PART A

Scientific Council Meeting, 2-16 June 2005

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Participants at Scientific Council Meeting, 2-16 June 205 (Bottom to top – left to right):

Don Power, Antonio Vazquez, Tissa Amaratunga
Margaret Treble, David Kulka, Romas Statkus
Joanne Morgan, Dorothy Auby, Mariano Koen-Alonso, Eugene Colbourne
Dawn Maddock Parsons, Manfred Stein, Konstantin Gorchinsky, Taras Igashov, Stanislav Kisovsky, Vladimir Babayan
Maris Vitins, Bjarne Lyberth, Karen Dwyer, Jean-Claude Mahe, Antonio Avila de Mello, Toomas Saat, Ole Jørgensen
Ricardo Alpoim, Diana Gonzalez Tronsco, Hilario Murua, Bill Brodie
Brian Healey, Fernano González-Costas, Evgeny Romanov

Not in Picture: Johanne Fischer, Barb Marshall, Cindy Kerr, Ricardo Federizon, Gary Maillet, Carolyn Miri, Mark Simpson, Stephen Walsh, Steven Campana, Blair Greenan, Mike Sinclair, Scott Tomlinson, Susana Junquera, Leonid Kokovkin, Lisa Hendrickson

Scientific Council Chairs and Executive Secretary, 2-16 June 2005:

Left to Right): Hilario Murua (Chair STACFIS), Eugene Colboune (Chair STACFEN), Joanne Morgan (Chair Scientific Council), Antonio Vazquez (Chair STACREC), Johanne Fischer (Executive Secretary) and Manfred Stein (Chair STACPUB)

STACFIS in session during 2-16 June 2005 Meeting.

REPORT OF SCIENTIFIC COUNCIL MEETING

2-16 JUNE 2005

Chair: M. Joanne Morgan Rapporteur: Tissa Amaratunga

I. PLENARY SESSIONS

The Scientific Council met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 2-16 June 2005, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (in respect of Greenland and the Faroe Islands), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal and Spain), Russian Federation, Ukraine and United States of America. The Executive Secretary, Johanne Fischer and the Deputy Executive Secretary, Tissa Amaratunga, were 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 1030 hours on 2 June 2005.

The Chair welcomed everyone to this venue in Dartmouth and the Deputy Executive Secretary was appointed rapporteur.

The Executive Secretary was invited to give an introductory presentation.

The Council was informed that authorization had been received by the Executive Secretary for proxy votes from Iceland, Japan and Norway to record their abstentions during any voting procedures.

Having reviewed the work plan, the Agenda (see Appendix V) was **adopted.**

The Chair noted that this is the election year for the officers of the Council and its Standing Committees. The Council was informed that a Nominating Committee consisting of Bill Brodie (Canada), Susana Junquera (EU) and Manfred Stein (EU), will consult the Council participants and make proposals for the nominations before the closure of this meeting. The Chair stressed the importance of these positions to the functioning of Council.

The opening session was adjourned at 1200 hours on 2 June 2005.

The Council through 2-16 June 2005 addressed various outstanding agenda items as needed. The Standing Committee reports of STACFEN, STACREC and STACPUB were **adopted** through the course of the meeting.

The concluding session was called to order at 1000 hours on 16 June 2005.

The Council considered and **adopted** the STACFIS Report and the Report of the Scientific Council of this meeting of 2-16 June 2005, noting changes as discussed during the reviews would be made by the Chair and the Deputy Executive Secretary.

The meeting was adjourned at 1100 hours on 16 June 2005.

The Reports of the Standing Committees as **adopted** by the Council are appended as follows: Appendix I – Report of the Standing Committee on Fisheries Environment (STACFEN), Appendix II – Report of Standing Committee on Publications (STACPUB), Appendix III – Report of Standing Committee on Research Coordination (STACREC) and Appendix IV – Report of Standing Committee on Fisheries Science (STACFIS).

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

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

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 2004

The Council noted recommendations made in 2004 pertaining to the work of the Standing Committees were addressed directly by the Standing Committees, while recommendations pertaining specifically to the Council's work will be addressed under each relevant topic of the Council agenda:

From Scientific Council Meeting, 3-17 June 2004

1. The Scientific Council had **recommended** that *the Chair of Scientific Council formally communicate to the Chair of Fisheries Commission the concerns of Scientific Council regarding the derivation and accuracy of catch information available, and request that for the future, each year prior to the June meeting of Scientific Council, Fisheries Commission conduct its own evaluation of catch information derived from various sources under Rule 5.1 pertaining to STACTIC, and provide Scientific Council with their agreed estimates by Contracting Party/Country to be utilized by Scientific Council in the conduct of stock assessments.*

   The Chair of Scientific Council wrote to the Chair of the Fisheries Commission in July 2004 detailing the problem with deriving catch estimates, and conveying the recommendation that Fisheries Commission provide catch estimates to Scientific Council. The Chair of Scientific Council also detailed the problem during the presentation of scientific advice to the Fisheries Commission during the September 2004 Annual Meeting. The Fisheries Commission discussed the issue during the 2004 Annual Meeting and the matter was referred back to Scientific Council.

2. Considering the progress made by the Limit Reference Point Study Group (LPRSG) which was held in Lorient, France, 15-20 April 2004, the Scientific Council had strongly **recommended** that *the Precautionary Approach Framework developed by Scientific Council be endorsed and implemented by the Fisheries Commission without further delay.*

   At its September 2004 Annual Meeting, the Fisheries Commission endorsed the application of a Precautionary Approach framework that can be used by the Fisheries Commission to make decisions for NAFO-managed stocks and decided to implement the PA on selected stocks. To ensure there is a sound understanding of the aspects of moving forward within the proposed framework of Scientific Council, the Fisheries Commission endorsed the proposed PA framework and requested the Scientific Council to provide advice for these selected stocks (Div. 3LNO yellowtail flounder and Div. 3M shrimp) in 2005 within the PA framework.

3. The Scientific Council had **recommended** that *the STACREC Chair in consultation with the Secretariat ensure any Scientific Council related matters be submitted to CWP Secretariat for inclusion in the CWP 21st Agenda.*

   The Council noted necessary steps were taken (see Appendix III item 3.b of this report for details)

4. The Scientific Council in June 2004 stated that it views that the FIRMS/NAFO Arrangement is an institutional arrangement between FAO/FIRMS and NAFO, and accordingly had **recommended** that *the General Council approve the FAO/FIRMS and NAFO Partnership Arrangement.*

   General Council approved the FAO/FIRMS and NAFO Partnership Arrangement at its September 2004 Annual Meeting (see Appendix III item 5a for further details).

From Scientific Council Meeting, 13-17 September 2004

1. The Scientific Council had **recommended** that *Chair of the Scientific Council contact the Chair of ACFM to develop a communications vehicle or protocol (e.g. joint subgroup, email group, etc.) that would efficiently facilitate joint and collaborative consideration by both advisory bodies of all new and forthcoming information on the pelagic S. mentella stock in the North Atlantic Ocean.*

The Chair of Scientific Council wrote to the Chair of ACFM in January 2005 to discuss this matter. It was agreed that an informal group of redfish experts from Council would receive information via email from the NWWG of ICES which assesses this stock for ICES. They would also participate in discussion during the course of the NWWG meeting. The Chair of Scientific Council has been informed that his group would report to Council during this June 2005 Meeting. It was noted that if possible the draft advice of ACFM would be forwarded to Council. The Scientific Council at this meeting agreed it would forward its advice for pelagic *S. mentella* to ACFM for its information.

2. The Scientific Council had noted that the new proposed dates for the NAFO Annual Meetings in 2006, overlap with meeting dates of the ICES Annual Meeting and observed its concerns regarding members attending both meetings. The Council had **recommended** that *the Chair of Scientific Council convey these concerns to the Chair of General Council and the Executive Secretary. The Council noted that should this matter not be resolved for 2006 and onward, the Council will be forced to consider the possibility of independently holding its annual meeting during different dates.*

   The Chair of Scientific Council wrote a letter to the Chair of General Council and the Executive Secretary in January 2005, expressing the concern of Scientific Council about this matter. In addition, the Chair of Scientific Council held discussion with staff of the ICES Secretariat on this matter in November 2004. The Secretariats of NAFO and ICES are working to coordinate future meeting dates to avoid conflicting dates.

3. The Council had **recommended** that *the NAFO/ICES Working Group on harp and hooded seals (WGHARP) provide Scientific Council with updates on the results of seal tagging studies using satellite telemetry tracking, collaborative studies and any other studies that are carried out regarding harp and/or hooded seals in the Northwest Atlantic.*

   The Council was informed by the Chair that WGHARP has not met since September 2004. It is expected they will meet in August-September 2005 and WGHARP will be requested to provide the report of the meeting to the September 2005 Annual Meeting of Scientific Council.

III. FISHERIES ENVIRONMENT

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

STACFEN made no formal recommendations during this 2005 meeting.

IV. PUBLICATIONS

The Council **adopted** the Report of the Standing Committee on Publication (STACPUB) as presented by the Chair, Manfred Stein. The full report of STACPUB is at Appendix II.

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

1. *all papers available in full text form be listed together on the first Journal web page. "Hot Topic" links could be used to showcase the latest Journals.*

2. *the copyright/disclaimer from Biodiversity Informatics be used on an interim basis and that the Secretariat should seek expert legal opinion in drafting text appropriate for the NAFO Journal.*

3. *we continue to publish Journal papers on-line under the name Journal of Northwest Atlantic Fisheries Science and the printed journal be given up. However, the Committee recognized the importance of the opinion of the Associate Editors of the Journal. The status quo will continue until the chair of STACPUB confers with the Associate Editors, and if any of them have strong concerns this decision will be revisited by June 2006 Meeting.*

4. *all participants who attend a symposium receive a bound copy of the symposium papers.*

5. *all efforts should be taken to ensure the continuation of the input to the database on national and international levels, and that NAFO through the Secretariat becomes an international partner of ASFA.*

6. *the proposal to publish the book "Early Stages of Fishes in the Western North Atlantic Ocean North of 35°N and West of 40°W" be accepted and that Scientific Council and the Secretariat draft a letter to be sent to the author (M. P. Fahay).*

7. *the revised "Instructions for Authors Submitting Papers to the Journal" be accepted.*

V. RESEARCH COORDINATION

The Council **adopted** the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chair, Antonio Vazquez. The full report of STACPUB 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 Fisheries Commission be informed of those countries for which STATLANT data are missing and be reminded about the importance of these data to the work of the Scientific Council.*

2. *North Atlantic Format of VMS data be submitted to Scientific Council for consideration.*

3. *all Contracting Parties take measures to improve the accuracy of their catch estimates.*

4. *Stephen Walsh (Canada) represent the NAFO Scientific Council in the review and revision process of the FAO International Standard Statistical Classification of Fishing Gear (ISSCFG) by the ICES/FAO Working Group on Fishing Technology and Fish Behaviour.*

VI. FISHERIES SCIENCE

The Council **adopted** the Report of the Standing Committee on Fisheries Science (STACFIS) as presented by the Chair, Hilario Murua. The full report of STACFIS is at Appendix IV.

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

A recommendation made by STACFIS for the work of the Scientific Council as **endorsed** by the Council, is as follows:

1. *all Contracting Parties take measures to improve the accuracy of their catch estimates and present them in advance of future June Meetings.*

VII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. **Fisheries Commission** (Appendix V, Annex 1)

The Scientific Council noted that the Fisheries Commission requests for advice on northern shrimp (Northern shrimp in Div. 3M and Div. 3LNO (item 1)) will be undertaken during Scientific Council Meeting in October/November 2005)

a) **Request for Advice on TACs and Other Management Measures for the Year 2006**

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 2004 agreed to consider certain stocks in 2006. This section presents reports for which the Scientific Council provided scientific advice for 2006 during this meeting.

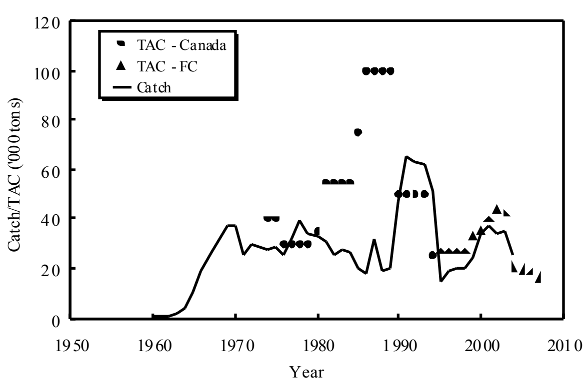
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 2 and Divisions 3KLMNO

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: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by Fisheries Commission. Catches increased sharply in 1990 due to a developing fishery in the NAFO Regulatory Area in Div. 3LMNO 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. The catch increased since 1998 and by 2001 was estimated to be 38 000 tons, the highest since 1994. The estimated catch for 2002 was 34 000 tons. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 tons to 38 500 tons. A fifteen year rebuilding plan has been implemented by Fisheries Commission for this stock. The 2004 catch was 25 500 tons, exceeding the 2004 rebuilding plan TAC by 27%.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	34	29[1]	40	44
2003	32-38.5[2]	27[1]	36	42
2004	25	16[1]	16	20
2005	-	-	-	19

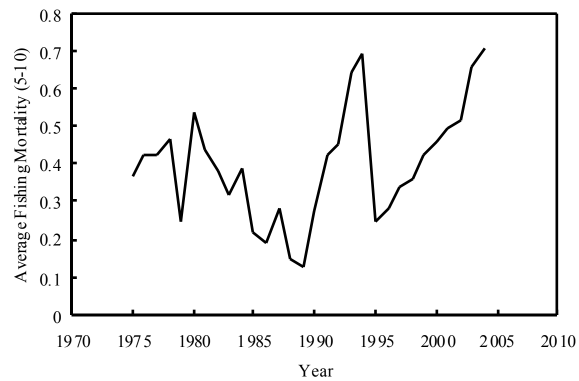
[1] Provisional.
[2] STACFIS could not precisely estimate the catch.



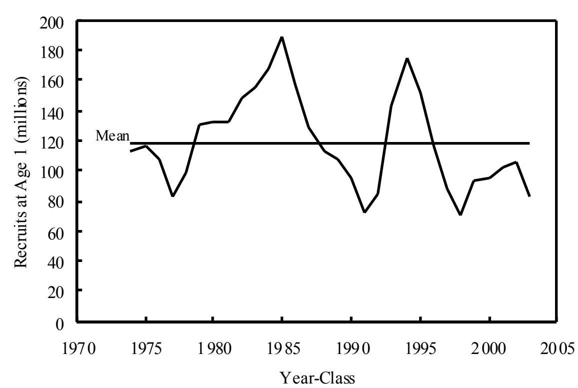
Data: CPUE data throughout the stock area were available from Canadian, and EU-Portugal fisheries. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2J+3KLMNO (1978-2004), EU in Div. 3M (1988-2004) and EU-Spain in Div. 3NO (1995-2004). Commercial catch-at-age data were available from 1975-2004.

Assessment: An analytical assessment using Extended Survivors Analysis (XSA) tuned to the Canadian spring (Div. 3LNO; 1996-2004), and autumn (Div. 2J, 3K; 1996-2004) and the EU (Div. 3M; 1995-2004) surveys was used to estimate the 5+ exploitable biomass, level of exploitation and recruitment to the stock. Natural mortality was assumed to be 0.20 for all ages.

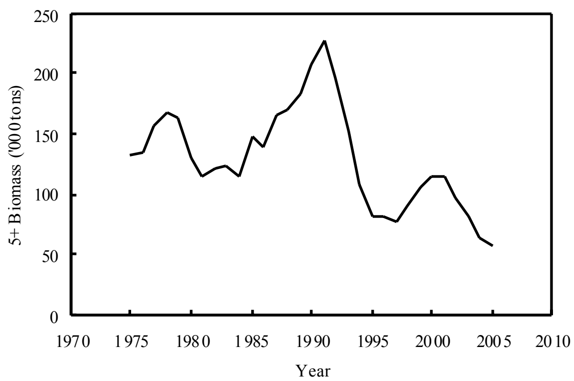
Fishing Mortality: High catches in 1991-94 resulted in $F_{5\text{-}10}$ exceeding 0.50. $F_{5\text{-}10}$ then dropped to about 0.20 in 1995 with the substantial reduction in catch. $F_{5\text{-}10}$ increased in recent years with increased catch, and the 2003 and 2004 estimates are substantially higher; $F_{5\text{-}10}$ in 2004 is estimated to be 0.71.



Recruitment: The above average 1993-95 year-classes have comprised most of the fishery in the recent past although their overall contribution to the stock was less than previously expected. Recruitment subsequent to the 1995 year-class has been below average. Contributions to the exploitable biomass over the next few years will be poor.



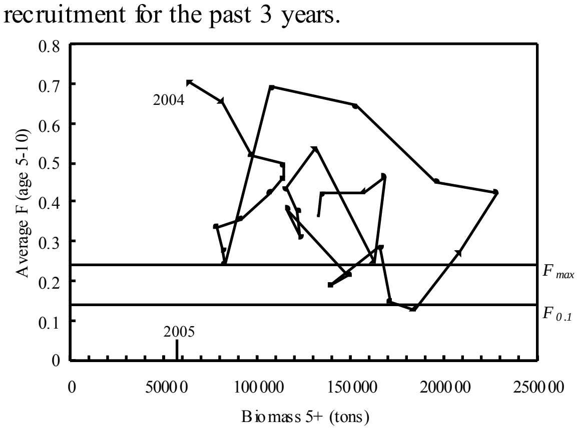
Biomass: The exploitable biomass (age 5+) was reduced to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. However, increasingly higher catches and fishing mortality since then accompanied by poorer recruitment has caused a subsequent decline. The 2005 estimate is the lowest in the series.



State of the Stock: The exploitable biomass has been declining in recent years and is presently estimated to be at its lowest observed level. Recent recruitment has been below average, and fishing mortality has increased substantially in recent years, and is currently estimated as the highest in the time series.

Reference Points: Limit reference points could not be determined for this stock.

For this stock F_{max} is computed to be 0.24 and $F_{0.1}$ is 0.14 based upon average weights and partial recruitment for the past 3 years.



Evaluation of the Management Strategy 2005-2007: Projections were conducted assuming that the catches in 2005 to 2007 do not exceed the rebuilding plan TAC values (19 000, 18 500 and 16 000 tons, respectively). Projection results (see figures below) indicate that although there is improvement in the 5+ biomass from the 2005 estimate, there is a high probability (>85%) that the projected biomass for 2008 remains below the level of 2003, when the Fisheries Commission rebuilding plan was implemented. Projected average fishing mortality indicates a reduction in average F under the rebuilding plan TACs from 2005 to 2007. Projections indicate that average fishing mortality in 2007 (0.38) will exceed F_{max}, and that current prospects for stock rebuilding are poor.

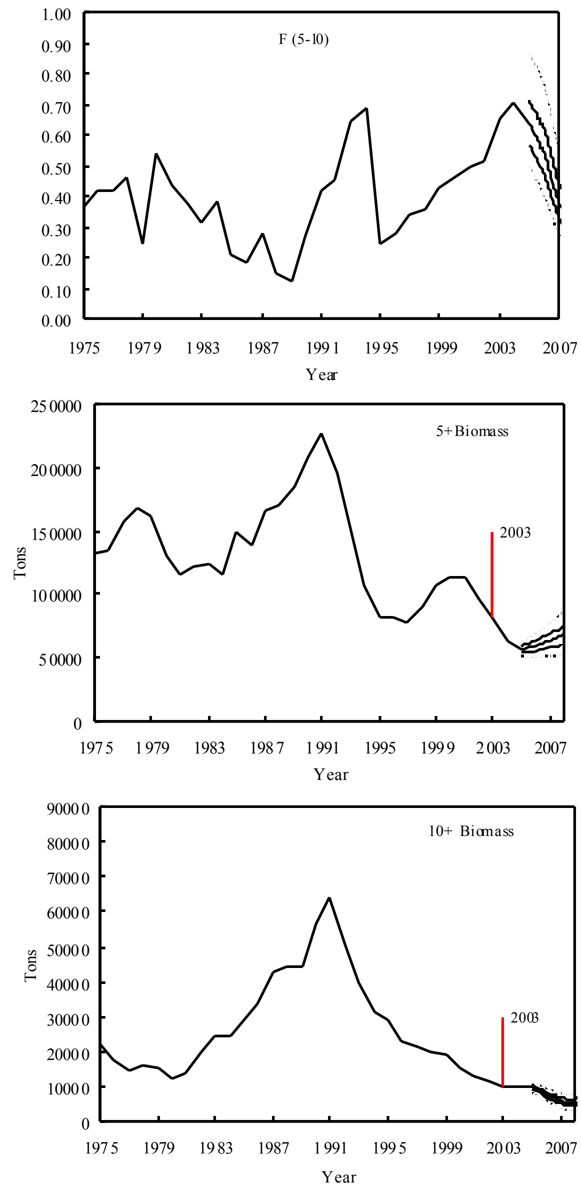
Scientific Council noted that the 2004 catch of 25 500 tons exceeded the 2004 rebuilding plan TAC by 27%. The projected 2008 5+ biomass in the current assessment is 15% lower than that predicted in the 2004 assessment. This discrepancy is consistent with the fact that the 2004 catch exceeded the TAC. Scientific Council noted that if the remaining rebuilding plan TACs were exceeded, the prospects for rebuilding would be further diminished.

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.

During previous assessments, Scientific Council has noted that fishing effort should be distributed in a similar fashion to biomass distribution in order to ensure sustainability of all spawning components.

It is strongly recommended that Fisheries Commission take steps to ensure that any by-catches of other species during the Greenland halibut fishery are true and unavoidable by-catches.

Sources of Information: SCR Doc. 05/8, 10, 27, 29, 34, 35, 37, 43, 62, 63, 64, 65; SCS Doc. 05/5, 6, 8, 12.



A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2005-2008, under the Fisheries Commission rebuilding plan. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

b) **Request for Advice on TACs and Other Management Measures for the Years 2006 and 2007**

The Scientific Council at its meeting of September 2004 reviewed the assessment schedule and agreed to consider certain stocks on a multi-year rotational basis. This section presents those stocks for which the Scientific Council provided advice for the years 2006 and 2007. The next assessment of these stocks will be in 2007.

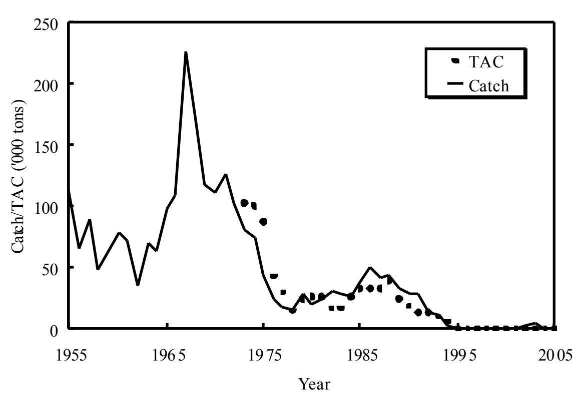
Cod (Gadus morhua) in Divisions 3N and 3O

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 and catches have increased steadily during this moratorium.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	2.2	1.2[1]	ndf	ndf
2003	4.3-5.4[2]	1.6[1]	ndf	ndf
2004	0.9	0.8[1]	ndf	ndf
2005			ndf	ndf

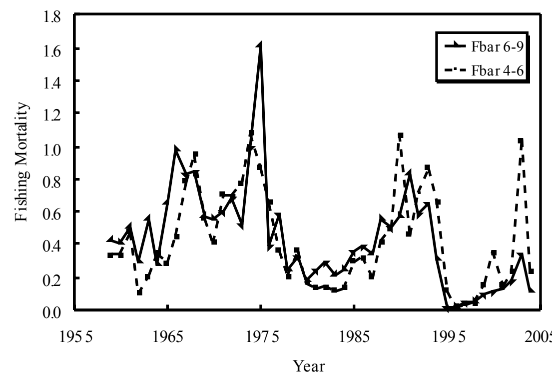
1 Provisional.
2 STACFIS could not precisely estimate the catch.
ndf No directed fishing.



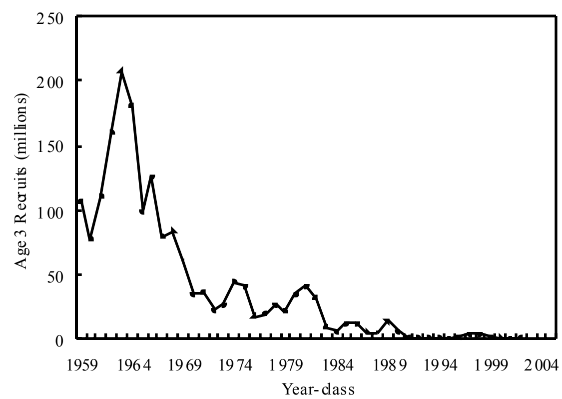
Data: Length and age composition were available from the 2003 and 2004 fisheries to estimate the total removals at age. Canadian spring (1984-2004) and autumn (1990-2004) survey data provided abundance, biomass and age structure information. Canadian juvenile research survey data were available up to 1994. Canadian Cooperative Industry surveys were available from 1996-2004. EU-Spain surveys were available from 1997-2004.

Assessment: An analytical assessment was presented to estimate population numbers in 2005.

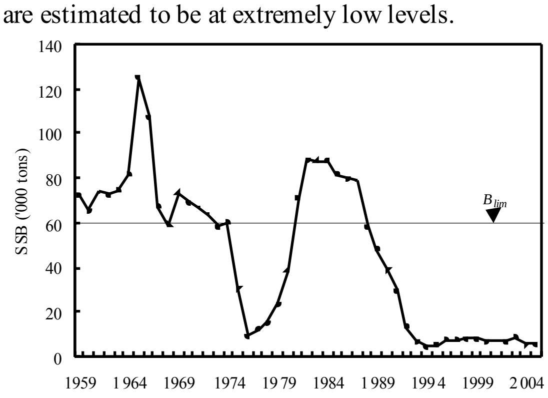
Fishing Mortality: Has increased since the moratorium, particularly on younger fish (ages 4-6).



Recruitment: Recent surveys and the VPA suggest that all recent year-classes have been at an extremely low level.



Biomass: The 2005 total biomass and spawning biomass are estimated to be at extremely low levels.

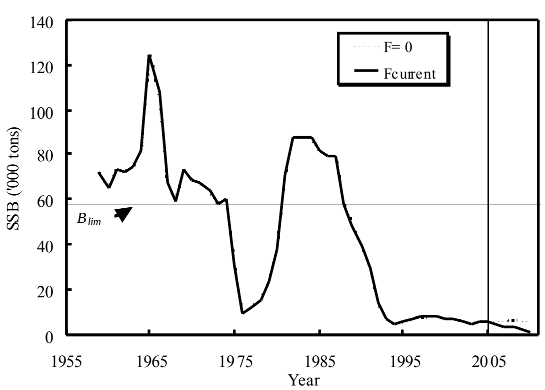


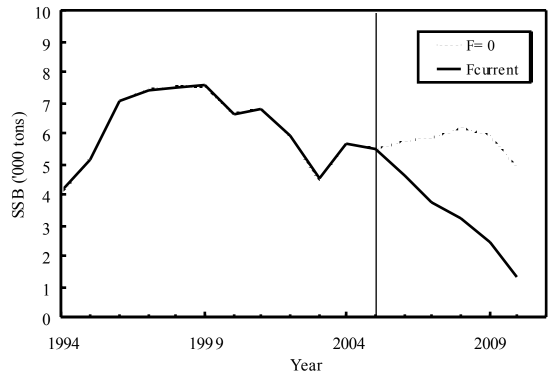
State of the Stock: The stock remains close to its historical low with weak representation from all year-classes.

Recommendation: There should be no directed fishing for cod in Div. 3N and Div. 3O in 2006 and 2007. By-catches of cod should be kept to the lowest possible level and restricted to unavoidable by-catch in fisheries directed for other species. Efforts should be made to reduce current levels of by-catch.

Reference Points: The current best estimate of B_{lim} 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. The Scientific Council recommended that it 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-term considerations: Deterministic projections were conducted to examine stock biomass over the next five years. Projections were limited to five years as extended projections are increasingly driven by recruitment assumptions. Spawner biomass was projected assuming $F = 0$, and under recently observed fishing mortality ($F = 0.50$). If there are no removals, spawner biomass is projected to decline by 11% by 2010. This projection is more pessimistic than the projection provided in 2003 because of the subsequent high catches that have reduced the population and recent low recruitment rate. If the stock continues to be fished at current rates, spawner biomass will decrease by 76% to about 1 300 tons by 2010. In the Figure below the first panel gives the entire time series trajectory of the SSB, and the second panel highlights trends since 1994.





Special Comments: Scientific Council is concerned that catches of cod have increased substantially since 1995. Fishing mortality is now at levels comparable to those during periods in the past when substantial fisheries existed, even though the stock is currently under moratorium and at a very low SSB.

The next assessment will be in 2007.

Sources of Information: SCR Doc. 05/9, 26, 67; SCS Doc. 05/5, 6, 8, 12.

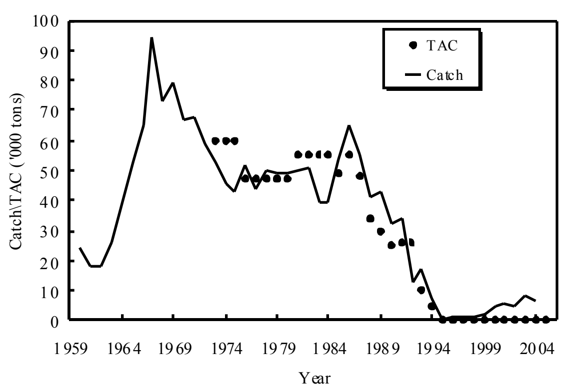
American Plaice (Hippoglossoides platessoides) in Divisions 3L, 3N and 3O

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. Even under moratorium, catches have increased substantially in recent years.

	Catch ('000 tons)		TAC ('00 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	4.9	3.1[1]	ndf	ndf
2003	6.9-10.6[2]	3.8[1]	ndf	ndf
2004	6.2	2.9[1]	ndf	ndf
2005			ndf	ndf

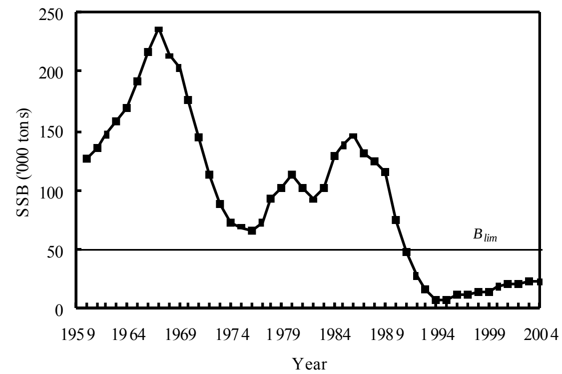
[1] Provisional.
[2] STACFIS could not precisely estimate the catch.
ndf No directed fishing.



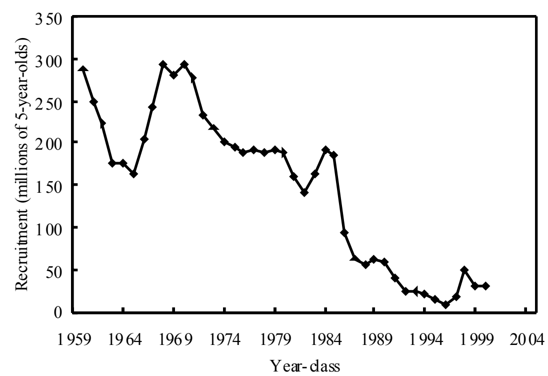
Data: Biomass and abundance data were available from several surveys. Age data from Canadian by-catch as well as length data from by-catch from Russia, EU-Spain and EU-Portugal were available.

Assessment: An analytical assessment using the ADAPTive framework tuned to the Canadian spring and autumn surveys was used. Natural mortality was assumed to be 0.2 for all ages except from 1989 to 1996 it was assumed to be 0.53.

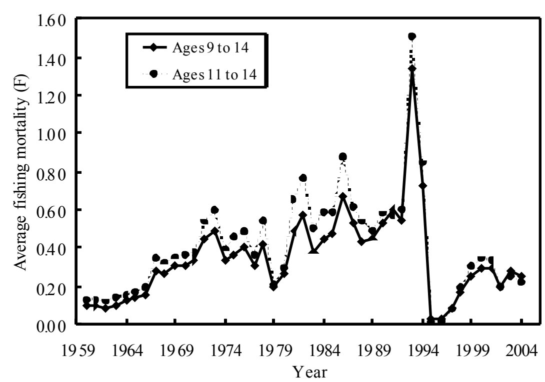
Biomass: Biomass and SSB are very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. It has increased since then but still remains very low at just over 23 000 tons.



Recruitment: There has been no good recruitment to the exploitable biomass since the mid-1980s.



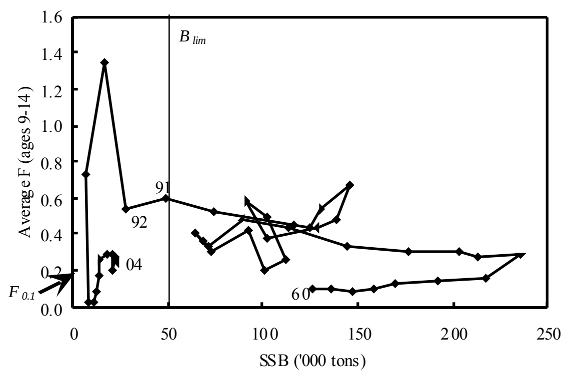
Fishing mortality: The average fishing mortality on ages 9 to 14 was 0.28 from 1999-2001 and decreased slightly to 0.24 from 2002-2004.



State of the Stock: The stock remains low compared to historic levels.

Recommendation: There should be no directed fishing on American plaice in Div. 3LNO in 2006 and 2007. By-catches of American plaice should be kept to the lowest possible level and restricted to unavoidable by-catch in fisheries directing for other species. Efforts should be made to reduce current levels of by-catch.

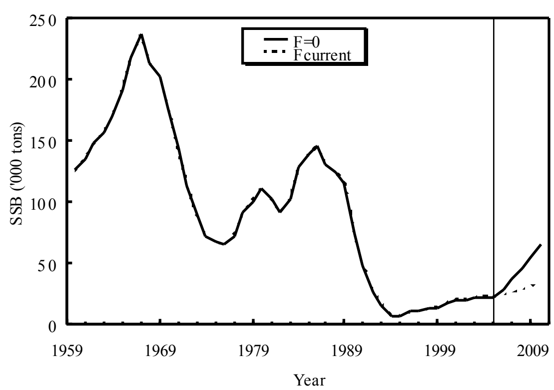
Reference Points: Good recruitment has not been observed in this stock when SSB has been below 50 000 tons and this is currently the best estimate of B_{lim}. The stock is currently below B_{lim}.

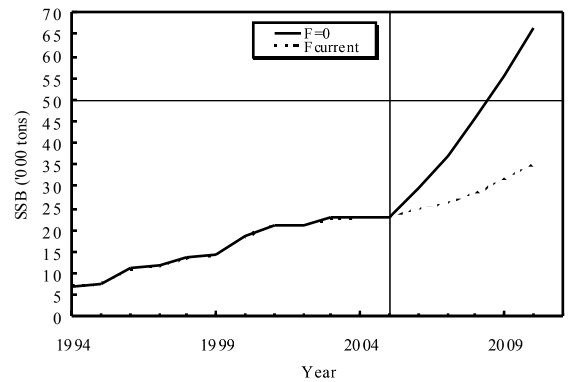


Medium term considerations: Deterministic projections were conducted to examine stock biomass over the next 5 years. Projections were limited to 5 years as extended projections are increasingly driven by recruitment assumptions. Spawner biomass was projected assuming F = 0 and under recently observed fishing mortality (F_9 = 0.30).

The first graph shows the period of the projection along with the historic trajectory of SSB. The lower panel shows only from 1994 on.

The increase in SSB is projected to be four times greater at F = 0 than at current F. At F = 0, SSB is expected to reach the B_{lim} of 50 000 tons by 2009.





Special Comment: The next assessment of this stock will be conducted in 2007.

Sources of Information: SCR Doc. 05/3, 9, 25, 30, 34, 61; SCS Doc. 05/5, 6, 8, 12;

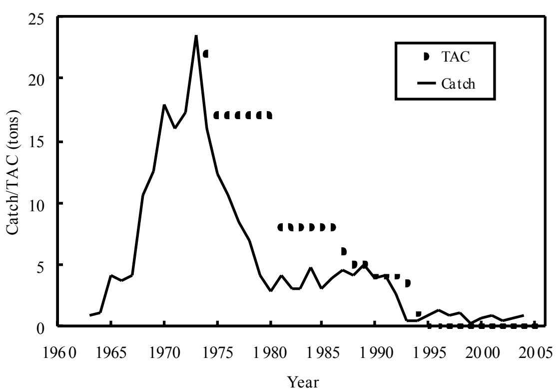
Witch Flounder (Glyptocephalus cynoglossus) in Divisions 2J, 3K and 3L

Background: Historically, the stock occurred mainly in Div. 3K although recently the proportion of the stock in Div. 3L is greater**.** In the past, the stock had been fished mainly in winter and springtime on spawning concentrations but is now only a by-catch of other fisheries.

Fishery and Catches: The catches during 1995-2003 ranged between 300 and 1 400 tons including unreported catches. The 2004 catch was about 830 tons.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	0.4	0.7[1]	ndf	ndf
2003	0.7	0.5[1]	ndf	ndf
2004	0.3	0.8[1]	ndf	ndf
2005			ndf	ndf

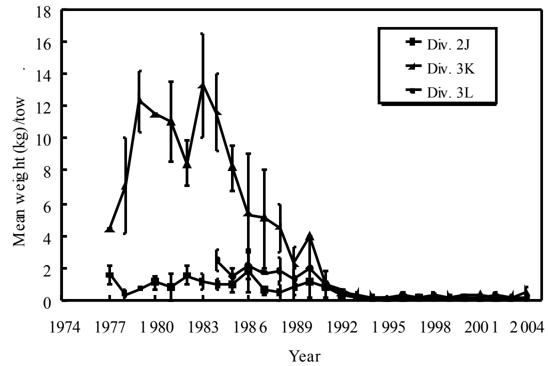
[1] Provisional and includes estimates from Div. 3M from 1998 onwards.
ndf No directed fishing.



Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian autumn surveys during 1978-2004. Age based data have not been available since 1993 and none are anticipated in the near future.

Assessment: No analytical assessment was possible.

Biomass: Survey mean weight (kg) per tow index showed a rapid downward trend since the mid-1980s and since 1995 has remained at an extremely low level.

