PART B

Scientific Council Meeting, 3-16 June 1999

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REPORT OF SCIENTIFIC COUNCIL MEETING
3-16 June 1999

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

I. PLENARY SESSIONS

The Scientific Council met at the Park Place Ramada Plaza Hotel, 240 Brownlow Avenue, Dartmouth, Nova Scotia, Canada, during 3-16 June 1999, to consider the various matters in its agenda.

Representatives attended from Canada, 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.

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 3 June 1999.

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

In the review of the Provisional Agenda, the Chairman noted some modifications were needed as a result of many intersessional activities. A draft with the proposed modifications was presented to the Council. In addition, the Council agreed each Standing Committee should review and report on the previous year's recommendations. The Council **adopted** the agenda with the proposed revisions (see Part E of this volume).

The Council accepted the Chairman's proposal to appoint a Nominating Committee composed of W. R. Bowering (Canada), M. Stein (EU-Germany), F. M. Serchuk (USA) and A. Vazquez (EU-Spain) to propose nominations for the offices of Chairman and Vice-Chairman of Scientific Council, Chairman of Standing Committee of Fisheries Science (STACFIS), Standing Committee on Research Coordination (STACREC), and Standing Committee on Publications (STACPUB).

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

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

The Chairman informed the Council that once again a local area network (LAN) would be used, and it will be similar to the LAN used during the 27 April to 1 May 1999 Scientific Council Meeting on the Precautionary Approach (PA) in San Sebastian. The Council agreed that for this meeting the LAN will contain three directories: one for individual computer ports, one for general use and one for read-only purposes. The Council agreed the use of networking software should be tried out in a stepwise approach during the September 1999 Meeting of the Scientific Council. In addition, the Council noted that the LAN server should be connected to the internet for future meetings.

The Chairman presented a short update on activities since the September 1998 Meeting and reviewed the progress and discussions with managers during the San Sebastian PA Meeting. Having reviewed the special requests from the Fisheries Commission and the Coastal States, the Council determined which items would be undertaken by the Council and which would be assigned to STACFIS.

There were short Council sessions during the course of the meeting to review work progress. The remaining agenda items were addressed by the Council during sessions on 14-16 June 1999, and are reported under the relevant sections of this report.

The concluding session of the Council was called to order at 0840 hours on 16 June 1999.

Outstanding agenda items were addressed.

The Council considered its meeting schedules and future meetings, conducted elections of officers for the term beginning the end of the Annual Meeting in September 1999, 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 3-16 June 1999, noting changes as discussed during the reviews would be made by the Chairman and Assistant Executive Secretary.

The meeting was adjourned at 1530 hours on 16 June 1999.

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

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

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

II. CHAIRMAN'S REPORT ON INTERSESSIONAL ACTIVITIES

1. Report on Eleventh ICES Dialogue Meeting

The Chairman of Scientific Council attended the Eleventh International Council for the Exploration of the Sea (ICES) Dialogue Meeting of 26-27 January 1999 in Nantes, France, as the NAFO Observer. The objective of the meeting was to enhance the mutual understanding of managers and scientists in relation to scientific advice. The complete report of the meeting was issued as an ICES publication and the report of the NAFO Observer (SCS Doc. 99/18) was reviewed by the Council. Of particular interest to the Council were the ICES conclusions on the Precautionary Approach (PA), form of advice and confidence building.

2 Report on Meeting of FAO and Non-FAO Regional Fishery Bodies

The Report of the Meeting of FAO and Non-FAO Regional Fishery Bodies or Arrangements, Rome Italy, 11-12 February 1999, was presented to the Council. The Council was informed that H. P. Cornus (Chairman Scientific Council) and P. Gullestad (Chairman Fisheries Commission) attended the meeting. As reported by these NAFO representatives (SCS Doc. 99/3), the NAFO objective of addressing PA terminology could not be achieved at the meeting because it was not the appropriate forum.

3. ICES ACFM Meeting May 1999

The Chairman of Scientific Council (as the NAFO Observer) attended the ICES ACFM (Advisory Committee on Fishery Management) Meeting, Copenhagen, Denmark, during the Plenary Sessions of 17-19 May 1999. The Council noted an overview of the Scientific Council Meeting on the PA and the Joint Scientific Council/Fisheries Commission Working Group (27 April to 5 May 1999) was presented to ACFM. ACFM recognized the importance of harmonizing concepts, abbreviations and definitions among agencies, and agreed that NAFO and ICES should jointly request FAO to take a lead role in this. The Observer's report was presented to the Council (SCS Doc. 99/19).

III. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 1998

The Council reviewed the following recommendations made in 1998 as listed in *NAFO Sci. Coun. Reports*, 1998, pages 249-257, as they pertained directly to the Council's considerations during this meeting (it is noted Standing Committee recommendations will be addressed under the responsible Committee).

1. Regarding the Meeting of FAO and Non-FAO Regional Bodies, 11-12 February 1999, the Council had recommended that *NAFO accept the invitation and that the Scientific Council nominate a representative to participate, noting also that this would be a suitable forum for discussion of harmonization of terminology in relation to the Precautionary Approach*. (Note this recommendation is repeated in the list).

   The Council was informed the Fisheries Commission Chairman, P. Gullestad, and Scientific Council Chairman, H. P. Cornus, were nominated by NAFO, and they attended the meeting. A report from this meeting is considered under Item II.2 above.

2. The Council had recommended that *its report be made available to the public through the FTP-server of the NAFO internet, (and any cost-savings related to this should be reinvested in the NAFO website and FTP-server)*.

   The Council noted this was achieved by the Secretariat. The Council congratulated the Secretariat for the work done to develop a well-designed website.

3. The Council had recommended that *a Special Scientific Council Meeting be held during the spring of 1999 to review progress on Precautionary Approach initiatives in preparation for the June 1999 meeting*.

   This was achieved and reported under Item IV.1 below.

4. The Council had recommended that *NAFO co-sponsors, along with ICES, the Joint ICES□NAFO Decadal Symposium to be held in August 2001 in Edinburgh*.

   The Council noted this was considered by STACFEN during this meeting and the outcome of discussions is reported in the STACFEN Report.

5. The Council had recommended that *the Chair of the Joint Working Group provide a detailed update of information on harp and hooded seals in the Northwest Atlantic to the Scientific Council for its consideration at the June 1999 Meeting*.

   The Council noted the report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals was considered under Item XIII below.

6. It had been recommended that *the Scientific Council consider asking the Secretariat to approach FAO requesting that a Scientific Council representative be invited to attend the October 1998 FAO Consultation on the Plans of Action for the conservation and management of sharks*.

   The Council noted that the General Council at its September 1998 Meeting had nominated D. Swanson (USA) to attend the FAO Consultation. The report of that meeting from D. Swanson was reviewed by the Scientific Council at this meeting.

7. It had been recommended that *the Executive Committee of the Scientific Council be more directly involved in the budgetary process of NAFO*.

   The Council was informed that the Executive Committee had a meeting with the Executive Secretary immediately after the June 1998 Meeting and many initial requirements of the Council such as, a new meeting site for the June meetings and computer requirements, were addressed. In addition, it was agreed at the Annual Meeting in September 1998 in Lisbon that the Council will appoint a member to attend the STACFAD meetings of September 1999 to address other financial needs of the Council.

IV. IMPLEMENTATION OF PRECAUTIONARY APPROACH (PA)

1. **Review of Results of San Sebastian 27 April-5 May 1999 Meetings, and Future Development**

The Council considered the points made regarding the PA during the Scientific Council Meeting held 27April-1 May 1999 (SCS Doc. 99/4) and the Joint Scientific Council/Fisheries Commission Working Group, 3-5 May 1999 (FC Doc. 99/2) in San Sebastian, and those are reflected in the advice provided under the relevant stocks during this meeting.

The Council agreed that other information pertaining to the PA, including research documents submitted at this meeting, will be taken up during the 13-17 September 1999 Annual Meeting of Scientific Council.

Future developments will also be discussed during the 13-17 September 1999 Meeting.

V. 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 **recommendations** 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, August 2001, should include the equivalent of GBP 3,500 (approximately CDN $8 000) to cover the cost of the art exhibition.*

VI. FISHERIES SCIENCE

The Council **adopted** the Report of the Standing Committee on Fisheries Science (STACFIS) as presented by the Chairman, R. Mayo. The full report of STACFIS is at Appendix II.

VII. RESEARCH COORDINATION

The Council **adopted** the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chairman, V. N. Shibanov. The full report of STACREC is at Appendix III.

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

1. *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.*

2. *the detection exercise of data discrepancies between agency databases should be repeated at short intervals at the discretion of the NAFO and FAO Secretariats.*

3. *STACFIS consider appointing a Designated Expert for elasmobranch species.*

4. *the ad hoc Working Group on Protocol for Scientific Data Collection should work inter-sessionally 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.*

VIII. PUBLICATIONS

The Council **adopted** the Report of the Standing Committee on Publications (STACPUB) as presented by the Chairman, W. B. Brodie. The full report of STACPUB is at Appendix IV.

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

1. *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"* and 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.*

2. *the issue of STACPUB membership be elevated to the Scientific Council for discussion and resolution.*

3. *Scientific Council Research Documents be submitted with an abstract of 250 words or less as described in the instructions for authors.*

4. *the final SCR documents ("yellow" cover) be made available to the public through NAFO website.*

5. *that NAFO Journal volumes 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 the NAFO website.*

6. *NAFO Journals prior to volumes 22 be accessible through the web provided they are available on electronic means.*

7. *Scientific Council request a cost accounting from the NAFO Secretariat on the costs involved in maintaining and operating the NAFO website and FTP server.*

8. *Scientific Council Chair should discuss with the NAFO Executive Secretary the inclusion on the website of the General Council and Fisheries Commission Reports.*

9. *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.*

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. **Progress Report on Special Session in 1999: Joint NAFO/ICES/PICES Symposium on "Pandalid Shrimp Fisheries – Science and Management at the Millennium" (co-conveners: P. A. Koeller, J. Boutillier and S. Tveite)**

   The Council was informed by the Assistant Executive Secretary that the Symposium arrangements had been progressing well and are now in the final stages of preparation. The co-convener, P. A. Koeller, had received more than 60 suggested papers and many of them were selected for oral presentation while others were selected for poster presentation. All papers will be considered for publication in a special issue of NAFO Journal. A book containing a list of Abstracts will be printed by the Secretariat for the meeting.

   The meeting venue will be the same as that for the 1999 NAFO Annual Meeting; the Holiday Inn, Dartmouth, Nova Scotia, Canada. The co-conveners (particularly P. Koeller) have collected a substantial amount of funds from various institutes and private sector donors to support invited speakers and also publication matters.

   The Council was pleased with the progress and expressed sincere gratitude to the co-conveners for the extensive preparatory work and looked forward to a successful and informative Symposium.

2. **Proposal for Special Session in 2000**

In accordance with the Scientific Council's request of September 1998 it received a proposal for a Symposium titled "Managing Marine Ecosystem Variability in the NAFO Area" prepared by a steering committee composed of S. J. Walsh (Canada), O. R. God (Norway), and M. Stein (EU-Germany). The objectives of this symposium will be to take a retrospective look at major changes in the ecosystems in the NAFO area over the past 40 years with influential effects on stock assessment and management. This will include presentations of single case or comparative studies of cyclic changes in the physical and biological environment and their effects on species assemblages and interactions, stock distribution, and demographic parameters. By contrasting various time periods such as before and after various fisheries collapses it should provide a conceptual framework in which to identify key areas which cause uncertainties in assessment, and come up with suggestions on ways to incorporate this information in stock assessment.

The Council was informed that Canada had recently initiated a project that encompasses subject areas suggested for this symposium theme. The Council therefore agreed that this proposal should be postponed to 2001 or 2002 when some additional information becomes available from the Canadian project.

Therefore the Council considered an alternative proposal to conduct a workshop on assessment methods, as a Scientific Council Special Session in conjunction with the Annual Meeting in September 2000. It was agreed such a workshop would be very informative to Council members and quite timely. The Council nominated D. Rivard (Canada) and C. Darby (EU-UK) to prepare a proposal to be presented at the September 1999 Scientific Council Meeting.

3. **Progress Report on Special Session in 2001: Symposium on Hydrobiological Variability**

The Council noted this matter was addressed by STACFEN under the proposed joint ICES/NAFO Symposium of August 2001, in Edinburgh, Scotland.

The Council recognized however that the Hydrobiological Variability Symposium does not coincide with the NAFO Annual Meeting, and as such NAFO scientists may not have the opportunity to attend it.

The Council therefore explored the possibilities of hosting a Special Session in conjunction with the 2001 Annual Meeting. Preliminary discussions on a symposium on deepwater fishes, including elasmobranchs, noted there is worldwide interest on the topic. Council members agreed to consider this topic further and provide proposals during the 13-17 September 1999 Meeting.

X. FUTURE SCIENTIFIC COUNCIL MEETINGS

1. **Scientific Council Meeting and Symposium, September 1999**

Due to the unavailability of data during the June 1999 Scientific Council Meeting to respond to the Fisheries Commission Special request with regard to shrimp in Divisions 3LNO (see Agenda, Annex 1, No. 7), the Scientific Council was forced to delay this agenda item to the September 1999 Annual Meeting. However, the initial scheduling of the September Meeting of the Council was planned without having this agenda item. Noting the extensive nature of the Fisheries Commission request, the Council agreed it would need to add 1 day to the initially announced schedule.

Consequently, the Scientific Council added the date of 7 September 1999 for the Scientific Council to review shrimp in Div. 3LNO. This was in advance of the presently scheduled 8-10 September 1999 for the Special Session: Joint NAFO/ICES/PICES Symposium on "Pandalid Shrimp Fisheries – Science and Management at the Millennium", and the 13-17 September 1999 continuation of the Meeting of the Scientific Council.

2. **Scientific Council Meeting in November 1999 (Assessment of Shrimp Stocks in Division 3M, Subareas 0+1 and Denmark Strait)**

The Council reconfirmed its shrimp stock assessment meeting scheduled for 11-17 November 1999, in Reykjavik, Iceland. Noting this meeting includes the assessment of shrimp in Div. 3M, the Council confirmed the 2 additional working days.

3. **Scientific Council Meeting, June 2000**

It was tentatively agreed that the June Meeting of the Council would be during 2-15 June 2000 (**note**: this represents a change to the dates and duration previously considered during the Council's deliberations in June and September 1998). However, it was noted that the Scientific Council will at its September 1999 Meeting review the structure and duration of its June Meetings.

4. **Scientific Council Meeting and Special Session, September 2000**

The Council noted the scheduled dates for the year 2000 Annual Meeting were 18-22 September 2000. The Council did not foresee, at this time, the need for additional work days.

The Council confirmed the proposed Special Session dates would be 13-15 September 2000.

5. **Scientific Council Meeting, November 2000**

The Council agreed the dates, duration and venue for the November 2000 Scientific Council Meeting on shrimp in Div. 3M, and Subareas 0+1 and Denmark Strait be reviewed during the September 1999 Meeting.

6. **Scientific Council Meeting, November 2001**

The Council agreed the dates, duration and venue for the November 2001 Scientific Council Meeting be reviewed during the 13-17 September 1999 Meeting.

XI. NOMINATION AND ELECTION OF OFFICERS

The Chairman's proposal (3 June 1999) to appoint a Nominating Committee composed of W. R. Bowering (Canada), M. Stein (EU-Germany). F. M. Serchuk (USA) and A. Vazquez (EU-Spain) was accepted. On 16 June 1999, the Chairman requested the Nominating Committee's proposals.

The Council noted the appointments were for two-year terms beginning at the end of the September 1999 Annual Meeting. Noting also that the Rules of Procedure were changed with respect to election of STACREC and STACPUB chairmanship, the Chairman called for nominations and elections.

Chairman Scientific Council. For the office of Chairman of Scientific Council, the current Vice-Chairman, W. B. Brodie (Canada) was nominated by the Committee. There being no other nominations, the Council elected him by unanimous consent.

Vice-Chairman Scientific Council. For the office of Vice-Chairman of Scientific Council the current Chairman of STACFIS, R. K. Mayo (USA), was nominated by the Committee. There being no other ```nominations, the Council elected him by unanimous consent.

Chairman STACPUB. For the office of Chairman of the Standing Committee on Publications (STACPUB), O. A. J rgensen (Denmark/Greenland) was nominated by the Committee. It was noted this position is now independent of the Vice-Chairman as per the new Rules of Procedure. There being no further nominations, the Council elected him by unanimous consent.

Chairman STACFIS. For the office of Chairman of the Standing Committee on Fisheries Science (STACFIS), H.-J. R tz (EU-Germany) was nominated by the Committee. There being no other nominations, the Council elected him by unanimous consent.

Chairman STACREC. The new Rules of Procedure (as of this meeting) determined that the Vice-Chairman would take the office of the Chairman of the Standing Committee on Research Coordination (STACREC). R. Mayo (USA) was accordingly appointed to the office.

XII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. **Fisheries Commission** (see Part E, Agenda II, Annex 1)

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 2000**

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 1998 agreed to consider certain stocks on a single year basis and others on a multiyear basis. This section presents those stocks for which the Scientific Council provided scientific advice for the year 2000.

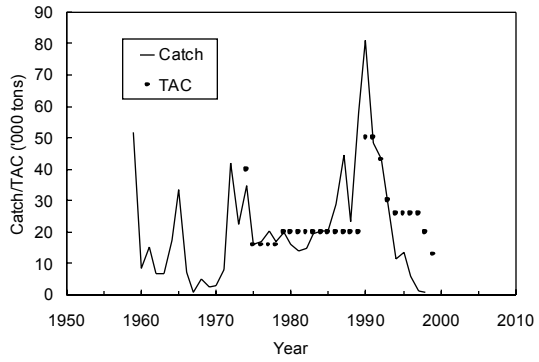
Redfish (Sebastes spp.) in Division 3M

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 fishery in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, falling continuously through 1998, when a catch of only 970 tons was reported, mostly as by-catch in the Greenland halibut fishery. The decline in the Div. 3M redfish catches from 1990 to 1998 is related to the reduction of fishing effort.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1996	6	20	26
1997	1.3	20	26
1998	0.97	20	20
1999		10	13

[1] Provisional.

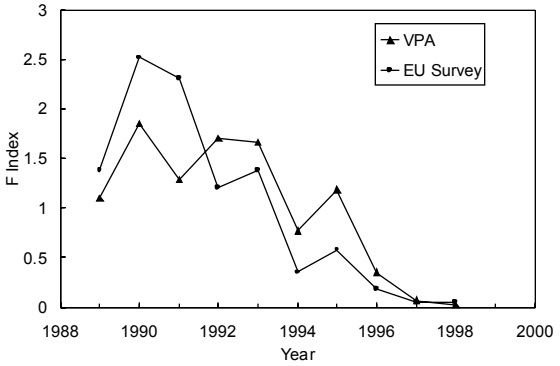


Data: Length and age data (1989-98) and observed CPUE data (1988-96) were available from Portuguese bottom trawlers. Another CPUE series, standardized with STATLANT 21B catch and effort data for most of the components of the fishery (1959-93) was also available.

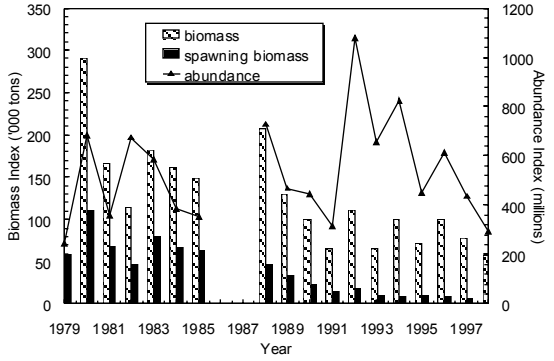
There are three survey series providing bottom biomass indices as well as length and age data for the Flemish Cap redfish stocks; Russia (1983-93 and 1995-96), EU (1988-98) and Canada (1979-85 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic component for the 1988-92 period.

Assessment: Survey bottom biomass and female spawning biomass were calculated from 1979-89 Canadian and 1988-98 EU surveys. A VPA and a surplus production analysis were conducted for the most recent period of 1989-98, providing estimates of stock biomass and fishing mortality trends.

Fishing Mortality: Fishing mortality declined since 1990 and is at present at a relatively low level.



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



Biomass: Survey indices and model results indicate a decline of total biomass since the late-1980s. Trends from both VPA and ASPIC models suggested a gradual recent increase in total biomass, 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.

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 relatively low fishing mortality, and with growth of the relatively strong 1990-91 year-classes, stock and spawning biomass should gradually increase.

Recommendation: The Council was unable to advise on a specific TAC for year 2000, 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 2000 be in the range of 3 000-5 000 tons.

Reference Points: It was not possible to develop a SSB/recruitment relationship for this stock with existing data. With the assumption of constant recruitment, fishing a $F_{0.1}$ of 0.11 would correspond to a long-term female spawner proportion in the stock biomass of about 30 . Given the intermittent pattern of redfish recruitment on a 5-10 year cycle the proportion of SSB should be maintained at a level greater than 30 of the total biomass. The long term fishing mortality associated with a female SSB at about 40 of the total stock biomass is 0.04.

Special Comments: Over the past 5 years, female spawning stock biomass has been about 9 - 20 of the total biomass. During the late-1970s and early-1980s, when the stock experienced relative stability, that proportion was about 40 .

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 caught being reported to Scientific Council each June.

Sources of Information: SCR Doc. 99/ 22, 30, 52, 53; SCS Doc. 99/16.

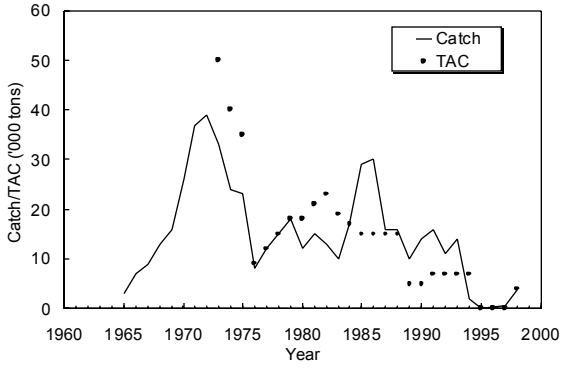
Yellowtail Flounder (Pleuronectes ferruginea) in Divisions 3L, 3N and 3O

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.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1996	0.3	ndf	0
1997	0.8	ndf	0
1998	4.4	4	4
1999		6	6

[1] Provisional.
ndf No directed fishery.

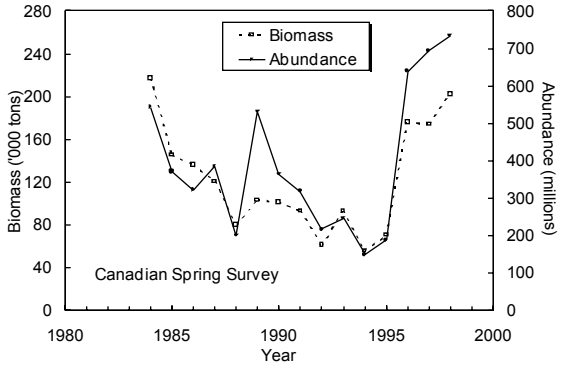


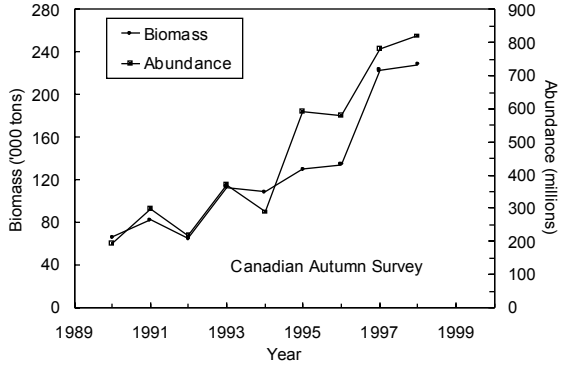
Data: CPUE were available from 1965 to 1998. Limited by-catch sampling data from the Portuguese and Spanish trawler fleets were available. Abundance and biomass indices were available from: annual Canadian spring (1984-98) and autumn (1990-98) bottom trawl surveys; co-operative Canadian Dept. Fisheries and Oceans/Canadian fishing industry quarterly surveys (1996-99); and, Spanish surveys in the NAFO Regulatory Area of Div. 3NO (1995-99).

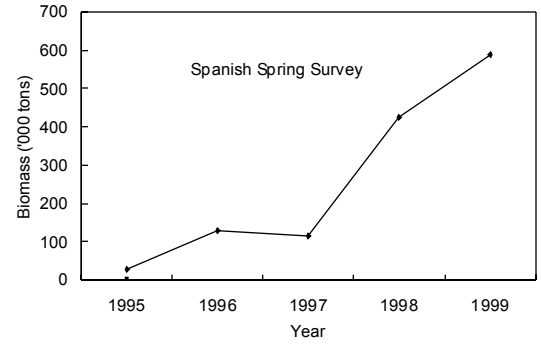
Assessment: No analytical assessment possible.

Recruitment: The 1994 and 1995 year-classes were somewhat weaker than the strong 1993 year-class, although among the highest in the time series.

Biomass:







State of Stock: Based on 8 additional surveys since the 1998 assessment, the current view is that the stock size has increased over the past year. The stock biomass is perceived to be at a level close to that of the mid-1980s.

Recommendation: During the Scientific Council Meeting on Precautionary Approach in San Sebastian (April-May, 1999) F_{buf} was determined to be 0.13 corresponding to an exploitation rate of about 11 . Applying this to the average estimate of fully recruited age 7+ biomass index from the Canadian spring and autumn surveys of 1998 (98 000 tons) results in a catch of about 10 000 tons. Scientific Council recommends the TAC be set at 10 000 tons for the year 2000.

Scientific Council notes that this is the same yield that would be achieved at 2/3 F_{msy} as estimated at that Scientific Council Meeting.

Reference Points: Scientific Council considered a F_{buf} of 0.13 but was unable to derive any biomass based reference points yet.

Research Recommendation: The 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.

Sources of Information: SCR Doc. 99/3, 5, 13, 16, 23, 42, 44, 54, 57, 59, 60, 61, 68; SCS Doc. 99/6, 16.

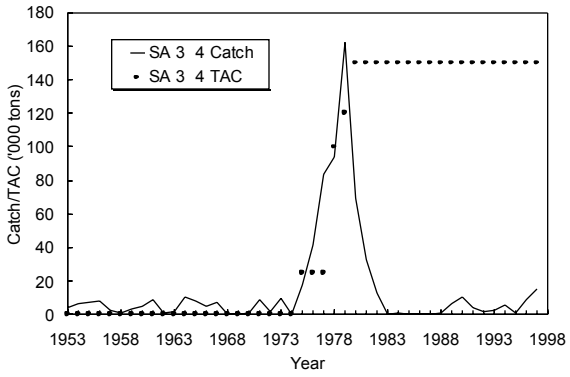
Short-finned Squid (Illex illecebrosus) in Subareas 3 and 4 (see also Agenda II, Annex 1, Fisheries Commission request 3-f)

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

Fishery and Catches: Catches in Subareas 3+4 increased during the late-1970s, averaging 81 000 tons during 1976-81, and peaking at 162 000 tons in 1979. Catches in Subareas 3+4 declined to 111 tons in 1986, ranged between 600 and 11 000 tons during 1987-95, increased to 14 500 tons in 1997, and declined to 1 900 tons in 1998. 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.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1996	9	na	150
1997	15	na	150
1998	2	na	150
1999		19-34	75

[1] Provisional.
na No advice provided.

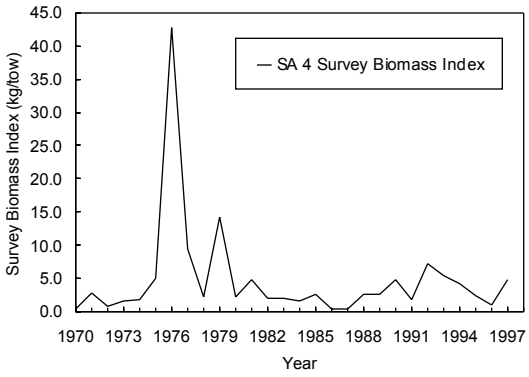


Data: Relative biomass and abundance indices were available from annual Canadian bottom trawl surveys conducted in Subarea 4 in July on the Scotian Shelf (Div. 4VWX, 1970-98) and in September in the southern Gulf of St. Lawrence (Div. 4T, 1971-98). The July survey indices are assumed to reflect relative stock size at the beginning of the fishing season. Size composition data were available from the Subarea 4 survey in July and from the inshore Newfoundland commercial jig fishery in Subarea 3. Maturity data were also available from Subarea 3.

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

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

Biomass: Survey biomass indices reached peak levels during the late-1970s indicating that this was a period of high squid productivity. Since 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 2000. 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 2000 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.

Based on the data from the Subarea 4 survey in July mean weights during the low productivity period (1982-98) were 50 of those during the high productivity period (1976-81). This suggests that changes in mean weights may be an indicator of changes in productivity levels.

Sources of Information: SCR Doc. 98/75; SCR Doc. 99/49, 50, 66; SCS Doc. 99/7, 8, 20.

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

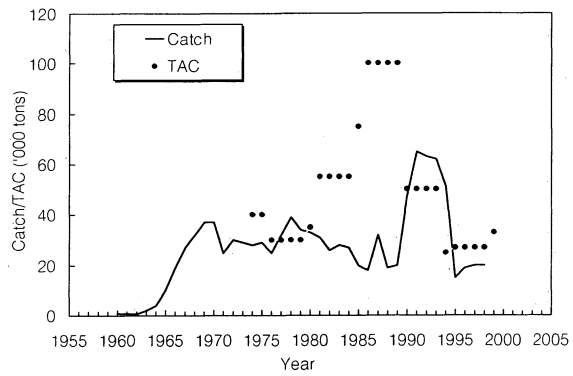
Background: The Greenland halibut stock in Subarea 2 and Div. 3KLMNO is considered to be part of a biological stock complex which includes Subareas 0 and 1.

Fishery and Catches: Catches increased sharply in 1990 due to a developing fishery in the Regulatory Area in Div. 3LMN and continued at high levels during 1991-94. The catch was only 15 000 to 20 000 tons per year in 1995 to 1998 as a result of lower TACs under management measures introduced by the Fisheries Commission. Catches have been well below TACs during 1995-98.

Catches in the following table are best estimates.

	Catch[1] ('000 tons)	TAC[2] ('000 tons) Recommended	Agreed
1996	19		27
1997	20		27
1998	20		27
1999		~30	33

[1] Provisional.
[2] Established autonomously by Canada in 1993-94 and NAFO Fisheries Commission in 1995-99.



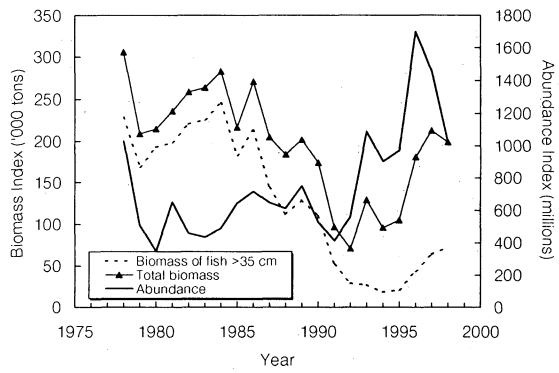
Data: CPUE data were available from otter trawl fisheries in Canadian zone and the Portuguese otter trawl fishery in the Regulatory Area of Div. 3LMN. Abundance and biomass indices were available from research vessel surveys of Canada (1978-98), EU (1988-98), and EU-Spain (1995-99). The Canadian autumn surveys in 1996 to 1998 covered most of the stock distribution, including Div. 2GH.

Assessment: Analytical assessments are not possible with available data.

Fishing Mortality: Not precisely known, but believed to be above sustainable levels during 1990-94. Sharp declining trend in 1994-97 as a result of significant reductions in fishing effort, but indications of an increase in 1998.

Recruitment: Above average recruitment indicated for all year-classes from 1990-95, but the 1996 and 1997 year-classes appear to be lower. Confidence in these observations, particularly for the most recent year-classes, will increase as additional years of surveys covering the entire stock become available.

Biomass: (Div. 2J and 3K only)



State of the Stock: Most survey indices of biomass increased from 1996 to 1998, and CPUE increased in 1997 and 1998 due mainly to recruitment of the 1990-92 year-classes. Above average recruitment is also indicated for all year-classes from 1993 to 1995. Indices of fishable biomass (greater than 35 cm) were below average in 1998, but should continue their recent gradual increase in 1999-2000 as these year-classes continue to recruit to the fishable stock.

Recommendation: The Council is unable to advise on a specific TAC for year 2000 and recommends that a catch in year 2000 of about 30 000 tons is likely to allow the stock to continue to increase.

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

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

Sources of Information: SCR Doc. 99/2, 9, 11, 22, 23, 31, 38; SCS Doc. 99/5, 6, 15, 16.

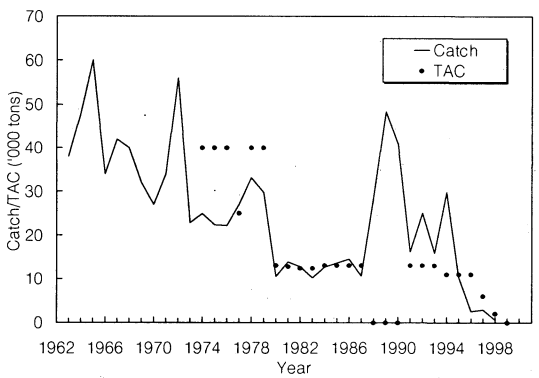
Cod (Gadus morhua) in Division 3M

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

Fishery and Catches: Catches exceeded the TAC from 1988 to 1994, however, were below the TAC since 1995. Large numbers of small fish were caught by the trawl fishery in most recent years. By-catches were estimated to be low in the shrimp fishery since 1993. The fisheries since 1996 were very small compared with previous years. Most of the fleets traditionally directing for Div. 3M cod did not participate. One-third of the 1998 catch was taken by vessels from non-Contracting Parties.

	Catch[1]	TAC ('000 tons)	
	('000 tons)	Recommended	Agreed
1996	3	[2]	11
1997	3	ndf	6
1998	1	ndf	2
1999		ndf	0

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



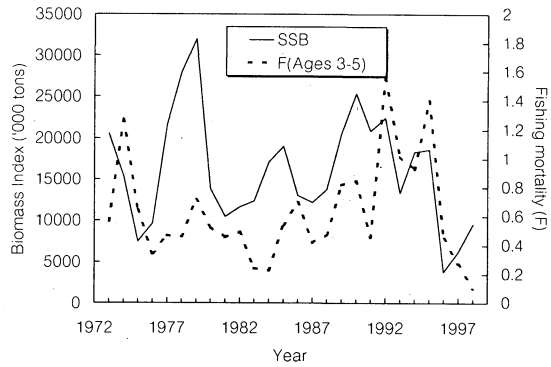
Data: Length and age composition of the 1998 catch were available for Portuguese and Russian trawlers. Data were also available from the EU bottom-trawl survey, which covers the whole distribution area of the stock.

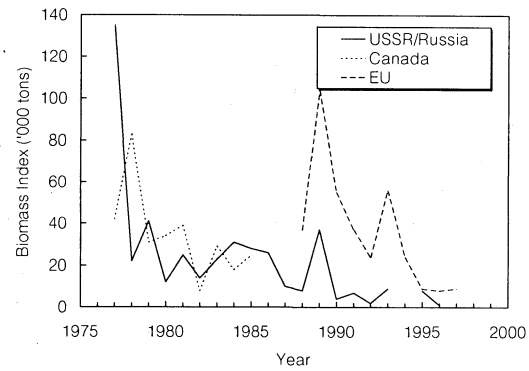
Assessment: An analytical assessment was presented.

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 1998 year-classes are even poorer.

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





State of the Stock: The stock has collapsed. The total stock biomass in 1996, 1997 and 1998 are the lowest on record. Recruitment at age 3 is expected to be poor in 1999 and 2000. The decrease in the age-at-maturity of the stock, interpreted as a reaction of the population to the decline of the stock, did not result in more abundant recruitments.

Recommendation: No directed fishery for cod in Div. 3M in year 2000. Also, by-catch of cod in fisheries directed to other species on Flemish Cap 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: Given the current state of the stock, no marked improvement in the fishable stock is expected over the next several years.

Sources of Information: SCR Doc. 99/10, 22, 29, 56; SCS Doc. 99/5, 16.

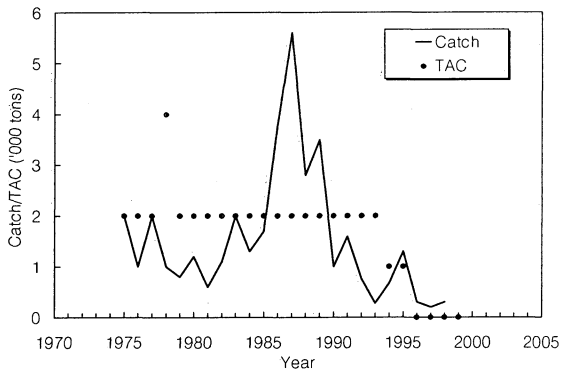
American Plaice (Hippoglossoides platessoides) in Division 3M

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. About 1/3 of the catch was taken by non-Contracting Parties in 1998.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1996	0.3	0	0
1997	0.2	0	0
1998	0.3	ndf	0
1999		ndf	0

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

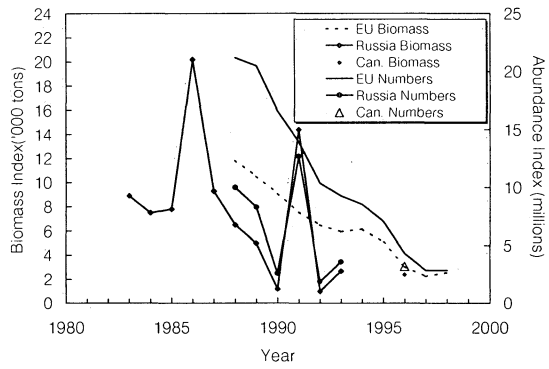


Data: Abundance and biomass indices from surveys were available from USSR/Russia (1983-93), EU (1988-98).

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

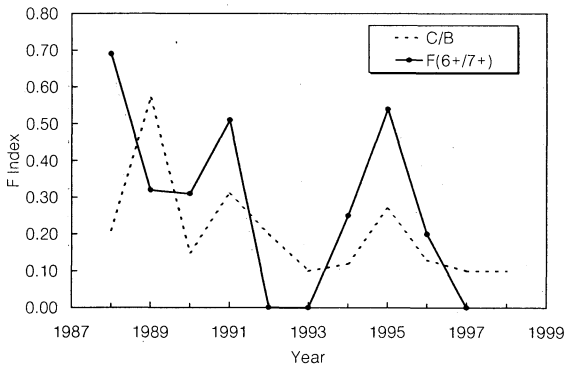
Recruitment: Only weak year-classes have been observed since 1990.

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 1998 was at the lowest level observed (24% of the 1988 level).

Fishing Mortality: Catch/Survey biomass ratio and average Z estimated for ages 6 and plus showed a decreasing trend during the 1990s.



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

Recommendation: There should be no directed fishery on American plaice in Div. 3M in year 2000. 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.

Sources of Information: SCR Doc. 98/51; SCR Doc. 99/22, 39; SCS Doc. 99/16.

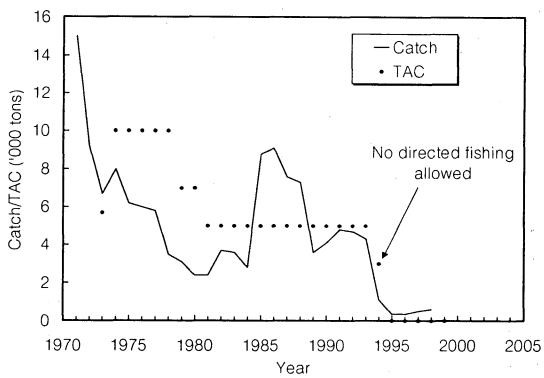
Witch Flounder (Glyptocephalus cynoglossus) in Divisions 3N and 3O

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.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1996	0.4	nf	0
1997	0.5	nf	0
1998	0.6	nf	0
1999	-	nf	0

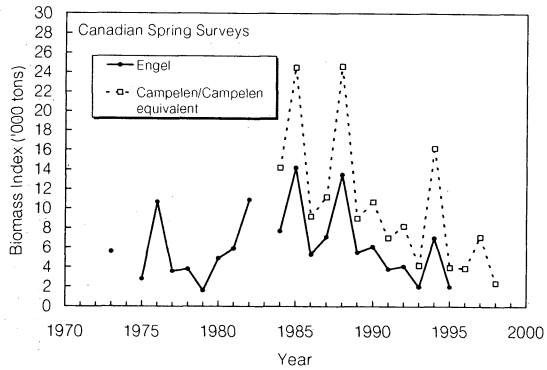
[1] Provisional.
nf No fishing.



Data: Abundance and biomass data were available from Canadian spring surveys during 1973-98 and autumn surveys during 1990-98 as well as Spanish surveys during spring 1995-99.

Assessment: No analytical assessment was possible with current data.

Biomass:



Recruitment: No information.

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

Recommendation: No directed fishing on witch flounder in the year 2000 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 ageing data were available since 1993 and none are anticipated in the near future.

Sources of Information: SCR Doc. 99/34, 57; SCS Doc. 99/6, 16.

b) **Request for Advice on TACs and Other Management Measures for Years 2000 and 2001**

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 1998 agreed to consider certain stocks on a single year basis and others on a multiyear basis. This section presents those stocks for which the Scientific Council provided scientific advice for the years 2000 and 2001.

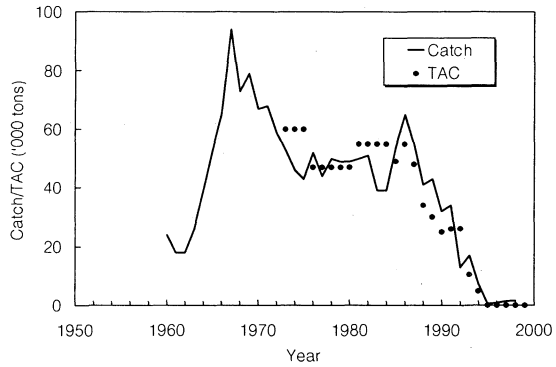
American Plaice (Hippoglossoides platessoides) in Divisions 3L, 3N and 3O

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

Fishery and Catches: In most years the majority of the catch has been taken by offshore otter trawlers. There was no directed fishing in 1994 and there has been a moratorium from 1995 to 1999.

		TAC ('000 tons)	
Year	Catch[1] ('000 tons)	Recommended	Agreed
1996	0.9	nf	0
1997	1.4	nf	0
1998	1.6	nf	0
1999		nf	0

[1] Provisional.
nf No fishing.



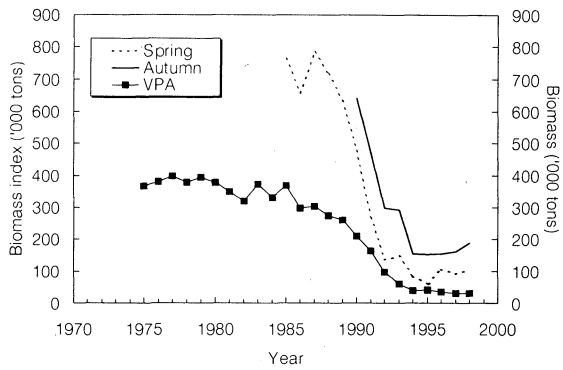
Data: Biomass and abundance data were available from several surveys. Limited sampling data from by-catch by Portuguese and Spanish vessels were available.

Assessment: An analytical assessment using the ADAPT framework tuned to the Canadian spring survey was used.

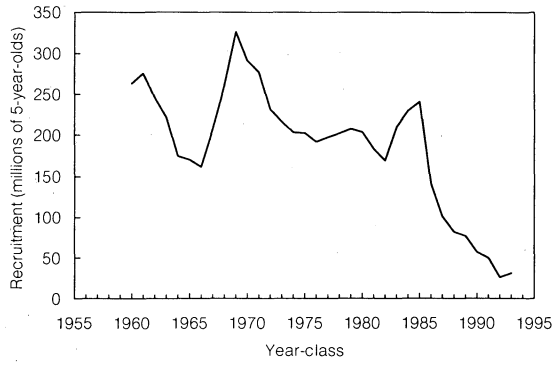
Biomass: The biomass has decreased substantially since the mid-1980s and remained at a very low level since 1994.

Recruitment: There have been no good year-classes since the mid-1980s.

Biomass index: The index was from Canadian spring and autumn surveys and biomass from VPA.



Recruitment: Recruitment was from VPA.



State of the Stock: VPA and Canadian spring and autumn surveys showed a large decline in biomass since the mid-1980s. Recruitment has been low since the mid-1980s. Total mortality remains high on young fish but has declined on older (5+) ages. The stock remains low compared to historic levels.

Recommendation: No directed fishing on American plaice in Div. 3LNO in years 2000 and 2001. By-catches should be kept at the lowest possible level.

Reference Points: Scientific Council concluded that given the large change in the SSB recruit relationship produced by the change in M in the VPA, it was not possible to provide reference points at this time and that the tentative B_{lim} (150 000 tons SSB) proposed in 1998 must be re-evaluated.

Medium and Long Term Considerations: Projections were attempted but given the uncertainties associated with the impact of changes in M on the stock recruit relationship, it was considered premature to use the results at this time.

Sources of Information: SCR Doc. 99/40, 42, 55, 57, 58, 69; SCS Doc. 99/6, 16.

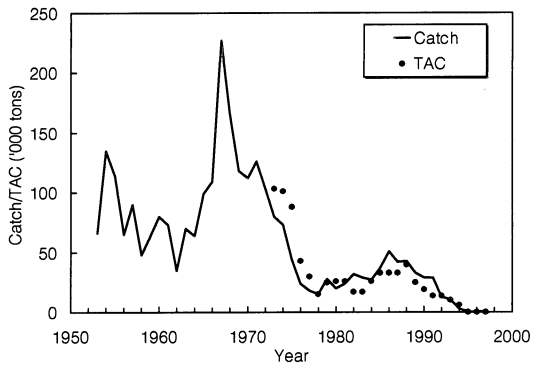
Cod (Gadus morhua) in Divisions 3N and 3O

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

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

	Catch[1] ('000 tons)	TAC ('000 tons) Recommended	Agreed
1996	0.2	nf	0
1997	0.4	ndf	0
1998	0.6	ndf	0
1999	-	ndf	0

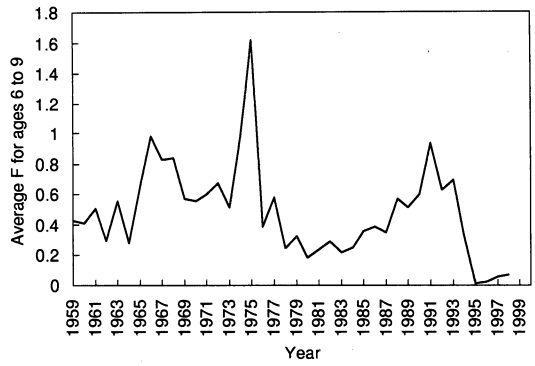
[1] Provisional.
nf No fishing
ndf No directed fishery and by-catches of cod in fisheries targeting other species should be kept at the lowest possible level.



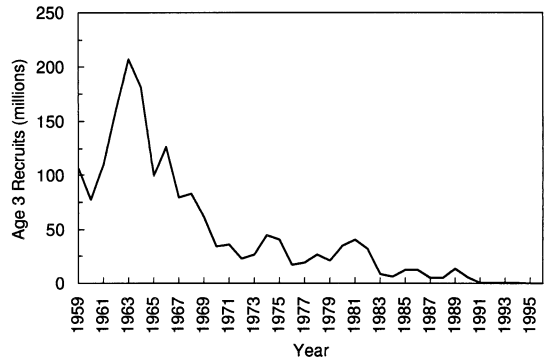
Data: Biological sampling data from by-catches of cod in 1998 were inadequate to estimate the age structure of total removals. Canadian spring and autumn survey data provided abundance, biomass and age structure information. Spanish spring survey data provided abundance and biomass information. Canadian juvenile research survey data were available up to 1994.

Assessment: An analytical assessment was presented to estimate population numbers in 1999.

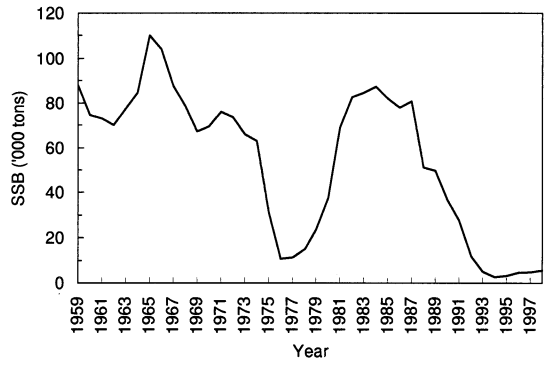
Fishing Mortality: Has been low since 1995.



Recruitment: Recent surveys and the VPA suggest that recruitment has been non-existent since 1990 year-class.

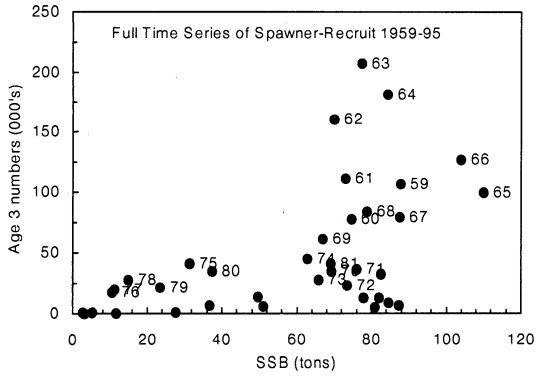


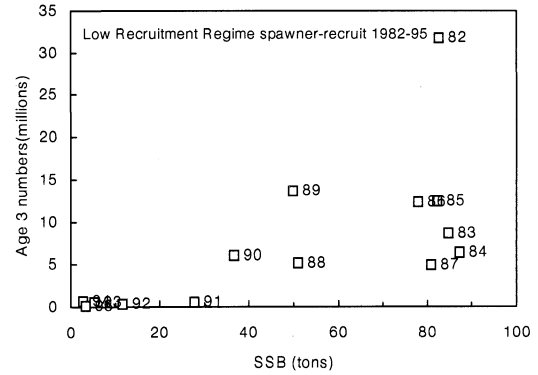
Biomass: The 1998 spawning stock biomass is estimated to be at an extremely low level.



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

Recommendation: There should be no directed fishing for cod in Div. 3N and 3O in years 2000 and 2001. By-catches of cod in fisheries targeting other species should be kept at the lowest possible level.





Note: change in scale

Reference Points. The current best estimate of B_{lim} for SSB is 60 000 tons. It was also concluded that in the recent period of low productivity, there is an indication of even further reduction in recruitment at about half the B_{lim} level. Scientific Council will review in detail the biological reference points in the context of the PA framework when the SSB has reached half the current estimate of B_{lim}.

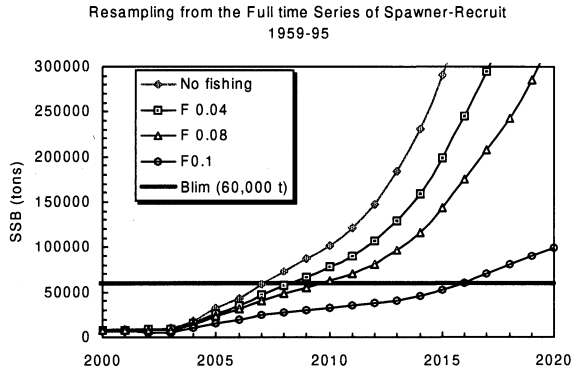
Medium and Long Term Considerations: Simulations were carried out to find the time to reach B_{lim} and half B_{lim} under various assumptions of spawner recruit regimes and different levels of fishing mortality. These simulations take into account the precision of the stock size estimates currently available and the variability in recruitment.

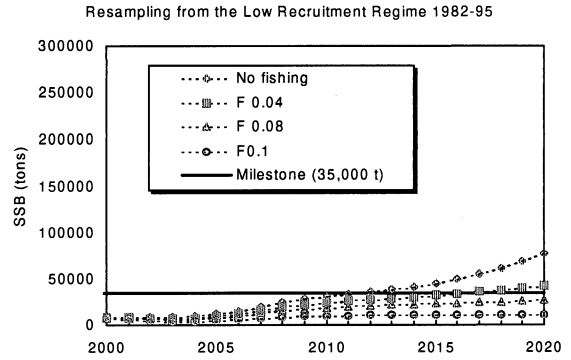
These results suggest that recovery time will largely depend upon which recruitment regime prevails in the future.

Time to recovery will be increased with increased fishing mortality. In particular, fishing mortalities in excess of the levels observed in recent years (which were associated with by-catch in fisheries for other species) could increase considerably the recovery time if future years are dominated by continuation of the low recruitment regime, which has prevailed since 1982.

The yield expected under low recruitment regime is about one-tenth that expected from recruitment levels that existed in the 1960s and 1970s.

The Scientific Council cautions that the projections illustrated are of median estimates only. This means that at the year in which B_{lim} is projected to be reached there is still a 50% chance that the true SSB is below B_{lim}.





Sources of Information: SCR Doc. 99/62, 57, 67; SCS Doc. 99/16.

Cod in Div. 3NO: results of simulations done to evaluate the impact of various fishery mortality levels on stock recovery.
Each simulation represents 2000 iteractions.

