cm. These surveys also pointed out the limited area available for conducting a directed fishery for yellowtail flounder within the 5% American plaice by-catch restriction.

Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO (SCR Doc. 00/46)**.** 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 has shown an increasing trend between 1995 (27 704 tons) and 1999 (589 200 tons). In 2000 biomass decreased by 24% to 447 403 tons (Fig. 12.4). Modal length of the 1998 survey was 27 cm and in 1999 it was 29 cm.

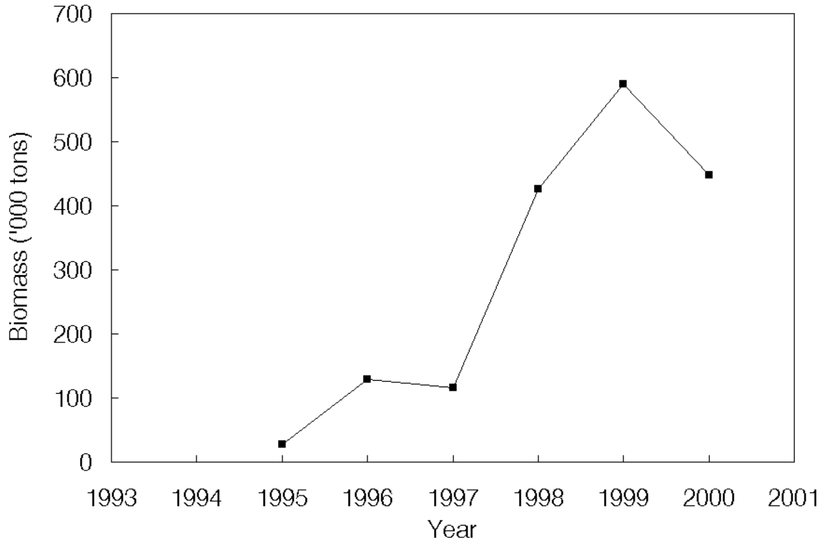


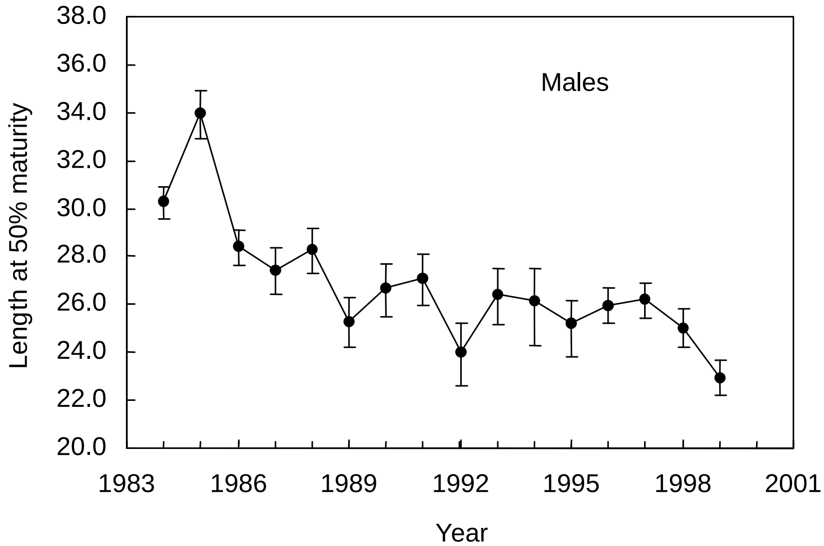
Fig. 12.4. Yellowtail flounder in Div. 3LNO: estimates of biomass from the Spanish spring surveys.

Stock distribution (SCR Doc. 00/35). Analysis of 1998 and 1999 spring and autumn surveys confirmed that the stock was more widely distributed in all three Divisions similar to that of the mid-1980s. The majority of the stock was consistently concentrated in Div. 3NO on and to the west of the Southeast Shoal. Based on catches during the 1998-99 surveys, expansion of the range back into Div. 3L has taken place.

Biological studies (SCR Doc. 00/32, 45). Preliminary analysis of age determination from whole and sectioned otoliths showed good agreement in ageing yellowtail flounder up to age 7. Noteworthy is that this was based on a sample size of 204 pairs of otoliths. From age 8 onward, sectioned otoliths gave higher readings than whole otolith readings. Maximum age of 13 years was estimated for males and 16 years for females in comparison for ages 10 and 11, respectively, from whole otoliths. Modal length frequency analysis using the Peterson method indicated good agreement for younger ages up to 5 years by whole otoliths. STACFIS noted the excellent progress made to reconcile age determination and **recommended** that *age validation studies be carried out to authenticate ageing by the new methods for yellowtail flounder in Div. 3LNO.*

Growth analysis of tag returns (125 with acceptable information) from tagging studies conducted in the early-1990s showed an average mean annual growth of 1.61 $\pm$ 0.18 cm/year (mean $\pm$ standard error). Growth rates were higher for smaller fish when compared to larger fish.

Length at 50% maturity (L_{50}) was calculated for males and females separately, from samples collected during the 1984-99 Canadian surveys in the Div. 3LNO. There has been a 5 cm decrease in length at 50% maturity in males from 30 cm to 25 cm, while female length at 50% maturity has remained fairly stable at about 34 cm (Fig. 12.5)



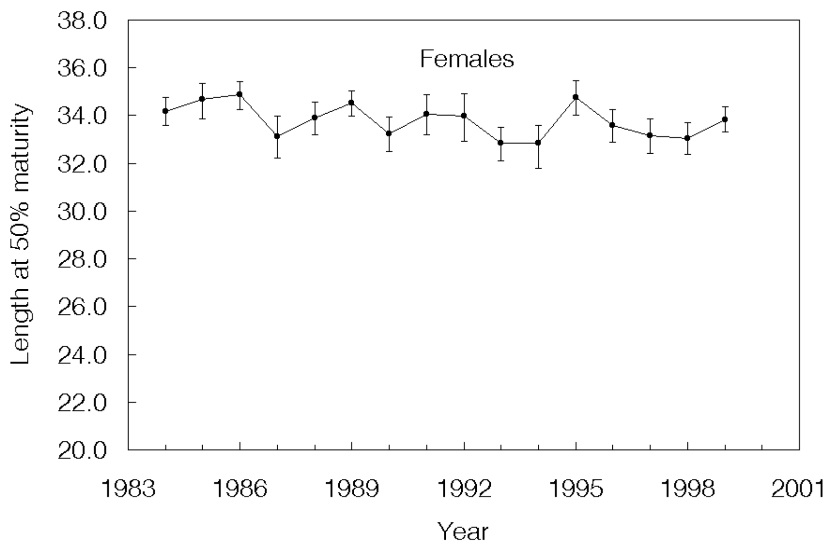


Fig. 12.5. Yellowtail flounder in Div. 3LNO: length at 50% maturity.

A length based female SSB was derived from the 1984-99 Canadian spring survey data, annual maturity ogives and annual mean weights-at-length. SSB declined from 90 000 tons in 1984 to 24 000 tons in 1989, then varied without trend around an average value of 28 000 tons from 1990-95. The SSB increased in 1996 and appeared stable at an average level of 66 000 tons from 1996-98. In 1999, there was a large increase in the survey index, which has been interpreted as a year effect (Fig. 12.6).

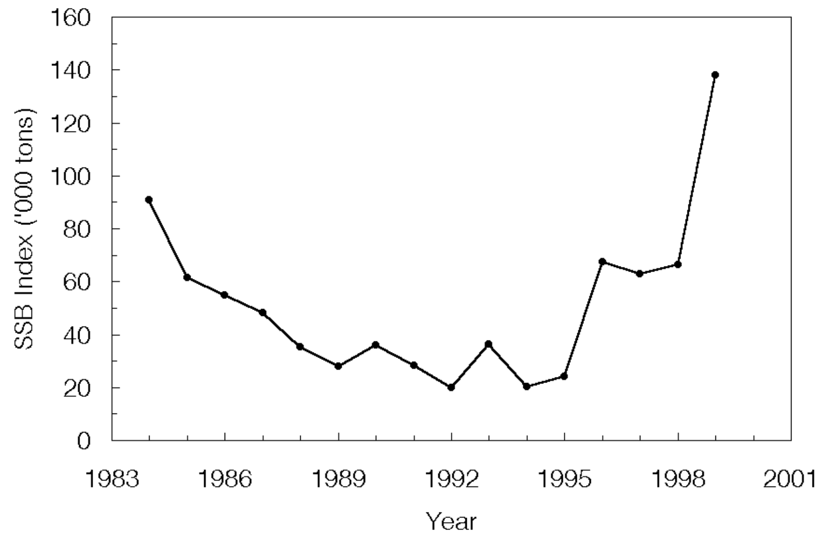


Fig. 12.6. Yellowtail flounder in Div. 3LNO: female spawning stock biomass estimated from the 1984-99 annual spring surveys.

Relative year-class strength was estimated from a multiplicative model using information based on abundance of cohorts at ages 3 and 4 from the 1984-99 spring and 1990-99 autumn survey time series (Fig. 12.7). Cohort strength was slightly stronger from 1984 to 1989 when compared with the period 1980-83. Year-class strengths increased each year from 1990 to 1993. The 1993 year-class was estimated to be the highest in the time series. The 1994, 1995 and 1996 year-classes were estimated to be somewhat weaker although they are still amongst the highest in the series.

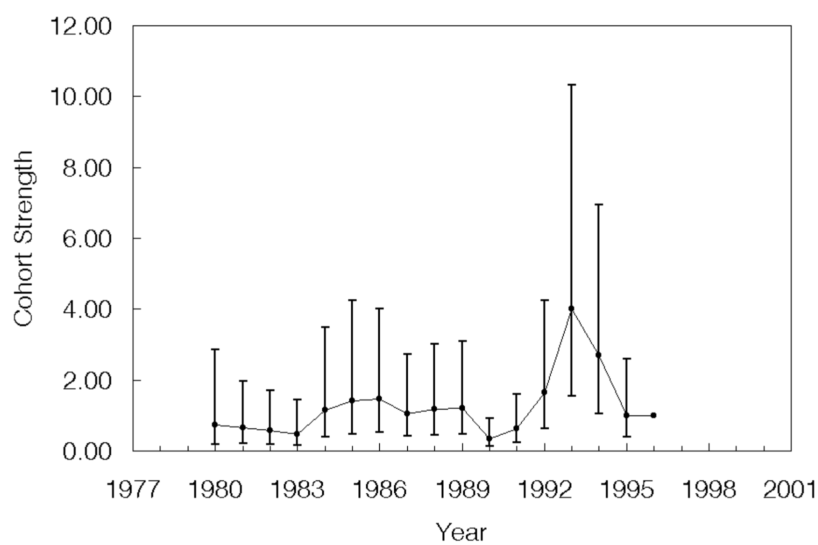


Fig. 12.7. Yellowtail flounder in Div. 3LNO: cohort strength estimated from a multiplicative model using age 3 and 4 data from annual spring and autumn surveys.

c) **Estimation of Parameters**

Several formulations of a surplus production analysis (ASPIC) were presented. STACFIS agreed that the model that provided the best fit to the data included the catch data (1965-2000), Russian spring surveys (1972-91), Canadian spring surveys (1971-82), Canadian spring (1984-99) and autumn (1990-99) surveys and the Spanish spring (1995-2000) surveys. Yield projections assumed that the TAC + 10% over-run will be taken in 2000 fishery, i.e. 11 000 tons.

Because of differences in catchability among the various indices, relative indices of biomass and fishing mortality rate were used instead of absolute values. As this stock was assessed with a production model, fishing mortality refers to yield/biomass ratio.

d) **Assessment Results**

The surplus production model suggests that a maximum sustainable yield (MSY) of 17 000 tons can be produced by total stock biomass of 83 000 tons (B_{msy}) at a fishing mortality rate of 0.21 (F_{msy}). The analysis showed that relative population size (B_t/B_{msy}) has been below the level at which MSY can be obtained since 1973. Since the moratorium the stock has been rebuilding so that $B_t = B_{msy}$ in 2000 (Fig. 12.8).

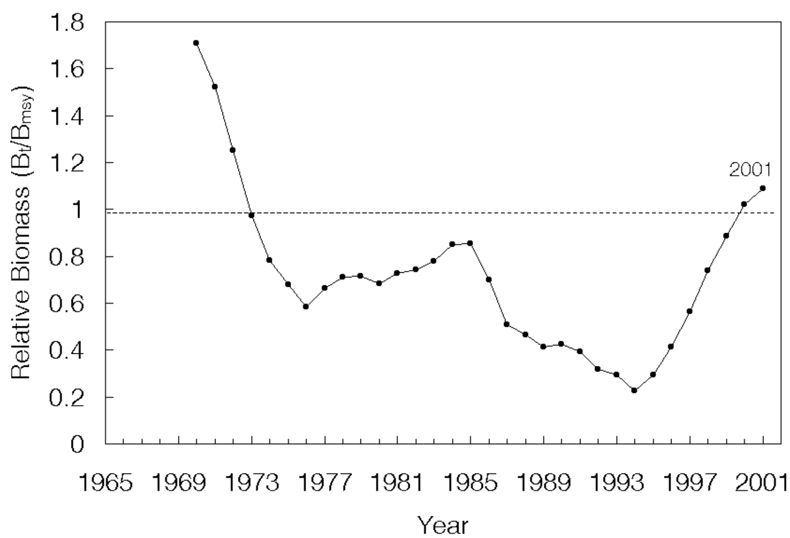


Fig. 12.8. Yellowtail flounder in Div. 3LNO: relative biomass trends.

Relative fishing mortality rate (F_t/F_{msy}) was above F_{msy}, in particular from the mid-1980s to early-1990s when the catches exceeded or doubled the recommended TACs (Fig. 12.9). In 2000, F is projected to be 61% F_{msy} if the TAC (+ 10% over-run) is taken

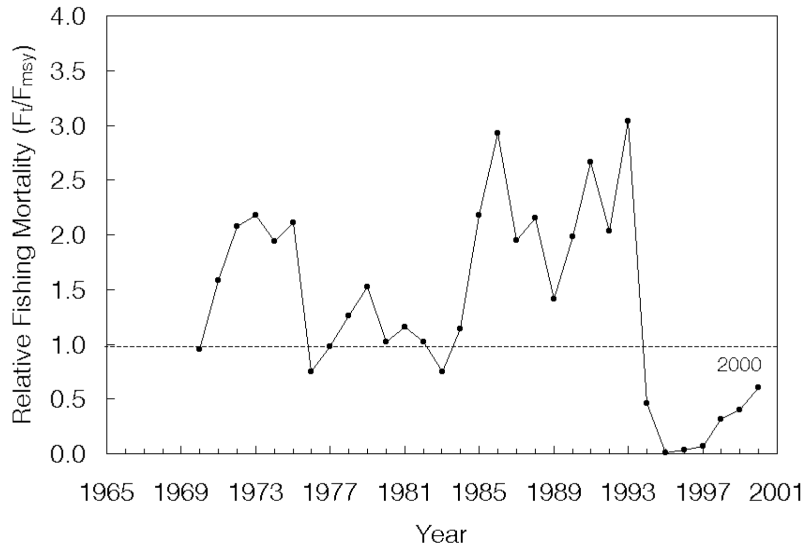


Fig. 12.9. Yellowtail flounder in Div. 3LNO: relative fishing mortality trends.

Since 1994, when the moratorium (1994-97) was put in place the estimated yield has been below sustainable production levels (Fig. 12.10).

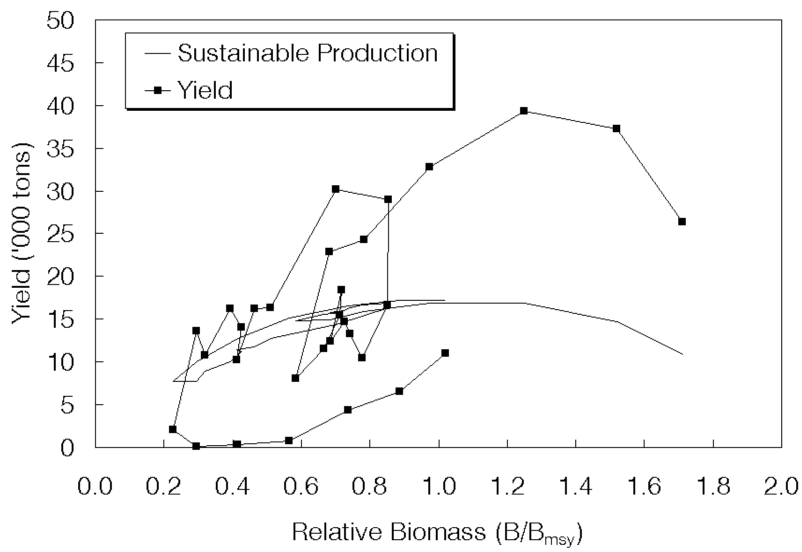


Fig. 12.10. Yellowtail flounder in Div. 3LNO: yield trajectory.

The model was bootstrapped to derive estimates of yield projections for 2001 assuming a *status quo* F (F_{2000}=F_{2001}) and assuming F_{2001}=2/3 F_{msy} an additional analysis was conducted. By constraining the catch in 2000 to 11 000 tons, percentiles of fishing mortality, yield and biomass for a series of multipliers were estimated (Table12.1). A *status quo* F results in a yield of 11 700 tons in 2001 and F_{2001}=2/3 F_{msy} results in a yield of 12 700 tons in 2001.

Table 12.1. Yellowtail flounder in Div. 3LNO: management options for 2001 and 2002. The percentiles of yield in 2001, and biomass ratio in 2002 are based on F in 2001 calculated as the product of the F multiplier and F in 2000.

	2001 F				
F multiplier	5	25	50	75	95
1.1	0.111	0.126	0.138	0.152	0.174
1.0	0.101	0.115	0.126	0.138	0.158
0.8	0.080	0.092	0.101	0.110	0.127
0.6	0.060	0.069	0.075	0.083	0.095
0.4	0.040	0.046	0.050	0.055	0.063
Fmsy	0.147	0.186	0.209	0.231	0.260
2/3 Fmsy	0.098	0.124	0.139	0.154	0.173

	2001 Yield				
F multiplier	5	25	50	75	95
1.0	11.40	11.60	11.71	11.82	11.95
0.8	9.21	9.38	9.48	9.57	9.69
0.6	6.97	7.11	7.19	7.27	7.37
0.4	4.70	4.80	4.86	4.91	4.98

	2002 Biomass / B_{msy}				
F multiplier	5	25	50	75	95
1.1	0.78	0.99	1.12	1.25	1.43
1.0	0.79	1.00	1.14	1.26	1.44
0.8	0.81	1.03	1.16	1.29	1.47
0.6	0.83	1.05	1.19	1.31	1.50
0.4	0.85	1.08	1.22	1.34	1.52

The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 11 000 tons in 2000.