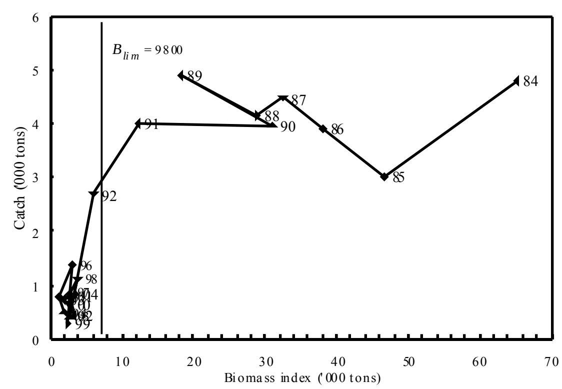


Recruitment: No information was available to this meeting.

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

Recommendation: No directed fishing on witch flounder in the years 2006 and 2007 in Div. 2J, 3K and 3L to allow for stock rebuilding. By-catches of witch flounder in fisheries targeting other species should be kept at the lowest possible level.

Reference Points: In the absence of an analytical assessment, B_{lim} was calculated as 15% of the highest observed biomass estimate (B_{lim} = 9 800 tons). Since the highest observed biomass estimates are in the early part of the time series when the survey did not cover the entire stock area, B_{lim} may be underestimated using this method. Nevertheless, the stock has been below this limit reference point since 1992.



Special Comments: The next assessment will be in 2007.

Sources of Information: SCR Doc. 05/53; SCS Doc. 05/5, 6, 8.

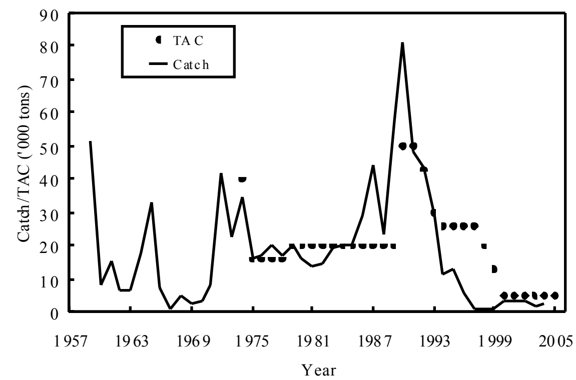
Redfish (Sebastes spp.) in Division 3M

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 since then until 1998-99, when a minimum catch around 1 100 tons was recorded mostly as by-catch of the Greenland halibut fishery. This decline was related with the simultaneous quick decline of the stock biomass and fishing effort. An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. However, in 2003 Russian catch fell by 90% and in 2004 Portugal consolidated its major role in the present fishery, while Russia recorded a catch near zero. The start in 1993 and further development of a shrimp fishery on Flemish Cap led to high levels of redfish by-catch in 1993-94. Since 1995 this by-catch in weight fell to apparent low levels but in 2001-2003 redfish by-catch increased significantly to an average of 840 tons, the highest level observed since 1994. In 2001-2003 the redfish by-catch in numbers from the Flemish Cap shrimp fishery was 78% of the total catch numbers and 44% in 2004.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	2.9	3.0[1]	3-5	3-5
2003	1.9	2.0[1]	3-5	3-5
2004	2.9	3.1[1]	3-5	3-5
2005			3-5	3-5

[1] Provisional.

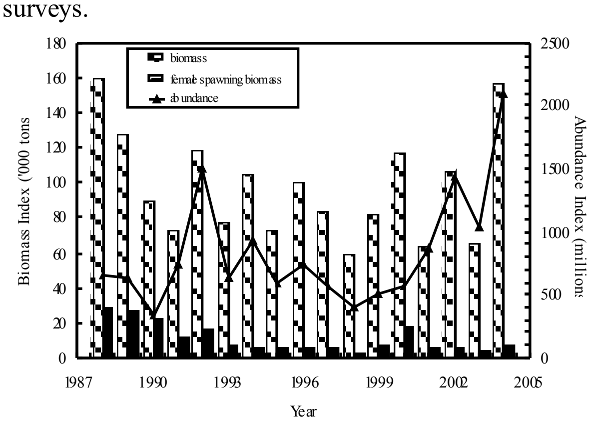


Data: Catch-at-age data were available from 1989-2004, including by-catch information from the shrimp fishery.

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, 1995-96 and 2001-2002), EU (1988-2004) 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.

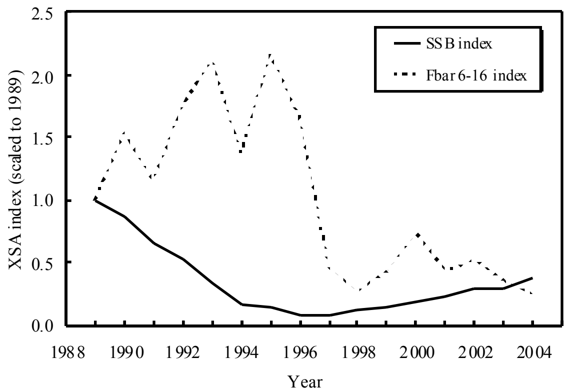
In June 2003 a new Spanish research vessel, the RV *Vizconde de Eza* replaced the RV *Cornide de Saavedra* that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 survey indices available the original time series of mean catch per tow, biomass and abundance at length distributions for beaked redfish have been converted to the new vessel units so that each former time series could be comparable with the correspondent new indices obtained since 2003 with the RV *Visconde de Eza*.

Assessment: Survey bottom biomass and female spawning biomass were calculated from 1988-2004 EU surveys.

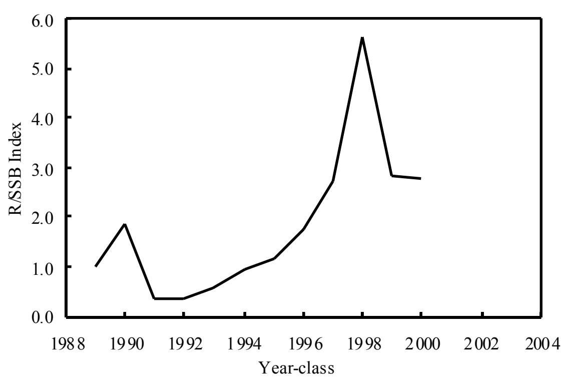


A virtual population analysis (XSA) was carried out for 1989-2004, providing indicators of stock biomass, female spawning biomass and fishing mortality trends.

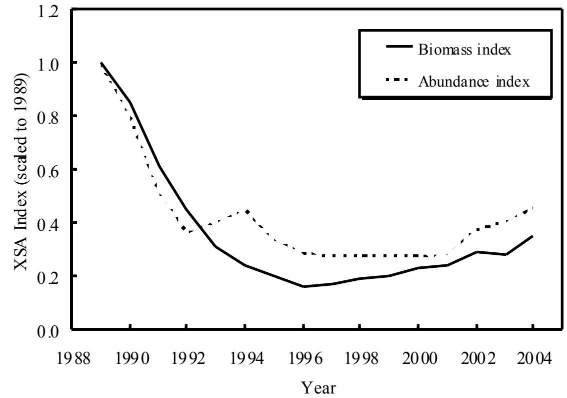
Fishing Mortality: Fishing mortality was at very high levels until 1996 and then dropped to relatively very low levels since 1997.



Recruitment: The recruits per SSB have increased through the 1990s, compensating for the SSB decline. Based on XSA, the 1998 year-class is relatively abundant.



Biomass: The Div. 3M beaked redfish stock experienced a steep decline from the second half of the 1980s until 1996. From 1997 onwards, low fishing mortalities allowed a slow but continuous growth of both 4+ biomass and female SSB. Abundance was kept stable at a low level from 1996 to 2001, increasing afterwards with the recruitment of the above average 1998-2000 year-classes. In 2004 female spawning stock biomass was still well below the SSB that produced the pulse of strong recruitment in 1990.



State of the Stock: Scientific Council concluded that the stock decline has been halted, and biomass and spawning biomass are gradually increasing. Nonetheless the total stock and spawning stock are currently at a low level compared to the earlier period in the time series. At the low fishing mortalities of the most recent years, with growth of the relatively strong 1990 year-class followed by the promising 1998 year-class, spawning biomass should continue to increase.

Recommendation: 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 2006 and 2007 be in the range of 3 000-5 000 tons.

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

Special Comments: At present, stock growth in biomass and in abundance is dependent upon the appearance and survival of cohorts past their early life stage so that they recruit to the commercial fishery and SSB. Scientific Council considers that it is important to keep the by-catch of this very small redfish to a minimum.

The next assessment will be in 2007.

Sources of Information: SCR Doc. 05/4, 29, 35, 47; SCS Doc. 05/5, 6, 8.

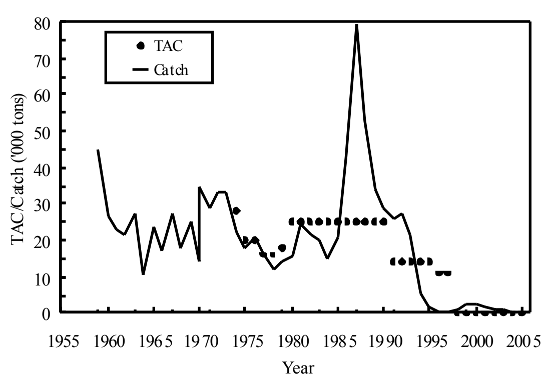
Redfish (Sebastes spp.) in Divisions 3L and 3N

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. Most studies the Council has reviewed in the past have suggested a closer connection between Div. 3LN and 3O, for both species of redfish. However, differences observed in population dynamics between Div. 3O and 3LN suggest that it would be prudent to keep Div. 3LN as a separate management unit.

Fishery and Catches: 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 450 tons in 1996. Catch increased to 900 tons in 1998, the first year under a moratorium on directed fishing, with a further increase to 2 600 tons in 2000 and declined again to 600 tons in 2004. Catches since 1998 were taken as by-catch primarily in Greenland halibut fisheries by EU-Spain, EU-Portugal and Russia.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	1.2	1[1]	ndf	0
2003	1.3	1.3[1]	ndf	0
2004	0.6	0.7[1]	ndf	0
2005			ndf	0

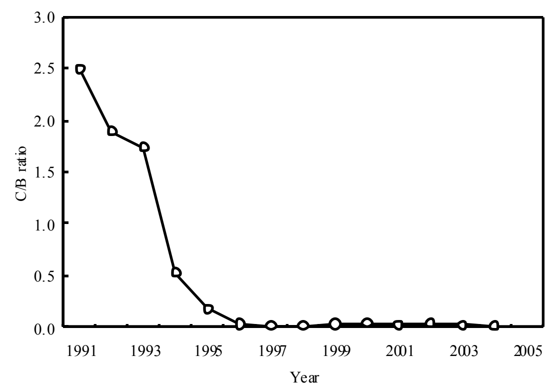
[1] Provisional.
ndf No directed fishing.



Data: Spring and autumn bottom trawl surveys conducted by Canada from 1991 to 2004 are the basis for the assessment of stock status.

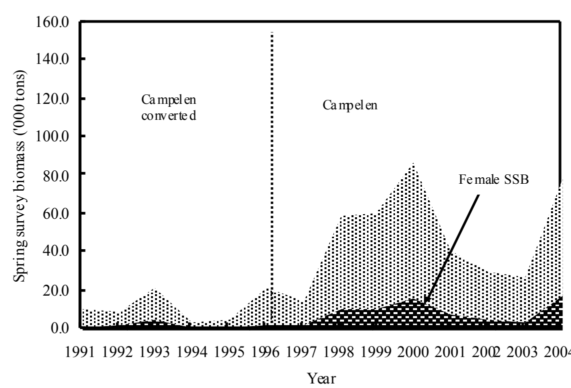
Assessment: No analytical assessment was possible.

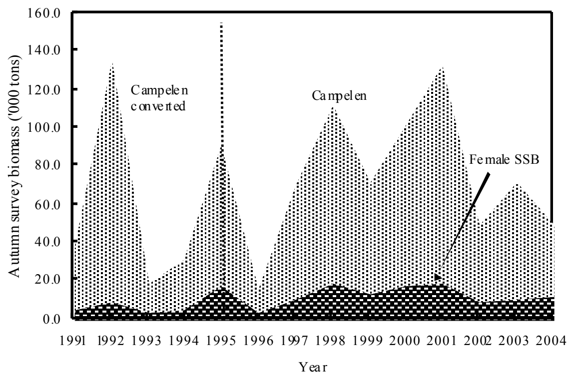
Fishing Mortality: Ratios of catch to spring survey biomass were calculated for Div. 3L and 3N combined and are considered a proxy of fishing mortality. Catch/Biomass ratio declined continuously from 1991 to 1996, with a dramatic drop between 1993 and 1994. From 1996 onwards the proxy of fishing mortality is kept at a level close to zero.



Recruitment: There was a relatively good pulse of recruitment observed in the Canadian autumn survey conducted in 1991-92 in Div. 3LN. There are no signs of any good year-classes since then.

Biomass: The spring and autumn survey index for Div. 3L suggests the stock was at its lowest level from 1992 to 1995 relative to the time period prior to 1986. For Div. 3N, survey index is only available for 1991 onwards. When Div. 3L and 3N spring and autumn survey biomass and abundance are summed up to give a picture of the relative size of this redfish management unit as a whole, both surveys suggest an increase in the size of the stock after 1996 despite the wide inter annual fluctuations of the indices.





State of the Stock: The Div. 3LN survey indices combined suggests that stock was higher in the mid-2000s than in the early 1990s in terms of, biomass, female spawning biomass and abundance. However the considerable inter-annual variability of the survey index makes it difficult to quantify the relative magnitude of this increase. Stock length structure has been improving from small to medium size fish as well, confirming the survival of recent year-classes regardless of their low sizes and the lack of good recruitment for more than a decade. Stock increase needs to be confirmed on both spring and autumn surveys in the forthcoming years.

Recommendation: Scientific Council advises no directed fishing for redfish in Div. 3LN in years 2006 and 2007.

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

Special Comments: By-catch of redfish in fisheries targeting other species should be kept to the lowest possible level. There is little information of the by-catch of redfish in the shrimp fishery in Div. 3L. By-catches of redfish should be kept to the lowest possible level in this fishery.

Differences observed in population dynamics between Div. 3LN and Div. 3O redfish suggest that it would be prudent to keep Div. 3LN as a separate management unit from Div. 3O.

The next assessment will be in 2007.

Sources of Information: SCR Doc. 05/50, 52; SCS Doc. 05/5, 6, 8.

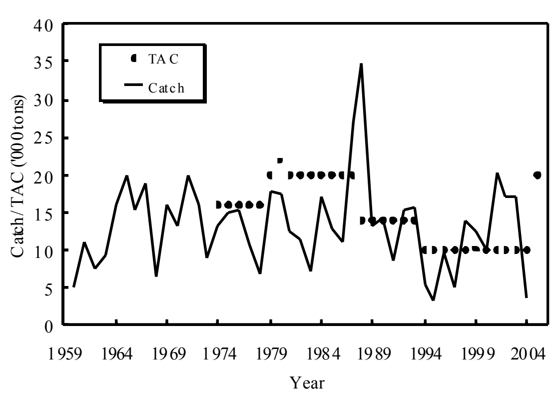
Redfish (Sebastes spp.) in Division 3O

Background: There are two species of redfish that have been commercially fished in Div. 3O; the deep-sea redfish (*Sebastes mentella*) and the Acadian redfish (*Sebastes fasciatus*). These are very similar in appearance and are reported collectively as redfish in statistics. Most studies the Council has reviewed in the past have suggested a closer connection between Div. 3LN and Div. 3O, for both species of redfish. However, differences observed in population dynamics between Div. 3LN and Div. 3O suggested that it would be prudent to keep Div. 3O as a separate management unit.

Fishery and Catches: Within Canada's fisheries jurisdiction redfish in Div. 3O have been under TAC regulation since 1974 and a minimum size limit of 22cm since 1995, whereas catch was only regulated by mesh size in the NRA of Div. 3O. The Scientific Council was unable to advise on a TAC in 2003. In September 2004, the Fisheries Commission adopted TAC regulation for redfish in Div. 3O, implementing a level of 20 000 tons per year for 2005-2007. This TAC applies to the entire area of Div. 3O. Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960. Up to 1986 catches averaged 13 000 tons then increased to 35 000 tons in 1988. From 2002-2003 catches averaged 17 200 tons then declined dramatically to about 3 800 tons in 2004.

	Catch ('000 tons)		TAC ('000 tons)
Year	STACFIS	21A	Agreed
2002	17.2	19.5[1]	
2003	17.2	21.6[1]	
2004	3.8	6.4[1]	
2005			20

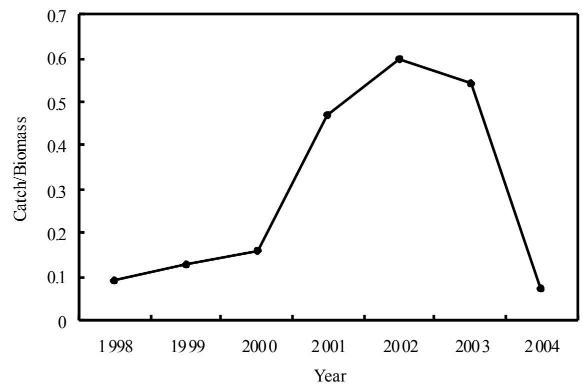
[1] Provisional.



Data: Bottom trawl surveys conducted by USSR/ Russia from 1983 to 1993 and by Canada from 1991 to 2004 are the basis for the assessment of stock status.

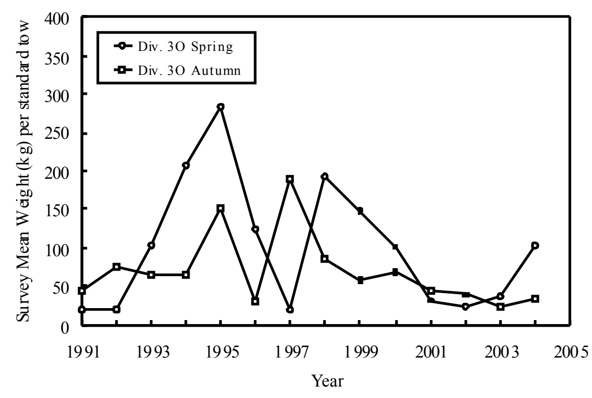
Assessment: No analytical assessment was possible.

Fishing Mortality: Catch/biomass ratios increased from 2000 to 2002 remained high in 2003 and declined in 2004.



Recruitment: Two pulses of recruitment were detected in the 2003 and 2004 surveys but their relative contribution to the population is currently not known. The 1988 year-class was the last good recruitment to the population.

Biomass: Survey biomass indices have remained stable since 2001 but at a lower level than the mid-1990s.



State of the Stock: Surveys indicate the stock has remained stable since 2001 but at a lower level than the mid-1990s.

Recommendation: Catches have averaged about 13 000 tons since 1960 and over the long term, catches at this level appear to have been sustainable. The Scientific Council noted that over the period from 1960 to 2004, a period of 45 years, catches have surpassed 20 000 tons in only three years. The Scientific Council noted there is insufficient information on which to base predictions of annual yield potential for this resource. Stock dynamics and recruitment patterns are also poorly understood. Scientific Council is unable to advise on an appropriate TAC for 2006 and 2007.

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

Special Comments: Differences observed in population dynamics between Div. 3LN and Div. 3O redfish suggest that it would be prudent to keep Div. 3O as a separate management unit from Div. 3LN.

Given that the bulk of the catches in recent years are comprised of fish less than 27 cm, these fisheries may be targeting predominantly immature fish, particularly if the catches comprise a greater proportion of *S. mentella*.

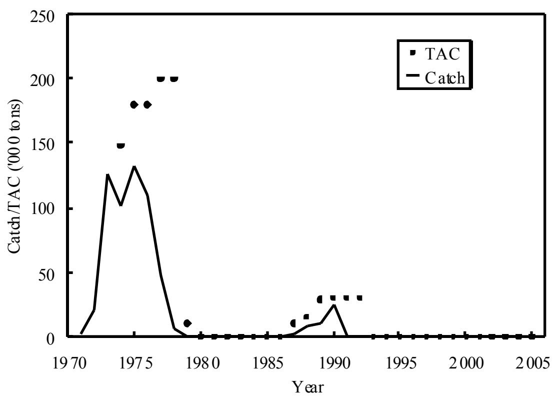
The next assessment will be in 2007.

Sources of Information: SCR Doc. 05/11, 59; SCS Doc. 05/5, 6, 8.

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

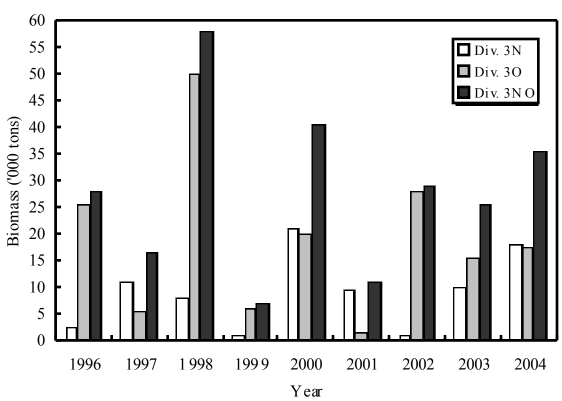
Fishery and catches: There has not been a directed fishery since 1993 when a moratorium was established, and no commercial catches have been reported since then.

Year	Catch ('000 tons)	TAC ('000 tons)
2002	0	0
2003	0	0
2004	0	0
2005		0

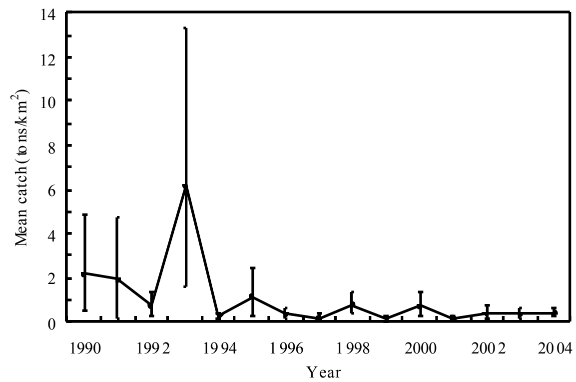


Data: Capelin catches from Canadian bottom trawl surveys conducted in 1990-2004, as well as historical data sets from Russian and Canadian trawl acoustic surveys directed to capelin.

Assessment: The only indicator of stock dynamics presently available is capelin biomass indices obtained during Canadian stratified-random bottom trawl surveys. In 1996-2004 trawlable biomass of capelin in Div. 3NO varied from 7.2 to 58.1 thousand tons. In 2003-2004, this parameter was 25.3 and 35.5 thousand tons respectively, when the average for the period from 1996 was estimated as 27.9 thousand tons.



Based on the assumption that catching efficiency of capelin fishing by Campelen was approximately 49 times higher than that of Engel, in 1990-2004 the mean catch per km^2 varied between 0.13 and 6.17. In 2003 and 2004, this parameter was 0.37 and 0.42 respectively. The estimate of 2004 corresponds to a low level of stock size that was observed in 1996, 2002-2003.



Since 1994, capelin biomass has remained at a low level compared to late 1980s.

Recommendation: Scientific Council recommends no directed fishery on capelin in Div. 3NO in 2006-2007.

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

Special Comments: Scientific Council noted that NAFO recognizes the role that capelin play in the Northwest Atlantic ecosystem as a very important prey species for fish, marine mammals and seabirds.

Historically, the spawning biomass was determined through the use of hydroacoustics.

It is not clear how precise the capelin indices from the bottom trawl surveys reflect the real stock distribution and stock status.

The next assessment will be in 2007.

Source of Information: SCR Doc. 05/17.

White hake (Urophycis tenuis) in Divisions 3N and 3O

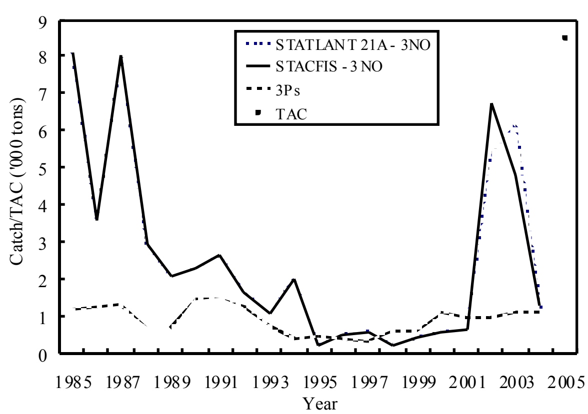
Background: The stock area is defined by Scientific Council as Div. 3NOPs, and is mainly concentrated in southern Subdiv. 3Ps and on the southwestern Grand Bank. Scientific Council is asked to provide advice on the portion of the stock in Div. 3NO only.

Fishery and Catches: Catches in Div. 3NO peaked in 1987 at 8 000 tons, then declined from 1988 to 1994 (2 090-ton average). Average catch was at its lowest in 1995-2001 (455 tons); then increased to 6 700 tons and 4 800 tons in 2002-2003, respectively. Total catch decreased to 1 267 tons in 2004.

Catches of white hake in Subdiv. 3Ps were at their largest in 1985-93; with an average of 1 114 tons. Average catch then decreased to 436 tons in 1994-99. Subsequently, catches in Subdiv. 3Ps increased to an average of 1 036 tons in 2000-2004.

	Catch ('000 tons)			
	Div 3NO		Subdiv 3Ps	
Year	STACFIS	21A	21A	TAC ('000 tons)
2002	6.7	5.4[1]	0.9[1]	-
2003	4.8	6.2[1]	1.1[1]	-
2004	1.3	1.9[1]	1.1[1]	-
2005				8.5[2]

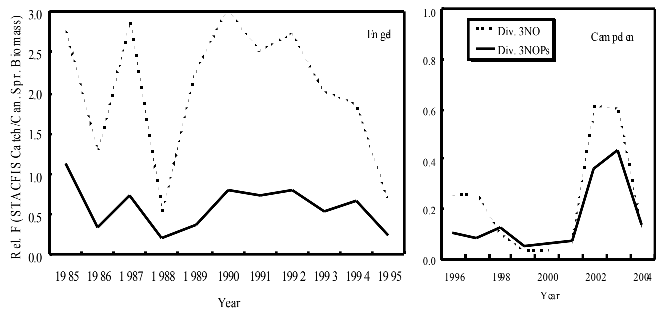
[1] Provisional.
[2] Set by Fisheries Commission at 8 500 tons for Div. 3NO for 2005-2007.



Data: Length frequency data from the Canadian fishery (1994-2005 preliminary), and from catches of Spanish (2002, 2004), Portuguese (2003-2004), and Russian trawlers (2000-2004) were available. Biomass and abundance indices were available from annual Canadian spring in Div. 3NOPs (1975-82; 1984-2004), autumn in Div. 3NO (1990-2004) bottom trawl surveys and Spanish spring surveys in the NAFO Regulatory Area of Div. 3NO (2001-2004).

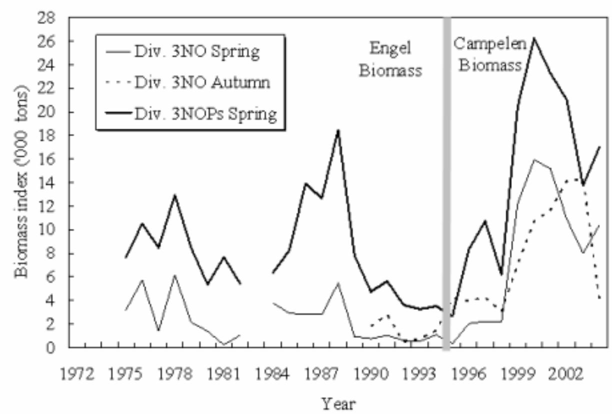
Assessment: No analytical assessment was possible.

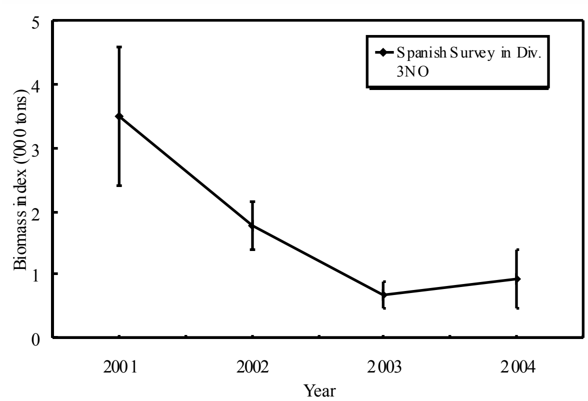
Fishing Mortality: STACFIS catch/Canadian spring survey biomass ratio fluctuated in the 1980s then declined in the 1990s. The index then increased in 2002-2003, and declined in 2004.



Recruitment: The 1999 year-class was large. Year-classes since then have been extremely low, as compared to the 1999 year-class.

Biomass: The biomass of this stock increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has substantially decreased.





State of the Stock: Following the dominance of 1999 fish in 2000, a progression of this year-class is observed through subsequent years; leading to increased catches in the white hake fishery in 2002-2003, when fish reached harvestable sizes. Overall, survey biomass indices were lower in 2004 relative to 2001.

Recommendation: Given the intermittent recruitment to this stock, and the change in fisheries between directed and by-catch, it is not possible to advise on an appropriate TAC. However, with lower biomass and poor recruitment after the 1999 year-class, Scientific Council advised that catches of white hake in Div. 3NO at the current TAC of 8 500 tons are not sustainable.

Reference Points: Scientific Council was unable to define reference points for this stock.

Special Comments: The next assessment of this stock will be in 2007.

Sources of Information: SCR Doc. 05/21, 26, 60, 66; SCS Doc. 05/5, 6, 8, 12.

c) **Special Requests for Management Advice**

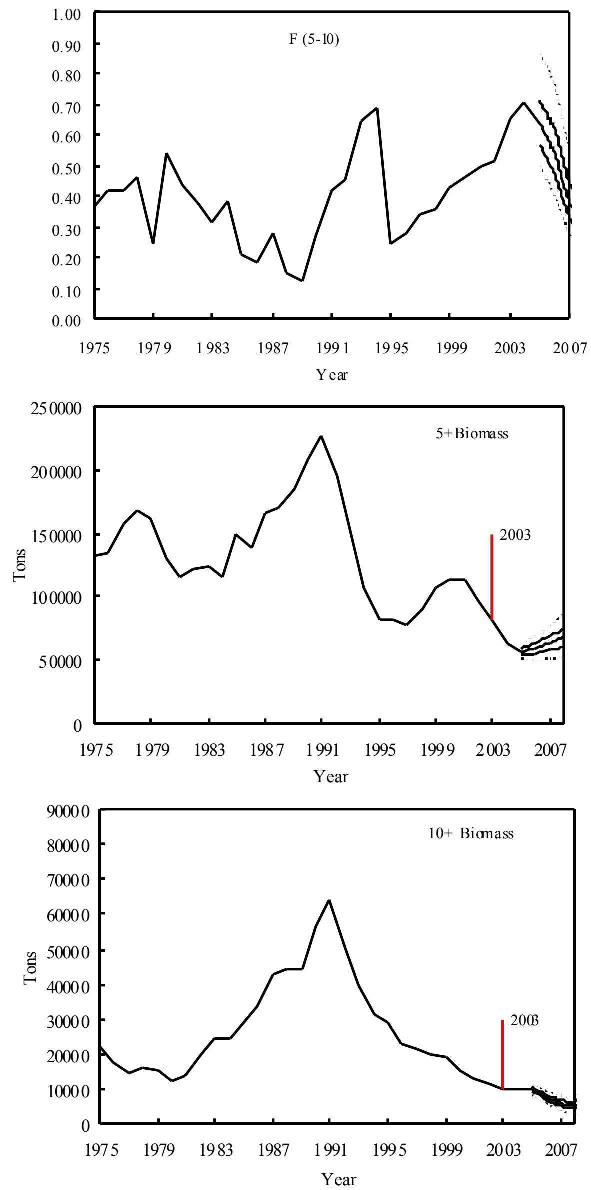
i) **Greenland halibut in Subarea 2 and Div. 3KLMNO rebuilding strategy** (Appendix 5, Annex 1, Item 5)

Fisheries Commission request for advice: *The Fisheries Commission with the concurrence of the Coastal State requests Scientific Council, at a meeting in advance of the 2005 Annual Meeting, to provide information on the status of the Greenland halibut in SA 2+ Div. 3KLMNO in relation to the Rebuilding Strategy including commentary on progress in relation to targets described in the Strategy.*

The Scientific Council responded:

Projections were conducted assuming that the catches in 2005 to 2007 do not exceed the Fisheries Commission rebuilding plan TAC values (19 000, 18 500 and 16 000 tons, respectively). Projection results (see figures below) indicate that although there is improvement in the 5+ biomass from the 2005 estimate, there is a high probability (>85%) that the projected biomass for 2008 remains below the level of 2003, when the Fisheries Commission rebuilding plan was implemented. Projected average fishing mortality indicates a reduction in average F under the rebuilding plan TACs from 2005 to 2007. Projections indicate that average fishing mortality in 2007 (0.38) will exceed F_{max}, and that current prospects for stock rebuilding are poor.

Scientific Council noted that the 2004 catch of 25 500 tons exceeded the 2004 rebuilding plan TAC by 27%. The projected 2008 5+ biomass in the current assessment is 15% lower than that predicted in the 2004 assessment. This discrepancy is consistent with the fact that the 2004 catch exceeded the TAC. Scientific Council noted that if the remaining rebuilding plan TACs were exceeded, the prospects for rebuilding would be further diminished.



A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2005-2008, under the Fisheries Commission rebuilding plan. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

ii) **The precautionary approach** (Items 7-9)

The Fisheries Commission had stated that:

Noting the Precautionary Approach Framework as endorsed by Fisheries Commission, the Fisheries Commission requests that the Scientific Council provide the following information for the 2005 Annual Meeting of the Fisheries Commission for the following stocks under its responsibility requiring advice for 2006: yellowtail flounder in Div. 3LNO, Shrimp in Div. 3M

a) *the limit and precautionary reference points as described in Annex II of the UN Fisheries Agreement indicating areas of uncertainty (for those stocks for which precautionary reference points cannot be determined directly, proxies should be provided);*

b) *the stock biomass and fishing mortality trajectory over time overlayed on a plot of the proposed PA Framework (for those stocks where biomass and/or fishing mortality cannot be determined directly, proxies should be used);*

c) *information regarding the current Zone the stock is within as well as proposals regarding possible harvest strategies to move the resource to (or maintain it in) the Safe Zone including medium term considerations and associated risk or probabilities which will assist the Commission in developing the management strategies described in paragraphs 4 and 5 of Annex II in the Agreement.*

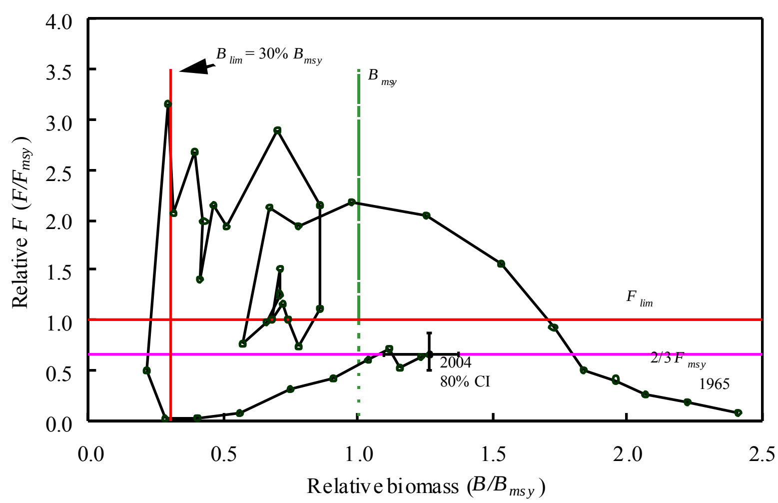
d) *a description of the advise using the Precautionary Framework differs from advice provided in the traditional manner.*

The Council noted that:

Substantial progress was made during 2004 on applying the PA to Div. 3LNO yellowtail flounder and Div. 3M shrimp.

With respect to **Div. 3LNO yellowtail flounder**:

Scientific Council considers 2/3 F_{msy} to be a fishing mortality target. By definition in the Scientific Council Precautionary Approach Framework, the limit reference point for fishing mortality (F_{lim}) should be no higher than F_{msy}. Scientific Council recommends that B_{lim} be set at 30% B_{msy}, following the recommendation of the Scientific Council Study Group on Limit Reference Points in 2004 (SCS Doc. 04/12). At present, it is not possible to express the risk of the stock being below B_{lim} = 30% B_{msy}. However, the estimated probability of the current (beginning of 2005) stock size being below B_{msy} is so small (less than 6%), that the probability of being below B_{lim} must be negligible.

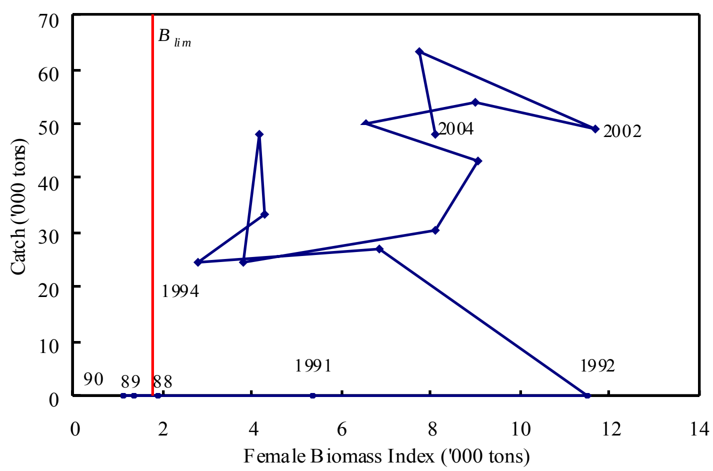


Currently the stock is estimated to be above B_{lim} and F below F_{lim}, so the stock is in the safe zone as defined in the Scientific Council's Precautionary Approach Framework (SCS Doc. 04/12). Maintaining F at or below 2/3 F_{msy} is projected to maintain the resource within the safe zone, at least in the medium term (10 years).

With the Div. 3LNO yellowtail flounder stock currently in the safe zone, and assessing the stock using a production model, it is unlikely that the advice from Scientific Council would differ for this stock if the PA framework were not applied.

With respect to **Div. 3M shrimp**:

Scientific Council considers that 15% of the maximum survey female biomass index is a limit reference point for biomass (B_{lim}) for northern shrimp in Div. 3M. It is not possible to calculate a limit reference point for fishing mortality at this time.