	Re-sampling full range of recruitment											
	No catch			F = 0.04 (current bycatch level)			F= 0.08 (twice current bycatch lev			F = 0.20 (F0.1)		
Year	Median SSB (t)	Median Yield (t)	Prob. SSB<60000 t	Median SSB (t)	Median Yield (t)	Prob. SSB<60000 t	Median SSB (t)	Median Yield (t)	Prob. SSB<60000 t	Median SSB (t)	Median Yield (t)	Prob. SSB<60000 t
1999	7740	0	100%	7765	354	100%	7786	695	100%	7747	1636	100%
2000	8448	0	100%	8153	378	100%	7830	717	100%	6926	1536	100%
2001	8907	0	100%	8254	440	100%	7630	809	100%	6007	1621	100%
2002	9691	0	100%	8609	708	100%	7736	1313	100%	5608	2879	100%
2003	11072	0	100%	9487	1006	100%	8319	1874	100%	5851	3583	100%
2004	18906	0	100%	15936	1322	100%	14185	2511	100%	10821	4707	100%
2005	32670	0	93%	26185	1724	98%	23074	3190	100%	15150	5685	100%
2006	43503	0	72%	35355	2165	86%	31520	3851	93%	19949	6576	100%
2007	58773	0	51%	46737	2612	69%	40927	4565	81%	24561	7397	100%
2008	72723	0	35%	57303	3122	54%	48603	5250	69%	27494	7983	99%
2009	87159	0	24%	66190	3722	42%	55205	6090	57%	30476	8733	98%
2010	102381	0	16%	77710	4441	31%	62893	7144	46%	32830	9454	97%
2011	121228	0	10%	90009	5383	23%	70473	8400	36%	35009	10301	94%
2012	147526	0	7%	106368	6520	15%	81461	10102	27%	37565	11431	89%
2013	184057	0	3%	129237	7999	10%	96226	12122	19%	40886	13047	80%
2014	230393	0	2%	159381	9749	7%	116280	14576	13%	45840	14949	69%
2015	290398	0	1%	198912	11943	4%	143603	17320	10%	52128	17652	60%
2016	368172	0	1%	245171	14273	2%	174190	20426	7%	60448	19848	50%
2017	453774	0	0%	294934	16896	2%	207726	24394	5%	70659	22290	41%
2018	540360	0	0%	354261	19561	1%	241971	28723	3%	80929	24404	35%
2019	629882	0	0%	419071	22092	1%	285382	32477	2%	90196	26478	30%
2020	706820	0	0%	480448	24564	1%	334915	36099	2%	98820	29159	27%

	Re-sampling recruitment since 1982											
	No catch			F = 0.04 (current bycatch level)			F= 0.08 (twice current bycatch lev			F = 0.20 (F0.1)		
Year	Median SSB (t)	Median Yield (t)	Prob. SSB<35000 t	Median SSB (t)	Median Yield (t)	Prob. SSB<35000 t	Median SSB (t)	Median Yield (t)	Prob. SSB<35000 t	Median SSB (t)	Median Yield (t)	Prob. SSB<35000 t
1999	7797	0	100%	7783	354	100%	7761	693	100%	7786	1641	100%
2000	8503	0	100%	8153	354	100%	7824	671	100%	6960	1414	100%
2001	8879	0	100%	8190	375	100%	7544	683	100%	5963	1294	100%
2002	9043	0	100%	8033	383	100%	7161	687	100%	5046	1208	100%
2003	9170	0	100%	7903	445	100%	6797	798	100%	4342	1401	100%
2004	9627	0	100%	8049	525	100%	6795	913	100%	4099	1543	100%
2005	12197	0	98%	10081	645	100%	8678	1123	100%	5331	1890	100%
2006	15195	0	92%	12620	774	97%	10422	1340	99%	6096	2213	100%
2007	19407	0	84%	15951	891	91%	13255	1513	97%	7535	2289	100%
2008	24436	0	74%	19902	982	86%	16256	1637	94%	9031	2466	100%
2009	28893	0	65%	22369	1106	80%	17814	1779	91%	9526	2625	100%
2010	30998	0	58%	24115	1186	75%	19028	1892	89%	9962	2723	100%
2011	34134	0	52%	26263	1265	71%	20199	1984	86%	10387	2803	100%
2012	36853	0	47%	28113	1340	67%	21201	2095	84%	10722	2805	100%
2013	38810	0	44%	29052	1396	64%	21905	2152	84%	10804	2847	100%
2014	41537	0	40%	30532	1467	60%	22966	2211	82%	10866	2838	100%
2015	45548	0	34%	32214	1548	56%	23739	2269	79%	10901	2821	100%
2016	49785	0	30%	33734	1614	52%	24231	2321	75%	10931	2846	100%
2017	54560	0	26%	36112	1711	48%	24868	2372	73%	10853	2839	100%
2018	60850	0	23%	37692	1811	46%	25375	2450	70%	10842	2819	100%
2019	68784	0	21%	39523	1965	43%	26107	2534	68%	10854	2831	100%
2020	77984	0	18%	42196	2109	41%	27023	2619	66%	10798	2846	100%

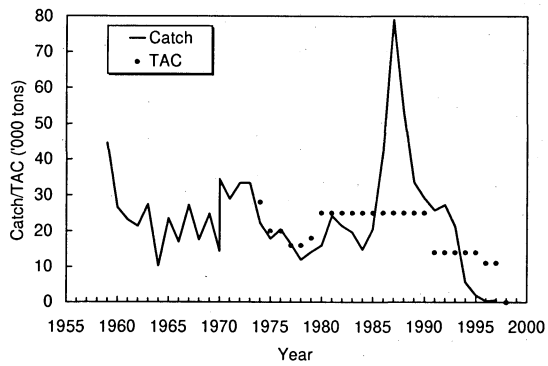
Redfish (Sebastes spp.) in Divisions 3L and 3N

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

Fishery and Catches: Catches averaged about 22 000 tons from 1959 to 1985, increased sharply to an historical high of 79 000 tons in 1987 then declined steadily to about 500 tons in 1996. Catch increased to 850 tons in 1998. A moratorium on directed fishing was implemented in 1998 and 1999. The 1998 catch was taken as by-catch in Greenland halibut fisheries primarily by EU-Portugal and EU-Spain. A portion of the catches, in some years substantial, have been taken by non-Contracting Parties from 1987 to 1994. These countries have not fished in Div. 3LN since 1994.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Agreed
1996	0.5	14	11
1997	0.6	14	11
1998	0.9	ndf	0
1999		ndf	0

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



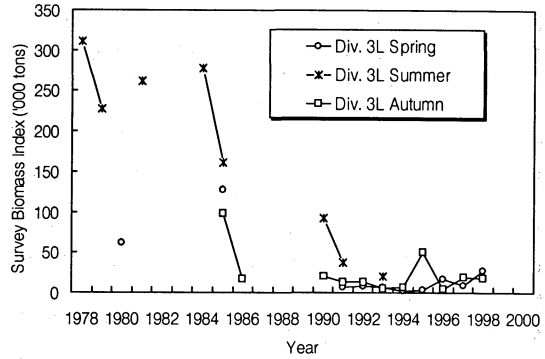
Data: Bottom trawl surveys conducted by USSR/Russia from 1984 to 1994, and by Canada from 1978 to 1998 are the basis for the assessment of stock status.

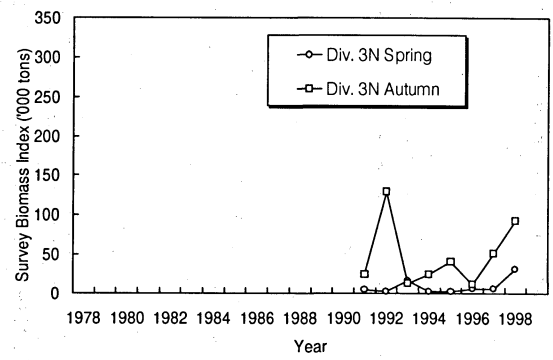
Assessment: No analytical assessment was possible.

Fishing Mortality: Unknown, but assumed to have declined due to reduced effort since 1994. In late-1980s large catches likely generated high fishing mortalities.

Recruitment: No sign of good recruitment since the 1986 and 1987 year-classes.

Biomass:





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

Recommendation: No directed fishing for redfish in Div. 3LN in years 2000 and 2001, and by-catches of redfish 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: The continuing uncertainties regarding the relationship between redfish in Div. 3LN and Div. 3O have important impacts on interpretation of available data.

The most recent relatively good year-classes, those of 1986-87, are recruiting to the SSB. These same year-classes will make up the greatest proportion of the SSB in the near future.

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

Sources of Information: SCR Doc. 99/65; SCS Doc. 99/5, 6, 15, 16.

c) **Special Requests for Management Advice**

i) **Precautionary measures**

The Fisheries Commission requested the Scientific Council to *consider precautionary measures for all stocks under its responsibility* (see Part E, Agenda II, Annex 1, Item 4).

The Council noted that precautionary measures relevant to certain stocks were addressed, and reported under specific scientific advice for those stocks.

ii) **Criteria for re-opening fisheries**

The Fisheries Commission requested that the Scientific Council *develop criteria to be evaluated during any consideration of possible fisheries re-openings* (see Part E, Agenda II, Annex 1, Item 5).

The Council addressed criteria for re-opening certain stocks, and relevant stock advice reports contain these considerations.

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

The Fisheries Commission requested the Scientific Council (see Part E, Agenda II, Annex 1, Item 3.f.) to:

1) provide advice on the approach that could be used on an ongoing basis to allow timely identification of the onset of a new productivity level (higher or lower).
2) advise on catch levels that would be appropriate for different levels of productivity.
3) evaluate the potential impacts of fisheries for squid in Subareas 3 and 4 on the portion of the squid (Illex) resource in Subareas 5 and 6.

Regarding request 1), the Council responded:

There are currently no pre-season surveys of larval or juvenile short-finned squid. It is therefore not possible to reliably identify changes in productivity prior to the fishing season in any given year. However, 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.

Regarding request 2), the Council responded:

Based on the available short-finned squid fisheries and survey data, the Scientific Council has identified only two general levels of productivity since the mid-1970s: a high productivity period during 1976-81, and a low productivity period from 1983 to the present.

As indicated in 1998 by the Scientific Council, the upper range of catches that might be expected under the current low productivity regime would be between 19 000 and 34 000 tons. In periods of high productivity, much higher catch levels would be appropriate.

Regarding request 3), the Council responded:

The Scientific Council considers that short-finned squid is an annual species (1-year life cycle) that comprises a unit stock throughout its range in the Northwest Atlantic Ocean, from Newfoundland to Florida including NAFO Subareas 3-6. Spawning occurs annually in association with the Gulf Stream generally at a common site south of Subareas 3 and 4. As the major peak of spawning occurs after the Subareas 3-6 fisheries, a sufficient level of total spawner escapement from all of the fisheries is required to maintain the spawning stock at or above a level that would ensure adequate recruitment in the following year.

In order for the short-finned squid (*Illex*) fisheries in Subarea 3 and 4 to directly impact the *Illex* resource in Subareas 5 and 6 within any given year, short-finned squid would have to become available to the Subareas 5 and 6 fishery after they emigrated from Subareas 3 and 4. A review of the available fisheries, survey and biological data did not provide any evidence for this situation.

iv) **Witch Flounder in Divisions 2J+3KL**

The Fisheries Commission requested the Scientific Council to *provide advice on catch levels for the Div. 2J and 3KL witch flounder resource, and provide information on distribution* (see Part E, Agenda II, Annex 1, Item 6).

The Scientific Council evaluated the status of the resource based on Canadian assessment and converted survey data. Canadian survey data throughout Div. 2J, 3K and 3L (including the NAFO Regulatory Area) indicated that this stock had been declining rapidly since about 1984 and by 1995 had reached a level of biomass less than 2% of the 1981-84 average when the stock was stable. The 1995-98 average biomass is about 5% of the 1981-84 average.

An evaluation of distribution patterns indicated that during the late-1970s and early-1980s witch flounder were widely distributed throughout the continental shelf in the deep channels around the fishing banks primarily in Div. 3K and a depth range of 200-500 m. By the mid-1980s, however, they were rapidly disappearing and by early-1990s had virtually disappeared from this area entirely, except for some very small catches along the continental slope in southern Div. 3K. By autumn of 1996 they were mainly located (although in very low numbers) along the deep continental slope area in Div. 3L both inside and outside the Canadian 200-mile fishery zone. Similar observations were made for the 1997 and 1998 survey data.

Based on the data examined here, the Scientific Council advises that there should be no fishing for witch flounder in Div. 2J and 3KL in 2000. Given the current state of the stock, the Scientific Council does not anticipate any marked improvement in the fishable part of the population over the next several years.

v) **Information on shrimp stock in Div. 3LNO**

The Fisheries Commission requested the Scientific Council to *provide information on shrimp in Div. 3LNO* (see complete request in Part E, Agenda II, Annex 1, Item 7).

> The Council noted no information was available for review during this June 1999 Meeting. It is anticipated that information necessary to address this request will be available for review in the week before the Annual Meeting September 1999.

vi) **Information on guidelines and protocol of fisheries research**

The Fisheries Commission requested the Scientific Council to *provide information on the types of fisheries research activities being conducted or that may be conducted in the future in the NAFO Regulatory Area. Further, the Scientific Council is requested to outline any guidelines and protocols that should be followed when conducting such research* (see Part E, Agenda II, Annex 1, Item 8).

In 1998, a number of different research activities took place in the NAFO Regulatory Area (ARA) independent of fisheries related data collections. Stratified-random bottom trawl multi-species surveys were carried out during both spring and autumn in all of Div. 3LNO, and during summer in Div. 3M. These surveys have been ongoing for a number of years. Information from these surveys routinely constitutes an important part of the data used for assessments of: Div. 3LNO American plaice, Div. 3LNO yellowtail flounder, Div. 3NO witch flounder, Div. 3NO cod, Div. 3LN redfish, Div. 3M cod, Div. 3M American plaice and Div. 3M redfish. In addition, information from these surveys is combined with data from surveys in the Canadian zone in Div. 2GHJ and Div. 3K as part of the assessment database for Subarea 2 and Div. 3KLMNO Greenland halibut. In 1998, another stratified random survey was also carried out in the NRA to provide information on groundfish in that area.

Results from the autumn survey of Div. 3LNO were also examined, in 1998, for information on shrimp in the area. Additional information on shrimp in Div. 3L has also been collected during stratified random surveys in the NRA directed at shrimp during 1996-98. These surveys also examined availability of commercial concentrations, as well as by-catches of groundfish in the area of shrimp concentrations.

Other surveys conducted in recent years include: 1) 0-group surveys in all of Div. 3LNO including the NRA aimed at monitoring pre-recruit fish during their pelagic stage (1994-98), 2) grid survey in cooperation with industry in Div. 3NO including a small portion of the NRA directed at yellowtail flounder (1996-98), and 3) cooperative industry stratified random survey in Div. 3LNO including the NRA for American plaice (1998).

Results of all of these surveys have been documented and reported to Scientific Council.

Based on available information, it is anticipated that all of these surveys will once again take place during 1999 and to varying degrees into year 2000 and beyond. In addition, another survey to conduct selectivity experiments in the NRA examining small fish catches is scheduled for 1999.

The surveys, as they are now conducted, follow normal pre-determined scientific protocols. The stratified-random schemes are well known, and followed (Doubleday, 1981[1]). Fishing gear and fishing protocol are kept the same from one year to the next if at all possible, and any deviations from these are reported to Scientific Council and fully discussed as part of the assessment process. At-sea sampling follows accepted protocol, and analyses are carried out using normal methods.

Selectivity work and by-catch studies also follow normal scientific protocol for data collection and sampling as does data analyses.

[1] Doubleday, W.B. 1981. Manual on Groundfish Surveys in the Northwest Atlantic. *NAFO Scientific Council Studies*, No. 2.

Work investigating the availability of commercial concentrations of any particular species is less 'scientific' in nature although biological sampling routinely occurs. This type of work is more oriented towards collection of information to determine the economic viability of a fishery based on CPUE (i.e. density) rather than overall abundance and as such fishing is directed to areas of high concentration. Usually, it is not possible to determine the entire area of distribution nor overall abundance/biomass unless this work is conducted in conjunction with a more structured survey designed to obtain this additional information.

Overall, Scientific Council is satisfied that the existing and planned surveys follow normal and accepted scientific protocol, and that the information from these surveys is fully reported to Scientific Council during its deliberations. With regard to 'exploratory' fishing for commercial concentrations of a species, Scientific Council notes that the scientific benefit of this type of activity is more secondary in nature. One result of this type of survey that is of direct use to science is information on by-catches in areas of commercial concentrations of the target species. While useful scientific information is collected during these exploratory surveys, the primary interest may be to industry and fishery managers. As such, it is considered more appropriate that the conduct of this type of activity be addressed by STACTIC.

2. **Coastal States** (see Part E, Agenda II, Annexes 2 and 3)

a) **Requests by Canada and Denmark (Greenland) for Advice on TACs and Other Management Measures for Year 2000**

The Scientific Council was requested by the Coastal States to provide advice on single year and multiyear considerations for certain stocks. This section presents stocks for which the Scientific Council provided advice for the year 2000.

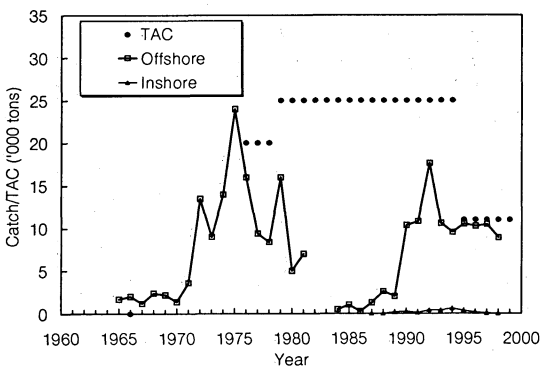
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 0 + Division 1A Offshore and Divisions 1B-1F

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

Fishery and Catches: Due to an increase in offshore effort, catches increased from 2 000 tons in 1989 to 18 000 tons in 1992 and have remained at about 10 500 tons annually since.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Autonomous
1996	10	11	11
1997	11	11	11
1998	9	11	11
1999		11	

[1] Provisional.



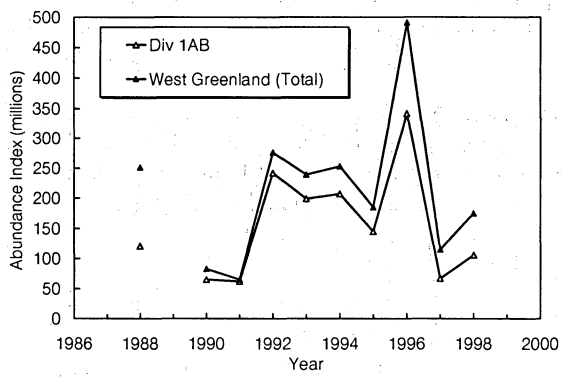
Data: Catch-at-age data were available for assessment from Div. 0B and Div. 1CD. Standardized and unstandardized catch rates were available from Div. 0B and Div. 1CD. Biomass estimates were available from Div. 1CD. Recruitment data were available from Div. 1AB from 1989-98.

Assessment: No analytical assessment could be performed. Combined standardized catch rates for Div. 0B + Div. 1CD have been stable during 1990-98.

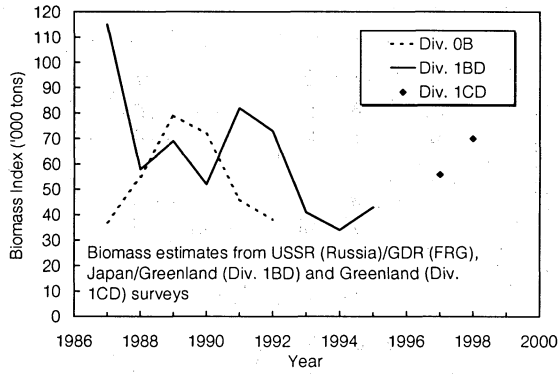
Fishing Mortality: Level not known.

Recruitment: Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 and 1997 year-classes were estimated to be below the average of the last decade.

Abundance:



Biomass: The biomass in Div. 1CD increased from 1997 to 1998.



State of the Stock: The age composition in the catches in Subareas 0 + 1 has been stable in recent years. Although the survey series from Subarea 1 in 1987-95 is not directly comparable with the series from 1997-98, 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.

Recommendation: The TAC for year 2000 should not exceed the current level of 11 000 tons for Greenland halibut in Subarea 0 + Div. 1A (offshore) and 1BCDEF, based on the relative stability of the stock.

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

Sources of Information: SCR Doc. 99/25, 27, 30, 45, 47, 53; SCS Doc. 99/5, 9, 17.

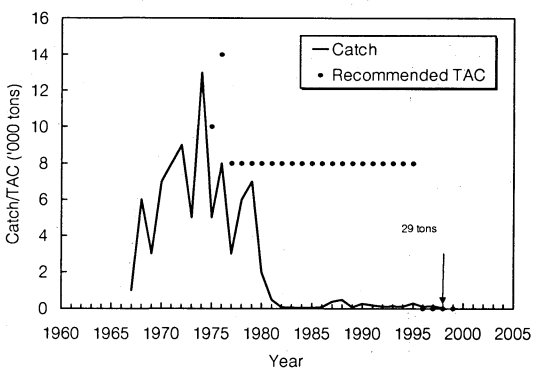
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 0 + 1

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

Fishery and Catches: Recommended TACs have been at 8 000 tons in the period 1977-95. The advice since 1996 has been that the catches should be restricted to by-catches in fisheries targeting other species. There has been no directed fishery for this stock since 1978. An unknown proportion of the reported catches are roughhead grenadier (*Macrourus berglax*).

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Autonomous[2]
1996	0.1	ndf	3.4
1997	0.2	ndf	3.4
1998	0.0	ndf	3.4
1999		ndf	3.4

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

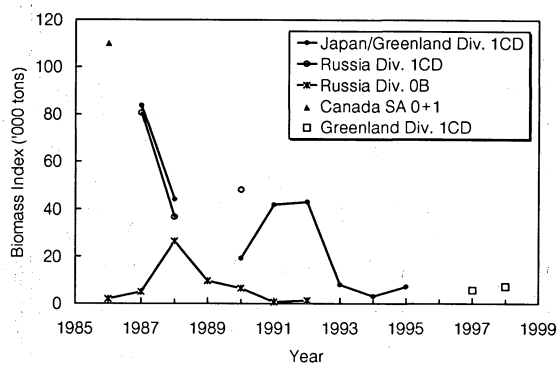


Data: Biomass estimates of roundnose grenadier from surveys in Div. 0B during the period 1986-92, from Div. 1CD during the period 1987-95 and from 1CD in 1997-98 were available.

Assessment: No analytical assessment could be performed.

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

Biomass: There are no recent estimates of biomass of roundnose grenadier for the entire stock area. In 1998 the biomass of roundnose grenadier was estimated at 7 300 tons compared to 5 700 tons in 1997 for Div. 1CD. In the same Divisions the biomass of roughhead grenadier was estimated at 4 300 compared to 2 300 tons in 1997.



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

Recommendation: There should be no directed fishing for roundnose grenadier in Subareas 0+1 in years 2000-2002. Catches should be restricted to by-catches in fisheries targeting other species.

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

Special Comments: The biomass of the stock component in Subareas 0+1 has been at very low level since 1993 and the stock is composed of small specimens.

Roundnose grenadier is a slow growing species and Scientific Council does not expect any major changes in the status of the stock in the near future. Therefore, Scientific Council is providing advice for roundnose grenadier in Subareas 0+1 for years 2000, 2001 and 2002 (i.e. 3-year advice).

Should any significant change be observed (i.e. from survey) in stock status, the Scientific Council will evaluate this change and provide appropriate advice to the Coastal States in intervening years.

Sources of Information: SCR Doc. 99/30; SCS Doc. 99/4, 9, 17.

b) **Request by Denmark (Greenland) for Advice on TACs and Other Management Measures for Years 2000 and 2001**

The Scientific Council was requested by the Coastal States to provide advice on single year and multiyear considerations for certain stocks. This section presents stocks for which the Scientific Council provided advice for the years 2000 and 2001, and includes Greenland halibut in Subarea 1 inshore, as requested by Denmark (Greenland).

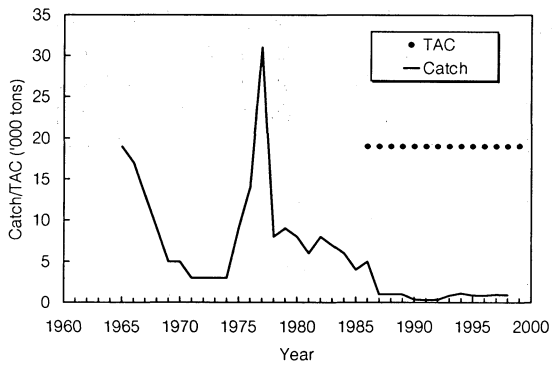
Redfish (Sebastes spp.) in Subarea 1

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

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

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended	Autonomous
1996	0.9	ndf	19
1997	1	ndf	19
1998	0.9	ndf	19
1999		ndf	19

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

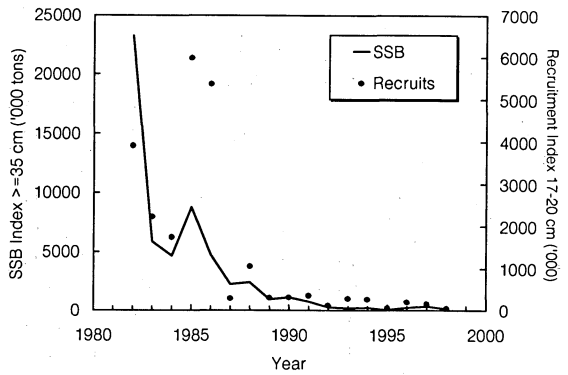


Data: No data on commercial CPUE were available. Spawning stock biomass and recruitment indices were calculated based on EU-German groundfish surveys.

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

Recruitment: The recruitment index during the last decade has been low.

SSB: SSB index has remained at historically low levels since 1989.

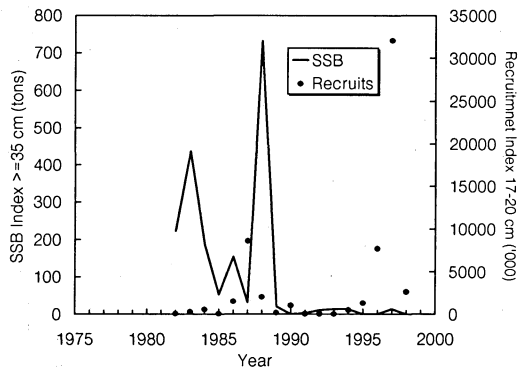


State of the Golden Redfish Stock: The stock of golden redfish in Subarea 1 remains severely depleted. There are indications that the probability of future recruitment is reduced at the current low SSB. Short-term recovery is very unlikely.

Reference Points: Based on the available data there appears to be a very high probability of decreased recruitment below SSB levels of 5 000 tons.

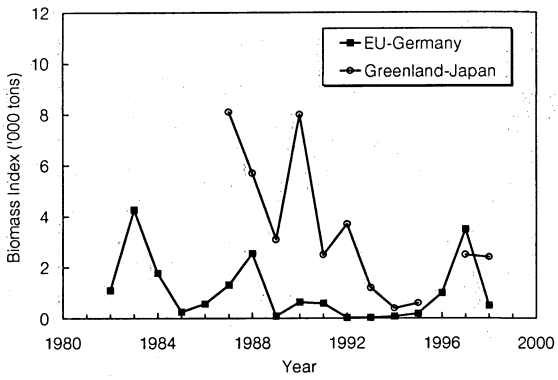
Assessment of Deep-sea Redfish: No analytical assessment of *Sebastes mentella* was possible.

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



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

Biomass: Total stock biomass indices increased in 1996-97 but subsequently have declined. The stock is composed of mostly immature fish.



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

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

Recommendation for Golden and Deep-sea Redfish Stocks: No directed fishery should occur on redfish in Subarea 1 in years 2000 and 2001. By-catches of redfish in the shrimp fishery should be at the lowest possible level.

Special Comments: The probability of recovery of the redfish stocks in Subarea 1 would be enhanced if the by-catch of redfish taken in the shrimp fishery would be significantly reduced.

Sources of Information: SCR Doc. 99/20, 27, 30; SCS Doc. 99/9, 17.

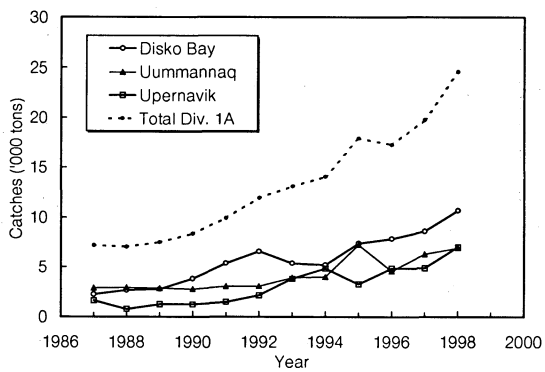
Greenland Halibut (Reinhardtius hippoglossoides) in Division 1A, inshore

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 fishery offshore has not been conducted since 1996.

	Catches ('000 tons)[1,2]			
	1996	1997	1998	TAC 1999
Disko Bay	7.8	8.6	10.7	7.9
Uummannaq	4.6	6.3	6.9	6.0
Upernavik	4.8	4.9	7.0	4.3
Total Div. 1A	17.3	19.8	24.6	-

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



Data: Catch-at-age data were available for years 1988-98 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.

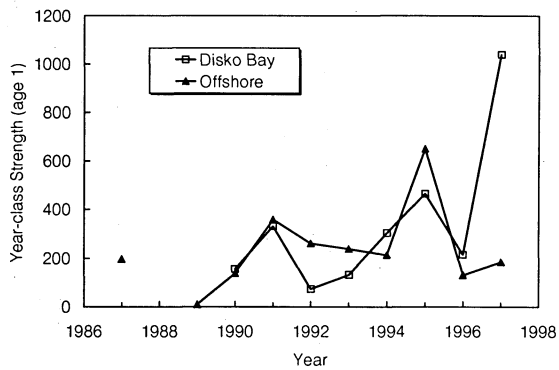
Assessment: The stock component in Disko Bay is composed of younger and smaller individuals than in the other two areas. In spite of the increasing catches, age and length composition in survey has not changed and in the commercial fishery an increase in mean length has been observed the latest years. There is indication of an increase in fishing mortality as well as stock biomass since the early-1990s.

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 in recent years.

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

Recruitment: Recruitment of the 1997 year-class in the inshore areas was the highest observed in the time series. The number of 3 year-old fish from the strong 1995 year-class was still above average. Offshore, the number of one-year-olds from the 1997 year-class was a little below average. The 1995 year-class that appeared very strong as one year olds had declined in strength, and were now considered to be about average.

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



Disko Bay: In spite of the increasing effort and fishing mortality the previously observed negative effect on stock structure has stabilized.

Uummannaq: There is indication of growth over-fishing of the stock.

Upernavik: There is indication of growth over-fishing of the stock components in the traditional fishing areas

around Upernavik. In the northern parts of the district, where new fish grounds are exploited, data are insufficient to determine the status of the resource.

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

Scientific Council still considers that separate TACs are appropriate for each of the three areas. In order to prevent escalating effort, it is recommended that the TACs are kept at a stable level. The TAC for year 2000 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, same as advised for 1999.

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

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

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

Sources of Information: SCR Doc. 99/25, 35, 48, 53; SCS Doc. 99/17.

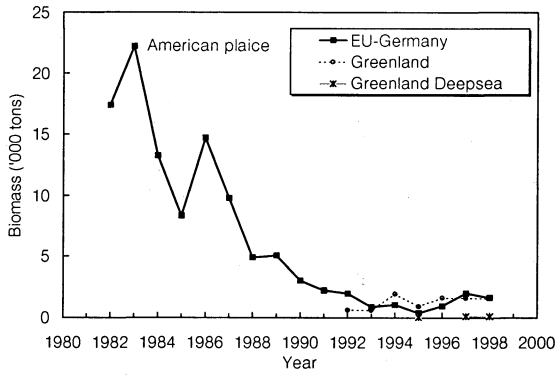
Other Finfish in Subarea 1

Background: The resources of other finfish in Subarea 1 are mainly Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffishes (*Anarhichas lupus* and *A. minor*), thorny skate (*Raja radiata*), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus hippoglossus*) and sharks. No recommendations can be made for Greenland cod, lumpsucker, Atlantic halibut and sharks.

Fishery Development and Catches: Greenland cod are taken inshore by directed fisheries. Other species are mainly taken as by-catch offshore in trawl fisheries directed to shrimp, cod, redfish and Greenland halibut. In 1998, reported catches of other finfishes amounted to 4 500 tons representing an increase by 6%, compared to the 1997 catch (4 246 tons). The catch figures do not include the weight of fish discarded by the trawl fisheries directed to shrimp.

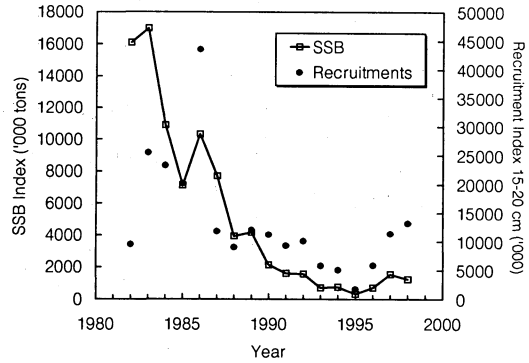
Data: No data on CPUE, length and age composition of the catches were available. Length frequencies were derived from the Greenland bottom trawl surveys. Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany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

Assessment of American plaice: No analytical assessment was possible.



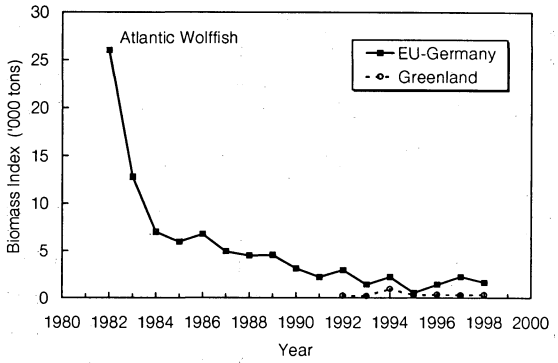
Recruitment: Recruitment index has been low since late-1980s but had increased to the average level since 1997.

SSB: During 1982-91, the SSB index decreased drastically to depletion without a significant increase since then.



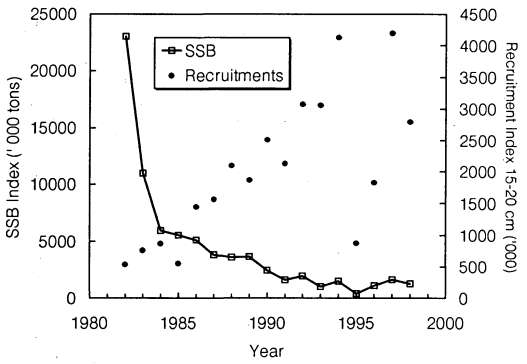
State of the American plaice stock: The stock remains severely depleted although there is an indication of increased recruitment.

Assessment of Atlantic wolffish: No analytical assessment was possible.



Recruitment: Index increased steadily since 1980s but varied considerably since 1995.

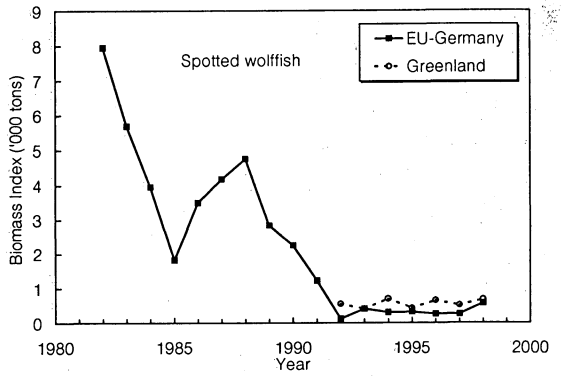
SSB: Since 1982, the SSB index decreased drastically and remained severely depleted since the early-1990s.

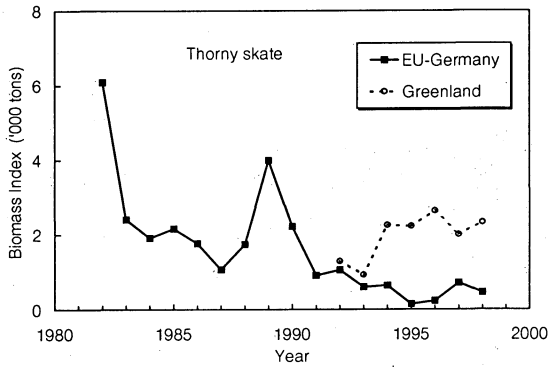


State of the Atlantic wolffish stock: The stock remains severely depleted despite a steady increase in recruitment since the early-1980s.

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

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





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

Recommendation for the stocks of American plaice, Atlantic wolffish, spotted wolffish and thorny skate: No directed fishery in Subarea 1 for American plaice, Atlantic wolffish, spotted wolffish and thorny skate should occur in years 2000 and 2001. By-catches of these species in the shrimp fisheries should be at the lowest possible level.

Reference Points: For all these stocks Scientific Council is not is a position to propose reference points at this time.

Special Comments: The probability of recovery of these stocks would be enhanced if the by-catches taken in the shrimp fishery are significantly reduced.

Sources of Information: SCR Doc. 99/21, 27, 30, 33, 37; SCS Doc. 99/9, 17.

c) **Special Requests for Advice by Denmark (Greenland)**

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

a) allocation of TACs to appropriate Subareas (Subareas 0 and 1),
b) allocation of TAC for Subarea 1 inshore areas
c) comment on advantages and disadvantages of a multiyear management advice for roundnose grenadier in Subarea 0+1

Concerning a): no new data were available since Div. 0B has not been surveyed in recent years (see STACFIS report on Greenland halibut in Subarea 0 and Div. 1B-1F and NAFO Sci. Coun. Rep., 1994, p. 110). There are, however, planned surveys that will cover Div. 0A in 1999 and 0B in 2000. The possibility of the existence of an isolated inshore population in Cumberland Sound (Div. 0B) is under investigation.

Concerning b): 99% of the inshore catches in Subarea 1 are taken in the inshore areas of Div. 1A.

Scientific Council considers that separate TACs are appropriate for each of the three areas. In order to prevent escalating effort it is **recommended** that *a TAC for Greenland halibut in Div. 1A in each inshore area for year 2000 should not exceed the average of the catches for 1995-97; Disko Bay - 7 900 tons, Uummannaq - 6 000 tons and Upernavik - 4 300 tons.* (See also Summary Sheet on p. 62)

Concerning c): there has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. The survey biomass in Subarea 1, where most of the biomass has been found, declined gradually from about 100 000 tons in 1986 to 8 000 tons in 1993 and has been below that level since then. Since 1987 the length distribution in the surveys, has been dominated by small individuals and in recent years composed almost exclusively of small individuals <12 cm (pre-anal fin length, measured from the snout to the basis of the first anal fin ray). Roundnose grenadier is a slow growing species and Scientific Council does not expect any major change in the status of the stock in the near future.

With no directed fishery and a biomass well below B_{lim}, Scientific Council does not see any disadvantages in giving advice on a triennial basis. Should any significant change be observed (i.e. from survey) in stock status, the Scientific Council will evaluate this change and provide appropriate advice to the Coastal States in intervening years.

The Scientific Council **advises** a schedule for providing triennial (every three years) advice for roundnose grenadier in Subareas 0+1 initiated in 1999 for the advice in 2000-2002. Triennial advice for roundnose grenadier will be in accordance with Scientific Council's attempt to improve the Council's working procedures.

d) **Request by Canada for Advice on TACs and Other Management Measures for Year 2000**

The Scientific Council was requested by the Coastal States to provide advice on single year and multiyear considerations for certain stocks. This section presents stocks for which the Scientific Council provided advice for the year 2000, as requested by Canada.

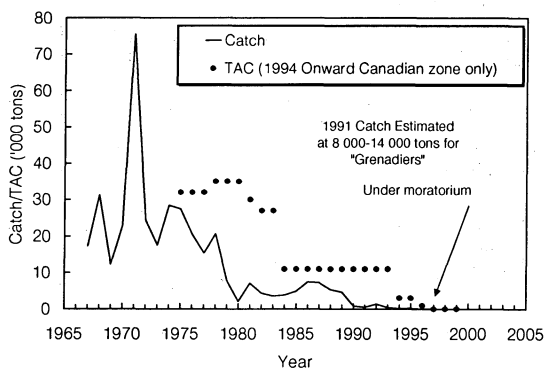
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 2 and 3

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

Fishery and Catches: The traditional fishery prior to 1990 occurred in Canadian waters in Div. 2GH and 3K by the former USSR and former GDR. Catches since 1991 have been taken as by-catch in Greenland halibut fisheries in Div. 3LMN primarily by EU-Spain and EU-Portugal. About 50 tons were reported for 1997 and 1998.

	Catch[1] ('000 tons)	TAC[2] ('000 tons)
1996	0.4	1
1997	+	0[3]
1998	+	0[3]
1999		

1 Provisional reported catches, <50 tons for 1997-98.
2 Canadian zone only.
3 Under moratorium.



Data: Surveys conducted by Canada (Div. 2G to Div. 3O) from 1996-98, Japan (Div. 2GH) in 1996 and Russia Div. 2GH from 1987 to 1992.

Assessment: 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.

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

Recommendation: Not possible to provide any advice for roundnose grenadier in Subareas 2 and 3 for year 2000.

For several years now, the Scientific Council has not been in a position to provide advice for roundnose grenadier in Subareas 2 and 3 due to the lack of sufficient data. The Scientific Council notes that it will be unable to provide advice – or provide reliable information on reference points – until appropriate data become available.

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

Special Comments: As it is not anticipated that the information base will improve over the next few years, it is recommended that the status of this stock not be reviewed again until 2002, and thereafter on a three-year cycle.

EU-Portugal reported that all of their catch of grenadiers since 1988 has been roughhead grenadier and this has been changed in the NAFO catch statistics. Grenadier catches by EU-Spain for 1992-96 are primarily roughhead grenadier. These data were misclassified because roundnose grenadier was the only name appearing in the statistical data reporting forms during this time. This misclassification has not been resolved in the official statistics for 1992-96 but the species has been reported correctly for 1997 and 1998.

Sources of Information: SCR Doc. 99/51; SCS Doc. 99/5.

e) **Special Requests for Advice by Canada**

i) **Overall assessment for Greenland halibut throughout Subareas 0 to 3**

Canada, subject to concurrence of Denmark (Greenland) requested the Scientific Council to *provide an overall assessment of status and trends in total Greenland halibut stock throughout its range* (see Part E, Agenda II, Annex 2, Item 1 for complete request):

Scientific Council provided advice for Greenland halibut as follows: Subareas 0+1 offshore, Div. 1A inshore, and Subareas 2 + Div. 3KLMNO. Surveys have been conducted in most of these areas, with the exception of Subarea 0. Thus is it is not possible at present to give an overview of the complete stock.

With regards to separate TACs for Subarea 2 + Div. 3K, and Div. 3LMNO, separate assessments were not carried out, although it is possible to advise on the distribution of biomass in these areas. Research vessel surveys have been conducted throughout these areas for 1996-98, although coverage is not complete in all Divisions in all years, particularly for Div. 2G and 3O. The percentage of total biomass in the northern area ranged from 75 to 81%, while the percentage of biomass of fish greater than 35 cm in this area was about 70% of the SA 2+Div. 3KLMNO total. During 1996-98, catches from Subarea 2 + Div. 3K comprised between 20 and 27% of catches from the Subarea 2 + Div. 3KLMNO area (see Fig. 1 and Table 1). The impact on the stock of taking about 75% of the recent catch from an area containing about 30% of the fishable biomass is not known.

No data are available to assess harvest patterns in terms of yield-per-recruit, although recent otter trawl fisheries continue to have a similar catch at age (mostly immature fish, predominant ages are 6-8) relative to previous years. There has been little distributional variation in the stock in recent years, with most of the young fish being found in channels between fishing banks in Div. 2J and 3K. Older fish tend to be found mainly along the deep slope areas, with highest abundance consistently found in Div. 3K and northern Div. 3L.

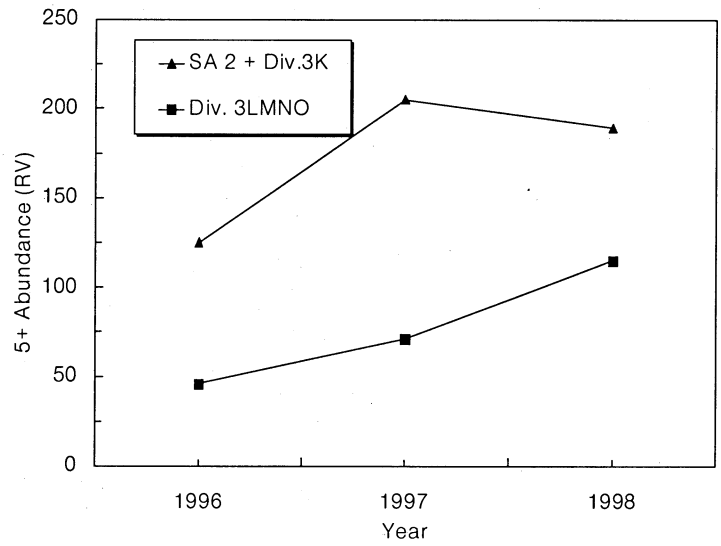


Fig. 1. Greenland halibut: abundance at age 5+ from research vessel (RV) surveys.

Table 1. Catches and biomass of Greenland halibut in Subareas 2 and 3 by Division.

Trawlable biomass (tons) from Canadian research surveys

	Division							
Year	2G	2H	2J	3K	3L	3M	3N	3O
1996	22 300	26 100	64 760	120 337	29 675	10 200	5 100	1 000
1997	15 500	38 600	82 095	130 546	48 596	7 000	6 400	2 100
1998	4 511	38 988	62 111	142 197	55 927	7 776	14 788	5 402

Nominal Catches (tons) (provisional)

	Division							
Year	2G	2H	2J	3K	3L	3M	3N	3O
1996	598	621	1 063	2 544	4 487	783	934	367
1997	365	619	1 734	2 658	9 227	1 965	2 958	332
1998	362	351	1 863	1 400	10 214	3 385	2 112	259

Ratio of catch to survey estimate of biomass

	Division							
Year	2G	2H	2J	3K	3L	3M	3N	3O
1996	2.7%	2.4%	1.6%	2.1%	15.1%	7.7%	18.3%	36.7%
1997	2.4%	1.6%	2.1%	2.0%	19.0%	28.1%	46.2%	15.8%
1998	8.0%	0.9%	3.0%	1.0%	18.3%	43.5%	14.3%	4.8%

ii) **Stock status of cod in Div. 2J and 3KL**

Canada requested the Scientific Council to review the status of cod stock in Div. 2J and 3KL (see Part E, Agenda II, Annex 2, Item 3 for complete request). The following summary sheet was provided by the Council.

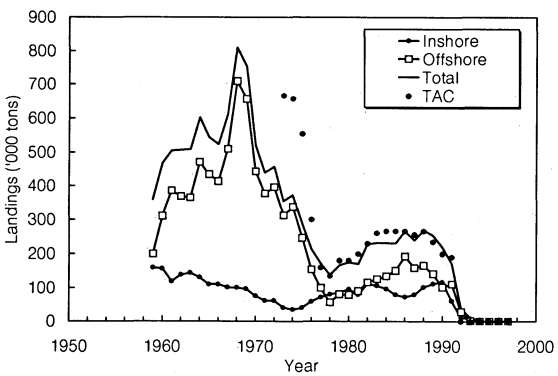
Cod (Gadus morhua) in Divisions 2J, 3K and 3L

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. There is evidence of denser aggregations in the inshore. Several lines of evidence, including results from genetic and tagging studies, indicate that the cod currently inshore may remain there throughout the year. However genetic studies were inconclusive and did not support the hypothesis of separate inshore and offshore stocks.

Fishery and Catches: The rapid decline in the resource in the early-1990s led to reduced TACs and eventually to a moratorium on commercial fishing in 1992. Some non-commercial fishing was permitted in 1992-94, 1996 and 1998 but not in 1995 and 1997. Catches also came from sentinel surveys in 1995-98, a food fishery and an index or test fishery in 1998.

	Catch[1] ('000 tons)	TAC ('000 tons)	
		Recommended[2]	Agreed
1996	1.5		0
1997	0.5		0
1998	4.5		0

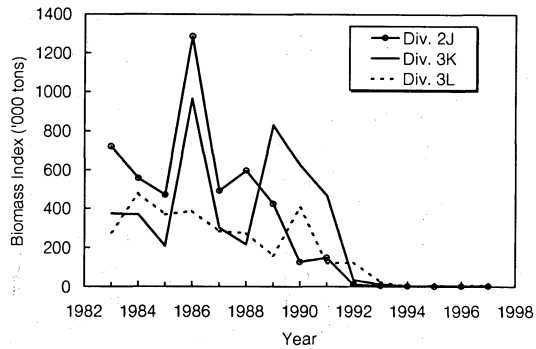
[1] Provisional.
[2] Advice not requested.



Data: Abundance and biomass indices were available from several surveys. Removals-at-age in 1998 were available from the limited by-catch, the sentinel survey, a food fishery and an index (test) 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 abundance 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 1998 estimate is close to the value from the previous year and extremely low compared to the 1980s. The biomass index from the spring research vessel survey in Div. 3L in 1998 is half the value from 1997 and extremely low compared to the 1980s.



The level of biomass in the inshore remains uncertain. Acoustic studies of a specific area produced estimates of about 14 000 tons. Exploitation rates calculated from tag return data indicate a population in Div. 3K and northern Div. 3L in autumn 1998 of 52 000 tons (95% confidence interval of 36 000-135 000 tons) and an additional biomass of no more than 15 000 tons in southern Div. 3L. Some of the fish in the latter area had migrated into Div. 3L from Subdiv. 3Ps in the spring/ summer.

Mortality: Based on previous analytical assessments, fishing mortality on fully recruited age groups was relatively stable at about 0.5 from 1977 to 1987, but increased rapidly to 1989. Fishing mortality rose above 1.0 in 1990 and continued to increase until the moratorium was introduced in 1992. Total mortality, as calculated from research vessel data, remained very high for two years following declaration of the moratorium. Total mortality declined during the mid-1990s but has remained well above 0.2, the value normally assumed for natural mortality. The cause for this has not been determined. Predation by harp seals and illegal removals may be contributors.

Recruitment: In the offshore, the pelagic 0-group survey and the bottom-trawl survey indicate that the 1994 year-class was stronger than other year-classes since the early-1990s, especially in Div. 2J, but was weak compared with most year-classes in the 1980s. The 1998 pelagic survey indicates that the 1998 year-class may be the strongest since 1994, but most of the

catch came from southern Div. 3L and may represent fish from Div. 3NO. Recruitment may be better in the inshore than in the offshore. The pelagic 0-group survey has recently had higher catch rates in the bays of eastern Newfoundland than in the offshore. Beach seine surveys indicate that the 1996 year-class is very weak but the 1997 and 1998 year-classes are stronger.

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

In the offshore there are no signs of recovery. The biomass is very small with few mature fish. Year-classes recruiting in the 1990s have been extremely weak.

The status in the inshore remains uncertain. Catch rates in sentinel surveys and a test fishery (1998 only) were good to excellent in the southern half of the stock range. Dense aggregations have been observed in one small area. A mark-recapture study indicates about 52 000 tons in Div. 3K and northern Div. 3L in autumn 1998, with an upper 95% confidence limit of 150 000 tons for the whole of Div. 3KL. Some of the fish in southern Div. 3L in spring-autumn came from pre-spawning and spawning concentrations in Subdiv. 3Ps.

Sources of Information: SCR Doc. 99/28, 36.

iii) **Stock structure of Greenland halibut in Subareas 0 and 1**

Canada, in the request to the Scientific Council, stated that: *In 1994, the Scientific Council noted that there was ongoing research which would allow the Scientific Council to review its opinion on the stock structure question pertaining to Greenland halibut in NAFO Subareas 0+1 (NAFO Sci. Coun. Rep., 1994, p. 102). Therefore, the Scientific Council is requested to review this information and, in particular, any tagging studies which could be used to answer the following questions: 1) is there any evidence that the Greenland halibut in Div. 1A contribute to the spawning stock in Div. 0+1 (offshore)? 2) Are the current management units for Greenland halibut in NAFO Subareas 0 +1 (0+1 offshore, Div. 1A) biologically appropriate?* (see Part E, Agenda II, Annex 2, Item 4)

Tagging studies have been on-going since the provision of advice in 1994. A total of 7 244 fish have been tagged with reliable information obtained from 499 returns. None of the fish were recaptured outside the inshore areas comprised of Disko Bay, Uummannaq and Upernavik areas and 90% of the fish were recaptured in the fjord where they were tagged indicating that these fish remain resident. Some limited migration between some of the inshore areas especially in inshore Disko Bay area was observed with fish moving between the Torsukattaq and Ilulisat fjord. There is still very little fishery offshore in Div. 1A and therefore tagging returns can not conclusively test a possible link with Greenland halibut occurring offshore and inshore in Div. 1A. There is hence no new information that indicates that the Greenland halibut inshore in Div. 1A contribute to the spawning stock in the Davis Strait (SA 0 and 1). Further, there is no biological information that indicates that the current management units for Greenland halibut in NAFO Subareas 0 and 1 (SA 0 and 1 offshore, Div. 1A) advised by STACFIS in 1994 should be changed.

iv) **Effects of spatial distribution of recent annual catches on yield and SSB of Greenland halibut in SA 2 + Div. 3K and Divisions 3LMNO**

Canada requested the Scientific Council to *provide specific information with respect to Greenland halibut in SA 2 and Div. 3K and Div. 3LMNO* (see Part E, Agenda II, Annex 2, Item 5 for complete request).