Medium term projections were carried out by extending the ASPIC bootstrap projections forward to the year 2010 under an assumption of constant fishing mortality at 2/3 F_{msy} . F was constrained to 2/3 F_{msy}, i.e. 0.139 and projections were made for a 10-year period. The output shows that yield reaches a maximum at 15 000 tons in the year 2010. The results depicted in Fig. 12.11 show the percentiles of predicted absolute yield and biomass yield relative to MSY and biomass relative to B_{msy}. The probability of biomass falling below B_{msy} is between 10 and 20% from 2003 onward. The projections are conditional on the estimated values of r and K.

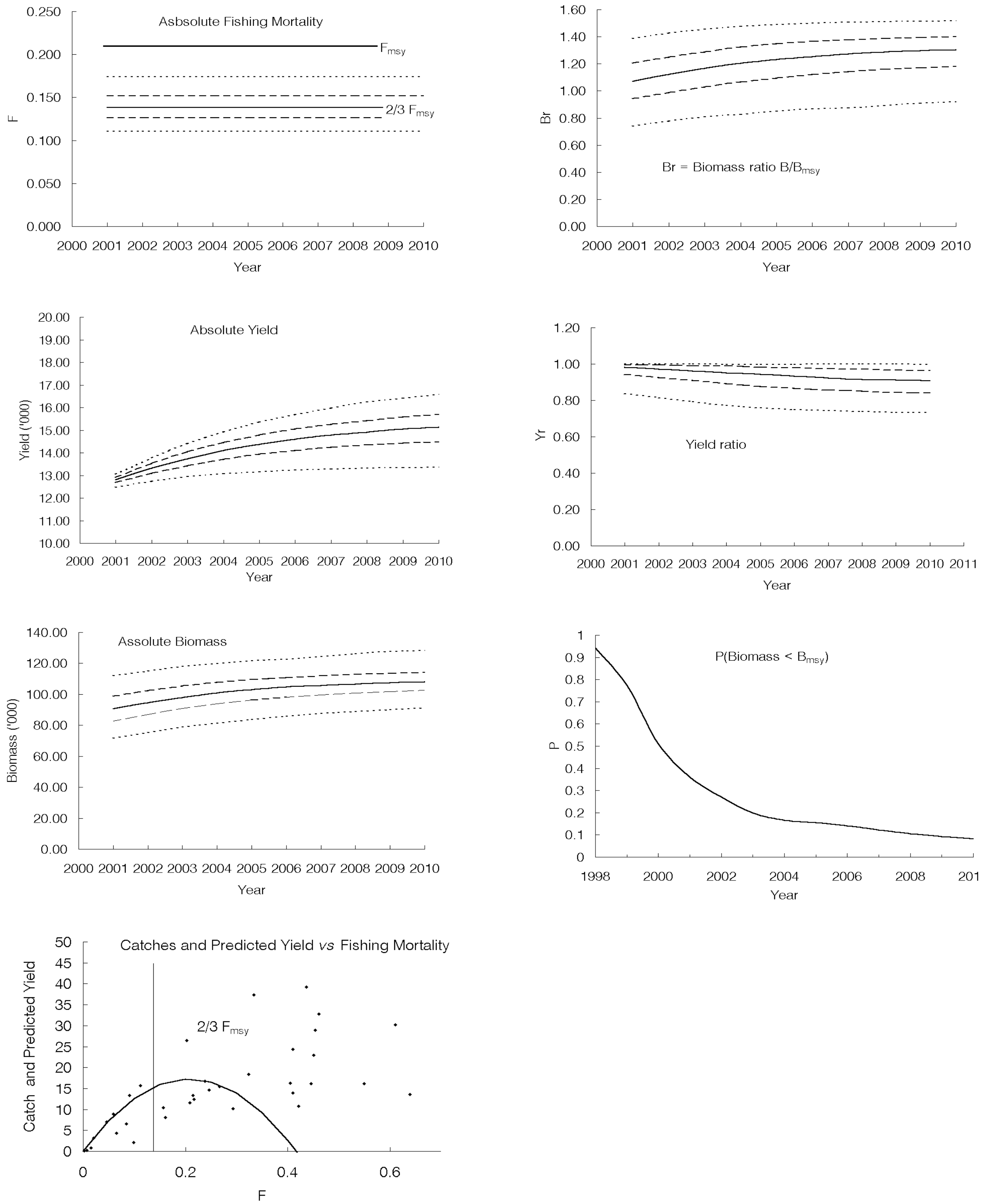


Fig. 12.11. Yellowtail flounder in Div. 3LNO: medium term projections at a constant fishing mortality of 0.66 F_{msy}. The figures show the 5, 25, 50, 75 and 95th percentiles of fishing mortality, yield, potential yield/MSY, biomass and biomass/B_{msy}. The probability of biomass being less than B_{msy} is also given. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 11 000 tons in 2000.

e) **Reference Points**

Stock-recruitment relationships (SCR Doc. 00/45). There is no apparent stock recruitment relationship evident for this stock using a length based SSB derived from Canadian spring surveys (1984-99) and cohort strength of ages 3 and 4 from Canadian spring and autumn (1990-99) surveys (Fig. 12.12).

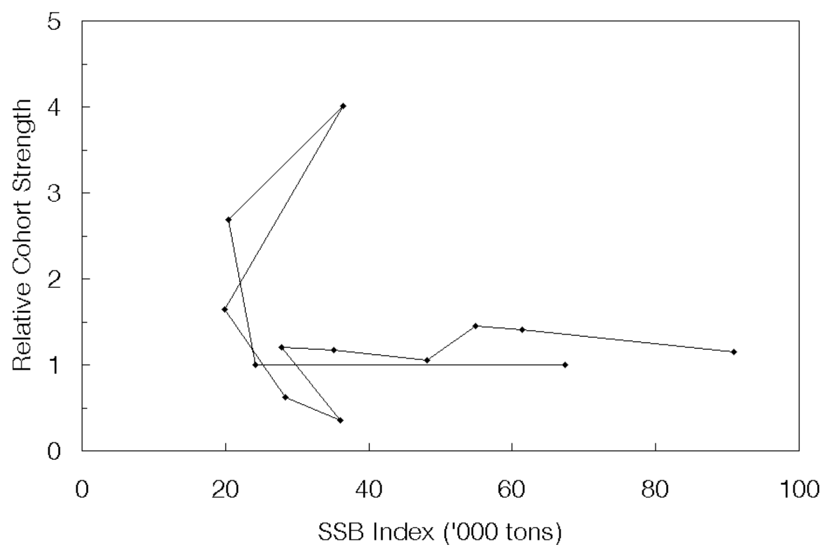


Fig. 12.12. Yellowtail flounder in Div. 3LNO: stock/recruitment plot.

Precautionary approach. The stock trajectory estimated in the surplus production analysis is depicted in Fig. 12.13 against proposed harvest control rule. Also illustrated is the trajectory of a projection based on a scenario of *status quo* fishing mortality, together with the confidence intervals of the relative fishing mortality and relative biomass at the end of 2001.

In this framework, the precautionary reference points were defined as follows. The limit fishing mortality, F_{lim}, was taken as F_{msy}. The limit biomass reference point was taken as the estimate of the biomass when the fishery was closed, as concerns with the biomass level (estimated with 1993 data) were key considerations in the 1994 discussions leading to the moratorium. It is noted that at that level of biomass, the stock responded rapidly to the reduction of fishing pressure. The fishing mortality target was taken as 2/3 F_{msy}, which represents the reference point typically requested by managers when production models are used. No target has been determined by managers for biomass and B_{msy} is used here, as an interim value, as the biomass target. Rather than provide buffer reference points, it is proposed to use risk analyses to make annual evaluations of the risk of passing limit reference points.

The management measure in place in recent years, which included moratorium on directed fisheries (1995, 1996 and 1997) and TACs based on a fishing mortality much below the 2/3 F_{msy} target, have led to a rapid increase of the stock so that the biomass is now estimated to be above B_{msy}. The harvest control rule described here captures many of the strategies that have governed the management of yellowtail flounder in recent years. In hindsight, such strategies appear to have been instrumental in rebuilding this stock. The formal adoption of such a framework as a working model would help to cast future management strategies in the perspective of such a precautionary approach.

STACFIS **noted** that annual risk analyses would allow separating the uncertainties attached with the recent estimates of stock abundance and fishing mortality from those associated with the estimates of the limits, i.e. buffer reference points. Also, harvest control rules using the reference points identified here as trigger points need to be tested through simulations. STACFIS **recommended** that *more work is needed on the* *precautionary framework and how the implementation would work when projections are based on risk analyses done annually and these aspects be investigated further in future assessments of yellowtail flounder in Div. 3LNO.*

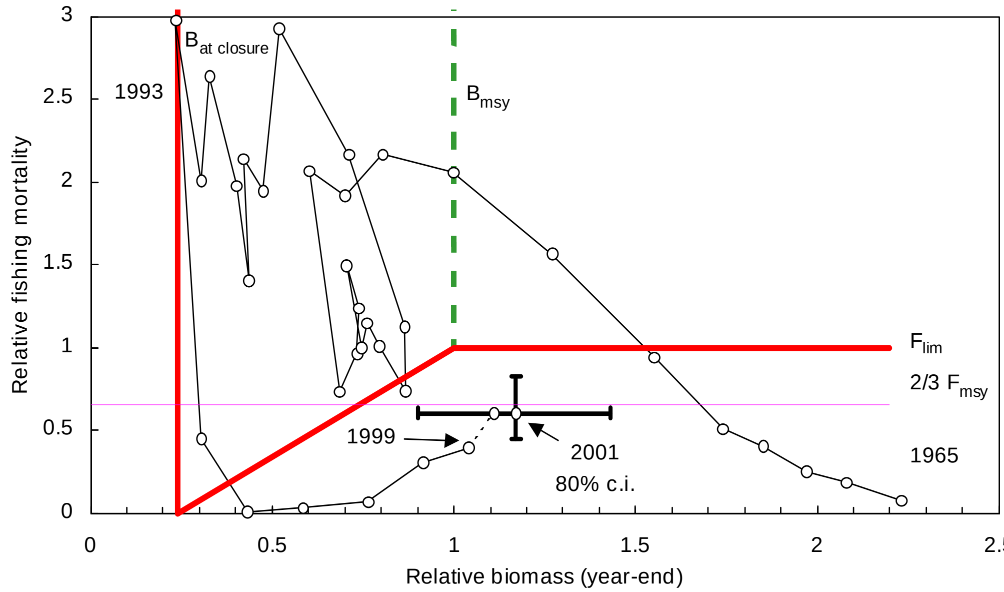


Fig. 12.13. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in the surplus production analysis under precautionary approach framework.

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 3N and 3O (SCR Doc. 00/14, 46; SCS Doc. 00/9, 16)

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. 13.1). With increased effort, mainly by EU-Spain and EU-Portugal, catches rose rapidly to 8 800 and 9 100 tons in 1985 and 1986, 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:

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	5	5	5	3[1]	ndf	ndf	ndf	ndf	ndf	ndf
Catch	5	5	4	1[2]	0.3[2]	0.3[2]	0.5[2]	0.6[2]	0.8[2]	

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

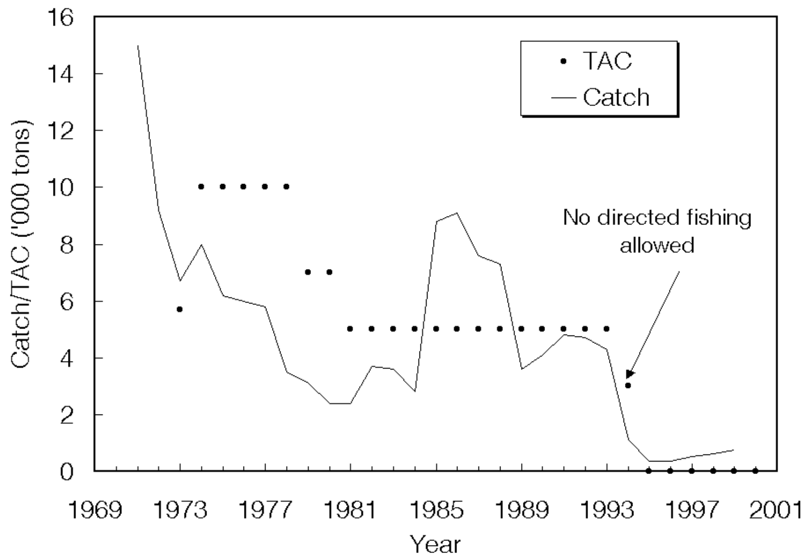


Fig. 13.1. Witch flounder in Div. 3NO: catches and TACs.

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 1997-99 catch estimates ranging from 500-800.

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 little or no catch 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**

Length frequency data from both EU-Portugal (SCS Doc. 00/16) and Russia (SCS Doc. 00/9) indicate a range of lengths from about 28-56 cm with a mode at 36-38 cm.

ii) **Research survey data**

Biomass estimates. Biomass estimates from Canadian converted spring surveys (SCR Doc. 00/14) in Div. 3N have been at very low levels during 1984-99 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 1991-99 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 in the time series (Fig. 13.2). The apparent increase in the 1999 survey is believed to be related to a distribution shift similar to those observed in some earlier years creating spikes in the index. In the context of those previous years, the estimate for 1999 remains low. Canadian autumn surveys from 1990-99 showed little or no trend during this period.

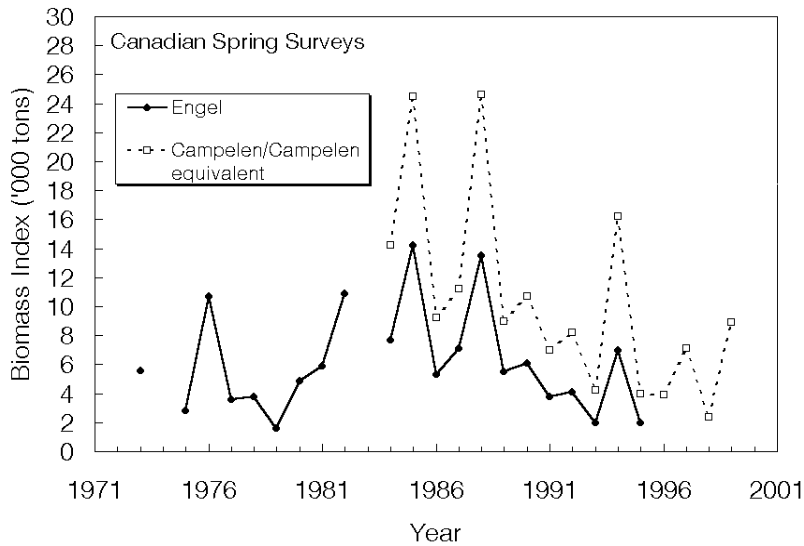


Fig. 13.2. Witch flounder in Div. 3NO: estimates of biomass.

Annual surveys have been conducted by EU-Spain in May since 1995 in the Regulatory Area of Div. 3NO (SCR Doc. 00/46). This is a relatively small part of the witch flounder stock area. The survey was extended from a maximum depth of 730 m in 1995 to 1 100 m in 1996 and 1 400 in 1997-2000. Given the stability in the size composition for these years and the unexplained increases in biomass indices for other species, STACFIS believed there were strong year effects in this survey series such that the observed increases are unlikely to be the result of a change in resource status.

c) **Assessment Results**

Based on the most recent data, STACFIS considers that the overall stock remains at a low level.

d) **Recommendations**

STACFIS found it difficult to fully evaluate the trends in the annual EU-Spain survey series in the Regulatory Area of Div. 3NO without the details of the entire time series. STACFIS **recommended** that *for future meetings the data for witch flounder in Div. 3NO be provided in detail for the entire time series in similar format as in the report of the EU survey series in Div. 3M* (SCR Doc. 00/9).

14. **Capelin (*Mallotus villosus*) in Divisions 3N and 3O** (SCS Doc.00/21)

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 2000 (Fig. 14.1).

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Advised TAC	30	30	ndf	ndf	ndf	ndf	na	na	na	na
TAC	30	30	0	0	0	0	0	0	0	0
Catch	+	+	+	0[1]	0[1]	0[1]	0[1]	0[1]	0[1]	

[1] Provisional.
ndf No directed fishery.
na No advice possible.

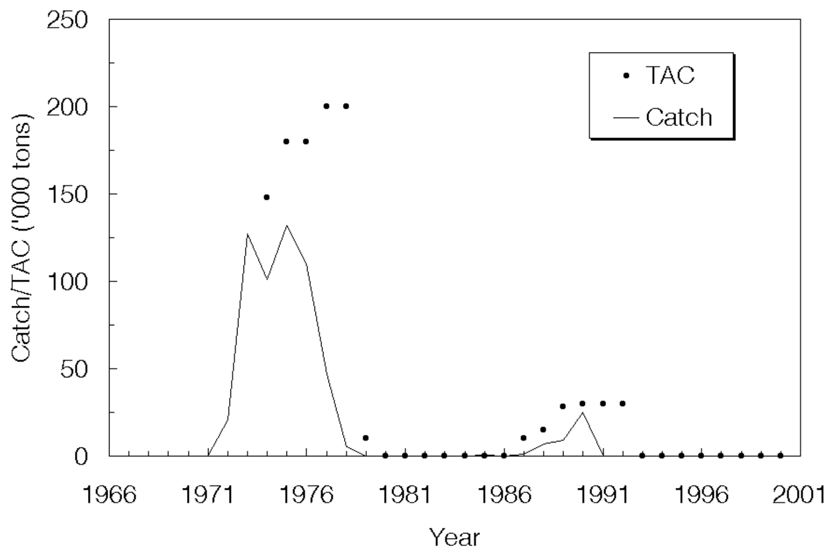


Fig. 14.1. Capelin in Div. 3N and 3O: catches and TACs.

b) **Input Data**

Input data are limited to historic series of USSR/Russia trawl-acoustic survey results conducted in 1975-94. The mean acoustic estimate of capelin biomass was 900 000 tons during 1975-77. During 1981-88 the mean estimate was only 300 000 tons. The biomass estimate from the 1994 Russian survey was only 83 000 tons which represented an approximate 50% reduction from the 1993 estimate. No surveys were conducted by Russia since 1994.

STACFIS has no data on Div. 3NO capelin on which the current status of that stock can be evaluated. There was information about new "a multidisciplinary pelagic juvenile fish survey on the Grand Bank conducted to provide pre-recruit indices for ages 0, 1 and 2 year old capelin" presented in SCS Doc. 00/21.