Currently, the biomass is estimated to be well above B_{lim}. Although it has not been possible to calculate a F_{lim}, this stock is considered to be in the safe zone. The stock appears to have sustained an average annual catch of about 48 000 tons since 1998 with no detectable effect on stock biomass. To increase the possibility that the stock will remain above B_{lim} catch should not exceed 48 000 tons, at least in the short term.

With the biomass of this stock at such a high level it is unlikely that the advice from Scientific Council would differ for this stock if the PA framework were not applied. However if a target fishing mortality reference point existed for this stock the advice would incorporate this target *F*.

Note that Annex 1, items 8 and 9 will be addressed best as possible in the specific stock assessments.

iii) **Pelagic *Sebastes mentella* (redfish) in Subareas 1-3 and adjacent ICES Area** (Item 10)

Regarding pelagic *S. mentella* redfish in NAFO Subareas 1-3, the Scientific Council is requested to: *review the most recent information on the distribution of this resource, as well as on the affinity of this stock to the pelagic redfish resource found in he ICES Surarea XII, parts of SA Va and XIV and to the shelf stocks of the redfish found in ICES Subarea V, VI and XIV, and NAFO Subareas 1-3.*

The Council responded as follows:

Based on the fisheries information, it was concluded that the fishing pattern in 2004 was similar to that in the past six years, both seasonally and geographically. Total landings declined from about 151 000 tons in 2003 to 124 000 tons in 2004. The amount taken within the NAFO Regulatory Area (NRA) in Div. 1F and Div. 2J increased from about 22 000 tons in 2003 to about 24 000 tons in 2004. There was no fishery independent information available on distribution in 2004 as the bi-annual trawl-acoustic survey was last conducted in 2003. There will be information available from the survey that is currently being conducted in June/July of 2005.

The Council noted from the Scientific Council Report of September 2004 there was no consensus among the "Study Group on Stock Identity and Management Units of Redfish" (SGSIMUR) or the "ICES Northwestern Working Group" (NWWG) members about the stock structure of redfish in the area, based on information available as of Sept. 2004. Accordingly, the ICES Advisory Committee of Fishery Management (ACFM) concluded in October 2004 to maintain the current advisory units until more information becomes available: a demersal unit on the continental shelf in ICES Divisions Va, Vb and XIV and a pelagic unit in the Irminger Sea and adjacent areas (V, VI, XII, and XIV)." This latter unit also includes pelagic redfish in the NAFO Convention Area.

During the April 2005 Meeting of NWWG, new information was available on stock structure of *S. mentella* based on biological studies of genetics, tagging, parasites and other biological characteristics. The working group did not have sufficient expertise to thoroughly review the scientific content of these papers. Subsequent to the NWWG report, ACFM in May 2005 recommended that this new information be reviewed in a comprehensive evaluation that integrates these results with those from other disciplines. ICES will assess the current advisory units when a synthetic review of stock identification information is available. Scientific council agrees with the conclusion of ACFM, that a comprehensive evaluation that integrates the new information with those from other disciplines is required.

iv) **Redfish in Div. 3LN and 3O** (Item 11)

Regarding redfish in Divisions 3L, 3N and 3O, Scientific Council is requested to: *review all available information and provide advice regarding whether the current management units (3LN and 3O) or any alternative may be the most appropriate.*

The Council responded:

The Council noted that results were available from a study of redfish population structure pertinent to the long standing recommendation on the appropriateness of Div. 3LN and Div. 3O as management units (SCR Doc. 05/50). The study compared genetic and morphometric characteristics of *S. fasciatus* and *S. mentella* based on samples within Div. 3LNO and Div. 3P area. For *S. fasciatus*, the results obtained suggested no difference in the biological characters studied amongst Div. 3L, Div. 3N and Div. 3O. It further suggested that *S. fasciatus* from Div. 3LNO and from the Subdiv. 3Ps area adjacent to Div. 3O form a population that exchanges individuals with redfish in the Laurentian Channel (Div. 3P4V). Therefore Div. 3O could be influenced by migration events originating from or towards the Laurentian Channel area (Div. 3P4V). For *S. mentella*, the results suggested Div. 3L is different from the Laurentian Channel area. These results confirmed the findings of a study by Roques *et al.* (2001). The latter study also found no genetic difference among samples of *S. mentella* from Div. 3LN, Div. 3O and Subarea 2 + Div. 3K. The Council noted statistically non-significant genetic differences between areas could be obtained from a relatively low mixing rate between these areas.

Most studies the Council has reviewed in the past have suggested a close connection between Div. 3LN and Div. 3O, particularly between Div. 3O and Div. 3N for both species of redfish. While many of the studies suggested a single management unit, differences observed in population dynamics between Div. 3O and Div. 3LN suggest that it would be prudent to keep Div. 3O as a separate management unit. This is also the suggestion of the 2005 study (SCR Doc. 05/50) with regard to the argument that Div. 3O may act as a buffer zone between surrounding populations.

Reference:

ROQUES, S., J.-M. SÉVIGNY, and L. BERNATCHEZ. 2001. Evidence for broadscale introgressive hybridization between two redfish (genus *Sebastes*) in the Northwest Atlantic redfish: a rare example. *Molecular Ecology*, **10**: 149-165.

d) **Monitoring of Stocks for which Multi-year Advice was Provided in 2004**

The Scientific Council in 2004 provided 2-year advice (for 2005 and 2006) for six stocks (cod in Div. 3M; American plaice in Div. 3M; yellowtail flounder in Div. 3LNO; witch flounder in Div. 3NO; thorny skate in Div. 3LNO and northern shortfin squid in SA 3+4). The Scientific Council reviewed the status of these six stocks (interim monitor) at this meeting of June 2005, and found no significant change in status for any of the stocks. Therefore, the Scientific Council has not provided updated/revised advice for 2006 for these stocks. The next Scientific Council assessment of these stocks will be in 2006.

2. **Coastal States**

a) **Request by Canada for Advice** (Appendix V, Annex 2)

i) **TAC for Greenland halibut in Subarea 2 and Div. 3K and in Div. 3LMNO** (Item 1)

The Scientific Council was requested by the Coastal State Canada to: *provide advice on appropriate TAC levels separately - for Greenland halibut in SA 2 + Division 3K and Divisions 3LMNO.*

The Scientific Council responded:

Canadian research survey data covering depths to 1 500 m suggest reasonable stability in the proportion of biomass in SA2 + Div. 3K and Div. 3LMNO, ranging between 75% and 84% in SA2 + Div. 3K, averaging about 80% in SA2 + Div. 3K and 20% in Div. 3LMNO. If the 2006 quota for Greenland halibut of 18 500 tons in SA2 + Div. 3KLMNO was apportioned according to biomass distribution, the split would be 14 800 tons (80%) from SA2 + Div. 3K and 3 700 tons (20%) from Div. 3LMNO.

b) **Request by Denmark (Greenland) for Advice** (Appendix V, Annex 3)

i) **Roundnose grenadier (*Coryphaenoides rupestris*) in Subareas 0 + 1**

In the Scientific Council report of 2002, scientific advice on the management of roundnose grenadier in Subareas 0+1 was given as a 3-year advice (for 2003, 2004 and 2005). Denmark, on behalf of Greenland, requests the Scientific Council to: *provide a 3-year advice on the scientific basis for the management of Roundnose grenadier in Subareas 0+1 for 2006, 2007 and 2008 and continue to monitor status of Roundnose grenadier in Subareas 0+1 annually. Should significant change in stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate* (Annex 3, Item 1).

The Scientific Council responded:

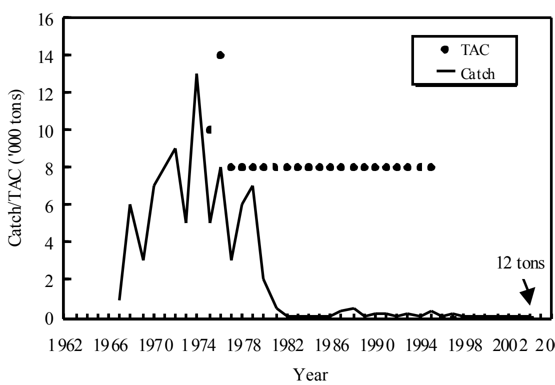
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 0 + 1

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

	Catch ('000)		TAC ('000 tons)	
Year	21A	STACFIS	Recommended	Autonomous[2]
2002	0.03[1]	0.03	ndf	4.2
2003	0.05[1]	0.05	ndf	4.2
2004	0.01[1]	0.01	ndf	4.2
2005			ndf	4.2

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

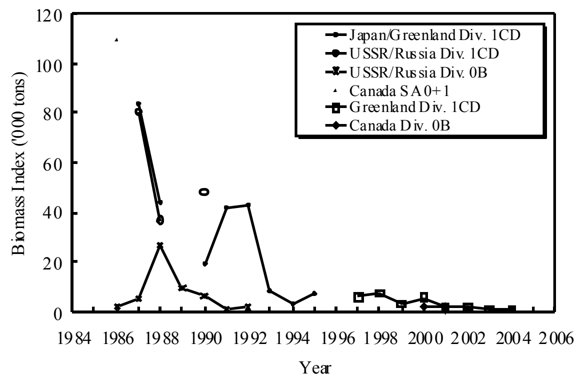


Data: Biomass estimates of roundnose grenadier from surveys in Div. 0B during the period 1986-92, from Div. 1CD during the period 1987-95, from Div. 1CD in 1997-2004 and Div. 0B in 2000-2001 were available.

Assessment: No analytical assessment could be performed.

Fishing Mortality: Exploitation level not known.

Biomass: There are no recent estimates of biomass of roundnose grenadier for the entire stock area. In 2004 the biomass of roundnose grenadier was estimated at 600 tons for Div. 1CD, the lowest ever observed. Surveys in Div 0B in 2000 and 2001 also showed a very low biomass; 1 700 and 1 300 tons, respectively. In Div. 1CD the biomass of roughhead grenadier was estimated at 4 300 tons, the same level as seen in previous years.



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

Reference points: No reference points available.

Recommendation: There should be no directed fishing for roundnose grenadier in Subareas 0 and 1 in 2006-2008. Catches should be restricted to by-catches in fisheries targeting other species.

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

Sources of Information: SCR Doc. 05/13; SCS Doc. 05/14.

ii) **Demersal redfish and other finfish in Subarea 1 (2006-2007) (Item 2)**

In 2003, advice for redfish (*Sebastes* spp.) and other finfish in Subarea 1 was given for 2004 and 2005. Denmark, on behalf of Greenland, requests the Scientific Council to: *provide a 2-year advice on the scientific basis for the management of redfish and other finfish in Subarea 1 for 2006 and 2007 and continue to monitor status of redfish and other finfish in Subarea 1. Should significant change in stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate* (Annex 3, Item 2).

The Scientific Council responded separately for demersal redfish and other finfish as follows:

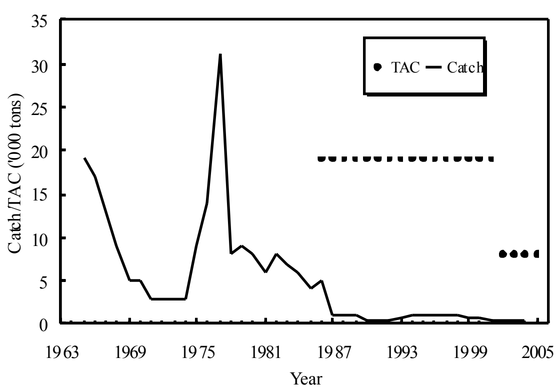
*Demersal Redfish (*Sebastes *spp.) in Subarea 1*

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 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]	TAC ('000 tons)	
Year	('000 tons)	Recommended	Autonomous
2002	0.5	ndf	19
2003	0.5	ndf	8
2004	0.5	ndf	8
2005		ndf	8

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

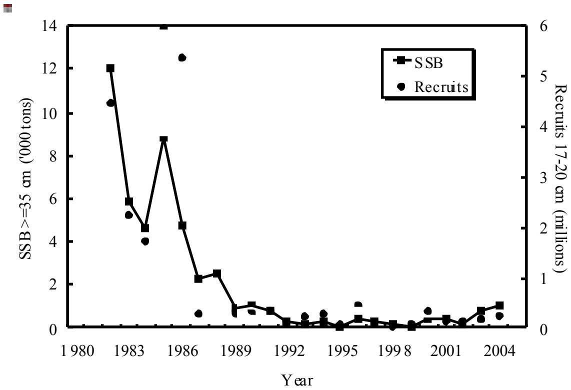


Data: Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland. Spawning stock biomass and recruitment indices for both redfish stocks were derived from EU-German survey data. No data on CPUE from any commercial fishery were available. Length frequencies were derived from a Spanish experimental fishery.

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

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

SSB: SSB index has remained at the historical low since 1989.

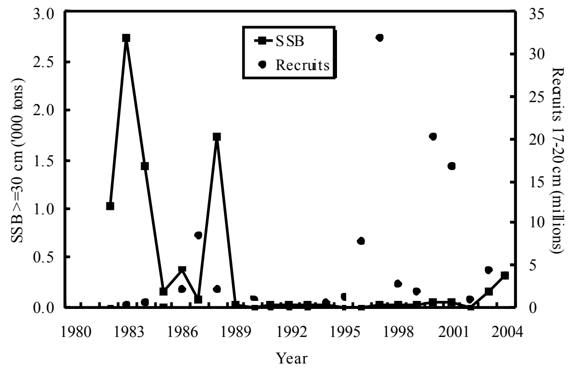


State of the Golden Redfish Stock: The stock of golden redfish in Subarea 1 remains severely depleted. There are indications that the probability of future recruitment is reduced at the current low SSB. Short-term recovery is very unlikely.

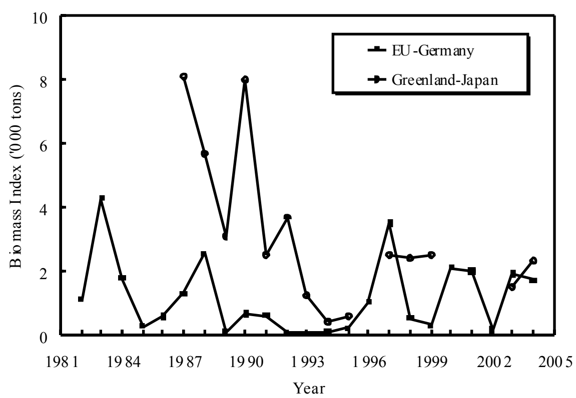
Assessment of Deep-sea Redfish: No analytical assessment of *S. mentella* was possible.

Recruitment: Recruitment variation for deep-sea redfish is high, and the 1997, 2000 and 2001 estimates were above average, but since 2002 recruitment indices have remained below average.

SSB: SSB index has been below average since 1989.



Biomass: Total stock biomass indices have been variable through time, with no clear trend. 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.

Recommendation for Golden and Deep-sea Redfish Stocks: No directed fishery should occur on redfish in Subarea 1 in 2006 and 2007. By-catches 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 demersal redfish taken in the shrimp fishery is significantly reduced. The introduction of mandatory sorting grids on 1 October 2000 will probably reduce this by-catch.

Sources of Information: SCR Doc. 05/20, 33, 39, 40; SCS Doc. 05/9, 14, 15

Other Finfish in Subarea 1

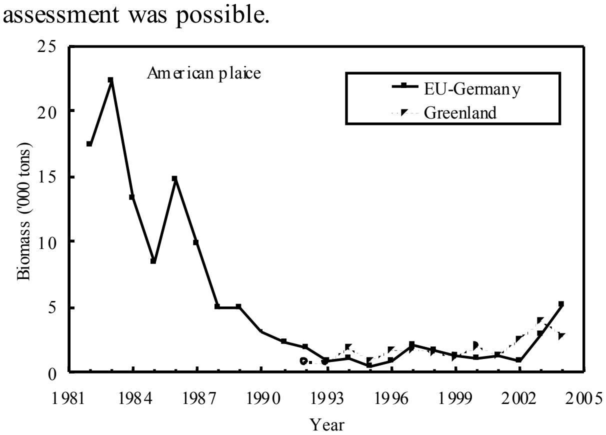
Background: The resources of other finfish in Subarea 1 are mainly Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffishes (*Anarhichas lupus* and *A. minor*), thorny skate (*Raja radiata*), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus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

Fishery Development and Catches: Greenland cod, wolffishes, Atlantic halibut and lumpsucker have been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. Other species are mainly taken as by-catch offshore in trawl fisheries directed to shrimp.

In 2003 and 2004, reported catches of other finfishes amounted to roughly 10 000 tons, representing an increase of about 3 000 tons, compared to the 2002 catch (7 400 tons). The catch figures do not include the weight of fish discarded by the trawl fisheries directed to shrimp.

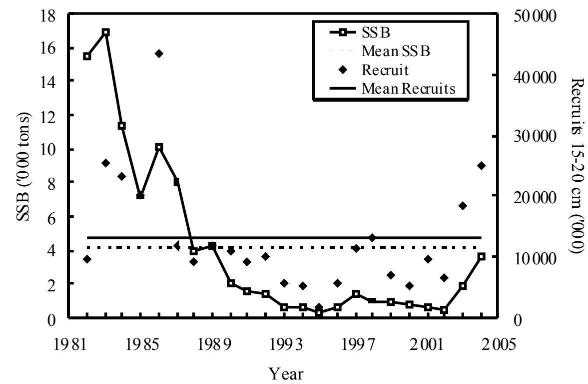
Data: Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland. Spawning stock biomass and recruitment indices for American plaice and Atlantic wolffish were derived from EU-German survey data.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

Assessment of American plaice: No analytical assessment was possible.



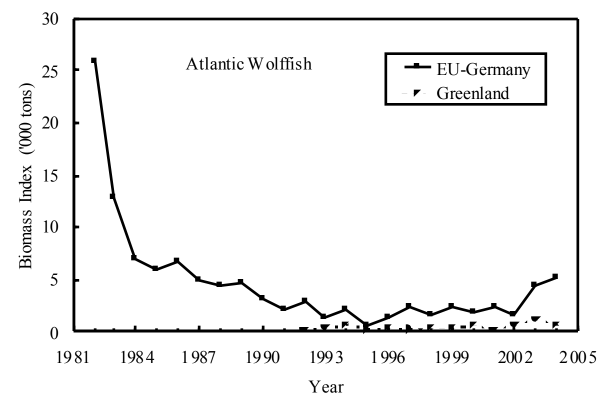
Recruitment: Indices from 2003 and 2004 are above the average level.

SSB: SSB increased in 2003 and 2004, but is still considered to be at low level compared to the early and mid-1980s.



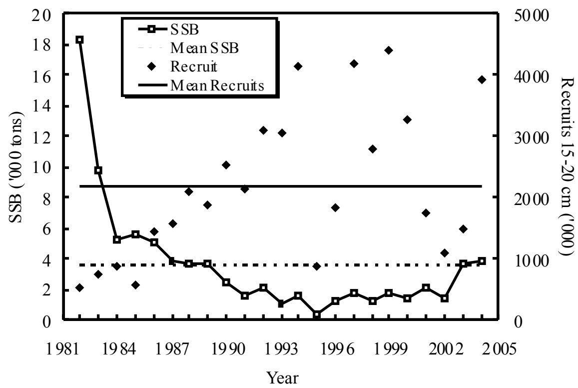
State of the American plaice stock: The stock remains severely depleted.

Assessment of Atlantic wolffish: No analytical assessment was possible.



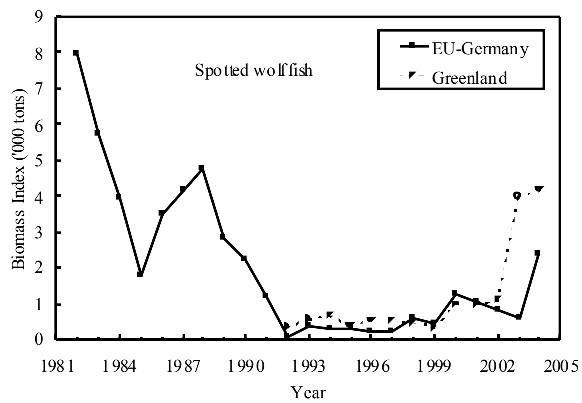
Recruitment: Index increased steadily up to 1995, but varied considerably thereafter.

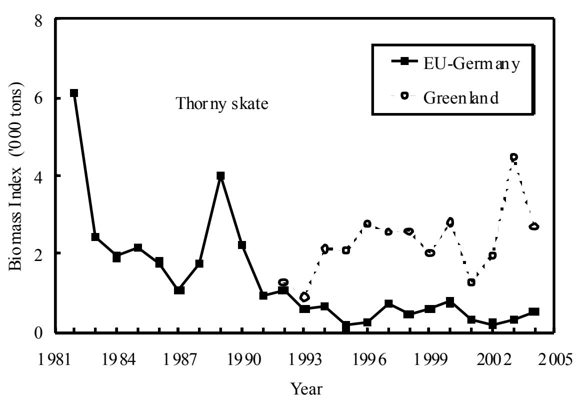
SSB: Since 1982, the SSB index decreased drastically and remained severely depleted since the early 1990s. SSB in 2003 and 2004 is at average.



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: Biomass indices for spotted wolffish show a weak increase since 2000. Thorny skate biomass indices are less clear, but after a decrease in 1980s, indices have remained at a 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 2006 and 2007. 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 in a position to propose reference points at this time.

Special Comments: The stocks of American plaice, Atlantic and spotted wolfish indicate significant recovery potential due to an increase in recruitment as well as the observed slight increases in biomass for the whole length range in the recent 2 years. They are presently composed of small and mainly juvenile specimens.

The probability of recovery of these stocks would be enhanced if the by-catch taken in the shrimp fishery were significantly reduced. The introduction of mandatory sorting grids on 1 October 2000 will probably reduce this by-catch.

Sources of Information: SCR Doc. 05/20, 33, 39, 41; SCS Doc. 05/9, 14, 15.

iii) **Greenland halibut (*Reinhardtius hippoglossoides*) in Division 1A inshore**

Scientific Council was requested: *to provide advice on Greenland halibut in Div. 1A inshore.*

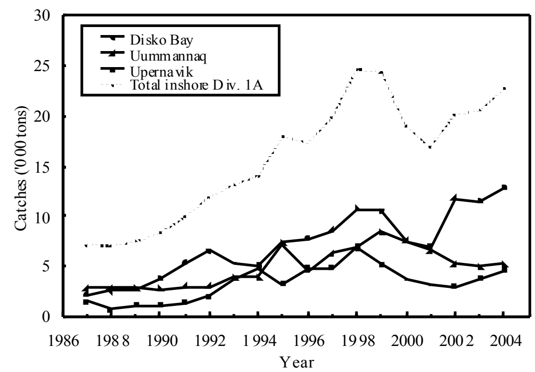
Greenland Halibut (Reinhardtius hippoglossoides) in Division 1A inshore

Background: The inshore stock is dependent on the spawning stock in Davis Strait and immigration of recruits from the offshore nursery grounds in Div. 1A and 1B. 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. Total landings in all areas were around 7 000 tons in the late-1980s but then increased gradually until 1998 when the landings were almost 25 000 tons. Landings then declined to 16 900 tons in 2001 but increased again during 2002-2004 reaching 23 000 tons. The latest increase in landings is observed for all three areas. In Uummannaq landings decreased from 1999-2003 but increased slightly in 2004 compared to 2003. Landings have increased by around 18% in Upernavik 2004 compared to 2003. In Disko Bay landings have been increasing since 2001 and in 2004 landings increased by 10% compared to 2003.

Area	Year	Catch ('000 tons) STACFIS	Advice ('000 tons) TAC
Disko Bay	2002	11.7	7.9
	2003	11.7	7.9
	2004	12.9	na[1]
	2005		ni[2]
Uummannaq	2002	5.4	6.0
	2003	5.0	6.0
	2004	5.2	na[1]
	2005		5.0
Upernavik	2002	3.0	4.3
	2003	3.9	2.4
	2004	4.6	na[1]
	2005		na[1]

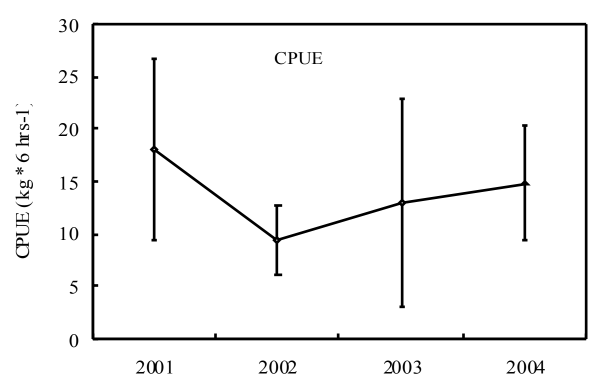
[1] No advice
[2] No increase in effort



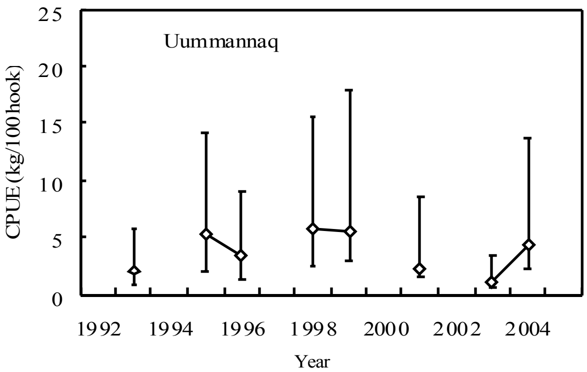
Data: Data on length frequency from commercial sampling were available for all three areas, and individual weight data were available for Upernavik. Catch rate and length frequency data were available from the longline survey in Uummannaq and a longline and gillnet survey in Disko Bay. A biomass estimate and recruitment index for age 1 was available from the Greenland shrimp trawl survey in Disko Bay. Catch-at-age data were available from Disko Bay and Uummannaq from 1988 to 2004.

Assessment: The lack of information on fishing effort makes it difficult to evaluate trends in landings relative to stock biomass.

Disko Bay: A new gillnet survey (2001-2004) shows stable catch rates over the last four years. Biomass indices from the shrimp survey, have from 1998 onwards been about twice as high as in previous years of the time series, indices have increased from 17 000 tons in 2003, which was the second highest on record, to 28 000 tons in 2004. Mean length in commercial catch shows a slight decrease over the last four years.

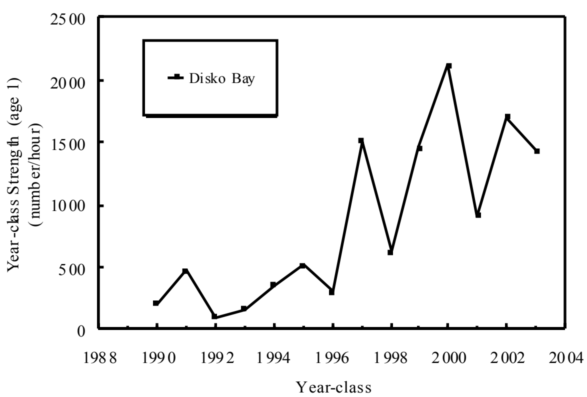


Uummannaq. Longline-survey abundance indices and landings decreased significantly from 1999 to 2003, but both survey index and landings increased slightly in 2004 compared to 2003. Mean lengths from both the surveys and in the fishery are relatively stable over the entire period, indicating that the trends in catch rates are for all lengths groups.



Upernavik. Surveys have not been conducted in Upernavik since 2000, sampling from the commercial fishery have not been carried out during 2002 to 2004, however length frequency sampling from the winter fishery in 2005 indicate that mean lengths have been stable during recent years. Sampling of individual weights in 2002-2005 shows a slight decrease in mean weight.

Recruitment: In recent years, indices of recruitment, at age one, from the shrimp survey seem to have been good, especially in Disko Bay. There is, however, uncertainty as to what degree these year-classes will contribute to the inshore fishery in the future.



State of the Stock: The age compositions in catches in all three areas have been reduced to fewer age groups compared to the early 1990s and the stock has thus become more dependent on incoming year-classes.

Disko Bay: CPUE index of abundance has been relatively stable in recent years; shrimp survey biomass has been increasing in the latest years.

Uummannaq. Survey CPUE indicates an increase in abundance until 1999. From 2001 to 2003 both landings and CPUE decreased significantly, but both landings and CPUE increased again in 2004.

Upernavik. Mean lengths in the winter fishery have been stable. But otherwise there is no basis to evaluate the state of the Greenland halibut stock in that area.

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

Disko Bay: From 2002 through to 2004 catches have been at a record high level. Gillnet survey CPUE, has been stable between 2002 and 2004, while the biomass has been increasing in the last two years, but both surveys primarily measures the pre-recruits to the fishable stock. Length distributions in the summer and winter fishery have been decreasing slightly.

Scientific Council is therefore not able to evaluate the impact of the recent increase in catches on the stock status, but expresses concern about the increase in catches. Scientific Council therefore recommends that effort should not be increased further in 2006.

Uummannaq: Catches have been steadily decreasing since 1999. In the same period the CPUE in the longline survey also decreased indicating that in recent years, catch levels of 6 200 tons (average catches 2000-2003) had been too high. Despite signs of slight recovery in survey data, Scientific Council advises that catch level in 2006 should not exceed last two years catch levels of 5 000 tons.

Upernavik: Due to the lack of information from surveys, no advice can be given.

Reference Points: not determined.

Special Comments: The lack of information on fishing effort makes it difficult to fully evaluate whether the change in catches is a result of a change in stock biomass or changing fishing effort.

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. 05/39, 58; SCS Doc. 05/14.

c) **Request by Canada and Denmark (Greenland) for Advice on TACs and Other Management Measures** (Appendix V, Annexes 2 and 3)

Canada requested the Scientific Council to subject to the concurrence of Denmark (on behalf of Greenland) as regards Subarea 1, to provide an overall assessment of status and trends in the total stock throughout its range and comment on its management in Subareas 0 + 1 for 2006, and to specifically: *advise on appropriate TAC levels for 2006, separately, for Greenland halibut in the offshore area of Divisions 0A +1AB and Divisions 0B+1C-F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of the resources* (Annex 2, Item 1a):

The Scientific Council response follows:

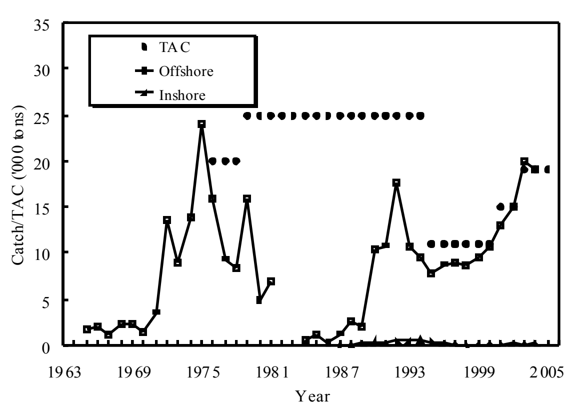
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 0 + Division 1A Offshore and Divisions 1B-1F

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 southward to Subarea 3.

Fishery and Catches: Due to an increase in offshore effort, catches increased from 2 000 tons in 1989 to 18 000 tons in 1992 and have remained at about 10 000 tons annually until 2000. Since then catches have increased gradually to 20 000 tons in 2003 primarily due to increased effort in Div. 0A and in Div. 1A. Catches dropped to 19 000 tons in 2004.

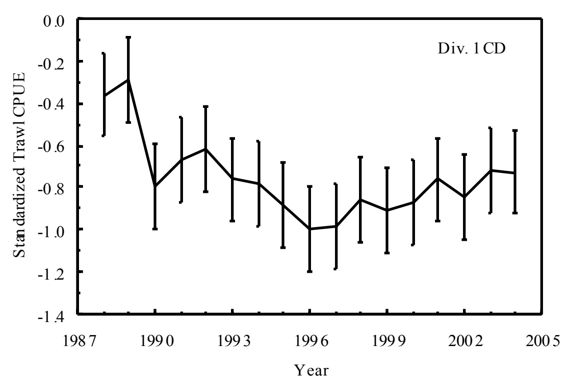
	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	15	15[1]	15[2]	15
2003	20	15[1]	19[2]	19
2004	19	7[1]	19[2]	19
2005			19[2]	19

1 Provisonal.
2 Including 4 000 tons allocated specifically to Div. 0A and 1A in 2002 and 8 000 tons from 2003 to 2005.



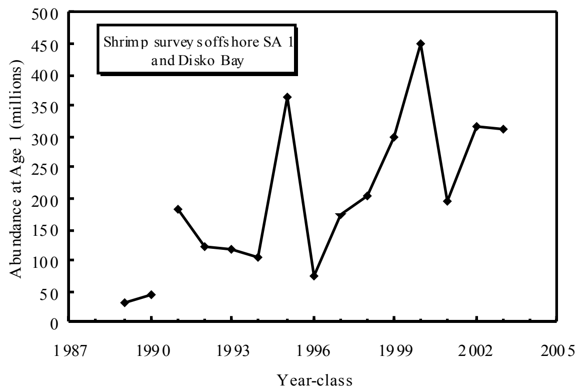
Data: Length distributions were available for assessment from SA0 and SA1. Standardized and unstandardized catch rates were available from Div. 1A and Div. 1CD. Biomass estimates from deep sea surveys in 2004 were available from Div. 0A, Div. 1A (73°N-77°N) and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2004.

Assessment: No analytical assessment could be performed. Combined standardized catch rates for SA 0 + Div. 1CD during 1990-2000 and standardized catch rates from Div. 1CD during 1990-2004 have been stable. Unstandardized catch rates in Div. 1A increased slightly between 2003 and 2004.

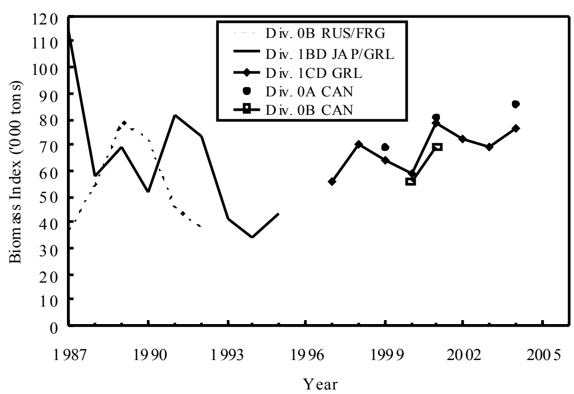


Fishing Mortality: Level not known.

Recruitment: Recruitment of the 2000 year-class at age 1 in the entire area covered by the Greenland shrimp survey was the largest in the time series, while the 2003 year-class was well above average. However, the recruitment of the 2003 year-class in the offshore nursery area (Div. 1A (to 70°N) - Div. 1B) was below average.



Biomass: The biomass in Div. 1CD in 2004 was estimated at 76 000 tons, above the average in eight years time series. The biomass in Div. 0A (south of 72°N) increased from 81 000 tons in 2001 to 86 000 tons in 2004. In two new surveys in the northern part of Div. 0A and Div. 1A the biomass was estimated at 46 000 tons and 54 000 tons, respectively. The biomass in the shrimp survey was estimated at 31 100 tons, which was almost exclusively found in Div. 1AB. The estimate is the highest in the time series.



State of the Stock: Length compositions in the catches has been stable in recent years. Based on survey indices from Div. 1CD the stock has been increasing since 1994 and is now at the level of the late 1980s and early 1990s.

Recommendation: Considering the relative stability in biomass indices and CPUE rates, for Greenland halibut in Div. 0B and 1C-1F the TAC for year 2006 should not exceed 11 000 tons.

In 2002, Scientific Council advised a catch of 8 000 tons for the developing fisheries in Div. 0A+1A. Based on new surveys in 2004 in not previously surveyed areas in the northern part of Div. 0A and 1A Scientific Council advises that TAC in Div. 0A and Div. 1A off shore + Div. 1B for 2006 should not exceed 13 000 tons.

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

Sources of Information: SCR Doc. 05/13, 14, 33, 39, 43, 51, 56; SCS Doc. 05/5, 8, 9, 12, 14.

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

i) **Roughhead grenadier (*Macrourus berglax*) in Subareas 2 and 3**

The Scientific Council on its own accord considered roughhead grenadier in Subareas 2 and 3 as given below:

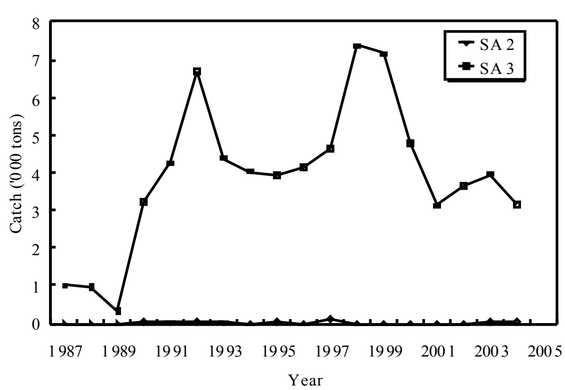
Roughhead Grenadier (Macrourus berglax) in Subareas 2 and 3

Background: Roughhead grenadier is distributed throughout Subareas 2 and 3 in depths between 300 and 2 000 m. This is not a regulated species

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

	Catch ('000 tons)	
Year	STATLANT 21A	STACFIS
2002	1.9[1]	3.7
2003	1.5[1]	3.8-4.2[2]
2004	1.7[1]	3.2
2005		

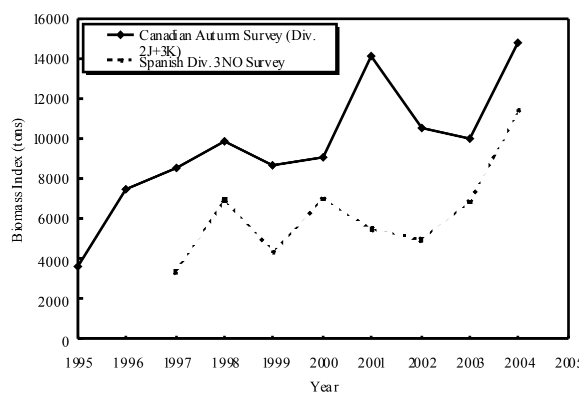
[1] Provisional
[2] STACFIS could not precisely estimate the catch.