The Council responded as follows: There are no indices of spawning stock biomass available for this stock at present. Thus, Scientific Council cannot comment on the effects on SSB of the spatial distribution of catches relative to the spatial distribution of SSB. Complete data on migration and spawning are also lacking, so it is not known how a concentration of catch in Div. 3LMN in recent years will impact on future yield or distribution of the resource. Most otter trawl fisheries on this stock operate at depths greater than 800 m, and often as deep as 1 400 m. Canadian gillnet fisheries, operating mainly in Div. 2J and 3K, use larger mesh (>190 mm) in depths beyond 732 m, and smaller mesh (>140 mm) in shallower depths. Table 2 shows the distribution of catch by Division in recent years.

Table 2. Catches of Greenland halibut by Division, 1977-98.

Year	Div. 2G	Div. 2H	Div. 2J	Div. 3K	2+3K	Div. 3L	Div. 3M	Div. 3N	Div. 3O	3LMNO	Total	Total
1977	1778	1524	8237	13446	24985	6956	42	3	62	7063	32048	
1978	1899	1207	3723	24107	30936	7596	528	6	4	8134	39070	
1979	577	1623	3415	19843	25458	8610	12	18	6	8646	34104	
1980	36	444	1466	17923	19869	12773	141	75	9	12998	32867	
1981	1799	2141	1358	16472	21770	8912	3	49	20	8984	30754	
1982	370	8984	5931	6794	22079	4135	2	56	6	4199	26278	
1983	111	5671	6028	11374	23184	4655	7	12	3	4677	27861	
1984	214	4663	6368	8432	19677	5132	43	12	9	5196	24873	26711
1985	193	2358	6724	5775	15050	3560	184	35	1	3780	18830	20347
1986	455	1564	6823	4237	13079	2799	49	8	4	2860	15939	17976
1987	2700	2631	12464	6860	24655	6283	307	173	0	6763	31418	32442
1988	2068	2463	1971	6389	12891	6195	48	75	6	6324	19215	19215
1989	837	1821	2952	7840	13450	6046	491	38	9	6584	20034	20034
1990	2809	1225	2845	4579	11458	10779	3040	1287	17	15123	26581	47454
1991	3715	2252	3045	2229	11241	15627	3426	4192	37	23282	34523	65008
1992	1373	235	476	3883	5967	29193	14902	7132	425	51652	57619	63193
1993	963	405	214	2398	3980	25092	8282	14693	644	48711	52691	62455
1994[1]	1045	210	203	1032	2490	18257	12741	14138	3403	48539	51029	51029
1995[1]	1109	412	375	641	2537	5843	3454	2948	490	12735	15272	15272
1996[1]	598	621	1063	2544	4826	4487	783	934	367	6571	11397	18840
1997[1]	365	619	1734	2658	5376	9227	1965	2958	332	14482	19858	19858
1998[1]	362	351	1863	1400	3976	10214	3385	2112	259	15970	19946	19946

[1] Provisional.

v) **Impact of by-catches in the NAFO Regulatory Area on the recovery of stocks currently under moratorium.**

The Scientific Council was requested to *evaluate the impact of by-catches in the NAFO Regulatory Area on the recovery of stocks currently under moratorium. Especially do the by-catches of these stocks in all other fisheries in the NAFO Regulatory Area impede their recovery?* (see Part E, Agenda II, Annex 2, Item 6)

Simulations were used to evaluate recovery time for cod on the southern Grand Banks (Div. 3NO) and for American plaice on the Grand Banks (Div. 3LNO) under various by-catch levels. These simulations take into account the precision of the stock size estimates currently available, as well as the observed variability in the stock-recruitment process. The Scientific Council also explored two interpretations of the stock-recruitment data: the first assumes that recruitment prospects are poor due to the persistence of a low productivity regime since the early- to mid-1980s, while the second assumes that future recruitment will return to historical levels as the spawning stock increases. The results of the simulations provide insight on the time it will take for these stocks to reach B_{lim} or any given milestone under various by-catch scenarios. The simulations also served to provide insight on the expected yield and biomass levels, on the long term, under various recruitment regimes.

The Scientific Council concludes that changes in productivity could have a major impact on the dynamics of the stock in future years and that recovery time will depend upon which recruitment process prevails in the future. Fishing mortalities in excess of the by-catch levels observed in recent years could increase considerably the recovery time in a

low recruitment regime, particularly for cod in Div. 3NO for which the drop in productivity is more pronounced than for American plaice under such a regime. It is not yet possible to predict when the recruitment regime will change.

Regarding other stocks under moratorium subject to by-catch (e.g. witch flounder in Div. 3NO, cod in Div. 3M, redfish in Div. 3LN, and American plaice in Div. 3M), conclusions on the impact of by-catch cannot be drawn at this time as the reaction to each stock depends on their dynamics.

While the simulations allow estimates of the probability distributions for recovery time and other parameter of interests, the results are described below in terms of the median to simplify their description. Once milestones have been established, it is the probability distribution of time to reach the milestone that should be focused on and not the median.

Cod in 3NO

This stock has been under moratorium since February 1994. By-catch is mainly occurring in the skate fishery and, in 1998, in the skate and yellowtail flounder fisheries. By-catch has increased from 174 tons in 1996 to 546 tons in 1998.

Mid term.

For cod in Div. 3NO, the spawning biomass was considered recovered when B_{lim} (60 000 tons) was reached for 50% of the replicates (i.e. the median). The recovery to B_{lim} was achieved by year 2012 in the low recruitment regime, and 2008 under the full regime under the "no by-catch" scenario. The fishing intensity had a noticeable impact on recovery time. For instance, taking the full recruitment regime into account, fishing at $F_{0.1}$ ($F = 0.2$) indicates the first year of recovery at 2016, compared to 2008 under no fishing. Under the low recruitment regime, recovery to the milestone of 35 000 tons (which was identified as a possible B_{lim} under a low recruitment regime at the Joint Fisheries Commission/Scientific Council Meeting of May 1999) was achieved in 2017 at current by-catch mortality but was not achieved by year 2020 with by-catch levels in excess of the levels observed in recent years. There is also a major difference between the level of biomass and the level of yield under each of the assumed recruitment regimes: both projected biomass and yield under the low recruitment regime are of the order of one tenth the projected levels under the full regime.

To evaluate the assumptions made in describing the recruitment dynamics under a low recruitment regime, the above analysis was compared to an analysis using a different method for describing recruitment. The second method suggests that recovery to the 35 000 tons threshold is unlikely by year 2020 under a low recruitment regime even with no removals. The sensitivity analysis was also performed for the "full" regime and no major differences were identified between the two approaches to modeling recruitment dynamics.

Long term.

The results of a production analysis indicate that the maximum equilibrium yield under the low recruitment regime is about one-tenth the equilibrium yield inferred from re-sampling the full recruitment range.

American plaice in 3LNO

This stock has been under moratorium since 1995. By-catch is mainly taken in the Greenland halibut fishery, in an unregulated skate fishery and, in 1998, in the yellowtail flounder fishery. By-catch has increased in each year since the introduction of the moratorium, from a level of 600 tons in 1995, to 1 600 tons in 1998.

Mid term

For these simulations, the spawning biomass was considered recovered when B_{lim} (150 000 tons) was reached for 50% of the replicates. B_{lim} was defined as the spawning biomass level below which the probability of having good recruitment is reduced. From the results of the 1999 assessment, the spawning biomass level at which there is a very low probability of having good recruitment is of the order of 60 000 tons. For the purpose of these simulations, this level was considered as a milestone towards recovery. Under the low recruitment regime, the time to the milestone of 60 000 tons under recent by-catch fishing mortality was increased by one year only in comparison to the "no fishing" scenario. With a doubling of the fishing mortality corresponding to the 1998 by-catch mortality, the time to reach this milestone was also increased by one year only.

The 1999 assessment assumes an increase in natural mortality from 1989 to 1996 for this stock. Because the assumed value of natural mortality will affect the stock-recruit relationship, a sensitivity analysis was done to evaluate the impact of this assumption. Assuming no increase in natural mortality in the 1989-1996 period, recent by-catch levels could increase the time to reach the first milestone by three to four years (i.e. 2014-2015, in comparison to 2011 under "no fishing") under a low recruitment regime. However, higher fishing levels would increase recovery time markedly and the milestone of 60 000 tons would only be reached by the year 2020 with a fishing mortality in the range of the 1998 estimate and would not be reached by year 2020 with an F of 0.2 (which is below the $F_{0.1}$ level of 0.26).

Long term

Overall, the expected yield at equilibrium under a low recruitment regime is about one half that expected under a regime where recruitment is allowed to return to the levels that existed in the 1960s and 1970s.

Source of information: SCR Doc. 99/67, 69.

vi) **Conservation measures (other than TACs based on reference points) in the context of the Precautionary Approach.**

Canada requested the Scientific Council to *discuss and recommend on this topic* (see Part E, Agenda II, Annex 2, Item 7 for complete request).

The Council commented that the first discussions of measures in addition to TACs based on reference points took place during the first Joint Scientific Council/Fisheries Commission Working Group held in 1998. Further discussion took place during the second meeting of this Working Group during May 1999. Annex II of the May 1999 Working Group Report lists a number of possible management measures. These can be summarized as:

- limited entry
- vessel replacement restrictions
- effort control
- conservation harvesting plans (CHPs)
- by-catch protection provisions

- minimum fish size
- in-season management including by-catch protocols and small fish protocols
- spawning closures
- juvenile closures
- by-catch closures
- fishing gear restrictions – minimum mesh size and/or separator grids
- observers
- dockside monitoring
- vessel monitoring systems
- air patrols
- ship patrols
- on-board inspections

In reviewing the above list, Scientific Council noted that any measures taken to ensure that all catches are fully and accurately reported (including by-catches and discards), along with fully adequate sampling of the catches will be within a precautionary approach to management as these will enable scientists to better determine stock status.

In addition, other measures such as closed areas/seasons related to juvenile distribution and spawning times, and rules developed to otherwise protect young fish of the target species and/or by-catch species are considered to have potential benefits. Scientific Council cautions, however, that it is unclear whether gains from these could be easily evaluated.

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

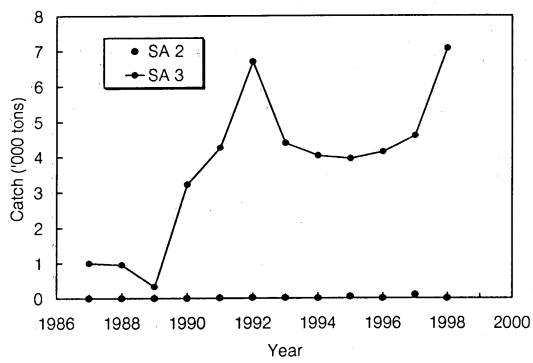
Background: Roughhead grenadier are distributed throughout Subareas 2 and 3 in depths between 300 and 2 000 m.

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.

The revised catches since 1987 are as follows:

	Catch ('000 tons)
1996[1]	4.1
1997[1]	4.7
1998[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 1978, the Canadian stratified deepwater bottom trawl surveys in Div. 3KLMN in 1991, 1994 and 1995, the Japanese stratified bottom trawl survey in Div. 2GH in 1996, the Spanish stratified bottom trawl spring survey in Div. 3NO Regulatory Area since 1995, 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 provides information on the roughhead grenadier depth distribution.

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 (1995-98) and catches-at-age (1997–98) are available from Portuguese and Spanish trawl catches.

Assessment:

Mortality: Total mortality was estimated at 0.43, based on the catch curve analysis on fully recruited age groups (8+) from commercial catches. The synthetic catch curve for 1994-98 EU-survey in Div. 3M, applied by sexes, gave estimates of Z = 0.47 for males and 0.28 for females. The mean lengths in the commercial catches have been stable since 1995.

Biomass: The available time series of catches-at-age is too short to allow the analyses of trends in the SSB. It should be noted that immature fish constituted 80% of the catch in 1997 and 90% in 1998.

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: 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.

Sources of information: SCR Doc. 99/14, 18, 22, 64; SCS Doc. 99/6, 9, 16; SCR Doc. 98/28, 48, 57; SCS Doc. 98/11, 13; SCR Doc. 97/19, 20, 25; SCS Doc. 97/9, 10; SCR Doc. 96/34; SCS Doc. 96/12, 14, 49; SCR Doc. 95/47, 51, 55; SCR Doc. 94/48.

XIII. REPORT OF THE JOINT ICES/NAFO WORKING GROUP ON HARP AND HOODED SEALS

The Scientific Council reviewed the 29 September-2 October 1998 meeting report of the Joint ICES/NAFO Working Group on Harp and Hooded seals in the Northeast and Northwest Atlantic (see SCS Doc.99/13, Ser. No. N4077). Of this report only the development of stocks in the Northwest Atlantic are presented in the following.

Canadian catches of the Northwest Atlantic harp seals in 1998 amounted to 283 000 animals, and these were believed to be primarily pups. Preliminary estimates of the Greenland catch was about 75 000 animals in 1996. Total removals in 1996 approximated 317 000 harp seals, which was greater than the replacement yields estimated by the Working Group in 1995 (275 000-285 000). Increases in Canadian catches since 1996 suggest that total removals may have continued to exceed replacement yields.

The Scientific Council appreciated the opportunity to review the Working Group Report (SCS Doc. 99/13) and the Council reiterated its recommendation that the Chair of the Joint Working Group, or designate, give a summary presentation of the formal deliberations of the Group to the June Meetings of Scientific Council each year when a meeting of this Working Group has taken place.

XIV. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOLS

The Scientific Council noted that this Agenda Item could not be handled totally at this meeting, and further issues will be discussed during the 13-17 September 1999 Council Meeting.

1. **Review of Rules of Procedure**

The Council endorsed the STACPUB recommendations pertaining to modifications of Rule 3 and Rule 5 in the Rules of Procedure of the Scientific Council. The new adopted text of the Rules of Procedure are as follows:

"Rule 3

.....

3.3 b. to act as Chairman of the Standing Committee on Research Coordination (STACREC)."

"Rule 5

.....

5.1 c. ii) consist of five other members appointed by the Scientific Council."

Regarding Rule 5 modifications: to Rule 5.1, c.ii, the Council discussed membership of STACPUB. Contrasting views were that a) STACPUB membership should remain in the present structure, noting that this body needs to conduct its business as referred to it by the Council; at a small group level, without impinging on the Scientific Council plenary work time, and b) it is not appropriate to limit STACPUB work to a few members and participation in STACPUB should be as in other Standing Committees (STACFIS, STACFEN and STACREC) – open to Scientific Council members at large, although certain types of STACPUB work should be done by a smaller group.

Scientific Council deferred a decision on this matter to the September 1999 Meeting.

Regarding Scientific Council participation in other NAFO Constituent Bodies: the Council noted many discussions at General Council and Fisheries Commission, and their subsidiary bodies are relevant to Scientific Council, and as such Scientific Council representation is needed, e.g. Scientific Council/STACTIC Meeting of September 1998. The Council agreed that representatives should be nominated in advance of those meetings, and every effort should be made to maintain continuity. It was suggested for example that STACREC Chairmen should attend STACTIC meetings as needed.

The Council at its meeting in September 1998 agreed that a Scientific Council member should attend the September 1999 meeting of STACFAD to elaborate on various Scientific Council financial requirements.

The Council nominated M. Stein (STACFEN Chairman, STACPUB member) to attend the forthcoming STACFAD meeting.

In addition the Scientific Council proposed that matters discussed by the Scientific Council that have budgetary relevance be presented to the Executive Secretary at the end of the June Meeting so that they can be appropriately incorporated to the Provisional Agenda.

The Scientific Council agreed that the relevant material, including Scientific Council recommendations, be issued as General Council and Fisheries Commission documents. Such material will be highlighted in the Scientific Council Report of the June Meeting.

2. **Adoption of the Form of Advice to PA Requirements**

The Council considered the adaptation of the Summary Sheets to address advice on the Precautionary Approach requirements.

The Scientific Council agreed that a section titled Reference Points be included in the Summary Sheets, and be placed immediately after the Recommendations. It was also agreed that, whenever available for a stock Summary Sheet, a section on medium and long-term considerations be included after the Reference Points.

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

The Council was informed that the present Chairman, after his term ends at the end of the 1999 Annual Meeting, may not be available to continue his appointment as the observer to ICES ACFM Meetings. It was noted that the Scientific Council should continue to have an observer attend the ICES ACFM Meetings. The Council agreed these nominations should be made on an *ad hoc* basis during the June Meetings of the Scientific Council, until a more long-term nomination can be made.

XV. OTHER MATTERS

1. **Recommendations from 1998 Symposium on Growth and Maturation**

In accordance with the recommendation of the Scientific Council Symposium on "Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish" held in Lisbo n, September 1998, Scientific Council established a Working Group on Reproductive Potential. The Council proposed the Chair of the Working Group be Dr. E. A. Trippel (Canada). The terms of reference for the working group are:

- Explore and review availability of information and existing data on reproductive potential by areas and species
- Explore possibilities to develop standard internationally coordinated research protocols to estimate egg and larval production
- Explore and evaluate alternative methods to estimate reproductive potential annually as part of routine in monitoring and sampling schemes (such as HSI)
- Review possibilities to develop methods and applications to estimate stock's reproductive potential for assessment and management

It was agreed that Scientific Council membership would include S. Junquera (EU-Spain), G. Lilly (Canada), M. J. Morgan (Canada), H. Murua (EU-Spain), and members from outside NAFO Scientific Council determined by the Chair. The group membership will be finalized by the September 1999 Meeting of Scientific Council. It was agreed that the Working Group will work by correspondence and provide a work plan to Scientific Council by May 2000.

2. **FAO ACFR Working Party on Status and Trends of Fisheries**

The Council reviewed a communication received from FIDI, FAO announcing the forthcoming meeting of the Advisory Committee on Fisheries Research (ACFR).

The terms of reference for that meeting are stated as:

1. Evaluate data needs for status and trends reporting on a global scale on marine fisheries, including fishery resources, fishing fleet capacity, participation in fisheries and economic performance, and propose a common template of essential information elements which could be used by the main providers of status and trends reports;

2. Propose arrangements for the involvement of regional fishery bodies and non-FAO experts in a consensus-seeking process for assembling, reviewing and disseminating fishery status and trends information (including reporting to COFI);

3. Advise on the relationship between FAO's data collection and status and trends reporting program and the Living Marine Resources module of the Global Ocean Observing System (GOOS); and

4. Report on these to ACFR.

The Council noted the Working Party meeting dates were 30 November to 3 December (prior to the 6-9 December 1999 meeting of ACFR), and that possible NAFO participation should be announced before the end of June 1999.

While recognizing that this meeting is within the 1999 fiscal year, the Council agreed that this ACFR meeting is important for NAFO to attend, especially to enhance NAFO presence within the community of Regional Fishery Bodies and FAO activities. It as agreed that trends in fisheries and resources in the Northwest Atlantic Region will be presented by NAFO in the FAO worldwide overview.

With respect to this type of international meetings, the Council considered the need of NAFO representation valuable for the Council and **recommended** that *NAFO should be represented by the Executive Secretary or the Assistant Executive Secretary at the 30 November-3 December 1999 meeting of ACFR in Rome.*

3. **NAFO Working Group on Transparency**

The Council noted that the Working Group of the General Council on Transparency met at NAFO Headquarters during 2-4 March 1999.

The Council observed that the Working Group had not finalized its report of that meeting (and it was likely that the General Council will receive a report during the 1999 Annual Meeting). However, it was noted that the Draft Working Group report suggested that Council should review its Rule 1.3 of the Scientific Council Rules of Procedure pertaining to this subject. The Council agreed to consider this matter during its September 1999 Meeting.

4. **Other Business**

The Council was concerned that much of its agenda dealing with Scientific Council business matters had to be postponed to the latter sessions of this meeting and due to time constraints then, did not receive conclusive discussions. It was therefore agreed that the September 1999 Meeting of the Scientific Council should focus on those matters. It was agreed, that STACFIS could attend to the considerations on shrimp in Div. 3LNO on 7 September 1999 before the Symposium begins.

XVI. 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 16 June 1999 **adopted** the reports of STACFEN, STACFIS, STACREC and STACPUB. It was noted that some text insertions and modifications as discussed at the Council plenary will be incorporated later by the Chairman and the Assistant Executive Secretary.

The recommendations from each Standing Committee are listed above in Sections V to VIII.

XVII. SCIENTIFIC COUNCIL RECOMMENDATIONS TO GENERAL COUNCIL AND FISHERIES COMMISSION

General Council

Scientific Council refers the following recommendations as they have cost implications and **recommended** that *these costs are included in the budgetary planning for the year 2000.*

Scientific Council noted that there is a likely intersessional meeting of the CWP during the course of year 2000 (to be decided at the CWP 18th Session in July 1999). The Council agreed that NAFO participation at that intersessional meeting is important and **recommended** that *the Assistant Executive Secretary and Chairman of STACREC represent NAFO at the next intersessional CWP meeting.*

Scientific Council **recommended** that *a complete accounting on the costs involved in maintaining and operating the NAFO website and FTP server be provided by the NAFO Secretariat to Scientific Council for consideration.*

The Scientific Council considered NAFO representation at international meetings as valuable for the Council and **recommended** that *NAFO should be represented by the Executive Secretary or the Assistant Executive Secretary at the 30 November-3 December 1999 Meeting of FAO ACFR in Rome.*

Scientific Council agreed to meet in the year 2000 in following sessions:

Scientific Council Meeting, 2-15 June 2000
Scientific Council Symposium, 13-15 September 2000
Scientific Council Meeting, 18-22 September 2000
Scientific Council Meeting, November 2000 (tentatively 7 days)

XVIII. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 16 June 1999, 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 15 and 16 June 1999 and other modifications as discussed at plenary.

XIX. ADJOURNMENT

The Chairman noted that the reduction of the June meeting duration by 2 days was successful although parts of the report could not be reviewed during the scheduled time frame. However, he expressed his confidence for the future June meetings that this would be achieved. He noted that some issues, especially discussions on Scientific Council working procedures and strategies were postponed for the 13-17 September 1999 Annual Meeting.

The Chairman expressed his gratitude to the Council members for their cooperation and especially to the Designated Experts and Standing Committee Chairmen for their extraordinary commitment to successfully complete the meeting.

The Secretariat was congratulated for its never-ending effort to support the meeting, and also for the successful implementation of the local area network (LAN) computer facilities which significantly improved the speed of the review process.

The Chairman wished everybody a safe trip home and there being no further business closed the meeting.

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

Chairman: M. Stein Rapporteur: K. Drinkwater

The Committee met at the Park Place Ramada Plaza Hotel, 240 Brownlow Avenue, Dartmouth, Nova Scotia, Canada, on 4 June 1999, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Scientists attended from Canada, Denmark (in respect of Faroe Islands and Greenland), Estonia, European Union, Japan, Russia and the United States of America.

1. Opening

The Committee noted the following documents would be considered: SCR Doc. 99/4, 6, 7, 8, 12, 17, 32, 38. Ken Drinkwater 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. Robert Dickson of the Centre for Environment, Fisheries and Aquaculture Science (CEFAS), Lowestoft, UK, who will present the invited lecture. The Chairman reported that his primary work between sessions was involved in preparing for this June Meeting. This included securing EU funding for Dr. Dickson to attend. The Chairman also commended the NAFO Secretariat for their excellent work on the website. In particular, he found the early posting of the research documents most helpful.

3. Review of Recommendations in 1998

At the June 1998 Meeting of STACFEN, the Committee recommended that NAFO co-sponsor, along with ICES, a Joint ICES/NAFO Decadal Symposium to be held in August 2001 in Edinburgh, Scotland. The purpose of the Symposium is to review physical, biological and fisheries changes during the 1990s and put them into context of the longer-term variability. The Chairman noted that this symposium is a separate agenda item and will be dealt with in detail under Item 9. No other recommendations from the 1998 meeting needed to be dealt with.

4. Invited Lecture

The Chairman introduced Dr. Dickson who presented a talk entitled "*Aspects of the physical and biological response to NAO variability*". The following is a brief summary.

> The North Atlantic Oscillation (NAO) is an index of the large-scale atmospheric circulation and is defined as the pressure difference between Iceland and either the Azores or Lisbon. A high NAO index results in strong westerlies across the North Atlantic, an intense Icelandic Low and a strengthened Azores High while a low index is the reverse. Dr. Dickson focused upon the NAO variability during the last 4 decades, which has been characterized by high decadal variability, a general increase from the 1960s to the mid-1990s, and a large decline in 1996.
>
> The NAO affects air and ocean temperatures, winds and precipitation. During low NAO years, storm tracks become concentrated in the Atlantic off the northeastern US and southern Canada with few storms making it into the Labrador Sea. In high NAO years, storms extend into the Labrador Sea and also into the Barents Sea in the Northeastern Atlantic. The NAO affects not only the position of the storm tracks but also the intensity of the storms. A higher NAO is associated with deeper (lower pressure) storms. Thus there is a strong correlation between wind speed and NAO index. In particular, there was a significant increase in windiness in the area north and east of Scotland as storm indices went from their lowest values in 1960s to their highest in the 1990s, in concert with the increase in the NAO. The increase in windiness also explains the observed increase in significant wave height in the 1970s and 1980s west of Scotland and the big increases in waves throughout much of northeastern Atlantic. Wind also affects primary production through mixing via the critical depth hypothesis of Sverdrup. Stronger winds in the NE Atlantic resulted in

more mixing, which delayed stratification. This is believed to have had an effect on zooplankton. For example, an inverse relationship was found between spring spawning *Calanus finmarchicus* and the NAO. There is also an inverse relationship between *C. finmarchicus* and the autumn spawning *C. helgolandicus*. It is thought that the increased mixing due to the higher winds delayed primary production resulting in a mismatch with the earlier spawning *C. finmarchicus* but favouring the later spawning *C. helgolandicus*.

During the high NAO years of the late-1980s and early-1990s, latent heat fluxes increased in Labrador Sea but decreased off the southeastern US. Thus, in the Labrador Sea and other areas where there were stronger winds and greater heat losses, the ocean cooled. The NAO also appears to influence cod recruitment through these changes in temperature, with a positive relationship between temperature and recruitment at the northern limits of the cod but negative at their southern boundaries. The NAO index also affects salmon. Salmon prefer temperatures between 7°C and 13°C isotherms when inhabiting the Labrador Sea in winter. The variability in a winter thermal habitat index based on the area of the Labrador Sea covered by sea surface temperatures in this range matches closes the variability of the NAO.

The NAO also influences ocean circulation. For example, in low NAO years there is deep-water convection in the Greenland Sea off East Greenland and increased formation of 18°C water in the Sargasso Sea. In high NAO years, as in the early-1990s, convection in the Labrador Sea was strong but weak in the Greenland Sea and Sargasso Seas. The NAO also influences the Gulf Stream transport with high NAO corresponding to increased flow. This is believed to be due to the spin up of both the subtropical and subpolar gyres. The NAO also affects the flow through the Faroe-Shetland Channel. High NAO results in increased SW winds, which in turn drive greater transport through the Channel. Not only does the NAO influence the transport, but it also influences the temperature and salinity of the transported waters as well. In high NAO years, greater numbers of more intense storms lead to higher precipitation, which in turn freshens the Nordic Seas. They are also freshened by increased ice transport through Fram Strait and less formation of marginal sea ice.

The large increase in the NAO index from the 1960s to the mid-1990s was unusual based on the observed record. Has it happened before? Evidence to answer this question is available from an NAO index derived from Moroccan tree rings. This proxy index suggests that such behaviour has happened before but it is rare. The tree-based index calibrates well against recent observations. Is the increase in NAO linked to global change? The speaker mentioned a study by Hurrell who suggested that it is. He found that El Nino Southern Oscillation (ENSO) and NAO together account for 50 of the variability in surface temperatures in the Northern Hemisphere. In addition, there are atmospheric links from NAO through the Arctic that influence global changes. For example, the NAO partially determines both the freshwater fluxes and the heat input to the Arctic. Although we have learned a great deal about the NAO and its influences most of this has been based upon data collected during the last 40 years. Analysis of earlier data suggests that the NAO has had less of an effect at other times, for example during the 1920s to the 1950s. Therefore, care must be exercised in extrapolating our understanding of the effects of the NAO in recent times too far back or forward in time.

5. Review of Environmental Conditions

a) Marine Environmental Data Service (MEDS) Report for 1998 (SCR Doc. 99/8)

The inventory of oceanographic data obtained by MEDS during 1998 was presented along with information on several new initiatives.

i) Hydrographic data collected in 1998

Data from 6 055 oceanographic stations collected in the NAFO area were sent directly to MEDS in 1998, but have not been archived, of which 4 870 were CTDs, 1 152 were XBTs and 33 were bottles. An additional 3 116 stations were received through IGOSS

(Integrated Global Ocean Service System). The number of stations received directly by MEDS decreased by approximately 12 from that obtained in 1997 while the number of stations obtained through IGOSS decreased by over 40 .

ii) **Historical hydrographic data holdings**

Data from 30 225 oceanographic stations collected prior to 1998 were obtained during the year, similar to the number received in 1997. Most of the data came from Canada.

iii) **Drift-buoy data**

A total of 109 drift-buoy tracks were received by MEDS during 1998 representing over 303 buoy months. The total number of buoys is a decrease of 49 over 1997 and the number of buoy months is a decrease by almost 24 .

iv) **Wave data**

In 1997, 78 754 wave spectra were processed, mostly from the permanent network of moored wave buoys in the area. This represented a 4.5 increase compared to 1997.

v) **Tide and water level data**

MEDS processes and archives operational tidal and water level data obtained from the Canadian Hydrographic Service (CHS). The data are derived from the CHS active permanent water level network. A total of 47 stations were processed during 1998, a decrease of 10 stations from 1997.

vi) **Recent activities**

MEDS reported on four recent initiatives. (1) In 1998, MEDS began acquiring and archiving data from the profiling buoys, known as PALACE floats. Over 200 such floats have been deployed, resulting in 2 547 profiles (primarily temperature) being received during 1998 of which 239 were collected in the NAFO area. (2) A number of ships have been equipped with thermosalinographs to collect surface temperature and salinity data. These are transmitted as station data via satellite with over 5 730 stations in the NW Atlantic being received during 1998. (3) The first set of CD-ROMs containing WOCE data was issued in May 1998 and contains data up to the end of 1997. A second version will be issued in May 2000. (4) MEDS continues to be involved with the Canadian Atlantic Zone Monitoring Program and has assumed the responsibility for leading the data management team. Included within this program has been the organizing of a biological database.

It was noted that data submissions to MEDS during 1998 decreased for most countries. It was stressed that in order to keep abreast of environmental changes scientists needed to insure that their data reach their national archives. MEDS obtains the data from the national archives. Where no national archive exists, scientists should send the data directly to MEDS.

b) **Review of Environmental Studies in 1998**

i) **Subareas 0 and 1** (SCR Doc. 99/4, 17)

A survey of oceanographic conditions at the West Greenland standard sections was carried out from 24 June and 8 July 1998 (SCR Doc. 99/4). Surface layer temperatures were relatively high throughout much of the region (from Cape Farewell to Holsteinsborg). At Fyllas Bank, it was the warmest summer and the largest annual increase in the near 50-year record. Near surface salinities at Fyllas Bank increased from the low value of 1997 to slightly above the long-term mean. The relative cooler, fresher Polar water was observed in

the southern most transects but the core of this water normally observed off Fyllas Bank, was absent. In the subsurface layers, a tongue of Irminger Water was found north of the Frederikshaab section. Temperatures in this core were higher-than-normal and are believed to have contributed to the warm surface layers. These data are suggestive of a large inflow of warm high saline water originating from the North Atlantic Current.

Analysis of air and sea temperatures and sea ice around Greenland also indicate warmer-than-normal conditions during 1998 (SCR Doc. 99/17). The annual air temperature at Nuuk/West Greenland was higher-than-normal in 1998. In general, there was less sea ice than usual except in the southwestern region of Julianehaab Bight where ice persisted from April to August. Sea surface temperature anomaly data derived from the IGOSS (Integrated Global Ocean Services System) data base suggested a large patch of above normal sea surface temperatures (SSTs) in the central Labrador Sea that persisted through most of the year, although the amplitude of the anomalies varied. Colder-than-normal SSTs were observed along the West Greenland and Labrador shelves. Hydrographic measurements were taken on the standard stations of the Cape Desolation and Fyllas Bank sections. At Cape Desolation, temperature and salinities were the highest on record. At Fyllas Bank temperatures from the surface to 300 m were as high as the previous warmest periods, i.e. in the mid-1970s and 1960s. Salinities were slightly above the long-term normal at Fyllas Bank and above 1997 values.

ii) **Subareas 2, 3 and 4** (SCR Doc. 99/32)

Interannual variations in bottom temperature for NAFO Subareas 2 and 3 on the Newfoundland Shelf were examined from the areal extent of the bottom covered with waters of temperature ≤0°C, between 0 and 1°C, and ≥1°C. The area of bottom waters 0°C during the autumn in Div. 2J and 3KLNO decreased during 1995 and has remained low through 1998. On the Grand Bank (Div. 3LNO), the bottom waters in 1998 were the warmest since 1983. The area of 0°C on the banks on the southern Newfoundland Shelf (Div. 3P) were very low in 1998 whereas the area covered by waters ≥1°C increased to 50 , the highest value since 1984. In all Divisions, the trends were most pronounced on the banks and in the near shore regions where the Cold Intermediate Layer (CIL) and meteorological forcing are greatest. The decline in Arctic cod abundance was attributed to the increase in the bottom temperatures off Newfoundland. As well, increases in the catches of juvenile cod, haddock and American plaice on the Grand Bank and the northern Newfoundland Shelf during the 1998 summer juvenile survey may also be related to the increase in temperature.

iii) **Subareas 5 and 6**

Monthly monitoring of surface conditions on a transect across the Middle Atlantic Bight revealed colder and fresher conditions in the slope waters just off the shelf during February to May. In the inshore areas, the beginning and end of the year saw below normal temperatures with above normal during the spring and summer. Bottom temperatures over the shelf showed a similar pattern to the SSTs except bottom water temperatures were warmer-than-normal during the early part of the year over the inner two-thirds of the shelf. Temperatures are also monitored along a transect crossing the Gulf of Maine. There, near-surface temperatures were above normal during the summer but dropped to below normal in the later half of the year. Bottom water temperatures were below normal in the eastern half of the Gulf and tended to be above normal on the western side. The cold conditions in the bottom waters on the eastern side of the Gulf are believed to be due to the influence of cold Labrador Slope water offshore. Hydrographic information from these transects are due to be published in the Journal of Northwest Atlantic Fishery Science in the autumn.

iv) **Interdisciplinary studies**

No papers were presented on this subject.

c) **Overview of Environmental Conditions in 1998** (SCR Doc. 99/36)

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 1998 with the largest amplitudes in the Gulf of St. Lawrence.

ii) The atmospheric circulation pattern in 1998 was similar to 1997 with the anomaly of the North Atlantic Oscillation (NAO) index being slightly positive and near to, but above, the value for 1997. This is well above the very low value of 1996 but below that recorded in the early-1990s.

iii) Due to warmer than normal air temperatures and weaker winds, ice formed late, left early and was of shorter duration in 1998 than normal off southern Labrador, Newfoundland and in the Gulf of St. Lawrence. Little to no ice reached the Scotian Shelf. In spite of this reduction in total amount of ice, the maximum areal extent on the Newfoundland Shelf was near normal.

iv) During 1998, the number of icebergs to reach south of 48°N increased relative to 1997 and was an above average iceberg year. This was surprising given the higher air temperatures and reduction in sea ice duration.

v) Temperatures in 1998 throughout most of the water column off Newfoundland changed from above to below normal in April, except near bottom where they were slightly above normal throughout the year.

vi) The volume extent of the CIL water off Newfoundland during the summer was near the 1997 value and just above the lowest value on record. The area of CIL water was near normal off northern Newfoundland and on the Grand Bank but was slightly below normal off southern Labrador.

vii) The CIL waters in the Gulf of St. Lawrence remained cold and their horizontal extent over the bottom of the Magdalen Shallows continued to be relatively large. Conditions cooled in 1998 relative to 1997 as evidenced by the decrease in temperatures and the increase in the area of the Magdalen Shallows by temperatures 0 and 1°C. Cause of this cooling is unclear as air temperatures in winter in the Gulf were above normal.

viii) Annual coastal SSTs at Boothbay Harbor, Maine, and St. Andrews, New Brunswick, were above average, a pattern similar to the previous three years. Halifax SSTs were also above normal, reversing the trend of the last few years of below normal values.

ix) Deep-water temperatures on the Scotian Shelf (Emerald Basin) decreased by upwards of 3°C in early 1998 and remained low during the rest of year. Low temperatures were also recorded in Georges Basin in the Gulf of Maine. The low temperatures in the deep basins on the Scotian Shelf and in the Gulf of Maine are due to the on-shelf penetration of cold Labrador Slope water from the shelf break region.

x) The cold Labrador Slope water observed in 1997 along the shelf edge off the Scotian Shelf remained and during 1998 moved further southward along the slope to the Middle Atlantic Bight region.

xi) Cold waters were observed near-bottom and at intermediate waters over the northeastern Scotian Shelf and off southwestern Nova Scotia, continuing a trend that began in the mid- to late-1980s. They continue to warm slowly, however, and are almost at their long-term mean value.

xii) Density stratification on the Scotian Shelf has been increasing steadily during the 1990s and is presently at or near its highest value in the 50 year record. No increase in stratification is observed in the Gulf of Maine.

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

6. **Formulation of Recommendations Based on Environmental Conditions in 1998**

The Scientific Council had requested STACFEN to provide short (1-2 sentences) descriptions of the environment, which would be incorporated into stock assessment reports of STACFIS. Discussions centered on what was required. It was felt that these brief summaries would cover groups of stocks, e.g. those in Subareas 0-1, Div. 3LNO and Div. 3M, and for those stocks that range widely, such as Greenland halibut. These summaries would be similar to what is presently given in the International Council for the Exploration of the Sea (ICES) reports and could probably be extracted from the executive summary of STACFEN. STACFEN agreed to provide the summaries to STACFIS and felt that no specific recommendation was required.

The NAFO data archive at MEDS has seen a reduction in the flow of data from many reporting countries. The Committee felt strongly that the hydrographic data, as well as other physical oceanographic data such as drift buoy tracks, wave spectra, currents, etc., should be processed quickly and sent to a data archive. With the reductions in sea-going surveys by most nations due to cost cutting measures, it becomes even more critical to obtain the data that are collected. STACFEN strongly urged scientists to submit their data to their national archives in a timely manner. STACFEN felt a specific recommendation to Scientific Council was required at this time.

7. **Environmental Indices – Implementation in the Assessment Process** (SCR Doc. 99/6, 7)

A review was given of recently published material on the relationship between fish productivity and environmental variables as well as between climate changes and the response of marine ecosystems (SCR Doc. 99/6). Strong evidence was provided for an environmental influence on distribution, recruitment and growth of a number of different stocks from a variety of geographical locations. The conclusion was drawn that despite the chaotic nature of the climate system, efforts should be made to incorporate environment into the stock assessment process, especially since we may be able to predict the environment on at least decadal scales.

Univariate seasonal Autoregressive-Integrated-Moving-Average (ARIMA) and intervention models were used to forecast monthly mean air and bottom water temperatures from 3 sites in the Northwest Atlantic, up to one year in advance (SCR Doc. 99/7). These models explained a reasonable amount of the total variability, with results showing a good agreement between the forecasts and observations. The structure of the random processes that generated the temperature time series was specified for most cases as ARIMA models with moving average terms.

These papers generated much discussion. More work on the predictions was required, especially using longer time series. One of the problems in fisheries is to determine what temperature fish actually experience. In the past, temperatures were usually taken from a fixed site, whereas we know that fish move and may traverse water masses of different temperatures. Temperature indices that take this movement into account are required. Finally, environmental information should be considered as part of the precautionary approach. For example, biological reference points may differ during different periods because of different environmental conditions. Thus reference points may need to be adjusted depending upon environmental conditions.

8. **Russian/German Project Data Evaluation** (SCR Doc. 99/12)

The Chairman presented the Third Report on the Joint Russian/German Project "Assessment of short-time climatic variations in the Labrador Sea". A workshop was held on 10-14 May 1999 in Hamburg, Germany.

Using historical data, the workshop analyzed air temperature, sea level pressure, and the NAO index. The Labrador Sea and the Irminger Sea regions exhibit a strong negative correlation with the NAO index. Positive correlations are seen in a band from the New England States to western Europe. Sea level pressure fields during low and high NAO years were also generated. The next workshop within this project is scheduled for 23-30 August 1999 in Murmansk, Russia.

9. **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. The co-convenors are to be Jens Meincke (Germany) and Bob Dickson (UK). The ICES Hydrography Working Group has supported the joint sponsorship with NAFO. The Chairman of STACFEN, M. Stein, was appointed to the Steering Committee for the symposium and K. Drinkwater to the editorial board for publication of the symposium proceedings. Given that both NAFO and ICES would be proposing to hold similar symposia on a review of the 1990s early in the next decade, 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.

The Executive Secretary of NAFO received a letter from the General Secretary of ICES regarding the possible financial contribution of NAFO. He noted that the Symposium coincides with the 70th anniversary of the Continuous Plankton Recorder (CPR) in Edinburgh where the Symposium will be held. They would like to mark this occasion by including as part of the Symposium, an art exhibition of approximately 100 water colours of marine organisms painted by the inventor of the CPR, Sir Alister Hardy. However, such an exhibition is feasible only if a donation can be secured to cover the costs of collecting, mounting, transporting and insuring the collection, which the Sir Alister Hardy Foundation of Ocean Science estimated at GBP 3 500 (approximately CDN $8 000).

STACFEN **recommended** that *NAFO's financial contribution to the Joint ICES/NAFO Symposium, August 2001, include the equivalent of GBP 3 500 (approximately CDN $ 8 000) to cover the cost of the art exhibition.*

10. **National Representatives**

The national representatives responsible for hydrographic data 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), J. Gil (STACFEN noted this will change but it was not sure who would be responsible)(Spain), F. Troyanovsky (Russia), L.J. Rickards (United Kingdom) and G. Withee (STACFEN noted this needs to be checked) (USA).

11. **Acknowledgements**

The Chairman thanked Dr. Bob Dickson for his outstanding lecture, the participants for their valuable contributions, and in particular the Assistant Executive Secretary and the NAFO Secretariat for preparation of documentation, and the rapporteur for compiling the report. There being no further business, the meeting was adjourned.

Left to Right: Chairman STACFIS R. K. Mayo (USA)
Chairman STACFEN M. Stein (EU-Germany)
Chairman Scientific Council H. P. Cornus (EU-Germany)
Vice-Chairman Scientific Council and Chairman STACPUB W. B. Brodie (Canada)
Chairman STACREC V. N. Shibanov (Russia)

STACFIS members in session using the LAN System during 3-16 June 1999 Meeting.

L to R: H. Murua, L. Motos, S. Junquera, A. Avila de Melo, R. Alpoim, J.-C. Mah, C. Darby, H.-J. Rtz

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

Chairman: R. K. Mayo Rapporteurs: Various

I. OPENING

The Committee met at the Park Place Ramada Plaza Hotel, 240 Brownlow Avenue, Dartmouth, Nova Scotia, Canada during 3-16 June 1999, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain finfish and invertebrate marine stocks. Representatives from Canada, Denmark (in respect of the Faroe Islands and Greenland), Estonia, European Union (France, Germany, Portugal, Spain and United Kingdom), Japan, Russian Federation and the United States of America attended. Various scientists assisted in the preparation of the reports considered by the Committee.

The Chairman, R. K. Mayo (USA), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The Chairman noted there were additional considerations on the Precautionary Approach reference points. The revised agenda was accordingly **adopted** (see Agenda II at PART E of this volume).

II. GENERAL REVIEW

1. **Review of Recommendations in 1998**

STACFIS reviewed the recommendations from 1998 within each stock considered.

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 1998. 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 from the NAFO area were inspected at the landing site in 1998. These provided other sources of catch data.

STACFIS considered a proposal to instruct Designated Experts to in future report catches as nominal catches (live weight equivalent of landings, excluding discards) when compiling catch data tables, and to indicate otherwise if catches represent something other than nominal catch. STACFIS agreed to this proposal.

Structure of STACFIS Report. STACFIS discussed a proposed revision to the structure of the STACFIS report as described in Section V.2. below, and agreed that the present report should reflect the revised order of presentation based on four geographic regions. It was agreed that general environmental overviews as presented by STACFEN would be provided for each geographic region.

III. STOCK ASSESSMENTS

A. STOCKS OFF GREENLAND AND IN DAVIS STRAIT

Overview of Physical Environment

Anomalous high surface and subsurface water temperatures and salinities were observed off West Greenland during summer and autumn of 1998. This continued an upward trend, which started in 1995. It

was supposed that warmer-than-normal air temperatures in the region, and inflow of warm high saline water originating from the North Atlantic Current, were responsible for these record high values.

1. **Greenland Halibut (*Reinhardtius hippoglossoides)* in Subarea 0 and Division 1A Offshore and Divisions 1B-1F** (SCR Doc. 99/25,27,30,45,47,53; SCS Doc. 99/5,9,17)

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 8 988 tons. In Subarea 0 catches peaked in 1992 at 12 400 tons, declined to 4 300 tons in 1994 and increased to 5 600 tons in 1995, and stayed at that level until 1997. In 1998 catches were 4 370 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 since (Fig. 1.1).

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

	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]
Recommended TAC[2]	25	25	25	25	25	25	11	11	11	11
SA 0	9	9	12	7	4	6	6	6	4	
SA 1 excluding Div. 1A inshore	1	2	6	4	6	6	5	5	5	
Total	11	11	18	11	10	11[3]	10[4]	11[5]	9[6]	

[1] Provisional.
[2] In the period 1986-94 the TAC included Div. 1A inshore.
[3] Including 3 308 tons non-reported.
[4] Including 3 153 tons non-reported.
[5] Including 4 128 tons non-reported.
[6] Including 1 105 tons non-reported.

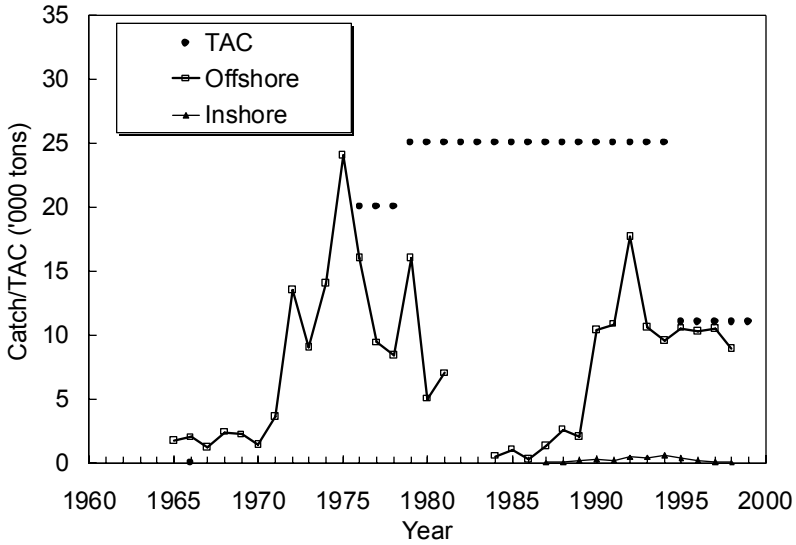


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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 Faroe Islands and Norway. In the beginning of the 1990s catches taken by these two countries increased and Canada, Russia and Japan entered the fishery. In 1995 a Canadian gillnet fishery began. In 1997 and 1998 only Faroe Island and Canada conducted a fishery in the area. In 1998 trawlers took about 2 300 tons while Canadian gillnetters and longliners took 1 900 tons and 233 tons, respectively. 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. Since then, catches have decreased to 285 tons in 1995 and 66 tons in 1997. In 1998 the catches were estimated to be below 100 tons. The decrease in catches in recent years is due to lack of ice cover.

An exploratory trawl fishery by Canada in Div. 0A in 1996 resulted in a catch of 295 tons. The fishery continued in 1997 and 1998 with catches of 240 tons and 42 tons respectively, which were the only catches reported from this area.

The fishery in Divisions 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 since. In 1998 3 859 tons were taken offshore by trawlers from Greenland, Norway, Russia and EU-Germany. A longline fishery started in 1994 and longliners from Greenland and Norway caught 662 tons in 1998. Inshore catches amounted to 7 tons. Almost all the fishery takes place in Div. 1D in the second half of the year.

b) **Input Data**

i) **Commercial fishery data**

For 1998 catch-at-age and weight-at-age data were available from the trawl fishery in Div. 1D and the trawl fishery and the gillnet and longline fishery (combined) in Div. 0B. Age 7 fish dominated the trawl catches in Div. 0B, while age 8 dominated in Div. 1D. In 1998 there was a slight increase in the number of older fish in the overall age distribution caused by a change in the mode in the gillnet fishery from ages 8-9 to 10-11 and because the relative importance of the gillnet catches increased from 1997 to 1998 (SCR Doc. 99/53).

Standardized annual catch rates were calculated for the trawl fishery in Div. 0B for 1990-98 based on observer data (SCR Doc. 99/47) and from Div. 1CD for 1987-98 based on available logbooks (SCR Doc. 99/53). 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. 99/53).

Catch rates for a longliner fishing in Subarea 1 were available for the period 1994-98. The catch rates increased 36 between 1994 and 1995, but declined to the 1994 level in 1996 and have been decreasing since. The 1998 data represents, however, only 14 of the catches and there are no data from 4th quarter where the catch rates were highest.

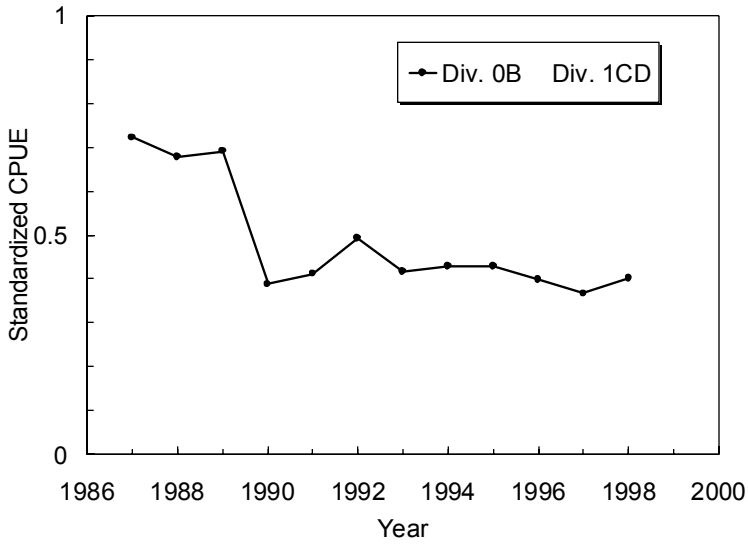


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): combined standardized CPUE from Div. 0B and Div.1CD.

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 70 000 tons in 1998 compared with 56 000 tons in 1997 (Fig. 1.3).

Biomass estimates ('000 tons) from USSR(Russia)/GDR(FRG) surveys, Japan/Greenland and Greenland surveys for the years 1987-97 in Subareas 0 and 1 are as follows:

	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	-

[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.

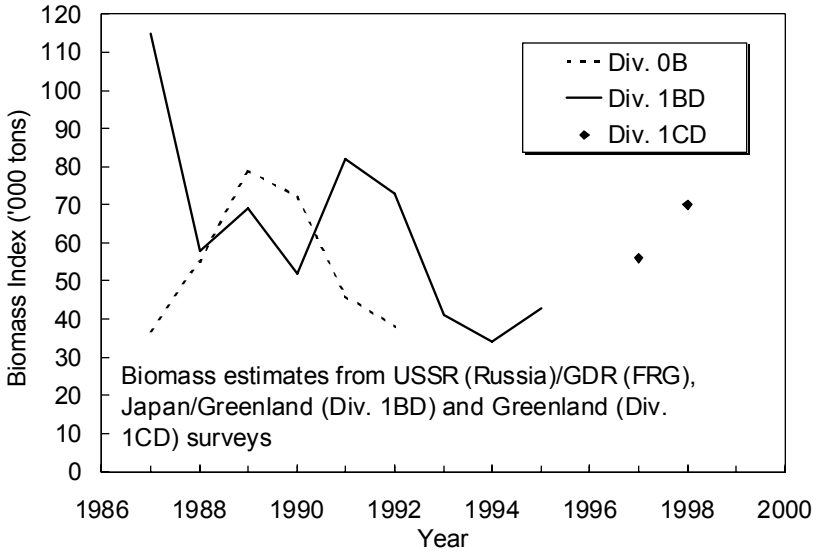


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from surveys.

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 1998 consisted mainly of one- and two-year old fish and the abundance was estimated at 175 million, which is an increase from 115 million in 1997. The estimate from 1998 is above the low levels (83-65 million) in 1990-91 but below the level in 1992-95 (200 million). In the nursery area (Div. 1A and B), which is a subset of the survey area, the abundance was estimated at 106 million which is an increase from 67 million in 1997 (SCR Doc. 99/27) (Fig. 1.4).