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 compiled and reviewed 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 ecosystem was recognized. Early quotas were based on surplus production estimates after predation 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 prey 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 neither surveys nor fishery directed to capelin in the Div. 3NO. In the absence of information it is not possible to evaluate the status of the 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.

STACFIS **recommended** that *all data available related to capelin Div. 3NO stock be compiled for the June 2001 Scientific Council Meeting.*

D. WIDELY DISTRIBUTED STOCKS

15. Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3 (SCR Doc. 00/9, 30, 39; SCS Doc. 00/9, 16, 20)

a) **Introduction**

i) **Description of the fisheries**

It has been recognised that a substantial part of the recent grenadier catches in Subarea 3, previously reported as roundnose grenadier correspond to roughhead grenadier. The misreporting has not yet been resolved in the official statistics before 1996, but the species are reported correctly since 1997. Roughhead grenadier is taken as by-catch in the Greenland halibut fishery, mainly in Div. 3LMN Regulatory Area (Fig. 15.1).

The revised catches ('000 tons) since 1991 (updated with 1998 and 1999 catches) are as follow:

	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]
Catch	4.3	6.7	4.4	4.0	3.9	4.1	4.7	7.2	7.2

[1] Provisional.

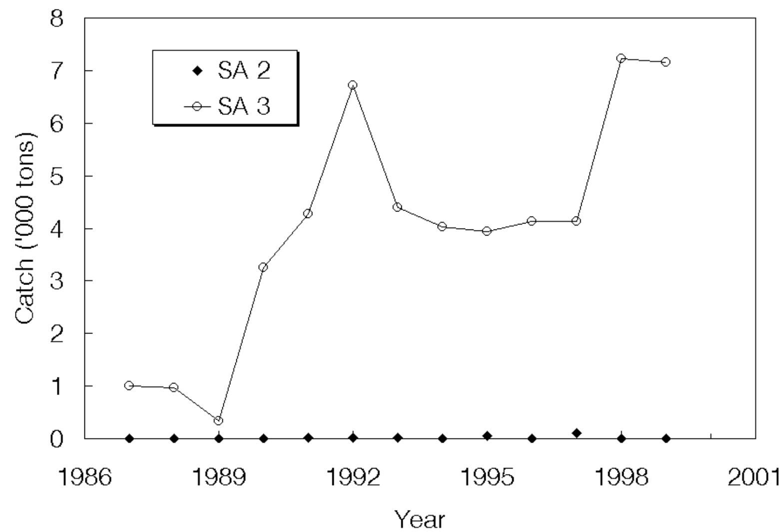


Fig. 15.1. Roughhead grenadier in Subareas 2+3: catches in Subarea 2 and Div. 3LMNO.

b) **Input Data**

i) **Commercial fishery data**

Length frequencies from the Spanish, Russian and Portuguese trawl catches in Div. 3LMNO are available since 1995 (SCS Doc. 00/9, 16, 20). In the commercial fishery, especially in Div. 3L, the proportion of females was higher than that of males, and females attain larger lengths. Catch-at-age data from the total catches in Div. 3LMNO are available since 1997.

ii) **Research survey data**

Canadian autumn surveys. Stratified random bottom trawl surveys have been conducted in Div. 2GHJ and Div. 3KL in autumn since 1978. Since 1990 the survey also covered Div. 3NO. Until 1994 an Engel trawl was used but this has been changed since then to a Campelen 1800. Survey depth was up to 1 000 m in Div. 2GHJ and 3K and to 730 m in Div. 3LNO and was extended to 1 463 m after 1995.

The roughhead grenadier biomass indices from this series of surveys are not directly comparable because of the change in the survey gear and variations in the depth coverage. However, the survey provides information on the stock distribution. It seems that the main part of the stock shifted from the northern Divisions (Div. 2GJ and Div. 3K) to the southern ones (Div. 3LN) and to greater depths (beyond 1 000 m.) since the early-1990s. At present, most of the survey biomass is caught in Div. 3L. In Fig. 15.2 are presented the biomass indices for the period 1996-99.

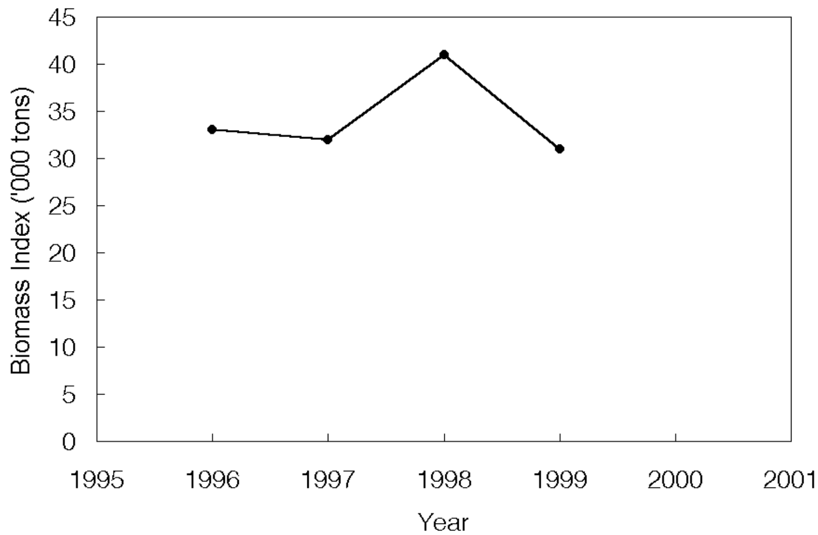


Fig. 15.2. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian autumn surveys.

Canadian spring surveys. Stratified random bottom trawl surveys have been conducted in Div. 3L and Div. 3N in spring since 1971. Until 1995 an Engel trawl was used but this was changed to a Campelen 1800 since then. The depth range of the surveys is up to 730 m. Again in this case a direct comparison of the biomass levels through the whole time series is not possible because of the changes in the survey gear. Biomass estimates from the spring survey series are considerably lower than the ones obtained in the autumn series. The first surveys cover only the southern Divisions and the shallower depths, where according to the other results this species is less abundant. Presently the main part of the stock could be distributed beyond 1 000 m depth, especially in the southern Divisions. The biomass indices for the period 1996-99 are presented in Fig. 15.3.

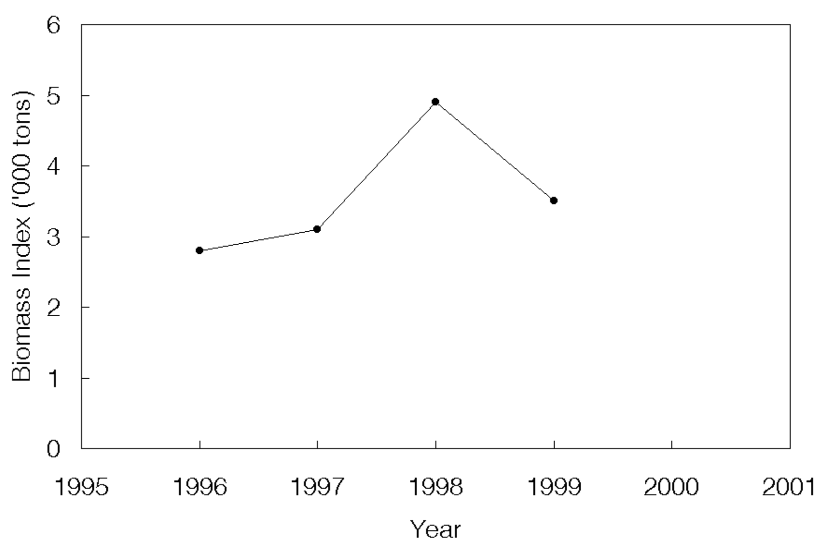


Fig. 15.3. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

Canadian deepwater surveys. Stratified deepwater bottom trawl surveys (750-1 500 m) in 1991, 1994 and in 1995 in Div. 3KLMN was carried out. The biomass estimates increased from 16 215 tons. in 1991 to 46 668 tons in 1995. Most of the biomass was taken in Div. 3L and Div. 3M, at depths beyond 1 000 m. However the increase could be related in part to the increased survey coverage.

Spanish spring survey. A stratified bottom trawl survey has been conducted since 1995 in Div. 3NO Regulatory Area (00/46). The depth range of this survey progressively increased every year, and a parallel increase in the biomass estimates was observed up to 1998. Those were 4 842 tons in 1996, 19 615 tons in 1997, 50 843 tons in 1998 and then it decreased to 25 589 tons in 1999. Biomass estimates were highest at depths beyond 500 m in every year.

EU (Spain-Portugal) longline deepwater survey. A deepwater longline survey was conducted 1995 in Div. 3LMN, at depths between 562 and 3 028 m. This survey does not provide a quantitative biomass index for roughhead grenadier, but gives information on the species bathymetric distribution. Roughhead grenadier was the most abundant species, accounting for 32% of the total catch. This species occurred mostly beyond 1 000 m, with maximum yields between 1 000-1 599 m. Below 2 000 m, roughhead grenadier became progressively less abundant and disappeared completely at 2 200 m, where they were replaced by another Macrouridae species (*Nematonurus armatus*).

EU (Spain and Portugal) summer survey. Stratified bottom trawl surveys in Div. 3M, up to depths of 730 m, have been carried out since 1988. The roughhead grenadier biomass indices from this survey series are presented in Fig. 15.4. Significant biomass was only found at depths beyond 500 m every year, although this survey does not cover the whole depth range of this species.

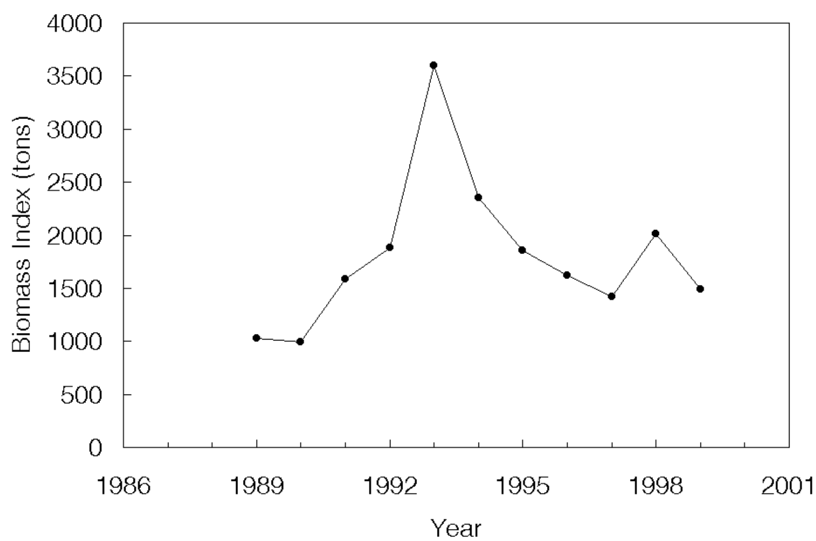


Fig. 15.4. Roughhead grenadier in Subareas 2+3: biomass indices from the EU- summer survey in Div. 3M.

iii) **Biological studies**

A paper was presented providing information on age structure in Div. 3M based on results from the EU-summer survey series. Age and length composition of the catches showed clear differences between sexes. The proportion of males in the catches decreased progressively as length increased. The bulk of the catches was composed of ages 7-9. The oldest male found was 15 years and the oldest female 18. The catches were dominated by the 1990 year-class.

c) **Assessment Results**

The state of the stock is not known.

Based on commercial catch-at-age data, full recruitment to the fishery occurs at age 8, and a catch curve analysis gives a total mortality estimate of 0.41. Estimates of Z by sex for a synthetic catch curve for the pair-trawl fleet catches in 1999 are provided. Z for males was 0.9, while that for females was 0.5. The catch / biomass (C/B) index obtained using the Canadian autumn survey data is at the same level as last year (C/B_{1999}= 0.27).

No decrease in the mean lengths have been observed since 1995. The available time series of catches at age is too short to analyse trends in the SSB, however it can be noted that only a 18%, 10% and 18% of the 1997, 1998 and 1999 catches, respectively, were above the female age at maturity (15 years). Information is scarce to assess an appropriate exploitation level.

d) **Reference Points**

STACFIS is not in the position to provide references points at this time.

16. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO** (SCR Doc. 00/6, 9, 12, 17, 24, 43, 46; SCS Doc. 00/9, 16, 19, 20)

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. 16.1). 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 from 1996-98 has been around 20 000 tons per year, with an increase to 24 000 tons in 1999. The major participants in the fishery in the Regulatory Area in 1999 were EU-Spain (9 000 tons), EU-Portugal (4 000 tons), Russia (3 100 tons) and Japan (2 400 tons). In both 1998 and 1999 more than half the total catch came from Div. 3L (SCR Doc. 00/43).

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 (SCR Doc. 00/43). Canadian catches ranged from 8 200 to 13 500 tons from 1985-91, then declined to between 2 300 and 6 200 tons per year from 1995 to 1999, with most of the Canadian catch in recent years taken by gillnets. Otter trawl catches by Canada were negligible in 1998 and 1999, down from around 1 000 tons in 1996 and 1997.

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC[1]	50	50	50	25	27	27	27	27	33	35
Catch[2]	55-75	63	42-62	51[3]	15[3]	19[3]	20[3]	20[3]	24[3]	

[1] Set autonomously by Canada 1985-94 and by the Fisheries Commission in 1995 to 2000.
[2] Includes estimated unreported catches in 1991-96.
[3] Provisional.

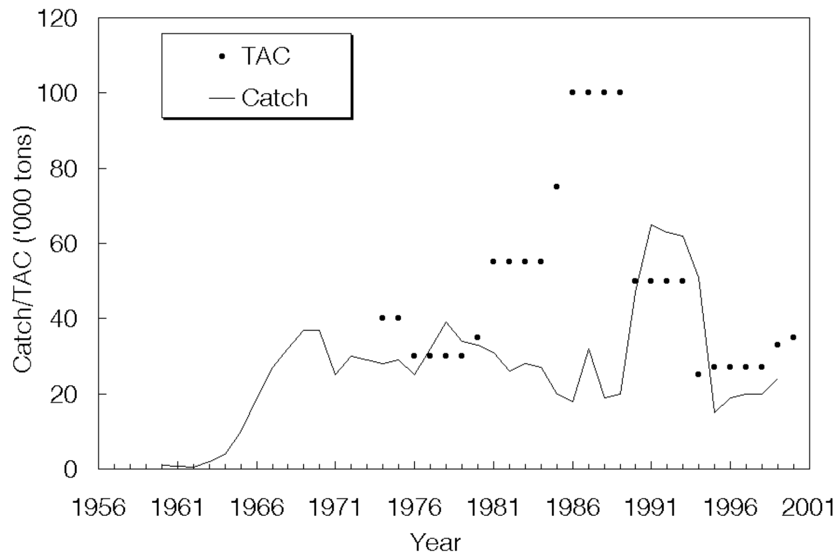


Fig. 16.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch and effort. Analyses of otter trawl catch rates from many fleets, but mostly from Canadian vessels, using both hours fished and days fished indicated a declining trend since about the mid-1980s, stabilizing at a low level during the mid-1990s. The standardized catch rate increased slightly from 1997-99 in the hours fished analysis but remained flat in the days fished analysis. Data available from recent years were very limited and in 1998 and 1999 comprised only a few Canadian observations (SCR Doc. 99/38).

Catch-rates of Portuguese otter trawlers fishing in the NAFO Regulatory Area (NRA) of Div. 3LMN from 1988-99 declined sharply from 1989 to 1991, and remained around this low level until 1994 (SCS Doc. 00/16. CPUE has gradually increased since then, and in 1999 it was almost double the low values in 1991-94, but still below the CPUE in 1988-90. Directed effort on Greenland halibut was present in Div. 3L in all years from 1988-99, in Div. 3N since 1990 but only since 1995 in 3M.

Catch-at-age and mean weights-at-age. Due to the uncertainty regarding catch information on fisheries in the NRA, as well as the lack of adequate sampling data for some fleets in some years, catch-at-age data for this stock have been incomplete since 1988. However, there are substantial amounts of length and age data available for many fleets and years. The Canadian catch-at-age for 1998 was also unavailable at last year's meeting. STACFIS had recommended, therefore, that the 1998 and 1999 Canadian catch-at-age should be calculated, and that the total international catch-at-age for years after 1988 should be compiled, allowing exploration of age based analytical assessments.

At the current meeting the Canadian catch-at-age for 1998-99 were provided as calculated in the usual fashion (SCR Doc. 00/43). In addition, the total international catch-at-age from 1989-99 was calculated and presented to STACFIS. These calculations were carried out by applying Canadian annual commercial age-length keys to length frequency data provided in national research reports by countries fishing the NRA (SCR Doc. 00/43). The resultant age compositions were then adjusted to the agreed best estimates of total catch. The mean weights-at-age (kg) were computed by applying a standard length-weight relationship to the mean lengths-at-age (cm) from the adjusted age-length keys.

Ages 6-8 dominated the catch throughout the entire time period with ages 12+ contributing about 10-15% on average to the catch biomass. Mean weights (kg) show peculiar patterns in the earliest period likely due to poor sampling and lack of individual weights. Mean weights-at-age for age groups 5-9 during the recent period are relatively stable. For older fish they are rather variable but with little appreciable trend (SCR Doc. 00/43).

ii) **Research survey data**

STACFIS reiterated that most research vessel survey series providing information on the abundance of Greenland halibut were deficient in various ways and to varying degrees. Lack of divisional and depth coverage creates problems in the comparability of results from different years. However, in the autumn of 1996-99 the Canadian survey included all Divisions in the geographical range of the Greenland halibut stock in Subarea 2 and Div. 3KLMNO. Nevertheless, the extent of coverage varied from year to year in all Divisions except for Div. 2H, 2J and 3K (SCR Doc. 00/12). During 1995, a new survey trawl (Campelen 1800 shrimp trawl) was introduced to the Canadian survey series. Conversions from the old trawl (Engel 145) to Campelen equivalents have been used for the data in Subarea 2 and Div. 3K, from 1978 to 1994, as described in previous STACFIS reports.

Canadian stratified-random surveys in Div. 2G and 2H (SCR Doc. 00/12). The biomass index for Div. 2G declined by nearly half from an average of about 50 000 tons during 1978, 1979 and 1981 to 23 000 tons during 1987-88. It further declined by another 50% to an average of 13 000 tons during 1996-99. The 1999 value of 10 000 tons is among the lowest observed despite one of the more complete years of survey coverage. A similar but less severe trend was experienced in Div. 2H. The biomass index declined from an average of about 52 000 tons (excluding 1979 which was considered to be anomously high) during 1978-81 to around 40 000 tons in 1987-88 and 34 000 tons during 1996-99. There are so many years throughout the series that have no surveys, that it is difficult to determine when the various declining trends actually began.