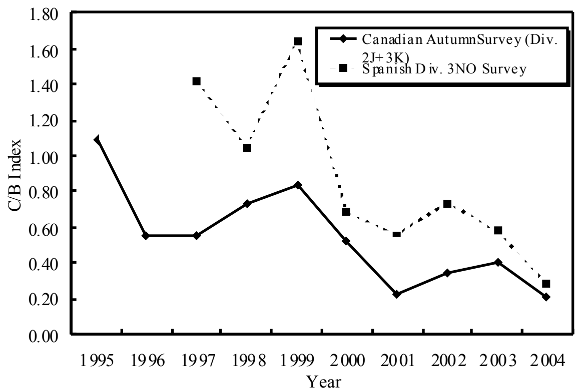
Data: Biomass indices were derived from: the Canadian stratified bottom trawl autumn surveys in Div. 2J and 3K since 1978, the Canadian stratified random bottom trawl spring surveys in Div. 3LNO since 1971, the Canadian stratified deepwater bottom trawl surveys in Div. 3KLMN in 1991, 1994 and 1995, the EU (Spain and Portugal) stratified bottom trawl Flemish Cap survey in Div. 3M since 1988 and the EU (Spain) stratified bottom trawl survey in Div. 3NO since 1997.

Assessment: No analytical assessment was possible with current data.

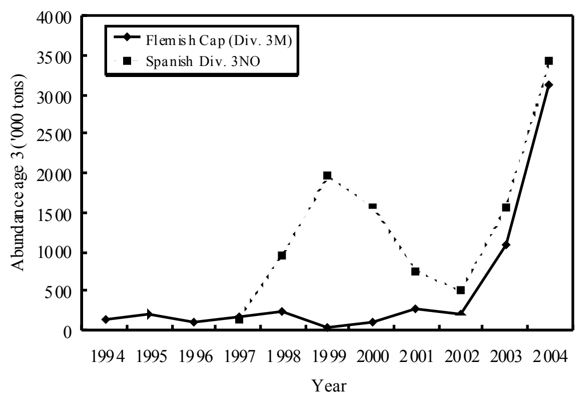
Biomass: Although the Canadian autumn survey series (Div. 2J+3K) and the Spanish survey in Div. 3NO do not cover the entire distribution of the stock, they are considered as the best survey information to monitor trends is resource status because their depth coverage is going down to 1 500 m. According to this survey information the roughhead grenadier total biomass indices indicate a general increasing trend from 1995 onwards.



Fishing mortality: The catch/biomass (C/B) index obtained using the Canadian autumn survey and the Spanish survey in Div. 3NO, is the lowest since 1995.



Recruitment: Abundance series for age 3 of the EU Flemish Cap survey and Spanish survey in Div. 3NO from 1994 to 2004 show a strong upcoming 2001 year-class in 2004.



State of the Stock: The biomass level is the highest in the time series from 1995.

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

Special Comments: It should be noted that immature fish constituted 92% of the catch in weight in 2004.

The next assessment will be held in 2007.

Sources of information: SCR Doc. 98/28, 05/8, 28, 29, 34, 36, 46, 54; SCS Doc. 05/5, 6, 8, 12.

VIII. FUTURE SCIENTIFIC COUNCIL MEETINGS 2005 AND 2006

1. **Scientific Council Meeting, September 2005, Tallinn, Estonia**

   The Council reconfirmed that the Annual Meeting will be held during 19-23 September 2005 in Tallinn, Estonia.

2. **Scientific Council Meeting, October/November 2005, Dartmouth, Canada**, (assessment of shrimp stocks) including proposal for joint meeting with ICES WGPAND.

   The Scientific Council agreed to the dates 26 October to 3 November 2005 for this meeting to be held jointly with the ICES *Pandalus* Assessment Working Group (WGPAND) at the NAFO Headquarters, Dartmouth, Nova Scotia, Canada.

   In order to facilitate the 2005 and future meetings the Chairs of Scientific Council, STACFIS and WGPAND have developed the following proposed plan for the 2005 meeting:

   The schedule and agenda will be developed by the Chairs Scientific Council, STACFIS and WGPAND. Each Chair will consult with the members of their own groups in this process. The STACFIS agenda will explicitly incorporate the assessments generally addressed by WGPAND.

   The Scientific Council portion of the meeting will be held as usual, chaired by Chair of Scientific Council.

   The assessments of the various shrimp stocks will be the joint responsibility of all meeting participants and will involve the participation of all members of STACFIS and WGPAND and will be chaired by Chair of STACFIS.

   The STACFIS report will contain the record of assessments as requested by the Fisheries Commission of NAFO and advice will be provided by Scientific Council on these requests. In addition, the assessments usually conducted by WGPAND will be contained in a special section of the STACFIS report. This special section of the report will be forwarded by the Chair WGPAND to the ICES ACFM. ICES will add an ICES front page on these sections. Chair WGPAND shall provide a 1st draft of the ICES advisory report in the ICES format. In 2005, these submissions will be made to ICES by 5 November 2005.

   Future meetings may incorporate review of methodological developments.

   The success of this meeting format and the need for future joint meetings will be assessed at the 26 October-3 November 2005 shrimp assessment meeting.

3. **Scientific Council Meeting, June 2006**

   The Council agreed to the dates of 1-15 June 2006 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada.

4. **Scientific Council Meeting and Special Session, September 2006**[1]

   Council noted that the Scientific Council sessions of the NAFO Annual Meeting for 2006 is scheduled for 6-15 September. Council was pleased that this does not overlap with the dates of the annual ICES Science Conference during 19-23 September 2006. The Council hoped that any conflict in dates between the two meetings can continue to be avoided in the future.

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[1] After the meeting it turned out that the dates for the Annual Meeting 2006 quoted above had been changed by General Council in 2004. The new NAFO Annual Meeting 2006 days (18-22 September) actually do overlap with the ICES Science Conference in 2006. Chair of Scientific Council and the Secretariat have taken action to request Contracting Parties to change the Annual Meeting dates in 2006.

5. **Scientific Council Meeting, November 2006** (assessment of shrimp stocks)

It is anticipated that the 2006 assessment of shrimp assessment meeting will be conducted in conjunction with ICES WGPAND, and will be at a location other than NAFO Headquarters, possibly ICES Headquarters.

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. **Progress Report on Special Session in 2006: "*Environmental and Marine Resources Histories in the NAFO Convention Area*"**

During the Symposium on the "*Ecosystem of the Flemish Cap*" participants felt that it would be valuable to have a Symposium organized by Scientific Council which compares the "*Environmental and Marine Resources Histories*" in the NAFO Convention Area. The Council agreed these "*Sub-Ecosystems*" should cover all the NAFO Subareas and comprise the Ecosystems of Greenland (East/West), Labrador Shelf/Grand Banks, Scotian Shelf Banks and Georges Bank. Similar to the Symposium "*The Ecosystem of the Flemish Cap*" held during 8-10 September 2004, the scope of the proposed Symposium should be to describe and compare these ecosystems considering their environmental and marine resources.

The Council at its meeting in September 2004 welcomed the proposed co-convenors; Bill Brodie (Canada), Helle Siegstad (Denmark/Greenland) and Manfred Stein (EU-Germany), but the Council agreed a convener from the USA would be valuable to address issues of SA 5 and 6. The Council invited Fred Serchuk to propose such a person intersessionally.

The Council was informed at this meeting that Dr. Jason Link from Population Biology Branch of NMFS, Northeast Fisheries Science Center, Woods Hole, USA, will be the fourth co-convenor.

The Council agreed to the following proposed theme sessions:

- *Large-scale climatic forcing on the physical oceanography of the Northwest Atlantic seas (Overview by Invited speaker);*
- *Physical and biological factors structuring ecosystems in the Northwest Atlantic (e.g., nutrient availability, sea ice, low temperatures, low species diversity, etc.);*
- *The transfer of energy and material through food webs, from primary producers through zooplankton and benthic fauna to fish, seabirds, marine mammals, and fisheries;*
- *Recent changes in NW Atlantic ecosystems, time scales of variation, and possible causes, including fishery effects;*
- *Inter-comparisons between marine ecosystems (e.g. between those in the NW Atlantic, and between NW Atlantic and other areas); and*
- *Economic, social impacts of ecosystem changes in NW Atlantic (Invited speakers from industry, communities, etc.).*

The next steps proposed were to prepare a poster for distribution this summer and to have discussions among convenors prior to the September 2005 Scientific Council meeting in Tallinn.

2. **Topics for Future Special Sessions**

There were no new topics discussed at this meeting.

X. REPORTS OF WORKING GROUPS

1. **Working Group on Reproductive Potential** (Chair: Ed A. Trippel)

Progress of the NAFO Working Group on Reproductive Potential was provided by Ed Trippel (Chair) and Joanne Morgan. The establishment of the Working Group on Reproductive Potential followed a recommendation of the Symposium on "*Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish*" hosted by NAFO Scientific Council from 9-11 September 1998, Lisbon, Portugal. The Working Group is comprised of members representing 9 countries (Canada, Denmark, Iceland, Ireland, Norway, Russia, Spain, United Kingdom, and USA).

The 4th Meeting of the NAFO WG on Reproductive Potential was held at FAO Headquarters, Rome, Italy, October 20-23, 2004. A total of 11 of the Working Group members were in attendance: Ed Trippel (Canada), Pauline King (Ireland), Gerd Kraus (Germany), Gudrun Marteindottir (Iceland), Joanne Morgan (Canada), Loretta O'Brien (USA), Richard Nash (Norway), Fran Saborido Rey (Spain), Jonna Tomkiewicz (Denmark), Peter Wright (UK), and Nathalia Yaragina (Russia). Local arrangements were provided by Fran Saborido Rey and Jorge Cirske (Chief of Marine Resources, Fishery Resources Division, FAO) which were greatly appreciated.

Significant progress on the second set of ToRs was achieved, both during the meeting and intersessionally. A brief summary of progress and future plans of each ToR are given below.

ToR 1: Co-Leaders: Jonna Tomkiewicz (Denmark) and Jay Burnett (USA)

Complete inventory of available data in standardized format on reproductive potential for fish stocks of the North Atlantic and Baltic Sea.

Members: everyone

The objective is to extend the tabulated information to comprise pelagic and demersal fish stocks in the North Atlantic, the Baltic Sea and the Western Mediterranean Sea. A total of 224 stocks have been identified, most of which have contributors. The existing 53 stock tables need to be updated to reflect the modified tabular format. It is anticipated that table preparation will be completed by late 2005, with a review of the quality and quantity of available data ready by late 2006.

ToR 2: Co-Leaders: Yvan Lambert (Canada) and Gerd Kraus (Germany)

Explore the use of correlation analysis to estimate the reproductive potential of fish stocks having limited data availability.

Members: Hilario. Murua (Spain), Nathalia Yaragina (Russia), Gudrun Marteinsdottir (Iceland), Peter Wright (UK), Peter Witthames (UK)

ToR 3: Co-Leaders: Hilario Murua (Spain) and Gerd Kraus (Germany)

Model the inter-annual and inter-stock variability in size-dependent fecundity for stocks having multi-year estimates.

Members: Olav Kjesbu (Norway), Peter Witthames (UK), Rick Rideout (Canada), Tara Marshall (UK), Yvan Lambert (Canada), Gudrun Marteinsdottir (Iceland)

These above two terms of reference are related and have been joined.

Identify proxies of fecundity/reproductive potential from ToR 3 (1st mandate of the WG) to be used in correlation analysis. Identify potential explanatory variables. At the stock level, these include stock identity (as a genetic variable), water temperature, prey abundance/availability, growth and surplus production. At the individual level, they include length, weight, condition (K), and liver index. Select multivariate statistical methods (e.g. cluster analysis, PCA) to group similar fecundity data and identify the most important explanatory variables of fecundity. Exploration of this approach has begun with a number of cod stocks in the Atlantic and the initial findings are positive.

ToR 4: Co-Leaders: Tara Marshall (UK) and Joanne Morgan (Canada)

Explore how the current use of biological reference points and medium-term projections can be adapted to include new information on reproductive potential.

Members: Loretta O'Brien (USA), Chris Chambers (USA), Hilario Murua (Spain), Gudrun Marteinsdottir (Iceland), Gerd Kraus (Germany), Coby Needle (UK)

A simulation study was presented at NAFO WG meeting in Rome, examining the effect of different fecundity exponents on slope at origin of S/R curve (a recommendation from the 3rd meeting of the WG). Small differences can produce large differences in the rate of population growth. This will be explored further using data from Icelandic cod and perhaps other stocks. Completion is expected by the end of 2005. Preliminary findings will be presented at the ICES 2005 annual meeting.

Work is underway to demonstrate for a variety of stocks the potential impact of different indices of RP on the setting of reference points and their use in stock projection. Compilation of data for several Canadian and European stocks is completed or underway. Expected completion date is the end of 2006. An example with Div. 3LNO American plaice was presented to STACREC during this June 2005 meeting of Scientific Council.

ToR 5: Co-Leaders: Peter Wright (UK) and Chris Chambers (USA)

Explore the consequences of fishery-induced changes in the timing and location of spawning to reproductive success.

Members: Jonna Tomkiewicz (Denmark), Saborido Rey (Spain), Rick Rideout (Canada), Ed Trippel (Canada), Gudrun Marteinsdottir (Iceland) and Joanne Morgan (Canada)

Literature review of spawning time and evidence of selection on birth date is underway. A study has started examining age related differences in spawning time using multinomial analysis. ToR members are supplying datasets to Peter Wright on select stocks and first results are expected by the end of August.

A simulation framework is being developed to evaluate the consequences of different spawning times via cohort simulation. In this framework key parameters are being varied to determine their effects on offspring fitness and population size.

ToR 6: Co-Leaders: Fran Saborido Rey (Spain) and Joanne Morgan (Canada)

Provide recommendations for the collection of required data in existing research surveys, sentinel fisheries and captive fish experiments that are required to improve annual estimates of reproductive potential for stocks varying in data availability.

Members: Anders Thorsen (Norway), Rick Rideout (Canada), Ed Trippel (Canada), Jonna Tomkiewicz (Denmark) and Jay Burnett (USA).

Type, quantity and quality of data that are needed to be collected to estimate reproductive potential will be identified. The importance as well as difficulty in sampling the variables will be considered Sampling strategies will differ depending on the fecundity type, i.e., for determinate and indeterminate species. Examples will be given. It has not yet been decided whether this should be a full sampling manual or a smaller set of guidelines

ToR 7: Co-Leaders: Loretta O'Brien (USA) and Nathalia Yaragina (Russia)

Explore the effects of the environment on Stock Reproductive Potential and how these relate of ToRs 2, 3 and 4.

Members: Chris Chambers (USA), Gerd Kraus (Germany), Rick Rideout (Canada), Yvan Lambert (Canada), Olav Kjesbu (Norway), Anders Thorsen (Norway), Tara Marshall (UK), Coby Needle (UK).

Scenario modelling will be used to determine how stock reproductive potential (SRP) responds in different environments (e.g. high, medium, or low temperatures, high or low age diversity). The effect of environment on SRP of about 20 stocks will be investigated using the final model (8 cod, 3 haddock, 3 herring, 2 American plaice, anchovy, sprat, redfish, and skate). Life table analyses will be employed in the modelling and an attempt will be made to establish a method to estimate juvenile survival. Initial results are expected in late 2005.

Future WG Activities

Scientific Council approved the progress of the WG and its future directions in completing the second set of ToRs. The format for publication of results for the second set of ToRs will likely include both peer and non-peer reviewed outlets and has yet to be determined for each specific ToR.

The 5th Meeting of the NAFO Working Group on Reproductive Potential will be held at the Institute Maurice Lamontagne, in Mont Joli, Quebec, during 26-29 October, 2005. Dr. Yvan Lambert (Canada) has kindly agreed to help coordinate local arrangements with the support of IML.

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

The Joint NAFO-ICES Working Group on Harp and Hooded Seals (WGHARP) will meet in St. John's during 30 August to 3 September 2005. Scientific Council **recommended** that *the WGHARP review the recent assessment of the status of Harp seals conducted by Canada and report its findings to the Annual Meeting of Scientific Council during 19-23 September 2005.* Scientific Council also **recommended** that *the WGHARP provide to the September 2005 annual meeting of Scientific Council the results of studies that are carried out regarding harp and/or hooded seals in the Northwest Atlantic, in particular any available results from tagging studies using satellite telemetry tracking.*

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. **Election of Chairs**

A nominating committee established by the Council at the beginning of this meeting composed of Bill Brodie (Canada), Susana Junquera (EU-Spain), Manfred Stein (EU-Germany) proposed the following candidates. The Scientific Council noted these positions will be for a 2-year period beginning immediately after the September 2005 Annual Meeting.

For the office of Chair of the Scientific Council the current Vice-Chair, Antonio Vazquez (EU-Spain) was nominated by the Committee. The Council elected him by unanimous consent.

For the office of Vice-Chair of the Scientific Council, Konstantin Gorchinsky (Russia) was nominated by the Committee. The Council elected him by unanimous consent.

For the office of Chair of the Standing Committee on Fisheries Science (STACFIS), Don Power (Canada) was nominated by the Committee. The Council elected him by unanimous consent

For the office of Chair of the Standing Committee on Publications (STACPUB), Manfred Stein (EU-Germany) was nominated by the Committee. The Council elected him by unanimous consent.

For the office of Chair of the Standing Committee on Fisheries Environment (STACFEN), Eugene Colbourne (Canada) was nominated by the Committee. The Council elected him by unanimous consent.

The Rules of Procedure determines that the elected Vice-Chair of Scientific Council would take the office of the Chair of the Standing Committee on Research Coordination (STACREC). Konstantin Gorchinsky (Russia) was accordingly elected to the office.

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

The Council noted a Scientific Council representative is usually appointed to attend the annual ICES ACFM meetings and report back on matters relevant to the Council. The Council was informed that the EU member from Latvia is a regular attendee of the ACFM meetings, and would be available to undertake the task. The Council extended its appreciation and invited the EU delegation to request his participation and report back to Council on important issues.

3. **General Plan of Work for Annual Meeting in September**

The Chair informed Council that the Fisheries Commission at its annual meeting in September 2005 is scheduled to start on Monday (19 September) afternoon, instead of the usual Tuesday's starting date. The Chair will present the Scientific Council's advice generated at this June 2005 Meeting to the Fisheries Commission on Monday afternoon, so that the information is tabled for early discussion at the Commission. The Council agreed that it will then have some time to address the shrimp assessments and present a verbal or written report to the Fisheries Commission later on during the meeting. The Chair will discuss the extent of the presentation with the Chair of Fisheries Commission in order to help tailor it to the needs of the Commission.

4. **Facilities, Technological and General Secretariat Support**

The Council discussed the meeting facilities and arrangements of this current meeting. The Council was fully satisfied with this year's arrangements, and agreed the venue for next year's meeting should remain the same.

5. **Other**

a) **Scientific Council Representation at STACFAD**

With respect to the September Annual meeting, the Scientific Council noted the importance of a Council representative to attend the STACFAD meetings particularly to address the budgetary aspects pertaining to the Council's activities. While it is anticipated that the present Council nominee, Chair of STACPUB, will continue to attend the STACFAD meetings this September, the Council found it prudent to appoint the Vice Chair of Scientific Council (who is STACREC Chair) as the alternate in the event that STACPUB Chair may not be available.

b) **Catch Data Reports**

The Council noted the difficulties in obtaining catch data in advance of the June meeting stock assessments, and noted in particular that both STACREC and STACFIS expressed the serious concerns at this meeting. Council felt that this problem is likely to get worse in the future. The Council accordingly saw the great importance of conveying the concerns and highlighting the problems to both Fisheries Commission and STACTIC. The Council Chair agreed to write to the Chair of Fisheries Commission on this matter.

c) **June Meeting**

The work load and length of the June Scientific Council meeting were discussed. It was noted that some assessments could be conducted on a less frequent basis than at present. It may also be possible to rearrange some of the work of the Standing Committees. Proposals for changes to the schedule of the June meeting were encouraged. Any proposals should be circulated to Council members prior to the 2005 annual meeting in September for consideration during that meeting.

XII. OTHER MATTERS

1. Possible Study Group to Evaluate HCR in the Context of the PA Framework

The Limit Reference Study Group (LRPSG) considered that it was highly desirable to evaluate LRPs and other reference points such as target and buffer reference points, through simulations in which the reference points are linked with Harvest Control Rules (HCRs) (SCS Doc. 04/12). Such simulations need to take into account uncertainty in estimates of the LRP and in the state of the stock.

Production models are easier to test than SPA-based models and the LRPSG suggested that NAFO start by taking the Div. 3LNO yellowtail flounder stock as a test case for developing and testing HCRs. HCR simulations will be particularly informative regarding the propagation of uncertainty and highlight situations such as when F is estimated with so high a CV that there is a problem of too high a probability of being on the wrong side of the limit even when in Safe Zone. For example, the target reference point of $2/3F_{msy}$ might result in a greater than 10% risk of falling below B_{lim}. Such an outcome would indicate an inconsistency in the LRP and acceptable risk levels, given the accuracy and precision of the assessment - either the LRP is too high, the risk tolerance too low, or the assessment is too uncertain.

Although Scientific Council viewed such studies as valuable, they did not feel they could form a study group at this time. Scientific Council encouraged research in this important area.

2. Report of 21st CWP Meeting, Copenhagen, Denmark, 1-4 March 2005

The 21st CWP Session was held at ICES Headquarters, Copenhagen, Denmark during 1-4 March 2005. The Executive Secretary and the STACREC Chair attended.

The session highlights were reviewed by STACREC, and the major topics of interest to NAFO were note in the STACREC report. The Council noted that all documents from the session are available on the CWP website http://www.fao.org/fi/body/rfb/cwp/cwp_home.htm.

3. Report from the FIRMS Steering Committee (FSC) Meeting of 25-26 February 2005

The Council noted the Executive Secretary and the STACREC Chair attended the meeting of the FIRMS Steering Committee (FSC), which was held during 25-26 February 2005 in Copenhagen, Denmark, prior to the CWP 21st Session. The Council noted that NAFO joined FSC in 2005 following the signing of the NAFO/FIRMS Partnership Arrangement by the General Council in 2004. Further details of the FSC meeting are available on the FIGIS website http://www.fao.org/fi/meeting/figis-firms.

4. Report of the FAO Committee on Fisheries (COFI) Meeting, Rome, 7-11 March 2005

The Executive Secretary and the STACREC Chair attended the meeting of the FAO Committee (COFI) in Rome, Italy 7-11 March 2005. STACREC discussed and reported on the proceedings. It was noted that the Ecosystem Approach to Fisheries discussed at COFI was of importance to the Scientific Council.

5. The FSC and CWP Intersessional Meeting 2006

This item was not discussed at Council.

6. Meeting Highlights for NAFO Website

The Chairs of each Committee submitted highlights of the meetings to the Secretariat. These will be placed on the website after this meeting.

7. Other Business

There was no other business.

XIII. ADOPTION OF COMMITTEE REPORTS

The Council, during the course of this meeting reviewed the Standing Committee recommendations. Having considered each recommendation and also the text of the reports, the Council **adopted** the reports of STACFEN, STACREC and STACPUB. At its concluding session on 16 June 2005, the Council adopted the recommendations of STACFIS and reviewed and adopted the report of STACFIS. It was noted that some text insertions and modifications as discussed at this Council plenary will be incorporated later by the Council Chair and the Deputy Executive Secretary.

XIV. SCIENTIFIC COUNCIL RECOMMENDATIONS TO GENERAL COUNCIL AND FISHERIES COMMISSION

The Council Chair undertook to address the recommendations from this meeting and to submit relevant ones, as follows to the General Council and Fisheries Commission:

> Recognizing the importance of reliable catch estimates to stock assessments and the considerable efforts of some Contracting Parties to produce more accurate catch estimates, Scientific Council **recommended** that *all Contracting Parties take measures to improve the accuracy of their catch estimates.*

XV. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 16 June 2005, the Council considered the Draft Report of this meeting, and **adopted** the report with the understanding that the Chair and the Deputy Executive Secretary will incorporate later the text insertions related to plenary sessions of 2-16 June 2005 and other modifications as discussed at plenary.

XVI. ADJOURNMENT

The Chair thanked the participants for their hard work and cooperation, noting particularly the effort of the Designated Experts and the Standing Committee Chairs and congratulated the incoming Chairs on their elections. The Chair thanked the Secretariat for their valuable support. There being no other business the meeting was adjourned at 1100 hr on 16 June 2005.

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

Chair: Eugene B. Colbourne Rapporteur: Gary L. Maillet

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 3 and 9 June 2005, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal and Spain), Russian Federation and Ukraine.

1. Opening

The Chair opened the meeting by welcoming participants to this June Meeting of STACFEN. The Chair welcomed Dr. Mariano Koen-Alonso from the Northwest Atlantic Fisheries Centre in St. John's, Canada as this year's invited speaker.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 05/1, 2, 5, 6, 7, 12, 19, 22, 23, 24, 31, 42, 44; SCS Doc. 05/5, 7, 12, and 14.

Gary L. Maillet (Canada) was appointed rapporteur.

2. Invited Speaker

The Chair introduced this year's invited speaker, Dr. Mariano Koen-Alonso (Northwest Atlantic Fisheries Centre in St. John's, Canada). The Committee was informed his research included multi-species modeling of the Patagonian Shelf off Argentina and is currently implementing a similar model for the Newfoundland and Labrador ecosystem. His presentation entitled "Multi-species bioenergetic-allometric models and ecosystem-based management: a synoptic (personal, and probably biased) view of the lessons learned and the road ahead", presented here is submitted to STACFEN as an abstract (SCR Doc. 05/42). The following is a summary of his presentation and the subsequent discussion.

Some of the core features of Ecosystem-based Management (EBM) were highlighted including (a) the concept of sustainability, both in terms of the ecological and socio-economic systems, (b) the requirement of integrating the management of all human activities which take place and/or use a common ecological system, (c) an objective-oriented framework, and (d) the conservation emphasis is put on preserving ecosystem structure and function, not just specific components of the ecosystem. Three approaches for building the EBM knowledge base can be distinguished: adaptive learning, soft predictability, and hard predictability. The "adaptive learning" approach implies abandoning any attempt of detailed understanding and it is focused in regulating the overall pressure on the system. It relies on meta-indicators which synthesize the overall state of the ecosystem without attempting to track specific interactions (e.g. mean trophic level of the catch, diversity indices), and the control of overall pressure can only be done through adaptive management. There is not necessarily *a priori* understanding of the processes which link human activities and indicators, and hence long term impacts of specific activity levels cannot be predicted. The "soft predictability" approach is based on structured sets of indicators. For example, in the Pressure-State-Response framework, a typical soft predictability approach, indicators are classified as indicators of pressures (e.g. effort), states of the system (e.g. size-spectrum), and responses (e.g. management actions). They are structurally linked and management is based on monitoring pressures and states of the system under examination. Relationships between pressure, state, and response indicators are typically assumed linear, or at least monotonic, and only direct pressure indicators are considered. This approach relies more heavily on qualitative or semi-quantitative predictions of the links/relationships in the system, together with a timely monitoring of the preselected indicators. The "hard predictability" approach is seen as an extension of current single species approaches which incorporate ecosystem considerations into the evaluation of impacts and responses to regulation. Typically it takes the form of quantitative dynamic models which can be multi-species and/or single species but with explicit inputs from the community/ecosystem. This approach relies more heavily on quantitative and highly accurate predictions of the dynamics of the exploited system.

The marine community of northern and central Patagonia is structured around the trophic triangle conformed by anchovy (*Engraulis anchoita*), squid (*Illex argentinus*) and hake (*Merluccius hubbsi*). Although all of them are commercial species, only squid and hake sustain major commercial fisheries. Another important industry in the region is wildlife-based tourism, and the sea lion (*Otaria flavescens*) is the most abundant marine mammal which actually forages on the Patagonian Shelf. Therefore, there is potential for conflicts of interest among human activities. In simple terms, if sea lions compete with fisheries for food resources, more sea lions might be a good thing for tourism but a bad thing for fisheries. This scenario makes this system a nice study case for exploring the different approaches to the EBM knowledge base. Early comparisons of top predators' food habits and the composition of fisheries catches have suggested that simple diet indicators can provide contradictory answers about the potential for competition between top predators and fisheries. Furthermore, these indicators usually assume a static view of the system (e.g. constant diets). To address some of these issues, multispecies models were developed. These models were purely trophodynamic (i.e. no environmental effects were included) and based on a bionenergetic-allometric framework. This framework describes population dynamics using a bioenergetic rationale and assumes that core model parameters can be described as power functions of individual body mass. To assess structural uncertainty, five different models were compared. The difference among them was the formulation of the functional response (i.e. the mathematical representation of the predation process), and the Akaike Information Criterion was used for model selection. Parameter uncertainty was assessed for the selected models by exploring their behaviour with extreme parameter values (i.e. parameter sets with the lowest likelihoods but still within the 95th percentile range). These simple models described the hake and sea lion dynamics fairly well, but the dynamics of lower trophic level species like squid and anchovy were poorly captured. Although the two selected models had similar fits to the data, they also produced different predictions under some exploitation scenarios (i.e. some predictions were model-dependent). In general, predictions from these models had high levels of uncertainty. Responses in the equilibrium biomasses to changes in exploitation rates were often counter-intuitive, typically nonlinear, and in most cases, non-monotonic (i.e. changes in exploitation rate not only can affect the magnitude of the response, but also its sign). In terms of their implications for building the EBM knowledge base, these results reinforce the idea that monitoring indicators *per se* is not enough to assure a sustainable use of the system, we need to understand the processes which drive indicators to change. They also suggest that linear simplifications, although useful, are unlikely to suffice to achieve this goal; medium and long-term planning should also consider indirect effects. We should expect nonlinear and non-monotonic responses to exploitation.

Another necessary component that needs to be considered is the effect of environmental variables on system dynamics. Due to its ubiquitous role, temperature is a reasonable starting point. As part of current allometric theory, recent developments provide a mechanistic description for temperature-dependence of metabolic rates. Because temperature is a modulator of individual metabolism, many temperature-related changes in a given population can be associated with temperature-dependent changes in the metabolism of the focal and other species in the system. The effects on these other species will reach the focal species through trophic interactions within the food web. Therefore, temperature-dependent metabolic rates in bioenergetic-allometric models should allow the incorporation of some of the potential effects of temperature. Fortunately, Vasseur and McCann (2005) recently expanded the Yodzis-Innes framework to allow for temperature-dependent vital rates. Now, we have the tools to start exploring some of the potential effects of temperature on multispecies dynamics within a mechanistic framework. Although incorporating environmental variables like temperature will certainly contribute to the completeness of any EBM implementation, probably the biggest issue for EBM does not lie in the target ecosystem itself. Ecological systems are being exploited all over the world, and the global economy links them through a common market. For example, fishery products from any corner of the planet can be found in the typically well provided markets of Japan or Spain, while American and German tourists have the choice of doing whale-watching in Newfoundland or Patagonia. In our economically connected world, the socio-economical sustainability of exploited ecosystems not only depends on the ecological sustainability of its own resources, it may also depend on the management practices in faraway ecosystems. The integration of ecological and socio-economical sustainability is the ultimate challenge for EBM. These considerations suggest that we have a long and difficult road ahead of us. Finally on more practical grounds, although current multi-species modelling approaches can provide a much-needed complement to classical single-species stock assessment within an EBM context, they do not constitute a magic tool. Multi-species models add one more layer of complexity over single-species ones, and hence, they do not replace single-species assessments. Instead, they integrate them. Successful EBM will most certainly require more and better information, including single-species assessments.

Overall the response from the Committee to Dr. Koen-Alonso lecture was very positive in support of implementation of ecosystem-based models to evaluate the potential effects from multiple fishing activities and environmental variability on resource populations in the NW Atlantic. Several questions were posed regarding some expectation of the multi-species models under various exploitation scenarios. For example, what happens when fishing is directed at multiple species simultaneously? In that case, it was indicated that the response would largely depend on which suite of species was being exploited and the relative intensity. Possible outcomes may include oscillating type behavior to effects that may cancel each other. It was also stressed that both linear and non-linear processes may be acting together to further complicate the system behavior. It was also indicated that it would be necessary to evaluate alternative exploitation scenarios and testing input data in order to derive information that will assist in model development and testing of goodness of fit criteria.

A general comment concerning the movement toward implementation of the ecosystem approach using as few stock indicators as possible in order to minimize the relative costs of assessments was considered. The general consensus from the Committee was that many of the present indicators being used were not proving to be reliable as measures of stock performance. It was stressed that EBM approach will continue to rely on both single species and multiple species assessments in order to explore, integrate, and evaluate interactions among resource populations. General agreement among Committee members supported continued efforts be made in the provision of high quality stock assessments in order to fully implement EBM's in the NW Atlantic. It was also stressed that both single species and multi-species assessments will be needed in order to develop an understanding of the potential interactions among component species in a dynamic ecosystem which has been shown to exhibit large changes in both demersal and pelagic fish and invertebrate stocks over the last decade.

Other comments raised the issue of the importance of large-scale indices such as climate change and socio-economic factors and their role in influencing species interactions and model behavior as well as their potential influence on human activities of fishing practices on marine resource populations. How these types of considerations will be incorporated in such an approach was put forward for discussion and debate, but was not resolved at this time. It was also pointed out that earlier lessons learned from model development in the South Atlantic are at present being extended to assist with efforts to apply the EBM approach in the north Atlantic system. Another question revolved around the application of suitable criteria to define and track sustainability criteria despite the relatively high variability observed in natural systems and the adaptability of natural resource populations to large changes in the ecosystem. Given these inherent difficulties, discussion regarding development of suitable criteria that may be useful in order to characterize current management practices as sustainable *versus* non-sustainable was debated.

The issue of integrating environmental variability into the model was addressed and discussed at length. The incorporation of important variables such as temperature and salinity changes and how they might influence other important physical processes such as mixing and stratification and their incorporation into the multi-species models was briefly addressed. The issue of model complexity was raised as an important point in the initial model development since the addition of more parameters increases the complexity and uncertainty in the model output results. Therefore, it was stressed that tradeoff's with incorporating additional complexity into the model from environmental sources and accuracy and robustness of the model output are important considerations. It was suggested that environmental processes could be incorporated into the model development through their impact on metabolic, growth, and mortality processes and is currently under consideration as part of the proposed model for the Newfoundland and Labrador ecosystem. It was also suggested that prior to incorporating additional complexity into the model, it would be recommended to evaluate the basic behavior of the models and predictability firstly before exploring additional parameters. In addition, incorporation of the lower trophic levels, such as phytoplankton and zooplankton populations as basal species may be a reasonable way to further develop and explore the potential impact of environmental variability.

3. **Marine Environmental Data Service (MEDS) Report for 2004** (SCR Doc. 05/24)

Since 1975, MEDS has been the regional environmental data centre for ICNAF (to 1979) and subsequently NAFO and as such is required to provide an inventory of all environmental data collected annually by Contracting Parties of NAFO within the Convention Area. It was noted that, as of June 2004 Canada, Spain and the USA have submitted high resolution water column profile data for 2004 in the NAFO Convention Area. It was indicated that the data collected by Danish Meteorological Institute and the Greenland Institute for Natural Resources had submitted data for Subarea 1, but as of 4 June 2005 it was not received by MEDS. It was also indicated that arrangements are in progress to transfer oceanographic data collected in Subareas 0 and 1 in 2004 by the Federal Republic of Germany's Research Centre for Fisheries and Canada's Department of Fisheries and Ocean's, Freshwater Institute to MEDS.

For the NAFO area, subsurface vertical profiles as well as surface observations, sample a variety of parameters such as temperature, salinity, oxygen, nutrients and other chemical and biological variables. MEDS receives these data either in real-time (within one month of observation) *via* the Global Telecommunications System reporting system or in delayed-mode directly from responsible institutions, and indirectly from national cruise summary reports and other reports of marine activities. The following is the inventory of oceanographic data obtained by MEDS during 2004 and information on several recent activities.

i) **Hydrographic data collected in 2004**

Data from 7 569 oceanographic stations collected in the NAFO area sent in delayed mode to MEDS in 2004 have been archived, of which 4 859 were CTDs, 1 654 were BTs and 1 056 were bottles. A total of 65 566 stations were received through the GTSPP (Global Temperature and Salinity Profile Programme) and have been archived, of which 1 894 were BTs and 63 772 were TESAC messages. This is a marked increase from the previous year (9 303) and is the result of hourly temperature and salinity profiles collected by buoys in the Gulf of Maine Ocean Observing System (GoMOOS).

ii) **Historical hydrographic data holdings**

Data from 9 399 oceanographic stations collected prior to 2004 were obtained and processed during 2004, of which 1 152 consisted of vertical CTDs, 4 939 were towed CTDs, 1 891 were BTs and 1 417 were bottle data.

iii) **Thermosalinograph data**

A number of ships have been equipped with thermosalinographs to collect surface temperature and salinity data while the vessels are under way. These are transmitted as station data *via* satellite and radio links with 1 191 stations in the Northwest Atlantic being received during 2004, up from the 592 stations received during 2003.

iv) **Drift buoy data**

A total of 65 drift-buoy tracks within NAFO waters were received by MEDS during 2004 representing 84 106 buoy messages and approximately 207 buoy months of data. The total number of buoys received decreased by 23 from 2003, but the total number of messages increased by 9 000.

v) **Wave data**

During 2004, MEDS continued to process and archive operational surface wave data on a daily basis around Canada. One-dimensional and directional wave spectra, calculated variables such as the significant wave height and peak period, concurrent wind observations, if reported, and the raw digital time series of water-surface elevations were stored. A total of 8 wave buoy stations were operational in the NAFO area during 2004 which is the same as 2003 but lower when compared to 2001 where there were 15.

vi) **Tide and water level data**

During 2004, MEDS continued to process and archive operational tides and water level data that are reported on a daily to monthly basis from the Canadian water level network. MEDS archives observed 15-minute heights, hourly heights and monthly instantaneous extremes collected around Canada. Approximately 70 000 new readings are updated every month from the network. The historical tides and water level data archives presently hold over 30 million records with the earliest dating back before 1900. A total of 28 stations were processed during 2004.

vii) **Current meter data**

A total of 46 current meter instruments were recovered in the NAFO area during 2004 and an additional 57 instruments were deployed. These included both conventional current meters and Acoustic Doppler Current Profilers (ADCPs). The recovered data are processed at the Bedford Institute of Oceanography (BIO) and are available on the web (http://www.maritimes.dfo.ca/science/ocean/welcome.html).

viii) **Recent activities**

MEDS reported on two other initiatives during 2004:

a) Argo is an international program to deploy profiling floats on a 3° by 3° grid in the oceans of the world. Each profiling float samples and reports both temperature and salinity from 2 000 m to the surface every 10 days. Data are distributed both on the Global Telecommunications System (GTS) and from two Internet servers within 24 hours of the float reaching the surface. MEDS carries out the processing of the data received from Canadian floats, to distribute the data on the GTS, to distribute the data to the Argo servers and to handle the delayed mode processing. As well, MEDS has developed a Canadian web site (http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/ argo/ArgoHome_e.html) that contains information about the Canadian floats, as well as some general information and statistics about the global array. General information is also available from the Argo Information Centre in Toulouse. In 2004, Canada deployed 29 floats in total which include 16 in the North Atlantic.

b) The Canadian DFO's Atlantic Zone Monitoring Programme (AZMP) activities include regular sampling for 6 fixed stations and 13 standard sections, and research surveys in the AZMP area to collect other physical, chemical and biological data. As part of MEDS' activities in the data management team, MEDS continues to build and maintain the AZMP website: http://www.meds-sdmm.dfo-mpo.gc.ca/ zmp/main_zmp_e.html. Physical and chemical data as well as graphical representations of the data from 1999 to the present are currently available on the web site. New developments for this year include phytoplankton data, wind related climate indices, Labrador Current transport index and new links within the remote sensing section.