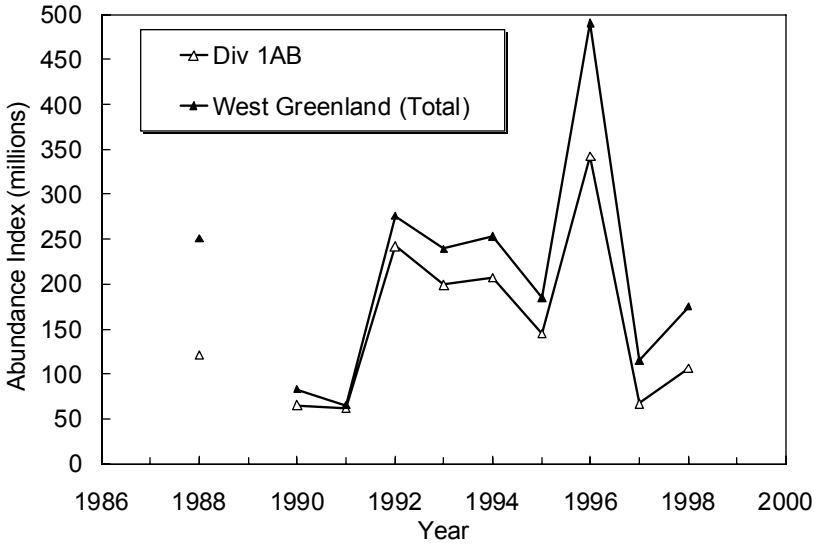


Fig. 1.4. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): offshore abundance from shrimp trawl surveys.

iii) **Biological studies**

A review of the tagging experiments on Greenland halibut that have been conducted in Greenlandic waters during the period 1986-98 was presented (SCR Doc. 99/25). In total 7 244 fish have been tagged inshore and offshore and 499 recaptures were recorded from the Northwest Atlantic area. A substantial proportion of the fish tagged in the Davis Strait, Baffin Bay and the fjords in southwestern and eastern Greenland migrated up to 2 500 km, primarily to the Denmark Strait between East Greenland and Iceland. But migrations from the southwestern Greenland to the Newfoundland coast were also observed. The migrations were probably prespawning and feeding migrations. The results indicated that some of the Greenland halibut in the Davis Strait and the southwest Greenland fjords originated from the spawning grounds west of Iceland.

Of the 4 319 fish tagged inshore in northwest Greenland (Div. 1A) 418 were recaptured up to 8 years after tagging. Of these 400 had reliable information on recapture position. No fish were recaptured outside the inshore areas comprised of Disko Bay, Uummannaq and Upernavik area, and 90 of the fish were recaptured in the fjord where they were tagged indicating that these fish are resident. Some limited migration was observed between some of the inshore areas especially in Disko Bay, where fish moved between the fjord Torsukattaq and Ilulisat. Further, the data indicated some seasonal migrations within the fjords probably related to feeding. There is still very little fishery offshore in Div. 1A and therefore tagging returns can not conclusively test a possible link with Greenland halibut occurring offshore and inshore in Div. 1A.

c) **Estimation of Parameters**

An ASPIC production model was run using standardized CPUE data from Div. 0B and Div. 1CD and biomass estimates from Div. 1CD together with catch data as input in order to estimate MSY and F_{msy}. The combined CPUE data from Div. 0B and Div. 1CD fitted the model best, but the estimates of a number of essential parameters were associated with wide confidence intervals. This was probably because the data series was relatively short and the ranges of both catch and CPUE data were small (SCR Doc. 99/53). The estimation of MSY and F_{msy} was not considered precise enough to be used.

d) **Assessment Results**

Catches peaked at 18 000 tons in 1992 but have been stable around 10 500 tons since then. The catch composition has been stable in recent years. Survey trawlable biomass in Div. 1CD was estimated as 70 000 tons in 1998 which is an increase from the 56 000 tons estimated for 1997.

Recruitment estimates at age 1 of the 1992-94 year-classes were lower than the presumably good 1991 year-class, but are still considered to be at or above average for the last decade. The 1995 year-class was estimated to be the best in the series. The 1996 and 1997 year-classes were estimated to be slightly below the average of the last decade.

A combined standardized CPUE index from Div. 0B and Div. 1CD has been stable during 1990-98.

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.

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 (not

presented) showed no significant improvement in the outcome of the analysis. An attempt to estimate MSY and F_{msy} by a production model (ASPIC) was not successful probably because there was a small range in the input data. This lack of contrast due to the low range in CPUE and biomass estimates also hampered estimation of precautionary reference points based on CPUE and biomass.

f) **Research Recommendations**

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. 99/25, 48, 53; SCS Doc. 99/17)

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 steadily since. In 1998 the catch was almost 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:

	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999
Disko Bay[2]	3.8	5.4	6.6	5.4	5.2	7.4	7.8	8.6	10.7	
Recommended TAC										7.9
Uummannaq	2.8	3.0	3.1	3.9	4.0	7.2	4.6	6.3	6.9	
Recommended TAC										6.0
Upernavik	1.2	1.5	2.2	3.8	4.8	3.3	4.8	4.9	7.0	
Recommended TAC										4.3
Offshore	-	-	-	-	+	+	+	-	-	
Unknown[3]	0.5	+	0.1	-	-	-	-	-	-	
Total	8.3	9.9	11.9	13.1	14.0	17.9	17.3	19.8	24.6	
Officially reported	7.5	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.

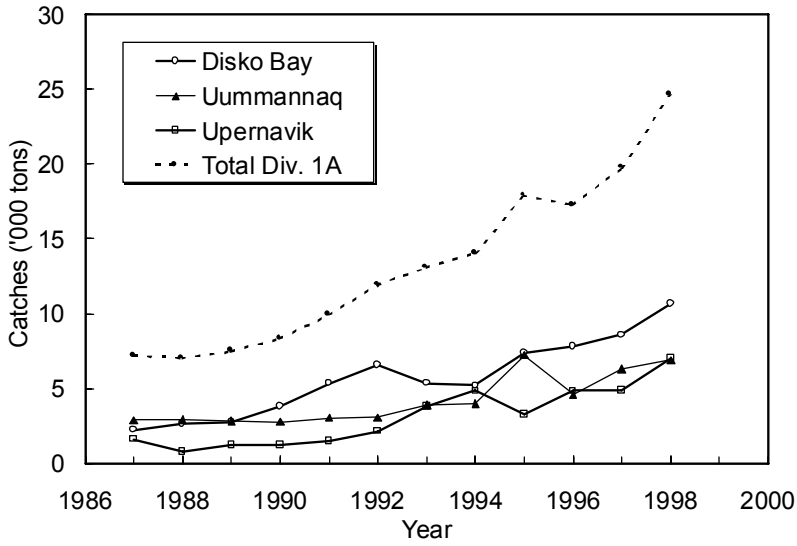


Fig. 2.1. Greenland halibut in Div. 1A: catches by area.

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 Greenlandic longliner; in 1995 13 tons by a Japanese trawler. No fishing was carried out in the area in 1996-98.

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. Gillnets will be banned in year 2000. 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. In 1998 a total of 1 127 licenses were issued, allocated as: Disko Bay 364, Uummannaq 377 and Upernavik 386 licenses.

The inshore fishery in Div. 1A is mainly located in three areas: Disko Bay (69°N), Uummannaq (71°N) and Upernavik (73°N). Landings in Qaannaq (77°N) were 16 tons in 1998.

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, Torssukattak, north of Ilulissat. Use of gillnets is prohibited in the inner parts of the ice fjords.

The catches in Disko Bay have increased from about 2 300 tons in 1987 to an historic high level of 10 670 tons in 1998. Longline catches comprised 54 of the total in 1998.

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. Gillnets are prohibited in the inner parts of the fjords in Uummannaq.

Catches have been increasing from a level of 2 000 tons before 1987 to a record high in 1995 of 7 200 tons. The catch in 1998 was 6 911 tons. The longline catches comprised 74 of the total in 1998.

Upernavik. The northernmost area consists of a large number of ice fjords. The main fishing grounds are Upernavik and Giesecke Ice Fjords. New fishing grounds around Kullorsuaq in the northern part of the area have recently been exploited. Use of gillnets is prohibited in Upernavik.

The catches in the Upernavik area have increased steadily from about 1 000 tons in the late-1980s to about 3 000 to 4 000 tons in 1993 to 1995 (Fig. 2.1). The total catch in 1998 was the highest on record, 7 000 tons.

b) **Input Data**

i) **Commercial fishery data**

Catch-at-age data for the three inshore areas separately were available, based on sampling from the commercial fishery covering area, gear and, in most cases, season. Where otolith sampling was missing or inadequate, age-length keys were applied from adjacent years or areas.

The age composition as 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 1998 in Disko Bay, Uummannaq and Upernavik indicated that the fishery is taking place on smaller sub-components of the stock, as size differences were observed between summer and winter. A decline in mean length was observed in Upernavik and Uummannaq while mean length has increased in Disko Bay the latest years.

Effort data from the fishery (logbooks, etc.) do not exist. However, analyses of fishing days allocated on area and landings size per fisherman per day, showed a close correlation between development in fishing days and annual landing. Thus it was concluded that the increase in landings was due to an increase in fishing effort. Overall the effort in the small-scale fishery (0-100 kg per landing) has declined while the larger scale fishery (500 kg per landing) has increased its effort.

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 1998 the research longline vessel *Adolf Jensen* covered the fjord areas of Uummannaq and Upernavik.

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

Area	1993	1994	1995	1996	1997	1998
Disko Bay	3.1	3.1	-	3.9	4.4	-
Uummannaq	2.8	-	6.6	4.5	-	6.1
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
Disko Bay	55.9	56.5	-	53.6	57.0	-
Uummannaq	57.5	-	57.8	59.5	-	61.2
Upernavik	-	64.6	60.8	-	-	57.1

From the surveys a significant change in mean length has not been observed. Length distribution seemed to be stable in Disko Bay and Uummannaq while declining in Upernavik.

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 1998 were presented as catch-in-numbers per age per hour, for both the offshore and inshore nursery areas (Fig. 2.2). Offshore, the number of one-year-olds from the 1997 year-class was a little below average. The 1995 year-class that appeared very strong as one year olds had declined in strength, as the numbers of 3-year-olds were not above average. Inshore recruitment from the 1997 year-class was the highest observed and 3-year-olds from the 1995 year-class were still considered strong.

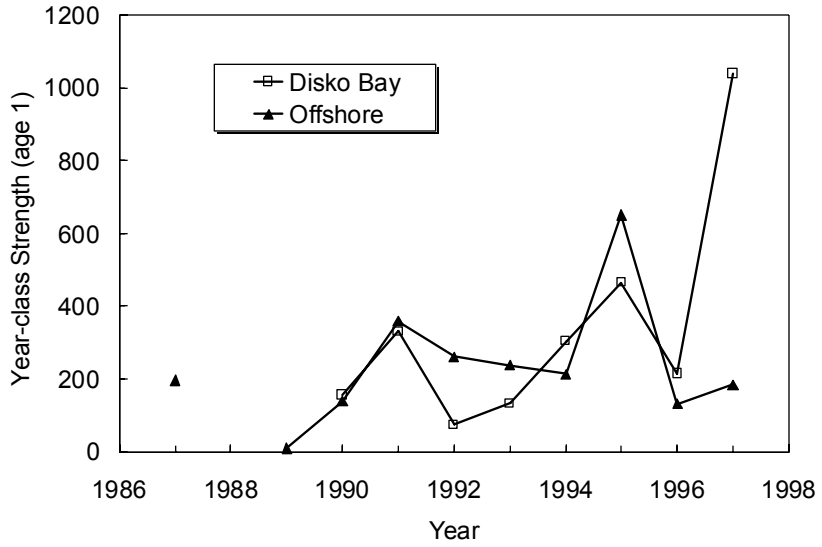


Fig. 2.2. Greenland halibut in Div. 1A: recruitment at age 1 on nursery grounds.

iii) **Biological studies**

A review of the tagging experiments in West Greenland in the period 1986-98 has been conducted (SCR Doc. 99/25). No fish tagged in the fjords have been caught in the offshore area in Div. 1A, but there is little to no fishing effort in this offshore area. Therefore the assumption that the stocks in the three main areas do not contribute to the offshore spawning stock in Davis Strait south of Div. 1A can be maintained. Very little intermingling between the fjords was observed. Therefore the three inshore areas can be assessed separately. Inshore tagging of Greenland halibut in Div. 1A was continued in 1998.

Sexual maturity of Greenland halibut was estimated in Uummannaq and Upernavik in the summer 1998. In both areas about 90 of the males and 60 of the females were immature. A study on maturity covering the entire year was initiated in 1998 and may clarify the extent of the inshore spawning.

c) **Assessment Results**

A separable VPA was carried out for the Disko Bay area. This area was selected because of a longer and continuous data series compared to Uummannaq and Upernavik.

The stock in all three areas consists of a large number of age groups. The age structure of the stock does not show signs of collapse, but there has been an apparent shift towards younger age groups.

Disko Bay. 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. Fishing mortality has been generally increasing since the early-1990s and both landings and biomass have been increasing as well.

Catches have been increasing continuously in the past 10 years from about 2 000 tons to 10 671 tons in 1998. Survey results from 1993 and onwards do not indicate any major changes in abundance. The stock component in Disko Bay is composed of younger and smaller individuals than in the other two areas. In spite of the increasing catches, length composition in the survey has not changed and, in the commercial fishery, an increase in mean length was observed in recent years.

Uummannaq. Catches have been increasing from a level of 2 000 tons before 1987 to a record high in 1995 of 7 000 tons. The catch in 1998 was 6 912 tons. Survey results from 1993 and 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 indicating growth overfishing, but has stabilized in the latest years. The stock component in Uummannaq is thus affected by the increasing fishery.

Upernavik. Catches have been increasing from a level of 1 000 tons before 1992 to about 5 000 tons in 1996 and 1997. In 1998 the catch of 7 012 tons was the highest on record.

Survey results from 1993 and onwards do not indicate any major changes in abundance. Age and 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 exploited. New fishing grounds in the northern part of the district have been exploited only recently, and therefore the stock components are considered virgin.

d) **Reference Points**

As fishing mortality could not be estimated, precautionary reference points could not be given. A "precautionary traffic light" (SCR Doc. 98/8) was adapted to the stock by the Scientific Council at the 1998 June meeting. As was seen in 1998, it is noted that nearly half of the items are still placed in the red zone, which raises cause for concern about the sustainability of the fishery under the current management regime.

e) **Research Recommendations**

The continuing increase in total landings of Greenland halibut in Div. 1A inshore generates concern, especially because lack of effort data from the commercial fishery impedes the assessment of the stocks. Therefore STACFIS **recommended** that *for the Greenland halibut commercial fishery in Div. 1A action should be taken to obtain measures of effort from the commercial fishery.*

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. 99/30; SCS Doc. 99/5, 9, 17)

a) **Introduction**

A total catch of 29 tons was reported for 1998 compared to 153 tons for 1997 (Fig. 3.1).

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Recommended TAC	8.0	8.0	8.0	8.0	8.0	8.0	0	0	0	0
Catch	0.29	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]

[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.

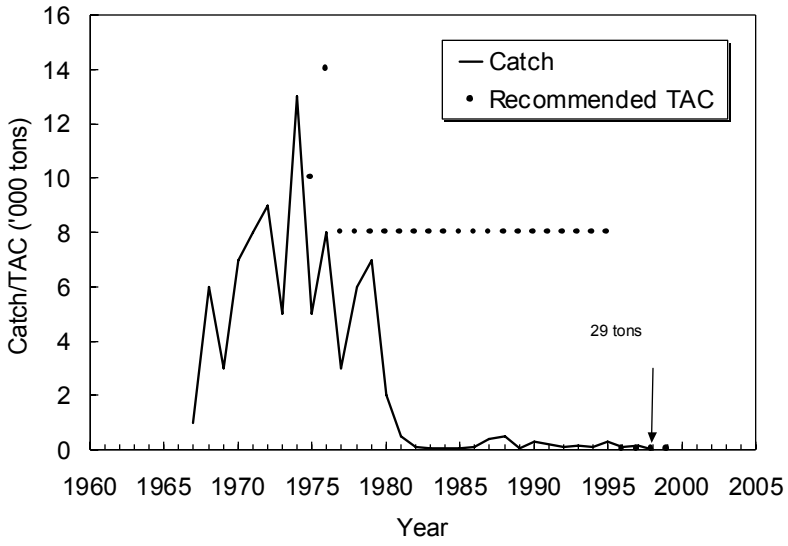


Fig. 3.1. Roundnose grenadier in Subareas 0+1: catches and TACs

b) **Input Data**

i) **Commercial fishery data**

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier was taken as by-catch in the Greenland halibut fishery. No update of the catch/effort analysis which was presented previously (*NAFO Sci. Coun. Rep.*, 1985, p. 72) was possible. Some of the reported catches are a mixture of roundnose

grenadier and roughhead grenadier (*Macrourus berglax*). The proportion of roughhead grenadier is not known.

ii) **Research survey data**

Roundnose grenadier. In 1986 Canada conducted a survey that covered Subareas 0 and 1 down to 1 250 m depth. In the period 1987-95 Japan in cooperation with Greenland conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. (The survey area was restratified and the biomasses recalculated in 1997). USSR/Russia has in the period 1986-92 conducted surveys covering Div. 0B and Div. 1CD at depths down to 1 250 m until 1988 and down to 1 500 m from then on. The surveys took place in October-November. In September/October 1997 and 1998 Greenland conducted surveys covering Div. 1CD at depths between 400 and 1 500 m. The trawlable biomass ('000 tons) was estimated as follows (Fig. 3.2):

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Canada													
Div. 0B	11.1												
Div. 1CD	99.9												
Russia													
Div. 0B	2.0	5.0	26.5	9.7	6.5	0.6	1.4						
Div. 1CD		80.6	36.8		48.1								
Japan/Greenland Div. 1CD			83.8[1]	44.2[2]	8.1[3]	19.2[4]	41.9[4]	43.1[4]	8.0[1]	3.1[4]	7.2[4]		
Greenland Div. 1CD												5.7[2]	7.3[2]

[1] June/July. Biomass at depth □1 000 m estimated by an ANOVA (47),
[2] September/October,
[3] April/May,
[4] August/September.

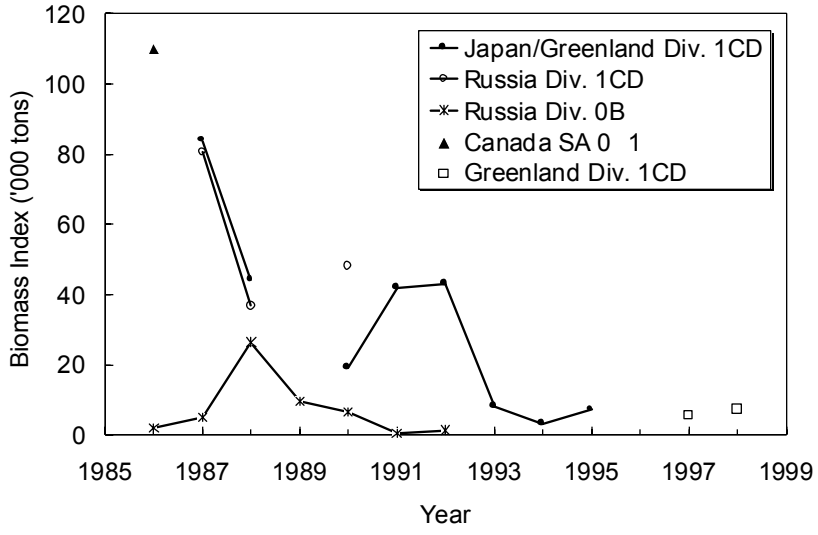


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from USSR/Russian, Japan/Greenland and Greenland surveys in Div. 0B and Div. 1CD.

In the 1998 survey the biomass and abundance was estimated at 7 263 tons and 75.2 million, respectively. This is an increase in biomass of about 1 500 tons and a doubling of the abundance compared to 1997. As in previous years almost all the roundnose grenadier was found at depths 1 000 m in Div. 1D, but most of the increase in biomass and abundance was seen in Div. 1C at 600-1 000 m. The fish were generally small, between 2 and 9 cm pre-anal fin length.

Roughhead grenadier. The abundance and biomass of roughhead grenadier in Div. 1CD in 1998 was estimated at 11.6 million and 4 314 tons, respectively, compared to 4.6 million and 2 259 tons in 1997. The abundance and biomass per km^2 was evenly distributed in the survey area at depths 800 m. Length ranged from 2.0 to 45 cm, pre-anal fin length, with modes near 11 and 14 cm.

c) **Assessment Results**

In the Greenland survey in 1998 the biomass in Div. 1CD was estimated at 7 263 tons, which is a small increase from 5 687 tons in 1997, but the biomass is still at the very low level observed since 1993.

d) **Reference Points**

STACFIS noted that reference points based on limited or target fishing mortality were not possible because of the limited data. Exploitation rates based on the ratio of catch to survey biomass were also considered unreliable because of an unknown mixture of roundnose and roughhead grenadier reported from catches taken as by-catches in the Greenland halibut fisheries.

STACFIS noted in 1998 that the trawlable biomass was in the order of 100 000 tons in Div. 1CD in 1986-87. Since the fishery has been at a very low level since the late-1970s, the stock in 1986-87 could be considered as virgin. Under this assumption, current trawlable biomass is about 7 of virgin stock size. The results of trial runs of a surplus production analysis completed in 1998 using commercial catch and effort data from 1968 to 1978, is still considered unrealistic. Although it was not possible to estimate a limit biomass level, it is most probable that any limit biomass would be substantially greater than 7 of the virgin level, the current situation as suggested by the survey data. Therefore it is considered that the current stock size is well below the limit biomass.

4. **Redfish (*Sebastes* spp.) in Subarea 1** (SCR Doc. 99/20, 27, 30, 41; SCS Doc. 99/9, 17)

a) **Introduction**

Historically, redfish were taken mainly as by-catch in the trawl fisheries for cod and shrimp. However, occasionally during 1984-86, a directed fishery on redfish was observed for German and Japanese trawlers. With the collapse of the Greenland cod stock during the early-1990s resulting in a termination of that fishery, catches of commercial sized redfish were taken inshore by long lining or jigging and offshore by shrimp fisheries only. There are also substantial numbers of juveniles discarded in the shrimp fishery.

Both redfish species, golden redfish (*Sebastes marinus* L.) and deep-sea redfish (*Sebastes mentella* Travin) are included in the catch statistics since no species specific data are available. Other data suggest that until 1986, landings were composed almost exclusively of golden redfish. Subsequently, the proportion of deep-sea redfish represented in the catches increased, and since 1991, the majority of catches are believed to be deep-sea redfish.

In 1977, total reported catches peaked at 31 000 tons (Fig. 4.1). During the period 1978-83, reported catches of redfish varied between 6 000 and 9 000 tons. From 1984 to 1986, catches declined to an average level of 5 000 tons due to a reduction of effort directed to cod by trawlers

of the EU-Germany fleet. With the closure of this offshore fishery in 1987, catches decreased further to 1 200 tons, and remained at that low level. The catch figure for 1998 is 929 tons.

Recent and historical catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp.

Recent catches ('000 tons) are as follows:

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Catch	0.4	0.3	0.3	0.8	1[1]	0.9[1]	0.9[1]	1[1]	0.9	
TAC	19	19	19	19	19	19	19	19	19	19

[1] Provisional

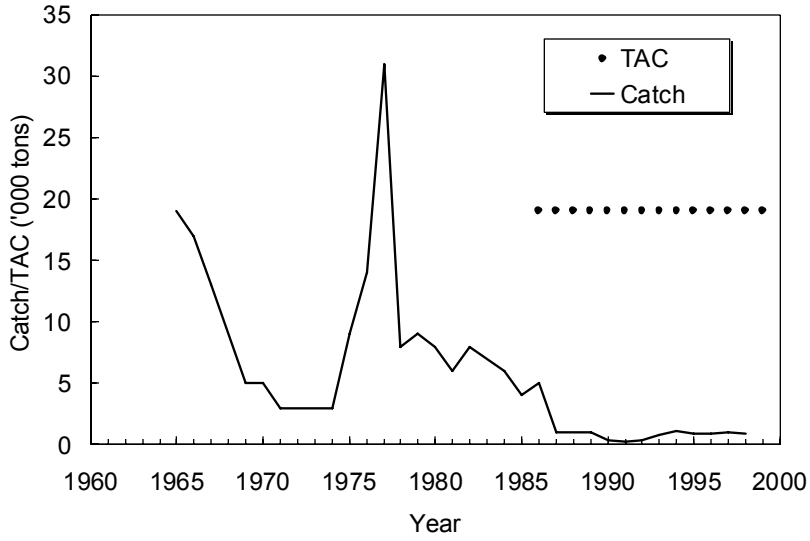


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

b) **Input Data**

i) **Commercial fishery data**

No data on CPUE were available. Information on historical length composition was derived from sampling of German commercial catches of golden redfish during 1962-90 covering fresh fish landings as well as catches taken by freezer trawlers. 118 samples were quarterly aggregated, and mean length was calculated. These data revealed significant size reductions of fish caught from 45 to 35 cm, with the biggest reductions occurring during the 1970s. There are no data available to estimate the size composition of historical catches of deep-sea redfish.

There was no information on by-catch in the shrimp fishery available for 1998.

ii) **Research survey data**

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400-m isobath of Div. 1B to 1F and were primarily designed for cod as target species. Therefore, the high interannual variation in

the estimates for redfish could have been caused as a result of the incomplete survey coverage in terms of depth range and pelagic occurrence of redfish. Nonetheless, the survey results indicated that both abundance and biomass estimates of golden redfish (≥17 cm) decreased by more than 90 until 1990 and remained at that low level since then (Fig. 4.2). Estimates for deep-sea redfish (≥17 cm) varied without a clear trend but have frequently been extremely low since 1989 (Fig. 4.3). However, the 1997 estimate indicated a significant biomass increase due to recruitment, which was not apparent in 1998. Unspecified redfish 17 cm were found to be very abundant, especially in 1986, 1991, and 1996-98 (Fig. 4.4). Reappearing peaks at 6, 10-12 and 15-16 cm might indicate annual growth increments and represent age groups 0, 1 and 2 years.

Greenland-Japan and Greenland groundfish surveys. During 1987-95, cooperative trawl surveys directed to Greenland halibut and roundnose grenadier have been conducted on the continental slope in Div. 1A-1D at depths between 400 and 1 500 m. This Greenland-Japan deepwater survey was discontinued in 1996 but conducted again since 1997 by Greenland with another vessel and changed gear. Deep-sea redfish were mainly caught at depths less than 800 m. Despite the technical changes, the increase in stock abundance and biomass from lowest level in 1995 is consistent with other survey information (Fig. 4.3). Length measurements revealed that the size composition of the stock is presently dominated by individuals 30 cm.

Greenland bottom trawl survey using a shrimp gear. Since 1988, a shrimp survey was conducted by Greenland covering Div. 1A to 1F down to 600 m depth. Due to changes in survey strategy and sampling of fish, determination of abundance and biomass indices and length composition were considered comparable only since 1992. Redfish was found to be most abundant in the northern Div. 1B. Abundance and biomass indices varied without a clear trend but indicated juvenile redfish to be very abundant, especially in 1994 and 1997 (Fig. 4.4). In 1998 the survey indicated a substantial decrease. During the entire survey series, catches were composed almost exclusively of redfish smaller than 15 cm.

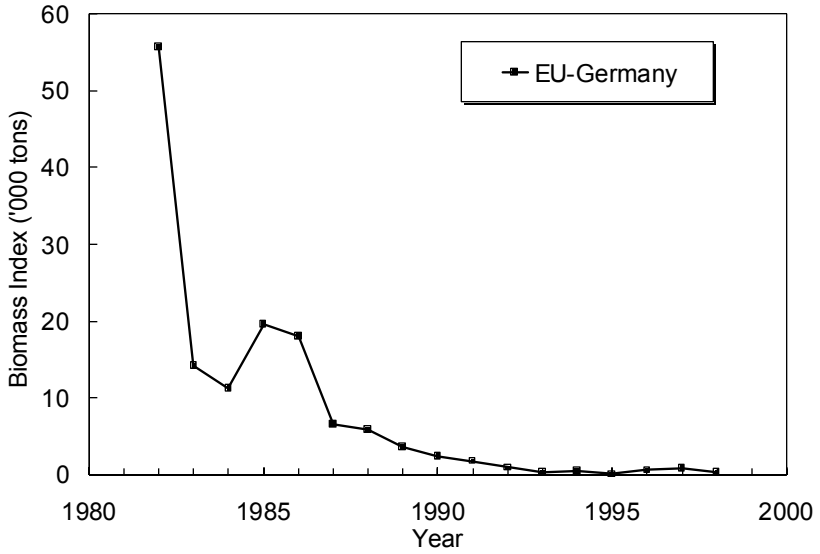


Fig. 4.2. Golden redfish in NAFO Subarea 1: survey biomass index.

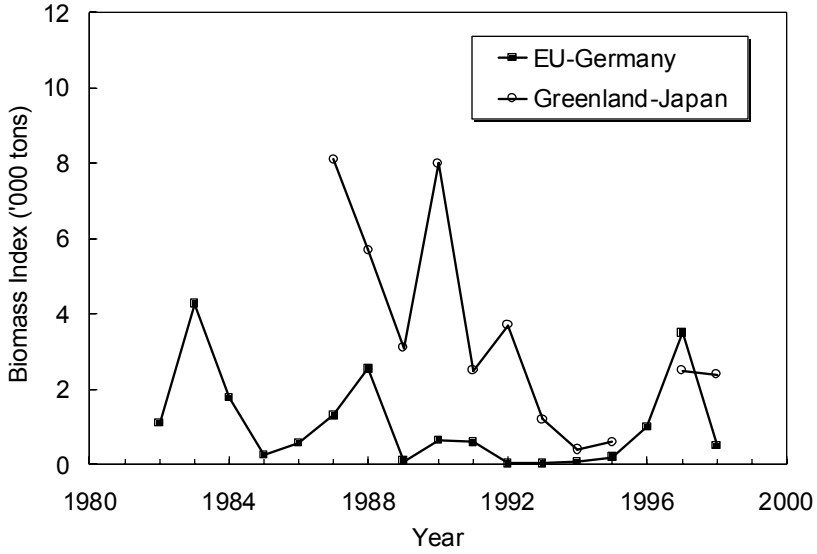


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass indices.

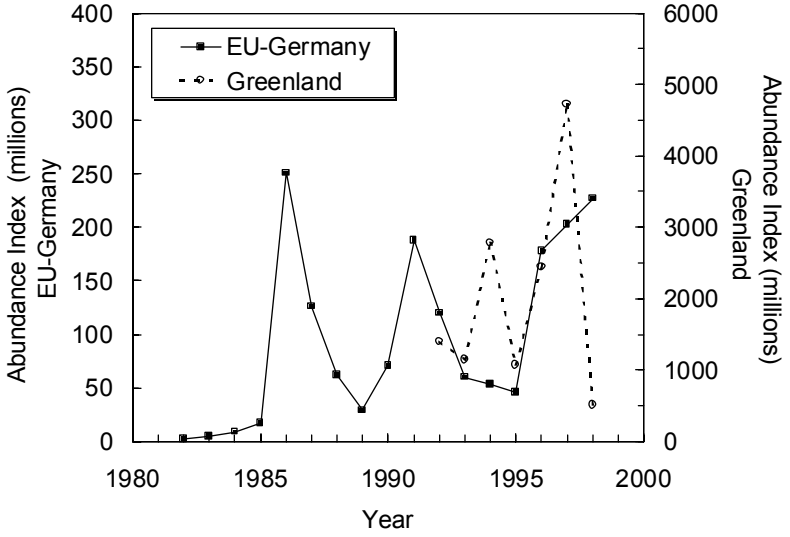


Fig. 4.4. Juvenile redfish (deepsea redfish and golden redfish combined) in Subarea 1: survey abundance indices.

c) **Estimation of Parameters**

The golden redfish SSB was estimated assuming knife edge maturity at 35 cm as observed in East Greenland applied to the length disaggregated abundance indices derived from the EU-Germany groundfish survey. The length groups 17-20 cm were chosen as recruitment indices. SSB and recruitment indices decreased drastically from 1982 and have remained significantly below average since 1989 (Fig. 4.5). Taking into account the recent very low SSB and the recruitment failure together with the absence of golden redfish in the Greenland surveys, the stock of golden redfish in Subarea 1 is considered to be severely depleted with no signs of recovery. There are indications that the probability of future recruitment is reduced at the current low SSB (Fig. 4.6).

The German survey biomass of fish ≥35 cm and the abundance of length groups 17-20 cm were taken as proxies for deep-sea redfish SSB recruitment, respectively. No clear trend can be derived

from these estimates but SSB has been below average since 1989 (Fig. 4.7). The recently depleted status of the SSB is confirmed by the lack of adult fish in the Greenland deepwater survey. Recruitment variation is high and the 1996-97 estimates were above average, the latter one representing the maximum of the time series.

d) **Assessment Results**

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

Substantial numbers of redfish are caught and discarded by the shrimp fishery, and concern must be expressed about the continuing failure of the juveniles to rebuild the pre-mature and mature stock components. Considering the depleted SSBs, the recruitment potential of the very abundant early life stages at an age of 0-2 years to the Subarea 1 stocks remains unclear. Recruitment indices for golden redfish have been extremely poor while those for deep-sea redfish indicate some recent increases.

The probability of recovery of the redfish stocks in Subarea 1 should increase if the by-catches taken by the shrimp fishery are reduced to the lowest level possible. Observation in 1986 did not reveal any mature adults. Therefore the relationship between spawning stock and recruitment is unclear in this area.

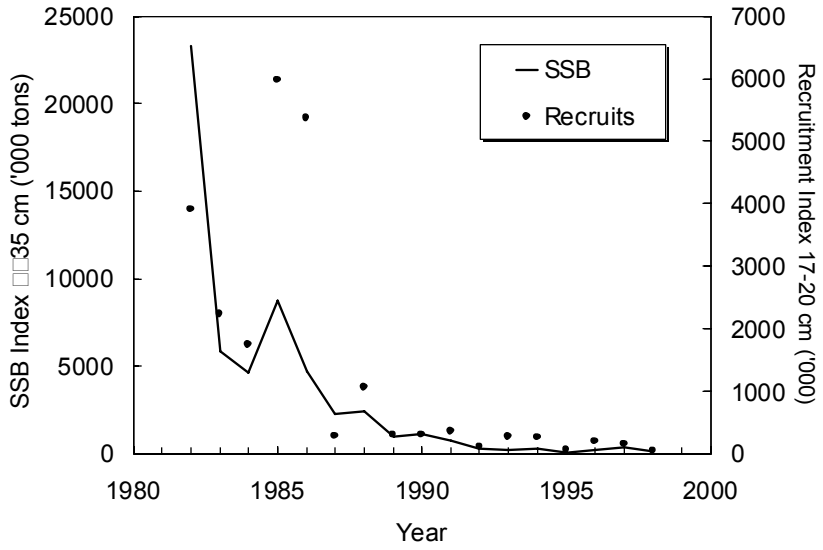


Fig. 4.5. Golden redfish Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

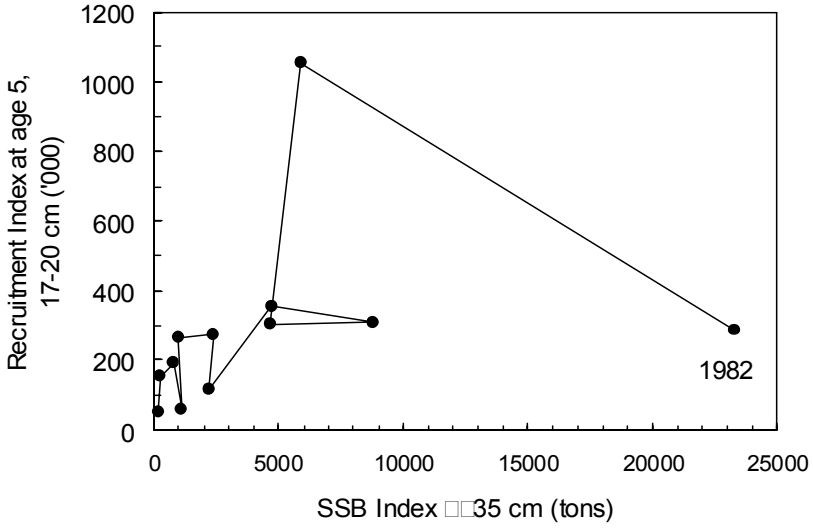


Fig. 4.6. Golden redfish Subarea 1: SSB-recruitment plot as derived from the EU-Germany groundfish survey.

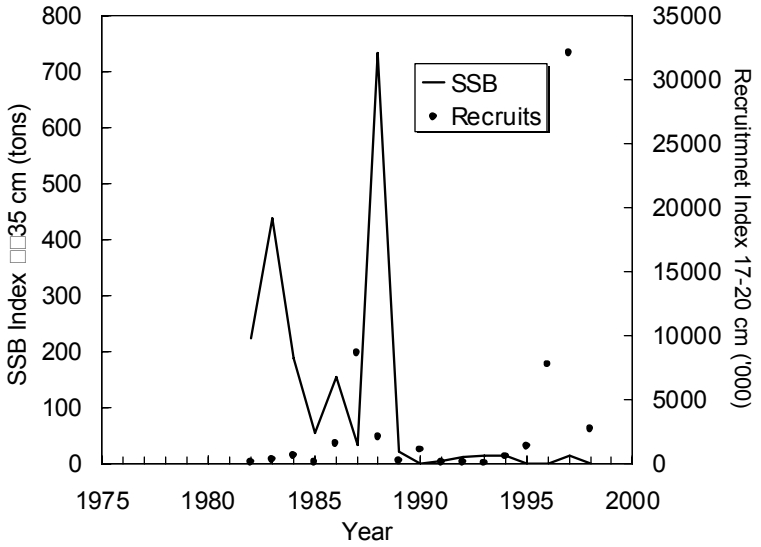


Fig. 4.7 Deep-sea redfish in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

e) **Reference Points**

Given the lack of long enough time-series of spawning stock and recruitment data and the uncertainties regarding reproduction and maturation of redfish in this area, STACFIS was unable to propose any limit or target reference points for fishing mortality or spawning stock biomass for the stocks of golden and deep-sea redfish in Subarea 1. However given the relationship observed for golden redfish between adult biomass and recruitment there appears to be a very high probability of decreased recruitment below biomass levels of 5 000 tons. Recent survey results indicate biomass of golden redfish remains below this level.

f) **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 2000 Scientific Council Meeting on a length disaggregated basis*.

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

5. **Other Finfish in Subarea 1** (SCR Doc. 98/41, 21, 27, 30, 33, 37; SCS Doc. 99/9, 17)

a) **Introduction**

Historically, catches of Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*A. minor*), thorny skate (*Raja radiata*), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus hippoglossus*) and sharks are mainly taken by offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut. Fisheries have also been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. In 1998, reported catches of other finfishes amounted to 4 500 tons representing an increase of 6 , compared to the 1997 catch (4 246 tons). The only significant change was the increase in lumpsucker catches by 85 . A catch of 2 143 tons of lumpsucker was reported for 1998. Most recent catches of other finfishes were dominated by Greenland cod (48), lumpsucker (48) and the category of non-specified finfish (13).

The catch figures do not include the weight of fish discarded by the trawl fisheries directed to shrimp.

Nominal reported catches (tons) are as follows:

Species	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]
Greenland cod	1 896	1 854	2 526	2 117	1 729	1 717
Wolffishes	157	100	51	47	68	30
Atlantic halibut	43	38	23	34	22	22
Lumpsucker	246	607	447	425	1 158	2 143
Sharks	10	34	46	135		
Non-specified finfish	411	643	618	609	1 269	588
Total	2 763	3 276	3 711	3 367	4 246	4 500

[1] Provisional

b) **Input Data**

i) **Commercial fishery data**

No data on CPUE, length and age composition of the catches were available. Length frequencies derived from the Greenland shrimp survey revealed that the shrimp trawl was capable of catching all predominant fish sizes. There was no information on by-catch in the shrimp fishery available for 1998.

ii) **Research survey data**

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400-m isobath of Div. 1B to 1F, and were primarily designed for cod as target species. Estimated biomass of American plaice, Atlantic wolffish, spotted wolffish and thorny skates remained severely depleted after severe declines until 1991. Recently, some stocks have shown increased recruitment which did not yet result in a significant increase in the mature biomass, i.e. American plaice, Atlantic wolffish (Fig. 5.1).

Greenland-Japan and Greenland deepsea surveys. During 1987-95, cooperative trawl surveys directed to Greenland halibut and roundnose grenadier have been conducted on the continental slope in Div. 1A-1D at depths between 400 and 1 500 m. This Greenland-Japan deepwater survey was discontinued in 1996. In 1997 a Greenland survey was initiated with another vessel and changed gear, which was also conducted in 1998. However, 1997 and 1998 estimates of biomass indices for American plaice were very low and amounted to 137 and 136 tons, respectively (Fig. 5.1).

Greenland bottom trawl survey using a shrimp gear. Since 1988, a shrimp survey was conducted by Greenland covering the Div. 1A to 1F down to 600 m depth. Due to changes in survey strategy and sampling of fish, determinations of abundance and biomass indices and length composition were considered comparable since 1992. Abundance and biomass indices of American plaice, Atlantic wolffish, and spotted wolffish were very low (Fig. 5.1). Thorny skates were mainly distributed in northern strata representing large areas causing higher abundance and biomass estimates. The stocks mentioned were dominated by juveniles as derived from length measurements.

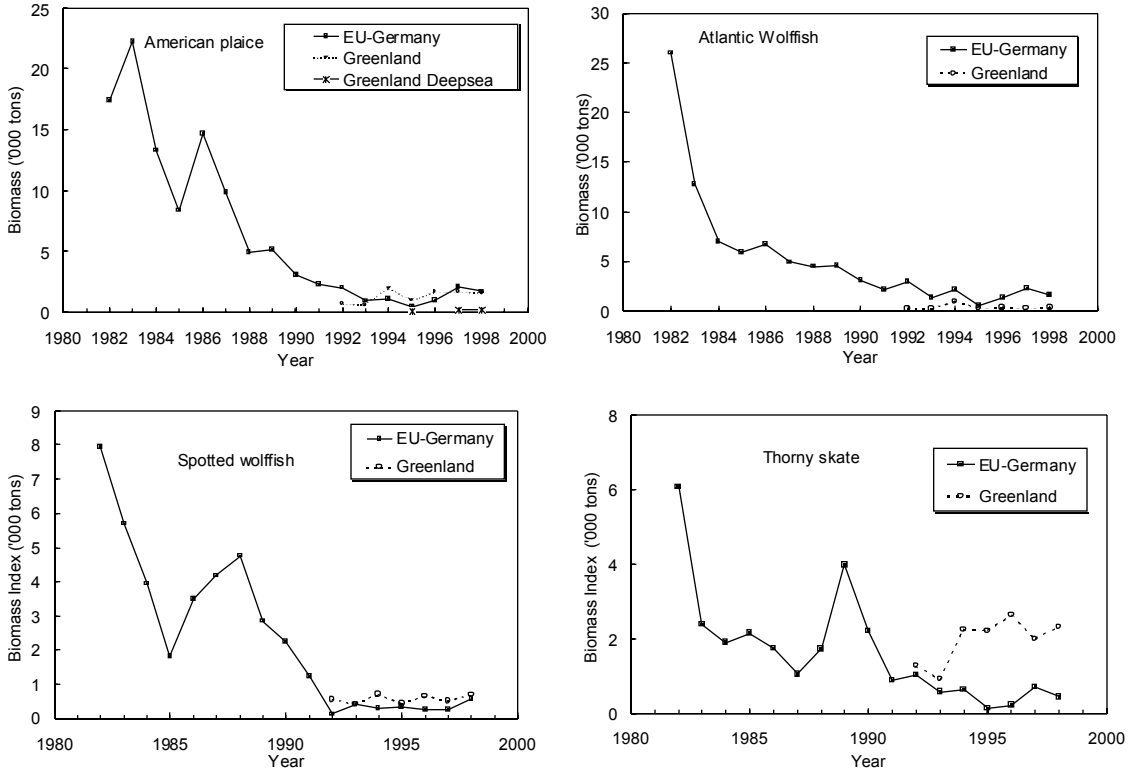


Fig. 5.1. Finfish in Subarea 1: survey biomass indices of various finfish species.

c) **Estimation of Parameters**

American plaice SSB was derived from EU-Germany length disaggregated abundance indices to which a length-maturity ogive was applied. During 1982-91, the SSB decreased drastically to depletion without a significant increase since then (Fig. 5.2). Recruitment is presented as abundance of small fish 15-20 cm representing age group 5 and is seen to have increased to the average level since 1997. Despite average recruitment in 1997 and 1998 (1992 and 1993 year classes), indications for reduced probability of recruitment at low SSB can be derived from the spawning stock and recruitment data (Fig. 5.2).

The estimation of Atlantic wolfish SSB and recruitment was performed in the same manner as for American plaice, i.e. using a length-maturity ogive and fish of 15-20 cm but representing 3 year old recruits. Since 1982, the SSB decreased drastically and remains severely depleted since the early-1990s (Fig. 5.3). In contrast, recruitment increased almost continuously over the time series but varied considerably since 1995. However, the abundant recruits did not contribute significantly to the SSB (Fig. 5.3).

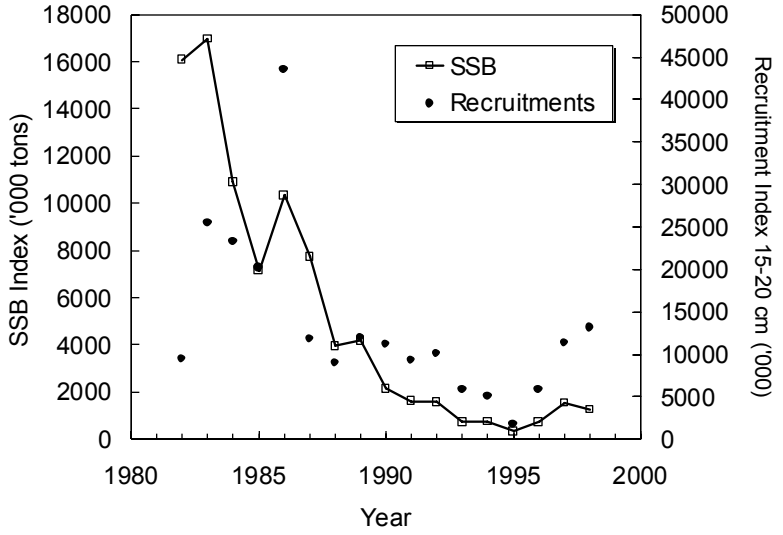


Fig. 5.2 American plaice in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey.

d) **Assessment Results**

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 indicate high mortality rates in excess of the sustainable level. The probability of stock recovery would be enhanced by minimizing the by-catch of finfish in Subarea 1 to the lowest possible level.

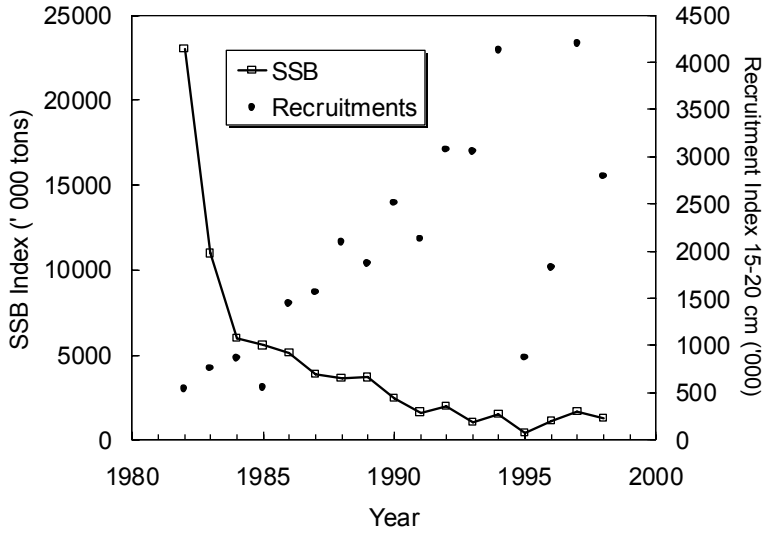


Fig. 5.3. Atlantic wolffish in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey.

e) **Reference Points**

Due to a lack of appropriate data, STACFIS was unable to propose any limit or target reference points for fishing mortality or spawning stock biomass for American plaice, Atlantic wolffish, spotted wolffish, and thorny skate in Subarea 1. Nevertheless, the current spawning stock biomass levels as derived from survey results are considered far below appropriate levels of B_{lim}.

f) **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 2000 Scientific Council Meeting on a species by species, as well as a length disaggregated basis*.

B. STOCKS ON THE FLEMISH CAP

Overview of Physical Environment

In the upper 100 m water layer on top of the Flemish Cap, temperatures and salinities have increased since 1995. At 200 m, however, temperatures have remained below normal and continue the trend established in the mid-1980s.

6. Cod (*Gadus morhua*) in Division 3M (SCR Doc. 99/10, 22, 29, 56; SCS Doc. 99/5, 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 null in the Icelandic fishery

in 1995 and 1996. The by-catch of cod in the past Russian pelagic fishery for redfish was also low. The fleet currently operating in Div. 3M includes vessels from non-Contracting Parties, most of them stern-trawlers.

ii) **Nominal catches**

From 1963 to 1979, the mean reported catch was 32 000 tons, with high variations between years. Reported catches declined after 1980, when a TAC of 13 000 tons was established, but Scientific Council regularly expressed its concern about the reliability of some catches 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.

The fishery in 1998 was at a very low level compared with previous years: most of the fleets traditionally directed to Div. 3M cod did not participate, particularly Portuguese gillnetters, Faroese longliners and Spanish pair-trawlers. The few Spanish pair-trawlers coming to the area in recent years redirected their catches to other target species. Most of the reported catches in 1998 were taken by Portuguese trawlers during a directed cod fishery. Russian trawlers reported a catch of 1.2 tons. A catch of 250 tons was estimated for vessels from non-Contracting Parties, based on Canadian Surveillance reports.

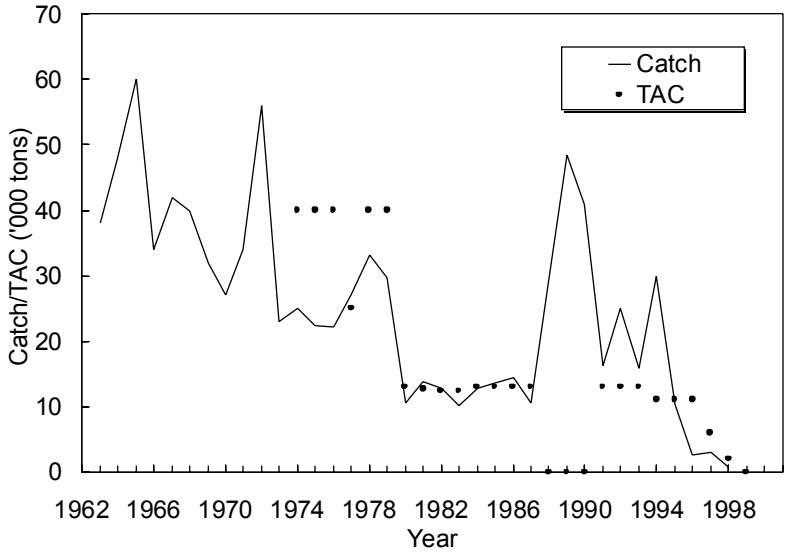


Fig. 6. 1. Cod in Div. 3M: catches and TACs. Catch figures include estimates of misreported catches since 1988.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	0	13	13	13	11	11	11	6	2	0
Catch	41[1]	16[1]	25[1]	16[1]	30[1,2]	10[1,2]	3[1,2]	3[1,2]	1[1,2]	

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

b) **Input Data**

i) **Commercial fishery data**

Length and age composition of 1998 catches were available from Portuguese trawlers and from a Russian trawler catch of 1.2 tons. Ages 4 and 5 dominated the catches.

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 are 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.

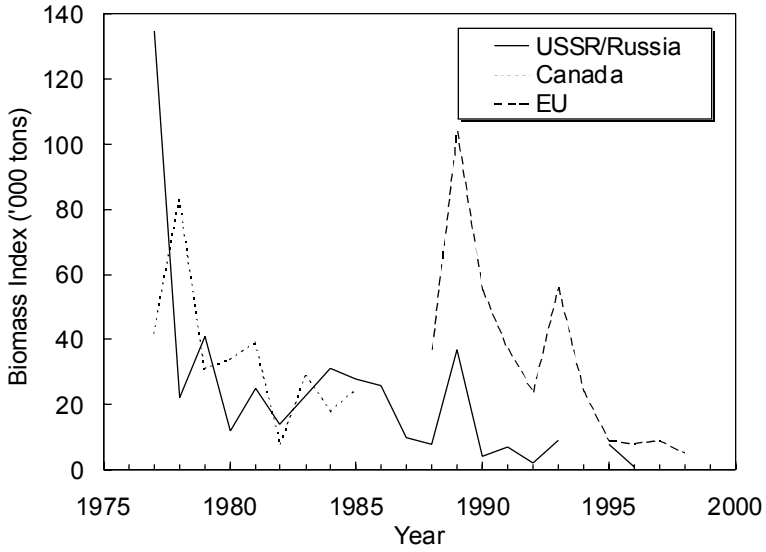


Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

Stratified-random bottom trawl surveys were conducted by the EU from 1988 to 1998. 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 to 4 500 tons. Surveys indicate poor recruitment of the 1992 and subsequent year-classes, particularly the 1995, 1996 and 1997 year-classes at all observed ages.

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.