The 1994 and 1995 year-classes were predominant in Div. 2GH combined during 1996-99, however, the 1999 survey was dominated by the 1997 and 1998 year-classes. The age composition in both Divisions in 1996-99 was comprised primarily of small fish, with ages 1-4 being the most abundant in catches.

Canadian stratified-random surveys in Div. 2J and 3K (SCR Doc. 00/12, 43) (Fig. 16.2). These surveys are conducted in the autumn (Oct-Dec). Length-weight relationships were applied to estimate biomass for this survey series, from abundance at length estimates.

In Div. 2J the biomass index was relatively stable from 1978-84 at an average level of about 115 000 tons. It then began to decline to reach an all time low in 1992 at about 18 000 tons and only increased marginally until 1995 after which it began to increase more rapidly. By 1999 it had reached a level of around 87 000 tons, the highest since 1986. In Div. 3K there was a rather long period of apparent stability from 1978-89 at an average annual biomass estimate of 130 000 tons. It then declined to a low of 44 000 tons in 1992 with an average of 63 000 tons between 1991-94. After 1994 the biomass index increased rather rapidly and steadily until by 1999 it reached an estimate of 176 000 tons, the highest in the time series. Since the 1995 to 1999 surveys were conducted with the new survey trawl, these increases were not artifacts of converted values.

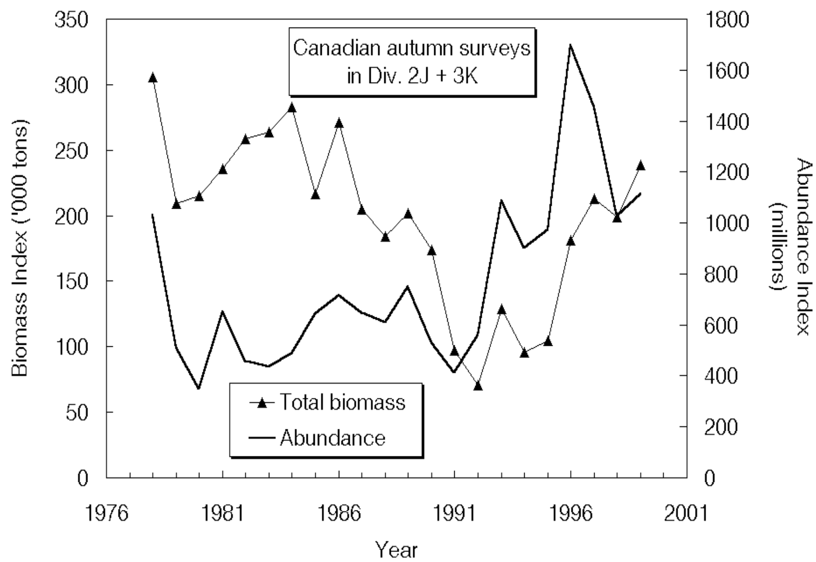


Fig. 16.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: estimates of biomass and abundance from Canadian surveys.

Biomass of fish greater than 35 cm was lowest in 1994, and increased steadily since then, with the 1999 value about two-thirds of peak values in 1983-84 (SCR Doc. 00/12). During the late-1970s and early-1980s Greenland halibut greater than 60 cm contributed about 20% to the estimated biomass. However, after 1984 this size category declined to the point that by 1992 virtually no Greenland halibut in this size range contributed to the estimates of stock biomass (Fig.16.3). Although there has been some slight improvement since 1995, the contribution to stock biomass from this size group remains extremely low (SCR Doc. 00/12).

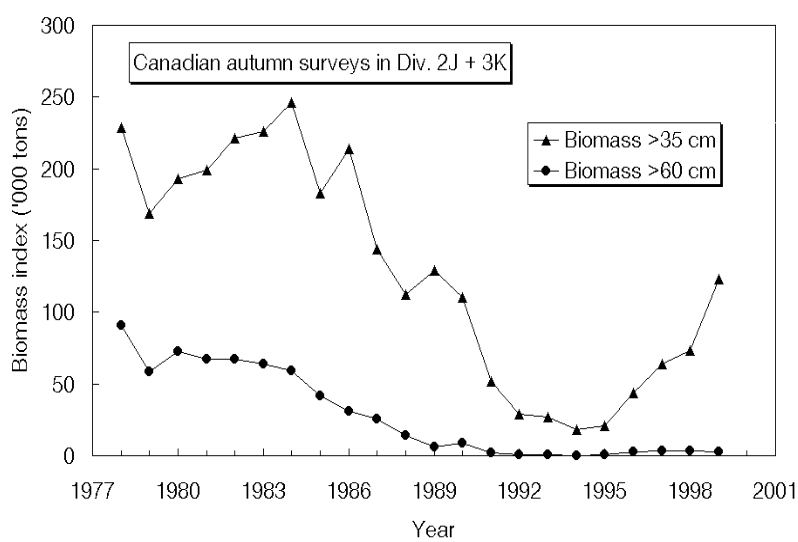


Fig. 16.3 Greenland halibut in Subarea 2 + Div. 3KLMNO: estimates of biomass >35 cm and >60 cm from Canadian surveys.

An examination of the age structure indicated that the ages 6+ abundance declined by over 80% from the peak values of the mid-1980s to the lowest point observed in 1994. Abundance increased steadily at these ages from 1994 to 1997 and stabilized in 1998. The 1999 value was about double the 1997 and 1998 estimates. Ages 10+ declined from the early-1980s to very low levels in 1994-95 when they virtually disappeared from the surveys. There has been a slight increase since then, but abundance at ages 10+ in 1996 to 1999 was still less than 10% of the estimates in the early-1980s. On the other hand, the abundance index of ages 3-5 slowly increased from the early-1980s to about 1989. The index for ages 3-5 generally remained above the long-term average since 1989 and reached a maximum in 1993. The index remained relatively high in 1996-99.

Estimates of total mortality (for the major commercial age groups 5-9) from the survey data indicate a general increase to very high levels in the early-1990s as catches from the stock increased sharply. Mortality values declined afterwards as catches declined substantially (SCR Doc. 00/43).

Canadian stratified-random surveys in Div. 3LMNO (SCR Doc. 00/12). As part of the annual Canadian autumn survey (September to December), coverage in 1996-98 was extended to Div. 3M (only Flemish Pass and Sackville Spur, deeper than 731 m in 1997-99), as well as to strata in Div. 3NO deeper than 731 m. However, coverage of the deep water in the southern areas, particularly Div. 3O, was not as extensive as further north. Biomass estimated in Div. 3LMNO increased from 53 000 tons in 1996 to 84 000 tons in 1998 then declined to 41 000 in 1999. Survey coverage was most complete in 1998 especially the deep water. Unlike the situation in Subarea 2 and Div. 3K, there were few Greenland halibut younger than age 4 observed. Overall, biomass in Div. 3LMNO comprised about 25% of the total biomass estimated from the Canadian autumn surveys in 1998, although deep strata in Div. 2G and 3O were not fully surveyed. This compares to about 19% in 1996-97 and 12% in 1999, when deepwater coverage in Div. 3NO was not as extensive as in 1998.

Summary of Canadian synoptic surveys, SA2 + Div. 3KLMNO, 1996-99. The biomass from all Divisions combined increased from 286 000 tons in 1996 to about 331 000 tons in each of 1997 and 1998 and 345 000 tons in 1999. Abundance estimates declined from about 2.3 billion fish in 1996, to 2.0 billion in 1997, and 1.4 billion in both 1998 and 1999. This was due to the natural decline in the numbers of the abundant 1994 and 1995 year-classes. Estimated abundance of fish aged 5+ increased steadily over this period, from 170 million in 1996 to 393 million in 1999, as the 1992-1994 year-classes entered this age range.

EU stratified-random surveys in Div. 3M (SCR Doc. 00/9). 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 24 000 tons in 1998, which was slightly more than double the 1996 estimate. The biomass declined to about 21 000 tons according to the 1999 survey. The age composition data indicated that the abundance in 1997 and 1998 was dominated by ages 3-7, compared to ages 4-7 in the 1999 survey indicating that an increase in recruitment was mainly responsible for the increase in biomass. The 1993, 1994 and 1995 year-classes were represented by high values at all ages thus far. Few fish older than age 10 were encountered in any of these surveys, probably because no depths greater than 730 m were fished.

Spanish stratified-random surveys in Div. 3NO Regulatory Area (SCR Doc. 00/46). During April-May of 1995 to 2000, 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 1998-2000. The estimated biomass (comparable strata from 1996-99 only) increased from about 35 000 tons in 1996 to 85 000 tons in 1998, then declined to about 45 000 tons in 2000. The total biomass estimated including the deep strata not surveyed previously, declined from 148 000 tons in 1998 to 101 000 tons in 2000. In 2000, the size composition was dominated by fish in the 36 to 46 cm range, with a peak at 40-42 cm. Few fish above 60 cm were caught, consistent with previous surveys.

iii) **Recruitment indices**

In past 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, along with the 1992 year-class, were predominant in virtually all fisheries throughout the Regulatory Area in 1996-98. In Subarea 2 and Div. 3K, the 1990 year-class was predominant in commercial catches in 1997.

Surveys in Div. 2J and 3K prior to 1996 suggested that the 1992 and 1993 year-classes were above average abundance. However, the 1996-98 surveys in these areas suggest that these year-classes appear to be average or below average. A regression analysis, presented at the 1999 STACFIS meeting, of cohort size at age 6 from surveys in Div. 2J and 3K against cohort size at age 3 from the same survey series was not significant. This supported the hypothesis that Greenland halibut may move out of Div. 2J and 3K, as they grow older, making it difficult to predict how year-classes will contribute to the fishable stock.

Recent Canadian surveys in Div. 2J and 3K and EU surveys in Div. 3M estimated the 1994 and 1995 year-classes to be the largest observed. The 1995 year-class was also strong in the 1998-99 surveys of Div. 3NO (NRA) by EU-Spain, based on length frequency data. However, this year-class did not appear to be as strong at age 3 and 4 in the Canadian surveys (all Divisions combined) in 1998 and 1999 as it did at ages 1 and 2. Its size in 1998 and 1999 appears similar to that estimated for the 1993 year-class at the same ages. Available survey data suggest that the 1996-98 year-classes are not as strong as those of 1993-95 and may be average to below average.

For the Canadian surveys, STACFIS again cautioned that comparisons of year-class strengths in the 1995-99 surveys with data prior to 1995 are very sensitive to the length conversion factors for small fish between the two survey series. Confidence in the estimates of year-class strength will increase as more years of Campelen survey data accumulate, and they can be confirmed by their contributions to the commercial fishery at younger ages.

c) **Biological Studies**

Estimates of maturity of Greenland halibut from Canadian autumn surveys in SA 2 + Div. 3KLMNO in 1996-99 were examined (SCR Doc. 00/6). Both sexes showed considerable interannual variability in most areas, with Div. 2GH giving the most consistent results among years. There were numerous cases (Division within a year) where there was not a significant fit of the model to the data. There was no consistent north to south relationship among the maturity estimates for either sex. Combining all Divisions, females showed a greater degree of variability among years than males. For females, L_{50} ranged from 74.1 cm in 1996 to 81.7 cm in 1998 and for males from 57.4 cm in 1999 to 61.4 cm in 1998. For females, A_{50} ranged from 12.0 years to 13.3 years, and for males A_{50} ranged from 8.8 years in 1999 to 10.2 years in 1997. Given the lack of trend in the data from Div. 2J3K, and considering that this species may have unusual maturity and spawning cycles, applying annual ogives to the 1996-2000 data, and an average maturity ogive from the 1996-2000 synoptic surveys to the historic time series may not be unreasonable.

Spawning fish were observed in all areas except Div. 3NO consistent with other studies. The presence of spawning fish throughout the area raises the possibility that a number of spawning components exist. This would heighten concern about the distribution of catch as spawning components could be eliminated (SCR Doc. 00/6).

d) **Assessment Methodologies**

An approach to evaluating fish stock dynamics when only partial catch-at-age data are available was presented in SCR Doc. 00/17. This approach was not in the event needed for advisory purposes in this case because a calculation of the complete catch-at-age matrix was provided. The method may however be useful for other stocks where only incomplete information is available.

For the first time since 1989 a complete catch-at-age matrix from the commercial fishery was available from 1975-99. Using fishery independent abundance indices i.e. the Canadian autumn surveys in Div. 2J and 3K from 1978-99 and the EU survey in Div. 3M from 1991-99 for calibration, several age-structured models were engaged to determine the current population abundance at age. STACFIS reviewed the results of three sequential population approaches, XSA, QLSPA and ADAPT (2 formulations)(SCR Doc. 00/53, 54).

e) **Assessment Results**

Based on the results of the three approaches, the resource has been increasing since the mid-1990s. This trend is consistent with the Canadian and EU surveys and is the result of better than average recruitment during the first half of the 1990s. However, the overall historical trajectory of the resource, as indicated in all three analyses, suggested that the current stock size is the largest in the time period from 1975 to the present. This did not fit the trend as suggested by the longest series of research data, those for Div. 2J and 3K (Fig. 16.4), nor did it fit overall perceptions of this resource over time.

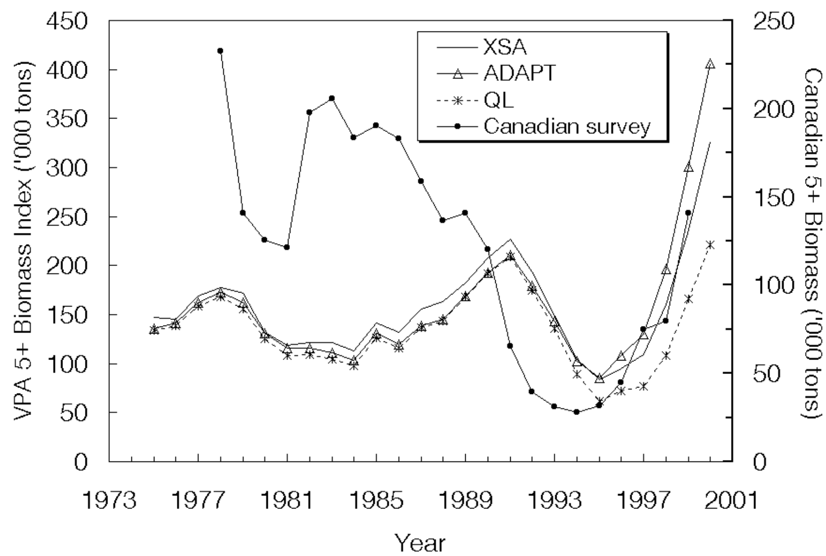


Fig. 16.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: comparison between the age 5+ biomass index from the Canadian surveys and the age 5+ biomass obtained from virtual population analyses (VPA) based on the ADAPT framework, the Quasi-likelihood method and the Extended Survivor Analysis (XSA).

An additional analysis that allowed for changes in natural mortality that could account for other changes such as movement in to or out of the core Div. 2J, 3K survey area was also reviewed. The results indicated a similar trend in recent estimates of stock size but a very different historical trajectory, one that was more in line with the Div. 2J, 3K survey results (Fig. 16.5).

STACFIS accepted the general upward trend apparent in the results of all approaches for the most recent years (since 1995) but believed that further work is necessary to capture the dynamics of the resource in earlier years. In particular, STACFIS **recommended** that *for Greenland halibut in Div. 2J and 3K, further analyses be carried out in order to investigate the possibility of changes in natural mortality (including sexual differences) or resource distribution inside and outside the Div. 2J and 3K area in order to enable better definition of the history of the stock size*.

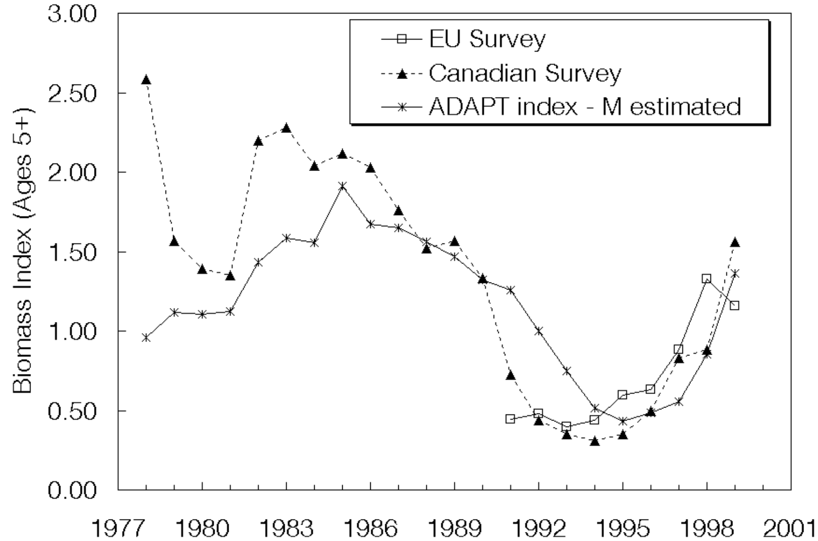


Fig. 16.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: comparison between the age 5+ biomass index from the EU and Canadian surveys and the age 5+ biomass (scaled) obtained from an ADAPT analysis treating natural mortality as a parameter for older ages (9 and over).

The various estimation procedures led to biomass estimates for year 2000 that covered a wide range of values and methods that produced high estimates of biomass and also produced low estimates of fishing mortality for 1999. While the levels of fishing mortality implied from these analyses were different, all methods indicated a fishing mortality level for 1999 that was relatively low in comparison to the early-1990s (Fig. 16.6).

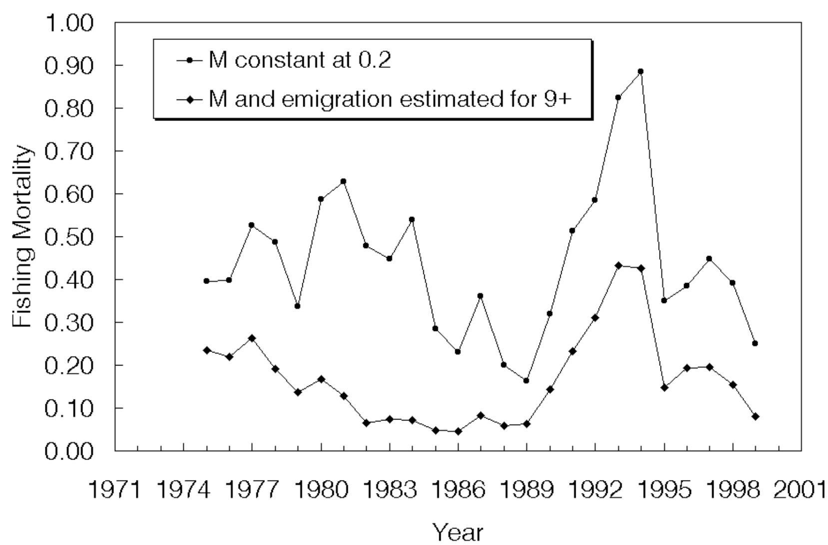


Fig. 16.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: fishing mortality (ages 6-9) trends estimated from VPA formulations using different assumptions for natural mortality.