4. Review of the Physical, Biological and Chemical Environment in the NAFO Convention Area During 2004

i) **General meteorological, sea-ice and sea-surface temperature conditions**

A review of meteorological, sea ice and sea-surface temperature conditions in the Northwest Atlantic in 2004 was presented (SCR Doc. 05/5). During 2004, the winter NAO index was below normal (~9 mb) for the fourth consecutive year and close to the 2001 value. A negative NAO index implies weakened winds, higher air temperatures and reduced heat loss from the ocean during winter over the Labrador Sea and partly over the Labrador and Newfoundland Shelf. Because of the important role that southward advection plays on the Canadian Atlantic seaboard, the effects of a negative (positive as well) NAO index, particularly four successive years of negative values, are eventually felt throughout the region. Annual average air temperatures were above normal by ~1.2°C over the Labrador Sea and Shelf, the Newfoundland Shelf and the Gulf of St. Lawrence; Scotian Shelf and Gulf of Maine air temperatures were about 0.4°C below normal. The winter wind anomalies over the Labrador Sea were generally towards the northwest at about 1-2 m/s, consistent with the negative NAO index and implying reduced heat flux from the ocean to the atmosphere. The Newfoundland ice coverage was the 2nd lowest in 42 years and its duration was generally less than average; the Gulf of St. Lawrence coverage was also less than normal ranking 11th of 42 years and its duration was typically less than average; on the other hand, the Scotian Shelf, where most of the ice is the result of export from the Gulf, featured unexceptional coverage (rank 19th of 43 years) with ice duration slightly longer than normal. The 262 icebergs that reached the Grand Bank was considerably less than the 927 in 2003 and the 5th lowest since 1985, when more accurate counts became available. The analysis of satellite data indicates a north-south gradient of sea-surface temperatures similar to the air temperature distribution. The Labrador Sea and Shelf, the northern Newfoundland Shelf and northern Grand Bank, featured sea-surface temperature anomalies that were 0.2-0.5°C above normal. Southeast Shoal and St. Pierre-Green Bank temperatures were slightly below normal. Above normal sea-surface temperatures were seen in the northeastern Gulf of St. Lawrence but the rest of the Gulf had values slightly below normal. Sea-surface temperatures on the Scotian Shelf and in the Gulf of Maine were 0.3-1.1°C below normal.

A review of meteorological and sea ice conditions around Greenland during 2004 was presented (SCR Doc. 05/2). The pattern of sea level atmospheric pressure over the North Atlantic was anomalous during winter of 2003/2004. The pressure anomaly fields during this winter differed considerably from a dipole pattern which is usually present in the North Atlantic region, with two pressure anomaly cells, one in the Icelandic Low area, the other in the Azores High area. As a consequence of this unusual anomaly pattern, the North Atlantic Oscillation (NAO) index for the winter 2003/2004 was weak and negative (-0.60). During the second half of the last century the 1960s were generally "low-index" years while the 1990s were "high-index" years. There was a major exception to this pattern occurring between the winter preceding 1995 and the winter preceding 1996, when the index flipped from being one of its most positive values to its most negative value this century. The direct influence of NAO on Nuuk winter air temperatures indicates that "low-index" year corresponds with warmer-than-normal conditions. Colder-than-normal climatic conditions at Nuuk are linked to "high-index" years. This indicates a negative correlation of Nuuk winter air temperatures with the NAO. Correlation between both time series is significant (r = -0.73, $P \ll 0.001$).

The annual air temperature cycles referenced to the climatic means at three sites off west and east Greenland were examined (SCR Doc. 05/2). March was the coldest month off West Greenland during 2004. At Egedesminde temperatures were mostly above normal, the Nuuk air temperatures reveal colder-than-normal conditions during March, July and December. The positive air temperature conditions as observed during December 2003 at the West Greenland sites were maintained through to January 2004. Air temperature anomalies during March were +2.5°C at Egedesminde and –0.8°C at Nuuk. Angmagssalik experienced climatic conditions which were mostly above the climatic mean throughout the year, except for December when air temperature anomalies were –0.3°C. The annual mean air temperature anomaly at Nuuk for 2004 was +1.1°C. This is a continuation of a series of warmer-than-normal years (0.2°C to 2°C) which started in 1996, with the exception of 1999 which was colder-than-normal (-0.3°C). Winter sea ice conditions were light during 2004 off West Greenland. The sea ice drift has a significant offshore component which is called the "West Ice". The southernmost location of the ice edge of "West Ice" was found around the end of March off Maniitsoq/Sukkertoppen. Multi-year sea ice coming from the Arctic Ocean *via* the East Greenland current to the Cape Farewell area is called "Storis". During early June the East Greenland coast was surrounded by sea ice with concentrations ranging from 7-10th. Sea ice formed again in Baffin Bay in the first decade of November when 4-10th of ice concentration was observed north off Baffin Island. Off East Greenland first sea ice formation was encountered in the Angmagssalik area and to the north during the third week of November.

An analysis of air-sea heat fluxes and sea-surface temperature conditions in the Labrador Sea was presented (SCR Doc. 05/7). On an annual average, the Labrador Sea loses heat to the overlying atmosphere. The greatest heat losses occur in January and February. The air-sea heat flux pattern during 2004 was similar to normal conditions however the maximum in the heat loss pattern for 2004 is displaced about 200 km to the northwest compared to the normal pattern. Values in the west-central Labrador Sea in 2004 were 20-30 W/m^2 less than normal. Annual mean heat losses at this location have been less than normal for the past seven years. The 2004 annual mean of 39 W/m^2 was the second lowest since 1987, with 2001 being the lowest. The winter (JFM) 2004 seasonal residual was the lowest since 1987 and the sixth lowest in the 1948-2004 time series. The 2004 SST map and the normal map show similar patterns, but again the isotherms in the 2004 map are displaced about 200 km to the northwest compared to the normal pattern. Values in the west-central Labrador Sea in 2004 were more than 1°C warmer than normal. Annual mean SST at this location has been warmer than normal since the mid-1990s. Both the 2004 annual mean and the 2004 winter (JFM) seasonal residual were record highs for

1960-2004. These changes reflect a northward shift of normal regional patterns of heat flux and sea-surface temperature by several degrees of latitude. Mean 2004 sea-surface temperatures in the west-central Labrador Sea from the UK Meteorological Office Hadley Centre's global sea-surface temperature data set were the warmest in the past 45 years.

In 2004 monitoring of sea-surface temperature (SST) at locations in the Labrador, Gulf Stream and the North Atlantic Currents were completed (SCS Doc. 05/5). For this purpose the mean monthly SST deviation from the long-term mean values for the period from 1977 to 2002 at 13 points located in NAFO Div. 2J, 3KLMN, 4VWX and adjacent open-sea area were used. At several locations in the Labrador Current and to the north of Flemish Cape positive deviations of SST were observed which were close to, or slightly higher than in those of 2003. Insignificant negative deviations were noted only in the winter period. In the North Atlantic Current area SST values were slightly below normal in spring, while in other seasons positive deviations were recorded. These temperatures were similar to that observed during 2003. On the Grand Bank of Newfoundland SST during 2004 was close to the long-term mean and to the level observed during 2003. Low negative anomalies were recorded at this location also in spring of 2004. On the Scotian Shelf SST was close to normal and was slightly lower than those in 2003. The lowest SST values in this area were observed on the shelf slope, where negative anomalies occurred in winter, spring and autumn. In all seasons SST values in this area were lower than in 2003. A similar SST pattern was recorded in the slope water mass of the adjacent ocean area. In the Gulf Stream front positive anomalies of SST were observed during 2004, similar to 2003.

ii) **Results of physical, biological and chemical oceanographic studies in the NAFO Convention Area**

Subareas 0 and 1. Hydrographic studies were conducted along standard sections off the west coast of Greenland during an oceanographic survey in the summer of 2004. The survey was carried out according to the agreement between the Greenland Institute of Natural Resources and Danish Meteorological Institute during the period 21 to 29 June 2004. In mid-July to early August the Greenland Institute for Natural Resources also carried out trawl surveys in the Disko Bay area and further north on board R/V *Paamiut*. During these surveys CTD measurements were carried out on national oceanographic standard stations (SCR Doc. 05/19; SCS Doc. 05/14).

During October and November 2004 the FRV *Walther Herwig III* conducted oceanographic observations at NAFO standard oceanographic sections Cape Desolation, Fylla Bank and along a new oceanographic section between Greenland and Canada. This section followed the NAFO standard section Holsteinsborg and the historical stations occupied by the Canadian RV *Hudson* during the autumn of 1965. During the German groundfish autumn survey oceanographic measurements were also performed at 65 fishing stations off West Greenland using a CTD-Rosette system (SCR Doc. 05/2 and SCS Doc. 05/9).

Two stratified random surveys were carried out in the Subarea 0 from September 4 to 12 and from 14 to 24 October 2004 on board the R/V *Paamiut* (SCR Doc. 05/44). This was a collaborative effort between Fisheries and Oceans Canada, the Nunavut Wildlife Management Board, Baffin Fisheries Coalition, Government of Nunavut, Nunavut Tungavik Inc., Indian and Northern Affairs Canada, and the Greenland Institute of Natural Resources. The first survey covered the northern portion of Div. 0A (72°N to 76°N) and the second survey covered the southern part of Baffin Bay. A Seabird 19 CTD equipped with a fluormeter was deployed at 4 stations along the Cape Jamenson Section and 5 stations along the Cape Liverpool-Lancaster Sound Section in September. During the October, survey 5 stations were sampled along the Cape Christian section in Baffin Bay. In addition, a Seamon temperature logger was mounted on one of the trawl doors and provided bottom temperature data for most fishing sets.

Results of the 2004 Danish summer surveys to the standard sections along the west coast of Greenland were presented together with CTD data obtained during their trawl surveys (SCR Doc. 05/19). The surface temperatures and salinities observations during 2004 show cold and low salinity conditions close to the coast off southwest Greenland reflecting the inflow of polar water to the area by the East Greenland Current. Water of Atlantic origin ($T>3^{o}C$; $S>34.5$) is found at the surface at the two outermost stations on the Cape Desolation section and on the outermost station on the Paamiut (Frederikshaab) Section. Temperature and salinity observations at intermediate depths showed that pure Irminger Water

(T ~4.5°C, S >34.95) was present at the Cape Desolation and (Paamiut) Frederikshaab sections. At the Fylla Bank section, the maximum salinity is very close to 34.95 with temperatures >5°C, which can almost be classified as Pure Irminger Water. Modified Irminger Water (34.88 < S < 34.95) was traced up to the Maniitsoq section. The northward extension of pure Irminger Water up to Fylla Bank indicates high inflow of water of Atlantic origin to the West Greenland area during 2004. The average temperature and salinity at 400-600 m depth observed west of Fylla Bank, which is where the core of the Irminger Water is normally found, indicates that the inflow of Irminger Water was high in 2004. The temperature of this layer was >5°C which is near 1°C higher than normal and the average salinity of 34.93 is 0.12 higher than normal and is the highest observed in the 54 year time series. The time series of mid-June temperatures on the top of Fylla Bank was about 1.5°C above average, while the salinity was slightly higher than normal. In general, temperatures in this area have been increasing since the mid-1990s and since 2000 the mean salinity in the 400-600 m layer has increased, indicating a strengthening of the Irminger Current. The surface salinity seems in general to be close to normal. The "Storis" (ice transported by the East Greenland Current), is occupying the Julianehaab Bight and this sea-ice is observed up to 61°N, which is normal for this time of the year. In the surface layer (0-100 m) week gradients between the cold, low-saline Polar Water and the warm, high-saline water of Atlantic origin was observed. Normally there is a very pronounced core of Polar Water, revealed by its low temperatures, just west of Fylla Bank at depth of 50-100 m, but in 2004 this core was hardly recognizable which is a sign of a reduced inflow of Polar Water in 2004. The core was even more absent than in 2002 and comparable to the conditions in 2003, indicating a low intensity in the East Greenland Current component. The weak Polar Water core is also observed at the Sisimiut (Holsteinsborg) Section from June and it has almost disappeared one month later in July, whereas the water of Atlantic origin is found in larger quantities in July. The strength of the inflow of Irminger Water peaks during autumn and winter whereas the inflow of Polar Water peaks in spring and early summer.

Results of the 2004 German autumn survey to the standard sections along the west coast of Greenland were presented in SCR Doc. 05/2. Based upon autumn measurements on Fylla Bank, the temperature anomaly time series reveals a warming trend which is persistent since 1993. Subsurface warming during 2004 was in the range of the warm 1960s temperatures, but was less than during autumn 2003 when temperatures were 2.4°C above normal. Since this time series on Fylla Bank is located at the bank slope, periodically the cold surface waters from Fylla Bank moves westward influencing the upper 200 m of the water column. It was shown that cold "polar events" during 1983, 1992 and 2002 characterize the long term ocean temperature time series. During these years, cold and diluted waters from the West Greenland banks reached well out to the slope regions of Fylla Bank which cooled the upper layer of the water column. The major heat input to the water column off West Greenland is derived by advection, i.e. the warm Irminger component of the West Greenland Current.

Measurements made along the Fylla Bank section during 2004, which crosses the core of the West Greenland Current, show temperatures and salinities >6.6°C and 34.98 at about 135 m depth. Maximum temperature and salinity of 7.1°C and 34.90 were found at 71 m depth. The surface layers were dominated by low saline (<33.5) water with temperatures in the range of 3°C to 4°C. Along the Cape Desolation section temperatures and salinities of 7.1°C and 34.96 were recorded at 27 m depth during 25 October 2004. At depths near 3 000 m *in situ* temperature and salinity values of 1.56°C and 34.87 were recorded. Observations made along the Holsteinsborg-Baffin Island section show the eastern Baffin Island Current exporting cold water (core temperatures <-1.64°C) from Baffin Bay southwards. On the eastern side of the section, the West Greenland Current flows northward along the shelf break transporting heat (core temperatures >5.9°C) into the Baffin Bay. The 2004 observations show a sub-surface tongue of warm West Greenland Current Water (>3°C) located under the cold Baffin Island Current. In general, the 2004 observations show temperatures in the West Greenland Current and on the West Greenland Shelf about 2°C warmer than normal during autumn.

A study entitled "Atlantic Subpolar Gyre Warming - Impacts on Greenland Offshore Waters?" was presented (SCR Doc. 05/1). Sea-surface temperature anomalies in the region of the North Atlantic Sub-polar Gyre indicate cold conditions in the 1980s and warming from the mid-1990s onwards. Peak warming was observed during October 2003. This is consistent with air temperature measurements from Nuuk, Greenland which document that 2003 was the warmest year since 1950. The sub-surface ocean hydrographic properties off West Greenland follow the observed warming of the Sub-polar Gyre, and show a significant upward trend which is considerably higher than the mean warming trend as documented for the North Atlantic basin. Warming of the West Greenland Current amounted to 0.096°C/year during 1983-2004. Long-term observations from Fylla Bank off West Greenland (1964-2004) reveal that during the 1960s similar warm sub-surface conditions were present in West Greenland Current waters; however, the recent years of the new century indicate record warming which exceeds the autumn observations during those times. Data from a newly formed oceanographic section across Davis Strait and the West Greenland Shelf show increased transport of the West Greenland Current through the 330 km wide passage between Holsteinsborg, West Greenland and Baffin Island, Canada. Ocean properties during 2004 were more saline and up to 2°C warmer-than-normal during autumn. Volume transport across this passage, computed from the 2004 data and compared to historic Canadian data, reveal that the transports based on the geostrophic method alone are +2.4 *Sv* ($1\ Sv = 10^6 m^3 sec^{-1}$) in the core of the West Greenland Current, +0.5 *Sv* on the West Greenland Shelf, and -1.9 *Sv* in the Baffin Island Current. While the northward (+) transport values are in the range of the mean October and November transport values (+1.6 *Sv* to +3.0 *Sv*), the southward (-) transport values are considerably smaller than those values given in the literature (-3.1 *Sv* to -4.6 *Sv*). The increased baroclinic transport to the north is a consequence of warmer-than-normal temperatures and more saline conditions in the West Greenland offshore waters.

Subareas 1 and 2. Hydrographic conditions in the Labrador Sea (SCR Doc. 05/7) depend on a balance of atmospheric forcing, advection and ice melt. Wintertime heat loss to the atmosphere in the central Labrador Sea is offset by warm waters carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried by the Labrador Current, freshwater from river run-off and ice melt. Wintertime cooling and evaporation increase the density of surface waters in the central Labrador Sea. Wind mixing and vertical overturning form a mixed layer whose depth increases through the cooling season. The winter heat loss, the resulting density increase, and the depth to which the mixed layer penetrates vary with the severity of the winter. In extreme winters, mixed layers deeper than 2 000 m have been observed. Labrador Sea Water formed by these deeper overturning events spreads throughout the northern North Atlantic. During milder years, the vertical stratification of temperature, salinity, and density is re-established. The late 1980s and early 1990s saw relatively cold winters and high heat fluxes over the Labrador Sea. Recent years have shown generally warmer conditions.

Ocean Sciences Division, DFO Maritimes Region has monitored hydrographic properties along a section crossing the Labrador Sea (AR7W line) in the early summer of each year since 1990. The 15th annual AR7W survey took place in late May 2004. Between 1990 and 2004 there has been a general trend to warmer and saltier conditions in the upper layers of the Labrador Sea. Changes in temperature and salinity averaged over the upper 150 m during this period amount to about 1°C and 0.1, respectively. Below the seasonal layer, the upper waters (averages over 150-1 000 m or 150-1 500 m) of the west-central Labrador Sea have become steadily warmer and more saline over the past four years. By this measure, conditions in 2004 were the warmest and saltiest in the 15 years of annual AR7W surveys. Density changes during the past few years have been relatively small, with changes linked to temperature and salinity nearly in balance. The May 2004 survey also encountered warm and saline conditions in waters in the offshore branch of the West Greenland Current, with maximum salinities greater than 34.95. High salinity near-surface waters extended westward into the central Labrador Sea. The May 2004 observations suggest that the 2003-2004 winter mixed layer had maximum potential density anomalies just less than 27.73 kg/m^3 and maximum depths of about 800 m, less than the corresponding values attained following the winter of 2002-2003 as observed in the 2003 AR7W survey.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador Region during 2004 was presented (SCS Doc. 05/12). Physical oceanographic observations are routinely collected during fish assessment and research surveys in the Newfoundland and Labrador Region. The Atlantic Zonal monitoring program (AZMP) initiated in 1998 continued during 2004 with three physical and biological oceanographic offshore surveys carried out. The first was conducted from 17 April to 2 May, the second from 20 July to 5 August and the last from 17 November to 7 December.

This program was established to include biological and chemical oceanographic sampling at a fixed coastal site (Station 27) at biweekly intervals and along offshore sections at seasonal time scales. The Newfoundland and Labrador Region conducted three annual physical/biological oceanographic surveys during 2004 along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Nain Bank on the mid-Labrador Shelf. These surveys were conducted during mid-spring, summer and during the autumn. The main objectives were to establish the seasonal temporal and spatial distribution and abundance of plant pigments, nutrients, microzooplankton and mesozooplankton in relation to the physical environment. Physical, biological and chemical variables being monitored include temperature, salinity, dissolved oxygen, ocean currents as well as measures of primary and secondary production and biomass, species composition of phytoplankton and zooplankton and nutrients. The oceanographic monitoring program currently conducted on the Newfoundland and Labrador Shelf should allow an understanding of changes in ecosystem productivity and changes in ecosystem structure over time. Data from this effort are used to produce annual physical, chemical and biological state of the ocean reports and in studies relating environmental conditions to marine resources.

Oceanographic observations in Subareas 2 and 3 on the Newfoundland and Labrador Shelf during 2004 referenced to their long-term (1971-2000) means were presented in SCR Doc. 05/23. The annual water-column averaged temperature at Station 27 for 2004 remained above the long-term mean and reached the highest value on record. The annual surface temperature at Station 27 was 1°C above normal, also the highest on record, while the annual bottom temperature was the highest since 1966. Water-column averaged (0-50 m) annual salinities at Station 27 remained above normal for the 3rd consecutive year. The cross-sectional area of the water mass with temperatures <0°C (CIL) on the Newfoundland and Labrador Shelf during the summer of 2004 decreased compared to that of 2003. The CIL areas were below normal from the Flemish Cap section on the Grand Bank, to the Seal Island section off southern Labrador. Off Bonavista for example, the CIL area was below normal for the 10th consecutive year. Seasonally, the CIL water mass extended to the surface during the spring, decreased to the smallest since 1965 in the summer and was completely eroded by late autumn of 2004. The areas of the CIL in recent years are in sharp contrast to the near record high values measured during the extremely cold years of the early 1990s on the Newfoundland and Labrador Shelf. Temperatures along the standard sections, except for some isolated cold surface anomalies, were generally above normal by 1° to 2°C in most areas during spring and summer and in all areas during the autumn. Except for slightly negative salinity anomalies at mid depth over the inner shelf during the spring most areas of the shelf during 2004 experienced generally saltier-than-normal conditions, particularly during the autumn. During the spring of 2004, bottom temperatures over St. Pierre Bank increased significantly over 2003 values with <0°C water restricted to the relatively deep waters at the approaches to Placentia Bay. Consequently, above normal temperatures were more widespread during 2004 compared to 2003, covering most of the bottom areas of the banks in the 3P region with values as high as 1°C above the long-term mean. In Div. 3LNO spring bottom temperatures were above normal in all areas of the Grand Banks by 1°C to 1.5°C. As a result the spring of 2004 had the lowest area of <0°C water in Div. 3L since the surveys began in the early 1970s. Bottom temperatures during the autumn of 2004 were predominately above normal in all areas by 0.5° to 2°C and were the highest on record in Div. 2J. In summary, the North Atlantic Oscillation (NAO) index for 2004 was below normal for the fourth consecutive year resulting in reduced Arctic outflow to the region which kept annual air temperatures over much of the Northwest Atlantic above normal for the 10th consecutive year in some areas. Winter sea ice extent on the Newfoundland and Labrador Shelf was also below normal for the 10th consecutive year during 2004. As a consequence water temperatures on the Newfoundland and Labrador Shelf remained above normal, setting records in many areas, continuing the warm trend experienced during the past several years. Upper layer shelf water salinities which increased to the highest observed in over a decade during 2002 also remained above normal in 2004.

Biological oceanographic observations from a fixed coastal station and oceanographic sections in Subareas 2 and 3 during 2004 were presented and referenced to previous information from earlier periods when data were available (SCR Doc. 05/22). Information concerning the seasonal and interannual variations in the concentrations of chlorophyll a, major nutrients, as well as the abundance of major taxa of phytoplankton and zooplankton measured from Station 27 and along standard transects of the Atlantic Zone Monitoring Program in 2004 was reviewed. Overall, the seasonality of chemical and biological variables at Station 27 and along the major AZMP sections in 2004 was similar to previous years (1999-

2003). The timing of events on the Newfoundland Shelf was once again similar to conditions observed in the early part of the program but in contrast to 2001 when the onset of the spring phytoplankton bloom was delayed. However, satellite information indicates that the relative delay in the onset of the spring bloom remained as one moved further north. It is becoming clear that inter-annual variations in the seasonality of vertical mixing and water column structure plays an important role in the seasonal phytoplankton cycle along the Newfoundland Shelf. In 2001, the delay in the onset of the spring bloom was associated with persistent deep mixing of the water column. Variations in the physical environment are likely to be contributing to the variability in the magnitude of the spring phytoplankton bloom. Since 2000, there has been a gradual intensification in the overall productivity and standing stock of phytoplankton during the spring until 2003. The gradual rather than abrupt shoaling of the mixed layer may have provided sufficient light and high nutrient availability to permit the development of denser phytoplankton population, mainly composed of diatoms, than in previous years. In 2004, it appears that the spring phytoplankton bloom followed a relatively abrupt shoaling of the mixed layer, that may have resulted in a smaller fraction of the surface nutrient inventory being converted into biomass However, in addition to the factors that regulate the vertical structure of the water column, there is a preliminary indication that inter-annual variations in incident light may also have contributed to the increase in the overall intensity of the spring phytoplankton bloom. In 2004, light levels were lower than the overall peak in 2001-2003.

The surface nutrient inventories at Station 27 appear to have been higher in 2004 than in the previous year, but the limited intensity of the spring phytoplankton bloom may be partly the cause. The deep nutrient inventories (>50 m) observed at Station 27 showed a 30-50% decrease over conditions in previous years but the change was not observed along any of the standard sections. The conditions at Station 27 persisted in 2004 but there appears to be limited evidence for nutrient depletion over the remainder of the Shelf. The decline in abundance of major phytoplankton taxa observed in recent years appears to have persisted into 2004. The cell densities of diatoms, dinoflagellates, and flagellates have continued to decrease. Although flagellates do not make up a substantial portion of the overall phytoplankton biomass compared to larger diatom and dinoflagellate cells, the decrease in the abundance of all taxa may suggest a change in the dynamics of the microbial food web dynamics in the area.

The overall abundance of zooplankton at Station 27 was generally in keeping with previous observations. The notable change in the zooplankton community structure at the fixed station has been in the increase in the abundance of cold water species of copepods observed in 2002 did not appear to persist into 2003 and 2004. The abundance of copepodites of *Metridia* sp., *C. glacialis*, *C. hyperboreus* and *Microcalanus* sp. which had become more frequent members of the community, although the overall increase in their abundance has been modest, returned to levels consistent with conditions at the start of the monitoring program. The warm water species, *T. longicornis*, whose abundance peaks during the autumn, has shown an increase in overall abundance and in relative frequency of occurrence at Station 27. The abundance of many dominant zooplankton reached their lowest levels encountered since routine collections in the late 1990s on the Grand Banks. In contrast, the abundance of many copepod species generally increased on the NE Newfoundland Shelf along oceanographic sections above 48°N in recent years.

Subarea 4. A description of environmental information collected on Scotian Shelf and in the Gulf of Maine and adjacent offshore areas was presented (SCR Doc. 05/6). A review of physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine and adjacent offshore areas during 2004 has shown the continuation of conditions similar to 2003. Cool conditions tended to dominate the Scotian Shelf and the eastern Gulf of Maine in 2004. The temperature data from Boothbay Harbor were suspicious; the Boothbay Harbor laboratory is investigating. St. Andrews sea-surface temperature was 0.8°C below normal making 2004 the 14th coldest in 84 years. At Prince 5, 0-90 m, monthly mean temperatures were generally below normal by about 0.9°C. Salinities were within 0.1 of normal throughout the year. Halifax sea-surface temperature was 1.0°C below normal, making 2004 the 9th coldest in 79 years. At Halifax Station 2, 0-140 m temperature anomalies were about -1°C; salinity was close to normal values. Misaine Bank, Emerald Basin, Georges Basin and eastern Georges Bank profiles featured anomalies of -1° to -2°C at most depths. Sydney Bight and Lurcher Shoals temperature profiles were quite variable. Standard sections in April, May and October on the Scotian Shelf support the overall conclusion of temperatures ~2°C below normal accompanied by an extensive cold intermediate layer on the shelf. Cabot Strait deep-water (200-300 m) temperatures were near normal. The temperatures from the July groundfish survey were exceptional with the outstanding feature being a very broad cold intermediate layer with below normal temperatures at 50 m, 100 m and the bottom. Break-up of the strong stratification pattern established in the late 20th and early 21st century continued in 2004 with substantial variability of the stratification parameter throughout the region. The overall stratification was slightly below normal for the Scotian Shelf region. The Shelf Water/Slope Water front and the Gulf Stream were about 20 km south of their mean positions during 2004.

Subareas 5 and 6. The United States Research Report listed several ongoing oceanographic, plankton and benthic studies conducted by the Northeast Fisheries Science Center (NEFSC) in NAFO Subareas 5 and 6 (SCS Doc. 05/7). During 2004 over 1830 CTD (conductivity, temperature, depth) profiles were made on 15 NEFSC cruises. The data were processed and made available *via* an anonymous FTP site. A report on the oceanographic conditions indicated by these observations is available *via* the NEFSC website at http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0503. Similar reports have been issued each year since 1991. The results indicated by this report show that bottom temperature of the entire northeast continental USA Shelf were colder-than-normal by ≥1°C for much of 2004. Similarly, the salinity anomaly pattern indicates that the shelf region was also fresher than the long-term mean. The salinity anomaly time series suggests a pattern of increasing freshness in the Georges Bank and Gulf of Maine regions with salinity values approximately 0.5 fresher than the reference period by the end of the year. The fresher surface and bottom salinities suggest an increase in cold, fresh Scotian Shelf Water entering the eastern Gulf of Maine and being advected during the year 'downstream' into the Georges Bank and Middle Atlantic Bight regions. During 2004, zooplankton community distribution and abundance was also monitored using 606 bongo net tows taken on seven surveys. Each survey covered all or part of the continental shelf region from Cape Hatteras northeastward through the Gulf of Maine. The Ship of Opportunity Program (SOOP), completed twelve sections across the Gulf of Maine from Cape Sable, Nova Scotia to Boston USA and nine sections across the Mid-Atlantic Bight from New York to the Gulf Stream during the same time period.

Highlights of environment conditions in the NAFO Convention Area for 2004

1. The North Atlantic Oscillation (NAO) index was below normal during 2004 for the fourth consecutive year, indicating a weakening of the Icelandic Low and Azores High resulting in reduced Arctic air outflow during the winter months.

2. Annual mean air temperatures over much of the NAFO Convention Area were above normal north of the Scotian Shelf, while values to the south were below normal.

3. Sea-ice coverage during 2004 remained below normal for the 10th consecutive year on the Newfoundland and Labrador Shelf decreasing to the lowest since the late 1960s. In West Greenland Waters sea-ice was also lighter than normal, while on the Scotian Shelf sea-ice was near normal.

4. Shelf water salinities which increased to the highest observed in over a decade during 2002 remained above normal in 2004, reducing the overall stratification of the water column throughout the waters of eastern Canada.

5. The waters over much of the Labrador Sea have become steadily warmer and more saline over the past four years and in 2004 the upper water column was the warmest and saltiest in the past 15 years, while sea-surface temperatures were the warmest in the past 45 years.

6. In the waters off West Greenland, warm-saline conditions dominated from summer to autumn. Polar inflows were weak and warm salty Irminger Current waters reached as far north as Fylla Bank.

7. The warm water conditions during 2003 and 2004 around Greenland waters coincided with increased production of haddock and cod as well as an increase in the distribution of saithe.

8. Ocean temperatures on the Newfoundland and Labrador Shelf remained above normal, setting

record highs in some areas thus continuing the warming trend experienced since the latter half of the 1990s.

9. In general, annual mean nitrate and silicate inventories increased in the upper layer in 2004 on the Newfoundland and Labrador Shelf compared to earlier years, while deep inventories of nutrients declined.

10. Phytoplankton biomass remained relatively stable throughout the late 1990s and recent years despite evidence of elevated nutrient inventories.

11. During 2004 the abundance of many dominant zooplankton species reached their lowest levels since routine collections began in the late 1990s on the Grand Banks.

12. Further south, on the Scotian Shelf, ocean temperatures were below normal (except for the deep basins) and in some areas they decreased to the lowest values since the cold period of the early 1990s.

13. In the region from the Gulf of Maine to the Mid-Atlantic Bight, water temperatures were generally colder and fresher than normal as Scotian Shelf waters from the north were advected into the Gulf of Maine.

5. **Interdisciplinary Studies**

An important role of STACFEN, in addition to providing climate summaries for the NAFO Convention Area, is to determine the response of fish and invertebrate stocks to the changes in the physical and biological oceanographic environment. It is felt that a greater emphasis should be placed on these activities within STACFEN and at the June 2002 Meeting STACFEN had recommended that *further studies be conducted attempting to link climate and fisheries and to bring forward such studies for review*.

The following studies were considered at this June 2005 Meeting:

a) Report of the workshop on "*Transport of fish larvae between Iceland and Greenland waters – hydrography and biology*", Copenhagen Denmark 9-10 December 2004 by Manfred Stein. The West-Nordic Ocean Climate research programme (funded by the Nordic Minister Council) held the two day workshop to consider research activities related to the transport of fish larvae between Iceland and Greenland waters. The meeting was attended by scientists from Norway, Denmark, Germany, Faroe Islands, Iceland and Greenland. During the first day of the meeting presentations were given on state of the art modelling of ocean properties in the North Atlantic Ocean on resolution scales of 80, 40 and 20 km (Nansen Centre, Bergen, Norway; Institute of Marine Research, Hamburg, Germany). Oceanographic observations in Norwegian waters and in the Iceland-Scotland Ridge area were also presented. Modellers had fulfilled tasks addressed to them during the previous meeting, held in Reykjavik, Iceland during March 2004 (see STACFEN report 2004). During the second day, new results from a Danish PhD study on the "Drift of Cod larvae from Iceland to Greenland" were presented, and information on Greenland cod research was given by scientists from Greenland Institute of Nature Resources at Nuuk, Greenland, and the Federal Research Centre for Fisheries, Hamburg, Germany. During the German autumn bottom trawl survey in Greenland waters significant amounts of saithe and haddock were found. It is suggested that the warm water conditions during 2003 and 2004 around Greenland favoured production of haddock and the increased distribution of saithe in quantities which are record high in the time series that starting in 1982. Good recruitment was also found for the cod stock off west and east Greenland waters during the past two years. It is suggested that anomalous high bottom water temperatures in the area have also favoured this recruitment. A paper was presented at the first workshop held in Reykjavik during 2004 and reported on at the June 2004 STACFEN Meeting (SCR Doc. 04/4) detailing the relationship between ocean climate and fish production in this region.

b) *Timing of Plankton Cycles on the Newfoundland Grand Banks: Potential Influence of Climate Change?* by Gary Maillet (SCR Doc. 05/12). The seasonality of plankton from the CPR survey in the northwest Atlantic during 1961-2003 was investigated. Results for the Northwest Atlantic show remarkable stability in the timing of seasonal peaks for plankton on the Newfoundland Grand Banks across of broad range of taxa and trophic levels, in contrast to the pattern observed in the central North Sea. Our results suggest the main seasonality of plankton has remained relatively stable throughout the 1960-1970s, 1990s and recent years despite comparable trends in ocean warming observed in the northeast Atlantic. The one result that was consistent between the NE and NW Atlantic was the lack of movement in the overall timing of the spring and autumn phytoplankton blooms. Recent studies suggest that day-length and photoperiod may regulate the timing of diatom blooms in general. The seasonality of phytoplankton during the 1960-1970s indicated that both the spring and autumn peaks were consistent from year to year, with no overall trend apparent during the first two decades of the CPR time series on the Grand Banks. The seasonality of dominant copepod taxa during the 1960-1970s also showed remarkable consistency from year to year. Inter-annual variability in seasonality of CPR copepods, particularly for *Paracalanus-Pseudocalanus* spp., can be high, and may mask any long-term trends. Variability in the seasonality of the macrozooplankton was observed during the early part of the time series. Inter-annual variability in seasonality of Chaetognatha and Euphausiacea revealed abrupt changes from summer to spring occurrence during the early to mid-1960s. These two plankton groups also show evidence of a systematic and gradual move back to the summer period during the later part of the time series. The transition to the 1990s and recent years revealed an apparent increase in the number of dominant CPR taxa across all functional groups examined. The seasonality of phytoplankton during the 1990s and recent years showed little change in the annual timing of peak abundance across the Grand Banks. This period is also characterized by consistent seasonality in timing of occurrence of CPR copepod taxa. The seasonality for most of the macrozooplankton taxa was generally consistent throughout the 1990s and recent years but, the overall trend for Chaetognatha and Limacina indicated a shift in peak abundance toward an earlier bloom. Overall, the results for the NW Atlantic show remarkable stability in the timing of seasonal peaks for CPR plankton on the Grand Banks in contrast to the pattern observed in the central North Sea. The majority of the values of the slope over the two time periods of interest (1961-1977 and 1991-2003) indicated that they were not significantly different from zero ($P > 0.05$; 50 out of total of 57 cases). The CPR taxa showing significant ($P < 0.05$) trends in slope were the *Calanus* stages CI-CIV (juvenile copepodite stages) and CV-CVI (adult stages), *Oithona* spp. (a small ubiquitous copepod on the Grand Banks), *Chaetognatha* (microzooplankton predators) and *Euphausiacea* (important macrozooplankton prey item for higher trophic levels). In general, the pattern in timing differed for these species during the respective time series, with later occurrence during 1961-1977, while a shift to earlier timing was observed during 1991-2003. Variability in ocean conditions have been linked to large-scale atmospheric winter circulation, sea ice conditions, local atmospheric forcing and advection reflected in the North Atlantic Oscillation (NAO). Given the large year-year changes in some of the CPR plankton groups, we explored the relationships between seasonality and the annual NAO anomaly and near-surface temperatures. No strong environmental signals were detected in either the NAO or temperature in relation to the seasonality of plankton on the Grand Banks during the study period.

c) *The Relationship between Water Temperature and Distribution of Greenland Halibut on the Flemish Cap in 1988-2002* by Taras Igashov (SCR Doc. 05/31). The relationship between dynamics of Greenland halibut catches and fluctuations in water temperature at different depths on the Flemish Cap area were examined. Mean catches of Greenland halibut taken using the sampling trawl (individuals/trawl and kg/trawl) during summer surveys by the European Union are compared with near-bottom water temperature. Their variability is estimated, correlation analysis of water temperature and catches by four depth intervals is made and significance of the relationships is determined. Results from the investigations show the existence of statistically significant relationship between fluctuations in the near-bottom water temperature and variations in the Greenland halibut catches in the Flemish Cap area. Variability in the mean values of catches decreased with depth. In the depth range of 185 m to 260 m, the lowest catches in numbers and weight occurred in 1990 and 1994, while the largest were in 1999. Significant correlations of catches and water temperature in the depth range of 185 to 370 m were found such that in the coldest years, indices of abundance and biomass are low, while no such relationship exist for depths >370 m. The most significant relationship (r from 0.71 to 0.74) both in numbers and weight was found for the depths between 185 and 260 m. For the deeper depth range >400 m, variations in water temperature are very small and do not significantly affect population dynamics. In conclusion, it was found that bottom temperature have an effect on the Greenland halibut distribution on the Flemish Cap and thereby on the results of instrumental surveys for this species.