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 1998, linking catch-at-age information used in past analyses with those of the most recent period. Catch-in-number data correspond to the estimates of total annual catch. Catch-at-age for years 1973 to 1983 have been calculated in the past primarily based on Spanish, Portuguese and Faroese research reports. This period was not included in the 1998 STACFIS analysis due to the doubts on reliability of the total reported catches of some years. Although concern on catch figures remains, this period was now included in the analysis to explore its usefulness to calculate some biological reference points. Catches-at-age for years 1984 to 1987, never included in an analytical assessment, were calculated following the same procedure. Data for years 1988 to 1997 were as used in the 1998 analysis. 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 1998.

The analysis showed a reasonably good fit, given the uncertainties associated with catch-at-age matrix. A retrospective analysis also showed an acceptable pattern.

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).

Estimated total biomass remained above 30 000 tons prior to 1995 when it declined to 24 000 tons; biomass has since remained at approximately 10 000 tons. The XSA results also confirms the relative abundance of the 1985, 1990 and 1991 year-classes at age 3 and the weakness of those from 1992 to 1995.

The stock at the beginning of 1999 remains at a very low level and is mainly composed of young fish from the 1995 and onward year-classes. Fish older than the 1994 year-class are scarce, particularly in comparison with the 1960s, when ages 5 and 6 dominated the fishery and fish older than 10 years were common.

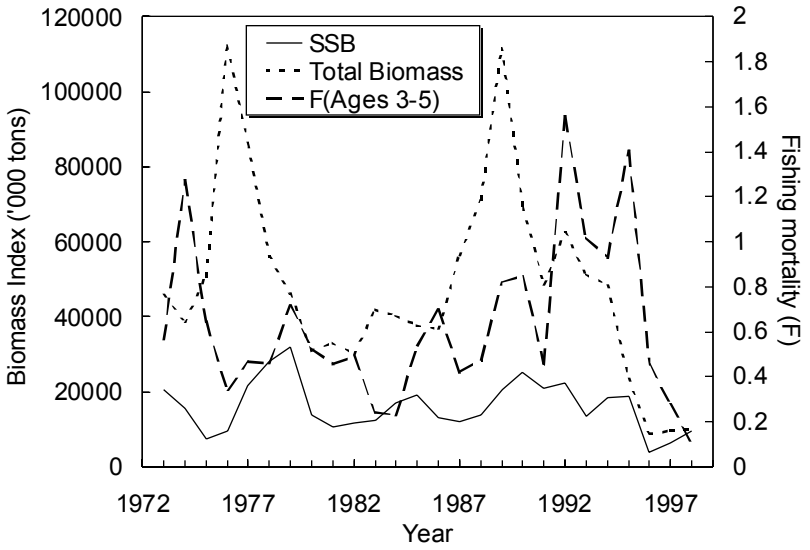


Fig 6.3. Cod in Div. 3M: results from Sequential Population Analysis

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 relationship observed (Fig. 6.4) appears to be very spreadout and with no clear pattern, requiring further investigations before STACFIS is able to derive PA reference points.

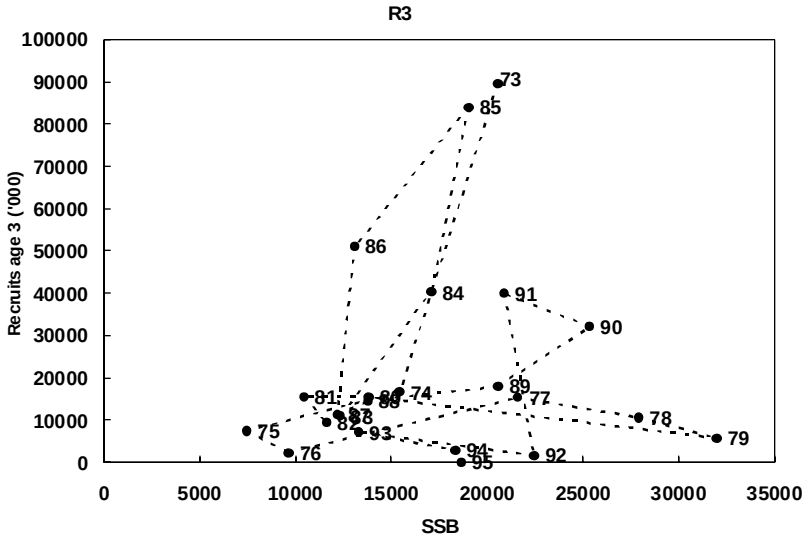


Fig. 6.4. Cod in Div. 3M: total biomass, SSB and recruitment at age 3

Reference points for F were poorly calculated due to the uncertainty in input biological parameters and in SSB/recruitment relationship. Although the values of various F-related BPR appear to be

consistent with these estimates for other cod stocks, the wide confidence limits of these estimates make it difficult to make any practical use of them.

7. Redfish *(Sebastes mentella* and *Sebastes fasciatus)* in Division 3M (SCR Doc. 99/22, 52; SCS Doc. 99/16)

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. Sexual maturity is reached at a median length of 26.5 cm for Acadian redfish, 30.1 cm for deep-sea redfish and of 33.8 cm for golden redfish.

i) Description of the fishery

Redfish catches in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990 (Fig. 7.1), but declined continuously through 1998, when a catch of only 970 tons was reported, mostly as by-catch in the Greenland halibut fishery. The most recent decline in the Div. 3M redfish catches from 1993 to 1998 is related to the reduction in fishing effort deployed in this fishery by fleets responsible for the high level of catches from the late-1980s and early-1990s (former USSR, former GDR and Korean crewed non-Contracting Party vessels). For the remaining fleets, such as the Portuguese trawlers, Div. 3M redfish is a secondary target compared to cod or American plaice and, more recently, Greenland halibut.

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

	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	50	43	30	26	26	26	26	20	13
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] Includes estimates of non-reported catches from various sources
[2] Provisional

The Div. 3M redfish stocks have been exploited in the past both by pelagic and bottom trawls. The majority of the bottom commercial catches are composed of beaked redfish. The species composition of the pelagic redfish catches, which dominated the fishery in the early-1990s, remains unknown. However, based on bottom survey results, *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.

b) Input Data

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. 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 data**

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

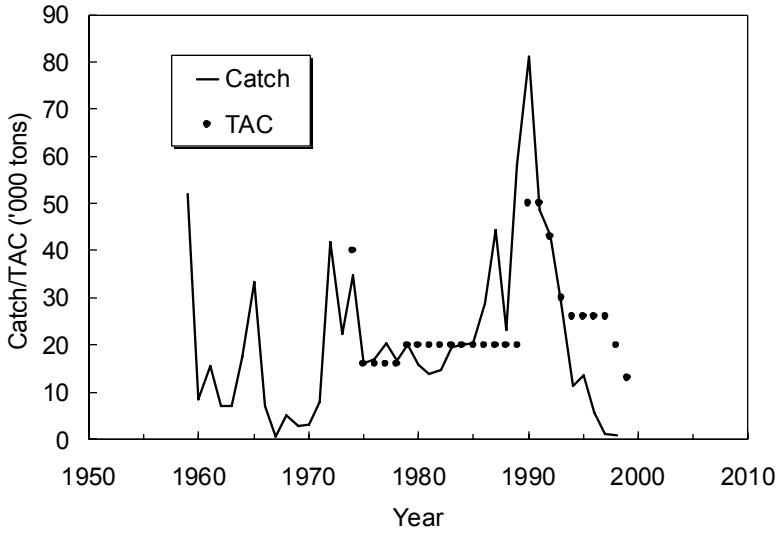


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

The 1989-98 length compositions of the Div. 3M beaked redfish Portuguese trawl catch (both sexes combined) were used, together with the Div. 3M beaked redfish length-weight relationship from 1989-98 EU survey data, to estimate the length frequencies of the Div. 3M redfish total catch for the same period. Age composition and mean weights-at-age of the catches were obtained using the *S. mentella* age-length keys from the 1990-98 EU surveys. The 1990 year-class, followed by those from 1989 and 1991 has continued to dominate the 1998 commercial beaked redfish catches.

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). Both series were used in a production analysis carried out in this assessment.

ii) **Research survey data**

The Russian bottom trawl survey was not conducted in 1997 or 1998, but the Russian survey beaked redfish bottom biomass indices (1983-93 and 1995-96) were included 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 1988-98 respectively, and on the Div. 3M beaked redfish length weight relationship from 1989-98 EU survey data. Female spawning biomass was calculated the same way as regards the most recent EU survey series, applying length maturity ogives from data collected during the 1992-94 surveys.

Age composition for the 1989-98 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 1990-98 EU surveys, with both sexes combined, and the Div. 3M beaked redfish length weight relationship.

Survey results. Biomass indices (swept area method) from EU surveys are presented in the following table:

Year	Beaked redfish	*S. Mentella*	*S. fasciatus*	Juveniles
1988	143.022	-	-	-
1989	113.696			
1990	88.000			15.117
1991	59.392	50.071	5.680	3.641
1992	98.256	71.810	5.308	21.138
1993	55.812	25.056	4.425	26.331
1994	88.341	35.710	7.829	44.802
1995	64.578	59.332	5.032	0.214
1996	89.221	77.897	11.025	0.299
1997	74.319	56.093	17.471	0.750
1998	52.795	45.358	6.436	1.001

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 42 of the total bottom biomass (Fig. 7.2). The more recent period (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 again in 1997 and 1998, when the lowest bottom biomass index was recorded (Fig. 7.2). Bottom female spawning biomass declined throughout the EU survey time series and also records a minimum in 1998. For the more recent period (1994-98), survey of spawning biomass represented on average just 9 of the survey bottom biomass.

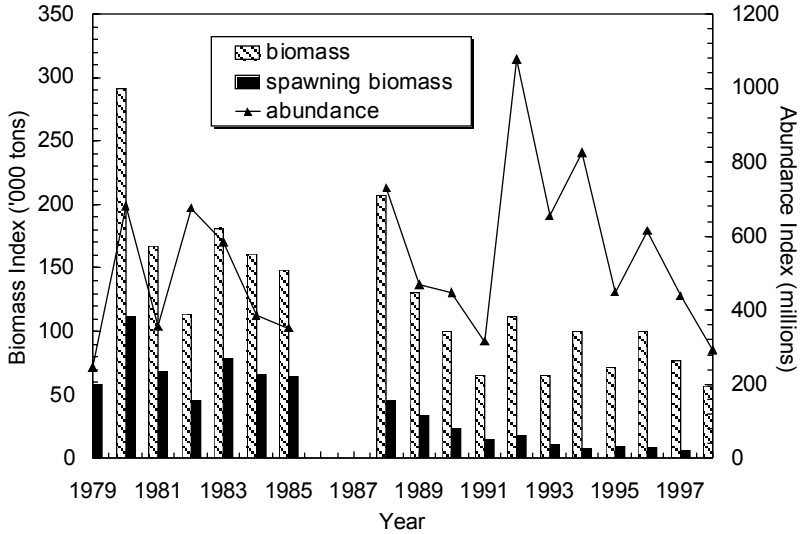


Fig. 7.2. Beaked redfish in Div. 3M: bottom biomass, female spawning biomass and abundance from Canadian (1979-85) and EU (1988-98) surveys.

c) **Estimation of Parameters**

A maturity ogive for Div. 3M beaked redfish was calculated as the mean proportion of mature females in the survey stock abundance-at-age. This maturity ogive was further incorporated in the yield-per-recruit and VPA analysis.

A partial recruitment vector for Div. 3M beaked redfish was revised assuming a flat top partial recruitment and adjusting a relative mean F index-at-age to a normal logistic curve. This F index has been derived from the 1995-98 per million age composition ratio between the Div. 3M redfish commercial catch and beaked redfish survey abundance.

The ratios between annual STACFIS estimates of Div. 3M redfish catches and EU beaked redfish survey bottom biomass were considered to be an index of the mean fishing mortality during the past 11 years.

A Separable VPA (Pope and Shepherd, 1982)[1] for the most recent period of 1989-98 was run. The model assumes that the exploitation pattern of the fishery remains unchanged. Based on the Portuguese sampling, no dramatic exploitation shifts are evident throughout the 1989-98 period. The Separable VPA runs assumed a constant natural mortality of 0.1. The age range was 4 to 18. The age of full recruitment was set at age 11, based on the observed exploitation pattern. A flat-topped selection pattern was assumed.

A traditional VPA was finally performed using the separately generated F matrix, providing estimates of total and female stock biomass for Div. 3M beaked redfish.

A logistic surplus production model which does not use the equilibrium assumption (ASPIC) was applied using the 1959-98 catch estimates with the STATLANT commercial catch and effort data (1959-93) as well as various commercial and survey bottom biomass indices and the VPA stock biomass for Div. 3M beaked redfish. The EU bottom biomass (1988-98) and the STATLANT based commercial CPUE (1959-93) gave a high correlation and so further ASPIC runs were made with these two series. 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 survey bottom biomass/VPA stock biomass ratio for the 1992-96 period, when the two series were overlapping with no apparent trend.

After a first ASPIC run judged to have acceptable fits for estimates of parameters, effort and survey pattern 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 resampled 1 000 times 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 1991 but gradually fell since then to very low levels in 1997 and 1998 (Fig. 7.3).

The results, of biomass and fishing mortality trends from the Separable VPA and the ASPIC analysis are similar. Both analyses indicated that the Div. 3M beaked redfish stock experienced a continuous decline until 1994 likely due to the sharp increase in fishing mortality that peaked in 1990 (Fig. 7.3). Since 1995 fishing mortality declined rapidly, allowing the survival of above average year-classes from the early-1990s. While both models suggested a gradual recent increase in biomass, this was not seen in the survey results (Fig. 7.4).

[1] Pope, J. G., and J. G. Shepherd. 1982. A simple method for consistent interpretation of catch-at-age data. *ICES J. Cons.*, **40**: 176-184.

The estimated 1989-1995 levels of fishing mortality, well above both $F_{0.1}$ and F_{msy}, affected primarily the larger length groups in the *S. mentella* and *S. fasciatus* populations, inducing a decline in beaked redfish female spawning biomass to a low level. From EU survey and VPA results the female spawning biomass still represented on average over the last five years between 9 to 20 of the stock biomass, while during the late-1970s and early-1980s, when there is evidence that the stock experienced a period of relative stability, that same proportion was slightly above 40 based on the Canadian survey series .

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 current relatively low fishing mortality, and with growth of the relatively strong 1990-91 year-classes, stock and spawning biomass should gradually increase.

STACFIS noted that the method of presentation of Div. 3M redfish by-catch information from the shrimp fishery has been variable in the past and that no new information for 1998 was available for inclusion in this assessment. STACFIS **recommended** that *the 1998 Div. 3M redfish by-catch information be presented during the November 1999 assessment of shrimp in Div. 3M and that in future the estimated numbers of redfish caught annually in the Div. 3M shrimp fishery as well as tables showing their size distribution be made available for the future June Scientific Council Meetings.*

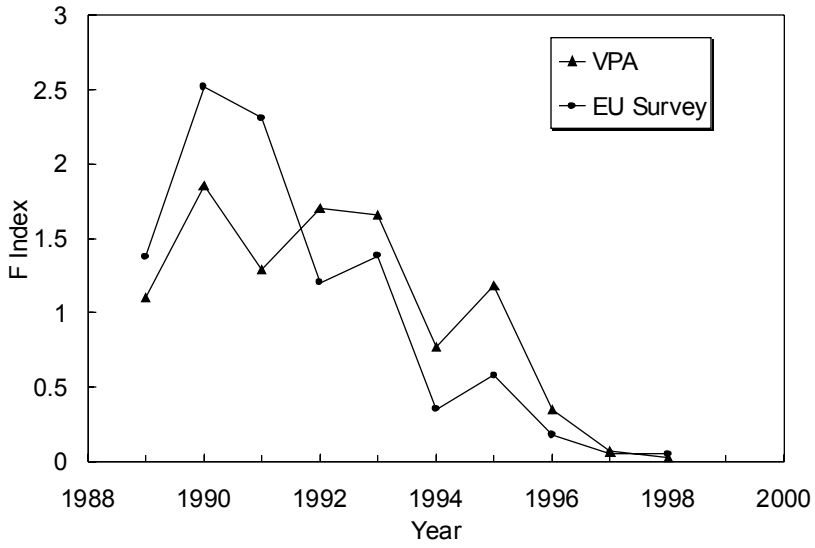


Fig. 7.3. Beaked redfish in Div. 3M: VPA and EU survey fishing mortality trends.

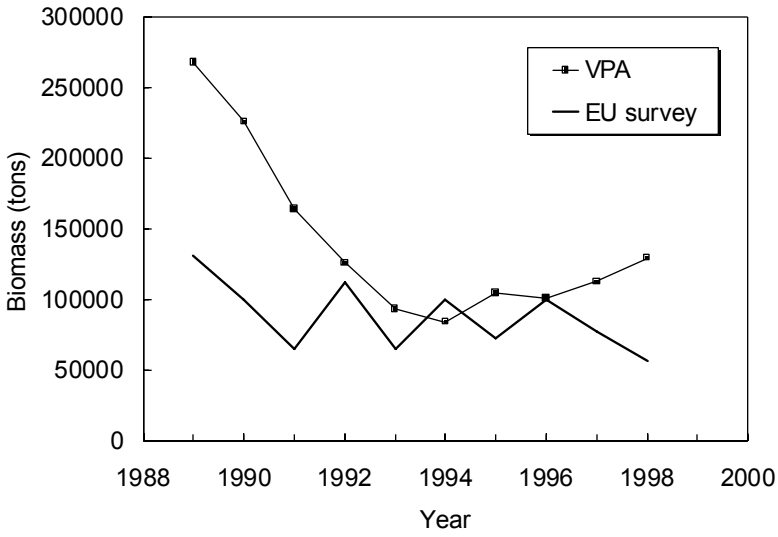


Fig. 7.4. Beaked redfish in Div. 3M: VPA total biomass and EU survey bottom biomass trends.

e) **Reference Points**

All biological information was derived for beaked redfish (*S. mentella* and *S. fasciatus*) as a single species. Natural mortality was assumed to be constant at 0.1.

It is not possible to develop a SSB/recruitment relationship for this stock with existing data.

From the yield, biomass and spawning biomass-per-recruit curves, different levels of reduction of spawning and total biomass were estimated for corresponding levels of fishing mortality. With the assumption of constant recruitment, the results indicated that the female spawning biomass should be at 30-35 of an estimated virgin stock size, corresponding to a female spawner proportion in the stock biomass of about 30 when fishing at an $F_{0.1}$ of 0.11. Given the intermittent pattern of redfish recruitment on a 5-10 year cycle the proportion of SSB should be maintained at a level greater than 30 of the total biomass. The long term fishing mortality associated with a female SSB at about 40 of the total stock biomass observed during the former period of stability is 0.04.

The bias corrected reference points from the production model (ASPIC) were not considered reliable at this time. Further investigation is necessary to explore the use of this type of model for long lived species with only intermittent good recruitment.

8. **American Plaice (*Hippoglossoides platessoides*) in Division 3M** (SCR Doc. 99/22, 39; SCS Doc. 99/16)

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 1998 was estimated to be 294 tons. Non-Contracting Parties took 34 of this catch.

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:

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	2	2	2	2	1[1]	1[1]	0	0	0	0
Catch	0.8	1.6	0.8	0.3	0.7[2]	1.3[2]	0.3[2]	0.2[2]	0.3[2]	

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

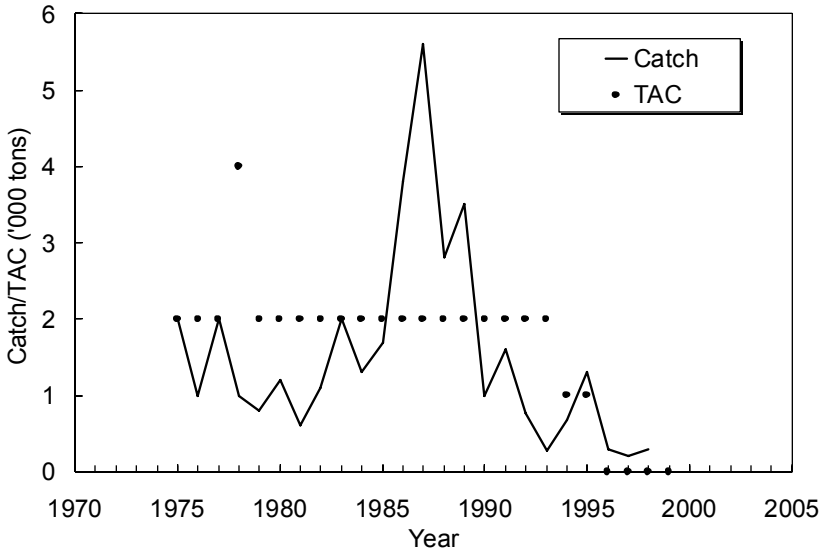


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs.

b) **Input Data**

i) **Commercial fishery data**

EU-Portugal provided length composition data of the trawl catches for the second and third quarter of the year. This information was used to estimate the length composition for the total catch (294 tons). The 1990 year-class (age 8 in 1998) appears as the most abundant one.

Mean weight-at-age in the catch showed slight decreasing trend from 1993 to 1997 for ages older than 8, but this trend seemed to stop in 1998; actually the values for these ages were slightly below the average.

ii) **Research survey data**

The series of research surveys conducted by the EU since 1988 was continued in July 1998.

The USSR-Russian survey series started in 1983 but was terminated in 1994.

A continuous decreasing trend in both indices of abundance and biomass was observed since the beginning of the EU survey series. In 1998 abundance and biomass was at the 1997 level, the lowest of the series. The USSR-Russian survey series, although more variable, also showed a decreasing trend between the 1986-93 period (Fig. 8.2).

During the survey series the age reader was changed three times, and age compositions of the survey may reflect different criteria. As in the commercial catches, age 8, corresponding to the 1990 year-class, was best represented in 1998. Since 1991, a series of very poor year-classes recruited to this fishery as shown by EU survey indices in successive years.

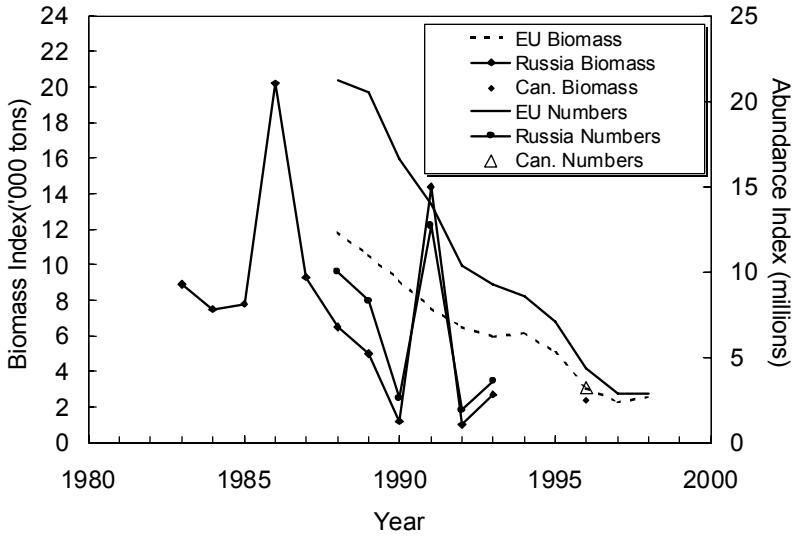


Fig. 8.2. American plaice in Div. 3M: trends in biomass and abundance indices in the surveys.

The method of calculating spawning stock biomass now incorporates estimates of mean weight derived on an annual basis from the EU survey. These results differ from those reported in the 1998 report. The spawning stock biomass (50 of that in age 5 plus age 6 and older), as estimated from the EU surveys, reached a maximum in 1988, the first year of the series; a slightly decreasing trend occurred from 1990 to 1993, in 1994 a little increase took place to a value between 1989 and 1990, but decreased since then (table below). The 1998 value was only 24 of the 1988 one, and was the second lowest observed in the survey series (1988-98).

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

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
SSB	9.9	7.8	6.0	5.8	5.2	5.1	6.4	4.6	2.7	2.1	2.4

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). For 1998 the index was 0.1, one of the lowest values in the

time series (Fig. 8.3). 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 0.2 (natural mortality). This last index, although exhibiting a considerable amount of interannual variability, follows the same trend. For 1997 this index gave a negative value, which indicated a very low value of fishing mortality. Recruitment was estimated as the age 2 index from the EU surveys.

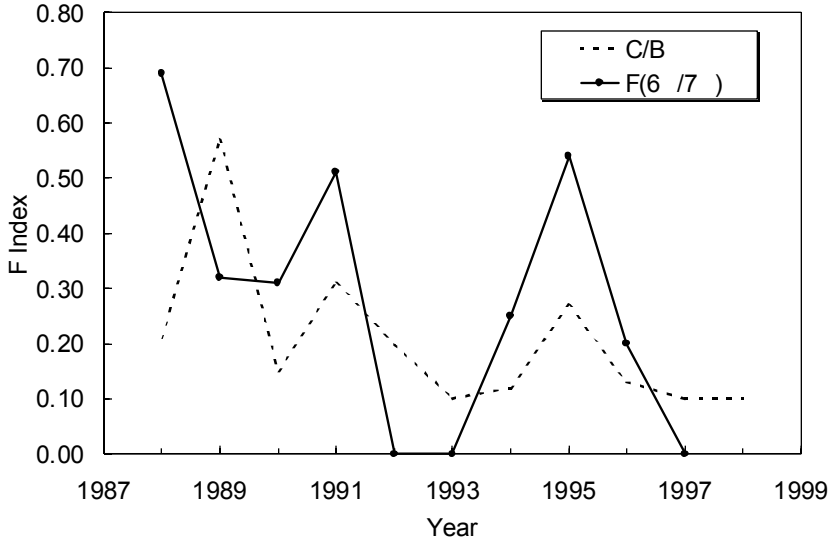


Fig. 8.3. American plaice in Div. 3M: comparison between the trends shown by two indices of F.

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 this stock is 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).

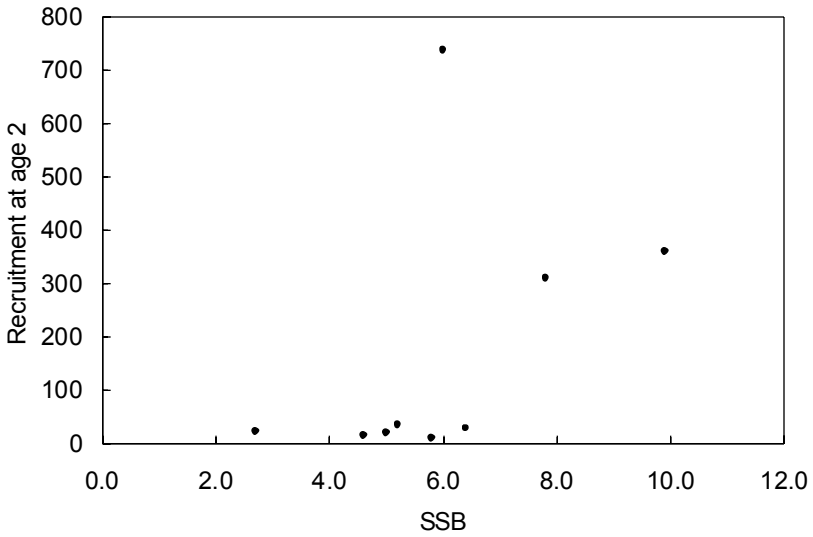


Fig. 8.4. American plaice in Div. 3M: SSB-Recruitment scatter plot.

Figure 8.5 represents an index of age 2 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 before 1990 and other one since 1991. In the recent period the amount of recruits surviving per unit of spawning biomass has declined substantially.

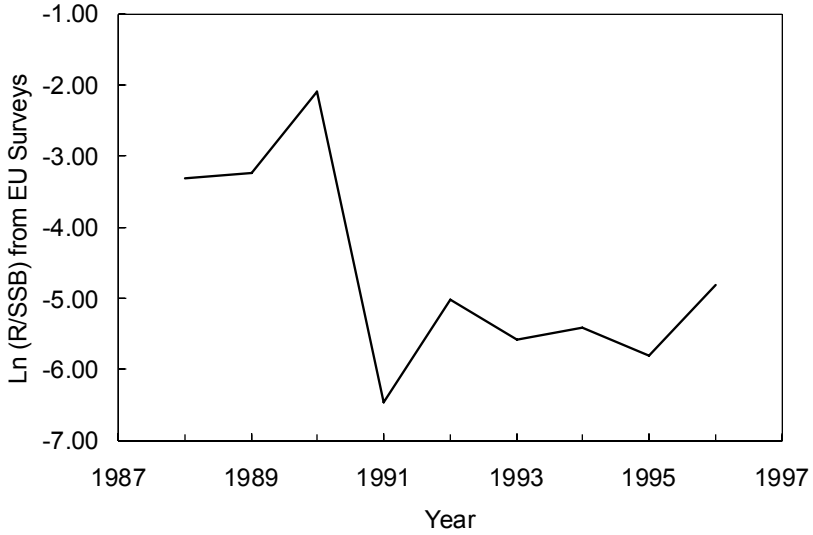


Fig. 8.5. American plaice in Div. 3M: recruits at age 2 produced per Kg of SSB index.

The yield-per-recruit analysis, was presented in 1998 using the following parameters: M□0.2; mean weight-at-age calculated as average values for the mean weight-at-age in the catch for the period 1988-97, and the selectivity pattern from Div. 3NO American plaice (SCR Doc. 98/51). This analysis gave the following results: F_{max} □1.47 and an $F_{0.1}$ □0.27. An update was made this year using the values for the mean weight-at-age in the catch for the yield obtained from the overall series for the period 1989-98 and the mean values obtained from the survey series (1988-98) to obtain the SSB. This update provides the following results: F_{max} □5.43 and $F_{0.1}$ □0.36, which show the sensitivity of these parameters to changes in mean weights-at-age.

C. STOCKS ON THE GRAND BANK

Overview of Physical Environment

On the Grand Bank (Div. 3LNO), the bottom waters in 1998 were the warmest since 1983. The area of 0°C water on the banks on the southern Newfoundland Shelf (Div. 3P) were very low in 1998 whereas the area covered by waters <-1°C increased to the highest value since 1984.

9. Cod (*Gadus morhua*) in Divisions 3N and 3O (SCR. Doc. 99/57, 62, 67; SCS Doc. 99/16)

a) Introduction

Nominal catches increased during the late-1950s and early-1960s, reaching a peak of about 227 000 tons in 1967. During the period from 1979 to 1991, catches ranged from 20 000 to 50 000 tons. The continued reduction in recommended TAC levels contributed to reduced catches in recent years to a level of about 10 000 tons in 1993 (Fig. 9.1). Directed fisheries on this stock ceased about mid-year in 1994. This suspension continued through 1998.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Recommended TAC				Same as agreed						
Agreed TAC	18.6	13.6	13.6	10.2	6	nf	ndf	ndf	ndf	ndf
Reported Catches	18	17	10.1	9	1.9[1]	0.17[1]	0.17[1]	0.42[1]	0.50[1]	
Non-reported Catches	11	12	2.5	0.7	0.8	0	0	0	0.05	
Total Landings	29	29	12.6	9.7	2.7[1]	0.17[1]	0.17[1]	0.42[1]	0.55	

[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.

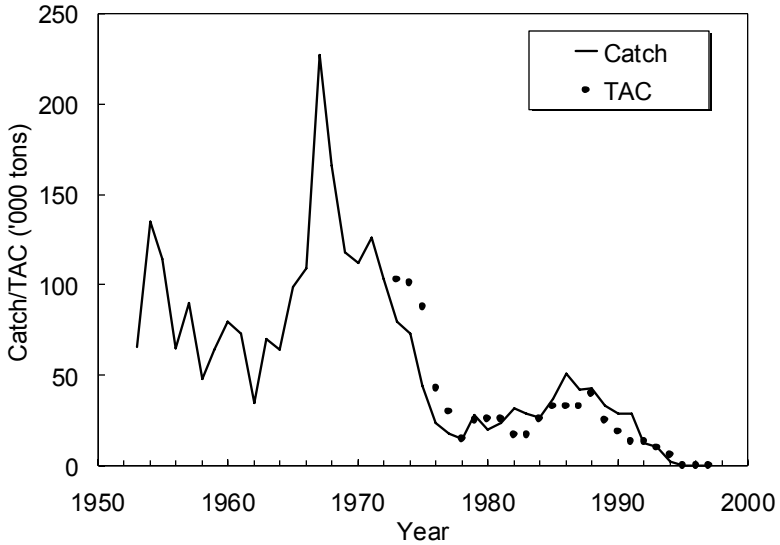


Fig. 9.1. Cod in Div. 3NO: catches and TACs.

Catches during 1998 totaled approximately 546 tons. All reported catches were by-catch, mainly from Canadian otter trawl and gillnet fisheries (396 tons) and EU-Portugal (94 tons), and 56 tons from other countries.

b) **Input Data**

i) **Commercial fishery data**

Catch rates. There was no 1998 catch rate information since there were no directed fisheries for cod.

Catch-at-age. Biological sampling data from by-catches of cod were inadequate to estimate the total removals-at-age. STACFIS **recommended** that *length and age data from by-catches of cod in Div. 3NO be presented at the June 2001 Scientific Council Meeting.*

ii) **Research survey data**

Canadian spring surveys. Stratified-random research vessel surveys have been conducted in spring by Canada in Div. 3N for the 1971-98 period, with the exception of 1983, and in Div. 3O for the years 1973-98 with the exception of 1974 and 1983.

A new survey trawl (Campelen 1800) was introduced to the Canadian survey starting with the autumn 1995 survey. The survey time series was converted to Campelen equivalents from 1984 to spring 1995. Consequently, comparisons of data from previous assessments with those in the current assessment should be approached with caution.

A sharp increase in biomass occurred in 1987 but then declined until 1992 when it was the lowest observed since 1982. The biomass increased in 1993 but from 1994 to 1998, estimates declined to very low levels. Abundance estimates for Div. 3NO suggested similar trends to those observed for biomass (Fig. 9.2).

Estimates-at-age indicated that the year-classes after 1983 have all been low relative to the year-classes that supported the fishery in the early-1980s. The dominant year-classes in the 1992 to 1995 surveys were from the 1989 and 1990 cohorts. All year-classes were at low levels in the 1996, 1997 and 1998 surveys.

Canadian autumn surveys. Additional stratified-random surveys have been conducted by Canada during autumn since 1990. Biomass and abundance estimates for Div. 3NO declined starting in 1991 and have remained low (Fig 9.3).

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

Spanish surveys. Stratified random surveys have been conducted by EU-Spain during spring since 1995 in the Regulatory Area of Div. 3NO. No concentrations of cod were observed.

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

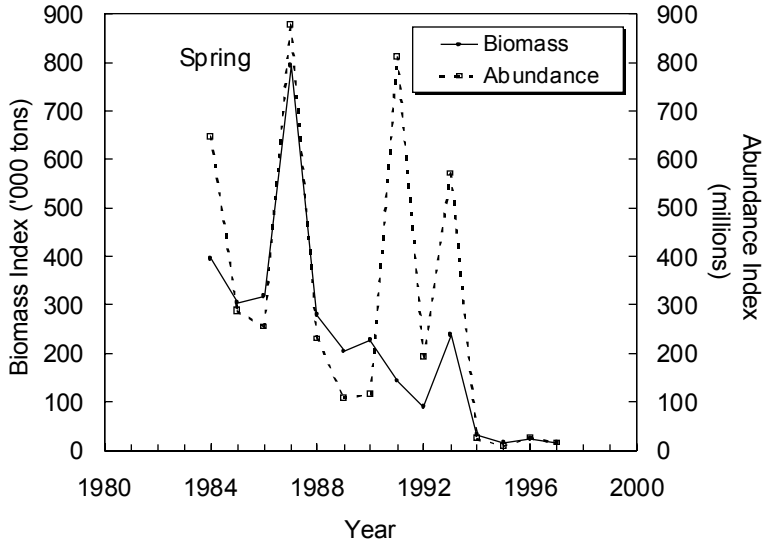


Fig. 9.2. Cod in Div. 3NO: abundance and biomass estimates from Canadian spring surveys.

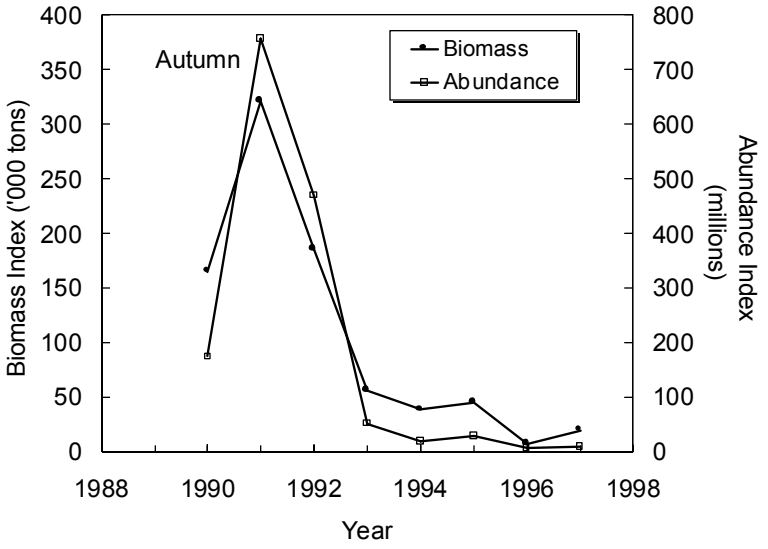


Fig. 9.3. Cod in Div. 3NO: abundance and biomass estimates from Canadian autumn surveys.

c) **Estimation of Parameters**

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

In the absence of recent catch-at-age data, STACFIS decided that for this assessment total catch for 1996-98 be proportioned by age using the partial recruitment vector from 1990-93 (from a previous ADAPT run) applied to an F in a catch projection chosen to match projected catch with observed catch. An ADAPT was then applied to catch-at-age calibrated with the spring, autumn and juvenile survey data to estimate population numbers in 1999. Spawner biomass estimate for 1999 is 6 300 tons (Fig. 9.4).

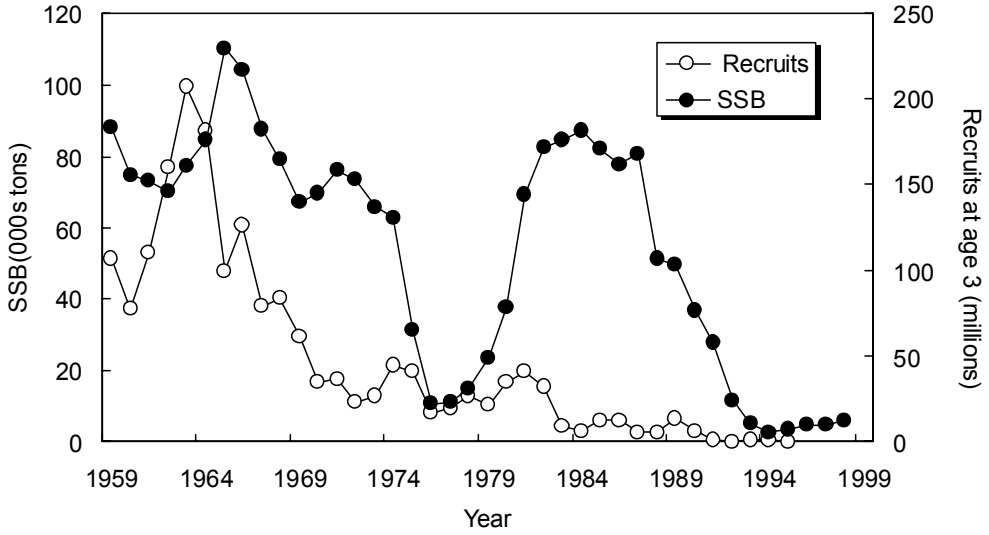


Fig. 9.4. Cod in Div. 3NO: time trend from the SPA of spawner stock biomass (SSB) and corresponding recruitment.

d) **Assessment Results**

Estimates of recent year-class sizes from survey data indicates that recruitment has been almost non-existent since the 1990 year-class. Estimates of total mortality for the moratorium period (since February 1994) from survey data indicate that the current *Z* is substantially higher than the assumed natural mortality value used in the SPA (0.2). Low spawner biomass, low recruitment and high total mortality point to poor prospects for this stock in the medium term. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

e) **Reference Points**

The SSB and recruitment data over the 1959-95 period indicate a sharp decrease in the likelihood of obtaining high recruitment at SSBs below 60 000 tons. In April 1999, the Scientific Council concluded that 60 000 tons was the current best estimate of B_{lim} (SCS Doc. 99/4). It was also concluded that in the recent period of low productivity, there was an indication of even further reduction in recruitment at about half the B_{lim} level (Fig. 9.5). Within this period of low productivity it is noted that at SSB above 60 000 tons recruitment has been relatively poor. In view of the difficulty in determining if the current low productivity will persist in the immediate future, it is **recommended** that *for cod in Div. 3NO the Scientific Council review in detail the biological reference points in the context of the PA framework when the SSB has reached half the current estimate of* B_{lim}.

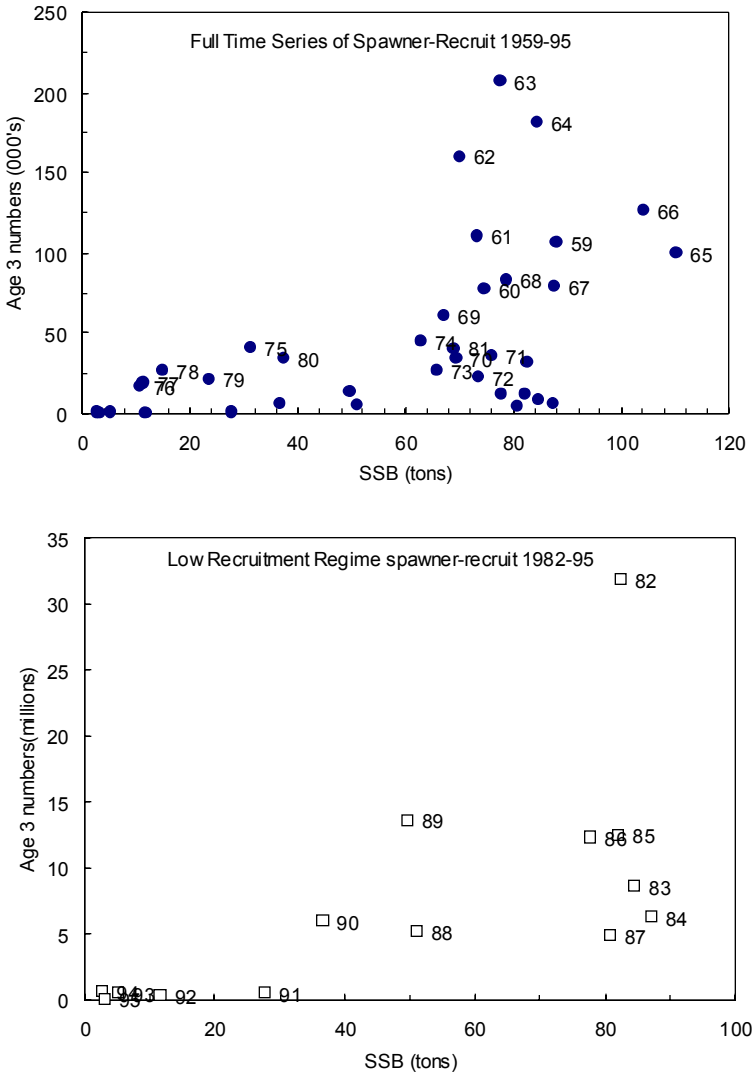


Fig. 9.5 Cod in Div. 3NO: spawner stock recruit scatter for two production regimes. A high production regime 1959 to 1981 (upper panel) and a low production regime 1982 to 1995 (lower panel).

10. **Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N** (SCR Doc. 99/65; SCS Doc. 99/5, 6, 15, 16)

a) **Introduction**

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

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

The average reported catch from Div. 3LN from 1959 to 1985 was about 22 000 tons ranging between 10 000 tons and 45 000 tons. Catches increased sharply from about 21 000 tons in 1985, peaked at an historical high of 79 000 tons in 1987 then declined steadily to about 500 tons in 1996. Catch increased to 600 tons in 1997 and to 850 tons in 1998.

In the early-1980s the former USSR, Cuba and Canada were the primary fleets directing for redfish. The rapid expansion of the fishery in 1986 and continued high catch in 1987 and 1988 was due to new entrants, primarily EU-Portugal and various non-Contracting Parties (NCP), most notably South Korea, Panama and Caymen Islands. These countries began to fish in the Regulatory Area and accounted for a catch of about 24 000 tons. In the period from 1988 to 1994 NCPs took between 1 000 tons and 19 000 tons annually; however, NCPs have not fished in Div. 3LN since 1994.

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

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

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

From 1980 to 1990 the TAC each year was 25 000 tons. The TAC was reduced to 14 000 tons for 1991 and maintained at that level through 1995. The TAC was reduced again in 1996 to 11 000 tons and maintained at that level in 1997. The Fisheries Commission agreed on a moratorium for this stock for 1998 and maintained this for 1999. In the 13-year period since 1986, TACs have been exceeded in all but the last five years. In some years catches have been twice (1988) and even three times (1987) the agreed TAC (Fig. 10.1).

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	25	14	14	14	14	14	11	11	0	0
Catch[1]	29	26	27	21[3]	6[2,3]	2[2,3]	0.5[2]	0.6[2]	0.9[2]	

[1] Includes catch estimated by STACFIS for 1989-94.
[2] Provisional.
[3] STACFIS could not precisely estimate the catch. Figures are midpoint of range of estimates.

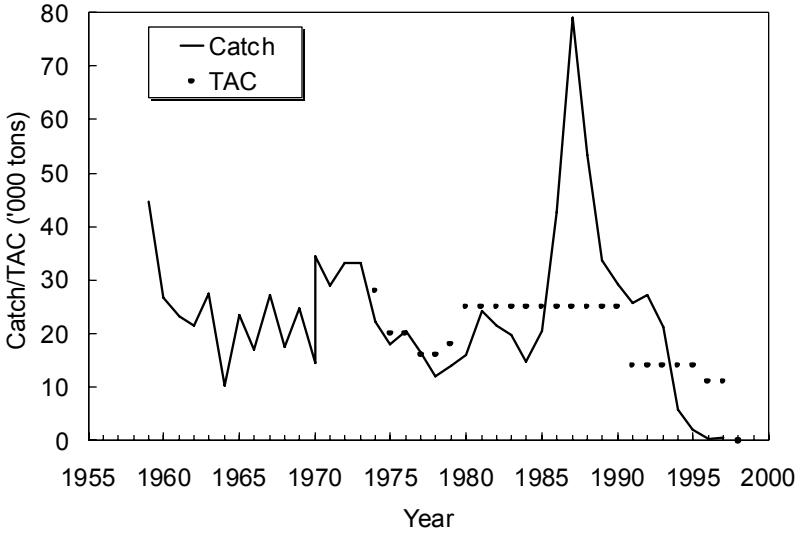


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

STACFIS reiterated its point of view that the commercial CPUE data are not reflective of year to year changes in population abundance (*NAFO Sci. Coun. Rep.*, 1996, p. 72), although they may be indicative of trends over longer periods of time. The annual update for the standardized catch-rate series provided little new information because of low catches in recent years prior to the moratorium on directed fishing in 1998. These indices of abundance are of little value in determining current stock status.

Sampling of redfish as by-catch was conducted by EU-Portugal in Div. 3LN and EU-Spain in Div. 3L from the 1998 trawl fishery for Greenland halibut. The compilation of annual catch at length in Div. 3L suggested the Portuguese by-catch were dominated by lengths between 22 cm and 27 cm with a mode at 24 cm. Spanish sampling in Div. 3L suggested the catches ranged from 24 cm-31 cm with a mode at 26-27 cm. The Div. 3N Portuguese sampling indicated that dominant lengths of redfish in the catches were between 24 cm and 34 cm with modes at 27 cm and 31 cm .

ii) **Research survey data**

Stratified-random surveys have been conducted by Canada in Div. 3L in various years and seasons from 1978 to 1998 during which strata down to a maximum depth of 732 m (400 fathoms) were sampled. Until the autumn of 1995 these surveys were conducted with an Engels 145 high lift otter trawl. Starting in the autumn 1995 survey, a Campelen 1800 survey trawl was used. The Engel data were converted into Campelen equivalent units in the 1998 assessment (*NAFO Sci. Coun. Rep.*, 1998, p. 76).

Results of bottom trawl surveys for redfish in Div. 3L indicated a considerable amount of variability. This occurred between both seasons and years. Although it is difficult to interpret year to year changes in the estimates, in general, the spring survey biomass index from 1992 to 1995 suggests the stock was at its lowest level (average 5 000 tons) relative to the time period prior to 1986 for surveys conducted in the first half of the year (winter/spring average 93 000 tons). A similar contrast occurs in the autumn survey biomass index from 1992 to 1995 (average 19 000 tons) relative to a time period prior to 1986 for surveys

conducted in the second half of the year (summer/autumn average 248 000 tons). From 1996 to 1998 the spring biomass index averaged 18 000 tons while the autumn index has averaged 14 000 tons over the same period.

Canadian surveys have also been conducted in Div. 3N in spring and autumn from 1991-98 and in summer in 1991 and 1993 (Fig. 10.2). These surveys also utilized the Campelen survey trawl beginning in the autumn of 1995. The Engel data prior to autumn 1995 were also converted into Campelen equivalents. Survey biomass and abundance estimates were generally higher in Div. 3N than in Div. 3L, but there was greater between survey variability than in Div. 3L. The source of this variability is unclear but is likely due to availability to the trawl gear or possible migrations between Div. 3N and 3O rather than real changes in population abundance. In any case, abundance in the surveys is higher during the autumn surveys than in the spring.

The average survey biomass index for the spring surveys from 1991-95 is about 6 000 tons. The average Campelen trawl spring biomass index from 1996-98 is about 14 000 tons. This average is highly influenced by the 1998 estimate for which two large sets occurred in strata that accounted for 65 of the biomass. For the autumn series the 1991-94 biomass index ranged from 13 000 tons to 123 000 tons (average 46 000 tons) compared to 1995-98 which ranged from 11 000 tons to 94 000 tons (average 49 000 tons).

There have been no Russian surveys conducted in Div. 3L since 1994 or in Div. 3N since 1993. A comparison of the Canadian and Russian bottom trawl surveys in Div. 3L indicated a similar decline in biomass estimates from 1984 to 1990 and both indices have remained at this relatively low level through 1994. It was noted, however, that the 1994 Russian survey did not cover the entire Div. 3L area. The Canadian spring and autumn indices continued to be relatively low through 1998 except for the increase observed in autumn 1995.

In Div. 3N, the Russian surveys indicated a relatively stable biomass from 1989-91 followed by an increase in 1993. This large increase in 1993 relative to 1991 was highly influenced by the trawling conducted in one stratum which accounted for 70 of the biomass but only represented about 9 of the area surveyed.

iii) **Recruitment**

Length distributions from the spring and autumn Canadian surveys in Div. 3L indicated there has been relatively poor recruitment for very many years. The autumn 1997 survey indicated the presence of some fish in the 10 cm range even though numbers caught were very low compared to numbers found during the late-1970s. There is no sign of any good recruitment in the recent surveys up to autumn 1998.

Length distributions from spring and autumn Canadian surveys in Div. 3N from 1991-98 generally showed smaller fish compared with Div. 3L. There was a relatively good pulse of recruitment picked up in the 1991 autumn survey in the range of 12-14 cm (1986-87 year-classes) that could be tracked through to 1998 at about 22-23 cm. There is no sign of any good year-classes subsequent to this in the surveys.

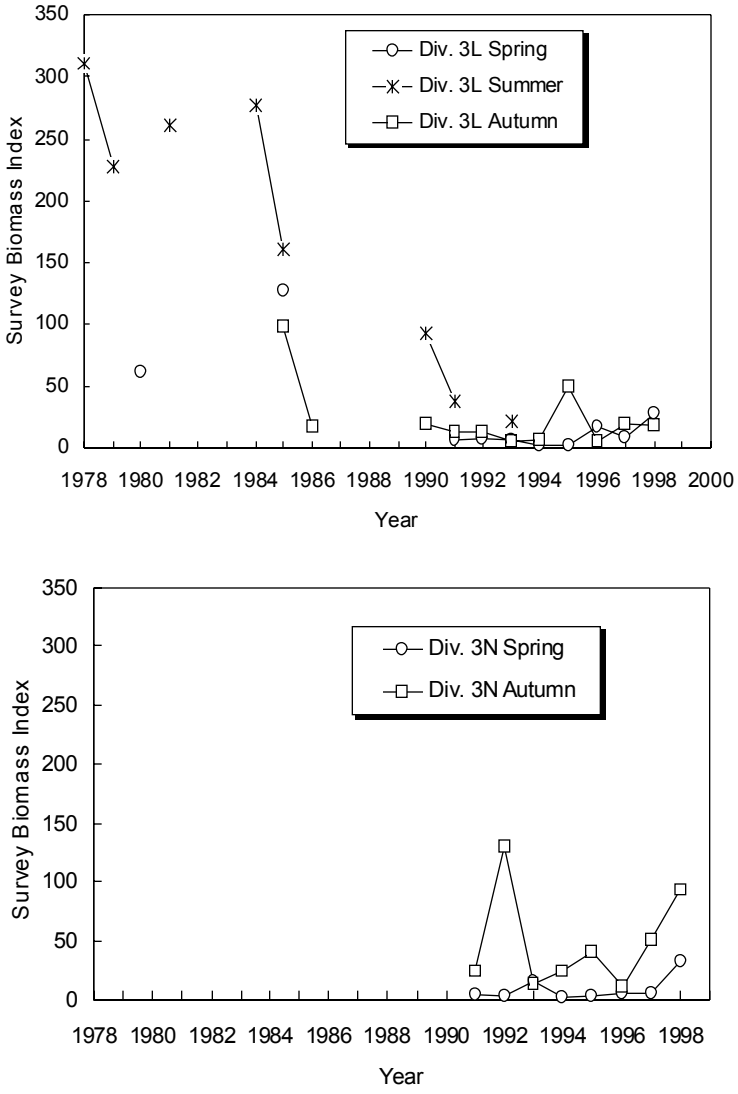


Fig. 10.2. Redfish in Div. 3LN: survey biomass indices from Canadian surveys in Div. 3L and Div. 3N in Campelen equivalent units for surveys prior to autumn 1995.

c) **Assessment Results**

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

Poor recruitment has persisted in Div. 3L since the late-1970s. The last good recruitment in Div. 3N was from the 1986-87 year-classes. Prior to the moratorium on directed fishing in 1998, these year-classes were available to the commercial fleets but did not result in a turn around in catch levels, which remained below the TAC level. This is interpreted as another sign of low overall stock sizes.