As the dynamics of the underlying population model are still uncertain, it is not possible to determine which method provides the best absolute estimate of biomass. Accordingly, projections were made under scenarios of *status quo* fishing mortality, instead of scenarios using traditional reference points. As all approaches gave similar results (within 10%) for *status quo* projections, only the XSA results are presented here.

All analyses suggested that the strength of pre-fishery recruits of the early-1990s has been greater than their apparent strength based on their catch in the fishery. Therefore, for projections, the year-classes of the first half of the 1990s were set at a more conservative level defined as the average of the XSA estimates and the long-term geometric mean. Trends in exploitable (ages 5+) and spawning stock biomass (represented by ages 10+), and the corresponding confidence intervals, are given in and Fig. 16.7 with the input parameters shown in Table 16.1.

Table 16.1. Greenland halibut in Div. 2J and 3K: short- and medium-term predictions input data.

Age	N	Catch Wt. (kg)	Stock Wt. (kg)	M	PR
1	154 560	0.030	0.000	0.2	0.000
2	129 140	0.145	0.000	0.2	0.000
3	115 557	0.176	0.000	0.2	0.000
4	112 099*	0.253	0.000	0.2	0.001
5	133 863*	0.358	0.358	0.2	0.017
6	106 199*	0.533	0.533	0.2	0.067
7	86 739	0.825	0.825	0.2	0.206
8	30 383	1.253	1.253	0.2	0.246
9	14 766	1.675	1.675	0.2	0.244
10	6 139	2.287	2.287	0.2	0.214
11	1 813	2.888	2.888	0.2	0.243
12	853	3.509	3.509	0.2	0.239
13	623	4.456	4.456	0.2	0.207
14	651	5.789	5.789	0.2	0.207

Source N = From XSA output except *
N* = 0.5N (actual XSA estimate) + 0.5N (XSA Geometric Mean 1975-97)
PR = F 97-99 scaled to F99, CV from average PR 97-99 scaled to 1
Recruitment = GM (75-97)

Confidence Intervals (of above input parameters)

Source Error model	Average VPA Lognormal	Average 96-99 Normal	Average 96-99 Normal	Assumed Normal	PR (97-99) Normal
Age					
1	0.79	0.000	0.000	0.15	0.000
2	0.79	0.504	0.504	0.15	0.000
3	0.47	0.186	0.186	0.15	0.000
4	0.27	0.083	0.083	0.15	0.201
5	0.20	0.043	0.043	0.15	0.303
6	0.17	0.045	0.045	0.15	0.142
7	0.16	0.029	0.029	0.15	0.191
8	0.15	0.032	0.032	0.15	0.156
9	0.14	0.020	0.020	0.15	0.137
10	0.15	0.015	0.015	0.15	0.226
11	0.19	0.030	0.030	0.15	0.218
12	0.20	0.058	0.058	0.15	0.407
13	0.21	0.064	0.064	0.15	0.483
14	0.25	0.036	0.036	0.15	0.483

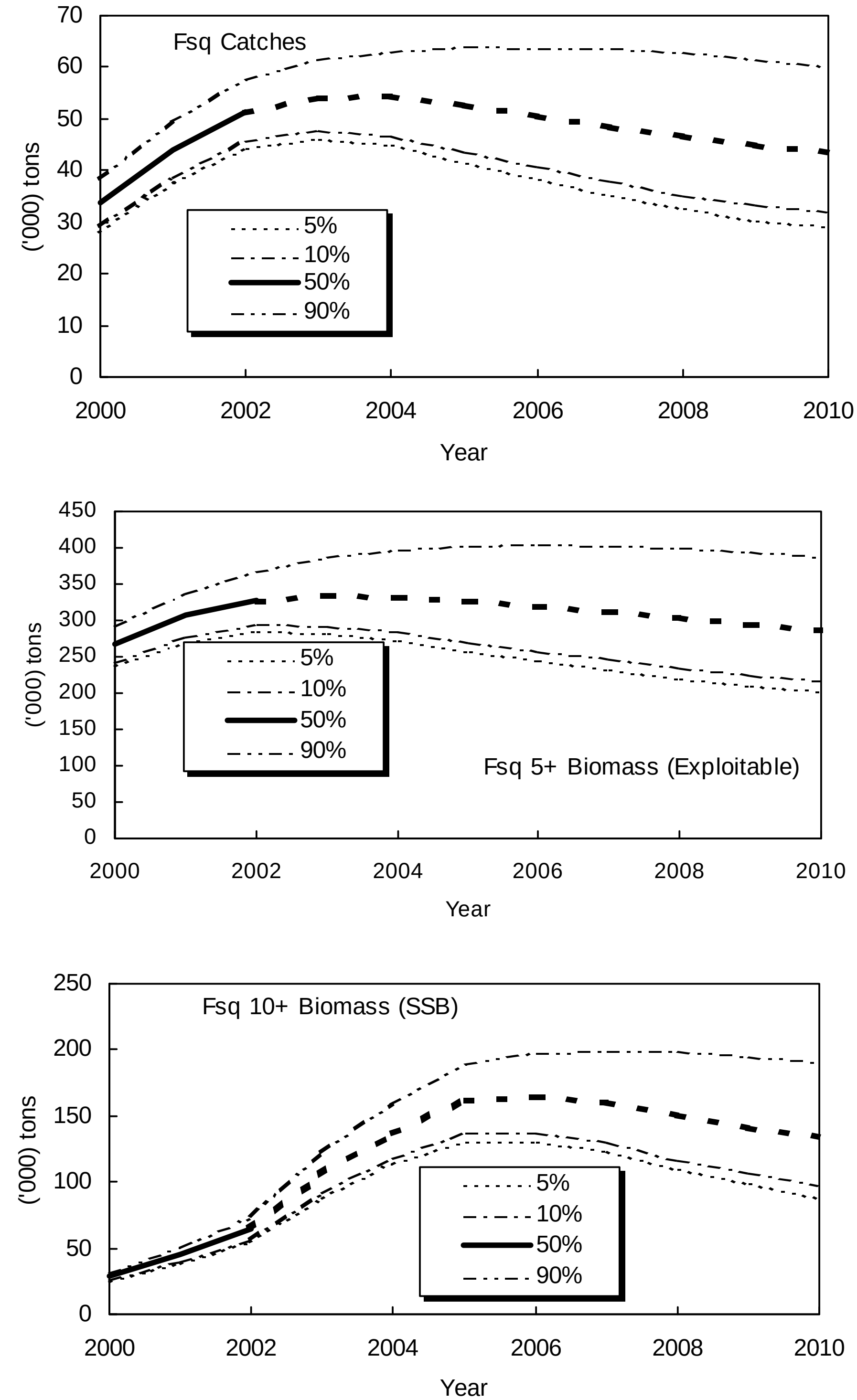


Fig. 16.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: medium term projections.

17. **Short-finned Squid (*Illex illecebrosus*) in Subareas 3 and 4** (SCR Doc. 00/36, 37)

a) **Introduction**

i) **Description of the Fisheries**

In Subareas 3+4 a TAC of 150 000 tons was in place during 1980-98. It was set at 75 000 tons for 1999 and 34 000 tons for 2000. Occasionally very low landings from Subarea 2 occur; these have been 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, then increased to 15 800 tons in 1997. Landings declined to 1 900 tons in 1998 and 300 tons in 1999 (SCR Doc. 00/37).

Since this annual species is now considered to constitute a single stock throughout Subareas 2-6, trends in Subareas 3+4 must be considered in relation to those in Subareas 5+6. Subarea 5+6 landings have ranged between 2 000 tons and 25 000 tons during 1970-99 (Fig. 17.1).

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

	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]	2000
TAC SA 3+4	150	150	150	150	150	150	150	150	75	34
Catch SA 3+4	4.00	2.00	2.67	5.97	1.03	8.73	15.78	1.93	0.31	
Catch SA 5+6	11.91	17.83	18.01	18.35	14.06	16.97	13.63	23.59	7.39	
Catch SA 3-6	15.91	19.83	20.68	24.32	15.09	25.70	28.15	25.53	7.70	

[1] Provisional catches.

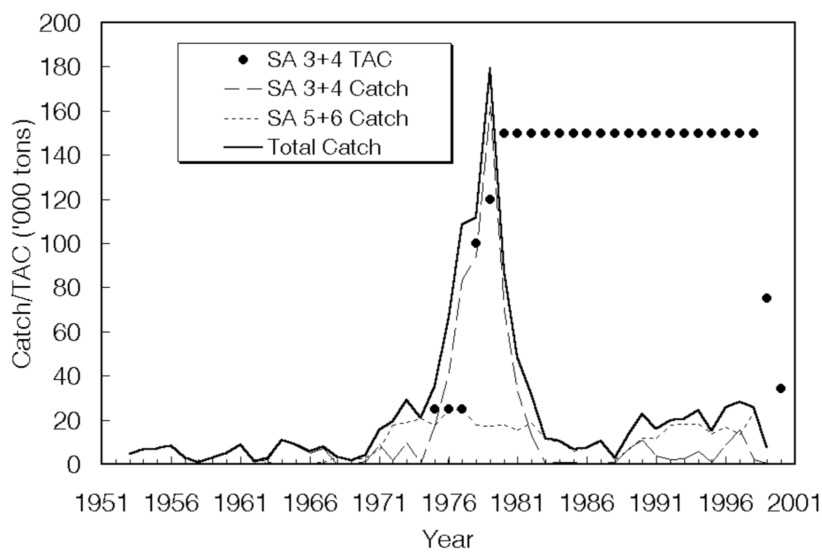


Fig. 17.1. Short-finned squid in Subareas 3+4: nominal catches and TACs in relation to SA 5+6 and total stock catches.

b) Input Data

i) Commercial fishery data

Estimates of total annual landings were available for Subareas 3+4 during 1953-99, and for Subareas 5+6 during 1963-99. 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 landings estimates for Subareas 3+4 is unknown, especially prior to the mid-1970s.

ii) Research survey data

Stratified random bottom trawl surveys were conducted in Subarea 4 on the Scotian Shelf (Div. 4VWX) during July of 1970-99, in the southern Gulf of St. Lawrence (Div. 4T) during September of 1971-99, and in Subareas 5+6 during September-November of 1967-99. Stratified mean weight (kg) and number per tow indices from the July Subarea 4 survey were assumed to represent relative biomass and abundance levels at the start of the fishing season whereas those from Subareas 5+6 were assumed to represent levels at the end of the fishing season.

Survey biomass indices (Fig. 17.2) were positively correlated between Subareas 4 and 5+6. These indices were also positively correlated with catches in all Subareas.

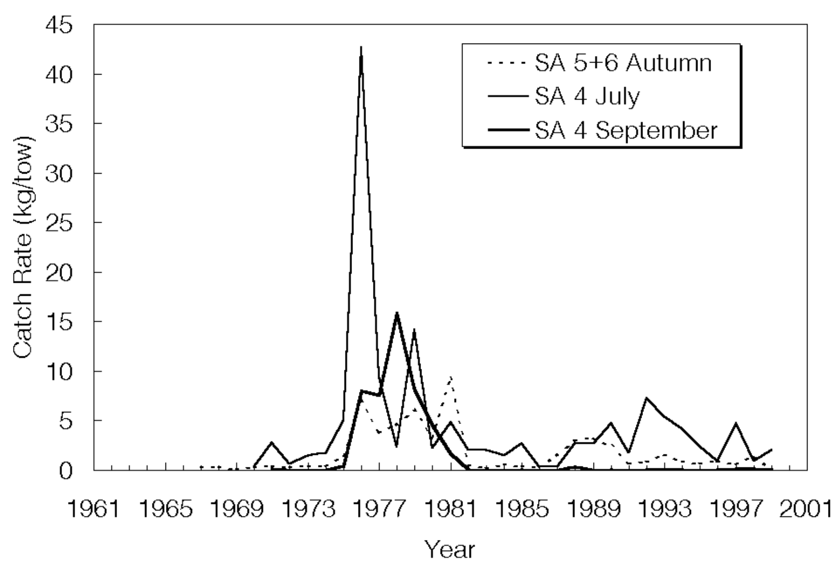


Fig. 17.2. Short-finned squid in Subareas 3+4: research survey biomass indices for Subarea 4 during July in Div. 4VWX, September in Div. 4T and during autumn in Subareas 5+6.

iii) Biological studies

No commercial samples were acquired from Subarea 3+4 in 1999. Annual mean body weight recordings from the July survey on the Scotian Shelf declined dramatically during 1982-83 following the 1976-81 period of highest landings in SA 3 + 4. Mean body weight increased gradually in subsequent years without a coincident increase in landings.

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 1983-99. STACFIS was unable to determine to what extent the decline in productivity was due to high fishing mortality levels *versus* environmental variation.

Survey biomass indices remain low (Fig. 17.2). There is currently no basis for reliably predicting recruitment for this annual species.

d) **Reference Points**

There is no more-recent information on reference points than those provided in 1998.

e) **Research Recommendations**

For short-finned squid in Subareas 3+4, STACFIS **recommended** that:

i) *in order to evaluate effects of annually variable effort levels, data on effective fishing effort should be collected in all Subareas.*
ii) *migration patterns within and between fishery areas for the total stock be investigated.*
iii) *annual variability in age structure, growth rate, and maturation throughout the stock area be monitored.*
iv) *additional research be carried out on the factors that affect recruitment.*

f) **Request on Squid (*Illex*) in Subareas 3 and 4** (Agenda VII 3a, Annex I, Item 3.f.)

The Fisheries Commission requests the Scientific Council to: *develop an in-season indicator of productivity level based on results from the annual July survey of the Scotian Shelf and any other source of data. If it is not considered possible to develop an in-season indicator, the Scientific Council is requested to comment on the research that would be required to develop such an indicator.*

Scientific Council noted in 1999 that it may be possible to identify the onset of a new productivity regime based on marked changes in (a) survey abundance and biomass indices; (b) the average size of squid in the population; and (c) environmental conditions which persist for two or more years. For an in-season predictive model to be of practical value it should be based on early-season indices that are simple and readily available.

An initial exploratory analysis was presented which used July research vessel abundance and size indices, fishery CPUE indices and an environmental index to predict annual SA 3+4 squid catches (SCR Doc. 00/36). While the results of this analysis were promising, further research and developmental work is required before a reliable in-season indicator of short-finned squid productivity is available. Considerable resources will be required to accomplish this work.

18. Cod (*Gadus morhua*) in Divisions 2J, 3K and 3L (SCR Doc. 97/68, 73, SCR Doc. 00/33)

a) Introduction

In the 1999 assessment, STACFIS determined that the Div. 2J and 3KL cod stock had not experienced a detectable increase in the offshore region. In the inshore, exploitation rates calculated from tag return data indicated a population of 52 000 tons in Div. 3K and northern Div. 3L and an additional 15 000 tons in southern Div. 3L. The 1999 status of the Div. 2J and 3KL cod stock was updated based on catch rates from the re-opened fishery in the inshore and an additional year of research bottom-trawl surveys, pre-recruit surveys, acoustic surveys in specific areas both offshore and inshore, sentinel surveys and returns from tagging studies.

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 commercial fishery in mid-1992.

Catches since 1992 have been small and have come from several sources. Small by-catches were taken in fisheries for other species. A Canadian food/recreational fishery was permitted in 1992-94, 1996, 1998 and 1999 but not in 1995 and 1997. A limited inshore fishery for scientific purposes (sentinel survey) was conducted in 1995-1999. In addition, an index or test fishery that caught 3 000 tons was conducted in the inshore in 1998.

The commercial fishery was reopened in 1999 with a quota for the inshore only of 9 000 tons (8 600 for the directed commercial fishery, 100 tons for by-catch and 300 tons for sentinel surveys). The directed commercial fishery was conducted during two periods (July and September to mid-November). The total landings of 8 470 tons in 1999 came from the commercial fishery (8 050 tons), the sentinel survey (200 tons) and the food/recreational fishery (220 tons). The catch came mainly (57%) from Div. 3L, with 43% taken in Div. 3K and less than 1% taken in Div. 2J.

No catch was reported in the Regulatory Area in Div. 3L in 1999.

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	190	120	0	0	0	0	0	0	9[1]	
Fixed Gear Catch	61	12	9	1.3[2]	0.3[2,3]	1.5[2]	0.5[2]	4.5[2]	8.5[2]	
Mobile Gear Catch	111[3]	29[3,4]	2[3]	0.5[2,3]	0[2]	0[2]	0[2]	0[2]	0[2]	
Total Catch[5]	172	41	11	1.4[2]	0.3[2]	1.5[2]	0.5[2]	4.5[2]	8.5[2]	

[1] Inshore fixed gear only.
[2] Provisional.
[3] Includes reported landings and Canadian surveillance estimates.
[4] Fishery closed by EU in June 1992.
[5] Moratorium on Canadian fishing became effective in July 1992.

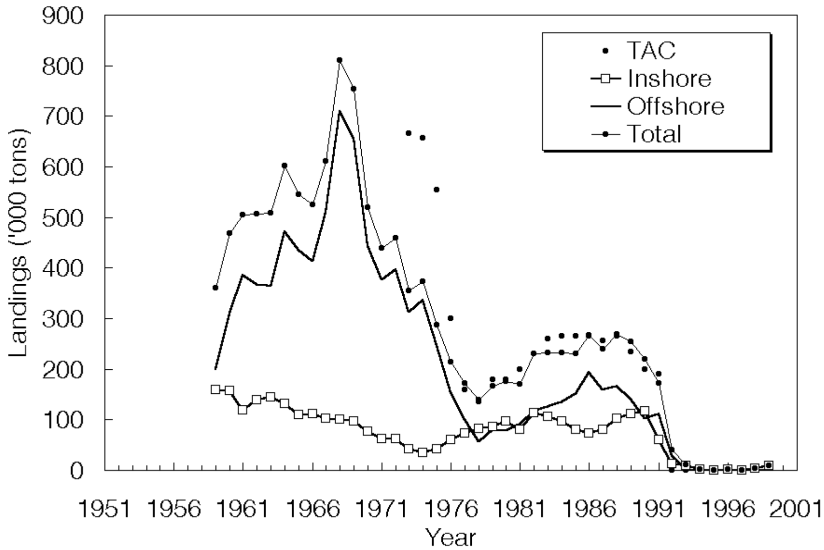


Fig. 18.1. Cod in Div. 2J+3KL: landings from fixed and mobile gears and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch and effort. Catch rates were calculated from catch and effort data recorded in logbooks maintained by participants in both the index fishery in 1998 and the commercial fishery in 1999. An among-year comparison was not attempted because of a difference in dates of fishing.