6. **A Review and Demonstration of the On-line Annual Ocean Climate Status Summary for the NAFO Convention Area**

At its June 2002 Meeting, STACFEN recommended that *beginning in 2003 an annual climate status report be produced to describe environmental conditions during the previous year*. This web-based annual summary for the NAFO area would include an overview that summarizes the overall general climate changes for the previous year and a regional overview that provided climate indices from each of the Subareas. M. Stein demonstrated the 2004 status summary that covered most of the NAFO Convention Area based on contributions received for Subareas 0-1, West Greenland (M. Stein and E. Buch), Subareas 2 and 3 (E. Colbourne), Subareas 4 and 5 (B. Petrie) and Subareas 5 and 6 (D. Mountain). This web-based report essentially replaces the traditional much larger environmental overview. It is intended that the current report will be posted on the NAFO website (http://www.nafo.int/science/frames/eco-ocs.html) shortly after this STACFEN meeting. The Committee agreed that the ocean climate status summary, among other important Scientific Council achievements, needs improved visibility on the NAFO website.

7. **Environmental Indices** (Implementation in the Assessment Process)

In addition to providing reviews of ocean climate and its effects on marine resources STACFEN provides advice on how relationships between ocean climate and marine production may be used to help improve the assessment process. A review of how Atlantic Canada currently incorporates environmental information into the regional fish stock assessment process and how this information is disseminated to scientists, managers and stakeholders in the fishing industry was presented at the previous STACFEN Meeting in June of 2004. It was concluded that a significant research effort is required to move forward, including identifying functional (causal) relationships underlying environment-stock associations, incorporating more information on primary and secondary production into stock assessments, and to evaluate the importance of environmental effects relative to fishing and natural mortality. At this meeting it was noted that the multi-species models currently under development in support of Ecosystem Based Management (EBM) may offer new opportunities to make further advances in this area.

8. **The Formulation of Recommendations Based on Environmental Conditions**

STACFEN made no formal recommendations during this 2005 meeting.

9. **National Representatives**

The Committee was informed that the national representative responsible for hydrographic data submissions remain unchanged for 2005. They are: E. Valdes (Cuba), S. Narayanan (Canada), E. Buch (Denmark), J.-C. Mahé, (France), F. Nast (Germany), H. Okamura (Japan), H. Sagen (Norway), J. Janusz (Poland), J. Pissarra (Portugal), B. F. Pristehepa (Russia), L. J. Rickards (United Kingdom), and K. J. Schnebele (USA).

10. **Other Matters**

No other matters were discussed by the Committee.

11. **Acknowledgements**

Upon completing the agenda, the Chair thanked the STACFEN members and invited guest, the Secretariat and the rapporteur for their support and contributions. The meeting was then adjourned.

APPENDIX II. REPORT OF STANDING COMMITTEE OF PUBLICATIONS (STACPUB)

Chair: Manfred Stein Rapporteur: Margaret A. Treble

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 5 and 11 June 2005, to consider publication-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal and Spain), Russian Federation, Ukraine and United States of America. The Executive Secretary and Deputy Executive Secretary were in attendance as were other members of the Secretariat's publication staff.

1. Opening

The Chair opened the meeting by welcoming the participants. The agenda as presented in the Provisional Agenda was adopted. Margaret A. Treble (Canada) was appointed rapporteur.

2. Review of Recommendations in 2004

a) Recommendations in June (reviewed during September 2004 Meeting of STACPUB)

The Chair referred to one recommendation of the June 2004 Meeting:

STACPUB **recommended** that *a link to a distribution list of e-mail addresses for current Committee and members e-mails be established to facilitate communication of information.*

The Committee was informed that action has been taken on this recommendation under the management of the Executive Secretary.

b) Recommendations in September

i) STACPUB recommended that *STACPUB Chair explore the implications of citations of individual papers in 2 different ways (in electronic html format and the usual hard copy Journal format) and report on this during the June 2005 STACPUB Meeting.*

Action has been taken on this recommendation under the management of the Executive Secretary.

ii) STACPUB recommended that *the Secretariat's work of placing electronic issues of the Journal on the NAFO website begin immediately, and that any other work needed to complete this in a speedy manner be identified and reported to STACPUB in June 2005.*

Action has been taken on this recommendation by the Secretariat.

iii) STACPUB recommended that *instead of the redfish and blue bar proposed for the cover of the NAFO Journal (JNAFS), a logo or background figure or typical figure out of the contributions of the given Symposium [see JNAFS Vol. 23 (map with drawings), 27 (Symposium logo)] be taken, and for "miscellaneous papers" issues of JNAFS, the figure of the satellite picture proposed by the Secretariat be taken.*

The Executive Secretary reported that it would be too costly to issue a separate cover design for each symposium issue of the Journal and requested that STACPUB reconsider this recommendation and accept the Secretariat's proposal to use the satellite image on all Journal volumes.

STACPUB **recommended** that *the satellite image be used on the cover of all Journal volumes.*

3. **Review of Publications**

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

STACPUB was informed that:

Volume 35. The publication of this volume was held back until the web e-Journal design and format was completed on 28 September 2004. The galley proofs, as noted in June and September 2004 STACPUB reports, were converted into html format and again approved by authors before electronic publication. The e-Journal publication of Journal Volume 35 containing 43 papers from the Symposium on "*Elasmobranch Fisheries: Managing for Sustainable Use and Biodiversity Conservation*" was completed on 8 April 2005.

The printed version of this issue was completed with a publication date of (late) April 2005. The printed Volume 35 (544 pages) containing 42 papers was circulated in mid-May 2005.

Volume 36. One **independent** paper has been published to day on the website e-Journal. In addition, there have been 9 **independent** papers received to date at the Secretariat for consideration for the Journal. These are at various stages of editorial review by the Associate Editors.

Volume 37. The schedule for the publications of papers presented at the September 2004 Symposium on "*The Ecosystem of the Flemish Cap*" was extended beyond to original one year period but the suggested time-frame for completion of this Journal issue is late 2005. The editorial process is currently underway on 16 papers, of which 2 papers have been edited and submitted to the Secretariat for technical editing and galley preparation.

b) **NAFO Scientific Council Studies**

STACPUB was informed that:

Studies Number 38 (54 pages) containing the publication on "*Yellowtail Flounder Ageing Manual*" by Karen Dwyer was completed (after the completion of Journal volume 35) with a publication date of May 2005 and circulated in late May.

Studies Number 39 (50 pages). Intersessional discussions among Scientific Council members confirmed that the report of the "*Workshop on Mapping and Geostatistical Methods for Fisheries Stock Assessment*" would be published as a Studies issue. The SCS Doc. 03/22 was accordingly reformatted and printed as Studies Number 39 with a publication date of May 2005 and circulated in late May.

c) **NAFO Statistical Bulletin**

STACPUB was informed that:

Catches statistics by country, species and Division are available on the NAFO website for 1960-2004. This is the most up-to-date information available at the Secretariat and is updated as new information become available. No Statistical Bulletin has been published since the publication and circulation of Vol. 49 containing 1999 data in January 2002.

d) **NAFO Scientific Council Reports**

STACPUB was informed that:

The *NAFO Scientific Council Reports 2004* (Redbook) volume (298 pages) containing reports of the June, September and November 2004 Scientific Council Meetings. This book will be distributed to participants of Scientific Council Meeting of June 2005. This version was compiled following the Scientific Council recommendation in September 2003 that *NAFO Sci. Coun. Reports* be printed as a single book each year.

The Website publication of Reports of all Scientific Council Meetings held in 2004 was issued in January 2005. It differs from the print versions mentioned in above paragraph in that it contains navigation tools to access various sections of the reports of meetings that took place in 2004.

e) **Index and Lists of Titles**

STACPUB was informed that:

The provisional index and lists of titles of 90 research documents (SCR Doc.) and 20 summary documents (SCS Doc.) which were presented at the Scientific Council Meetings during 2004 were compiled and presented in SCS Doc. 05/4 (excel format) for this June 2005 Meeting.

f) **Others**

STACPUB was informed that:

At its meetings since 1980, STACPUB has nominated a total of 823 research documents. This includes 16 documents from the Symposium on "*The Ecosystem of the Flemish Cap*" in September 2004. Since 1980, a total of 730 papers have been published in the Journal (415) and Studies (315). One document SCR Doc. 04/5 - paper on "*Yellowtail Flounder Ageing*" was nominated in 2004.

In addition, 5 papers from outside of the STACPUB nomination process were submitted for Journal consideration since June 2004.

4. **NAFO Website**

a) **Web Statistics (with focus on the Journal)**

The Executive Secretary gave a presentation reviewing the process of developing the *Journal of the Northwest Atlantic Fishery Science*, statistics on the number of issues and pages per year as well as time for review and time from submission to printing for each volume. The number of monthly visitors at the website since 2001 indicated a significant increase since January 2005 following the September 2004 online publishing of the NAFO e-journal.

Issues related to the electronic publication of the electronic version of the Journal include: 1) an appropriate copyright/disclaimer and 2) the perception that NAFO has two separate journals, one in print and one on-line and the effect that having an on-line journal might have if NAFO were to re-apply for listing in the Science Citation Index. The Committee undertook a general discussion on these and other issues related to the Journal and e-Journal and made the following recommendations:

STACPUB **recommended** that *all papers available in full text form be listed together on the first Journal web page. "Hot Topic" links could be used to showcase the latest Journals.*

STACPUB **recommended** that *the copyright/disclaimer from Biodiversity Informatics be used on an interim basis and that the Secretariat should seek expert legal opinion in drafting text appropriate for the NAFO Journal.*

STACPUB **recommended** that *we continue to publish Journal papers on-line under the name Journal of Northwest Atlantic Fisheries Science and the printed journal be given up. However, the Committee recognized the importance of the opinion of the Associate Editors of the Journal. The status quo will continue until the chair of STACPUB confers with the Associate Editors, and if any of them have strong concerns this decision will be revisited by June 2006 Meeting.*

STACPUB **recommended** that *all participants who attend a Symposium receive a bound copy of the Symposium papers.*

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

a) **Invitational Papers**

There were no proposals for invitational papers.

b) **Scientific Citation Index (SCI)**

STACPUB received a report from the Executive Secretary on the possibility of making an application to the ISI Current Contents Connect with searchable web content. The Executive Secretary reported on the criteria used by ISI in assessing whether or not a journal would be included in their index. The NAFO journal is able to meet most of these. One problem is the publication frequency and length of time between submission for review and publication. The Executive Secretary noted that electronic journals are reviewed under the same criteria as print journals, that several have been listed on the SCI and suggested that electronic publication of the NAFO Journal might improve the chance of success in the ISI application process.

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

There were no issues concerning CD-ROM versions of reports.

d) **New Initiatives for Publications**

STACPUB was informed that the Secretariat is trying to enhance the visibility of the NAFO Journal and has contacted other institutions and reference sites to ask them to link to our Journal site. For example the NAFO Journal has been submitted to Google Scholar to be included on their search engine site that specializes in academic research publications (http://scholar.google.com/).

6. **Editorial Matters Regarding Scientific Publications**

a) **Review of Editorial Board**

STACPUB reviewed the Editorial Board and was informed that no changes have occurred in the membership. STACPUB asked the Secretariat to confirm that contact information for these members was current.

b) **Progress Report of Publications of 2002 Elasmobranch Symposium Proceedings**

Further to what was reported under agenda item 3, there was no additional information on this topic.

c) Progress Report of Publications of 2003 Workshop on "*Mapping and Geostatistical Methods for Fisheries Stock Assessment*"

Further to what was reported under agenda item 3, STACPUB Chair noted that intersessional e-mail exchange facilitated the review of final drafts for this volume.

d) **Progress Report of Publications of Council Studies Issue on Yellowtail Ageing Manual**

Further to what was reported under agenda item 3, there was no additional information on this topic.

e) **Progress report of Publication of 2004 Journal Issue of Miscellaneous Papers**

Further to what was reported under agenda item 3, there was no additional information on this topic.

f) **Progress Report of Publication of 2004 Symposium "*The Ecosystem of the Flemish Cap*"**

Further to what was reported under agenda item 3, STACPUB was informed that all but one paper was through the review process and either with authors for revision, or in galley proofs.

7. **Papers for Possible Publication**

a) **Review of Proposals Resulting from 2004 Meetings**

i) **Papers nominated by STACPUB**

STACPUB Chair reminded the Committee to review the research documents submitted to the June 2005 Meeting.

ii) **Up-date since June 2004**

At its meetings since 1980, STACPUB has nominated a total of 823 research documents. This includes 16 documents from the Symposium on "*The Ecosystem of the Flemish Cap*" in September 2004. Since 1980, a total of 730 papers have been published in the Journal (415) and Studies (315). One document SCR Doc. 04/5 - paper on "*Yellowtail Flounder Ageing*" was nominated in 2004.

In addition, 5 papers from outside of the STACPUB nomination process were submitted for Journal consideration since June 2004.

8. **Other Matters**

a) **Consider Becoming a Member of the Aquatic Sciences and Fisheries Abstracts (ASFA)**

STACPUB was informed by the Executive Secretary that NAFO is currently not a member of ASFA and does not have free access to this database. NAFO publications and documents are currently being provided to ASFA by Fisheries and Oceans Canada. Membership in ASFA also carries certain responsibilities to meet given standards in documentation, and input all the NAFO bibliographic records to the ASFA database on a regular basis.

STACPUB **recommended** that *all efforts should be taken to ensure the continuation of the input to the database on national and international levels, and that NAFO through the Secretariat becomes an international partner of ASFA.*

b) **Proposal to Publish a Book on "*Early Stages of Fishes in the Western North Atlantic Ocean North of 35°N and West of 40°W*"**

STACPUB reviewed a proposal from Michael P. Fahay to publish a book updating his previous book on this subject published by NAFO (Vol. 4 No. 4, 1983).

STACPUB **recommended** that *the proposal to publish the book "Early Stages of Fishes in the Western North Atlantic Ocean North of 35°N and West of 40°W" be accepted and that Scientific Council and the Secretariat draft a letter to be sent to the author (M. P. Fahay).*

c) **Instructions for Authors Submitting Papers to the Journal**

Proposed changes were reviewed by STACPUB with a suggestion to include the ASFA thesaurus as a source for key words.

STACPUB **recommended** that *the revised "Instructions for Authors Submitting Papers to the Journal" be accepted.*

d) **Closing**

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

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

Chair: Antonio Vazquez Rapporteur: Lisa Hendrickson

The Committee met at Alderney Landing, at 2 Ochterloney Street, Dartmouth, Nova Scotia, during 2-16 June 2005 to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of the Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal and Spain), the Russian Federation, Ukraine, and the United States of America. The Executive Secretary and Deputy Executive Secretary were in attendance.

1. Opening

The Chair opened the meeting by welcoming the participants. L. Hendrickson (USA) was appointed rapporteur. The agenda was **adopted** as proposed.

2. Review of Previous Recommendations

a) From June 2004 Meeting

Fishery Statistics

STACREC had noted that there was a widespread lack of respect of the deadlines for the STATLANT submissions, and **recommended** that *the General Council be reminded of the importance of these STATLANT data to the work of the Scientific Council.*

This issue was considered again under agenda item 3.

NAFO Observer Program

STACREC **recommended** that *the Secretariat determine the resources required to complete the task of digitizing the observer data to enable its use by Scientific Council, and funding to support this work be requested during the September 2004 Meeting of STACFAD.*

This issue was considered again under agenda item 6.

Review of SCR and SCS Documents

STACREC **recommended** that *SCR Doc. 04/5 on yellowtail flounder (Limanda ferruginea) ageing manual be published in Studies.*

The manual was published as: DWYER, K. 2005. Yellowtail flounder ageing manual. *NAFO Sci. Coun. Studies*, **38**, 54 p.

b) From September 2004 Meeting

NAFO Observer Program

STACREC **recommended** that *the Secretariat should seek permission from the Contracting Parties to have their existing digitized data from the NAFO Observer Program be made available to the Secretariat to increase the efficiency and cost effectiveness of the data digitizing process. In the interim, the NAFO Secretariat should compile a list of available data, and begin the process of digitizing data to better evaluate costs.*

This issue was considered again under agenda item 6.

3. Fisheries Statistics

a) Progress Report on Secretariat Activities in 2004/2005

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

The Deputy Executive Secretary described the status of the STATLANT data submissions for recent years (Table 1 and Table 2) and informed the Committee that, due to an incomplete STATLANT data set, there has been no publication of the Statistical Bulletin since 1999. However, it was noted that the STATLANT data are consistently updated on the NAFO website as soon as they are received. STACREC noted a continued widespread lack of respect of the deadlines for STATLANT data submissions. As a result, STACREC **recommended**, once again, that *the Fisheries Commission be informed of those countries for which STATLANT data are missing and be reminded about the importance of these data to the work of the Scientific Council.*

TABLE 1. Dates of receipt of STATLANT 21A and 21B reports for 2002-2004 at the Secretariat up to 30 June 2005.

Country/ Component	STATLANT 21A (deadline, 15 May)			STATLANT 21B (deadline, 30 June)		
	2002	2003	2004	2002	2003	2004
BGR*	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
CAN-CA	26 May 03	-	-	-	-	
CAN-M	01 May 03	13 May 04	11 May 05	15 Jan 04	28 Feb 05 (partial)	
CAN-N	15 May 03	20 May 04	2 Jun 05	16 Jan 04	18 Feb 05	
CAN-Q	22 Apr 03	22 Mar 04	22 Dec 04	14 Jan 04	-	
CUB	-	-	-	-	-	
E/EST**	09 May 03	17 Mar 04	13 May 05	30 Jun 03	17 Mar 04	
E/DNK	14 May 03	13 May 04	06 May 05	13 Jun 03	-	06 May 05
E/FRA-M	No fishing	-	-	No fishing	-	
E/DEU	12 May 03	11 May 04	13 May 05	-	15 Jun 04	
E/NLD	No fishing	-	-	-	-	
E/LVA**	22 May 03	25 May 04	13 May 05	02 Jul 03	29 Jun 04	
E/LTU**	12 May 03	18 May 04	09 May 05	-	-	
E/POL**	09 May 03	01 Sep 04	16 Feb 05	13 May 03	01 Sep 04	01 Mar 05
E/PRT	30 May 03	22 Jun 04	07 Jun 05	20 Sep 04	19 Aug 04	
E/ESP	29 May 03	01 Jun 04	31 May 05	29 May 03	01 Jun 04	
E/GBR	No fishing	26 May 04	No fishing	No fishing	30 Jun 04	No fishing
FRO	01 May 03	03 Sep 04	-	21 Sep 04	21 Sep 04	
GRL	07 May 04	07 Jun 04	-	-	-	
ISL	10 Apr 03	14 May 04	16 May 05	10 Apr 03	14 May 04	
JPN	27 May 03	27 May 04	13 May 05	27 May 03	27 May 04	
KOR	No fishing	-	-	No fishing	-	
NOR	20 May 03	20 May 04	3 Jun 05	-	-	
RUS	14 May 03	26 May 04	06 Jun 05	03 Jun 03	23 Jul 04	
USA	-	-	-	-	-	
FRA-SP	31 Mar 03	20 Feb 04	12 May 05	31 Mar 03	28 Apr 04	
UKR	No fishing	14 Sep 04	17 May 05	No fishing	14 Sep 04	27 May 05

* Note Bulgaria has not reported in recent years but records indicate there was no fishing.
** Accession to the European Union (EU) 1 January 2005.

TABLE 2. List of countries that have not submitted STATLANT 21A and 21B data through 2002-2004. **Note**: **Bulgaria** has not reported in recent years and **USA** data from 1994-present are not available.

STATLANT 21A				STATLANT 21B				
2001	2002	2003	2004	2000	2001	2002	2003	2004
Cuba	Cuba	Canada (C&A)	Canada (C&A)	Greenland	Canada (C&A)	Canada (C&A)	Canada (C&A)	Due date 30 June,
		Cuba	Cuba	Canada (C&A)	Cuba	Cuba	Canada (M) (partial)	4 received to date.
		EU-France (M)	EU-France (M)		Greenland	EU-Germany	Canada (Q)	
		EU-Netherlands	EU-Netherlands		Lithuania	EU-Netherlands	Cuba	
		Korea	EU-Spain			Greenland	EU-Denmark	
			Faroe Islands			Lithuania	EU-France (M)	
			Greenland				EU-Netherlands	
			Korea				Greenland	
							Korea	
							Lithuania	
							Norway	

b) **Report of the Coordination Working Party on Fishery Statistics (CWP) 21st Session, Copenhagen, 1-4 March 2004**

The STACREC Chair and the NAFO Executive Secretary were in attendance at the CWP meeting. In reporting about the meeting, it was recalled that ICNAF, in addition with the FAO and ICES, had sponsored The Expert Meeting on Fishery Statistics in the North Atlantic Area (Edinburgh, Scotland, 22-29 September 1959) from which CWP was founded. Documents from the CWP meeting are available on the CWP website at http://www.fao.org/fi/body/rfb/CWP/cwp_home.htm. The CWP agenda was reviewed and the following highlights from the meeting were presented:

A list of ecosystem indicators for assessments based on an the Ecosystem Approach to Fisheries was presented by the ICES attendees, after being prepared in collaboration with OSPAR, the Convention for the Protection of the Marine Environment of the North-East Atlantic. The Chair noted that the Ecosystem Quality Objectives could be used as an initial reference for any future ecosystem-based approach to fisheries assessment and management in NAFO.

STATLANT 21A data in FAO's FISHSTAT Plus format has been available on the NAFO website since June of 2000. The CWP reviewed the current FISHSTAT Plus vers. 2.3, and made recommendations for vers. 3.0 which is being developed by FAO.

A document on 'Fisheries Data Quality Indicators: review of progress and possible approaches to addressing data quality and cost-effectiveness' was prepared by FAO following a recommendation of the CWP 20th session. The issue was considered to be in a very preliminary state.

The report of the 'RFB-STF Workshop: The Role of Regional Fishery Bodies (RFBs) in Implementation of the FAO Strategy-STF, 28 February-1 March 2005, Copenhagen, Denmark', was reviewed. The STACREC Chair and the NAFO Executive Secretary attended the meeting. The purpose of the meeting was to request collaboration of interested RFBs to develop monitoring systems for small-scale fisheries in developing countries. The Strategy-STF, the Strategy for Improving Information on Status and Trends of Capture Fisheries, is a 2003 initiative of both the FAO Committee on Fisheries (COFI) and of the United Nations General Assembly. The FAO Fisheries Department's FishCode program to promote responsible fisheries was commissioned for development by the FishCode-STF Project. STACREC noted that the expertise available in the NAFO Scientific Council is valuable in this context and should be made available if requested.

CWP had a comprehensive discussion on a number of recommendations by the FAO Expert Consultation on Data Formats and Procedures for Monitoring, Control and Surveillance. One of the most important recommendations made by the FAO Expert Consultation concerned the adoption of the North Atlantic Format (NAF, see NAFO Conservation and Enforcement Measures, Annex XXIII) for developing international standards for VMS position and catch reporting. CWP encouraged its members to participate in the process of developing NAF but also concluded that it was not currently in a position to review and possibly recommend NAF as a standard, particularly since the instrument is not yet fully developed. It was also agreed to establish an inter-sessional electronic working group consisting of all CWP members and coordinated by NAFO. The working group was asked to propose possible amendments to the present NAF that would ensure its usefulness for assessment and scientific purposes.

The Executive Secretary requested NAFO Scientific Council to review the NAF which is presently being developed by NAFO and NEAFC and which is meant to become a comprehensive list of possible data formats for real time data communications by fishing vessel masters and/or observers *via* the VMS. Any recommendations of the Scientific Council or a dedicated Working Group of the Council should be communicated to the Executive Secretary to be included in the assessment of the CWP Working Group. STACREC **recommended** that *NAF be submitted to Scientific Council for consideration.*

4. **Research Activities**

a) **Biological Sampling**

i) **Report on activities in 2004/2005**

STACREC reviewed the list of Biological Sampling Data for 2004 (SCS Doc. 05/11) prepared by the Secretariat and noted that any updates will be inserted during the summer, prior to finalizing the SCS Document which will be published for the September 2005 Meeting.

ii) **Report by National Representatives on commercial sampling conducted**

Canada (SCS Doc. 05/12): Information was obtained from the various fisheries taking place in all areas from SA 0, 2, 3 and portions of SA 4. Information on fisheries and associated sampling for, Greenland halibut (Div. 0AB, SA 2+ Div. 3KLMNO), Atlantic salmon, Arctic charr, Atlantic cod (Div. 2GH, Div. 2J+3KL, Div. 3NO, Subdiv. 3Ps), American plaice (SA 2 + Div. 3K, Div. 3LNO, Subdiv. 3Ps), witch flounder (SA 2 + Div. 3KL, 3NO, Subdiv. 3Ps), yellowtail flounder (Div. 3LNO), redfish (Div. 3LN, Div. 3O, Unit 2), northern prawn (Div. 0AB, Div. 2GHJ, Div. 3LMNO), Iceland scallop (Div. 2HJ, Div. 3LN, Subdiv. 3Ps, Div. 4R), snow crab (Div. 2J+3KLNO, Subdiv. 3Ps, Div. 4R), squid (SA 2+3), thorny skate (Div 3LNOP), white hake (Div. 3NOP), and capelin (SA 2 + Div. 3KL) was included.

EU-Spain (SCS Doc. 05/8): Subarea 1: Nine Spanish trawlers operated in Div. 1F and 2J, in the pelagic redfish fishery, during 2004. More information about the Spanish redfish fishery can be found in SCR Doc. 05/15.

In the second semester of 2004, three Spanish bottom trawlers carried out experimental fishing in the Greenland waters of Subarea 1 (SCR Doc. 05/33). The depth coverage of this experimental fishing was up to 1 463 m. The main objective was to search for cephalopod concentrations. However, Greenland halibut was the main species caught and cephalopods were not found. Catch length frequency distributions, by NAFO Division, were presented for Greenland halibut, shrimp, cod, American plaice and redfish.

Subarea 3 - A total of 32 Spanish trawlers operated in Div. 3LMNO, during 2004, and accumulated a total of 5 123 days (81 2642 hours), which implies a decrease of 25% in 2004 compared to 2003. Total catches for all species combined was 23 371 tons in 2004. Total effort and catch was estimated based upon information collected by EU observers onboard the fishing vessels.

The Spanish fishery in the NAFO Regulatory Area is mainly directed on Greenland halibut (mainly in Div. 3LM), alternating with the skate fishery in the second half of the year (Div. 3NO), shrimp fishery (Div. 3LM), and other species (Div. 3NO). Data on the length and age compositions of the trawl catches were obtained for Greenland halibut and roughhead grenadier. Data on the length compositions of the trawl catches were obtained for cod, yellowtail flounder, witch flounder, American plaice, skate, white hake and redfish.

Subareas 4 and 6 - During last quarter of 2004, two months of experimental fishing was carried out in the NAFO Regulatory Area (Subareas 4 and 6) and in adjacent international southern waters with one polyvalent Spanish trawler, using Gloria pelagic gear and bottom trawl gear. Approximately 76% of the trawling hours were conducted with pelagic gear and 24% with bottom trawl. Alfonsino (*Berix splendens*) was the main species caught with both gears and was caught primarily in Div. 6G. More information about this experimental fishery was presented in SCR Doc. 05/32.

Denmark/Greenland (SCS Doc. 05/14): Length frequency and catch-at-age data were available from the inshore fishery for Greenland halibut in Div 1A. Length frequencies were also available from the trawl fishery for Greenland halibut in Div. 1ABD. CPUE data were available from the trawl fishery for Greenland halibut.

Russia (SCS Doc. 05/5): Data on catch, sex, maturity, age, individual weight and length composition were obtained from bottom trawl catches for Greenland halibut (Div. 1ACD, Div. 3LMNO) and redfish (Div. 1F, 2J). Data on catch, sex, maturity and length composition from bottom trawl catches were available for redfish (Div. 3LMNO), cod (Div. 2J, 3KLMNO), roughhead grenadier (Div. 3LMNO), American plaice (Div. 3LNO), three beard (Div. 3LMN), white hake (Div. 3O) and thorny skate (Div. 3LMNO). Data on catch by trawl were presented for witch flounder (Div. 3LMNO), yellowtail flounder (Div. 3LNO) and American plaice (Div. 3M).

EU-Portugal (SCS Doc. 05/6): Data on catch rates and length composition were obtained from trawl catches for Greenland halibut (Div. 3LMNO). Data on length composition of the catch were obtained for cod (Div. 3NO), redfish (Div. 3LMNO), American plaice (Div. 3LMNO), yellowtail flounder (Div. 3N), roughhead grenadier (Div. 3LMNO), witch flounder (Div. 3LMNO), Atlantic halibut (Div. 3NO), white hake (Div. 3NO), thorny skate (Div. 3LMNO), spinytail skate (Div. 3LMNO) and monkfish (Div. 3NO).

Ukraine (SCS Doc. 05/15): Ukrainian observers collected size frequency data for American plaice (Div. 3N), yellowtail flounder (Div. 3N), northern prawn (Div. 3L, 3M), and redfish (Div. 3O).

iii) **Report on data availability for stock assessments (by Designated Experts)**

The Chair demonstrated the use of a password-protected NAFO web page where Designated Experts have been directed to include the data utilized in each stock assessment on an annual basis.

b) **Biological Surveys**

i) **Review of survey activities in 2004** (by National Representatives and Designated Experts)

Canada (SCS Doc. 05/12): Research survey activities carried out by Canada (N) were summarized and details were provided in various research documents associated with the stock assessments.

Denmark/Greenland (SCS Doc. 05/14): A survey of oceanographic stations along the West Greenland standard sections was carried out in 2004.

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimp, was initiated in 1988 and was continued in 2004. In July-August, 209 research trawl hauls were made in the main distribution area of the West Greenland shrimp stock, including areas in Subarea 0 and the inshore areas in Disko Bay and Vaigat. The surveys also provide information on Greenland halibut, cod, demersal redfish, American plaice, Atlantic and spotted wolffish and thorny skate.

A Greenland offshore trawl survey for Greenland halibut was initiated in 1997. The survey is a joint Japanese/Greenland survey that was conducted during 1987-1995. In 1997-2004, the survey covered Div. 1C and 1D, between the 3 nautical mile line and the 200 nautical mile line or the midline of Canada, at depths between 400 and 1 500 m. In 2004, 51 valid hauls were conducted. In 2001, the survey area was expanded to include Div. 1B-1A (to 74°N). In 2004, a new survey was conducted in the northern part of Baffin Bay, between 73°N and 77°N, where 62 valid hauls were conducted. All surveys have been carried out as stratified random bottom trawl surveys.

A longline survey for Greenland halibut, in the inshore areas of Disko Bay, Uummannaq, and Upernavik, was initiated in 1993. No longline survey was conducted 2002 due to technical problems and in 2003 and 2004 the longline survey was conducted in Uummannaq only.

Since 2001, a gillnet survey has been conducted in the Disko Bay area. In 2004, a total of 52 gillnet sets were made along four transects. Each gillnet was composed of four panels with different mesh sizes (46, 55, 60 and 70 mm stretched mesh). The highest densities of Greenland halibut were found in the mouth of the ice fjords.

EU-Germany (SCS Doc. 05/9; SCR Doc. 05/20, 40, 41): During the fourth quarter, stratified random surveys covered shelf areas and the continental slope off West Greenland (Div. 1B-1F) outside the 3-mile limit to the 400 m isobath. In October-November 2004, 65 valid hauls were carried out and the standard survey area was completely covered. Based on this survey information, assessments of the stock status for demersal redfish (*Sebastes marinus*, *S. mentella*), American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), and thorny skate (*Raja radiata*) are documented.

EU-Spain (SCS Doc. 05/8): Subarea 3 - The bottom trawl survey of NAFO Regulatory area in Div. 3NO was conducted in June 2004 using the R/V *Vizconde de Eza* and a Campelen trawl. A stratified random design was employed. A total of 122 hauls were conducted at depths of up to 1 450 m. The results of the Spanish Div. 3NO bottom trawl surveys conducted during 1995-2004, including biomass indices with their errors and length distributions as well as biomass estimates based on conversion of the length frequencies, are presented for: American plaice and yellowtail flounder (SCR Doc. 05/25); Atlantic cod, thorny skate and white hake (SCR Doc. 05/26); Greenland halibut (SCR Doc. 05/27); and roughhead grenadier (SCR Doc. 05/28), and were compared to the estimates based on CPUE ratios.

In 2003, it was decided to extend the area sampled during the Spanish survey in Div. 3NO to include Div. 3L. During 2004, a total of 50 valid hauls were conducted by the R/V *Vizconde de Eza* in 24 strata (at depths up to 1 464 m), in the Flemish Pass area of Div. 3L, with the usual survey gear (Campelen).

EU-Spain and EU-Portugal: The EU bottom trawl survey on Flemish Cap (Div. 3M) was carried out between June 25 and 2 August 2004. In recent years, the survey area has been extended to include depths of up to 1 400 m following the same procedure as in previous years and increasing the number of hauls to 195. The conversion factors for the main species caught in the survey were estimated (SCR Doc. 05/29) and the indices, for 1988 to 2002, were standardized based on the new vessel. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice and Greenland halibut are presented in SCR Doc. 05/35, as well as in SCR Doc. 05/36 for roughhead grenadier and SCR Doc. 05/47 for redfish. Shrimp data were presented in SCR Doc. 04/77. Feeding studies on the main species were continued, and samples for histological assessment on sexual maturity of cod, redfish, Greenland halibut and roughhead grenadier were also taken.

USA (SCS Doc. 05/7): Highlights from the report include: an increase in Barndoor skate biomass indices, during 2004, to levels observed during the mid-1960s; collaboration between scientists from the Northeast Fisheries Science Center (NEFSC) and Norway in MAR-ECO, an international Census of Marine Life (CML) project to explore the northern Mid-Atlantic Ridge; the use of a new vessel and gear beginning in 2006 for all NEFSC research bottom trawl surveys; the development of a method to optimize the allocation of available sea days for observer coverage to minimize either the variance of discard estimates or the number of sea days for a discrete set of fisheries; and information about the second industry-based monkfish survey. The software package called the NOAA Fisheries Toolbox (http:/nft.nefsc.noaa.gov; username = nft, password = nifty) has been updated and now includes 14 types of analytical programs available for use in conducting stock assessments.

In addition, a parallel haul study was conducted during February to determine the effectiveness of a square-mesh escape panel in reducing finfish by-catch in a small-mesh bottom trawl used in the *Loligo pealeii* fishery. The panel was effective in reducing catches of the predominant by-catch species, scup and black sea bass, but the experimental net will require a reconfiguration to reduce the loss of squid catch.

ii) **Surveys planned for 2005 and early 2006**

An inventory of biological surveys planned for 2005 and early 2006, as submitted by the National Representatives and Designated Experts, was compiled by the Secretariat. An SCS document summarizing these surveys will be prepared for review at the September 2005 Meeting.

iii) **Stock assessment database**

Recognizing the importance of reliable catch estimates to stock assessments and the considerable efforts of some Contracting Parties to produce more accurate catch estimates, STACREC **recommended** that *all Contracting Parties take measures to improve the accuracy of their catch estimates.*

c) **Selectivity Studies**

Russia (SCR Doc. 05/18): Russia conducted a midwater trawl selectivity study, during December 2003 and February 2004, involving the Div. 3O redfish fishery. The change in selectivity of trawl bags with nominal mesh sizes of 95, 100 and 105 mm was examined using a small-mesh, bag-shaped cover. The redfish catches were dominated by *S. fasciatus* (up to 85%) characterized by a smaller size and earlier maturity compared to *S. mentella*. An analysis of the size of individuals that escaped (16-43 cm) *versus* those retained (20-43 cm) in the trawl showed that the redfish length intervals were nearly the same for all three mesh sizes. Selectivity coefficients for the three mesh sizes of 95, 100 and 105 mm were estimated to be 2.6 and the selectivity ranges were also similar (5.4, 4.1 and 5.5 cm, respectively).

Estimation of instantaneous losses when changing the mesh size from 100 mm to 130 mm showed that the catch was reduced almost four-fold. Realization of the same TAC will require an appropriate increase in fishing effort. This will increase the probability of repeated escapement of the redfish through the trawl bag. Russian research in the Barents Sea (SCR Doc. 95/25) showed that 18-30% of the redfish escaped through the meshes when hauling in the trawl and died as a result of an abrupt change in hydrostatic pressure. From the aforesaid, it follows that because of the increase in fishing effort due to the use of a 130 mm mesh size, the post-traumatic mortality of the redfish will increase markedly.

There was considerable discussion of this study. STACREC felt that such work was extremely valuable and would form an important component of any discussion of mesh size changes. However, STACREC concluded that further study on the implications for different selectivity patterns on redfish yield per recruit and on by catch was needed.

5. FAO Cooperation

a) **Report of the Fisheries Resources Monitoring System (FIRMS) Steering Committee (FSC) Meeting, Copenhagen, 25-26 February 2005**

FIRMS is a partnership that is comprised of international organizations, regional fishery bodies and national scientific institutes to report and share information on the status and trends of fishery resources. FIGIS, the FAO Fisheries Global Information System, is the tool powering the FIRMS website, and it handles the management and dissemination of information shared within the FIRMS partnerships. NAFO joined FIRMS in 2005 following the NAFO General Council agreement in 2004. Both the NAFO Executive Secretary and STACREC Chair attended the FSC meeting. The objectives of the FSC are related to the development of a final product, to promote the participation of other partners, and to promote FIRMS as a single implementing mechanism of the Strategy-STF.