Based on the above, STACFIS considers that the stock remains at a very low level and recruitment has been poor for more than a decade.

d) **Reference Points**

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

e) **Future Studies**

No new information was available to address an outstanding recommendation concerning the relationship between Div. 3LN and Div. 3O redfish. STACFIS was informed that work on redfish stock discrimination continues within Canada to address questions related to stock structure and migration of redfish. These studies have included Div. 3O, Div. 3LN and areas north of Div. 3L, and results will be presented at a Workshop to be held in Canada in autumn 1999 which was rescheduled from the previous year.

STACFIS regards this stock issue to be important as the continuing uncertainties regarding the relationship between redfish in Div. 3O and Div. 3LN have important impacts on interpretations of available data. STACFIS again **recommended** that *(1) redfish data in Div. 3LN and 3O be analyzed further to determine if a relationship exists between Div. 3O and Div. 3LN that may help in the interpretation of the indices of abundance; and (2) data be examined to evaluate the appropriateness of Div. 3LN and Div. 3O as management units for redfish*.

11. **American Plaice (*Hippoglossoides platessoides*) in Divisions 3L, 3N and 3O** (SCR Doc. 99/40, 42, 55, 57, 58; SCS Doc. 99/6, 16)

a) **Introduction**

This fishery was under moratorium in 1998. Total catch in 1998 was 1 618 tons, mainly taken in the Regulatory Area (Fig. 11.1), and as by-catch in the Canadian yellowtail flounder fishery. There has been a slight increase in catch each year since 1995. Canadian catch in 1998 was about 212 tons, and catches by EU-Portugal and EU-Spain were 313 and 999 tons, respectively.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	24.9	25.8	25.8	10.5	4.8[1]	0	0	0	0	0
Catch	32[2,3]	34[3]	13[3]	17[4]	7[5]	0.6[5]	0.9[5]	1.4[5]	1.6[5]	

[1] No directed fisheries allowed.
[2] Includes a percentage of the "flounder non-specified" catch reported to NAFO by South Korea.
[3] Includes estimates of misreported catches.
[4] Catch may be as high as 19 400 tons.
[5] Provisional.

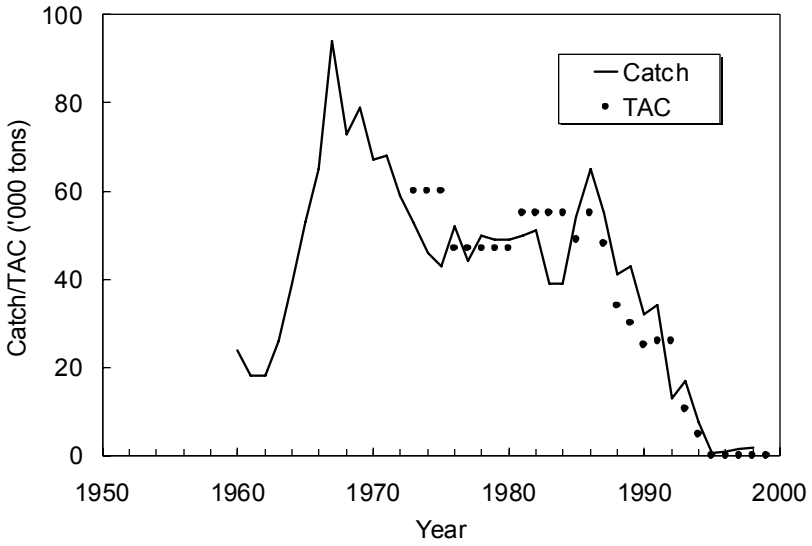


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

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

Catch-at-age. There was no age sampling of the 1998 by-catches but there was length sampling of by-catch in the Portuguese and Spanish fisheries. In the Portuguese catch in Div. 3L there was a mode at about 34-36 cm while in Div. 3N the mode was 36-38 cm and in Div. 3O the mode was 40 cm (SCS Doc. 99/16). The catch of the Spanish trawler fleet showed a mode of 30-37 cm in Div. 3L and of 36-40 cm in Div. 3NO (SCS Doc. 99/6). Catch-at-age from 1994 to 1998 was produced by applying Canadian survey age length keys to length frequencies collected each year by EU-Spain and EU-Portugal. The catch in 1994 to 1997 was dominated by ages 7 to 9 while in 1998 it was dominated by ages 8 to 10.

ii) **Research survey data**

Canadian stratified-random groundfish surveys. Data from **spring surveys** in Div. 3L, 3N and 3O were available, with some exceptions, from 1985 to 1998. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 1998, the depth range has been extended to at least 731 m in each survey.

The 1998 biomass estimates for Div. 3L, 3N and 3O were 19 000, 25 000 and 58 000 tons, respectively. The values for Div. 3L and 3O were up slightly from 1997 while the value for Div. 3N was down slightly from the 1997 estimate. Biomass in Div. 3LNO combined has been relatively stable since 1996 but is only 14 that of the mid-1980s (SCR Doc. 99/40, Fig. 11.2).

The total abundance for 1998 was slightly higher than that in 1997. Divisions 3L and 3O have shown an increase of 30 and 10 respectively in 1998 over 1997 while abundance in Div. 3N declined by 14 . The abundance of younger fish (ages 0 to 5) has declined since 1996, while the abundance of age 6+ fish has increased slightly. In 1998, 18.5 of the population was made up of fish age 9+ while this was less than 8 in 1996

and 1997. From 1985 to 1990, about 80-85 of the stock was located north of 45°N, most of which was in Div. 3L. The proportion north of 45°N declined rapidly after that and since 1993 less than 50 of the biomass has been north of this latitude.

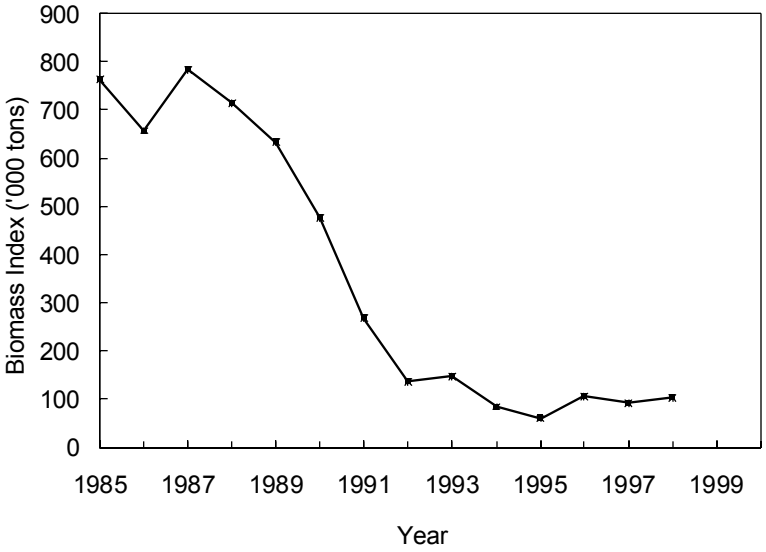


Fig. 11.2. American plaice in Div. 3LNO: biomass from spring surveys.

From Canadian **autumn surveys** (maximum depth of 731 m since 1990 in Div. 3L and 1993 in Div. 3NO) biomass estimates in 1998 were 48 000, 78 000 and 67 000 tons for Div. 3L, 3N and 3O, respectively. These values are all higher than the estimates from the 1997 autumn survey. There appears to have been an increasing trend since 1995 with total biomass increasing from 152 000 to 188 000 tons from 1995 to 1998. The biomass index remains well below that of 1990 with the 1998 index representing only 30 that of 1990.

Since the autumn surveys began in 1990, estimates of abundance and biomass have been higher in the autumn than in the spring surveys of the same year, although both surveys showed similar declining trends in this period (Fig. 11.3).

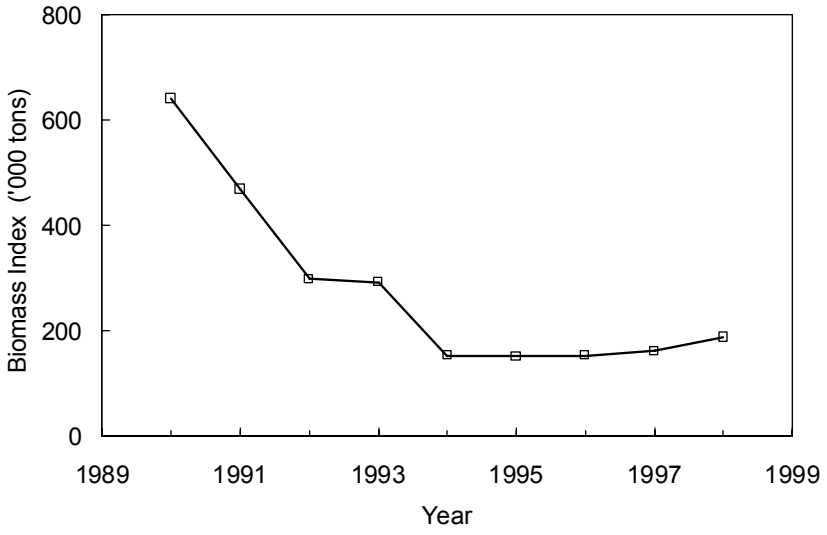


Fig. 11.3. American plaice in Div. 3LNO: biomass from autumn surveys.

Survey by EU-Spain. Surveys have been conducted annually from 1995 to 1999 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 462 m (since 1998). Surveys since 1996 are comparable in coverage. Biomass and abundance declined between 1996 and 1997 then increased in 1998 and 1999. Modal size of males was 28-33 cm, and 36-43 cm for females (SCR Doc. 99/57).

Canadian Joint DFO-Industry Surveys. Since 1996 grid surveys directed at yellowtail flounder have been conducted in Div. 3NO. Information is also collected on American plaice. These surveys show a clear seasonal pattern in catch rate but no trend across years (SCR Doc. 99/42).

In autumn 1998 a stratified random survey was conducted with sets allocated in relation to American plaice abundance and stratum area. This survey used commercial gear without a liner and therefore estimates were of the exploitable portion of the stock. The industry survey and the Canadian autumn survey conducted by the Department of Fisheries and Oceans (DFO) showed similar distribution of American plaice with fish being widely distributed throughout Div. 3LNO but most abundant in southern and southwestern Div. 3NO. For Div. 3LNO as a whole this survey caught more older fish than the DFO survey. However comparisons on a Division by Division basis and comparisons of sets made at the same locations in the two surveys showed that this was not a consistent result (SCR Doc. 99/55). The relative age distribution of age 8+ fish was similar in the 2 surveys.

iii) **Biological studies**.

Analyses of age and length at 50 maturity were produced from spring RV data. For males, A_{50} has been declining since 1985. L_{50} has been declining for both sexes since the early-1980s. The current L_{50} for males is 17.8 cm compared to 25.0 cm in 1980. The current L_{50} for females is 33.0 cm compared to 42 cm in 1980.

Female spawning stock biomass (SSB) was calculated using spring RV data from 1985 to 1998. SSB declined rapidly from the late-1980s to the early-1990s. SSB has shown an increase from 35 000 to 45 000 tons between 1997 and 1998, but is only 17 of the level of the mid-1980s.

Relative cohort strengths were estimated from the Canadian spring surveys. Cohorts from 1980 to 1986 were generally stronger than those after that period, except for 1994 and 1996. The 1994 and 1996 cohorts appear to be above average for the 1980 to 1996 period. The 1996 cohort is represented by only a single data point in the model and the results for this cohort should be treated with caution. An earlier model using only Engel data showed that the cohorts of the early-1980s were weak compared to earlier cohorts. Both models show the 1985 cohort to be the strongest in the 1980s. Based on this comparison with the earlier model the 1994 cohort is probably weaker than those of the 1970s.

Total mortality for ages 1 to 16 was calculated from the Canadian spring and autumn surveys. Both surveys indicate an increase in mortality up to the mid-1990s. Since that time mortality has declined on older ages (5+) but has continued to increase on younger ages, particularly ages 2 to 4. The estimates of total mortality from the spring and autumn surveys indicate that mortality was very high after the moratorium on fishing was introduced. The average Z for ages 5 to 10 in 1995 and 1996 was approximately 0.6. The estimates of Z were very high from 1989 through 1996 but decreased substantially in 1997 and 1998.

c) **Estimation of Parameters**

Several formulations of virtual population analyses (VPA) were presented. STACFIS agreed that the model that provided the best fit to the data included a natural mortality of 0.6 on all ages from 1989 to 1996 and 0.2 otherwise. An M of 0.6 may be considered high for American plaice. However, the estimates of total mortality from the survey indicate that mortality was very high even during the period of the moratorium. As well, the adjacent American plaice stock in Subarea 2 + Div. 3K declined by 95 during the late-1980s and early-1990s when catches were extremely low. Also, increasing M in the analyses is making an adjustment for unaccounted mortality, whatever the cause, or an adjustment for possible changes in catchability.

For American plaice in Div. 3LNO, a higher M was employed for several years in the VPA. This is a large departure from previous models and STACFIS **recommended** that *the effect of the increase in natural mortality and estimation of M within the ADAPT framework be explored.* In recent years catch at older ages was low or nonexistent and therefore, STACFIS **recommended** that *the number of ages in the catch-at-age 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 **recommended** that *the current VPA be examined for a retrospective pattern*.

d) **Assessment Results**

These analyses showed that population size has decreased substantially since the mid-1980s and has been stable at a low level since 1994 (Fig. 11.4). Average F is much lower than during the 1970s and 1980s but has shown a slight increase since 1995 (Fig. 11.5). 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.

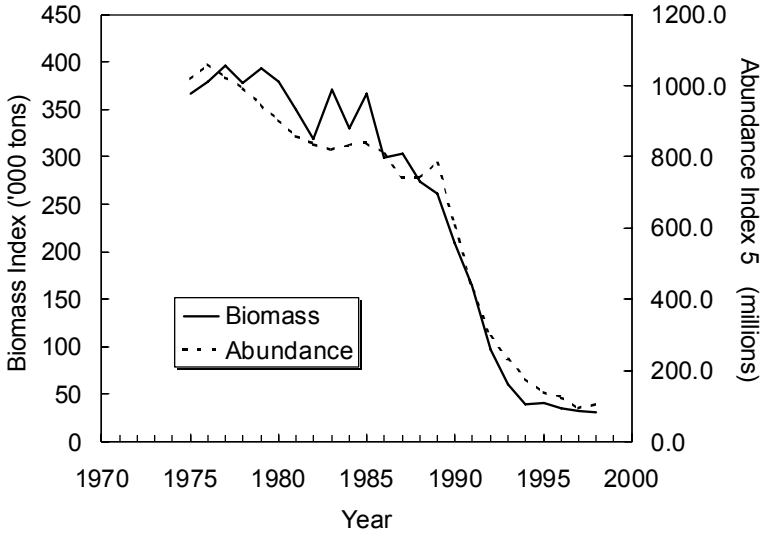


Fig. 11.4. American plaice in Div. 3LNO: population abundance and biomass from VPA.

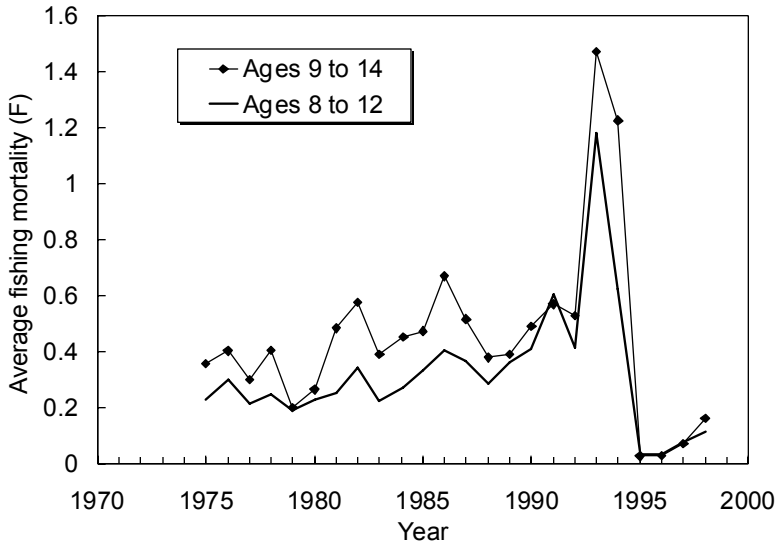


Fig. 11.5. American plaice in Div. 3LNO: Average fishing mortality from VPA.

The VPA and the Canadian spring and autumn surveys all show a very large decline in abundance and biomass since about the late-1980s. The EU-Spain survey in the Regulatory Area of Div. 3NO has shown a steady increase in biomass and abundance since 1997. Both the VPA and the survey data indicate that the year-classes since the mid-1980s have been weak. The spring survey indicates that the 1994 cohort may be stronger than the average for the 1980 to 1996 period but probably weaker than those of the 1970s. Mortality as estimated on an age by age basis from the Canadian spring and autumn surveys indicate an increase in mortality up to the mid-1990s. Since that time mortality has declined on older ages (5+) but has continued to increase on younger ages, particularly ages 2 to 4. Most of the indicators evaluated suggest that the stock remains low compared to historic levels.

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

At the Scientific Council PA Workshop in March 1998, data from this stock were chosen for use in the various models employed at that meeting (see Section II, of *NAFO Sci. Coun. Rep*., 1998). It was tentatively agreed that a B_{lim} value of 150 000 tons of SSB was reasonable for this stock. Calculations were largely based on data from a sequential population analysis model used in the 1993 assessment. The updated VPA presented in this assessment indicates that reference points for this stock need to be reconsidered (Fig. 11.6). STACFIS **recommended** that *for American plaice in Div. 3LNO, the stock recruit relationship from VPA should be explored further.*

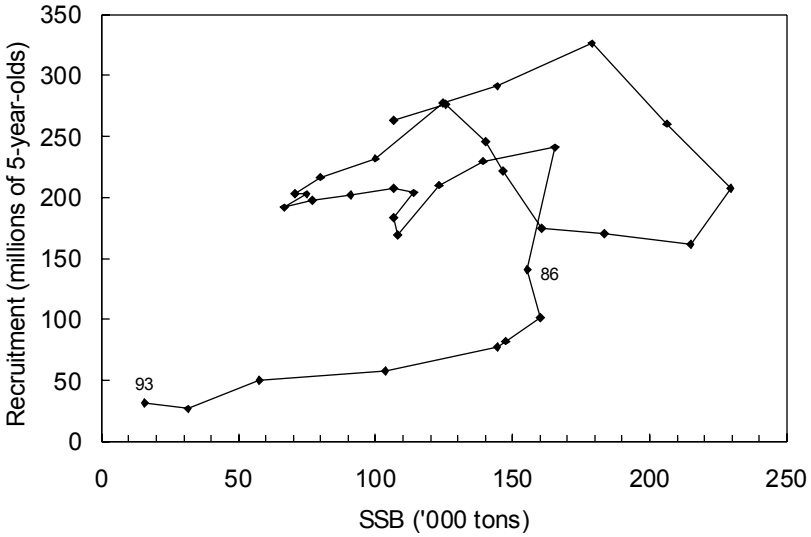


Fig. 11.6. American plaice in Div. 3LNO: spawning stock biomass and recruitment from VPA.

12. **Yellowtail Flounder (*Pleuronectes ferruginea*) in Divisions 3L, 3N and 3O** (SCR Doc. 99/3, 5, 16, 23, 42, 44, 46, 54, 57, 59, 60, 61, 63, 68; SCS Doc. 99/6, 16)

a) **Introduction** (SCR Doc. 99/68)

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, mainly as by-catch in other fisheries (Fig. 12.1). In the 1998 fishery, a catch of 4 400 tons was taken. Catches exceeded the TACs in each year from 1985 to 1993. 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 under the categorization of unspecified flounder catches.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	5	7	7	7	7[1]	0[1]	0[1]	0[1]	4	6
Catch	14[2]	16[2]	11[2]	14[2]	2[1,3]	0.1[1,2,3]	0.3[1,3]	0.8[1,3]	4[3]	

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

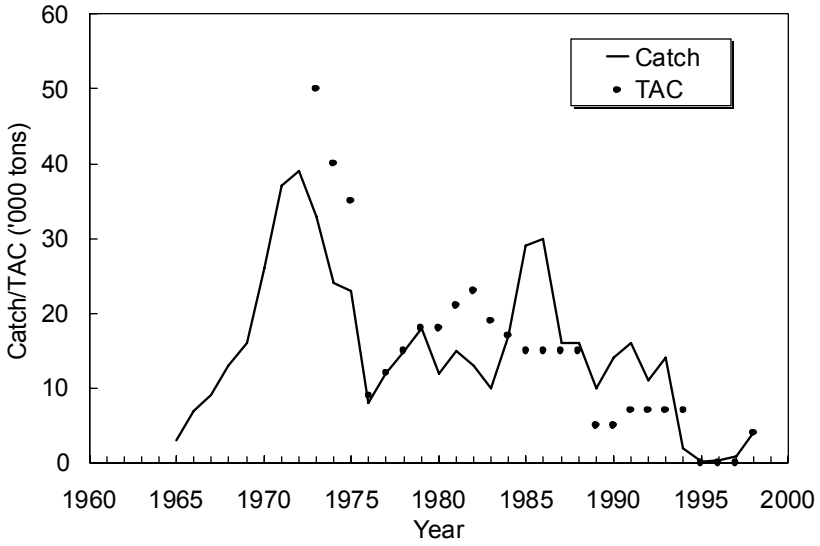


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data** (SCS Doc. 99/6, 16; SCR Doc. 99/61, 72)

There were catch and effort data from the Canadian commercial fishery in 1998, which were included in a multiplicative model to analyze the CPUE series from 1965 to 1998. 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 CPUE value was the highest in the time series; however this value was not directly comparable to CPUE indices from previous years because of changes in the 1998 fishing pattern. The 1998 catch rate was related to the fleet's fishing pattern, which because of the 5 by-catch rule resulted in concentration of 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 (2.3) and American plaice (4.2) down. The deployment of excluder grates also contributed to the low by-catch levels, particularly for cod. Juvenile catches were reduced by the use of large mesh sizes (145-155 mm) in the codend. Average size of males and females in the catch was 36.5 cm and 39.5 cm respectively. Analysis of maturity data indicated that the period of the fishery occurred after spawning was finished.

There was limited sampling of yellowtail flounder from by-catches in an EU-Spain skate fishery and from EU-Portugal in the Regulatory Area of Div. 3N. The length frequency of yellowtail flounder in the catches ranged in size from 26 to 46 cm, peaking at 34 cm. STACFIS 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. 99/46,63). Strict quality control fishing protocols are in place to minimize variability in gear deployment and trawl performance during the annual Canadian bottom trawl surveys. Geometry and performance of the Campelen 1800 shrimp trawl during the 1995□98 surveys were estimated from acoustic trawl instrumentation data. Statistical differences in geometry were estimated in comparisons between years and between the two vessels used in these surveys. The effect of these differences on change in catchabilities has not been estimated.

The design, performance and geometry of the survey bottom trawl, Engel 145 high lift otter trawl, used in the cooperative Canadian Department of Fisheries and Oceans (DFO)/Industry seasonal surveys of Div. 3NO yellowtail flounder were examined. The use of long trawl sweeps increases the effective trawl width in comparison to the Campelen survey trawl, however, its effect on differences in catchability has not been evaluated.

Canadian stratified-random spring surveys (SCR Doc. 99/44). These surveys covered depths from 42 to 731 m. In 1998, most of the trawlable biomass of this stock continued to be found in Div. 3N, where the index 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 an average level of 56 000 tons for 1997-98.

In 1998, the total trawlable biomass index in Div. 3LNO was estimated to be 202 000 tons, a 14 increase since 1997 (Fig. 12.2).

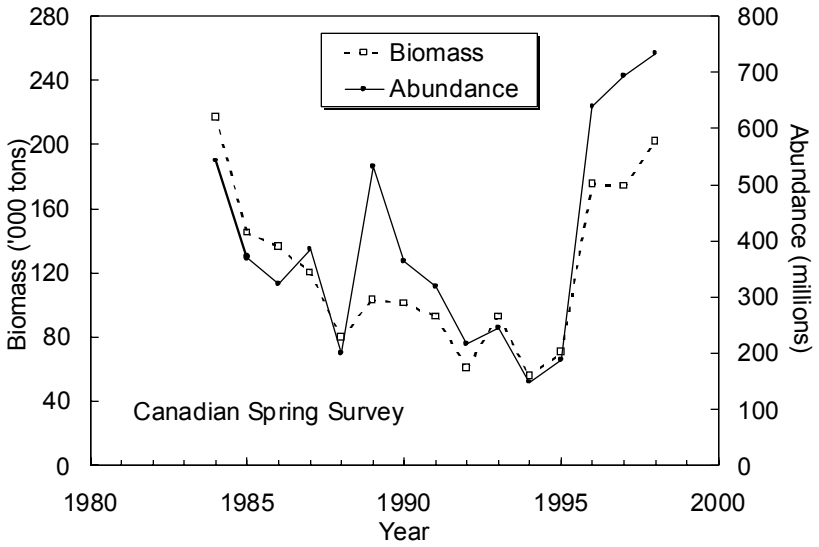


Fig. 12.2. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian spring surveys

The survey catches have been usually dominated by yellowtail flounder aged 6-7 years, however, in 1996 and 1997 the catches were dominated by ages 4-7 and in 1998 by ages 4-5. The age 7+ biomass index was estimated to be 89 000 tons, representing 44 of the

survey estimate.

Total mortality for ages 4 to 9 was calculated from the Canadian spring survey data (SCR Doc. 99/68), however, the analyses were inconclusive due to the unresolved questions about ageing of older fish.

Canadian stratified-random autumn surveys (SCR Doc. 99/44). 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 228 000 tons in 1998 (Fig. 12.3). Most of this biomass was found in Div. 3N; Div. 3L had a biomass estimate of 2 000 tons. The survey catches were dominated by yellowtail flounder aged 4-5 years in 1996 and 5-6 years in 1997 and 6-7 years in 1998. In 1998, the age 7+ biomass index was at 108 000 tons, representing 48 of the survey estimate.

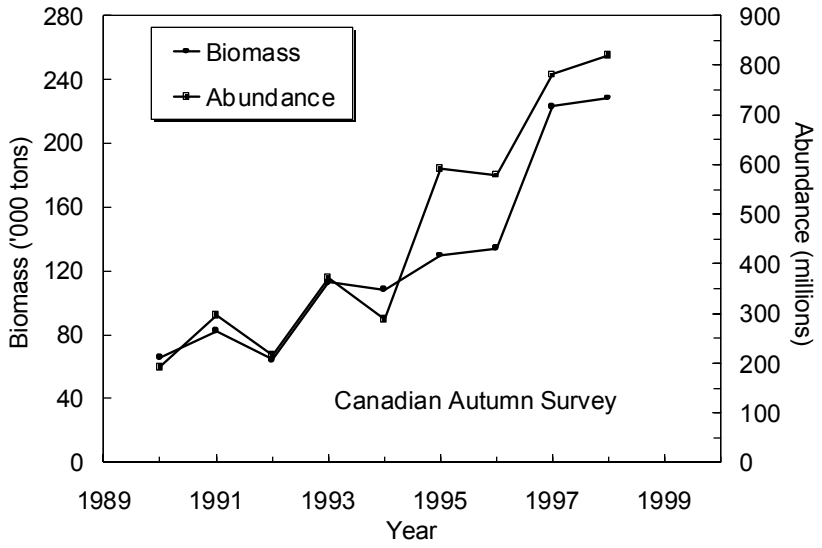


Fig. 12.3. Yellowtail flounder in Div. 3LNO: estimates of biomass and abundance from Canadian autumn surveys.

Canadian Cooperative DFO/fishing industry seasonal surveys (SCR Doc. 99/42). Cooperative quarterly surveys between Department of Fisheries and Oceans (DFO) and the Canadian fishing industry in Div. 3NO were carried out since 1997 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.

Yellowtail flounder in these surveys ranged from 23-52 cm and only 15 of the catch in any one trip was less than 30 cm; an exception was July 1998 where the percentage was 39. Ages 6-8 dominated the catch. These surveys also pointed out the limited area available for conducting a directed fishery for yellowtail flounder within the 5 A. plaice by-catch restriction.

Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO (SCR Doc. 99/57)**.** 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) (Fig. 12.4).

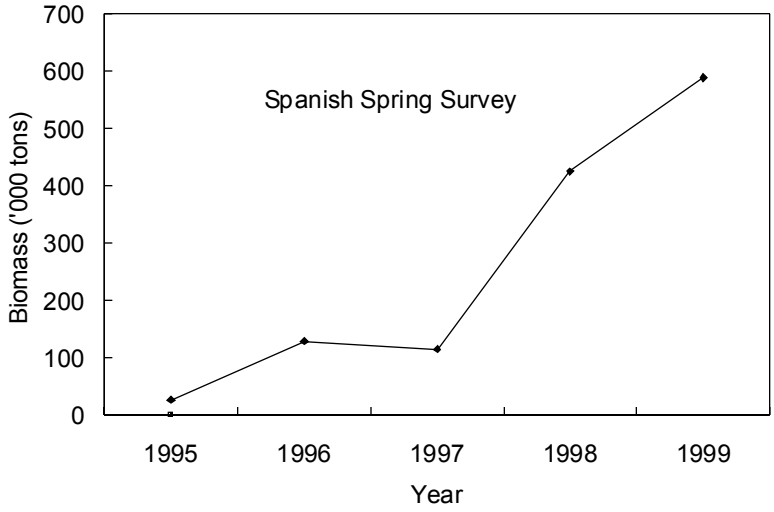


Fig. 12.4. Yellowtail flounder in Div. 3LNO: estimates of biomass from the Spanish surveys in the Regulatory Area of Div. 3NO.

Modal length of the 1995-97 catches was 24 cm, but increased to 27 cm in 1998 and 28 cm in 1999. Using the mean-length-at-age from the Canadian survey, the peak in the 1998 and the 1999 catches was at age 5.

Stock distribution (SCR Doc. 99/44, 59, 60). Analysis of 1985-97 autumn surveys using geostatistics confirmed that the stock was more widely distributed in all three Divisions prior to the 1990s. The majority of the stock is consistently concentrated in Div. 3NO on and to the west of the Southeast Shoal. Temperature and depth are significant factors affecting their distribution. Based on catches during the 1998 surveys, some expansion of the range into Div. 3L may be taking place.

The proportion of juveniles (ages 0 to 3) in the 1985-97 autumn surveys on the Southeast Shoal was, on the average, about twice that in the adjacent area immediately west of the shoal. Both locations constitute the nursery area.

Biological studies (SCR Doc. 99/16, 68). Mean length-at-age in both the 1990 to 1998 Canadian spring and autumn surveys indicated a significant linear relationship between age and length.

The weights of both sexes were equal up to about 38 cm, beyond which females were heavier than males at comparable sizes.

Average weight-at-age (sexes combined) showed no obvious trends during 1990-98 based on Canadian spring and autumn survey data.

Information on age and growth was also derived from length and otolith information obtained from tagging experiments of the early-1990s. The analysis indicated there may be an ageing problem with older fish, and that growth rates may be much lower than previously published information. STACFIS noted concern about these conclusions and

recommended that *new investigations into ageing techniques of yellowtail flounder be started to cross-validate the current age reading.* STACFIS also **recommended** that *a new tagging program for Div. 3LNO yellowtail flounder be started to gain more information on growth rates*.

Length at 50 maturity (L_{50}) was calculated for males and females separately, from samples collected during the 1995-99 Spanish surveys in the Regulatory Area. There has been a decreasing trend in length at 50 maturity in both sexes especially from 1997 to 1998. STACFIS noted that it is not clear if this decrease is representative of the entire population since the samples taken in the Regulatory Area of Div. 3NO did not contain many older fish. Age at 50 maturity data from the Canadian spring survey series indicated a small decrease for both sexes from 1997 to 1998 (Fig. 12.5).

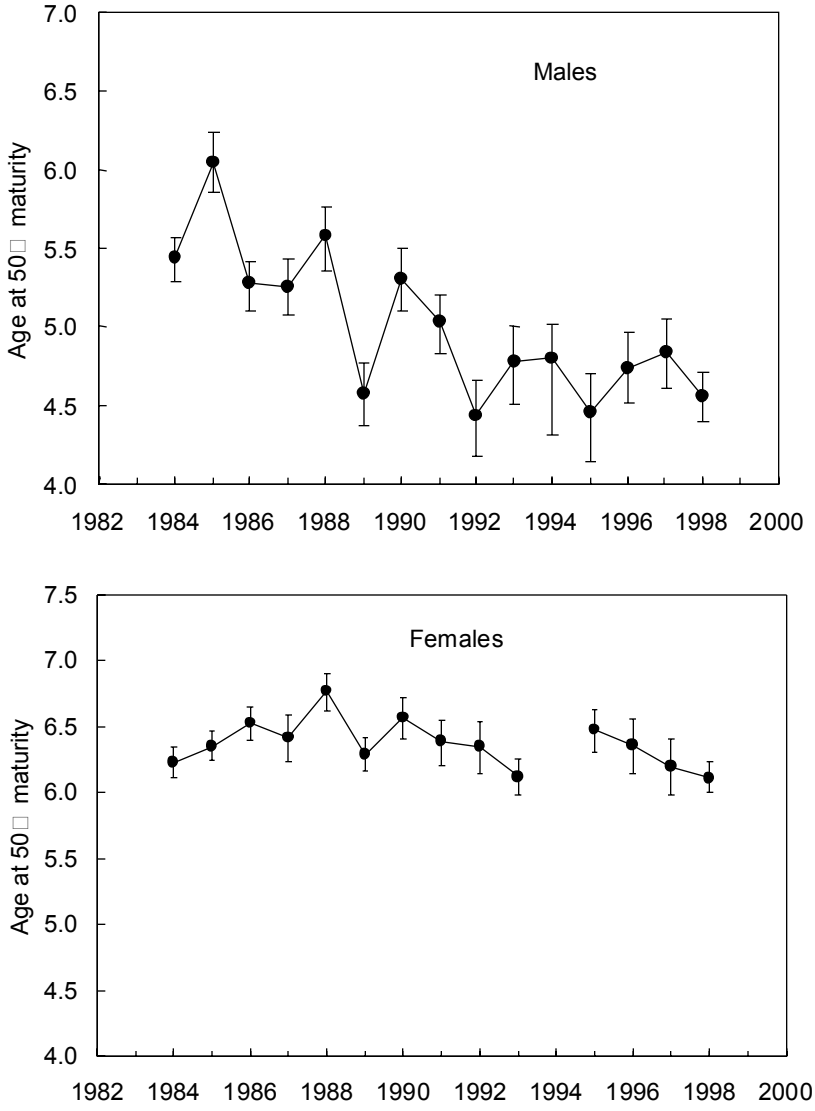


Fig. 12.5. Yellowtail flounder in Div. 3LNO: age at 50

c) **Assessment Results**

Female SSB was derived from the 1984-98 Canadian spring survey data, annual maturity ogives and annual mean weights-at-age. SSB declined from 50 000 tons in 1984 to an average of 13 000 tons in 1988-89, then varied without trend around an average value of 26 000 tons from 1990-95. The SSB increased in 1996 and appears stable at an average level of 64 000 tons from 1996-98, the highest values in the time series (Fig. 12.6).

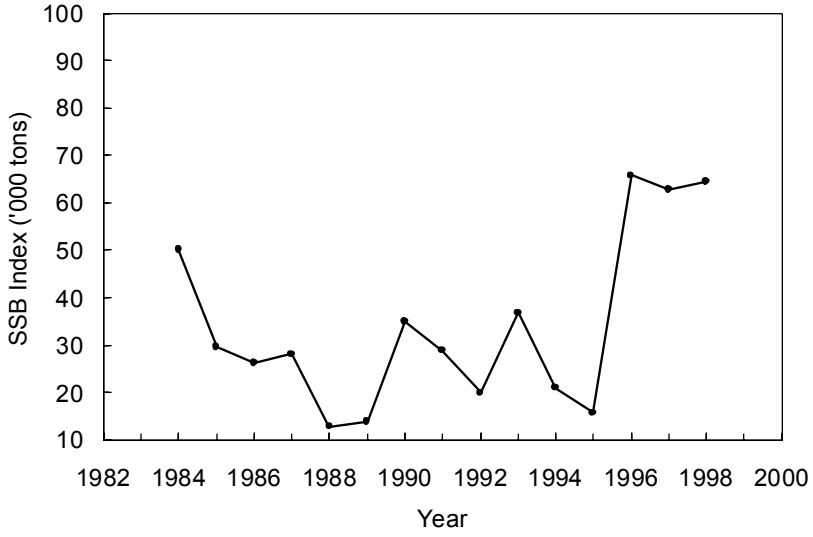


Fig. 12.6. Yellowtail flounder in Div. 3LNO: female spawning stock biomass estimated from the 1984-98 annual spring surveys.

Relative year-class strength was estimated from a multiplicative model using information based on abundance of cohorts at ages 3 and 4 from the 1984-98 spring and 1990-98 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 and 1995 year-classes were estimated to be somewhat weaker although they are still amongst the highest in the series.

Spatial analysis indicates the stock is more widely distributed in Div. 3NO in 1997-98 than in the early-1990s but not as extensively as prior to the mid-1980s. The Canadian spring and autumn surveys and the Spanish surveys in the Regulatory Area show that stock abundance and biomass has been increasing in recent years. The increase in biomass is related to fish growth as well as above average recruitment.

Many age classes are contributing to the biomass in 1996-98. The SSB is at a higher level in recent years relative to the mid-1980s and the relative year class strength is above average for the 1993-95 year-classes. The mean weights-at-age have also remained stable. Based on 8 additional surveys since the 1998 assessment, the current view is that the stock size has steadily increased since 1994.

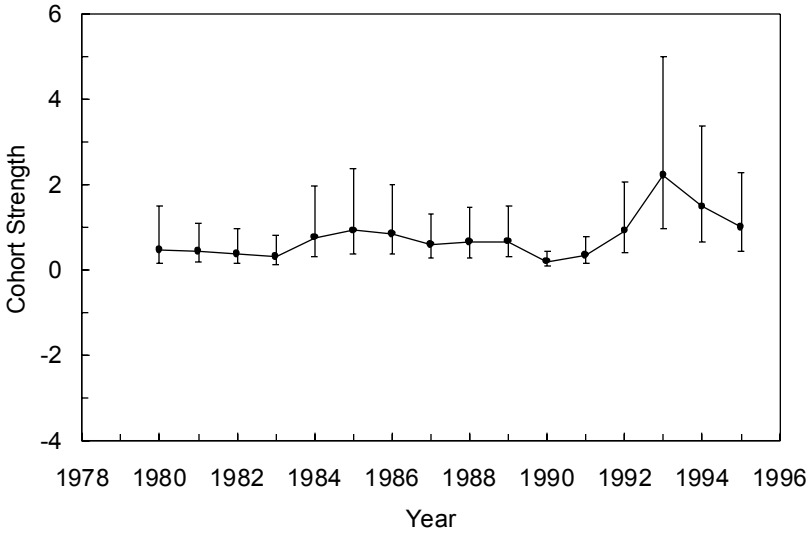


Fig. 12.7. Yellowtail flounder in Div. 3LNO: cohort strength estimated from a multiplicative model using age 3 and 4 data from annual spring and autumn surveys.

d) **Reference Points**

Stock-recruitment relationships (SCR Doc. 99/68). There is no apparent stock recruitment relationship evident for this stock (Fig. 12.8). However, STACFIS expressed concern about the possible effects of errors in the aging of older fish on the estimation of SSB. STACFIS **recommended** that *estimation of a length based SSB be explored for Div. 3LNO yellowtail flounder*.

Preliminary reference points based on a production model were developed at the PA meeting (SCS Doc. 99/3). No further results are available at the present meeting.

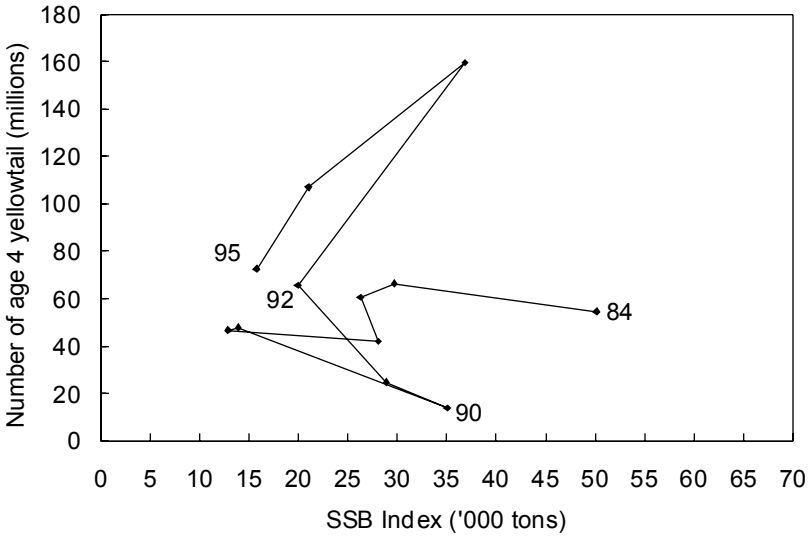


Fig. 12.8. Yellowtail flounder in Div. 3LNO: stock/recruitment plot.

13. **Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 3N and 3O** (SCR Doc. 34, 57; SCS Doc. 99/6, 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:

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	5	5	5	5	3[1]	0	0	0	0	0
Catch	4	5	5	4	1[2]	0.3[2]	0.3[2]	0.5[2]	0.6[2]	

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

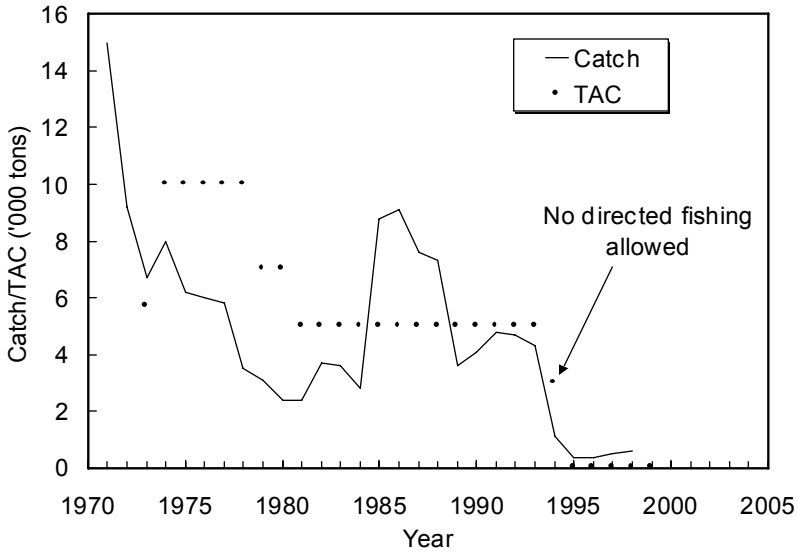


Fig. 13.1. Witch flounder in Div. 3NO: catches and TACs.

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 and 1998 catches just over 500 tons and 600 tons, respectively.

Catches by Canada ranged from 1 200 tons to 4 300 tons from 1985 to 1993 (about 2 650 tons in 1991 and 4 300 tons in 1992) and were mainly from Div. 3O. Only 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 EU-Portugal (SCS Doc. 99/16) indicate a range of lengths between 28-56 cm with a mode at 36-38 cm. Similar data from EU-Spain (SCS Doc. 99/6) indicated a range of 30-57 cm with modes at 36-37 cm and 40-41 cm.

ii) **Research survey data**

Biomass estimates. Biomass estimates from Canadian converted spring surveys (SCR Doc. 99/34) in Div. 3N have been at very low levels during 1984-98 and in most years were less than 1 000 tons. For Div. 3O the estimates of biomass fluctuated annually, on average between 8 000 and 24 000 tons in the late-1980s. It was observed that despite the fact that survey coverage in Div. 3NO during 1991-98 has been the most complete in the time series, including much deeper water, there was a declining trend since about 1984 with the 1998 value the lowest observed (Fig. 13.2). Canadian autumn surveys from 1990-98 showed little or no trend during this period.

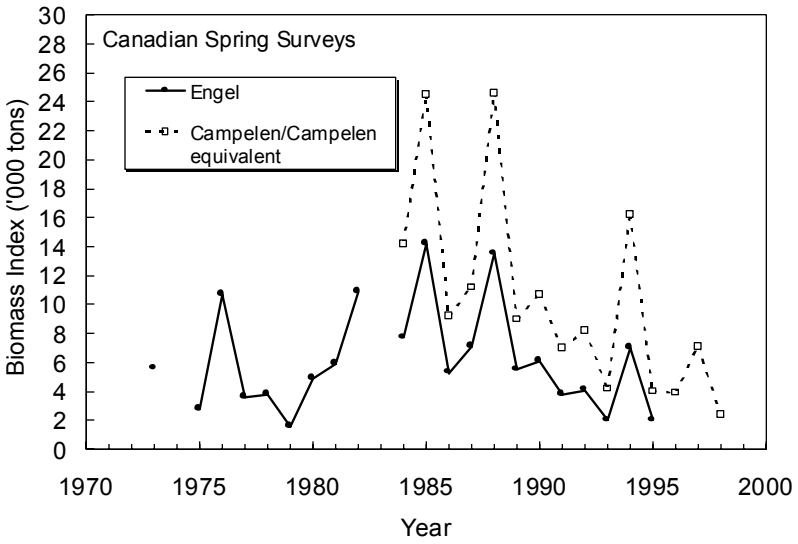


Fig. 13.2. Witch flounder in Div. 3NO: estimates of biomass.

Annual surveys have been conducted by EU-Spain in May since 1995 in the Regulatory Area of Div. 3NO (SCR Doc. 99/57). The survey was extended from a maximum depth of 730 m in 1995 to 1 100 m in 1996 and 1 400 in 1997-99. The biomass index was about the same between 1996 and 1997 at about 4 000 tons but increased sharply to 14 000 tons in 1998 and 16 000 tons in 1999. 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.

c) **Assessment Results**

Based on the most recent data, the overall stock remains at a very low level with no apparent improvement.

d) **Reference Points**

At the June 1998 Scientific Council Meeting attempts were made to investigate potential reference points by examining historic commercial catch-effort data from 1974-92 using CEDA (Catch Effort Data Analysis) software (SCR Doc. 98/49). A range of trial runs was conducted to evaluate the sensitivity of the analysis to model choice, error structure and input parameters. It was concluded that under equilibrium conditions the MSY may be in the order of about 5 000 tons with an associated F_{msy} of about 0.25. The MSY value was most robust in all analyses that were considered reasonable, however, other potential reference points were much more sensitive to changes in the input parameters. Due to lack of ageing and fishery data STACFIS was unable to provide more definitive results on the required reference points.

D. WIDELY DISTRIBUTED STOCKS (Subareas 2 and 3, 3 and 4)

Overview of Physical Environment

Observations on horizontal near-bottom temperature distributions in Div. 2J and Div. 3KL indicate a complete absence of 0°C waters. Bottom water temperatures during the autumn of 1997 and again in 1998 remained above normal over most areas, particularly on the offshore portion of the shelf. Lower than normal temperatures in the deep basins on the Scotian Shelf and in the Gulf of Maine are due to the on-shelf penetration of cold Labrador Slope water from the shelf break region.

14. Roundnose Grenadier (*Coryphaenoides rupestris*) in Subareas 2 and 3 (SCR Doc. 99/51; SCS Doc. 99/5)

a) **Introduction**

It has been recognized for a number of years that recent catches of grenadiers by EU-Portugal and EU-Spain reported to NAFO as roundnose grenadier from directed Greenland halibut fisheries in the Div. 3LMN area were primarily roughhead grenadiers. EU-Portugal reported that all of their catch of grenadiers since 1988 has been roughhead grenadier and this has been changed in the NAFO catch statistics. Grenadier catches by EU-Spain for 1992-96 are primarily roughhead grenadier. These data were misclassified because roundnose grenadier was the only name appearing in the statistical data reporting forms during this time. This misclassification has not been resolved in the official statistics for 1992-96 but the species has been reported correctly for 1997 and 1998.

i) **Description of fishery**

Over most of the years of the directed roundnose grenadier fishery, the bulk of the catch came from Div. 3K with the exception of 1971 when over 50 000 tons was reported from Div. 2G. This traditional fishery was conducted by the former USSR and former GDR during the second half of the year. These fleets fished before the establishment of the 200-mile limit in 1977 and under bilateral arrangements with Canada afterwards. Beginning in 1993 there have been no allocations to non-Canadian vessels inside the Canadian 200-mile zone.

The distribution of actual roundnose grenadier catches by area and season in the Regulatory Area in recent years has not been confirmed, but based on reports to NAFO,

catches of roundnose and roughhead combined have been taken primarily as by-catch during the first half of the year corresponding to the period of the most effort for Greenland halibut.

ii) **Nominal catches**

The first reported catch of roundnose grenadier in Subareas 2 and 3 was 17 000 tons in 1967. From 1967 to 1977 nominal catches were on average about 23 000 tons with the exception of the largest recorded catch of 75 000 tons in 1971. Catches declined rapidly to 8 000 tons in 1979, averaged about 5 000 tons up to 1989 and declined to 800 tons in 1990. The 1991 catch could not be estimated precisely but the total 1991 estimate for both roundnose and roughhead grenadier is thought to be in the range of 8 000 tons to 14 000 tons. From 1992 to 1996 catches of roundnose grenadier were between 100 tons and 500 tons. Catches have been about 50 tons each year from 1997-98 (Fig. 14.1).

A TAC was first imposed on roundnose grenadier at 32 000 tons in 1974, increased marginally to 35 000 tons in 1977 and decreased to 27 000 tons by 1982. A reduction to 11 000 tons occurred for 1983 and the TAC was maintained at this level to 1993. From 1994 to 1995 a 3 000 ton TAC was in effect for the Canadian 200-mile zone only. This was reduced to 1 000 tons for 1996. Currently there is a moratorium on the directed fishery imposed within the Canadian 200-mile zone.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	11	11	11	11	3	3	1	0	0	0
Catch[1]	1	8-14[2]	1	0.4	0.1[3]	0.2[3]	0.4[3]	+[3]	+[3]	

[1] Based on revised catch statistics for EU-Portugal and estimates for EU-Spain.
[2] Estimate for grenadiers, the amount and proportion of roundnose grenadier could not be determined precisely.
[3] Provisional.

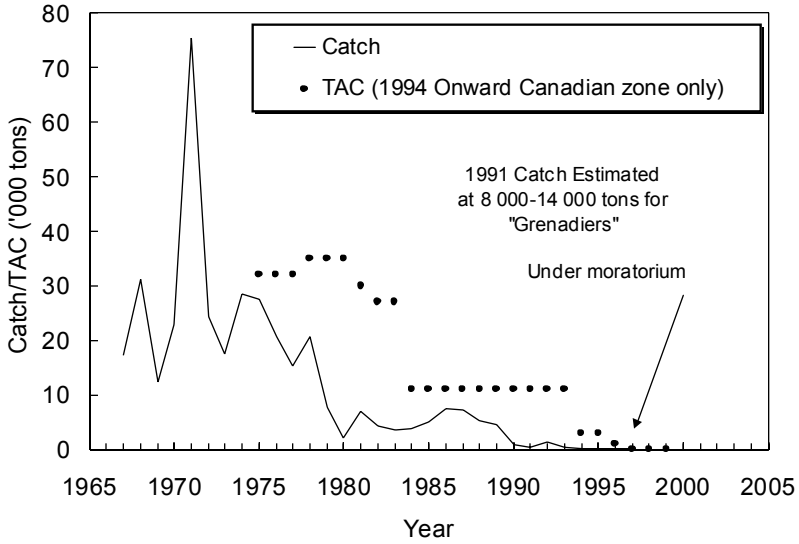


Fig. 14.1. Roundnose grenadier in Subareas 2+3: catch and TACs.

b) **Input Data**

i) **Commercial fishery data**

Limited sampling information available for the 1998 roundnose grenadier by-catches suggested that in Div. 3LMN roundnose grenadier total length ranged from 13-84 cm with the bulk of the catch between 30 to 36 cm. These were based on samples collected in October and November.

ii) **Research survey data**

Canada conducted a stratified-random multi-species bottom trawl survey in 1996-98 during September to December in Subareas 2 and 3 with the exception of Div. 3P. Strata in Div. 2G were only partially covered in 1997-98 from 400 m-1 250 m with even less coverage (500 m) in 1996. Coverage of strata was complete down to 1 500 m in Div. 2J and 3KL and almost complete in Div. 2H. Coverage of Div. 3M in the north and west strata of Flemish Cap only included strata beyond 350 m in 1996 and beyond 730 m 1997-98. Div. 3NO was completely covered to 1500 m in 1998 but only covered to 730 m in 1996-97.