The spatial pattern in catch rates was similar in the two years, with catch rates very low north of White Bay in central Div. 3K. Catch rates increased from White Bay to eastern Notre Dame Bay, were generally high from northern Bonavista Bay to western Trinity Bay, lower from eastern Trinity Bay to the eastern Avalon Peninsula and higher again on the southern Avalon Peninsula. (See Fig. 18.2 for the location of geographic areas.)

Catch-at-age. The sentinel surveys were sampled intensively for both lengths and ages. The directed commercial fishery was well sampled during July and September. The food/recreational fishery was not sampled. Age compositions of the landings (all sources combined) were initially calculated by gear, unit area (a Subdivision of NAFO Division for statistical purposes) and month. In terms of numbers of fish, the total catch was dominated by gillnet (81%), followed by handline (16%), line trawl (3%) and cod trap or poundnet (<1%). The catch consisted mainly of cod of ages 5-7, with age 7 (the 1992 year-class) dominant.

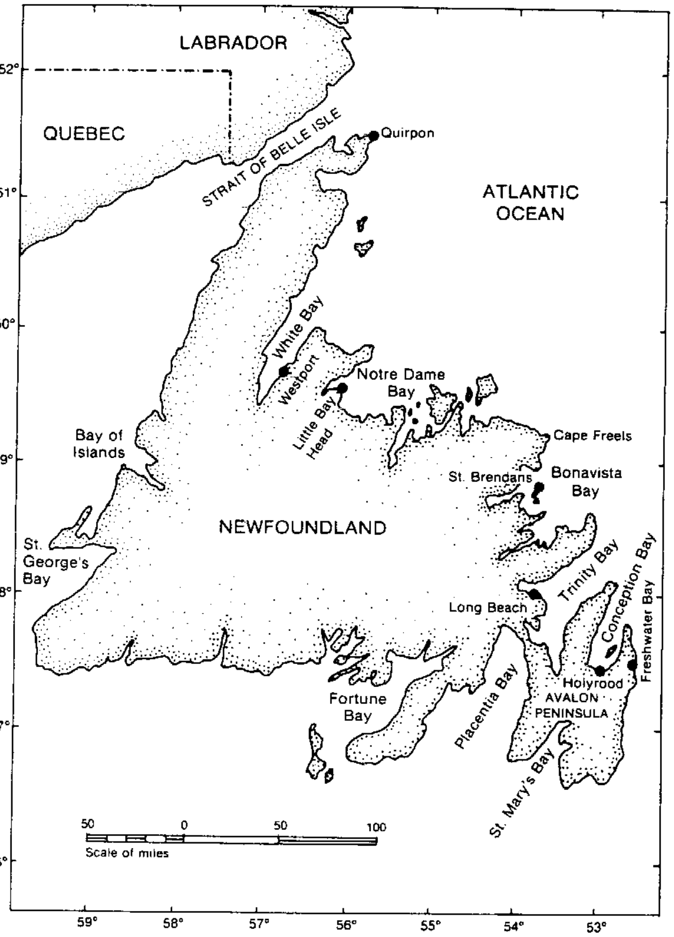


Fig. 18.2. Cod in Div. 2J+3KL: Map illustrating geographic features mentioned in the text.

Sentinel survey. The inshore sentinel survey in Div. 2J and 3KL was initiated in 1995 to provide commercial-like indices of cod abundance in coastal waters during the period of the moratorium. It has been conducted primarily with gillnets. Line trawls have been used extensively in only a few areas. Handlines and cod traps have been used much less. In Div. 2J and in Div. 3K north of White Bay, catch rates have been low since the start of the surveys. From White Bay to the southern boundary of the stock, fish have existed in sufficient density to enable moderate to high catch rates in some times and places.

The sentinel survey data were standardized to remove site and seasonal effects and produce annual indices of total catch rate and catch rate at age for Div. 3K and Div. 3L combined. Gillnets and line trawls were treated separately. Gillnet catch rates increased from 1995 to 1998 but declined from 1998 to 1999. Line trawl catch rates showed relatively little change from 1995 to 1996, increased in 1997, and declined again in 1998 and 1999. The catch rates at age indicated that the 1990 and 1992 year-classes were strong relative to other year-classes from the late-1980s to the mid-1990s. The pattern in age-aggregated gillnet catch rates is consistent with the 1990 and 1992 year-classes entering and then passing through the fishery and being replaced by weaker year-classes.

ii) **Research survey data**

Starting in the autumn of 1995, the Canadian research bottom-trawl survey gear was changed from the Engel trawl to the Campelen trawl in both the autumn surveys in Div. 2J and Div. 3KL and the spring surveys in Div. 3L. The data collected with the Engel trawl have been converted to Campelen equivalent units using conversion factors derived from extensive comparative fishing between the two gears (SCR Doc. 97/68, 73). Biomass estimates from the autumn surveys of the offshore area in Div. 2J and 3KL (combined) declined abruptly in the early-1990s (Fig. 18.3). The 1999 estimate was 2.4% of the average in the period 1983-88 (excluding 1986).

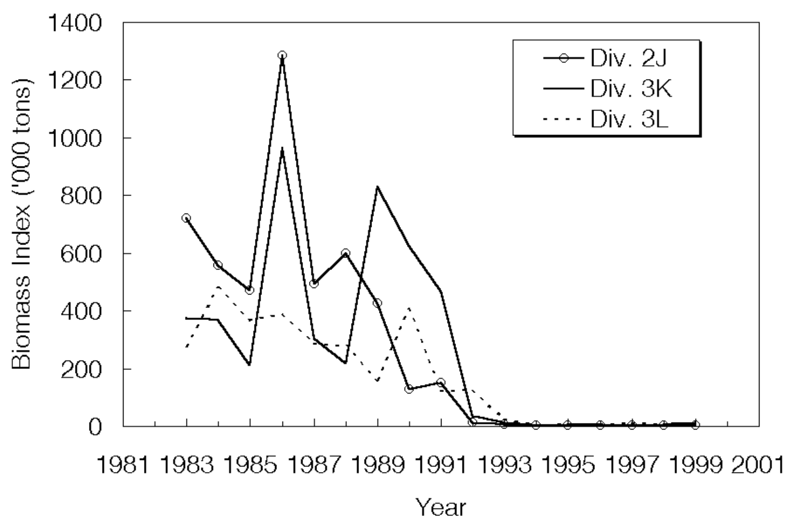


Fig. 18.3. Cod in Div. 2J+3KL: biomass indices from autumn surveys.

The biomass estimate from the spring research vessel survey in the offshore area of Div. 3L increased from 1998 to 1999 but was still only 2.7% of the average level in 1986-89.

There is no fishery-independent index available for the inshore region of Div. 2J and 3KL. However, acoustic surveys have been conducted in various areas of the inshore. An aggregation of cod in Smith Sound (western Trinity Bay, Div. 3L) has been surveyed acoustically at various times from spring 1995 to winter 2000. Biomass estimates at times when aggregations were found varied from 13 000 to 22 000 tons. Detailed information regarding these surveys was not available for STACFIS to review.

iii) **Biological studies**

Distribution and stock structure. In the offshore the cod appeared to be broadly distributed at very low density. In the inshore, cod appeared to be in low abundance in Div. 2J and in Div. 3K north of White Bay but to be broadly distributed from late-spring to late-autumn at traditional fishing depths (less than about 50-60 m) from White Bay south to the boundary with Subdiv. 3Ps. It appears that some of these cod overwinter in dense aggregations in deep inshore waters. In January 2000 a large and dense aggregation was again located in Smith Sound. An exploratory acoustic survey at that time in deep-water inlets from western Trinity Bay to western Notre Dame Bay found no other aggregations anywhere near the size of that in Smith Sound.

Tagging studies in 1999 support the earlier conclusion that the inshore of Div. 3KL is inhabited by at least two groups of cod: (1) a northern resident coastal group that inhabits an area from western Trinity Bay in Div. 3L northward to western Notre Dame Bay in Div. 3K and (2) a migrant group from inshore and offshore areas of Subdiv. 3Ps that moves into southern Div. 3L during late-spring and summer and returns to Subdiv. 3Ps during the autumn. The tagging also provides evidence of considerable movement of cod among Trinity, Bonavista and Notre Dame bays. Any migration to the offshore area of Div. 2J and 3KL could not be detected because of an absence of fishing in the offshore.

A new genetic study indicates that populations on the Flemish Cap, on the southern Grand Bank and in Gilbert Bay in southern Labrador are substantially different from populations offshore in Div. 2J and Div. 3KL and inshore in Div. 3KL. Recent samples from the offshore in Div. 2J and Div. 3KL have been aggregated into 3 geographic groupings, each of which is distinct from the others, suggesting that there are at least three offshore components. In the inshore, populations in all bays are different from one another, with the exception that Notre Dame Bay is not different from Bonavista Bay. Populations in inshore areas are more similar to one another than they are to populations in the offshore. Documentation of this new study was available but STACFIS was unable to evaluate the results due to the lack of the appropriate expertise at the June 2000 Meeting.

Size-at-age 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 and early-1990s appeared to have been reversed in recent years.

The age of 50% maturity of females fluctuated between 6.0 and 6.5 during the 1980s, declined during the late-1980s and early-1990s, and fluctuated considerably at about 5.0 to 5.5 in recent years. Much of the recent year-to-year variability may be caused by small sample sizes, particularly for older fish.

Recruitment trends. A new recruitment index was derived from catch rates of juvenile (ages 0-3) cod during studies with the following gears: experimental squid traps (1991-94); experimental fixed-station bottom-trawling with a Campelen trawl, both inshore and offshore (1992-95); beach seine (1992-97); pelagic 0-group monitoring with an IYGPT trawl, both inshore and offshore (1994-99); sentinel survey line trawl and 5.5 inch gillnet (1995-99) and 3.25 inch gillnet (1996-99); and stratified-random bottom-trawl monitoring with a Campelen trawl, both inshore (1996-98) and offshore (1995-99).

The recruitment data from inshore and offshore were treated together because the inshore appears to be an important nursery area for cod populations spawning in both the inshore and the offshore. These data were combined to produce a single index of relative year-class strength (Fig. 18.4). The index declines from 1989 to 1991, increases to 1994, declines to 1996, and then increases to 1999. The ultimate strength of the 1998 and 1999 year-classes is yet to be determined. Their present strength is known only imprecisely. Moreover, the ability of the index to predict recruitment to the fishable population remains uncertain, particularly because it does not pick up the 1992 year-class that was relatively strong in sentinel and commercial catches.

Survey estimates of total mortality (Fig. 18.5). The year-to-year changes in mean catch at age per tow of individual cohorts, as estimated from catches during autumn research vessel surveys, were used to calculate total mortality for cod up to age 14. Although there was a marked decrease in the total mortality after the stock collapsed, 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.

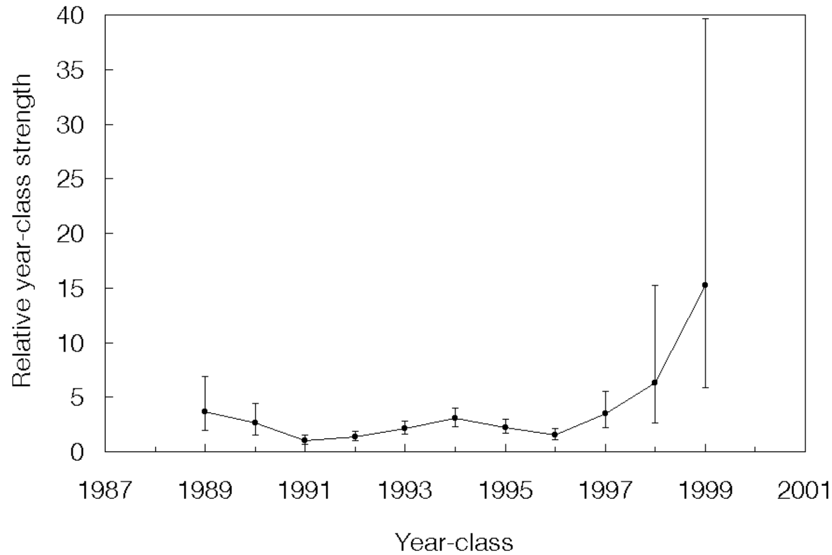


Figure 18.4. Cod in Div. 2J+3KL: standardized year-class strength.

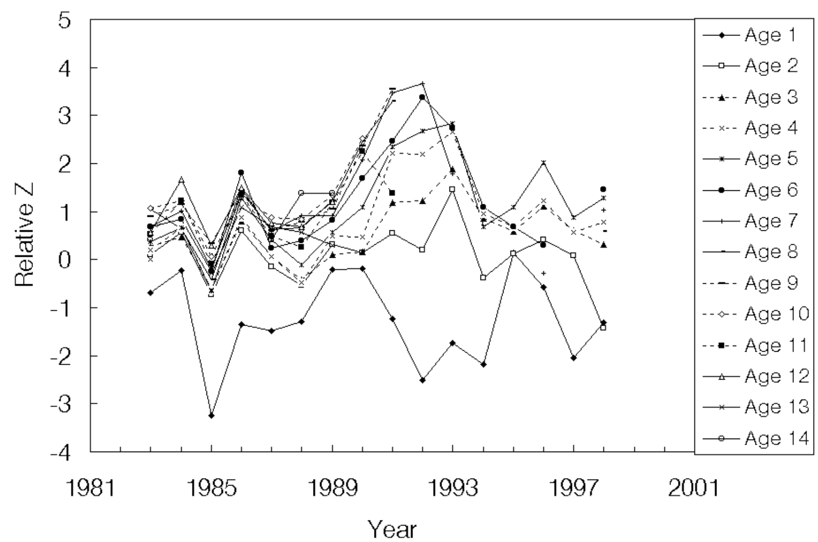


Fig. 18.5. Cod in Div. 2J+3KL: mortality rates calculated from the autumn research vessel bottom-trawl data for 1983-99. Mortality calculated from age *a* in year *y* to age *a+1* in year *y+1* is plotted for age *a* in year *y*.

Predation by harp seals. In 1999 the quantity of cod consumed by harp seals during the period 1972-98 was calculated using estimates of harp seal population numbers, energy requirements of individual seals, the relative distribution inshore and offshore, and stomach contents of seals sampled in the inshore and offshore in winter and summer. The estimate for Div. 2J and 3KL in 1998 was 50 000 tons. From 1986 to 1991 most of the predation was on cod of ages 0-2, with the bulk occurring on age 1. In 1992, 1993 and especially 1995 there was a greater proportion of older cod (ages 3-5) in the diet. A recent study of the size of the Northwest Atlantic harp seal population indicated almost no change in the population numbers used for the 1999 estimate of cod consumption. There was no new information on other inputs to the calculation.

The above information on consumption and age composition does not incorporate belly-feeding, wherein seals bite the bellies from the cod, removing the liver and much of the gut but leaving the rest of the body, including the head. This manner of predation includes some cod larger than those represented by otoliths in seal stomachs. The incidence of belly-feeding may have increased in the inshore in the past three years.

c) **Assessment Results**

An analytical assessment of the Div. 2J and 3KL cod stock was not attempted. The inability to reconcile reported catches and the research vessel index in the late-1980s and early-1990s has not been resolved. Perhaps more importantly, the surveys do not cover the shallow coastal waters where good catch rates have been experienced in the sentinel surveys, the 1998 index fishery, and the 1999 commercial fishery. In addition, the sizes and ages of cod taken in the offshore surveys do not represent the larger and older cod caught in the inshore.

It is clear that the size of the stock as a whole and the size of incoming year-classes remain low relative to levels in the 1980s.

Cod in the offshore of Div. 2J and 3KL show no detectable signs of recovery. The spawning biomass continued to decline after imposition of the moratorium in 1992 and has for several years been very small, especially north of Div. 3L. Year-classes recruiting in the 1990s have been extremely weak.

The status of cod in the inshore was determined from the analysis of tag return data. The inshore was divided into three geographic areas: Div. 3K, northern Div. 3L (Bonavista and Trinity bays) and southern Div. 3L. The returns from tags applied during 1999 were highest for fish tagged in Div. 3K (26%), lowest for fish tagged in northern Div. 3L (7%) and intermediate in southern Div. 3L (11%). Many of the recoveries of the tags applied in southern Div. 3L occurred in Subdiv. 3Ps. It is presumed that these fish had migrated into Div. 3L from Subdiv. 3Ps during the spring.

Information from recaptures of cod tagged in the inshore of Div. 3KL during 1997, 1998 and 1999 were used to estimate exploitation rates for each of the two periods of the 1999 fishery: the July opening and the first 5 weeks of the September-November opening. Exploitation rates for the first and second openings were estimated to have been at least 19% and 13% in Div. 3K and 2.3% and 3.8% in northern Div. 3L. The exploitation rates could possibly be higher because of the effect of an unknown level of migration of tagged fish out of the areas. The exploitation rates for each period represent the fractions of fish available to the fishery that were removed by the fishery. Because of migration effects, the extent to which the exloitation rates are additive is unknown. (Note that when an exploitation rate is low then it is approximately equal to fishing mortality.) Reliable estimates of exploitation rate could not be produced for southern 3L because of the strong seasonal contribution of fish from Subdiv. 3Ps. When combined with the catches recorded for each area and time period, the exploitation rates suggest biomasses of at most 8 900 tons in Div. 3K and 49 000 tons in northern Div. 3L during July, and 11 000 tons in Div. 3K and 42 000 tons in northern Div. 3L during September-October.

In summary, biomass remains very low in the offshore compared with levels in the 1980s. The biomass available to the 1999 inshore commercial fishery in Div. 3K and northern Div. 3L was estimated to be at most 55 000 tons. There are no comparable estimates for years prior to 1998. An unquantified additional biomass was available in southern Div. 3L, but much of this migrated seasonally from Subdiv. 3Ps.

It remains difficult to estimate the impact of harp seals on cod. However, the estimate of cod consumption by harp seals is high relative to population estimates. Considering the increase in the seal population and the increase of cod seen in the diet of seals since the early-1990s it appears that predation by seals has become a more important source of mortality on cod. There is the possibility that predation by seals is retarding the recovery of the cod stock.

19. Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 2J, 3K and 3L (SCR Doc. 00/13; SCS Doc. 00/16)

a) Interim Monitoring Report

Although the stock has been under moratorium since 1995 the annual by-catch of witch flounder has ranged between 800 to 1 400 tons during 1995-98. The estimated catch in 1999 is about 300 tons, the lowest annual catch since the fishery began in the early-1960s (Fig. 19.1).

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TAC	4	4	3.5	1	0	0	0	0	0	0[1]
Catch	4	3	0.4	0.5[2]	0.7[2]	1.4[2]	0.8[2]	1.1[2]	0.3[2]	

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

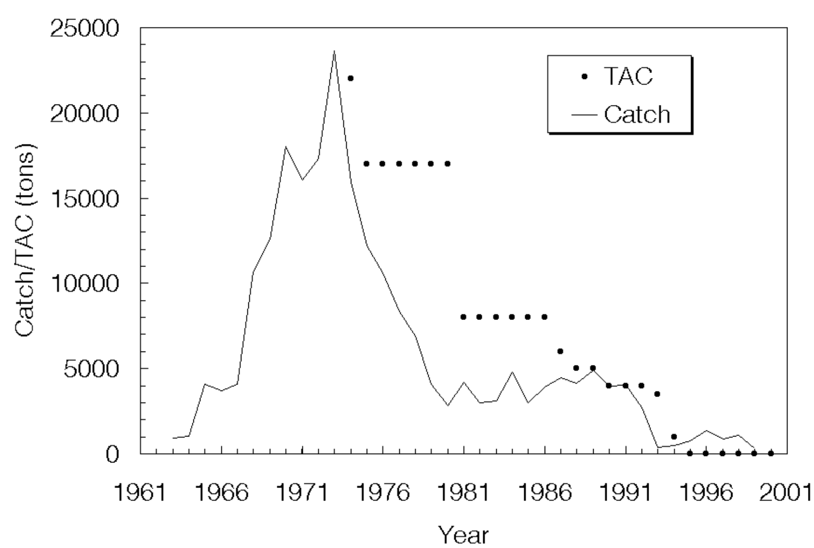


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC

Survey biomass indices show that the stock declined very rapidly during the 1980s and by the early-1990s had reached an extremely low level (Fig. 19.2). No improvement in the stock has been observed since then including the most recent 1999 autumn survey.

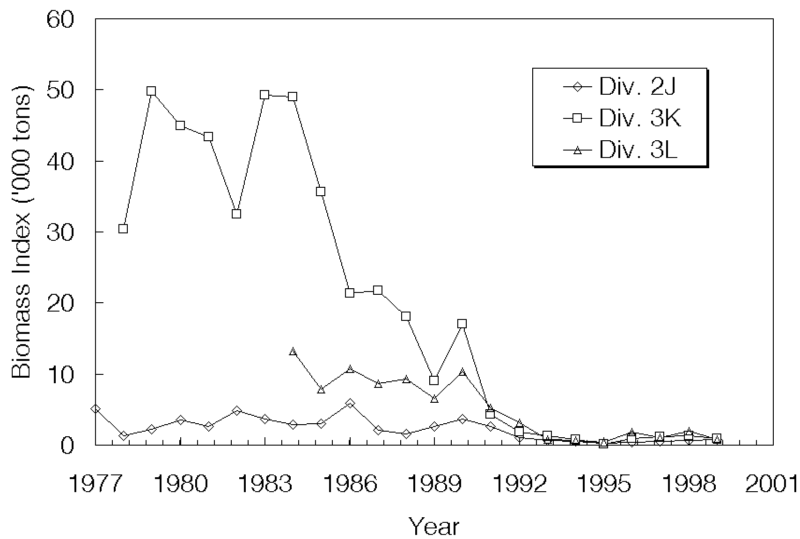


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: biomass indices from Canadian autumn surveys.

20. **Elasmobranchs in Subareas 0-6** (SCR Doc. 00/15, 18, 19, 27, 31, 46; SCS 00/9, 20)

a) Introduction

For the first time, the Fisheries Commission requested the Scientific Council to: *summarize all available information from the Convention Area on catches of elasmobranchs, by species and by the smallest geographical scale possible*. The Scientific Council was requested to: *review available information from research vessel surveys on the relative biomass and geographic distribution of elasmobranchs by species, and to quantify the extent of exploitation on these resources*. Further, the Scientific Council was requested to: *initiate work leading to the development of precautionary reference points*.

Species for consideration are listed below.

Code	Short name	Common name	Scientific name
452	Spiny dogfish	Spiny (picked) dogfish	*Squalus acanthias*
460*	Sand tiger	Sand tiger shark	*Odontaspis taurus*
462	Porbeagle	Porbeagle	*Lamna nasus*
464	Shortfin mako	Shortfin mako shark	*Isurus oxyrinchus*
470	Sharpnose shark	Atlantic sharpnose shark	*Rhizoprionodon terranovae*
467*	Dusky shark	Dusky shark	*Carcharhinus obscurus*
468*	Blue shark	Great blue shark	*Prionace glauca*
473	Boreal shark	Boreal (Greenland) shark	*Somniosus microcephalus*
472	Black dogfish	Black dogfish	*Centroscyllium fabricii*
474	Basking shark	Basking shark	*Cetorhinus maximus*
480	Little skate	Little skate	*Leucoraja erinacea*
482*	Arctic skate	Arctic skate	*Amblyraja hyperborea*
484	Barndoor skate	Barndoor skate	*Dipturus laevis*
487	Winter skate	Winter skate	*Leucoraja ocellata*
490	Spinytail skate	Spinytail (Spinetail) ray	*Bathyraja spinacauda*
488	Thorny skate	Thorny skate (starry skate)	*Amblyraja radiata*
489	Smooth skate	Smooth skate	*Malacoraja senta*

* Additions since 1999.

b) **Input Data**

i) **Description of the Fisheries**

Subarea 0

Elasmobranchs are taken only as by-catch in this area, primarily from the Greenland halibut and shrimp fisheries that have been in existence since the late-1970s. Several species of skate and Greenland shark are taken at low levels. There are no quotas in place in this area.

Subareas 2 to 4

Although poorly represented in the landings statistics, skate were caught in Canadian waters (SA 2 and 3) previous to 1994. Fishery observer records showed that skates consistently comprised the greatest non-commercial by-catch in the Newfoundland offshore trawl fisheries, averaging 3 000-4 000 tons during the early-1980s, primarily from SA 3. Skate was sometimes the dominant by-catch of Grand Bank fisheries for American plaice, cod, redfish and yellowtail flounder, although nearly all of this incidental catch was discarded at sea. As a result, landing statistics for skate in Canadian waters prior to 1994 represent only a fraction of the actual catch.

For Subarea 2, elasmobranchs (primarily thorny skate, Greenland shark and basking shark) are taken only as by-catch primarily from the shrimp and Greenland halibut fisheries in SA 2. Although shrimp fishery effort in this area increased sharply in recent years, the introduction of a sorting grate in the early-1990s (as well as reduced biomass of skates in this area) effectively reduced elasmobranch by-catch to very low levels, well below the numbers recorded in the 1980s and early-1990s.

For Subarea 3, until 1993, skate (primarily thorny) taken by Canada were incidental to the catches of other groundfish, and were usually discarded (Table 20.1). Most of the reported catches of skate prior to 1994 were attributable to non-Canadian fishing effort outside 200 miles. From the time of the extension of jurisdiction to 1984, skate landings reported to NAFO averaged 5 000 tons. Since that time, catches have increased. This was due in part to the emergence of an unregulated non-Canadian directed fishery outside 200 miles in 1985, and more recently to the introduction of a regulated directed Canadian skate fishery inside 200 miles starting in 1994.

The non-Canadian fishery is an otter trawl fishery that occurs in Div. 3LMN between 40-200m, primarily in the autumn (September to December). The Russian effort is concentrated in Div. 3M and Div. 3N (SCS Doc. 00/09) while the Spanish effort is concentrated in Div. 3N (SCS Doc. 00/20). The discard rate for skate in the Spanish fishery was 4% of the total catch (SCS 00/20). By-catches of regulated species, some of which are under moratorium, have been reported from this unregulated fishery.

By-catch of elasmobranchs in the Spanish Greenland halibut fishery in Div. 3LMNO were provided. The black dogfish (*Centroscyllium fabricii*) and the Greenland shark (*Somniosus microcephalus*) were the main species in the by-catches, 505 tons and 107 tons, respectively for 1999. Black dogfish is retained in the catch, and boreal shark is discarded. The percentage of black dogfish retained in the catches has been increasing in recent years.

Table 20.1. Elasmobranchs in Subareas 0-6: thorny skate catch (tons) for Canadian and non-Canadian fisheries within Subarea 3.

	Div. 3L		Div. 3N		Div. 3O		Subdiv. 3Ps	Canadian and Non-Canadian				
Year	Can.	Non-Can.	Can.	Non-Can.	Can.	Non-Can.	Can.	Div. 3L	Div. 3N	Div. 3O	Subdiv. 3Ps	Total
1985	1 676	1 850	870	13 000	1 126	900	1 299	3 526	13 870	2 026	1 299	20 22
1986	1 830	1 500	1 314	10 500	1 596	700	1 105	3 330	11 814	2 296	1 105	18 546
1987	2 307	1 200	1 708	8 500	935	600	4 999	3 507	10 208	1 535	4 999	2 049
1988	9 785	950	1 431	6 500	1 567	400	2 006	10 735	7 931	1 967	2 006	22 639
1989	1 367	1 000	1 910	7 400	1 324	500	2 424	2 367	9 310	1 824	2 424	15 925
1990	2 033	1 800	485	12 400	953	900	3 396	3 833	12 885	1 853	3 396	21 966
1991	1 710	1 550	549	10 500	771	700	4 023	3 260	11 049	1 471	4 023	19 803
1992	436	600	343	5 800	1 953	200	2 85	1 036	6 143	2 153	2 385	11 717
1993	303	1 100	853	4 600	3 417	150	711	1 403	5 453	3 567	711	11 135
1994[1]	269	650	63	6 700	1 219	150	1 38	919	6 763	1 369	1 238	10 290
1995[1]	182	250	3	2 600	2 603	50	1 59	432	2 603	2 653	1 959	7 647
1996[1]	58	1 200	6	3 000	1 218	200	645	1 258	3 006	1 418	645	6 328
1997[1]	26	650	81	7 950	2 086	275	860	676	8 031	2 361	860	11 928
1998[1]	63	250	49	7 200	1 043	300	1 469	313	7 249	1 343	1 469	10 374
1999[1]	70	1 100	82	5 200	1 165	500	1 278	1 170	5 282	1 665	1 278	9 395

[1] Provisional.

The Canadian directed effort occurs primarily near the border of Div. 3O and Subdiv. 3Ps. The fishery is prosecuted with otter trawls, gillnets and longlines.

Directed skate catches constitute a mix of species. Thorny skate (*A. radiata*) dominate in most areas and comprise more than 95% in the directed fishery on the Grand Banks although historically, skate by-catches from trawls have contained a more diverse species mix. Offshore trawl by-catches of skate in the mid-1980s from the Northeast Newfoundland Shelf and the Grand Banks comprised about 20% of species other than thorny skate.

Barndoor skate have been taken with some frequency in the past as by-catch.

Thorny and winter skate are fished on the Scotian Shelf in Div. 4V as a mixed fishery. There is also a porbeagle fishery, in existence since the late-1950s, on the Scotian Shelf and the Grand Banks. Canada assesses these fisheries and no data were available at the June 2000 Meeting. These fisheries are regulated through quota controls.

Subareas 5 and 6

Total nominal catch of skates (all species combined) in Subareas 5 and 6 increased from less than 100 tons per year in the early-1960s to a peak of 9 500 tons in 1969 (Table 20.2). Catches subsequently declined to low levels (<1 000 tons) in the early-1980s. Average catches in the mid-1980s increased to 5 000 tons, mostly due to by-catch in USA fisheries. In the late-1980s, a directed fishery for skates (primarily large skate wings) developed and catches increased to 13 000 tons in 1993. With the decline in biomass of the large-bodied species of skates, catches then declined. Catches then increased due to a demand for bait and were comprised mainly of smaller-bodied species.

The species composition in the skate fisheries varies by area, but catches are primarily dominated by winter skate and little skate in most areas. Thorny skate are commonly taken in some fisheries, particularly in the Gulf of Maine. Skate fisheries in Subareas 5 and 6 are currently unregulated.

Nominal catches of spiny dogfish in Subareas 2-6 increased from very low levels in the early-1960s to an average of 24 000 tons in the 1970s (Table 20.3). Catches then declined to by-catch levels in the mid-1980s. With the development of an overseas market for dogfish fillets, USA catches sharply increased in the early-1990s, peaking at 28 300 tons in 1996. Landings have since declined to 15 000 tons in 1999. Spiny dogfish catches in Subareas 5 and 6 are currently regulated by USA Fishery Management Plans.

Table 20.2. Elasmobranchs in Subareas 0-6: total commercial landings of skate (tons) in Subareas 5 and 6 by country from 1960-98.

Year	USA	USSR/Russia	Others	Total
1960	61	0	0	61
1961	36	0	0	36
1962	44	0	0	44
1963	33	0	0	33
1964	4 081	0	2	4 083
1965	2 343	0	20	2 363
1966	2 738	0	106	2 844
1967	2 715	2 121	62	4 898
1968	2 417	3 974	92	6 483
1969	3 045	6 410	7	9 462
1970	1 583	2 544	1	4 128
1971	900	5 000	5	5 905
1972	866	7 957	0	8 823
1973	1 191	6 754	18	7 963
1974	2 026	1 623	2	3 651
1975	752	3 216	0	3 968
1976	754	412	46	1 212
1977	1 143	240	35	1 418
1978	1 130	216	7	1 353
1979	1 280	79	1	1 360
1980	1 577	0	4	1 581
1981	838	0	9	847
1982	878	0	0	878
1983	3 603	0	0	3 603
1984	4 157	0	0	4 157
1985	3 984	0	0	3 984
1986	4 159	0	94	4 253
1987	5 078	0	0	5 078
1988	7 255	0	9	7 264
1989	6 717	0	0	6 717
1990	11 403	0	0	11 403
1991	11 332	0	0	11 332
1992	12 525	0	0	12 525
1993	12 904	0	0	12 904
1994[1]	8 829	0	0	8 829
1995[1]	7 222	0	0	7 222
1996[1]	14 226	0	0	14 226
1997[1]	10 952	0	0	10 952
1998[1]	16 936	0	0	16 936
1999[1]	12 159	0	0	12 159

[1] Provisional.

Table 20.3. Elasmobranchs in Subareas 0-6: catches of spiny dogfish from Subareas 2 to 6.

Year	Subareas 2-6 ('000 tons)	Year	Subareas 2-6 ('000 tons)
1960	-	1980	5.4
1961	-	1981	10.2
1962	0.2	1982	7.1
1963	0.6	1983	6.0
1964	0.7	1984	5.4
1965	0.7	1985	6.1
1966	10.0	1986	4.5
1967	2.7	1987	4.5
1968	4.6	1988	5.0
1969	9.3	1989	6.7
1970	5.8	1990	17.8
1971	11.6	1991	15.2
1972	24.1	1992	19.0
1973	18.9	1993	23.3
1974	24.7	1994[1]	21.7
1975	22.7	1995[1]	24.4
1976	17.3	1996[1]	28.3
1977	8.1	1997[1]	19.1
1978	1.5	1998[1]	22.3
1979	6.3	1999[1]	14.7

[1] Provisional.

ii) **Research survey data**

Subareas 0 and 1

A survey conducted in Div. 0A recorded catches of thorny skate (*A. radiata*) and Arctic skate (*A. hyperborea*). Thorny skate biomass and abundance was estimated to be 241 tons and 617 000 individuals, respectively. They were distributed primarily at depths <751 m in the area of Davis Strait. Biomass and abundance for Arctic skate was estimated to be 2 268 tons and 2.02 million individuals, respectively. They were distributed primarily between 501 m and 1500 m throughout Davis Strait and Baffin Bay. There were also five Greenland shark *(S. microcephalus*), and one round skate (*Raja fyllae*) caught during the Div. 0A survey.

A biomass index for thorny skate from Subarea 1 can be found in the STACFIS report on Other Finfish in Subarea 1.

Subareas 2 and 3

The Canadian spring survey index for thorny skate in Div. 3L, 3N, 3O and Subdiv. 3Ps shows a declining trend in biomass over the entire area from 1986 to 1994 with a slight increasing trend since then (Fig. 20.1). However, the survey gear used to collect this data was changed in the autumn of 1995. The data presented here have not been converted, therefore are not directly comparable across the time period. The proportion of mature adults has increased substantially in the last three years. Also, as has been noted for other stocks, the increase seen in 1999 may, at least in part, be due to increased catchability due to increasing temperatures in the survey area.

Skate perform seasonal migrations, tending to move into deeper water along the shelf edge during winter-spring. The spring survey may not cover the entire area of distribution due to this seasonal migration of fishes between the shelf and the deeper waters. There is also an autumn survey but it does not include Subdiv. 3Ps and is therefore not considered a reliable index of biomass or abundance for thorny skate in Subarea 3.

Analyses of distribution of thorny skate in the Canadian bottom trawl surveys (Div. 3LNO and Subdiv. 3Ps) indicate that there is a single concentration on southern Grand Banks that straddles the Div. 3N and 3O and Subdiv. 3Ps divisional borders. Spring and autumn surveys and data from the fishery suggest migrations across these borders both between years and seasonally within years. Whether this concentration of fish constitutes part of a larger stock, a single stock or several stocks is unclear. However, the distribution dynamics and some of the earlier morphometric studies suggest a single stock. Survey data suggest that in the past greater abundance of skates was distributed further to the north in Div. 3K and 3L.

Analysis of the Canadian spring and autumn survey data from the 1995-99 period suggests that on average less than 20% of the overall biomass in Div. 3LNO and Subdiv. 3Ps is found in the NAFO Regulatory Area (NRA).