The FSC has a technical role, and the participation of persons other than RFBs Executive Secretaries was questioned because it might jeopardize the completion of the FSC tasks. In terms of technical participation by NAFO, the NAFO Executive Secretary noted that Barb Marshall, the NAFO Information Manager, will attend a meeting in December 2005 that involves a website implementation initiative.

b) **Report of the FAO Committee on Fisheries (COFI) Meeting, Rome, 7-11 March 2005**

The NAFO Executive Secretary and the STACREC Chair were in attendance at the COFI Meeting. The COFI meeting is a forum for member countries, Regional Fisheries Bodies (RFBs) and Non- Governmental Organizations to debate regional and global problems related to fisheries; both resources and communities are involved. The Implementation of the Code of Conduct for Responsible Fisheries (CC) by countries and RFBs was reported upon, as well the implementation of the Related International Plans of Action (Capacity, IUU Fishing, Seabirds and Sharks), and the Strategy for Improving Information on Status and Trends of Capture Fisheries (Strategy-STF). The CC was approved by COFI in 1995 and was recognized as valuable by all speakers. However, many countries and RFBs have difficulties with its implementation. International cooperation was claimed necessary to help those counties with this task. The latest development of the CC is the Ecosystem Approach to Fisheries (EA) that was approved by the World Summit on Sustainable Development at Johannesburg in 2002. The principles of the EA have economic, social and ecological components, but the system indicators, policy goals and operational objectives are still in a preliminary state of definition in a global context. Should the EA be implemented in NAFO, the Scientific Council would cover only some of the EA components

Other important issues covered at the meeting included: the assistance to the fishing communities affected by the 2005 tsunami in the Indian Ocean, the recent developments with regard to eco-labelling, and the role of coastal states and RFBs in the sustainability of deep sea fisheries. Small-scale fisheries have a strong presence in this forum because they are more numerous than industrial fisheries on a global scale.

c) **An Ecosystem Approach to Fisheries Stock Assessment** (Invited speaker: Mike Sinclair, CA)

Mike Sinclair, from the Bedford Institute of Oceanography (Division of Fisheries and Oceans, CA), gave a presentation entitled 'Ecosystem-based management: what does it mean?'. The presentation included information regarding the legal foundations of ecosystem-based management (EBM) and a description of how the scientific community has interpreted the objectives of EBM. The geographic boundaries of EBM may be either ecological or governance-based. In the case of Canada, seven ecoregion boundaries have been established for the region located between the Scotian Shelf and Labrador. A nested approach to EBM has been proposed for this ecoregion because ecological features larger than the EBM area will require coordinated management actions amongst relevant contiguous areas whereas small but critical ecological features will require fine spatial resolution of management actions within EBM area.

The Eastern Scotian Shelf Integrated Management (IM) Pilot was presented as an example of an IM Area chosen for initial study of EBM. Conservation and operational objectives of EBM, along with the IM hierarchical structure of the various sectors that will participate in EBM, were described. Each sector will have its own management plan and examples of such plans were presented along with the steps necessary to operationalize the plans. Examples of the identification of the issues and conservation objectives for each ecosystem component were described and the importance of cumulative impacts on various seascape/ecosystem types was emphasized. The management actions required to accomplish the operational objectives of the plan were discussed.

The conclusions of the presentation included the need to: embrace the disaggregated aspects of EBM; provide practical information that can be used now in EBM in absence of understanding of ecosystem dynamics; enhance monitoring to generate indicators for EBM plus contextual indicators for explanatory power; focus research on processes controlling biogeographic patterns and ecosystem functioning through comparative studies; and to understand that in order for the EBM process to evolve we need to build on what already exists.

6. **NAFO Observer Program: Data Available and Accessibility to Scientific Council**

The NAFO Executive Secretary reported on the progress made by the Secretariat regarding digitization of NAFO Observer Program data. The Secretariat previously requested submittal of the data in electronic form but noted that there have been no electronic reports received to date. However, the NAFO Executive Secretary reported that in 2004 Fisheries Commission had adopted a STACTIC recommendation to make available detailed observer data to Scientific Council through the NAFO Secretariat and that accordingly the digitized data with vessels not identified could be passed on to Scientific Council. It was reported that the Observer data have no harmonized formats, some are set-based and others are daily aggregates of catches, and that a small but growing portion of the reports are not submitted in English. The Secretariat holds a total of 1 898 Observer reports in paper format from 1997 to 2004. Average digitization time for each report was estimated at 95 to 110 minutes and the associated costs for all these reports in the order of $54 000. In addition, based on this analysis about $6 000 will be needed per year to digitize incoming reports on a routine basis. The NAFO Executive Secretary proposed to include a budget for retrospective and current observer data digitization of $16 000 year until the retrospective work is done and then continue with a budget of $6 000 for the new reports. Consensus could not be reached regarding the utility of continuing to digitize the NAFO Observer data because the data quality has purportedly deteriorated in recent years. As a result, STACREC members decided to postpone the decision until the September meeting and asked the Executive Secretary to include a provisional estimate of the cost to conduct the work in the proposed budget for 2006 in the event that Scientific Council decides to proceed with the digitization.

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

SCR Doc. 05/3: Estimates of reproductive potential for Div. 3LNO American plaice were produced by sequentially incorporating estimates of proportion mature-at-age, sex ratio-at-age and potential egg production. The estimates of reproductive potential produced by each method were broadly similar but there were important differences. Perceptions of current stock status ranged from 16 to 40% of B_{lim} depending on the index of reproductive potential used. The different indices of reproductive potential showed stock size at the end of a 10-year projection period to range from less than 60% to 150% of B_{lim} depending on the index.

SCR Doc. 05/8: Stratified random multi-species trawl surveys have been conducted during autumn by the Department of Fisheries and Oceans in the Newfoundland and Labrador Region annually since 1977. During 1995, the Campelen 1800 shrimp trawl was adopted as the standard survey gear, and survey coverage has been extended to include NAFO Div. 2HJ and 3KLMNO to a maximum depth of 1 500 m.

Problems with survey vessels during the 2004 survey resulted in the complete absence of survey sets deeper than 731 m in Div. 3LMNO, lack of coverage in several other strata in Div. 3L, reduction in coverage in some strata in Div. 3K, and extension of the timing until 1 February 2005. The 645 sets fished in 2004/05 is the lowest number in the autumn survey since 1995.

There are at least three sources of uncertainty resulting from the problems encountered during the autumn surveys of recent years: gaps in coverage (missed strata, reduced numbers of sets); changes in timing (survey coverage extended later, coverage of some strata/Divisions often spread out over a much longer period than planned); and vessel effects (no direct comparisons of the three vessels used and the use of vessels in areas where they have had little or no coverage in previous years).

Careful attention to survey gear and fishing protocols, along with set-by-set monitoring with trawl sensors ensures minimal variability during tows. However, the problems with survey coverage and timing have introduced an additional degree of uncertainty in the survey estimates for many species.

SCR Doc. 05/34: The Canadian autumn multi-species survey is an integral component in assessing many stocks within the NAFO Convention Area. During the course of the 2004 autumn multi-species survey, operational difficulties lead to incomplete coverage of the survey in NAFO Div. 3LNO. We explore the importance of the un-sampled strata in 2004 for computing indices of biomass and abundance, based upon survey results from the previous decade. We restrict this examination to those stocks that incorporate the autumn multi-species survey into analytical assessment methods, focusing on Greenland halibut and American plaice stocks. Given the results reviewed by the committee, it seems most prudent not to include the Div. 3LNO Canadian autumn 2004 survey results for Greenland halibut in any assessment models. The coverage deficiencies are substantial. For American plaice in Div. 3LNO, it is recommended that percent numbers at age in Div. 3L (and Div. 3LNO combined) be examined for the usage in the 2006 assessment.

SCR Doc. 05/43: Two age validation methods, chemical marking with oxytetracycline (OTC) and bomb radiocarbon dating (^{14}C released during atmospheric testing of nuclear bombs in the 1960s) are examined for Greenland halibut. In addition we analyzed growth of tag-recaptured fish and the precision of three age determination methods, left whole otoliths, otolith sections and scales (polarized transmitted light method). The growth model used for tag-recaptured data suggests a growth rate of approximately 2-3 cm/yr for fish in the size range of 55-70 cm. Age bias plots comparing the age interpretations among structures showed that whole otolith age and otolith section age tended to be similar across all ages. However, both otolith preparations underestimated scale ages in older fish. Ageing precision was somewhat lower for the otolith-based methods (coefficient of variation of 8.4% and 11.1% for whole otoliths and otolith sections, respectively) than for the scale ages (5.2%). Three OTC marked otoliths were examined. One of these, a 66 cm female that had been at-large for 3 years, 10 months had an annual growth rate of approximately 1.5 cm/yr. The OTC mark was visible at the edge on the whole otolith but we could not determine what should have been 3 annuli within the new growth area. The authors were able to make out what they presumed to be three annuli on the otolith cross-section. The ^{14}C based age values of mature otoliths indicate that the ages for all but one of these samples were beyond the age determined by either the whole otolith method or the otolith section. While the section ages were somewhat closer to the minimum age determined by the ^{14}C it was not always able to match the assumed true age based on the ^{14}C. Comparable scale ages were not available.

8. Other Matters

a) Calibration Studies

i) **EU-Spain and EU-Portugal** (SCR Doc. 05/29): In 2003, the vessel that performs the EU survey in 3M changed from the R/V *Cornide de Saavedra* to R/V *Vizconde de Eza*. In 2003 and 2004, a series of 111 valid paired hauls was performed in order to convert the indices for 1988 to 2002 from the former vessel into the new vessel. Two different conversion methods were used, one for biomass and another for lengths. The method used to convert the biomass indices was developed by Robson and calculates a Factor Power Correction by use of the catch per unit of effort (CPUE) observations for the two vessels. To convert the length distributions, a multiplicative model proposed by Warren was modified. Conversion factors were computed for Atlantic cod, American plaice, redfish, Greenland halibut, roughhead grenadier and Northern shrimp (SCR Doc. 04/77).

ii) **Canada** (SCR Doc. 05/48): In 1998, conversion of yellowtail flounder indices from the Canadian 1985-1994 autumn juvenile groundfish surveys of the Grand Bank was based on the 1996 comparative fishing trials of the Yankee shrimp trawl and the Campelen shrimp trawl. In 1998, STACFIS reviewed the results of the comparative fishing and recommended that conversion factors be derived for re-calculating the Yankee trawl survey time series into Campelen trawl units. The analyses showed no difference in length selection and catching efficiency of the two trawls when adjusted for differences in swept area (i.e. 30 minute Yankee tow *vs.* 15 minute Campelen tow) of the two trawls. Conversion of the time series from Yankee trawl units into Campelen trawl units was based on adjustment for the difference in swept area of the two trawls.

b) Other Business

i) **Gear codes**: At its meeting in June 2004, STACREC noted (*NAFO Sci. Coun. Rep.*, 2004, p. 83) that new gear category; a twin otter trawl, was in use in the Greenland halibut fishery in northern Atlantic waters and there was no FAO Gear Code available for such a gear type. The Secretariat was requested to determine an identifiable gear type for it and request FAO to assign an appropriate gear code.

The Deputy Executive Secretary informed STACREC that there was an FAO gear type that was similar to the twin trawl gear type used in the Greenland halibut fishery and that would be suitable for use, but it had not been assigned a NAFO gear code (2-digit number). The FAO International Standard Statistical Classification for Fishing Gear (ISSCFG) code for Otter Twin Trawl (OTT) is 3.3.0. For NAFO purposes, the Secretariat accordingly assigned a new 3-digit NAFO Gear Code, 192, to the otter twin trawl gear type. The statistical offices reporting to NAFO will be informed of this new code.

The Deputy Executive Secretary noted that in reviewing the FAO and NAFO gear codes, errors were found in the STATLANT 21 data system. The ISSCFG codes for the gear OTT and Mid-water Pair Trawl (PTM) gear were incorrect. The necessary modifications and corrections were introduced in the STATLANT 21 data system and revised questionnaires for the 2005 data were circulated by FAO/CWP.

The Deputy Executive Secretary also informed STACREC that there is currently no FAO ISSCFG code assigned to the NAFO gear Otter Twin Shrimp Trawl (OTS) and that the 2-digit NAFO Gear Code is 19.

The Deputy Executive Secretary also noted that the last update of the FAO gear classification and assignment of the ISSCFG gear codes that are currently in use is based on the FAO Fisheries Technical Paper No. 222 published in 1982. A working group of gear experts from FAO and ICES, the ICES/FAO Working Group on Fishing Technology and Fish Behaviour, met in April 2005 and added the following term of reference for the working group's 2006 meeting: to review and update the existing "definitions and classification of fishing gear categories" to the same level as in the FAO Technical Paper 222. The new classification will be presented at the Coordinating Working Party on Fishery Statistics (CWP) for formal adoption in 2007.

STACREC noted the importance of NAFO participation in the gear review process, particularly with respect to gear used in NAFO Area. Accordingly, STACREC **recommended** that *Stephen Walsh (Canada) represent the NAFO Scientific Council in the review and revision process of the FAO International Standard Statistical Classification of Fishing Gear (ISSCFG) by the ICES/FAO Working Group on Fishing Technology and Fish Behaviour*.

ii) **Acknowledgements**

The Chair thanked the participants for their valuable contributions to the Committee. Special thanks were extended to the rapporteur and to the Deputy Executive Secretary and staff of the NAFO Secretariat for their invaluable assistance in preparation and distribution of documents. There being no other business, the Chair closed the June 2005 STACREC Meeting.

A good time was had by all at the Lobster Dinner, MacAskill's Restaurant.

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

Chair: Hilario Murua Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 2–16 June 2005, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain fish stocks. Representatives attended from Canada, Denmark (in respect of Greenland and the Faroe Islands), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal and Spain), Russian Federation, Ukraine and the United States of America. Various scientists assisted in the preparation of the reports considered by the Committee. The Deputy Executive Secretary, Tissa Amaratunga, was in attendance.

The Chair, Hilario Murua (EU-Spain), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The provisional agenda was **adopted**.

II. GENERAL REVIEW

1. **Review of Recommendations in 2004**

STACFIS agreed that relevant stock-by-stock recommendations from previous years should be reviewed before the assessments were undertaken.

STACFIS also agreed that research recommendation could be conducted during the interim year of assessment of the stocks, and in this case there will be presented under STACFIS sessions during interim year of assessment and included in the research recommendation section of STACFIS report.

Recommendations in June 2004

i) **Considering Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 0 and Division 1A offshore and Divisions 1B-1F**;

STACFIS had recommended that *the investigations of the by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued and the results should be made available before the assessment in 2005.*

STATUS: No progress has been made.

STACFIS had recommended that *the CPUE series and catch-at-age for Greenland halibut from Div. 0B should be updated.*

STATUS: No progress has been made.

ii) **Considering Greenland halibut (*Reinhardtius hippoglossoides*) in Division 1A inshore**;

It was noted that in 2001 an annual gill net survey with small mesh net was started in the Disko Bay in order to estimate relative year-class strength of pre recruits to the fishery. STACFIS had recommended *that a study should be conducted to calibrate the gill net survey to the longline survey in order to allow use of the whole time series for Greenland halibut in Disko Bay.*

STATUS**:** A calibration study was carried out and presented to the June meeting (SCR Doc. 05/57).

Voluntary logbooks were introduced in 1999 but have only covered a small proportion of the landings due to poor return rates. STACFIS had recommended that *authorities consider means to ensure a higher return rate of inshore logbooks from the Greenland halibut commercial fishery in Div. 1A*.

STATUS**:** From 1 June 2005, logbooks become mandatory for vessels 30 feet or longer in all Greenlandic fisheries.

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

STATUS**:** No progress has been made.

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

STATUS**:** No progress has been made.

iii) **Considering demersal redfish (*Sebastes* spp.) in Subarea 1**;

STACFIS had recommended that *the quantity of redfish discarded in the shrimp fishery in Subarea 1 be quantified.*

STATUS: No progress has been made.

STACFIC had recommended that *determination of maturity of redfish caught during surveys in Subarea 1 be carried out.*

STATUS**:** No progress has been made.

iv) **Considering other finfish in Subarea 1**;

STACFIS had recommended that *the species composition and quantity of other finfish discarded in the shrimp fishery in Subarea 1 be quantified.*

STATUS: No progress has been made.

v) **Considering redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Division 3M**;

STACFIS had recommended that *an update of the Div. 3M redfish by-catch information be compiled on an annual basis, including the estimated weights and numbers of redfish caught annually in the Div. 3M shrimp fishery as well as tables showing their size distribution*.

STATUS: Implemented.

vi) **Considering redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N**;

STACFIS had recommended that *(1) redfish data in Div. 3LN and Div. 3O be analyzed further to determine if a relationship exists between Div. 3LN and Div. 3O 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.*

STATUS: Results were available from a study of redfish population structure pertinent to the long standing recommendation on the appropriateness of Div. 3LN and Div. 3O as management units (SCR Doc. 05/50).

STACFIS had recommended that *an update of the Div. 3L redfish by-catch information from the shrimp fishery be compiled on an annual basis, including the estimated weights and numbers of redfish caught annually as well as tables showing their size distribution.*

STATUS: No progress has been made.

vii) **Considering witch flounder (*Glyptocephalus cynoglossus*) in Divisions 3N and 3O**;

STACFIS had recommended that *the use of stock production models be attempted in the next assessment of Div. 3NO witch flounder.*

STATUS: No progress has been made because 2004 was an interim monitoring year.

viii) **Considering capelin (*Mallotus villosus*) in Divisions 3N and 3O**;

STACFIS had recommended that *initial investigations to evaluate the status of capelin in Div. 3NO utilize trawl acoustic surveys to allow comparison with the historical time series.*

STATUS: No progress has been made.

ix) **Considering redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Division 3O**;

STACFIS had again recommended that *(1) redfish data in Div. 3LN and Div. 3O be analyzed further to determine if a relationship exists between Div. 3LN and Div. 3O 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.*

STATUS: Results were available from a study of redfish population structure pertinent to the long standing recommendation on the appropriateness of Div. 3LN and Div. 3O as management units (SCR Doc. 05/50).

x) **Considering thorny skate (*Amblyraja radiata*) in Divisions 3LNO**;

STACFIS had recommended that *investigations into length-cohort analyses of commercial catches, standardization of the two research survey series (Engel and Campelen) and non-equilibrium production modeling be carried out for thorny skate in Div. 3LNO.*

STATUS: The calibration of two research surveys series was conducted during the interim monitoring assessment of this stock (SCR Doc. 05/49). The rest of the recommendations will be carried out during the next assessment of this stock.

xi) **Considering Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO**;

STACFIS had recommended that *all available information on by-catch and discards of Greenland halibut in Subarea 2 and Divisions 3KLMNO be presented for consideration in future assessments.*

STATUS: During the September 2004 SC meeting, Bowering and Orr (SCR Doc. 04/67) presented by-catch information from the Canadian shrimp fishery in Div. 2J and 3KL, from 1996 to 2003. Difficulties exist in producing reliable estimates of by-catch prior to 1996. Prior to this time period, the observer data required to produce independent estimates of by-catch are sporadic.

STACFIS had recommended that *age-readers of Greenland halibut in Subarea 2 and Divisions 3KLMNO participate in a 2005 Workshop to reach agreement upon common age reading practices and eliminate biases in age interpretation.*

STATUS: The workshop was postponed until 2006, as new research indicates (SCR Doc. 05/43) that there may be larger aging biases than previously thought.

STACFIS had recommended that *age-disaggregated indices of Greenland halibut in Subarea 2 and Div. 3KLMNO from the Spanish survey in Div. 3NO be presented for use in future assessments.*

STATUS: A research document was tabled presenting the age-disaggregated results for this survey (SCR Doc. 05/27).

xii) **Considering northern shortfin squid (*Illex illecebrosus*) in Subareas 3 and 4**

STACFIS had recommended that *distribution maps of squid abundance from the Canadian multi-species bottom trawl surveys in Div. 2J+3KLNO (September-October) and in Div. 3LNO + Subdiv. 3Ps (April-June) be produced, beginning with 1995, to determine the most appropriate subset of strata to use when deriving relative abundance and biomass indices from these surveys.*

STATUS: No progress has been made because 2004 was an interim monitoring year.

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 Subareas 2 and 3 in 2004. In addition to the catches reported (available to date) in STATLANT 21A reports and national research reports, and in order to derive the most appropriate estimates of catches for the various stocks in Subareas 2 and 3, data from various sources were considered.

STACFIS agreed in the best estimate catches (table below). STACFIS also agreed to continue documenting the preliminary tabulations of catch data from SATLANT 21A reports and the catches determined by STACFIS in the introductory catch table for each stock.

STOCKS	CATCHES ('000 tons) STATLANT 21A[1]	STACFIS
Stocks off Greenland and in Davis Strait		
Greenland halibut in Subarea 0 and 1 offshore and Div. 1B-1F	7	19
Greenland halibut in Div. 1A inshore		22.7
Roundnose grenadier in Subareas 0 and 1	0.01	0.01
Demersal Redfish in Subarea 1		0.5
Other finfish in Subarea 1		10.2
Stocks on the Flemish Cap		
Cod in Div. 3M	0.0	0.0
Redfish in Div. 3M	3.4	2.9
American plaice in Div. 3M	0.1	0.1
Stocks on the Grand Banks		
Cod in Div. 3N and 3O	0.8	0.9
Redfish in Div. 3L and 3N	0.7	0.6
American plaice in Div. 3L, 3N and 3O	2.9	6.2
Yellowtail flounder in Div. 3L, 3N and 3O	13.4	13.4
Witch flounder in Div. 3N and 3O	0.6	0.6
Capelin in Div. 3N and 3O	0.0	0.0
Redfish in Div. 3O	6.4	3.8
Skate in Div. 3LNO	11.8	9.3
White hake in Div. 3LNO	1.9	1.3
Widely Distributed Stocks		
Roughhead grenadier in Subareas 2 and 3	1.7	3.2
Witch flounder in Div. 2J+3KL	0.3	0.8
Greenland halibut in Subarea 2 and Div. 3KLMNO	16.0	25.5
Short-finned squid in Subareas 3 and 4	2.3	2.3

[1] Provisional.

Recognizing the importance of reliable catch estimates to stock assessments and the considerable efforts of some Contracting Parties to produce more accurate catch estimates, STACFIS **recommended** that *all Contracting Parties take measures to improve the accuracy of their catch estimates and present them in advance of future June Meetings*.

III. STOCK ASSESSMENTS

A. STOCKS OFF GREENLAND AND IN DAVIS STRAIT: Subareas 0+1

Environmental Overview

Hydrographic conditions in this region depend on a balance of atmospheric forcing, advection and ice melt. Wintertime heat loss to the atmosphere in the central Labrador Sea is offset by warm waters carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried south by the east Baffin Island Current. Temperature and salinity within 1 500 m depth over much of the Labrador Sea have become steadily warmer and more saline over the past number of years compared to the early 1990s. The low temperature and salinity values in the inshore region of southwest Greenland reflect the inflow of Polar Water carried by the East Greenland Current. Water of Atlantic origin with temperatures >3°C and salinities >34.5 is normally found at the surface offshore off the shelf break in this area. Historical data from Fyllas Bank revealed several cold "polar events" during 1983, 1992 and 2002. During these years, cold and diluted waters from the West Greenland banks reached well out to the slope regions of Fyllas Bank in the upper layers.

Temperature and salinity within 1 500 m depth over much of the Labrador Sea have become steadily warmer and more saline over the past four years and in 2004 were the warmest and saltiest in the past 15 years of surveys. Sea surface temperatures over much of the Labrador Sea were the warmest in the past 45 years. The northward extension of pure Irminger Water up to Fylla Bank indicates high inflow of water of Atlantic origin to the West Greenland area during 2004. The average temperature west of Fylla Bank, which is where the core of the Irminger Water is normally found, shows temperatures near 1°C higher than normal during 2004 and was the highest observed in the 54 year time series. The time series of mid-June temperatures on top of Fylla Bank was about 1.5°C above average conditions, while the salinity was slightly higher than normal. In general, temperatures in this area have been increasing since the mid-1990s and since 2000 the mean salinity in the 400-600 m layer has increased indicating a strengthening of the Irminger Current. Oceanographic data collected during autumn survey to the standard sections along the west coast of Greenland show temperatures in the West Greenland Current and on the Western Greenland Shelf about to 2°C warmer than normal during autumn.

1. Greenland Halibut (*Reinhardtius hippoglossoides)* in Subarea 0 and Division 1A Offshore and Divisions 1B-1F (SCR Doc. 05/13, 14, 33, 39, 43, 51, 56; SCS Doc. 05/5, 8, 9, 12, 14)

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. During 1993-2000 catches fluctuated between 8 300 and 11 400 tons. The catches increased gradually from 13 400 tons in 2001 to 20 000 tons in 2003 but decreased to 19 000 tons in 2004 (Fig. 1.1).

In Subarea 0 catches peaked in 1992 at 12 400 tons, declined to 4 300 tons in 1994 then stayed at that level until 2000 and then increased to 5 500 tons. Catches increased further to 7 600 tons in 2001, primarily due to an increase in effort in Div. 0A. Catches remained at that level in 2002 (7 800 tons) but increased again in 2003 to 10 400 tons. Catches dropped to 9 400 tons 2004. Catches in Div. 0A increased gradually from a level around 300 tons in the late-1990s and 2000 to 4 300 tons in 2003 but dropped to 3 740 tons in 2004.

Catches in Div. 1A offshore and Div. 1B-1F fluctuated between 900 and 2 400 tons during the period 1987-92. After that catches have fluctuated between 3 900 and 5 900 tons. Catches increased gradually from 5 500 tons in 2001 to 9 600 in 2003, primarily due to increased effort in Div. 1A. Catches stayed at that level in 2004 (9 700 tons). Prior to 2001 catches offshore in Div. 1AB have been low but they increased gradually from 150 tons in 2000 to 4 000 tons in 2003 and further to 4 200 tons in 2004.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	11	11	11	11	11	15[1]	15[1]	19[2]	19[2]	19[2]
SA 0	5	4	4	5	5	8	8	10	9	
SA1 exl. Div. 1A inshore	4	5	5	5	5	6	7	10	10	
Total STATLANT 21A	9	9	9	17[3]	7[4]	13[4]	15[4]	15[4,5]	7[4]	
Total STACFIS	9	9	9	10	11	13	15	20	19	

[1] Including a TAC of 4 000 tons allocated specifically to Div. 0A and 1A.
[2] Including a TAC of 8 000 tons allocated specifically to Div. 0A and 1AB.
[3] Including 7 603 tons reported by error from Subarea 1.
[4] Provisional.
[5] Including 1 366 tons reported by error from Subarea 0.

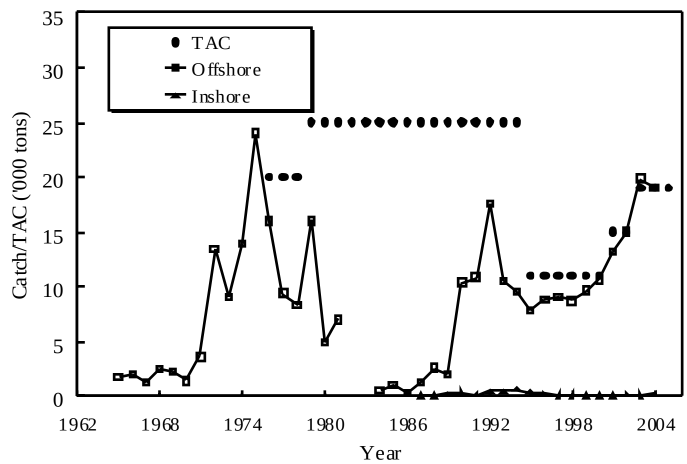


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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. During 1998-2003 Canada was the only country fishing in Div. 0B. In 2004, 300 tons were taken by longlines, 1 413 tons by gill net and 3 851 tons by trawlers.

Besides Canadian trawlers, trawlers from a number of different countries chartered by Canada participated in the fishery in Div. 0A in 2001-2003. In 2004 all catches (3 740 tons) in Div. 0A were taken by Canadian vessels, almost exclusively trawlers. Only 15 tons were taken by gill netters. The longline fishery in the area, which took about 1/3 of the catches in 2003, has apparently ceased.

A longline fishery in Cumberland Sound started in 1987. The catches gradually increased to 400 tons in 1992 where they remained until 1994. Catches decreased to 285 tons in 1995. During 1996-2001 catches were below 100 tons. The decrease in catches in recent years has been due to decrease in effort as a result of poor ice conditions. Catches Cumberland Sound amounted to 244 tons in 2003 but dropped to 63 tons in 2004.

The fishery in Div. 1A offshore + Div. 1B-1F. Traditionally the fishery in SA 1 has taken place in Div. 1D and to a minor extent Div. 1C. Catches have mainly been taken by trawlers from Japan, Greenland, Norway, Russia, Faeroe Islands and EU (mainly Germany). These countries, except Japan, were also engaged in the fishery in the area in 2004. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 tons in 2004. An offshore longline fishery in Div. 1CD was started in 1994 but there has been no longline fishery since 2002. Inshore catches in Div. 1B-Div. 1F amounted to 172 tons, which were mainly taken by gill nets.

During the years there have been a number of research fisheries offshore in Div. 1A but the catches have always been less than 200 tons annually. The catches increased gradually during 2000-2003 to 4 000 tons in 2003. Catches stayed at that level (4 100 tons) in 2004. All catches were taken by trawlers. The main part of the fishery in SA1 takes place during autumn and winter at depths between 1 000 and 1 500 m.

b) **Input Data**

i) **Commercial fishery data**

Information on length distribution was available from the trawl fishery in Div. 0AB and gill net fishery Div .0A. The length distributions in the trawl fishery were almost identical in Div. 0A and 0B with modes at 48-51 cm and resembled the length frequency seen in previous years. The bulk of the catches in the gill net fishery in Div. 0A were between 50 and 70 cm with modes at 57 and 63 cm.

Information on length distribution of catches was available from Greenland trawlers from Div. 1ABD and from trawlers from Russia (SCS Doc. 05/5) and Norway fishing in Div. 1D.

The length distributions in Div. 1AB showed a mode at 48-51 cm and there were generally more large fish in the catches compared to Div. 1D as seen in previous years. The length distribution in Div. 1D showed clear modes at 49, 50, and 52, in the Russian, Norwegian and Greenland fishery, respectively. The mode in the trawl fishery in Div. 1D has been at 47-51 cm in the last decade.

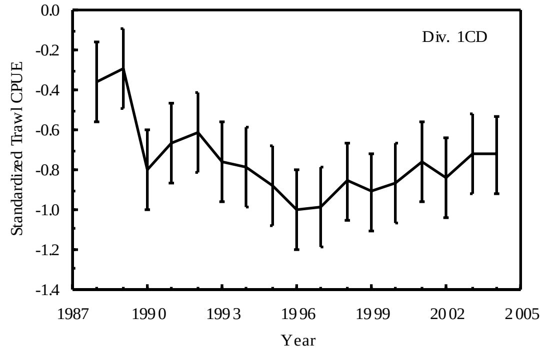
Age distributions were available from the Russian trawl fishery in Div. 1D. Age 6 and 7 dominated the trawl catches in Div. 1D as seen in previous years (SCS Doc. 05/05) while ages 6-8 dominated the Greenland catches in Div. 1D.

Unstandardized catch-rates from the trawl fishery in Div. 0A showed a gradual increase between 2001 and 2003 for both single and twin trawls, respectively (SCR Doc. 04/44). This increase in catch rates probably does not reflect an increase in the stock but rather that the fishery has moved northward to areas not previously fished, combined with increased experience in the fishery. There was no update of the Div. 0A catch rates available for 2004. The catch rate in the Greenland trawl fishery in Div. 1A was stable between 2001 and 2002 but showed a decrease in 2003 to increase again in 2004 (SCS Doc. 05/14).

Standardized annual catch rates were calculated for the trawl fishery in Div. 1CD for 1988-2004 based on available logbooks and the EU-Germany fishery in Div. 1D (SCS Doc. 05/9). The catch rates have been stable during the period 1990-2004 (Fig. 1.2). CPUE increased slightly between 2002 and 2003 but dropped slightly from 2003 to 2004.

Combined standardized annual catch rates were calculated for the trawl fishery in SA 0 for 1990-2000 and from Div. 1CD for 1988-2000 based on available logbooks and the EU-Germany fishery in Div. 1D (SCR Doc. 01/48, SCS Doc. 01/13). The combined catch rates showed a decrease from 1988-89 (one large vessel with high catch rates) to 1990, but have remained stable since (Fig. 1.2). The catch rates series has not been updated in the recent years due to lack of data from SA0.

Due to the frequency of fleet changes in the fishery both in SA 0 and Div. 1CD, the indices of CPUE should be treated with caution.



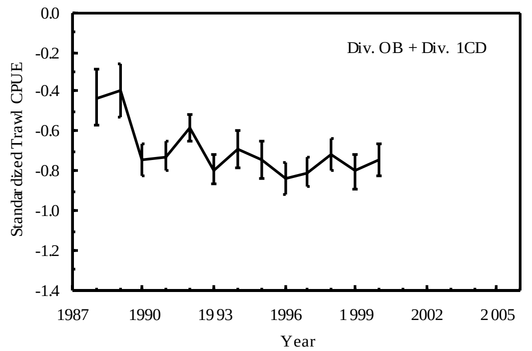


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawl CPUE from SA0 and Div. 1CD. B: Standardized trawl CPUE from Div. 1CD with $\pm$ S.E.

ii) **Research survey data**

Japan-Greenland and Greenland Deep-sea surveys. During the period 1987-95 bottom-trawl surveys were conducted in Subarea 1 jointly by Japan and Greenland (the survey area was re-stratified and the biomass estimates were recalculated in 1997 (SCR Doc. 97/21)). In 1997 Greenland initiated a new survey series covering Div. 1CD. The survey is conducted as a stratified-random bottom trawl survey covering depths between 400 and 1 500 m. The trawlable biomass in Div. 1CD was estimated to be 76 000 tons in 2004, which is slightly increase from 69 000 tons in 2003 and above average for the time series (56 000-78 000 tons) (Fig. 1.3) (SCR Doc. 05/13).

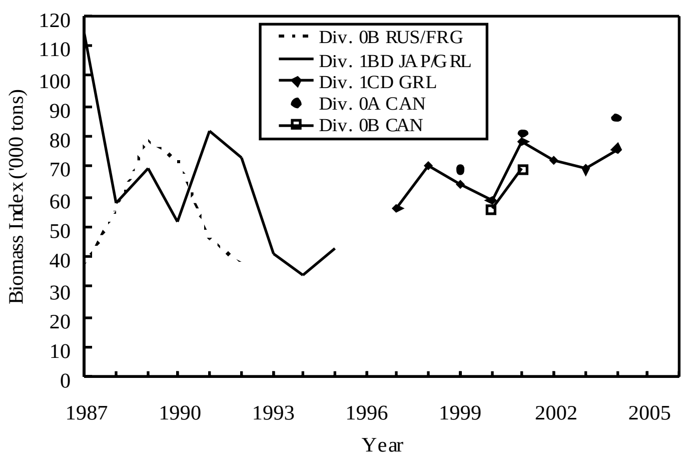


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from surveys.

Greenland deep sea survey in the northern part of Baffin Bay. In 2004 Greenland conducted a bottom trawl survey aimed at Greenland halibut in the Greenland part of the Baffin Bay between 73ºN and 77ºN at depths down to 1 500 m. The swept area biomass and the abundance were estimated as 54 000 tons and 78 mill individuals, respectively. At shallow water (400-800 m) the length distribution was dominated by modes at 30 and 45cm, while the length distribution at depths >800 m was dominated by a mode at 48-51 cm (SCR Doc. 05/14).

Canadian deep sea survey in Baffin Bay (Div. 0A). Canada has conducted surveys in the southern part of Div. 0A in 1999, 2001, and 2004 and the biomass was noted to increase gradually from 69 000 tons *via* 81 000 tons to 86 000 tons in 2004 (Fig. 1.3). The abundance decreased, however, slightly from 118 million in 2001 to 111 million individuals in 2004. The mode in catches increased from 42 cm in 2001 to 45 cm in 2004. In 2004 Canada conducted a survey in the northern part of the Baffin Bay. The biomass was estimated at 46 000 tons. The length frequencies in the catches showed a mode at 48 cm (SCR Doc. 05/56).

Deep sea surveys in SA0+1. Most of SA 0 and SA 1 has been covered by deep sea surveys in recent years and the biomass has been estimated (Fig. 1.4). These estimates should be considered as relative indices and not absolute values (See text table below). It should be noted that Div. 0B and Div. 1A (south of 73°N) - Div. 1B has not been covered by deep sea surveys since 2001 and there is no information about the development of the stock in these areas since then. Div. 1A (south of 72°30'N) - Div. 1B has, however, been surveyed down to 600 m by the Greenland shrimp survey, see below. The only part of the area that has not been covered by deep sea surveys is Div. 1EF, which, due to the steep continental shelf, has little area at depths relevant for commercial fisheries. Div. 1EF and has, however, been surveyed down to 600 m by the Greenland shrimp survey.

Biomass indices estimated from various deep sea surveys, all conducted by same vessel and gear.

SA 0	Biomass index	SA 1	Biomass index
Div. 0A north	45 877	Div. 1A N of 73°	53 867
Div. 0A south	86 176	Div. 1B-1A S of 73°	36 416[1]
Div. 0B	68 917[1]	Div. 1CD	75 896

[1] Latest estimate 2001, other estimates are from 2004. Div. 0A north: north of 72°N.

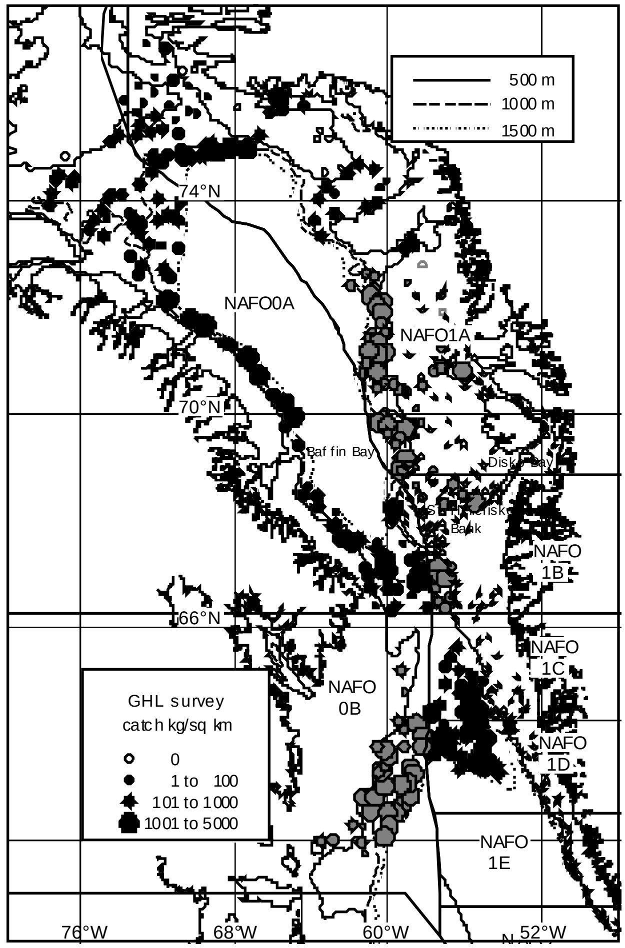


Fig. 1.4. Distribution of catches in deep sea surveys conducted by Canada and Greenland in 2001 (grey) and 2004 (black). Further the position of the hauls in the 2004 Greenland shrimp survey are shown as stars (This survey is using a different gear and the catches are not directly comparable to the catches in the deep sea survey).