Overall, highest abundance of roundnose grenadier occurred in strata beyond 750 m in all Divisions. The most abundant areas were in Div. 2H and Div. 3K. The total biomass index for Div. 2HJ and 3K declined from 59 000 tons in 1996 to 19 000 tons in 1997 and 1998. The total biomass for Div. 3LM increased from about 8 500 tons in 1996 to 15 000 tons in 1997 followed by a decline to 6 000 tons in 1998. Abundance was low in Div. 3NO. The total biomass index for the survey area (Div. 2GHJ and 3KLMNO) indicated a decline from 68 000 tons in 1996 to 25 600 tons in 1998.

Size distributions of roundnose grenadier (using pre-anal fin length measurements) from the Canadian survey by year and Division indicated a smaller size range and predominantly smaller fish in the southern Divisions, at least for Div. 3LM, compared to the northern Div. 2HJ and 3K. The substantial decrease in Div. 2H and 3K occurred over most of the size ranges that were observed in 1996 (5 cm to 15 cm) indicating a possible year effect. The increase for Div. 3L in 1997 occurred in the larger sizes (6 cm to 11 cm) compared to the 1996 distribution. In Div. 3M the increase from 1996 to 1997 occurred in the same dominant size range (5 cm to 8 cm) that was sampled in 1996. The 1998 size distributions were similar to 1997 in Div. 2H and Div. 2J with modes at about 4.0-4.5, 8.0 and 13.0 cm. The largest mode for Div. 2H was 8.0 cm while the largest in Div. 2J was at 4.0 cm. Div. 3K had modes at 4.0 cm and 7.0-8.0 cm with largest at 8.0 cm. The largest mode in Div. 3L occurred at 5.0 cm while in Div. 3M there were modes at 4.0 cm and 7.0-8.0 cm, the largest occurring at 8.0 cm. There were too few fish captured in Div. 3NO to draw any comparisons.

Japan conducted a stratified-random trawl survey in Div. 2GH in August 1996. The survey covered strata from 201 m to 1 500 m and utilized the same stratification scheme as the Canadian survey. Tow duration was 30 minutes at 3.5 knots. The gear used had 140 mm mesh codend with a 30 mm liner. The survey biomass estimate for roundnose grenadier was 2 250 tons for Div. 2G and 2 736 tons for Div. 2H.

USSR/Russia conducted stratified-random trawl surveys in Div. 2GH from 1987 to 1992 directed to Greenland halibut. The surveys covered depths to 1 250 m during 1987-89 and to 1 500 m from 1990-92. Division 2H was not surveyed in 1990. The surveys were conducted with a 12-mm liner in the codend and tows were of one-hour duration. Coverage was incomplete in most years. The survey biomass index for roundnose grenadier ranged from 5 800 tons (1988) to 67 200 tons (1989) in Div. 2G, and from 1 500 tons (1992) to 14 000 tons (1989) in Div. 2H.

c) **Assessment Results**

There has been very limited commercial data since the cessation of fishing within the Canadian 200-mile zone in 1993. Canadian surveys indicate a substantial decline in the survey biomass index between 1996 (59 000 tons) and 1998 (19 000 tons) for Div. 2HJ and 3K where the traditional directed fishery occurred, although this decline may be a year effect since it occurred over all fish sizes. Although these surveys cover depths to 1 500 m for most of the area it is known from other investigations that roundnose grenadier inhabit waters down to 3 000 m. It is also well known that grenadier size increases with depth so intuitively the surveys will be unable to track the full life cycle. STACFIS cannot determine the status of the current stock compared with the historical period when a directed fishery occurred.

d) **Reference Points - Roundnose Grenadier**

It is not possible to determine limit or target reference points based on spawning stock biomass or fishing mortalities. Surveys conducted to determine relative abundance have not included all of the geographical area and have not sampled deeper than 1 500 m although it is known that grenadier inhabit depths to 3 000 m. To provide the basis to establish any reference points STACFIS requires knowledge on the extent of the distribution and relative abundance in addition to essential biological data on age, growth, maturity and the spawning cycle. Investigations to determine the extent of the distribution and relative abundance may be limited by the technological ability of vessels to fish adequately in depths beyond 1500 m.

15. **Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3** (SCR Doc. 99/14, 18, 22, 64; SCS Doc. 99/6, 9,16; SCR Doc. 98/28, 48 57; SCS Doc. 98, 11, 13; SCR Doc. 97/29, 20, 25; SCS Doc. 97/9, 10; SCR Doc. 96/34; SCS Doc. 96/12, 14, 49; SCS Doc. 95/47, 51, 55; SCR Doc. 94/48)

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 (SCR Doc. 98/28). 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 (tons) since 1990 (SCR Doc. 98/57, updated with 1998 catches) are as follow:

	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]
Catch	3.2	4.3	6.7	4.4	4.0	3.9	4.1	4.7	7.2

[1] Provisional.

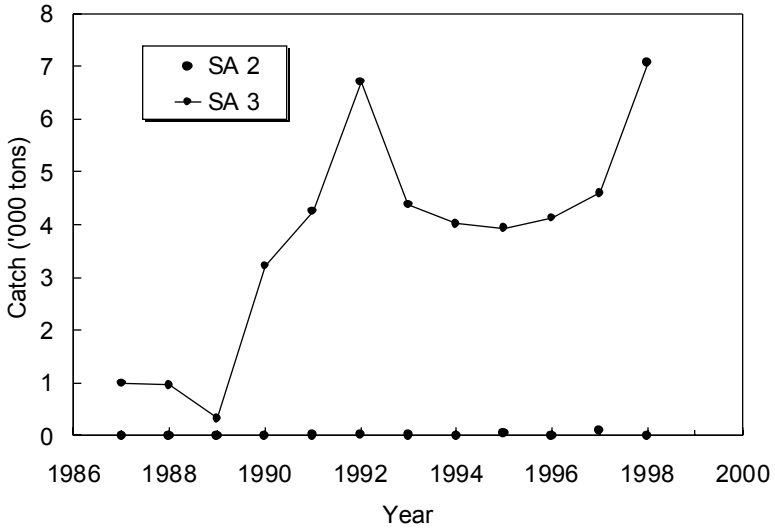


Fig. 15.1. Roughhead grenadier in Subareas 2+3: catches in Subarea 2 and Div. 3LMN.

b) **Input Data**

i) **Commercial fishery data**

Length frequencies from the Spanish and Portuguese trawl catches in Div. 3LMNO are available since 1995 (SCS Doc. 96/14, 12, SCS Doc. 97/10, 9, SCS Doc. 98/13, 11). 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 Spanish catches in Div. 3LMN are available for 1997 and 1998.

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 1995 an Engel trawl was used but this was changed since then to a Campelen 1800. Survey depth is up to 1 500 m in Div. 2GHJ and 3K and to 730 m in Div. 3LNO and was extended to 1 463 m after 1995.

The roughhead 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 1996-98.

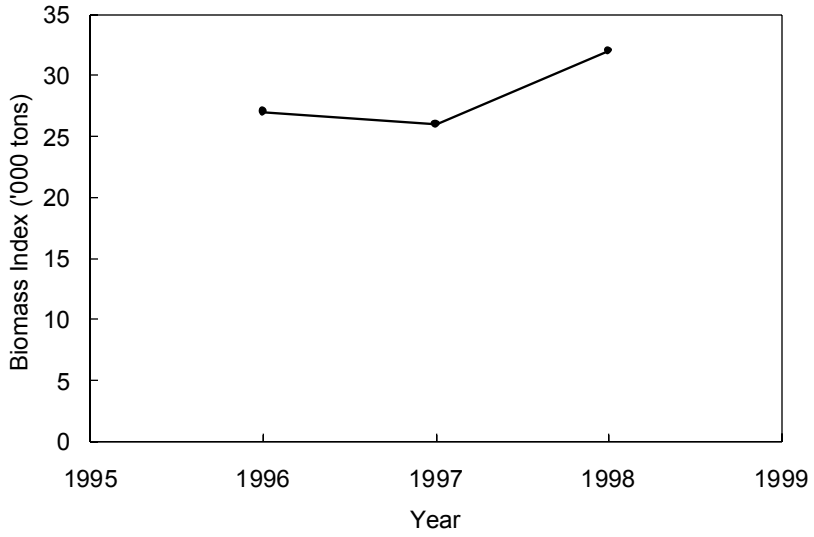


Fig. 15.2. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian autumn surveys.

Canadian spring surveys. Stratified random bottom trawl surveys have been conducted in Div. 3L and Div. 3N in spring since 1978. Until 1996 an Engel trawl was used but this was changed to a Campelen 1800 since then. The depth range of the surveys is up to 914 m. Again in this case a direct comparison of the biomass levels through the whole time series is not possible because of the change in the survey gear since 1995. 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 1996-98 are presented in Fig. 15.3.

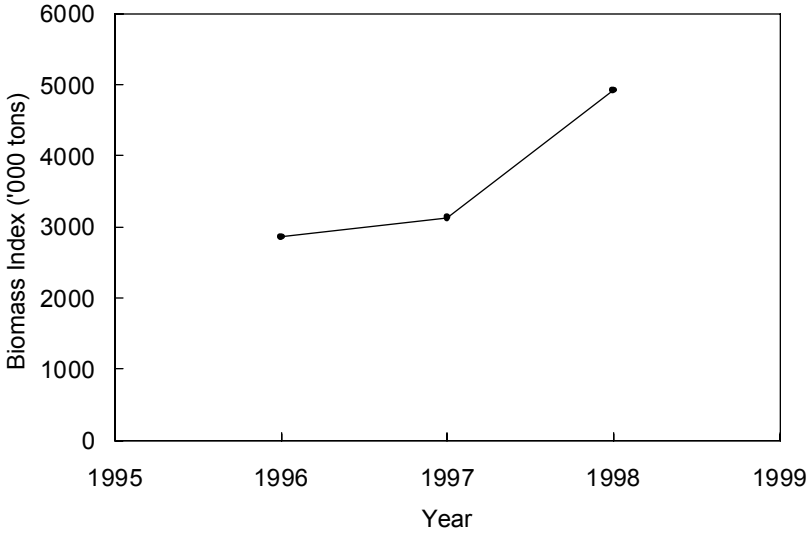


Fig. 15.3. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

Canadian deepwater surveys. Stratified deepwater bottom trawl surveys (750-1500 m) in 1991, 1994 and in 1995 in Div. 3KLMN have been performed (SCR Doc. 94/48 and SCR Doc. 95/51). 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 (SCR Doc. 95/55, 96/49, 97/25, 98/48). The depth range of this survey progressively increased every year, and a parallel increase in the biomass estimates was observed. Those were 4 842 tons in 1996, 19 615 tons in 1997 and 50 843 tons in 1998. 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. (SCR Doc. 96/34). This survey does not provide a quantitative biomass index for roughhead grenadier, but gives information on the species bathymetric distribution. Roughhead 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.

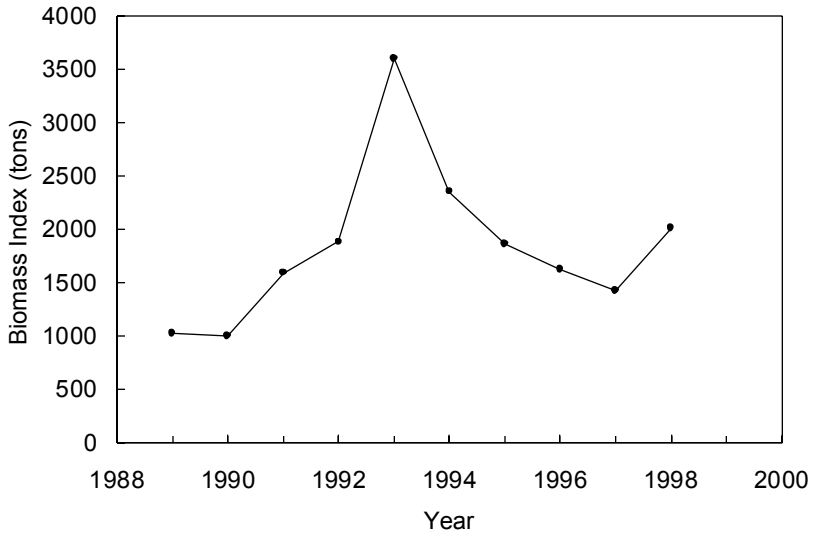


Fig. 15.4. Roughhead grenadier in Subareas 2+3: biomass indices from the EU-summer survey in Div. 3M.

iii) **Biological studies**

Two papers were presented providing information on the stock 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 6-8. The oldest male found was 14 years and the oldest female 18. The catches were dominated by the 1990 year-class.

An analysis of the reproductive biology of the roughhead grenadier, with a maturity curve based on historical analysis in Div. 3LMN is found in SCR Doc. 97/19 and 97/20. The female roughhead grenadier age at 50 maturity was 15, corresponding to a preanal fin length of 26.2 cm.

A selectivity curve for 130 mm mesh is available for this species in SCR Doc. 95/47.

c) **Assessment Results**

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 0.43. Research survey estimates of Z by sex for a synthetic catch curve for 1994-98 are provided. Z for males was 0.47, while that for females was 0.28.

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 and 10 the 1997 and 1998 catches, respectively, were above the female age at maturity (15 years). Information is scarce to assess an appropriate exploitation level.

d) **Reference Points**

The results of a preliminary yield-per-recruit analysis, using a constant M 0.2, are F_{max} 0.27 and $F_{0.1}$ 0.13. It must be noted that this output is sensitive to sex-related differences in M.

16. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO** (SCR Doc. 99/2, 9, 11, 22, 31, 38, 57; SCS Doc. 99/5, 6, 15, 16)

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 since then has been around 20 000 tons per year, although estimates from other sources were as high as 22 000 tons in some years. The major participants in the fishery in the Regulatory Area in 1998 were EU-Spain (7 200 tons) and EU-Portugal (3 200 tons). Just over half the total catch in 1998 came from Div. 3L.

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. The Russian catch in 1998 was about 1900 tons.

EU-Portugal, EU-Spain and Japan have taken catches from this stock each year since 1984, and catches by these three nations have been stable during 1996-98. 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 1998, with most of the recent Canadian catch taken by gillnets. Otter trawl catches by Canada were negligible in 1998, down from around 1 000 tons in 1996 and 1997.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC[1]	50	50	50	50	25	27	27	27	27	33
Catch[2]	47	55-75	63	42-62	51[3]	15[3]	19[3]	20[3]	20[3]	

[1] Set autonomously by Canada 1985-94 and by NAFO Fisheries Commission in 1995 to 1999.
[2] Includes estimated unreported catches in 1990-96.
[3] Provisional.

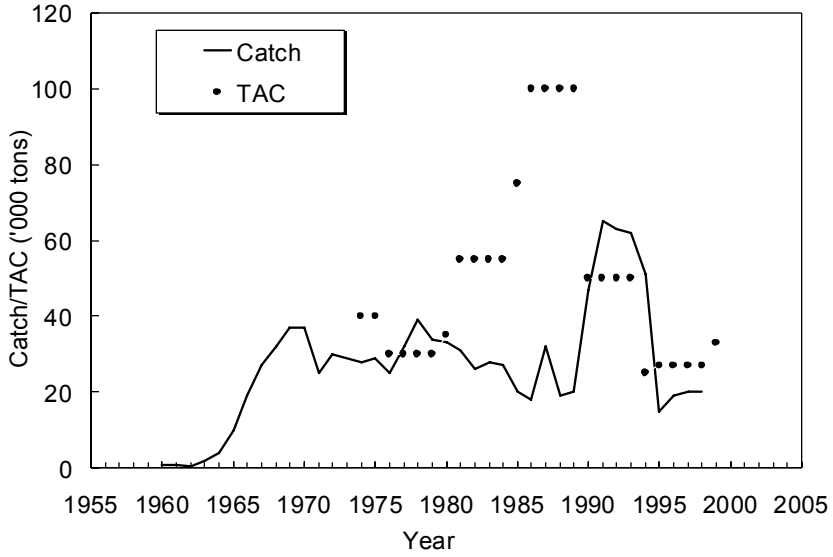


Fig. 16.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch and effort. An analysis of otter trawl catch rates from many fleets, but mostly from Canadian vessels, indicated a declining trend since about the mid-1980s, stabilizing at a low level from 1991 to 1996. The standardized catch rate increased in 1997-98 to a level similar to that of the late-1980s, although there were large variances associated with the 1997, and particularly the 1998 data. Data from these years were very limited as a result of low effort and in 1998 only 2 observations were available (SCR Doc. 99/38).

Catch-rates of Portuguese otter trawlers fishing in the NAFO Regulatory Area of Div. 3LMN from 1988-98 declined sharply from 1989 to 1991, and remained around this low level until 1994. CPUE has gradually increased since then, and in 1998 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 1988-98, but only in more recent years in Div. 3N and 3M.

Length and age compositions. Sampling data were available from the 1998 catches of Russia, Spain, France, and Portugal. The Russian fishery in Div. 3LM caught fish mainly in the range 34-50 cm, with a peak at 38 cm in Div. 3L and 42 cm in Div. 3N. The Spanish fishery consisted mainly of fish in the same length range, which were aged 5-7. The peak age in each of Div. 3L, 3M and 3N was 6. French catches in Div. 3L were comprised of similar sized fish, although the catches in Div. 3M were mainly fish between 50 and 60 cm. Length and age compositions of the Portuguese catches in Div. 3LMN were similar to the Spanish catches in that ages 6 and 7 predominated. Overall, ages 5-8 appeared to dominate otter trawl catches, with a peak usually at age 6 or 7, depending on fleet and area. This is similar to size and age compositions of otter trawl catches from this stock in other years.

No data were available on size or age composition of the Canadian catch of Greenland halibut from this stock in 1998. As well, no data from the Canadian shrimp fisheries in Subareas 2 and 3 were available at this time. Sampling data from Canadian catches from 1988-97, presented in the 1998 assessment, showed no trends in the mean weights over the period 1988-97.

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 are incomplete. However, there are substantial amounts of data for many fleets and years.

Therefore, for the 2000 assessment of Greenland halibut in Subarea 2 and Div. 3KLMNO, STACFIS noted that the Canadian catch-at-age for 1998 and 1999 should be calculated, and that the total international catch-at-age for years after 1989 should be compiled, allowing exploration of age based analytical assessments.

ii) **Research survey data**

STACFIS noted once again that most research vessel survey series providing information on the abundance of Greenland halibut were deficient in various ways and to varying degrees. The surveys were often initiated to obtain abundance indices for other species and this remains a major objective for most surveys. The geographical and depth range of many surveys have been progressively adapted in accordance with changes in the fishery for Greenland halibut and possible changes in the geographical distribution of this species and others. This creates problems in the comparability of results from different years. However, in the autumn of 1996, 1997, and 1998 the Canadian survey covered almost the entire geographical range of the Greenland halibut stock in Subarea 2 and Div. 3KLMNO, giving estimates of stock abundance and biomass. Unfortunately, there is no single survey series prior to 1996 with which the total results of the 1996-98 surveys can be compared.

Canadian stratified-random survey in Div. 2G and 2H (SCR Doc. 99/38). During September-October 1998, a stratified random survey of Div. 2GH was carried out by Canada on the R/V *Teleost,* in depths from 100 to 1 473 m. The biomass estimate for Div. 2GH combined was about 44 000 tons, and was similar to the 1996–97 biomass estimates. Coverage of Div. 2G was incomplete in 1996 and 1998. The 1994-96 year-classes were predominant in both Divisions in 1998. The age composition in both Divisions in 1996-98 was dominated by small fish, with ages 1-4 being the most abundant in catches. Estimates of biomass and abundance from the surveys in Div. 2GH in 1996-98 are not directly comparable with estimates from previous surveys in this area, but suggest that biomass is lower than in the late-1970s and early-1980s.

Canadian stratified-random surveys in Div. 2J and 3K (SCR Doc. 99/38) (Fig. 16.2). These surveys are conducted in the autumn (Oct-Dec). During 1995, a new survey trawl (Campelen 1800 shrimp trawl) was introduced to this survey series. Conversions from the old trawl (Engel 145) to Campelen equivalents have been used for the data in Div. 2J and

3K, from 1978 to 1994, as described in previous STACFIS reports. Revised length-weight parameters (SCR Doc. 99/31) were applied to estimate biomass for this survey series, from abundance at length estimates.

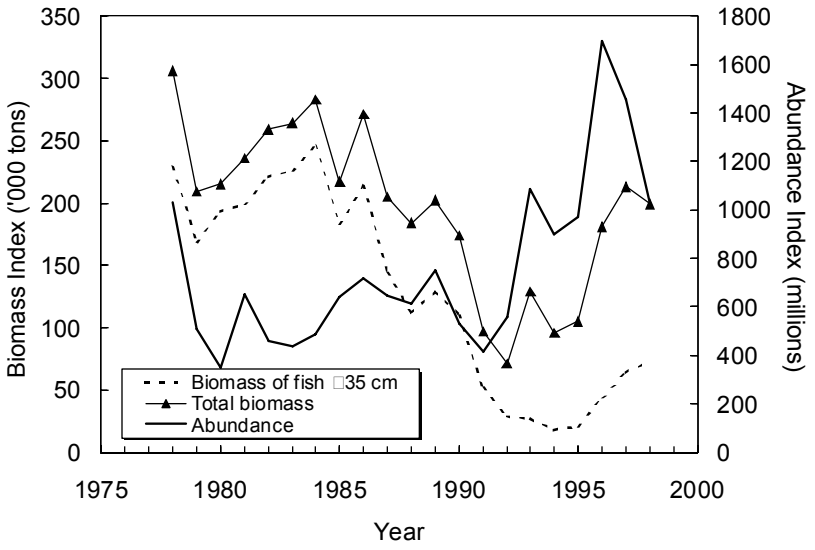


Fig. 16.2. Greenland halibut in Div. 2J and 3K: estimates of biomass and abundance from Canadian surveys.

The results indicated that the biomass index for Div. 2J and 3K combined generally increased from the late-1970s, peaking in the mid-1980s around 270 000 tons (Fig. 16.2). The index then declined sharply to its lowest level observed, about 70 000 tons in 1992. The estimates have increased since then, with the 1995 value about the same as that of 1991 (around 100 000 tons). The 1996 value was about 80 higher than the 1995 point, although coverage was incomplete in 1995. The 1997 and 1998 points (approximately 200 000 tons) were about 15 higher than the 1996 value, and were similar to the levels observed in the mid-1980s, but below the peak values observed in the late-1970s and early-1980s. It should be noted that the 1995 to 1998 surveys were actually conducted with the new survey trawl and are not converted values. Biomass of fish less than 36 cm has increased substantially in recent years, and 1997 appears to be the highest point in the series and these fish now comprise the bulk of the biomass. However, comparisons at these sizes are heavily dependent on the accuracy of conversion factors applied to the small fish in the Engel surveys. Biomass of fish greater than 35 cm was lowest in 1994, and has increased steadily since then, but is still less than one-third of peak values in 1983-84.

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 at these ages from 1994 to 1997, stabilized in 1998, but remained well below average levels. Ages 10+ declined from the early-1980s to very low levels in 1994-95. There has been a slight increase since then, but abundance at ages 10+ in 1996 to 1998 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 has generally remained above the long-term average since 1989 and reached a maximum in 1993. The index has remained relatively high in 1996-98.

Estimates of total mortality from the survey data indicate an increase to very high levels (Z 1.1) in the early-1990s as catches from the stock increased sharply. Mortality values were relatively low as measured by surveys in 1995/96 and 1996/97 (0.3 to 0.6), but increased from 1997 to 1998 to approximately 1.0.

Canadian stratified-random survey in Div. 3LMNO (SCR Doc. 99/38). 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 1997-98), 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. 3L increased from 37 000 tons in 1996 to 49 000 tons in 1997 and to 56 000 in 1998. Biomass in Div. 3MNO combined was higher in 1998, although not enough deep water strata were fished in Div. 3NO in 1996-97 to consider these surveys as reliable indicators of Greenland halibut biomass in these Divisions. Fish greater than 36 cm made up the bulk of the biomass in Div. 3LNO, unlike the situation in Div. 2J and 3K. 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, when deepwater coverage in Div. 3NO was not as extensive as in 1998.

Summary of Canadian synoptic surveys, SA2 + Div. 3KLMNO, 1996-98. The biomass from all Divisions combined increased from 286 000 tons in 1996 to about 331 000 tons in each of 1997 and 1998. Abundance estimates declined from about 2.3 billion fish in 1996, to 2.0 billion in 1997, and 1.4 billion in 1998. This was due to the natural decline in the numbers of the 1994 and 1995 year-classes. Estimated abundance of fish aged 5+ increased over this period, from 170 million in 1996, to 275 million in 1997 and to 305 million in 1998, as the 1992 and 1993 year-classes entered this age range.

EU stratified-random surveys in Div. 3M (SCR Doc. 99/22). 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 age composition data indicated that the abundance in 1998 was dominated by ages 3-7, similar to the 1997 survey, indicating that an increase in recruitment was mainly responsible for the increase in biomass. The 1994 and 1995 year-classes had the highest values in the time series at ages 1, 2 and 3. Few fish older than age 10 were encountered in any of these surveys, probably because no depths greater than 730 m were fished.

Spanish stratified-random surveys in Div. 3NO Regulatory Area (SCR Doc. 99/57). During April-May of 1995 to 1999, 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 1998-99. The estimated biomass (comparable strata from 1996-99 only) was about 35 000 tons in 1996, 45 000 tons in 1997, 85 000 tons in 1998, and 75 000 tons in 1999. The total biomass estimated in 1999, including the deep strata not surveyed previously, was 121 000 tons, compared to 148 000 tons in 1998. In 1999, the size composition was dominated by fish in the 32 to 41 cm range, with a peak at 34-35 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 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 supports the hypothesis that Greenland halibut 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. The 1995-97 Canadian surveys in Div. 2J and 3K and the EU surveys in Div. 3M in 1995-98 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 in the Canadian survey (all Divisions combined) in 1998 as it did at ages 1 and 2, with its size in 1998 being similar to that estimated for the 1993 year-class in the 1996 survey. Available survey data suggest that the 1996 and 1997 year-classes are not as strong as those of 1993-95. For the Canadian surveys, STACFIS again cautions that comparisons of year-class strengths in the 1995-98 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, particularly if the entire stock area is covered.

c) **Biological Studies**

i) Estimates of maturity of Greenland halibut from Canadian autumn surveys in SA 2 + Div. 3KLMNO in 1996-98 were examined (SCR Doc. 99/9). 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, with 1996 being significantly different from 1998, but 1997 not being significantly different from 1998. For females, L_{50} was 74.1 cm in 1996, 76.2 cm in 1997, and 81.7 cm in 1998. 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 1996-98 data, and an average maturity ogive from the 1996-98 synoptic surveys to the historic time series may not be unreasonable.

ii) Biological characteristics and distribution of Greenland halibut in the Flemish Pass during the Russian fishery in 1998 were reviewed (SCR Doc. 99/11). Most of the catch consisted of immature fish and those maturing for the first time, agreeing with observations from most otter trawl fisheries on this stock. Feeding intensity appeared to increase from May to November, before declining in December. Fish, cephalopods, and shrimp were the most important prey items. The percentage of fish with empty stomachs was 63 , and Greenland halibut appeared to be feeding more actively at depths between 800 and 1 000 m compared to other depths. Cannibalism was not high in the stomach samples examined. The proportion of females in the 1998 catch was 0.61, which was lower than proportions reported from the Spanish fishery in the early-1990s.

iii) Based on data from the annual Canadian autumn surveys, length-weight relationships of Greenland halibut were estimated for Div. 2GHJ and 3KLMNO for the years 1990 to 1997 (SCR Doc. 99/31). Relationships were estimated by year, sex and Division where data permitted. The relationship between length and weight varied between different areas within one year, and also between years. The estimated weight for a 50 cm Greenland halibut varied over the time period investigated. The overall trend in estimated round weight in all Divisions was a decrease until 1995, followed by an increase in 1996,

stabilizing in 1997. The new length-weight relationships were applied to the survey abundance at length to produce biomass at length, and explained the discrepancy seen in previous assessments between swept-area biomass estimates and biomass estimates calculated with an older length-weight relationship.

d) **Assessment Methodologies**

STACFIS discussed the application of a new method to analyse populations trends, define biological reference points and make stock projections in absence of VPA, to the Div. 2J and 3KLMNO Greenland halibut population in the NAFO Regulatory Area (SCR Doc. 99/2). The method uses catches (in weight) and an abundance index of numbers-at-age from direct surveys or commercial data (CPUE).

The method is a modification of the equations to estimate M proposed by several authors (see, for example, Paloheimo, 1961, *J. Fish. Res. Board. Can*., **18**: 645-662).

STACFIS considered the method promising and technically correct. However, the current estimates of total mortality are estimated using a predictive linear regression of Z on C/B, this assumes that the C/B ratios are measured without error. Regression models, which use alternative error assumptions and structures, should be evaluated.

In the actual simulation for the model, the variability assigned to weight-at-age (lognormal errors of mean 1 and 0.2 standard error) was judged to be low. It was agreed the levels of uncertainty used in the simulation should reflect the real levels of variability on the input parameters.

Since the model interprets the escapement of old ages from the fishing gear as natural mortality, concerns were expressed about the application of this method to the particular case of Greenland halibut. The concern is that the high natural mortality could artificially raise the F-reference point (or its proxies $C/B_{0.1}$ or C/B_{max}) calculated in the yield-per-recruit. The effect of emigration from the area covered by the survey could not be distinguished from natural mortality on the older ages.

STACFIS agreed that sensitivity tests have to be carried out to check the performance of the method regarding all the concerns expressed above, before it can be used to project catches. It was also advised that the performance of the method should be evaluated by applying it to other stocks in which analytical assessments have been performed.

e) **Assessment Results**

In the 1998 assessment of this stock, STACFIS concluded that following a decline in the fishable stock up to 1995, there had been improvement in most indices of abundance, although the biomass of older fish clearly remained at a low level. As well, there were repeated indications from various surveys of good recruitment from the year-classes of the early- and mid-1990s.

The year-classes of 1990 and 1991 have recruited to fisheries in most areas, and CPUE indices increased somewhat since 1994. The biomass of fish greater than 35 cm remains below average in 1998, and appears to be increasing slowly. The number of older, mature fish in the surveys remains low, and SSB estimates are still uncertain. Otter trawl fisheries catch mainly immature fish.

Surveys in 1997 confirmed the abundance of year-classes previously thought to be strong. In 1998, the 1995 year-class does not appear to be as strong as previously thought, based on the Canadian surveys. The 1996 and 1997 year classes do not appear to be as strong as those of 1993-1995, based on data at ages 1 and 2 from some recent surveys. Some concerns exist about the ability to predict the strength of year classes recruiting to the fishery from their size at younger ages in the surveys, given the short time series (1996-98) of data covering the entire stock. This also affects interpretation of mortality estimates from surveys.

There was a significant reduction in catches from a range of 50 000 to 70 000 tons in the early-1990s, to between 15 000 and 20 000 tons in 1995-98. Based on the available information STACFIS concluded that the biomass of fish greater than 35 cm continues to increase, although at a slow rate. This biomass is still at a relatively low level (about half of long-term average from surveys in Div. 2J3K), but should continue to increase in 1999-2000, if current levels of exploitation are maintained. The success of most fisheries in 1999-2000 will depend mainly on the 1992 and 1993 year-classes, based on typical age compositions observed in the past. The 1994 and 1995 year-classes should not have a major effect on most fisheries until 2001.

f) **Reference Points**

STACFIS presented an initial interpretation of the Precautionary Approach for this stock in the report of the June 1998 Scientific Council Meeting. No new reference points have been developed, although STACFIS noted that the assessment methodology presented in SCR Doc. 99/2 may be useful in developing reference points, based on catch and survey data. As well, if the recommended use of VPA-based methods to assess this stock is successful, calculation of the usual suite of reference points should be possible.

g) **Research Recommendations**

STACFIS **recommended** that *for the year 2000 assessment of Greenland halibut in Subarea 2 and Div. 3KLMNO that the Canadian catch-at-age for 1998 and 1999 should be calculated, and that the total international catch-at-age for years after 1989 should be compiled, allowing exploration of age based analytical assessments.*

17. **Short-finned Squid (*Illex illecebrosus*) in Subareas 3 and 4** (SCR Doc. 99/49, 50, 66; SCR Doc. 98/75; SCS Doc. 99/7, 8, 20)

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. 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 14 500 tons in 1997. Landings declined to 1 900 tons in 1998 (SCR Doc. 99/50). A sharp decline in landings in Subarea 3 in 1998 may be partially related to reduced levels of fishing effort.

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 1970-98 (Fig. 17.1).

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

	1990	1991	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999
TAC SA 3+4	150	150	150	150	150	150	150	150	150	75
Catch SA 3+4	11.00	4.00	2.00	2.67	5.97	1.03	8.73	14.52	1.92	
Catch SA 5+6	11.67	11.91	17.83	18.01	18.35	14.06	16.97	13.63	22.71	
Catch SA 3-6	22.67	15.91	19.83	20.68	24.32	15.09	25.70	28.15	24.63	

[1] Provisional catches.

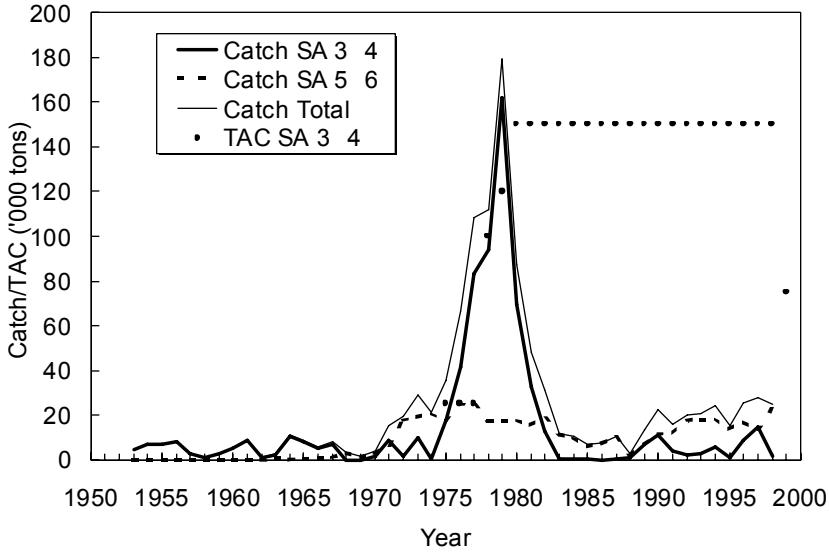


Fig. 17.1. Short-finned squid in Subareas 3+4: nominal catches and TACs in relation to SA 5+6 and total stock catches.

b) **Input Data**

i) **Commercial fishery data**

Estimates of total annual landings were available for Subareas 3+4 during 1953-98, and for Subareas 5+6 during 1963-98. 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 1970-98, in the southern Gulf of St. Lawrence (Div. 4T) during September of 1971-98, and in Subareas 5+6 during September-November of 1967-98. Stratified mean weight (kg) and number per tow indices from the July Subarea 4 survey are assumed to represent relative biomass and abundance levels at the start of the fishing season whereas those from Subareas 5+6 are 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.

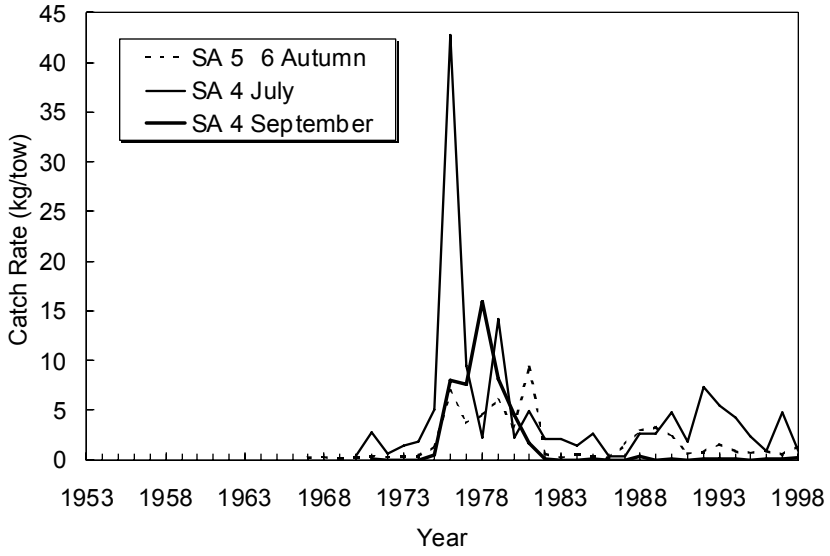


Fig 17.2. Short-finned squid in Subareas 3+4: research survey biomass indices for Subarea 4 during July in Div. 4VWX, and September in Div. 4T, as well as during autumn in Subareas 5+6.

iii) **Biological studies**

Several papers contributed information on biological characteristics. A review of historical distribution and migration patterns indicated that migrations are complex and that there is movement to progressively greater depths along the slope of the continental shelf during late autumn in all Subareas. Mean mantle length in Subarea 3 was largest during the high productivity period in the late-1970s. Annual mean weights from the Scotian Shelf and Subareas 5+6 declined dramatically in 1982, following the period of highest landings (1976-81), and have since remained low.

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 1983-98. STACFIS was unable to determine to what extent the decline in productivity was due to high fishing mortality levels *versus* environmental variation. It was noted that surplus production models, previously applied to this stock, have recently been found to be unsuitable.

Survey biomass indices remain low (Fig. 17.2). There is currently no basis for reliably predicting recruitment for this annual species.

d) **Reference Points**

STACFIS in 1998 estimated the upper range of yields that might be expected under the recent low productivity regime. Catches during the high productivity period (1976-81) were adjusted by the ratio of the relative survey biomass indices from the high and low productivity periods. This approach assumes that the peak relative fishing mortality rates estimated for the high productivity period (10 times higher than at present) are appropriate during the current low productivity period. The results indicate an upper range of catches between 19 000 and 34 000 tons. If the high landings taken in the late-1970s were responsible for the subsequent declines in

the resource in the early-1980s, then the estimated range of yields might best be considered as maximum values for catches.

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 that would assist, if taken into consideration, in forecasting the onset of high productivity period.

18. **Cod (*Gadus morhua*) in Divisions 2J, 3K, and 3L** (SCR Doc. 99/28, 36)

a) **Introduction**

In the 1998 assessment, STACFIS determined that the Div. 2J and 3KL cod stock had not experienced a detectable increase in the offshore region of Div. 2J and 3KL and that there was no reliable information from which stock abundance in the inshore area could be determined. The 1998 status of the Div. 2J and 3KL cod stock was updated based on an additional year of data from commercial by-catch, the research vessel bottom-trawl surveys, pre-recruit surveys, acoustic studies in specific areas both offshore and inshore, sentinel surveys and a brief food fishery. A new source of information was an index or test fishery in the inshore and the offshore. Also new were descriptions of cod distribution and migrations based on returns from recent tagging studies and an estimate of population size based on those returns. Estimates of the consumption of cod by seals were revised and updated.

b) **Description of the Fishery**

Prior to the 1960s the Div. 2J and 3KL cod stock supported fisheries catching from 200 000 to 300 000 tons annually. During the 1960s good recruitment along with high exploitation rates resulted in catches averaging about 580 000 tons (Fig. 18.1). However, the stock was in a period of decline from the 1960s until the mid-1970s. Reduced exploitation and some improved recruitment after that time allowed the stock to increase until the mid-1980s, when catches were about 230 000 tons. With the subsequent stock decline, catches decreased and in 1992 only 41 000 tons were landed as a result of closure of the commercial fishery in mid-1992.

A Canadian food and subsistence fishery was permitted in 1992-94, 1996 and 1998 but not in 1995 and 1997. A limited inshore fishery for scientific purposes (sentinel survey) caught 163 tons in 1995, 397 tons in 1996, 346 tons in 1997 and 388 tons in 1998. In addition, an index or test fishery caught 3 019 tons from the inshore in 1998. The sentinel survey, index fishery, food fishery and by-catch gave a total catch of 4 501 tons in 1998. There was evidence of removals from the inshore in excess of the above four sources but the magnitude of these removals cannot be estimated.

No catch was reported in the Regulatory Area in Div. 3L in 1998.

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

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TAC	199	190	120	0	0	0	0	0	0	0
Fixed Gear Catch	117	61	12	9	1.3[1]	0.3[1,2]	1.5[1]	0.5[1]	4.5[1]	
Mobile Gear Catch	103	111[2]	29[2,3]	2[2]	0.5[1,2]	0[1]	0[1]	0[1]	0[1]	
Total Catch[4]	220	172	41	11	1.4[1]	0.3[1]	1.5[1]	0.5[1]	4.5[1]	

[1] Provisional.
[2] Includes reported landings and Canadian surveillance estimates.
[3] Fishery closed by EU in June 1992.
[4] Moratorium on Canadian fishing became effective in July 1992.

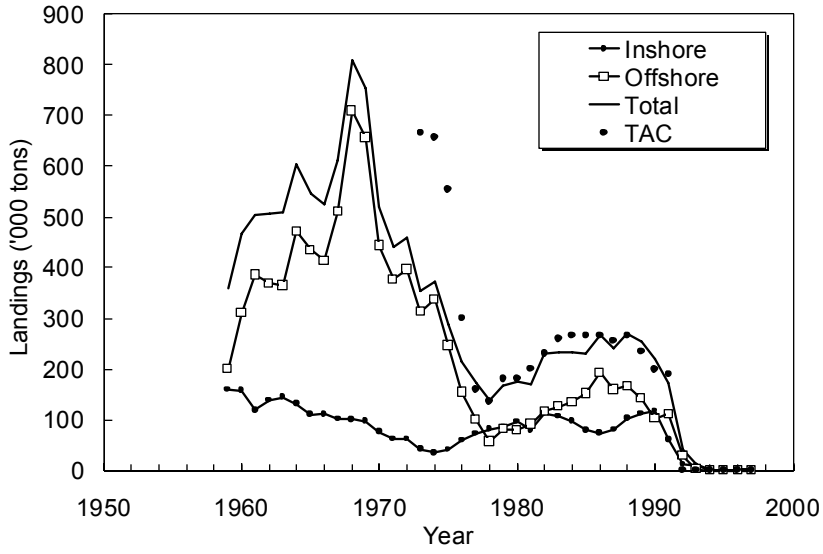


Fig. 18.1. Cod in Div. 2J+3KL: landings from fixed and mobile gears and TACs.

The 1998 catch came mainly (55) from Div. 3L, with 44 taken in Div. 3K and less than 1 taken in Div. 2J. In terms of numbers of fish, the catch was dominated by gillnet (49), followed by handline (35), linetrawl (15) and cod trap or poundnet (2). The catch consisted mainly of cod of ages 4-8, with age 6 (the 1992 year-class) dominant.

c) **Oceanographic Environment**

Ocean temperature indices in much of southern Labrador, northern Newfoundland and the Grand Bank area were generally above normal in 1998, continuing a trend that began in 1996. This was seen especially at Hamilton Bank, in the near-bottom temperatures during the spring on Grand Bank, during the autumn off northern Newfoundland, and at Station 27 throughout the year. In addition, the volume of the Cold Intermediate Layer (CIL) was well below normal in both summer and autumn. Temperatures in the upper water column at Station 27 were warmer than normal from January to April but through most of the remainder of the year were cool compared to long-term means.

d) **Biomass Trends**

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. 2J3KL 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. 18.2). The 1997 and 1998 estimates were very similar at about 1.5 of the average in the period 1983-88 (excluding 1986). The biomass estimate from the spring research vessel survey in the offshore area of Div. 3L in 1998 was half the value from 1997 and less than 1 of the average level in 1985-88.

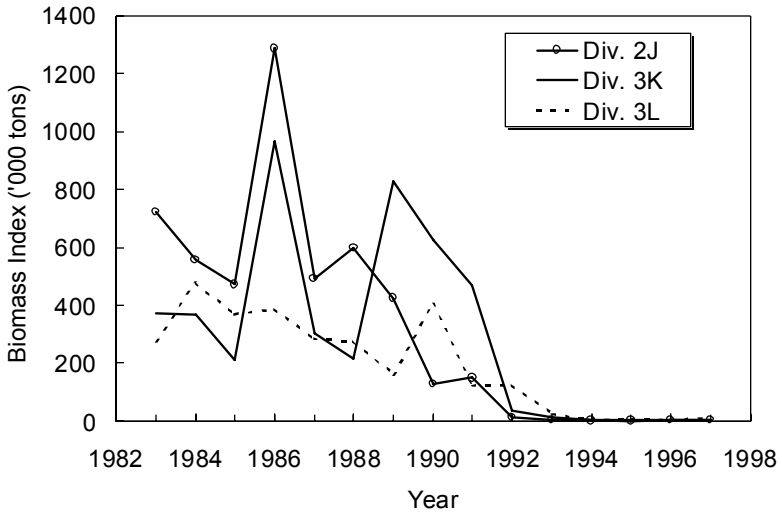


Fig. 18.2. Cod in Div. 2J+3KL: biomass indices from autumn surveys.

There is no fishery-independent index available for the inshore region of Div. 2J and 3KL. However, Smith Sound in western Trinity Bay (Div. 3L), where a dense aggregation of cod was found in spring 1995, has been surveyed acoustically at various times from spring 1995 to winter 1999. Biomass estimates at times when aggregations were found varied from 13 000 to 20 000 tons, with no trend over time.

e) **Spatial Patterns of Abundance and Distribution**

The distribution of cod differed from the historical norm. There were very few cod in the offshore. From catches during the autumn bottom-trawl survey, the cod, while only present in low numbers appeared to be broadly distributed, with most of the larger/older cod on the plateau of Grand Bank in Div. 3L. Acoustic studies in Hawke Channel in offshore Div. 2J in spring 1998 and winter 1999 revealed small cod at low density.

In the inshore area of Div. 2J and 3KL, cod appeared to be in low abundance north of White Bay (in central Div. 3K) 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 appeared that some of these cod overwinter in dense aggregations in deep inshore waters.

Tagging studies in the inshore area of Div. 2J and 3KL demonstrated that some of the cod undertake short seasonal migrations to adjacent bays, usually toward the north in the spring and back in the autumn. Any migration to the offshore area of Div. 2J and 3KL could not be detected because of an absence of fishing. The tagging studies also indicated that cod north of a line down

the axis of Trinity Bay (central Div. 3L) tend to remain north of that line. A portion of the cod caught south of that line were from pre-spawning and spawning aggregations tagged in Subdiv. 3Ps.

Genetic studies were inconclusive and did not support the hypothesis of separate inshore and offshore stocks.

f) **Changes in Lengths, Weights and Maturity**

Mean weights-at-age of cod caught in the commercial fishery declined during the 1980s and early-1990s after peaking in the late-1970s and early-1980s. Research survey sampling showed a strong decline in lengths-at-age and weights-at-age in Div. 2J, a lesser decline in Div. 3K, and little or no decline in Div. 3L. The trend of decreasing mean lengths-at-age and weights-at-age during the 1980s 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.

g) **Recruitment Trends**

The fifth annual pelagic 0-group survey was conducted in 1998. The index in 1998 was higher than in 1996-97 but lower than in 1994-95. Catches in 1998 were very poor offshore in Div. 2J and 3K, good in the inshore in Div. 2J and 3K, and very high offshore in southern Div. 3L. It is suspected that cod in the large catches in Div. 3L may have come from spawning in Div. 3NO.

A broadscale beach seine survey of demersal 0-group and 1-group cod was conducted in 1992-97 but not in 1998. Catch rates from sampling on a much smaller spatial scale in Bonavista Bay (Div. 3L) in 1995-96 and 1998 were consistent with the broadscale survey. A combination of the two beach seine series indicated that the 1997 and 1998 year-classes are stronger than the 1995 and 1996 year-classes. Mean catch-at-age per tow during the autumn bottom-trawl survey revealed very weak recruitment in the 1990s.

A comparison of all three data sources indicated that the 1994 year-class appears to have been large relative to other year-classes in the 1990s, especially in Div. 2J, but small compared to most year-classes in the 1980s. The 1998 year-class is strong in the southern part of the stock area offshore, but it is not clear if this will recruit to the Div. 2J and 3KL stock or the Div. 3NO stock. There was some evidence that recruitment may have been higher in the inshore than in the offshore in the past few years. In the inshore, the 1997 and 1998 year-classes were stronger than the 1996 year-class.

h) **Sentinel Survey**

The inshore sentinel survey in Div. 2J and 3KL was initiated in 1995 to provide indices of cod abundance in coastal waters during the period of the moratorium. It has been conducted primarily with gillnets and linetrawls, but also with handlines and cod traps. Catch rates have been low north of White Bay (Div. 2J and northern Div. 3K), but are considered by sentinel participants to be good from White Bay south (southern Div. 3K and Div. 3L).

An analysis of standardized catch-rates in Div. 3K and Div. 3L combined revealed that gillnet catch rates increased from 1995 to 1996, remained steady in 1997, and increased in 1998, whereas linetrawl catch rates showed little change from 1995 to 1996, increased in 1997 and declined in 1998 to approximately the level seen in 1995. Because of the paucity and poor quality of small vessel catch-rate data prior to the moratorium and the differences in the nature of the sentinel survey and a commercial fishery, it is difficult to use the sentinel survey catch rates to draw

inferences regarding the size of either the whole Div. 2J and 3KL cod stock or that portion of the stock currently inshore.

i) **Index fishery**

An index or test fishery was conducted in the inshore during the autumn of 1998 to supplement the information from sentinel surveys. Many fish harvesters north of White Bay did not fish or attained poor catch rates. Catch rates from White Bay south were reported to be good to excellent. Logbook records indicate catch rates were highest in eastern Notre Dame Bay, in a continuous band from northern Bonavista Bay to western Trinity Bay, and in St. Mary's Bay.

An index fishery was conducted in the offshore of Div. 2J and 3KL, which included both a sounder survey and test fishing. No cod concentrations were located and catch rates were extremely low.

j) **Consumption of cod by harp seals**

The quantity of cod consumed by harp seals during the period 1972-98 was calculated using revised 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. Revisions and additions to several data sets and changes in some assumptions contributed to a substantial reduction in the estimates of the quantity of cod consumed when compared to estimates made in 1998. The estimate for Div. 2J and 3KL in 1998 was 50 000 tons.

The number of cod at various ages consumed by harp seals was calculated using the above estimate of the weight of cod consumed, the length frequencies of cod consumed as determined from the sizes of cod otoliths found in seal stomachs, and ages at length determined from sampling during spring bottom-trawl surveys in Div. 3L and autumns surveys in Div. 2J and 3KL. 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.

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 tends to involve cod larger than those represented by otoliths in seal stomachs. The incidence of belly-feeding may have increased in the inshore in the past two years.

k) **Survey Estimates of Total Mortality**

Research vessel survey data were used to calculate total mortality. Although there was a marked decrease in the total mortality after the 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.

l) **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 both the sentinel surveys and the 1998 index fishery, and the sizes and ages of cod taken in the offshore surveys do not represent the larger and older cod caught in the inshore.

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 remains uncertain. Acoustic survey estimates in Smith Sound in Trinity Bay (Div. 3L) were 14 000 to 15 000 tons in 1998-99. Additional aggregations exist in Trinity, Bonavista and Notre Dame bays, but the number and size of these aggregations are not known. Exploitation rates calculated from tag return data indicate a population in Div. 3K and northern Div. 3L in autumn 1998 of 52 000 tons, with a 95 confidence interval of 36 000-135 000 tons. An additional biomass of no more than 15 000 tons of cod was estimated to have been available to the index fishery in southern Div. 3L. Some of these fish had migrated into Div. 3L from Subdiv. 3Ps during spring/summer. Catch rates during the sentinel survey and the index fishery were good, but the biomass to be inferred from these catch rates is not clear.

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.

IV. RESEARCH ACTIVITIES

1. Report on Comparative Fishing Studies Between Campelen Survey Trawl and Spanish Survey Gear

STACFIS noted that a comparative fishing study between the Canadian Campelen trawl and the Spanish survey gear was proposed to take place in Div. 3NO beginning in the spring of 1999 and it was proposed that at least two days be set aside during future Canadian and Spanish spring surveys to conduct the comparative fishing experiments. STACFIS was informed that the comparative studies have not yet been conducted. However, STACFIS suggested this work should be repeated in subsequent years to develop an acceptable database to allow comparisons between vessels.

2. Other Activities

There were no other activities to consider.

V. OTHER MATTERS

1. New Designated Experts

STACFIS noted that vacancies will exist in the upcoming year for Designated Experts for the following stocks:

Greenland Halibut in Subareas 2 and 3, and
American plaice in Division 3M
Redfish in Subarea 1
Other Finfish in Subarea 1

In addition STACFIS was informed that D. Kulka (Canada) would be the Designated Expert for elasmobranch stocks.

2. Structure of the STACFIS Report

The STACFIS Chairman presented a proposed revision to the structure of the STACFIS report. The proposal was to report stock assessments by geographic regions, which groups species by each of 4 general

regions. Each section dealing with each geographic region is to include an introductory short overview of the environment, resource trends and fishery trends of the region. STACFIS agreed to adopt the proposed structure, and the present report reflects this revision. Only the section on the physical environment appears this year as it was agreed that sections on resource trends and fishery trends will be written by the Designated Experts over the upcoming year to be included in the year 2000 STACFIS report.