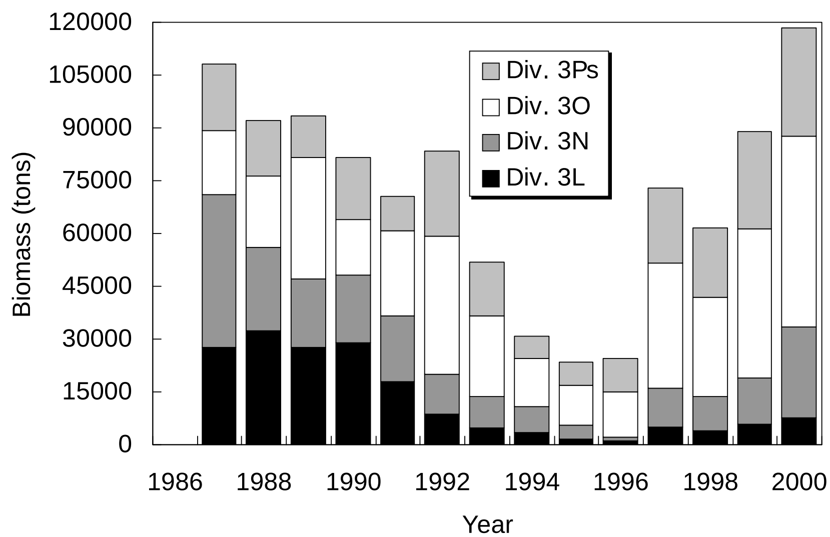


Fig. 20.1. Elasmobranchs in Subareas 0-6: Canadian spring research survey biomass indices for thorny skate from Subarea 3, 1986 to 1999.

The biomass estimate for the Spanish spring bottom trawl survey in NRA portion of Div. 3NO increased from 142 438 tons in 1999 to 208 644 tons in 2000 (SCR Doc. 00/46).

Subarea 4

No data were available for the June 2000 Meeting.

Subareas 5 and 6 (Fig. 20.2)

Winter skate were most abundant in the Georges Bank and Southern New England offshore regions, with few fish caught in the Gulf of Maine or Mid-Atlantic regions. Little skate were abundant in the inshore and offshore areas in all regions of the northeast USA coast, but were most abundant on Georges Bank and in the Southern New England region.

Barndoor skate were most abundant in the Gulf of Maine, Georges Bank, and Southern New England offshore regions, with very few fish caught in inshore (<27 m depth) waters or the Mid-Atlantic region. Historically barndoor skate were found in inshore waters to the tide-line, and in depths as great as 400 m off Nantucket.

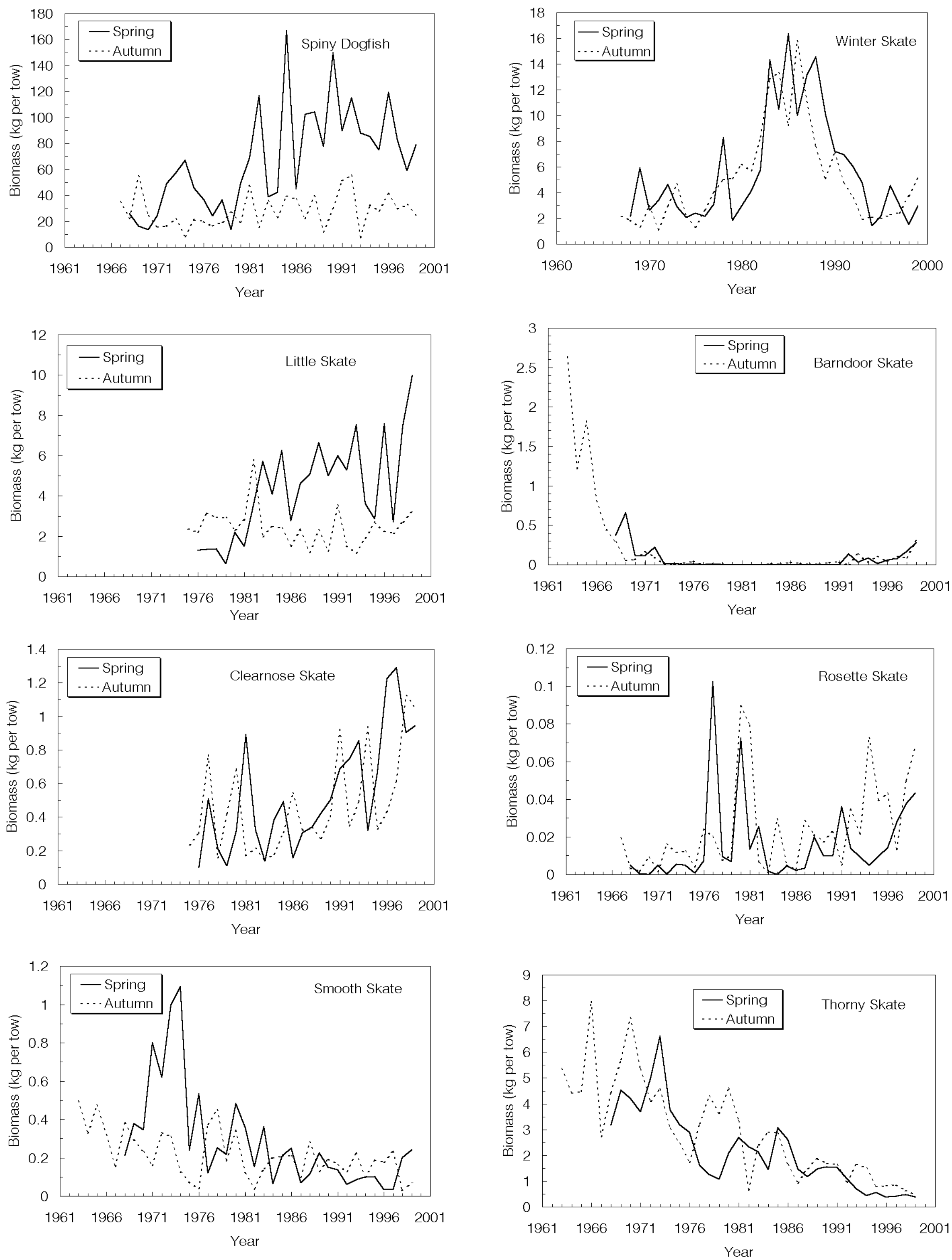


Fig. 20.2. Elasmobranchs in Subareas 0-6: biomass indices (shown as Biomass (kg per tow)) from US bottom trawl surveys covering Subareas 5 and 6, 1960-99.

Thorny skate and smooth skate are most abundant in the Gulf of Maine and Georges Bank offshore regions, with very few fish caught in inshore (<27 m depth) areas, and in the Southern New England and Mid-Atlantic regions. Clearnose skate and rosette are most abundant in the Mid-Atlantic region, with very few fish caught in Southern New England and no fish caught in other regions.

Winter skate biomass indices increased from low values in the 1970s to a peak around 1985 and are now about 25% of the peak. Little skate biomass estimates for the spring are presently at record high levels. Barndoor skate biomass decreased sharply in the early-1960s and remained very low until an increase beginning in the early-1990s. The abundance, however, is still less than 10% of the values in the 1960s. Thorny skate biomass has decreased over the time series and current biomass is about 15% of the 1960s, the lowest in the time series. Smooth skate survey biomass declined during the 1980s, before stabilizing during the early-1990s at about 25% of the autumn and 50% of the spring survey values of the 1970s. Clearnose skate indices have increased steadily over the time series and are currently two to three times the values in the mid-1970s. Rosette skate biomass peaked in the late-1970s and early-1980s declined to low levels in the mid-1980s, and have since increased. Indices of relative abundance for spiny dogfish showed an increase from the late-1970s to the early-1990s. Biomass indices show a slight decline over the last five years. This change is due largely to the decline in adult female biomass (>80cm).

iii) **Biological Studies**

The seasonality of the catches and reproductive parameters of thorny skate from Div. 3N were examined (SCR Doc. 00/18). Samples were collected during the autumn Spanish thorny skate fishery from a restricted area of Div. 3N in <100 m of water. The results show that the fishery is based largely on a skate mating concentration. The estimated length at 50% mature for males and females is 51 cm and 55 cm, respectively.

Length frequency data were provided for samples from both the Spanish (Div. 3N) and Russian (Div. 3LMN) fisheries (SCS Doc. 00/9, 00/20). Mean lengths for thorny skate sampled from the Russian fishery in Div. 3M and Div. 3N were 53 cm and 58.9 cm, respectively (SCS Doc. 00/9). The modal length for thorny skate sampled from the autumn Spanish commercial fishery in Div. 3N was 44-45 cm (SCS Doc. 00/20) while the modal length for the 2000 Spanish spring bottom trawl survey in Div. 3NO was 48 cm (SCR Doc. 00/46).

c) **Assessment Results**

Subareas 0 and 1

The survey conducted in Div.0A in 1999 was the first to cover this area so it is not possible to compare these estimates to any previous time period. A biomass index for surveys in SA 1, conducted by EU-Germany and Greenland, cover the time period from 1982 to 1999 and show a generally decreasing trend reaching historic low levels in the early-1990s.

There is no information available to assess exploitation in Subareas 0 and 1.

Subareas 2 and 3

The Canadian spring biomass index for thorny skate in Div. 3LNO and Subdiv. 3Ps has increased in recent years from 62 670 tons in 1997 to 119 628 tons in 1999. The biomass estimated for the Spanish spring bottom trawl survey in Div. 3NO increased from 142 438 tons in 1999 to 208 644 tons in 2000 (SCR Doc. 00/46).

There is no information available to assess exploitation in Subareas 2 and 3.

The information on barndoor skate from commercial catches indicates that the species may be more widely distributed than reflected by research survey data and continuously distributed along deep slope waters of the Northwest Atlantic. Apparent changes in abundance as observed from research surveys may in part reflect periods of expansion and contraction into and out of the shallower waters within its range rather than reflecting overall changes in status.

Subareas 5 and 6

Winter skate biomass is currently about the same as in the early-1970s, at about 25% of the peak observed during the mid-1980s. Little skate biomass began to increase in the early-1980s, and has increased to its highest level since 1975. Biomass of barndoor skate declined continuously through the 1960s, reaching historic lows during the early-1980s. Since 1990, however, biomass of barndoor skate has increased slightly but steadily.

Biomass of thorny skate has declined to an historic low. Current biomass is about 10%-15 % of the peak observed in the late-1960s to early-1970s. Biomass of smooth skate was highest during the early-1960s and late-1970s, biomass of clearnose skate has been increasing since the mid-1980s, and biomass of rosette skate has been increasing since 1986.

For the aggregate skate complex, biomass remained relatively constant from 1963 to 1980, then increased significantly to peak levels in the mid-to late-1980s. The index of skate complex biomass then declined steadily until 1994, but recently began to increase again. The large increase in skate biomass in the mid-to late-1980s was dominated by winter and little skate. The biomass of large sized skates (>100 cm maximum length; barndoor, winter, and thorny) has steadily declined since the mid-1980s and the recent increase in aggregate skate biomass has been due to an increase in small sized skates (<100 cm maximum length; little, clearnose, rosette, and smooth). All large-bodied skates (winter, barndoor, and thorny) and all primary skate species in the Gulf of Maine (thorny and smooth) are currently at low biomass.

Biomass of spiny dogfish has fluctuated considerably, but there has been a general increase since the early-1970s. In recent years, spiny dogfish biomass has declined due to a reduction in adult female biomass. The biomass index of mature females (greater than 80 cm) declined from around 200 000 tons during the late-1980s to an average of around 50 000 tons since 1997, and the size structure has become truncated.

Exploitation rates for winter skate decreased in the late-1970s and early-1980s. With the onset of the directed skate fishery, fishing mortality increased and was estimated to be 0.4 in 1999. Little skate fishing mortality has also increased in recent years and is estimated to be 0.3 in 1999. Fishing mortality on large female spiny dogfish has increased from low values (~0.05) in the 1980s to values ranging from 0.35-0.5 during 1997-99.

d) **Reference Points**

No reference point available.

e) **Research Recommendations**

STACFIS **recommended** that *for elasmobranchs in SA 0-6,*

1) *life history characteristics (growth, maturation and fecundity) should be investigated for the most common elasmobranch species.*

2) *information on growth rates and stock structure (tagging studies) should be elaborated to enhance knowledge of the current status of thorny skate in Div. 3LNO and Subdiv. 3Ps.*

3) *a program to promote identification of elasmobranchs species taken in commercial catches should be initiated throughout all Subareas.*

4) *a sampling program of the commercial catches of elasmobranchs should be initiated to define removals by size and possibly by age.*

21. **Information on Catches and/or Discards of Juvenile Fish in the Various NAFO Fisheries** (SCR Doc. 99/96; 00/46)

a) **Introduction**

As the distribution of demersal species often overlaps, a directed fishery hardly ever avoids by-catches completely. Also, as fishing aggregations often include fish of all sizes, the capture of small, immature fish, has been inescapable given the current gear configurations and fishing practices.

A preliminary inquiry was carried out among Designated Experts to collect information on relevant catch statistics, biology etc. for the considered stocks. As a result of the sporadic research effort in this area, there is a relatively large number of cases with no available information. Information from NAFO Observers Program should be of great benefit in providing information on by-catches and discards.

The number and weight of juveniles were calculated as numbers in the size distribution less than L_{50} for maturity of females.

b) **Catches of Juveniles**

The result of the inquiry with quantitative catches are presented by stock units for 1999 are listed in Table 21.1.

c) **By-catches in the Shrimp Fishery**

By-catch rates of Greenland halibut in Subareas 2 and 3 in Canadian shrimp vessels greater than 500 GRT calculated for combined grates (22 and 28 mm) in 1997, 1998, 1999 was 12.5, 9.9 and 5.9 kg/hr, respectively. Indication from analysis of age disaggregation show that no more than 1.5 % of any cohort was removed by the offshore shrimp fleet in this period. Theoretical losses computed from yield-per-recruit analysis showed that total loss due to shrimp by-catch mortality in this fishery in 1997, 1998, 1999 were 449 tons, 275 tons and 202 tons, respectively. The loss for each year will be distributed over the 17-year life span of the fish.

d) **By-catches Technical Measures**

No specific technical management measures aimed at reducing catches of juvenile fish were evaluated. A number of examples were discussed during the assessments of various stocks (mesh size, exclusion grates, etc.). STACFIS noted that a document on codend mesh selection studies was presented (SCR 00/49), and that there was a considerable amount of valuable information contained in this paper. As well, STACFIS noted that research vessel surveys should provide useful data in delineating distributions of species, including juveniles. In addition, the data could also be used to delineate areas where by catches would probably occur, and areas where such by-catches would be unlikely. An example using Canadian autumn survey data in Div. 3LNO suggested that by-catches of yellowtail flounder in a fishery for Greenland halibut would be expected to be extremely low, given that there is very little overlap in the depth distribution of these species.

Table 21.1 Overview of catch, by-catch, discard, by-catch of juveniles, discards of juveniles of relevant fish species and squid in the NAFO area for 1999 if not otherwise stated.

	Size limits		Directed fishery									By-catch in other fisheries							
	A	B	C	D	E	F	G	H	I	J		K	L	M	N	O	P	Q	R
Stocks	Length at 50% mature female (L50), cm	Minimum landing size, cm	Total catch, t	Total catch in numbers ('000)	Catch of juveniles, t	Catch of juveniles in numbers ('000)	Discarded catch, t	Discarded catch in numbers ('000)	Discarded juveniles, t	Discarded juveniles in numbers ('000)	Fleet	Total bycatch, t	Total bycatch in numbers ('000)	Juveniles in bycatch, t	Juveniles in bycatch in numbers ('000)	Discarded by-catches, t	Discarded by-catches in numbers ('000)	Discarded juveniles in by-catch, t	Discarded juveniles in by-catch in numbers ('000)
American plaice in Div. 3LNO	33	25	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	163	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											Yellowtail flounder	212	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											Skate/Greenland halibut	1,243	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											TOTAL	1,618	2,898	84	338	N/A	N/A	N/A	N/A
American plaice in Div. 3M	34	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut/Redfish	255	280	1	3	N/A	N/A	N/A	N/A
Capelin in Div. 3NO	14-16	N/A	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cod in Div. 2J3KL	about 43	N/A	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cod in Div. 3M	43.47	45	353 2)	189 2)	13 2)	14 2)	N/A	N/A	N/A	N/A	Redfish	3	2	0	0	N/A	N/A	N/A	N/A
Cod in Div. 3NO	N/A	41	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Skate	584	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											Other	325	N/A	N/A	N/A	N/A	N/A	N/A	N/A
											TOTAL	909	60	16	15	N/A	N/A	N/A	N/A
Thorny skate	55	None	10,374	N/A	~500	N/A	433	N/A	N/A	N/A		<662 3)	N/A	N/A	N/A	117	N/A	N/A	N/A
Greenland halibut in Div. 1A, inshore	N/A	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Greenland halibut in SA 0+1	57	None	9,667	6,185	5,290	5,038	~0	~0	~0	~0	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Greenland halibut in SA 2+3KLMNO	74.1-81.7	35	24,232	23,702	21,973	23,406	N/A	N/A	N/A	N/A	Shrimp	85	N/A	85	N/A	N/A	N/A	N/A	N/A
Other finfish in SA 1	N/A	None	4,983	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Redfish in Div. 3LN	28-30	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	2,300	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Redfish in Div. 3M	29	8	1100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Shrimp	55	1,434	55	1,434	N/A	N/A	N/A	N/A
Redfish in SA 1	35	None	98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roughead grenadier in SA 2+3	26	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	7,052	13,078	5,149	12,560	N/A	N/A	N/A	N/A
Roundnose grenadier in SA 0+1	N/A	None	10	N/A	N/A	N/A	~0	~0	~0	~0	Shrimp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roundnose grenadier in SA 2+3	N/A	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	83	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Squid in SA 3+4	N/A	None	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Silver hake	294	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Witch flounder in Div. 2J3KL	40	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	1000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Witch flounder in Div. 3NO	44-46	None	NDF	NDF	NDF	NDF	NDF	NDF	NDF	NDF	Greenland halibut	800	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yellowtail flounder in Div. 3LNO	34	25	5,413	N/A	N/A	4)	N/A	N/A	N/A	N/A	Greenland halibut	96	N/A	N/A	2%	N/A	N/A	N/A	N/A
											Greenland halibut/Redfish	300	N/A	N/A	2%	N/A	N/A	N/A	N/A
											Skate	752	N/A	N/A	8%	N/A	N/A	N/A	N/A
											TOTAL	1,148	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A: Not available. NDF: No directed fishery. NCP: non-contracting parties.
1) All data for 1998 2) NCP 3) Canada by-catches <50 t 4) 0.4% fro Canada

IV. OTHER MATTERS

1. New Designated Experts

S. Junquera (Designated Experts for roughhead grenadier in SA 2+3) and A. Vazquez (Designated Expert for cod in Div. 3M) were not able to attend this June 2000 Meeting. The Chairman expressed the Committee's appreciation to H. Murua (EU-Spain) and S. Cerviño (EU-Spain) for acting as Designated Experts for roughhead grenadier in SA 2+3 and cod in Div. 3M, respectively.

2. Other Business

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.