There being no other business, the Chairman thanked the participants for their contributions, and in particular the Designated Experts and the Secretariat for their work during the meeting.

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

Chairman: V. N. Shibanov Rapporteur: D. Cross

The Committee met at the Park Place Ramada Plaza Hotel, 240 Brownlow Avenue., Dartmouth, Nova Scotia, Canada, at various times during 3-16 June 1999, to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, 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 1998**

a) **From the June 1998 Meeting**

i) STACREC had recommended that *online access to data on the NAFO website be at the STATLANT 21A level and that access to 21B data should be via restricted FTP accounts.*

See item 3(a) iii below for discussion.

ii) STACREC recognized the value of work (interagency review of discrepancies) in safeguarding the credibility of the databases and STACREC had recommended that *inter-agency statistical data harmonisation be continued as a regular procedure in order that the discrepancies be detected at as early a stage and possible* and that *national authorities should be encouraged to submit statistics with a maximum of detail with regard to the species composition of the catch, in order to minimise one of the main causes of inter-agency discrepancies.*

See item 3(a) iv below for discussion.

iii) STACREC had recommended that *the Scientific Council be represented at the CWP-18 session in Luxembourg in July 1999 by the Assistant Executive Secretary and the STACREC Chairman.*

See item 3(b) below for discussion.

iv) STACREC had recommended that regarding biological sampling, *the Secretariat examine the various datasets compiled by different NAFO Committees, which may be available electronically in the future, and consider appropriate codes and abbreviations in order to develop means of cross referencing the information easily.*

The Assistant Executive Secretary reported that this matter was being attended to at the Secretariat with respect to papers from other Constituent bodies. STACREC noted that dissemination of this information on the NAFO website would require a decision by the General Council.

v) STACREC had recommended that *the Secretariat make provisions for a new code for Canada - Central and Arctic.*

The Assistant Executive Secretary reported that, in discussions with FAO to establish a code, it had been agreed that CAN-CA would be an appropriate code for Canada-Central and Arctic.

STACREC, noting that fisheries in the area started in 1986, considered that, while first priority should be given to the latest data, submission of historic data would be of value.

vi) STACREC noted the increasing interest in elasmobranchs worldwide and had recommended that *analyses on the distribution and abundance of elasmobranchs and other non-traditional species be carried out and the results presented to STACREC at the earliest opportunity*.

See item 6a) below for discussion.

vii) Regarding the report on Northwest Atlantic/Gulf/Caribbean Regional Shark Management Workshop STACREC had recommended that *the Scientific Council consider asking the Secretariat to approach FAO requesting that a Scientific Council representative be invited to attend the October 1998 FAO Consultation on the Plans of Action for the conservation and management of sharks*

STACREC noted that the General Council had nominated the USA to represent NAFO at the FAO Consultation. The NAFO Executive Secretary had received a report by Dr Swanson (USA).

See also item 6 below for further discussion on sharks.

viii) STACREC had recommended that *NAFO accept the invitation from FAO to attend the preparatory meeting of FAO and non-FAO Regional Fishery Bodies to be held in Rome on 11-12 February 1999 and that this would also be a suitable forum for discussion of harmonisation of terminology in relation to the Precautionary Approach.*

STACREC noted that the Scientific Council Chairman had presented a report of this meeting to the Scientific Council.

See Scientific Council item II.2 above for report.

ix) STACREC noted that FAO is also developing a plan of action on the incidental capture of seabirds in longline fisheries, STACREC had recommended that *the NAFO Secretariat inform FAO of its interest in these initiatives and request that FAO keep NAFO informed of any progress*.

The Assistant Executive Secretary reported that this matter had been attended to by the Secretariat and will be revisited with the FAO representative at the CWP-18 Session.

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

STACREC noted that posters, in English and French, to be used for the identification of species of North Atlantic deepwater sharks had been made available to the Secretariat but considered that, due to the size of the poster, their usefulness was

probably limited to situations where they could be clearly displayed and consulted. It was suggested that the author of the poster should consider the preparation of a smaller format version for use in less convenient situations. It was noted that Spanish and Portuguese versions of this poster had been made available by the European Union. STACREC **recommended** that *the Secretariat contact Heads of Delegations informing them of the availability of these posters and requesting advice as to whom and in what numbers copies of the poster could be sent*.

See also item 6(c) below for related discussion.

xi) STACREC had recommended that *identification of grenadiers should be publicised and that the Scientific Council consider for 1999 that members with data on roughhead grenadier in Subareas 2□3 bring such data to its June 1999 meeting to attempt an assessment on this species.*

STACREC noted that the assessment of roughhead grenadier was to be discussed by STACFIS at this June 1999 meeting.

see STACFIS item 3(e) above.

xii) STACREC had recommended that *the Scientific Council inform the Fisheries Commission that the information on protocol for data collection by the Pilot Observer Program being requested has already been furnished to the Fisheries Commission.*

STACREC noted that joint Scientific Council/STACTIC session at the 1998 Annual Meeting had clarified this issue.

See also items 9 and 10 below for further developments.

xiii) STACREC had recommended that *its proposed definition of fishing effort for boat seines (Danish seines, etc.) should be referred to the CWP to determine its suitability for global definition.*

The Assistant Executive Secretary reported that, by the intermediary of the CWP Secretary, the CWP agencies had been informed of NAFO's proposal for the definition change. Apart for some minor textual changes the agencies had accepted the definition, which would be formally approved at the CWP-18 session.

b) **From the September 1998 Meeting**

xiv) STACREC had recommended that *the Working Group on Biological Information Database proceed forward to develop a data exchange protocol and data format for a candidate stock based on the structure of the biological information files mentioned above.*

See item 7 below for update.

xv) Regarding sharks, other elasmobranchs and non-utilized resources, STACREC had recommended that *an expanded list of individually identified species of elasmobranchs be included on the STATLANT 21A questionnaire and that the national authorities be requested to submit catch statistics with a maximum degree of detail.* (This is repeated from the June 1998 Meeting and also addressed above at 2.a.x.)

See also item 6(c) for update.

3. Fisheries Statistics

a) Progress report on Secretariat Activities in 1998/99

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

The Assistant Executive Secretary outlined the status of STATLANT data submissions for recent years. The following table shows the dates of receipt of STATLANT 21A and 21B submissions for 1996-98 received by the Secretariat up to 9 June 1999.

	STATLANT 21A (deadline, 15 May)			STATLANT 21B (deadline, 30 June)		
Country	1996	1997	1998	1996	1997	1998
BGR	-	-	-	-	-	-
CAN-M	20 May 97	22 Jun 98	10 May 99	04 Mar 98	12 Jan 99	-
CAN-N	16 May 97	02 Jun 98		15 Feb 99	-	-
CAN-Q	20 Jun 97	15 May 98	10 May 99	26 Aug 97	02 Sep 98	-
CUB	30 May 97	-	-	30 May 97	-	-
EST	17 Sep 97	27 May 98	17 May 99	17 Sep 97	27 May 98	-
E/DNK	02 Feb 99	02 Feb 99	07 Jun 99	23 Mar 99	23 Mar 99	
E/FRA-M	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
E/DEU	04 Jun 97	23 Mar 98	23 Apr 99	24 Jun 97	23 Mar 98	27 Apr 99
E/NLD	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
E/PRT	14 May 97	24 Apr 98	26 Apr 99	04 Sep 97	14 Sep 98	-
E/ESP	07 Jun 97	14 Sep 98	01 Jun 99	23 Jun 98	14 Sep 98	-
E/GBR	16 Jul 97	30 Mar 99	11 May 99	30 Mar 99	30 Mar 99	-
FRO	24 Oct 97	03 Feb 99	-	-	-	-
GRL	06 Jun 97	28 May 98	28 May 99	03 Feb 99	03 Feb 99	-
ISL	16 May 97	24 Jul 98	07 Jun 99	12 Jun 97	12 Nov 98	-
JPN	24 Apr 97	14 Apr 98	29 Apr 99	24 Apr 97	14 Apr 98	14 Apr 99
KOR	No fishing	No. fishing	No fishing	No fishing	No fishing	No fishing
LVA	17 Apr 97	22 Apr 98	14 May 99	17 Apr 97	04 Jun 98	14 May 99
LTU	17 Feb 98	17 Feb 98	-	17 Feb 98	-	-
NOR	22 May 97	20 Nov 98	25 May 99	18 Jun 97	-	-
POL	-	-	10 May 99	-	-	-
ROM	-	-	-	-	-	-
RUS	22 Jul 97	02 Apr 98	01 Jun 99	11 Jul 97	08 Jul 98	01 Jun 99
USA	-	-	-	-	-	-
FRA-SP	06 Mar 97	29 Jan 99	02 Jun 99	06 Mar 97	29 Jan 99	-
HND	-	-	-	-	-	-
VEN	-	-	-	-	-	-

\- No report.
Non-Contracting Party.

ii) Publication of statistical information

STACREC noted that publication of *NAFO Statistical Bulletin*, Vol. 44, 45 and 46 (containing data for 1994, 1995 and 1996, respectively) had not been completed due to the absence of data for 1994-96 from the United States and data for 1995 and 1996 from the Faroe Islands.

The following table lists the countries/components that have not submitted data through 1994-97. (N.B. Bulgaria and Romania have not reported any fishing in recent years.)

STATLANT 21A				STATLANT 21B			
1994	1995	1996	1997	1994	1995	1996	1997
USA	USA	USA	Cuba USA	USA	Faroe Island USA	Faroe Islands USA	Canada-N Cuba Faroe Islands Lithuania (Questions on Norway Poland)

STACREC was informed that the United States had undertaken to submit data for 1994 by September 1999 and that the data for the Faroe Islands will be available in 2-3 weeks. STACREC agreed that the Statistical Bulletins should be published as soon as these data are available.

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

The Assistant Executive Secretary reported that STATLANT 21A data-files for 1994-98 had been made available for downloading from the NAFO website. However technical problems had delayed making the STATLANT 21B data available on the website. STACREC congratulated the Secretariat on the progress it has made.

In the near future, it is envisaged that the NAFO Website will be the principal vehicle by which NAFO provides access to and distributes information on the activities, accomplishments, decisions, documents, and reports of the General Council, Scientific Council, Fisheries Commission to other fisheries and scientific organizations in the world, and to the general public. It is therefore essential that close collaboration occur between the Constituent Bodies of NAFO (and the NAFO Secretariat) in enhancing and further developing the NAFO Website so that its full potential can be realized.

STACREC therefore **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.*

iv) **Interagency data harmonization (NAFO/FAO)**

The Assistant Executive Secretary reported that the national authorities of the countries, for which major discrepancies between the catch data held by NAFO and FAO had been detected during the June 1998 exercise, had received individual listings of the discrepancies with a request that they attempt to eliminate them. Only very limited responses had been received. Information received so far was that:

- many of the discrepancies in the Japanese data were for early years and would be difficult to eliminate, that Japan had not submitted data for certain tuna species but had done so to FAO (via ICCAT) and that, in some instances, catches had been reported under different species items to NAFO and FAO,
- the Canadian national services have revised data provided to FAO to exclude from the Canadian data catches by foreign vessels fishing from Canadian quotas and had noted that, in cases where the national data reported to FAO conflicted with provincial data reported to NAFO, the provincial 21A data were probably more reliable,

- the major discrepancies in the USA data were for the 1960s and it was very unlikely that it would be possible to resolve the problems after such a passage of time,
- contacts were continuing with the Russian Federation authorities to attempt to resolve the problems with the data for the former-USSR.

STACREC reiterated its view that the earlier these (inter-agency databases) discrepancies were detected, the easier they would be to eliminate and accordingly **recommended** that *the (error) detection exercise of data discrepancies between agency databases should be repeated at short intervals at the discretion of the NAFO and FAO Secretariats.*

b) **The CWP 18th Session**

STACREC noted that the Assistant Executive Secretary and the STACREC Chairman would be representing the Scientific Council at the 18th Session of the CWP to be held in Luxembourg, 5-9 July 1999. It also agreed that M. Showell (Canada) should be invited to attend as a member of the NAFO representation. The Assistant Executive Secretary noted that there were several items on the CWP-18 agenda for which NAFO would be contributing documentation, based on the report of this Scientific Council Meeting.

4. **Biological Sampling**

a) **Report on Activities in 1998/99**

STACREC noted and reviewed the listings of Biological Sampling Data prepared by the NAFO Secretariat. These listings (SCS Doc. 99/12) include biological sampling data for 1997 and 1998 reported to the Secretariat prior to the present meeting.

b) **Report by National Representatives on Commercial Sampling Conducted**

Russia. Samples were obtained from commercial bottom trawl fishery directed to Greenland halibut in Div. 3LMN during May-December. Length compositions of Greenland halibut, roughhead grenadier, American plaice and witch flounder in Div. 3LMN and cod in Div. 3M were collected by observers on-board the vessels during May-December 1998. Data on catch rates were taken as well.

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), redfish (Div. 3M) and American plaice (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. 3N), roughhead grenadier (Div. 3LMNO) and witch flounder (Div. 3LMNO).

EU-Spain. Samples of length composition obtained from observers on-board the freezer trawl fleet were available for Greenland halibut in Div. 3LMN, roughhead grenadier in Div. 3LM, witch flounder in Div. 3LMNO, American plaice in Div. 3LNO,yellowtail flounder in Div. 3NO, thorny skate in Div. 3LNO and redfish in Div. 3L and Div. 3NO.

Denmark-Greenland. Subarea 1: samples from the trawl fisheries for shrimp and Greenland halibut were taken at sea. Length composition of shrimp samples were carried out by observers on-board the vessels. Samples of Greenland halibut, cod, snow crab, salmon and scallops were taken at ports of landings.

Division 3M: the fishery for shrimp in Div. 3M was not sampled in 1998.

c) **Report on Data Availability for Stock Assessments (by Designated Experts)**

Available data from commercial fisheries relevant for stock assessment on a stock by stock basis was prepared with inputs from Designated Experts (Table 1).

Table 1. Commercial fisheries data collected in 1998 and available for the stock assessment in 1999. (+ is data available).

			Biological Sampling					
Stock	Country[1]	Catch	CPUE	Sex	Length	Age	Individual Weight	Maturity
2J3KL Cod	CAN-N	+	+	+	+	+	+	+
3M Cod	E/PRT	+			+	+		
	RUS	+			+	+		
3NO Cod	CAN	+			+	+		
	EU/PRT	+			+			
SA 1 Redfish	GRL	+						
	NOR	+						
3M Redfish	E/PRT	+	+		+	+		
	RUS	+						
	E/DNK	+						
	E/ESP	+						
	E/GBR	+						
3LN Redfish	CAN	+						
	JPN	+						
	E/FRA	+						
	E/PRT	+			+			
	E/ESP	+			+			
	RUS	+						
3M American plaice	EU/PRT	+			+	+	+	
	EU/ESP	+						
3LNO American plaice	RUS	+						
	CAN-M	+						
	CAN-N	+						
	E/PRT	+			+			
	E/ESP	+			+			
	JPN	+						
3NO Witch flounder	E/ESP	+			+			
	CAN	+						
	E/PRT	+			+			
3LNO Yellow-tail	CAN	+	+	+	+	+		+
	E/ESP	+		+	+			
	E/PRT	+						
SA 0 + 1B-F Greenland halibut	E/DEU	+	+			+	+	
	RUS	+	+			+	+	
	CAN	+	+					
	GRL	+	+					
	NOR	+	+					

Table 1. Continued.

		Biological Sampling						
Stock	Country[1]	Catch	CPUE	Sex	Length	Age	Individual Weight	Maturity
SA 1A Greenland halibut	GRL	+		+	+	+	+	+
SA 2+3 Greenland halibut	CAN	+	+					
	E/PRT	+	+	+	+	+		
	E/ESP	+		+	+	+	+	+
	JPN	+	+	+	+			
	RUS	+	+	+	+	+		+
	FRA	+	+	+	+			
SA 0+1 Roundnose grenadier	RUS	+						
	E/DEU	+						
	GRL	+						
SA 2+3 Roundnose grenadier	JPN	+						
SA 2+3 - Roughhead Grenadier	E/ESP	+		+	+	+	+	+
	E/PRT	+			+		+	
	RUS	+						
3NO Capelin		NO DATA AVAILABLE						
SA 3+4 Squid	CAN	12 616	+	+	+			+
SA 1 Other finfish	GRL	+						
Shrimp Div. 3LNO		to be provided at the September 1999 Meeting of the Scientific Council.						
3M Shrimp		to be provided at the November 1999 Meeting of the Scientific Council.						
SA 0+1 Shrimp		to be provided at the November 1999 Meeting of the Scientific Council.						
Denmark Strait Shrimp		to be provided at the November 1999 Meeting of the Scientific Council.						

[1] Country abbreviations as in Statistical Bulletin.

5. Biological Surveys

a) Review of Survey Activities in 1998

An inventory of biological surveys conducted in 1998 as submitted by National Representatives and Designated Experts was prepared by the Secretariat (Table 2).

Table 2. Inventory of biological surveys conducted in the NAFO Area during 1998.

Subarea	Division	Country[1]	Month	Type of survey	No. of sets
				Stratified-random Surveys	
1	A	GRL	5-6	Snow crab	360
1	B		5-6	Snow crab	840
1	B-F	E/DEU	10	Groundfish, oceanography	63
1	A-F	GRL	7-9	Trawl survey for shrimp and groundfish	212
1	CD		7-8	Deepsea trawl survey for Greenland halibut	56
1	E		9-10	Snow crab	780
2+3	GHJKLMNO	CAN-N	9-12	Groundfish/shellfish trawl	784
3	LNO	CAN-N	5-6	Groundfish trawl	344
3	M	EU	7	Groundfish	119
3	NO	E/ESP	4-5	Bottom trawl	124
3	Ps	CAN-N	4-5	Groundfish trawl	200
3	Ps	FRA-SP	7	Iceland scallops	-
3+4	PnRST	CAN-Q	8-9	???	228
4	T	CAN-M	7	Sea scallop	N/A
4	T		9	Groundfish	217
4	T		11	Lobster	10
4	TW		1	Mackerel egg	64
4	Vn		5	Cod	9
4	Vn		9	Cod	12
4	VW		7	Groundfish	111
4	WX		7	Groundfish	96
4	X	USA	4	Spring bottom trawl	23
4	X	CAN-M	6	Scallop	269
4	X		8	Scallop	100
4	X		9	Scallop	96
4	X	USA	10	Autumn bottom trawl	23
5	YZ	USA	3-4	Spring bottom trawl	194
5	YZ		7-8	Northern shrimp	61
5	Z	CAN-M	2	Groundfish	96
5	Z	USA	2	Winter bottom trawl	61
5	Z		8	Sea scallops	335
6	ABC	USA	2	Winter bottom trawl	77
6	ABC		3	Spring bottom trawl	151
6	ABC		7	Sea scallops	235
6	ABC		9-10	Autumn bottom trawl	137
				Other Surveys	
0		CAN-M	10	Oceanography	19
1	A	GRL	7-8	Lomgline, inshore Greenland halibut	61
1	BDF		6-7	Gillnets, inshore juvenile cod	149
1+2+3	FGHJKL	CAN-N	9-10	Atlantic salmon post smolt	-
2+3	JKL	CAN-N	6	Cod acoustics research	-
2+3	JKL		9	0-group survey	-

Table 2. Continued

Subarea	Division	Country[1]	Month	Type of survey	No. of sets
				Other Surveys (cont'd)	
2,3,4	HJKLX	CAN-M	6	Oceanography/plankton	43
3	K	CAN-N	9-10	Snow crab trawl/pot recruitment	-
3	L		5-6	Snow crab trawl/pot	-
3	L		7	Larval fish survey	-
3	L		8	Snow crab trawl/pot	-
3	L	CAN-N	11-12	Herring acoustics	-
3	LOP	CAN-M	9	Oceanography	23
3	OPs	CAN-N	3	Redfish acoustics	-
3	Ps		4-5	Cod tagging	-
3	Ps		10	Cod tagging	-
4	NK	CAN-M	5	Oceanography	31
4	R	CAN-N	5	Cod acoustics	-
4	T	CAN-M	5	Lobster	N/A
4	T		6	Snow crab habitat	13
4	T		7	Lobster video	34
4	T		8	Sea urchin	161
4	T		8	Snow crab collection	N/A
4	T		8	Herring spawning	N/A
4	T		9	Herring acoustic	N/A
4	T		9	Sea urchin	40
4	T		10	Lobster	N/A
4	T		11	Snow crab collection	N/A
4	T		11	Sea urchin	38
4	V		2	Shrimp	60
4	V		2	Shrimp	70
4	VsW		5	Snow crab	N/A
4	VsW		6	Fish disease	90
4	VW		4	Oceanography/plankton	200
4	VWX		9	Oceanography/plankton	293
4	W		4	Benthic sampling	N/A
4	W		5	Trawl impact study	12
4	W	CAN-N	5	Herring acoustics research	-
4	W	CAN-M	7	Oceanography/plankton/GLOBEC	17
4	WX	CAN-M	1	Spawning haddock sampling	10
4	WX		9	Oceanography/plankton/GLOBEC	180
4	X	USA	1	Ecosystem monitoring	4
4	X	CAN-M	5	Fish food collection	N/A
4	X		5	Live fish sampling	N/A
4	X	USA	6	Ecosystem monitoring	9
4	X	CAN-M	7	Scallop survey	75
4	X		8	Larval lobster tracking and GLOBEC	176
4	X	USA	8	Ecosystem monitoring	12
4	X		8	Marine mammal biology	N/A
4	X		8-9	Marine mammal survey	N/A
4	X	CAN-M	9	Live fish sampling	N/A
4	X		9	Scallop	32
4	X		10	Live fish sampling	N/A
4	X		11	Oceanography	44
4	X	USA	11	Ecosystem monitoring	8
4+5	XZ	CAN-M	10	Larval herring	135

Table 2. Continued

Subarea	Division	Country[1]	Month	Type of survey	No. of sets
				Other Surveys (cont'd)	
4+5	XZ		11	Larval herring	122
4+5	YZ	USA	3	Marine mammal biology	N/A
5	YZ	USA	3-4	Hydroacoustic testing	N/A
5	YZ		6	Ecosystem monitoring	84
5	YZ		8	Ecosystem monitoring	53
5	YZ		8-9	Hydroacoustic survey	N/A
5	YZ		9	Ecosystem studies	N/A
5	YZ		9-10	Hydroacoustic survey	N/A
5	YZ		10	Shark tagging/biology	N/A
5	YZ		11	Ecosystem monitoring	65
5	Z		1	GLOBEC broad scale	77
5	Z		2	GLOBEC broad scale	80
5	Z		2	Hydroacoustic testing	N/A
5	Z		3	GLOBEC broad scale	85
5	Z		4	GLOBEC broad scale	82
5	Z		5	GLOBEC equipment testing	N/A
5	Z		5	GLOBEC broad scale	81
5	Z		6	GLOBEC broad scale	41
5	Z		7	Marine mammal biology	N/A
5	Z		8	Marine mammal biology	N/A
5	Z		8-9	Marine mammal survey	N/A
6	AB	USA	7	Marine mammal biology	N/A
6	AB		7-8	Marine mammal survey	N/A
6	ABC		3	Marine mammal survey	N/A
6	ABC		5	Ecosystem monitoring	23
6	ABC		11	Ecosystem monitoring	33
6	BC		5	Apex predator	24

[1] Country abbreviations as in Statistical Bulletin.

b) **Surveys Planned for 1999 and Early-2000**

An inventory of biological surveys planned for 1999 and early-2000 as submitted by National Representatives and Designated Experts was prepared by the Secretariat (Table 3).

Table 3. Biological surveys planned for the NAFO Area in 1999 and early-2000.

Area/Div.	Country[1]	Type of Survey	Dates
		Stratified-random Surveys - 1999	
0A	CAN-CA	Groundfish	Oct
1A-B	GRL	Snow crab	May-Jun
1A-F	GRL	Trawl survey for shrimp and groundfish	Jul-Sep
1B-F	E/DEU	Groundfish, oceanography	22 Oct-10 Nov
1C-D	GRL	Deepsea trawl survey for Greenland halibut	Sep-Oct

Table 3. Continued.

Area/Div.	Country[1]	Type of Survey	Dates
		Stratified-random Surveys – 1999 (cont'd)	
2GHJ+ 3KLMNO	CAN-N	Groundfish/shellfish trawl	8 Oct-22 Dec
3LNO	CAN-N	Groundfish/shellfish trawl	21 May-2 Jul
3M	EU	Groundfish	24 Jun-28 Jul
3NO	E/ESP	Bottom trawl	Jul
3Ps	CAN-N	Groundfish bottom trawl	12 Apr–7 May
3P+4V	CAN-N	Redfish trawl	2-21 Aug
3Pn+4RST	CAN-Q	Summer multidisciplinary survey in the Estuary and Gulf of St. Lawrence	3 Aug-3 Sep
4R	CAN-Q	Herring biennial survey	4-25 Oct
4R	CAN-Q	Herring assessment by trawling	8-16 Oct
4S	CAN-Q	Snow crab assessment	6-17 May
4S	CAN-Q	Scallop assessment – Mingan Archipelago	26 Jun-3 Jul
4S	CAN-Q	Snow crab assessment – Lower North Shore	10 Jul-3 Aug
4T	CAN-M	Stock assessment	Jun
4T	CAN-M	Stock assessment	Jul
4T	CAN-Q	Prerecruitment of the northern shrimp	28 Apr-5 May
4T	CAN-Q	Monitoring of the interannual variations of the number of larvae produced by redfish females	18-25 May
4T	CAN-Q	Toxic bloom assessment	mid Jun-late Aug
4T	CAN-Q	Plaice sampling preliminary trial	26 May-2 Jun
4T	CAN-Q	Water and fish larvae (redfish) larvae	May
4T	CAN-Q	Zooplankton monitoring	Jun
4T	CAN-Q	Prerecruitment of the northern shrimp	3-12 Jun
4T	CAN-Q	Sampling of live animals (fish and invertebrates)	13-20 Jun
4T	CAN-Q	Sampling during low water period	4-9 Jul
4T	CAN-Q	Prerecruitment of the northern shrimp	4-15 Aug
4T	CAN-Q	Grounds mapping using the EM-1000	5-12 Aug
4T	CAN-Q	Scallop assessment – Magdalen Islands	16-28 Aug
4T	CAN-Q	Lobster assessment – Magdalen islands	29 Aug-13 Sep
4T	CAN-Q	Zooplankton assessment	13-23 Sep
4T	CAN-Q	Cod sampling	9-12 Oct
4T	CAN-Q	Prerecruitment of the northern shrimp	17-26 Oct
4VW	CAN-M	Stock assessment	Jul
4VWX	CAN-M	Groundfish	Mar
4WX	CAN-M	Stock assessment	Jul
4X	CAN-M	Stock assessment	Jun
4X	CAN-M	Stock assessment	Jul
4X	CAN-M	Stock assessment	Sep
4X+5YZ	USA	Spring bottom trawl	1 Mar-23 Apr
4X+5YZ +6ABC		Autumn bottom trawl	7 Sep-29 Oct
5YZ	USA	Northern shrimp	26 Jul- 7 Aug
5Z	CAN-M	Groundfish	Feb
5Z+6ABC	USA	Winter bottom trawl	1-24 Feb
5Z+6ABC	USA	Surf clam/quahog survey	1 Jun- 23 Jul
5Z+6ABC	USA	Sea scallop survey	12 Jul- 10 Aug

Table 3. Continued.

Area/Div.	Country[1]	Type of Survey	Dates
		Other Surveys – 1999	
1A	GRL	Longline, inshore Greenland halibut	Jul-Aug
1B-D	GRL	Gillnets, inshore juvenile cod	Jun-Jul
1A-C	GRL	Oceanography	June
1F+2GHJ +3KL	CAN-N	Atlantic salmon post-smolt distribution	20 Sep-8 Oct
2J+3KL	CAN-N	Cod acoustics	29 May-18 Jun
2J+3KL	CAN-N	Biological/physical oceanography	16 Jul-1 Aug
2J+3KL	CAN-N	0-group survey	23 Aug-10 Sep
SA2+3	CAN-M	Physical and biological oceanography	Nov
SA234	CAN-M	Physical oceanography	Sep
3K	CAN-N	Snow crab recruitment	7 Sep-24 Sep
3KL	CAN-N	Capelin acoustics	10-28 May
3L	CAN-N	Snow crab trawl/pot survey	19 May-4 Jun
3L	CAN-N	Cod habitat and acoustics	10-19 Jun
3L	CAN-N	Snow crab	2-13 Aug
3L	CAN-N	Snow crab trawl/pot survey	28 Sep-9 Oct
3L	CAN-N	Herring acoustics	8 Nov-10 Dec
3L	CAN-N	Cod habitat and acoustics	22 Nov-24 Jan
3LNO	E/ESP	Selectivity	Apr
3LOPs	CAN-M	Physical oceanography	Jun
3NO	CAN-N	Otter trawl selectivity	15-21 Mar
3Ps	CAN-N	Offshore cod tagging	29 Mar- 9 Apr
3Ps	CAN-N	Inshore cod tagging	28 Apr-12 May
3Ps	CAN-N	Iceland scallop	5-15 Jul
3Ps	CAN-N	Inshore cod tagging	15-30 Nov
3+4	CAN-M	Habitat research	May
3Pn+4RST	CAN-M	Stock assessment	Aug
4R	CAN-N	Iceland scallop survey	10-18 May
4T	CAN-M	Monitoring	Apr
4T	CAN-M	Biological sampling	May
4T	CAN-M	Lobster	May
4T	CAN-M	Monitoring	Jun
4T	CAN-M	Monitoring	Aug
4T	CAN-M	Monitoring	Aug
4T	CAN-M	Lobster	Sep
4T	CAN-M	Stock assessment	Sep
4T	CAN-M	Monitoring	Sep
4T	CAN-M	Stock assessment	Oct
4T	CAN-M	Monitoring	Oct
4T	CAN-M	Stock assessment	Oct
4T	CAN-M	Monitoring	Oct
4T	CAN-M	Biological sampling	Nov
4T	CAN-M	Monitoring	Nov
4V	CAN-M	Shrimp	Feb
4VWX	CAN-M	Monitoring	Apr
4VWX	CAN-M	Disease, parasite	Jun
4VWX	CAN-M	Monitoring	Oct
4W	CAN-M	Monitoring	Apr
4W	CAN-M	Habitat research	May
4W	CAN-M	Climate research	Jun
4W	CAN-M	Environment and bio monitoring	Jun
4W	CAN-M	Monitoring	Oct

Table 3. Continued.

Area/Div.	Country[1]	Type of Survey	Dates
		Other Surveys – 1999 (cont'd)	
4WX	CAN-M	Herring	Oct
4X	CAN-M	Broodstock collection	May
4X	CAN-M	Herring	May
4X	CAN-M	Physical oceanography	Jul
4X	CAN-M	Herring	Jul
4X	CAN-M	Stock assessment	Aug
4X	CAN-M	Stock Assessment	Aug
4X	CAN-M	Monitoring	Sep
4X	CAN-M	Stock assessment	Sep
4X	CAN-M	Broodstock collection	Oct
SA4	CAN-M	Stock assessment	Aug
4WX+5Z	CAN-M	Herring	Nov
4X+5YZ	USA	Ecosystem monitoring	20-27 Jan
4X+5YZ	USA	Ecosystem monitoring	1-11 Jun
4X+5YZ	USA	Marine mammal survey	26 Jul-3 Sep
4X+5YZ +6ABC	USA	Ecosystem monitoring	16 Aug-3 Sep
4X+5YZ +6ABC	USA	Ecosystem monitoring	1-22 Nov
5Y	USA	Harbor porpoise/hydroacoustics	22Feb-12 Mar
5Y	USA	Benthic habitat	17-26 Mar
5YZ	USA	Hydroacoustic survey	7 Sep-15 Oct
5Z	USA	GLOBEC broad scale	12-24 Jan
5Z	USA	GLOBEC broad scale	17-29 May
5Z	USA	GLOBEC broad scale	14-26 Jun
5Z	USA	Benthic habitat	28 Jun-9 Jul
5Z+6ABC	USA	Deep water systematics	1-19 Feb
5Z+6ABC	USA	Marine mammal survey	12-30 Apr
		Surveys planned for Early-2000	
2J+3P	CAN-N	Pre-spawning cod acoustics	4-16 Jan
3Ps	CAN-N	Herring acoustics	8 Mar-7 Apr
4VsW	CAN-M	Stock assessment	Jan
4VsW	CAN-M	Groundfish	Feb
5Ze	CAN-M	Stock assessment	Feb

[1] Country **abbreviations as in Statistical Bulletin.**

6. Non-traditional Fishery Resources in the NAFO Area

a) Distribution Data from Surveys

The species composition, distribution and abundance of sharks in both the Spanish commercial catches (1991-98) and research surveys (1988-98) in Div. 3LMNO were reviewed (SCR Doc. 99/19). Shark species are by-catches of the Greenland halibut fishery. The proportion of shark species in the total catch is small and the main retained species is the black dogfish whereas the

main discard is the boreal shark. Since 1996 the retained proportion of black dogfish has increased noticeably, as well as the proportion of total sharks. In the surveys this shark is the species with the highest biomass index. Black dogfish is found in the deepest waters. The length range of black dogfish was mainly between 50 and 80 cm, with a mode around 62-63 cm. No evident geographic pattern in the length distribution was observed during the studied period.

STACREC noted information on abundance indices of thorny skate (*Raja radiata*) off West and East Greenland (SCR Doc. 99/33) was considered by STACFIS under its agenda item 4(c).

b) **Collection of Scientific Data and Catch Statistics on Elasmobranchs and Other Non-traditional Species**

STACREC noted that a manual for elasmobranch identification prepared by the Newfoundland Region Department of Fisheries and Oceans for the use by fishery observers in the region would be useful for wider application.

STACREC stressed that, with the development of the Precautionary Approach, it was important that collection of data on the fisheries, distribution and biology of elasmobranch species should be accorded particular attention.

STACREC proposed that past and current data on these species be reviewed at the June 2000 Meeting of the Scientific Council.

STACREC further **recommended** that *STACFIS consider appointing a Designated Expert for elasmobranch species.*

c) **Expanded Species List for STATLANT 21A and B**

STACREC noted that, with the objective of maximizing the responses of the request for elasmobranch data by the national reporting authorities, it was important that the species for which data are required be printed on the STATLANT 21 questionnaire. STACREC noted the expanded list of elasmobranchs would be forwarded to CWP Secretariat for reprinting the STATLANT form for year 2000.

STACREC reviewed and based on their occurrence in Subareas 3 and 4 approved a list of elasmobranch species for which catch statistics should be requested on the STATLANT 21A and 21B questionnaires. However, STACREC requested representatives to review this list and forward any modification to the Secretariat in advance of the September 1999 Annual Meeting.

CODE	SHORT NAME	COMMON NAME	LATIN NAME	ABBRE.	CATEGORY
462	PORBEAGLE	PORBEAGLE	*LAMNA NASUS*	POR	3
464	SHORTFIN MAKO	SHORTFIN MAKO SHARK	*ISURUS OXYRINCHUS*	SMA	3
470	SHARPNOSE SHARK	ATLANTIC SHARPNOSE SHARK	*RHIZOPRIONODON TERRAENOVAE*	RHT	3
472	BLACK DOGFISH	BLACK DOGFISH	*CENTROSCYLLIUM FABRICII*	CFB	3
473	BOREAL SHARK	BOREAL (GREENLAND) SHARK	*SOMNIOUSUS MICROCEPHALUS*	GSK	3
474	BASKING SHARK	BASKING SHARK	*CETORHINUS MAXIMUS*	BSK	3
452	SPINY DOGFISH	SPINY (PICKED) DOGFISH	*SQUALUS ACANTHIAS*	DGS	3
480	LITTLE SKATE	LITTLE SKATE	*RAJA ERINACEA*	RJD	3
484	BARNDOOR SKATE	BARNDOOR SKATE	*RAJA LAEVIS*	RJL	3
487	WINTER SKATE	WINTER SKATE	*RAJA OCELLATA*	RJT	3
488	THORNY SKATE	THORNY SKATE (STARRY RAY)	*RAJA RADIATA*	RJR	3
489	SMOOTH SKATE	SMOOTH SKATE	*RAJA SENTA*	RJS	3
490	SPINYTAIL SKATE	SPINYTAIL (SPINETAIL RAY)	*RAJA (BATHYRAJA) SPINICAUDA*	RJQ	3

7. **Report of the Working Group on Biological Information Database**

A spreadsheet in Microsoft Excel for data exchange was presented by the Chairman of the *ad hoc* Working Group (E. de Cardenas EU-Spain) to STACREC during this June 1999 Meeting. After the examination of the different sheets from this notebook, STACREC agreed to use the Div. 3NO cod data as a pilot stock to check how it works.

STACREC agreed the Designated Expert for Div. 3NO cod will distribute this spreadsheet by e-mail, and will compile the information submitted by the different countries before the STACREC September 1999 Meeting.

During the Scientific Council September 1999 Meeting, STACREC will review this pilot dataset and evaluate whether the spreadsheet is adequate to compile the information for the other stocks.

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

a) The inter-annual dynamics of growth and maturation of cod on Flemish Cap at ages 3-8 were investigated (SCR Doc. 99/10) using the data collected in 1980-96 during the Russian spring-summer trawl surveys. High rate of linear and weight growth of cod compared to the long-term average was observed during the cold period from 1985 to 1993. In 1991-96 the growth rate decreased. The age composition of the cod catches changed from ages 5-8 in 1960-75 to ages 3-5 in 1980-86 and to the ages 2-3 in the latest period. During the period investigated, the amount of mature fish varied from 10.4 to 47.7 . The age and length at which 50 of fish become mature varied from 3.6 to 6.6 years and 39.5-64.2 cm respectively. In 1980-85 50 of females became mature at age 5-7, in 1986-91 at age 5-6 and in 1995-96 the age of maturation decreased to 4-3.6 years.

b) The results of Russian investigations on population structure of redfish (*Sebastes mentella*) in the North Atlantic were presented (SCR Doc. 99/24). STACREC noted the material collected in the Irminger Sea for 1982-95 was summarized. The data on the "oceanic" redfish distribution at the various stages of life cycle including seasonal cycles and data on length distribution and "maturation curves" were analyzed. The regularity of seasonal variations by length, sex ratio, mature in different areas of the North Atlantic was revealed. As a whole the latter may be considered as the single population area sub-divided into reproductive and nursery regions. It was assumed that *S. mentella* of the North Atlantic is represented by a single population.

c) Recent trends in the population of Northwest Atlantic Harp Seals (*Phoca groenlandica*) were presented (SCR Doc. 99/26). Trends for the period 1960 to 1998 were estimated using survey estimates of pup production and annual estimates of pregnancy rates and age structure of the catch. These data were fit to an age structured population model under two different assumptions regarding pup mortality. Replacement yield and sustainable yield were estimated under both mortality assumptions. New catch data for Greenland were included and different scenarios for unreported mortality (which includes seals struck and lost) were explored. The population size was estimated to have been relatively stable after 1996 and to have been between 5.3 and 5.5 million seals in 1998.

9. **Protocol for Scientific Data on Pilot Observer Program**

STACREC was informed that a draft of the NAFO Observer Manual had been circulated to Heads of Delegations by the Executive Secretary and will be discussed by the Fisheries Commission at the 1999 Annual Meeting. Section III (Protocol for Scientific Data Collection) of the Manual was circulated to STACREC.

STACREC stressed the importance of harmonized data transmissions by the Contracting Parties and proposed that, in preparation for the discussions with the Fisheries Commission and STACTIC an *ad hoc*

Working Group (Chairman: M. Showell (Canada)) be established to review the contents of Section III to the proposed NAFO Observer Manual.

The Working Group met on two occasions to review documentation relevant to the Pilot Observer Program. It was agreed that the protocols outlined in Section III of the proposed NAFO Observer Manual would require considerable revision to function as a manual for at-sea collection of scientific information.

The Working Group reviewed several examples of recent observer reports completed by Contracting Parties, and noted a current lack of harmonization in the collection of gear, catch and effort information. It was agreed that the data forms developed by Canada and used by several countries captured relevant gear and catch/effort data required by Scientific Council, and could be easily enhanced to include the collection of length frequency data. It was agreed that this set of forms could form the basis of a harmonized reporting format, to be used by all Contracting Parties, for the collection of information of interest to both STACTIC and Scientific Council.

The Working Group considered several matters related to length frequency sampling protocols and data forms required to record this information. However, it was recognized the time available during this June 1999 meeting was not sufficient to permit the development of a finished, quality product. STACREC **recommended** that *the ad hoc Working Group on Protocol for Scientific Data Collection should work inter-sessionally 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.*

10. **Format of Data from Pilot Observer Program for Scientific Council Purposes**

This subject was discussed under Agenda Item 9 above.

11. **Other Matters**

a) **Tagging Activities**

Scientific Council Research Document 99/23 was discussed. This study updates previous work by Morgan and Walsh (NAFO SCR Doc. 96/66) on tagging experiments conducted on yellowtail flounder (*Pleuronectes ferruginea*) on the southern Grand Bank. Yellowtail flounder were recaptured a greater distance from their release position the longer they were at large. However, after more than 8 years at liberty they had traveled only 83.6 ± 4.0 naut. miles. This indicates that the fish are relatively sedentary. Returns from the 1998 Canadian commercial fishery indicate that the fishery occurred mainly in two relatively small areas.

STACREC reviewed the list of tagging activities carried out in 1998 (SCS Doc. 99/10) compiled by the Secretariat, and requested national representatives to update the list during this meeting.

b) **Conversion Factors**

D. Cross (EU) reported that the compilation of conversion factors has continued and a draft of an *FAO Statistical Bulletin* has been prepared.

c) **Other Business**

STACREC noted that the scientific name for the yellowtail flounder used in the NAFO species list was *Limanda ferruginea* and that this may have been superseded by *Pleuronectes ferruginea*. The Secretariat was requested to review the literature in order to determine the appropriate name to be used.

The Chairman thanked all the participants for their valuable contributions and cooperation. He especially thanked the Assistant Executive Secretary and the other members of the NAFO Secretariat for the preparation of the documentation, and the Rapporteur for compiling the report. There being no further business he closed the June 1999 STACREC Meeting.

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

Chairman: W. B. Brodie Rapporteur: M. Stein

The Committee met at Park Place Ramada Plaza Hotel, 240 Brownlow Avenue, Dartmouth, Nova Scotia, Canada on 7, 8, 9, 10 and 14 June, 1999. In attendance were H.P. Cornus (Chairman, Scientific Council, EU-Germany) (some sessions), W.B. Brodie (Canada), M. J. Morgan (Canada), V. A. Rikhter (Russian Federation), F. M. Serchuk (USA), M. Stein (EU-Germany), A. Vazquez (EU-Spain) and the Assistant Executive Secretary (T. Amaratunga).

1. **Opening**

The Chairman welcomed the Committee. The agenda as presented in the Provisional Agenda was **adopted**. M. Stein was appointed rapporteur.

2. **Review of Recommendations in 1998**

STACPUB recommendations from the June 1998 and September 1998 meetings as listed *in NAFO Sci. Coun. Rep*., 1998, were reviewed.

It was noted that an *ad hoc* group had met with the Executive Secretary of NAFO during the June 1998 meeting to discuss the computer and site requirements needed for the NAFO Scientific Council Meetings in 1999.

3. **Review of STACPUB Membership and Chairmanship**

There was no change in STACPUB membership.

Proposals made available to STACPUB members prior to this June 1999 meeting of Scientific Council by F. M. Serchuk (USA) and M. Stein (EU-Germany) were discussed by STACPUB. The proposals suggested that considering the type of work of STACPUB, it would be more suitable for an independently elected chairperson to chair STACPUB and not come under the duties of the Scientific Council Vice-chairman. STACPUB members agreed with the proposal and **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 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 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 was therefore **recommended** that *the issue of STACPUB membership be elevated to the Scientific Council for discussion and resolution.* A Scientific Council Working Paper presenting the different views on this matter was prepared.

4. **Review of Scientific Publications Since June 1998**

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

Volume 23, containing 16 papers (277 pages) presented at the 1997 Symposium on "What Future for Capture Fisheries", held during 10-12 September 1997 in St. John's, Newfoundland, and 1 notice, was published with a publication date of October 1998.

Volume 24, containing 4 miscellaneous papers and 3 notices (97 pages), was published with a publication date of November 1998.

Volume 25, containing 19 papers 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, is in the final editing stage. This issue is expected to be complete by mid-1999.

There are presently 8 papers in Secretariat files for future Journal issues.

b) **NAFO Scientific Council Studies**

Studies Number 31, containing 8 miscellaneous papers and 3 notices (165 pages) was published with a publication date of December 1998.

Studies Number 32, containing 8 miscellaneous papers and 3 notices is in the printing stage. This issue is expected to be published before mid-1999.

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

c) **NAFO Statistical Bulletin**

NAFO Statistical Bulletin, Vol. 43 for 1993, was published with a publication date of December 1997.

Deadline for submission of STATLANT 21B reports for 1994 was 30 June 1995. As of May 1999, data were still outstanding from USA.

Deadline for submission of STATLANT 21B reports for 1995 was 30 June 1996. As of May 1999, data were still outstanding from Faroe Islands and USA.

Deadline for submission of STATLANT 21B reports for 1996 was 30 June 1997. As of May 1999, data were still outstanding from Faroe Islands and USA.

Deadline for submission of STATLANT 21B reports for 1997 was 30 June 1998. As of May 1999, data were still outstanding from Canada-N, Cuba, Faroe Islands, Lithuania and USA. Some clarification of data was needed from Norway and Poland.

d) **NAFO Scientific Council Reports**

The volume (257 pages) containing reports of the 1998 meetings of the Scientific Council in June, September and November was published and distributed in January 1999.

e) **Index and Lists of Titles**

The provisional index and lists of titles of 124 research documents (SCR Doc.) and 21 summary documents (SCS Doc.) which were presented at the Scientific Council Meetings during 1998 were compiled and presented in SCS Doc. 99/11 for the June 1999 Meeting. The last 5-year compilation for 1990-94 was published in November 1995.

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

a) **Review of Cost and Revenues**

STACPUB noted that there was a considerable reduction in numbers of printed Journals and Studies. This was in part due to the critical review of mailing list by STACPUB members, and due to increased costs in production of colour prints.

b) **Proposal for Publications of 1999 Symposium Proceedings**

With respect to the scientific papers to be presented at the Joint NAFO/ICES/PICES Symposium on "Pandalid Shrimp Fisheries Science and Management at the Millennium", 8-10 September 1999, in Dartmouth, Nova Scotia, Canada, STACPUB was informed that several authors were requested by the conveners to provide their contributions in poster form. STACPUB considered desirable to have the posters available on the NAFO website. STACPUB noted that the conveners had successfully obtained funding for the conduct and logistics of the Symposium.

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

a) **Invitational Papers**

The NAFO Secretariat had received the manuscript of the invitational paper by Sv. Aa. Horsted, "A Review of the cod fisheries at Greenland after the Second World". The manuscript will be sent to one of the Associate Editors of the NAFO Journal for an expedited technical/editorial review.

STACPUB noted that the invitational paper by D. G. Parsons on Flemish Cap shrimp was published in Journal Vol. 24.

STACPUB also noted that the invitational paper by V. A. Rikhter on silver hake was in the second review.

STACPUB was informed that the invitational paper by E. B. Colbourne on a 5-year review of the Flemish Cap oceanography still requires some work by the author.

b) **Abstracts from Research Documents**

As indicated during 1998 June meeting of STACPUB, the Secretariat plans to provide an annual publication of abstracts of SCR Documents, Studies and Journals. These collated abstracts will go to the FTP-server linked to the NAFO website, and to agencies like ASFA (Aquatic Science and Fisheries Abstracts). To facilitate the dissemination process STACPUB **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" covers will be available on the NAFO website only for internal purposes. STACPUB **recommended** that *the final SCR documents ("yellow" cover) be made available to the public through NAFO website.* Authors are requested to check that their final manuscripts sent to NAFO are error free.

c) **NAFO Website**

There was ample discussion on the potential of the NAFO website. In addition to the discussion and recommendation under item 6 b) STACPUB also **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.* Assistant Executive Secretary indicated that this task could be fulfilled by September 1999. Further to that STACPUB **recommended** that *NAFO Journals prior to No. 22 be accessible through the web provided they are available on electronic means*.

STACPUB was pleased to see the progress being made in the quality and amount of information available through the NAFO website. STACPUB, noting that further development of the website has been requested, **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.*

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

STACPUB noted that STACPUB Chairman had sent a letter and copies of the NAFO Journal to the Institute for Scientific Information (ISI) to recommend the Journal for inclusion in the scientific citation index. Up to present no answer was received from ISI, and the chairman agreed to contact ISI again to follow up on this matter.

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

Since December 1998 NAFO Secretariat has been equipped with the necessary technical means to produce CD-ROM versions of the Scientific Council Report. As a follow up of this new technology NAFO Secretariat sent out a letter to Scientific Council members to explore in their home institutions and administrations the potential acceptance of CD-ROM based Scientific Council Reports. The returns of this inquiry did not show any clear trend or preference. STACPUB noted it would be desirable to have all Scientific Council Reports, Journal and Studies volumes available on a single CD-ROM.

f) **New Initiatives for Publication**

STACPUB emphasized that information on other constituent bodies of NAFO (General Council, Fisheries Commission) should also be accessible through the NAFO web. STACPUB therefore **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 **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.*

7. **Editorial Matters Regarding Scientific Publications**

a) **Review of Editorial Board**

STACPUB noted that there were no changes in the composition of the Editorial Board. Noting that most members of the Editorial Board may be present at the September 1999 Symposium, STACPUB agreed to hold an intersessional meeting with STACPUB members and the Editorial Board members at sometime during the Symposium. STACPUB chair will provide a provisional agenda for this meeting to discuss new initiatives in the publication process of NAFO.

b) **Editorial Workload Related to Publication of Symposium Proceedings**

The co-convener of the 1998 Symposium, J. Morgan, indicated that conveners had been very busy with the editorial work connected to the Symposium but that dividing the work among three conveners made the workload manageable. To expedite the review process, reviewers were asked before the papers were sent to them, whether the review could be done in narrow time frame. With this and the work of the NAFO Secretariat on the editorial work, the Symposium volume is ready for publication. It was noted that the recommendation as given during the June 1998 Meeting of STACPUB (see *NAFO Sci. Coun. Rep.*, 1998, p. 152) helped to speed up the publication process.

c) **Progress Review of Publication of 1998 Symposium**

STACPUB was informed that the publication of the 1998 Symposium is progressing well and all edited papers were being prepared for publication. It was noted that the conveners were currently preparing the Introduction to the Journal volume.

d) **Review of Editorial Process – Scientific Council Studies**

In the 1980 STACPUB Report, the purpose for establishing *Scientific Council Studies* was stated as:

"A secondary scientific publication is required to promote the work of the Council. It is proposed that its scope would be papers of topical interest and importance to the current and future activities of the Council and its Standing Committees, including publication of manuals, contributions to special meetings and symposia, etc., initiated by the Scientific Council."

Various views were presented by STACPUB members stating the 'pros' and 'cons' of continuing to publish *Scientific Council Studies*. Three different options for the future of *Scientific Council Studies* were identified:

(1) Continue to publish *Scientific Council Studies* as is (including non peer-reviewed research papers which are almost exclusively SCR Documents),

(2) Continue to publish *Scientific Council Studies* but ONLY publish manuals, workbooks, database compilations, and papers of topical interest and importance to the current and future activities of the Council and its Standing Committees,

(3) Discontinue the publication of *NAFO Scientific Council Studies*.

No agreement was reached by STACPUB during this meeting. It was therefore decided to discuss the item intersessionally by e-mail, and finalize a decision at the September 1999 meeting.

8. **Papers for Possible Publication**

a) **Review of Proposals Resulting from the 1998 Meetings**

Of the 12 papers nominated at the June 1998 meeting, four papers have been submitted to NAFO Scientific Council Studies. Only one paper was nominated by STACPUB at the September 1998 meeting, and there has been no response from the author.

In addition, four papers from outside the STACPUB nomination process have been submitted since June 1998.

STACPUB noted that a total of 58 papers were published or are in their final stage of galley preparation (41 in the Journal and 17 in Studies) since June 1998.

b) **Review of Contributions to the April-May 1999 Meeting on Precautionary Approach**

There were no papers submitted for possible publication.

c) **Review of Contributions to the June 1999 Meeting**

As at the June 1998 STACPUB Meeting, considerable discussion again occurred as to the role of STACPUB in identifying, evaluating, and reviewing Scientific Council meeting documents for possible publication in either the NAFO 'Journal' or 'Studies'. Although most papers published are in fact those nominated by STACPUB, it was recognized that authors who wish to submit documents for consideration for publication in the 'Journal' can freely do so via direct contact with the NAFO Secretariat without going through STACPUB. STACPUB agreed a policy was needed to be developed for selection or nomination of papers. Therefore, as a matter of policy, STACPUB agreed that it would only review those SCR documents which authors had explicitly indicated they wished STACPUB to evaluate for publication in the 'Journal' or 'Studies'. With respect to nomination of papers from this June 1999 meeting, STACPUB agreed it would be

difficult to find adequate time during this meeting. For those papers at the June 1999 Scientific Council Meeting, STACPUB members will share their reviews and evaluations via e-mail communications prior to the September 1999 Annual Meeting. At the September 1999 STACPUB meeting, the evaluation of papers from the June 1999 Meeting will conclude with the nomination of papers for publication.

9. **Other Matters**

The Chairman thanked the participants for their valuable contributions, and in particular the Assistant Executive Secretary and the NAFO Secretariat for preparation of documentation, and the rapporteur for compiling the report. There being no further business, the meeting was adjourned.