A TAC for Div. 0A + 1A on 4 000 tons was advised for 2001 based on a survey in the southern part of Div. 0A in 1999. This TAC was increased further to 8 000 tons for 2003 based on surveys in 2001 in the southern part of Div. 0A and southern part of Div. 1A. The ratio between the biomass estimated at that time and TAC was 0.048 and 0.063, respectively (the biomasses have since then been recalculated based on better stratification). In 2004, new areas have been surveyed in the northern part of Baffin Bay (Div. 0A and 1A). The biomass was estimated at 46 000 and 54 000 tons, respectively, in the two areas. Based on average ratio of previous TAC calculations the TAC for both areas would be set at 5 000 tons.

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 biomass in the offshore area has been stable on a relatively high level in recent years and the estimate for 2004 (31 100 tons) was the highest in the time series which dates back to 1992. (The biomass and abundance estimates were recalculated in 2004 based on better depth information and new strata areas.) (SCR Doc. 05/39).

The number of one-year-old fish in the total survey area including Disko Bay increased gradually from 1996 to a peak of 450 million in 2001. The estimate was 196 million one-year-old specimens in

2002, which is above the recruitment of the 1989 to1994 year-classes but below the recruitment levels since then, except the 1996 and 1997 year-classes. The number of one-year-olds increased in 2003 to 317 million and stayed at that level in 2004 (314 million) (Fig. 1.5).

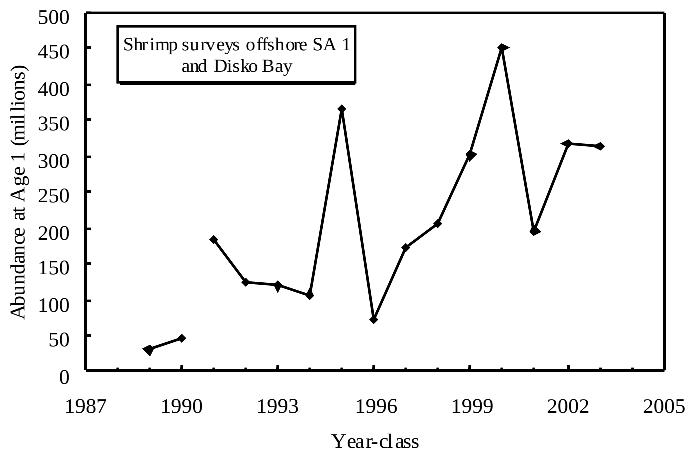


Fig. 1.5. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (The 1989 and 1990 year-classes are poorly estimated as age 1).

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1B-1AS dropped between 2003 and 2004 to the third lowest value since the outstanding large 1995 year-class and the 2003 year-class was below the average for the time series which dates back to the 1991 year-class. (Data from before that is considered incomplete due to limited coverage by the survey) (SCR Doc. 05/39).

c) **Estimation of Parameters**

An Extended Survivors Analysis (XSA) stock assessment model fitted to the stock data from SA 0+1 was presented in 2003. The analysis was considered to be provisional due to problems with the catch-at-age data and the short time series, but the outcome was considered to reflect the dynamics of the stock. (SCR Doc. 03/54). The XSA was not updated this year due to lack of catch-at-age data, primarily from SA0.

d) **Assessment Results**

Divisions 0A + 1A (offshore) + Division 1B

The southern part of Div. 0A was surveyed in 1999, 2001, 2004 and the southern part of Div. 1A and Div. 1B was surveyed in 2001. Based on the survey in 1999 a separate TAC on 4 000 tons was set for Div. 0A + Div. 1A for 2001 and 2002 and, based on the surveys in 2001, the TAC was increased to 8 000 tons for 2003-2005 for Div. 0A + Div. 1AB. The biomass in the southern part of Div. 0A increased from 81 000 tons in 2001 to 86 000 tons in 2004, while the abundance decreased from 118 millions to 111 millions individuals.

In 2004 Canada and Greenland conducted surveys in the northern part of the Baffin Bay (Div. 0A and 1A), that not has been surveyed before. The trawlable biomass was estimated to 46 000 tons and 54 000 tons, respectively, in the two areas.

Further, the Greenland Shrimp Survey has covered, among others, Div. 1B and part of Div. 1A (to 72°30'N) annually since 1992. The biomass, which is mainly found in Div. 1AB, estimated in Greenland

Shrimp Survey has been relative high and stable in recent years and in 2004 was the highest observed in the time series.

The length distribution in the trawl fishery in Div. 0A has been stable during 2002-2004, with a mode around 48 cm. The mode in the trawl fishery in Div. 1A has varied between the different fleets in resent years but was around 50 cm in 2004.

Unstandardized trawl CPUE indices showed an increase between 2001 and 2003 in Div. 0A. The unstandardized trawl CPUE was stable in 2001 and 2002, decreased in 2003 but increased again in 2004.

Divisions 0B + 1C-1F

The survey biomass index in Div. 1CD increased between 2003 and 2004 and was estimated as 76 000 tons in 2004, which is above average for the seven year time series (56 000-78 000 tons). Although the survey series from 1987-95 is not directly comparable with the series from 1997-2004, the decline in the stock observed in Subarea 1 until 1994 has stopped and the stock seems to be back at the level of the late 1980s and early 1990s.

The mode in the trawl fishery in Div. 1D was around 50 cm in 2003 while modes at 48, 49 and 51, were seen in three different fleets fishing in Div. 1D in 2004.

A combined standardized trawl CPUE index from SA 0 and Div. 1CD was stable during 1990-2000 and a standardized trawl CPUE index from Div. 1CD has been stable during 1990-2004.

Subarea 0 + Division 1A (offshore) + Divisions 1B-1F

Estimates of trawlable one-year-olds in the entire area covered by the Greenland Shrimp survey, including Disko Bay, has been steadily increasing since 1996 and the 2000 year-class was the largest in the time series. The 2003 year-class is considered to be above average. It was noted, that the 1995 year-classes was estimated to be a very strong year-class at age one but it has not shown up in the fishery as a particularly strong year-class.

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1B-1AF dropped between 2003 and 2004 to the third lowest value since the outstanding large 1995 year-class and the 2003 year-class was below the average for the time series which dates back to the 1991 year-class.

e) **Precautionary Reference Points**

Age-based or production models were not available for estimating of precautionary reference points and CPUE and survey series were short, showed to little variation and covered too little of the assessment area to be used for estimation of reference points.

f) **Research Recommendation**

STACFIS **recommended** that *the investigations of the by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued and the results should be made available before the assessment in 2005.*

STACFIS **recommended** that *the CPUE series and catch-at-age for Greenland halibut from SA0 should be updated and the location and distribution of the catches be provided.*

STACFIS **recommended** that *the reason for the discrepancies in ageing of Greenland halibut between different laboratories should be investigated further.*

2. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Division 1A Inshore** (SCR Doc. 05/39, 58; SCS Doc. 05/14)

a) **Introduction**

The main fishing grounds for Greenland halibut in Div. 1A are located inshore. The inshore landings in Div. 1A were around 7 000 tons in the late 1980s then increased until 1998 when the landings were almost 25 000 tons. Since 1999 landings have declined and were 16 900 tons in 2001 but increased again the following years to 22 700 tons in 2004 (Fig. 2.1).

Recruitment to the inshore stock is dependent on recruitments 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 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.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC						7.9	7.9	7.9	na	ni
Disko Bay[1]	7.8	8.6	10.7	10.6	7.6	7.1	11.7	11.6	12.9	
Recommended TAC						6.0	6.0	6.0	na	5.0
Uummannaq	4.6	6.3	6.9	8.4	7.6	6.6	5.4	5.0	5.2	
Recommended TAC						4.3	4.3	4.3	na	na
Upernavik	4.8	4.9	7.0	5.3	3.8	3.2	3.0	3.9	4.6	
Unknown[2]	-	-	-	-	-	2.2				
STATLANT 21A	17.3	20.8	19.7	24.3	21.1[3]	16.7[3,4]	17.6[3]	20.6[3]		
STACFIS	7.3	19.8	24.6	24.3	21.0	16.9	20.1	20.5	22.7	

na no advice.
ni no increase in effort.
[1] Formerly named Ilulissat.
[2] Landings from unknown areas within Div. 1A.
[3] Provisional. Landings data from 2000 are likely to be underestimated by 2 000 tons.
[4] Includes catches from the offshore area.

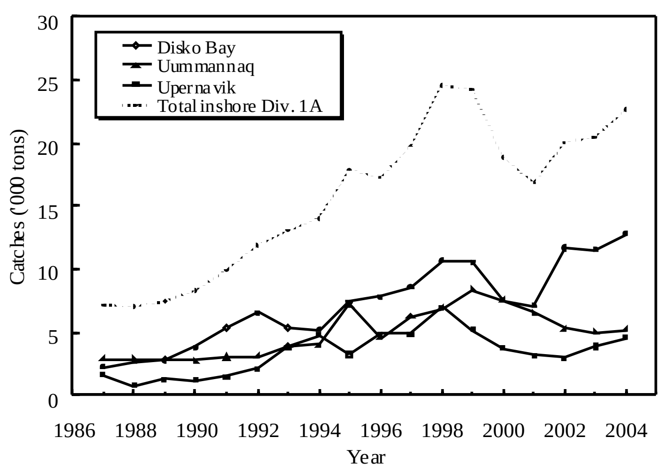


Fig. 2.1. Greenland halibut in Div. 1A inshore: landings by area.

This fishery takes place in the inner parts of the ice fjords at depths between 500 to 800 m. Longlines are set from small boats, or in winter through the ice. Since the mid-1980s gillnets were used in the fishery. A total ban on gillnets has been in force since 2000, although dispensation is presently given to a gillnet fishery at Ilulissat in Disko Bay. Dispensations were also given to a gillnet fishery in the outer parts of the fjords in Uummannaq and Upernavik in 2002. In 2003 the areas of dispensation from gillnet ban were increased, and authority to lay down local rules have been given Uummannaq and Upernavik minicipalities. The minimum mesh size allowed is 110 mm (half meshes).

There are no regulations on landings, but from 1998 a fishery licence has been required to land Greenland halibut. The total number of licenses is about 1 300 which involves about 200 vessels and an unknown number of smaller boats.

The inshore fishery in Div. 1A is mainly located in three areas: Disko Bay (68°30'N-70°N), Uummannaq (70°30'N-72°N) and Upernavik (72°30'N-75°N), which are dealt with separately in the following:

Disko Bay. The Greenland halibut fishery is conducted in, and in front of an ice fjord in the immediate vicinity of Ilulissat town, and in an ice fjord, Torssukattaq, north of Ilulissat.

The landings in Disko Bay increased from about 2 300 tons in 1987 to a high level of about 10 500 tons in 1998. Thereafter landings declined to 7000 tons in 2001, after that landings have increased every year until 2004 where landings reached a record high of about 12 900 tons.

Uummannaq. The area consists of a large system of ice fjords where the fishery is conducted. The main fishing ground is in the southwestern part of the fjord system. During earlier times Qarajaqs Ice fjord was the main fishing area but during the last decade the fishery spread further north to include Sermilik and Itiviup ice fjords.

Landings increased from a level of 2 000 tons before 1987 to a record high in 1999 of 8 425 tons. The landings declined to 5 000 tons in 2003 and increased again slightly in 2004 to about 5 200 tons.

Upernavik. The northernmost area consists of a large number of ice fjords. The main fishing grounds are Upernavik and Giesecke ice fjords (up to 73°45'N). New fishing grounds around Kullorsuaq (74°30’N) in the northern part of the area have been exploited recently.

The landings in the Upernavik area increased steadily from about 1 000 tons in the late 1980s to about 4 000 tons in 1995 and reached the highest on record in 1998 at 7 000 tons (Fig. 2.1). Landings gradually decreased since then to 3 000 tons in 2002, since then, landings have increased to 3900 tons in 2003 and further in 2004 to about 4 600 tons.

b) **Input Data**

i) **Commercial fishery data**

Landings data available at the time of the assessment were preliminary, however, they were considered reliable. Length distributions were available from longlines and gill nets from the summer and winter fisheries in Disko Bay and Uummannaq and from winter fishery in Upernavik.

Length measurements (Fig. 2.2) of the commercial longline landings from 1993 to 2005 in Disko Bay indicated that the fisheries take place on smaller sub-components of the stock, as size distribution differs substantially between summer and winter.

Mean length in Disko Bay has been relatively stable in the summer fishery since 1993. The mean length in the winter fishery showed an increasing trend until 2001; except for winter 2000 when weather conditions prevented the traditional fishery. Mean length in the winter fishery decreased from 2002 to 2005, but is still at the average level for the period 1993-2001. In Uummannaq, a decreasing trend in mean length was observed until 1999 for the summer fishery, but this has stabilized since then. In the winter fishery mean length was relatively stable up to 2001. In the winter of 2002 mean length increased but stabilised in 2003 and 2004 to average of the time series, followed by a decrease in 2005.

In Upernavik, the mean length has varied but an overall negative trend was observed until 1999, especially in the winter fishery where the reduction was statistically significant. From 1999-2002 the mean length has been stable around 62 cm in both the winter and summer fisheries. From 2002 until 2005 no data were obtained from the commercial longline fishery in Upernavik, samples from 2005 winter fishery show that mean length remains stable.

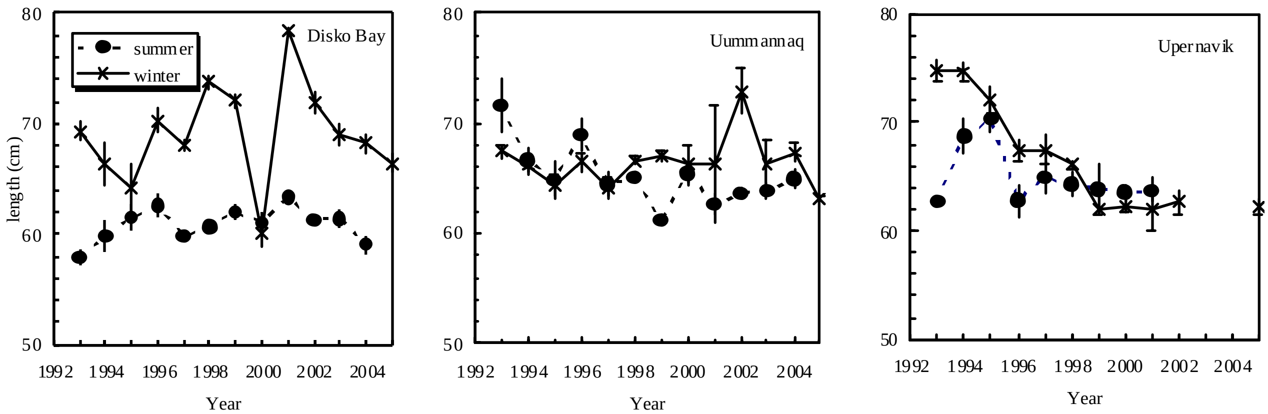


Fig. 2.2 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik with 95% conf. Int.

In recent years the age composition has changed towards fewer and younger age groups especially in Upernavik. In Disko Bay and Uummannaq age composition in the catches has stabilized at 50 to 75% fish being 10 years and younger.

Logbooks have from 1st June 2005 become mandatory for vessels more than 30 feet long. In 1999 logbooks were introduced on a voluntary basis. Available logbooks constituted an insignificant part of the fishery (<1%), and data are thus too scarce to be used in the assessment. Earlier attempts to estimate fishing effort showed a significant correlation between effort (expressed as fishing days) and landings.

ii) **Research survey data**

In 1993 a longline survey program for Greenland halibut was initiated for the inshore areas, Disko Bay, Uummannaq and Upernavik. The surveys have been conducted annually covering two of the three areas in rotation, with approximately 30 fixed stations in each area. Revisions in the database for the area Uummannaq in the year 1999 and the inclusion of a length-of-line effect in the standardization process have led to somewhat revised standardized CPUE values, resulting in a downward revision of CPUE for the year 1999 in Uummannaq. Standardised CPUE for Disko Bay have been increasing from 1999 to 2001 and decreased slightly in 2004. Standardised CPUE for Uummannaq has been decreasing from 1999 to 2003, followed by an increase in 2004 (Fig. 2.3). However none of the changes in standardised CPUE were significant.

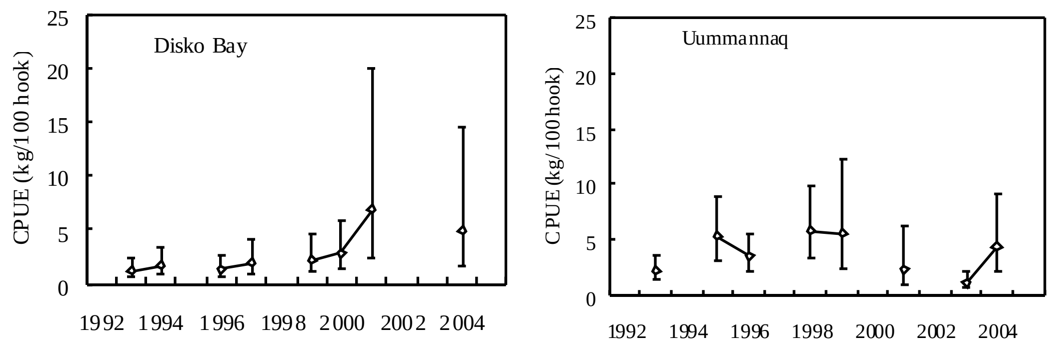


Fig. 2.3 Greenland halibut in Div. 1A inshore: standardised CPUE from longline surveys in Disko Bay and Uummannaq 1993-2004, re-transformed values given as kg/100 hooks, while in the 2004 report it was presented as relative re-transformed values

Since 2001 gillnet surveys have been carried out in Disko Bay. Both CPUE and NPUE from the gillnet surveys have decreased from 2001 to 2002, but increased slightly again during 2002-2004, though not significantly (Fig. 2.4). However the area covered by the gillnet surveys was larger in 2002-2004 compared to that in 2001.

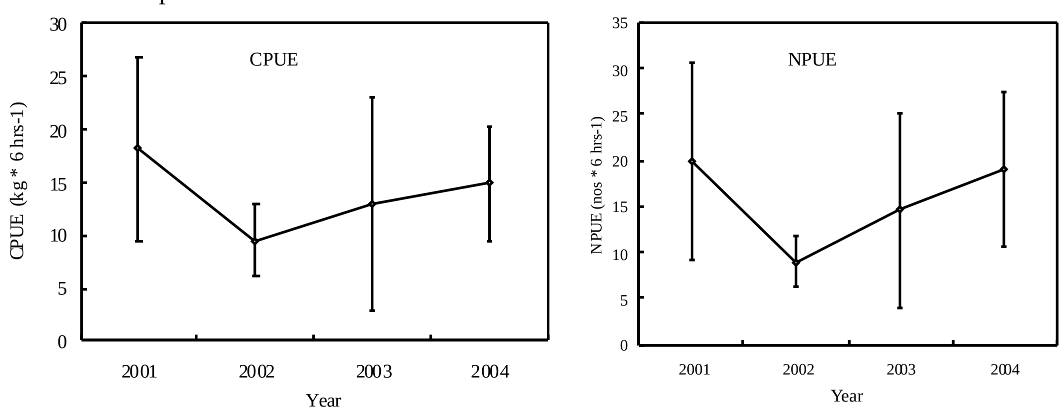


Fig. 2.4. Greenland halibut in Div. 1A inshore: CPUE and NPUE from gillnet survey Disko Bay 2001-2004

Since 1988 annual trawl surveys have been conducted with a shrimp trawl 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 has been included. Standardized recruitment indices based on the survey were presented as catch-in-numbers per age per hour, for the Disko Bay area (Fig. 2.5). The index was recalculated in 2003 using hauls from depths >300 m only. The recalculations resulted in an increase in the absolute values, but the overall trends in the series did not change. Recruitment indices of year-classes from 1997 and onwards have been around or above average of the time series.

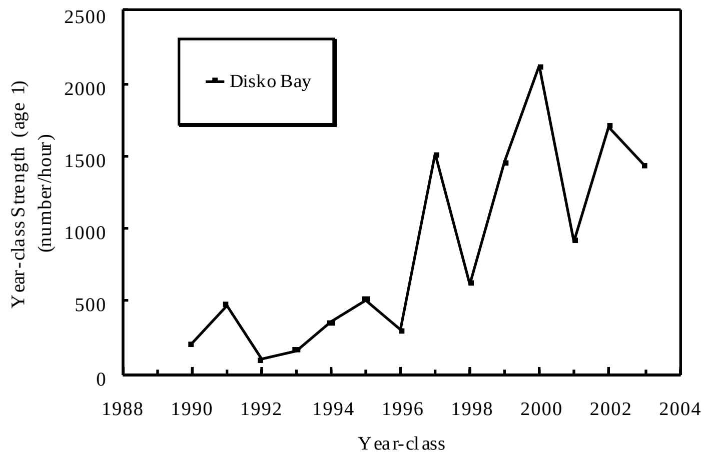


Fig. 2.5 Greenland halibut in Disko Bay: recruitment at age 1 from Greenland shrimp trawl survey.

Biomass indices of Greenland halibut in Disko Bay have, from 1998 and onwards been about twice as high as in previous years of the time series and increased from 17 000 tons, which was the second highest on record in 2003 to 28 000 tons in 2004 (Fig. 2.6).

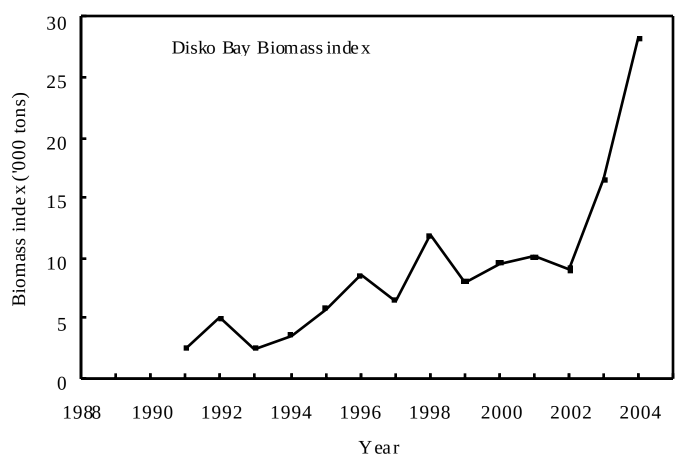


Fig. 2.6 Greenland halibut in Disko Bay: biomass indices from Greenland shrimp trawl survey.

c) **Assessment Results**

General Comment. Catch data, biological data (mean length and age) from the fishery and information from longline and gillnet surveys were available. The lack of information on fishing effort makes it difficult to evaluate trends in landings relative to stock biomass or fishing effort.

Exploitation of younger age groups has increased considerably for all areas in the past 10-15 years.

Disko Bay. Indices of abundance have been relatively stable since 1993. A new gillnet survey (2001-2004) shows stable catch rates over the last two years. Mean length in commercial catches shows a decrease over the last three years. Biomass index in Disko Bay is highest on record. Recruitment indices from Disko Bay suggest high 1997 and onward year-classes, which might benefit the fishery in future years.

Uummannaq. Abundance indices indicate an increase until 1999, from 2001 to 2003 abundance indices decreased and in the same period landings declined, and in 2004 both abundance index and landings increase slightly. Mean lengths from both the surveys and in the fishery are relatively stable over the entire period, indicating that trends in catch rates are for all lengths groups.

Upernavik. Since no surveys and sampling from landings has been conducted in Upernavik from 2002 until winter 2005, there is no basis to evaluate the state of Greenland halibut stocks in that area.

Information from the fishing industry and fishermen about the fishery in 2002 and 2003 suggests that: the increase in landings in Disko Bay in recent years is a result of a rise in effort. Gillnet vessels from Uummannaq participate in the fishery in Torssukattaq in Disko Bay and thus shifted effort from Uummannaq to Disko Bay. In Upernavik 2002 several 25-35 ft vessels were lost in a fire, and 4 of the larger vessels, normally fishing Greenland halibut, shifted to a new fishery for snow-crab. Effort was thus reduced in Upernavik in 2002. The increase in landings 2003 and 2004 suggests however that effort has increased, possibly due to a decreasing snow crab fishery.

d) **Reference Points**

Precautionary reference points could not be given.

e) **Research Recommendations**

It was noted that in 2001 an annual gill net survey with small mesh net was started in the Disko Bay in order to estimate relative year-class strength of pre recruits to the fishery. STACFIS **recommended** that *the study to calibrate the gill net survey should be continued in order to allow use of the whole time series for Greenland halibut in Disko Bay.*

STACFIS **recommended** that *investigations of by-catch of juvenile Greenland halibut in the commercial shrimp fishery in Subareas 0+1 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. 05/13; SCS Doc. 05/14)

Interim Monitoring Report

a) **Introduction**

A total catch of 12 tons has been reported for 2004 compared to 47 tons for 2003 (Fig. 3.1).

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.12[2]	0.15[3]	0.03[4]	0.04	0.1[1]	0.06[1]	0.03[1]	0.05[1]	0.01[1]	
STACFIS	0.12[2]	0.15[3]	0.03[4]	0.04	0.1	0.06	0.03	0.05	0.01	

[1] Provisional.
[2-4] Includes roughhead grenadier from Div. 1A misreported as roundnose grenadier: 30[2] tons, 28[3] tons, 3[4] tons.

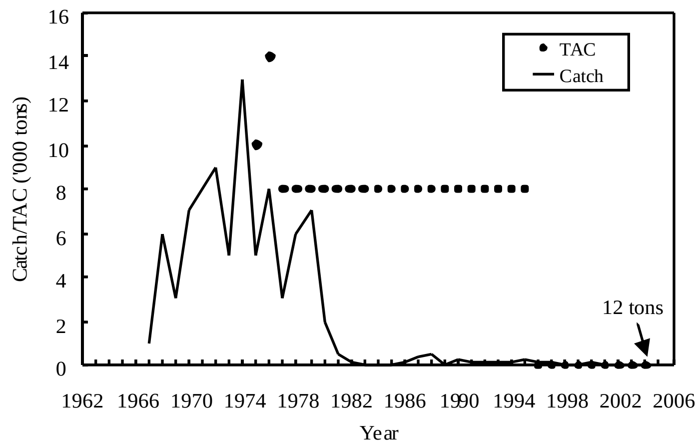


Fig. 3.1. Roundnose grenadier in Subareas 0+1: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is 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.

ii) **Research survey data**

In the period 1987-95 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. (The survey area was restratified and the biomasses recalculated in 1997). Russia has in the period 1986-92 conducted surveys covering Div. 0B and Div. 1CD at depths down to 1 250 m until 1988 and down to 1 500 from then of. The surveys took place in October-November. During 1997-2004 Greenland has conducted a survey in September - November covering Div. 1CD at depth between 400 and 1 500 m. Canada conducted surveys in Div. 0A in 1999, in Div. 0B in 2000 and in Div. 0AB in 2001 at depths down to 1 500 m. Roundnose grenadier was not observed in Div 0A (Fig. 3.2).

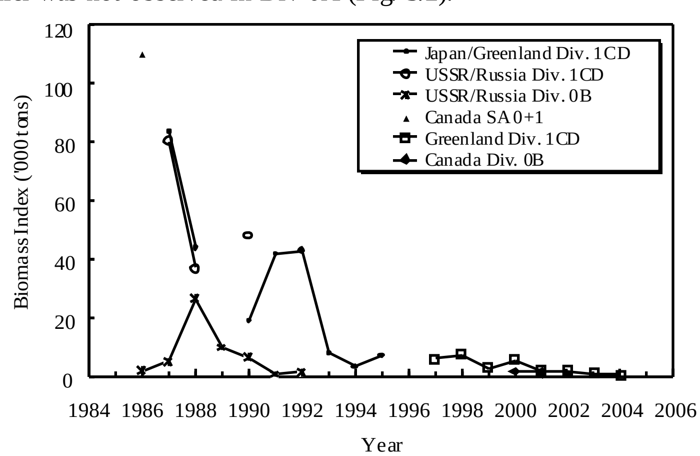


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland and Greenland surveys in Div. 0B and Div. 1CD.

iii) **Precautionary Approach**

The biomass was estimated at 111 000 tons in SA 0+1 in 1986 by a Canadian survey. Almost all the biomass (90%) was located in SA 1. The fishery has been at a very low level since the late 1970s and the stock could in 1986 be considered as virgin. If B_{lim} is set at 15% of B_{virgin} the biomass has been well below B_{lim} in recent years.

c) **Conclusion**

In the Greenland survey in 2004 the biomass in Div. 1CD was estimated at 633 tons, the lowest in the time series, and hence the biomass has remained at the very low level observed since 1993. Almost all the biomass was found at depths >1 000 m in Div. 1D. The fish were generally small, between 3 and 8 cm pre anal fin length. The Canadian surveys in Div. 0B in 2000 and 2001 also showed very low biomasses, 1 660 and 1 256 tons, respectively.

4. **Demersal Redfish (*Sebastes* spp.) in Subarea 1** (SCR Doc. 05/20, 33, 39, 40; SCS Doc. 05/9, 14, 15)

a) **Introduction**

There are two redfish species of commercial importance in Subarea 1, golden redfish (*Sebastes marinus* L.) and deep-sea redfish (*Sebastes mentella* Travin). Relationships to other north Atlantic redfish stocks are unclear. Both redfish species are included in the catch statistics since no species-specific data are available.

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 have been 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. Since 1 October 2000, however, sorting grids have been mandatory, probably reducing the amount of by-catches.

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 a low level. The estimated catch figure in 2003 and 2004 of redfish in Subarea 1 is less than 500 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:

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TAC	19	19	19	19	19	19	19	19	8	8
Catch	0.9	0.9	1	0.9	0.8	0.7[1]	0.3[1]	0.5[1]	0.5[1]	0.5[1]

[1] Provisional.

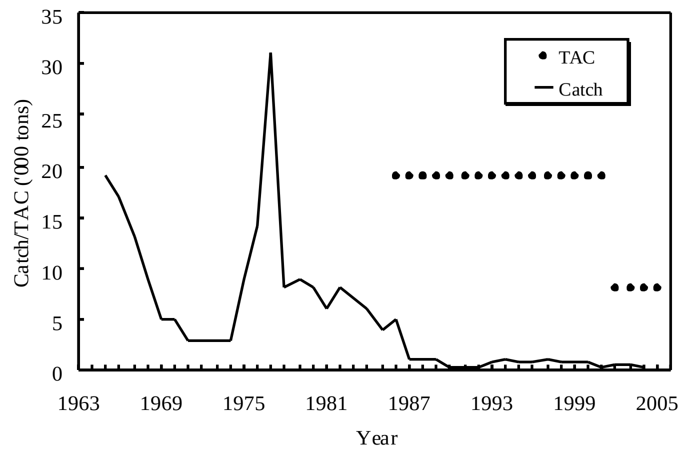


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

b) **Input Data**

i) **Commercial fishery data**

In a Spanish experimental fishery in NAFO Subarea 1 the main catches were Greenland halibut (73%), northern prawn (9%) and cod (5%), but also a minor catch of 5 tons *Sebastes* spp. was reported. Small fish between 9 cm and 12 cm dominated the catch.

For other redfish fishery no data on length distribution or CPUE were available. Also no new quantitative information on the amount of juvenile fish in the by-catches of the shrimp fishery was 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. 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.

ii) **Research survey data**

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400 m isobath of Div. 1B to 1F and were primarily designed for cod as target species. Therefore, the high variation of the estimates for redfish could be caused as a result of the incomplete survey coverage in terms of depth range and pelagic occurrence of redfish.

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). Recently, the stock is mainly composed of golden redfish varying among 25-40 cm in body length.

Estimates for deep-sea redfish (≥17 cm) varied without a clear trend (Fig. 4.3). Since 1996, the survey abundance has increased but the stock consists mainly of juvenile fish below 25 cm. It must be noted, that the survey does not cover the entire distribution area of deep sea redfish, and the survey results should be carefully interpreted.

The amount of unspecified redfish <17 cm has varied over a wide range since 1982 (Fig. 4.4), but the indices have been among the lowest observed since 2001. The length composition of the stock has revealed peaks at 6-7, 10-12 and 14-16 cm, probably corresponding to ages 0, 1 and 2 years. Comparisons between the survey results off West and East Greenland revealed that all three redfish components were almost exclusively distributed off East Greenland.

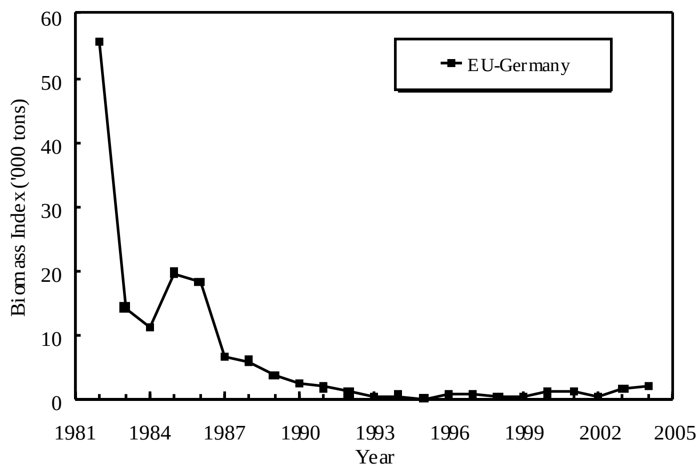


Fig. 4.2. Golden redfish in NAFO Subarea 1: survey biomass index.

Greenland-Japan and Greenland deep-sea surveys. During 1987-95, cooperative trawl surveys directed towards 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 deep-water survey was discontinued in 1996 but conducted again since 1997 by Greenland with another vessel and changed gear. Deep-sea redfish were mainly caught in Div. 1C and at depths less than 800 m. In 2000 and 2002, the survey did not cover the shallow areas (<800 m) sufficiently. Therefore, no abundance and biomass indices were calculated. The biomass indices has been stable at about 2 000-2 500 tons since 1997 (Fig. 4.3). Length measurements revealed that immature individuals <30 cm presently dominate the size composition of the stock.

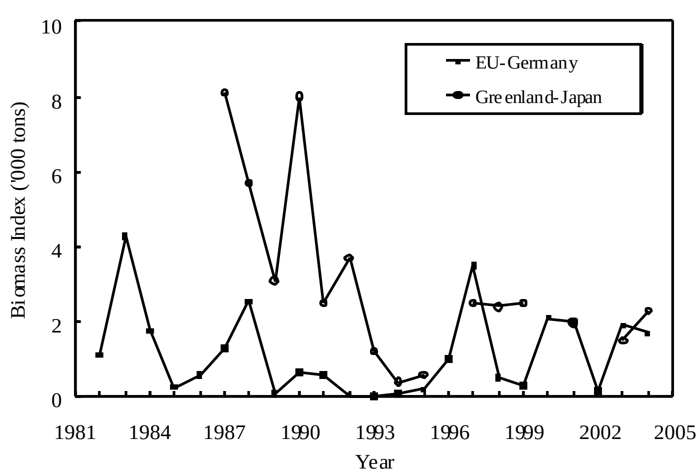


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass indices.

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, estimations of abundance and biomass indices and length composition can be considered comparable back to 1992 Redfish was found in all the survey areas, but was most common in Div. 1B and 1C. The abundance and biomass estimated in the period 1992-96 have fluctuated without a clear trend between 0.9-2.4 billion individuals and 14 000-38 000 tons. From 1997-2004 biomass and abundance have decreased to between 165-719 millions individuals and 11 000-23 000 tons. A historic low was observed in abundance in 2000 followed by an increase in biomass as well as abundance in 2003, the level decreased again in 2004 to a historic low biomass (Fig. 4.4).

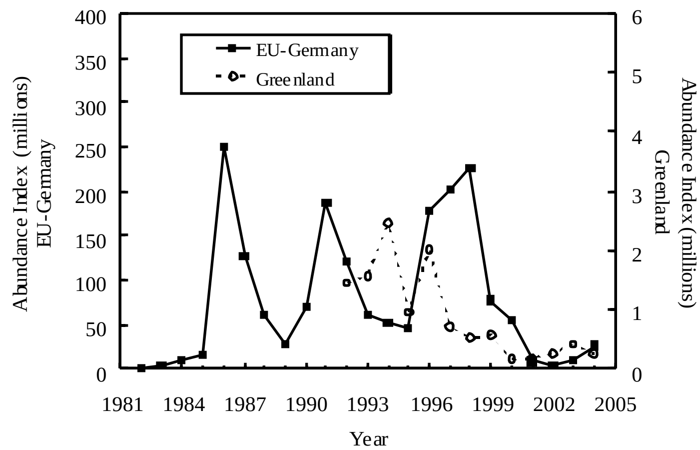


Fig.4.4. Juvenile redfish (deep-sea redfish and golden redfish combined) in Subarea 1: survey abundance indices.

c) **Estimation of Parameters**

The golden redfish SSB was assessed assuming knife-edge maturity at 35 cm. The length groups 17-20 cm was chosen as recruitment indices. SSB and recruitment indices decreased drastically from 1982 and have remained significantly below the average level 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 as well in the Spanish experimental fishery the stock of golden redfish in Subarea 1 is considered to be severely depleted with no signs of recovery.

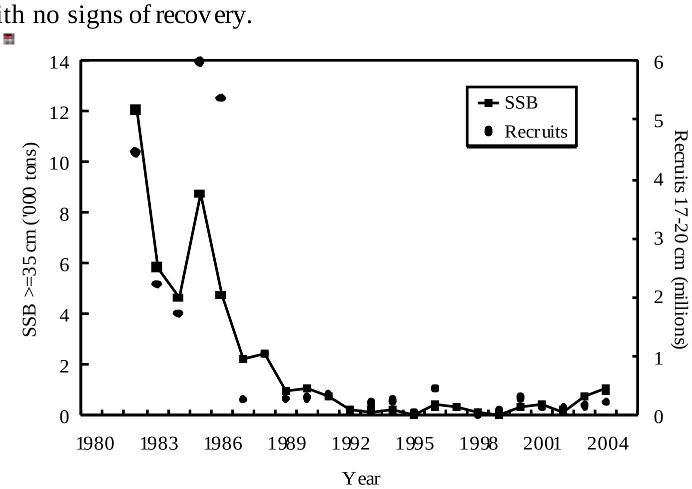


Fig. 4.5. Golden redfish Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

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 de derived from these estimates but SSB has been below average since 1989 (Fig. 4.6). The depleted status of the SSB is confirmed by the lack of adult fish in the Greenland deepwater survey as well in the Spanish experimental fishery. Recruitment variation for deep-sea redfish is high, and the 1997, 2000 and 2001 estimates were above average, but since 2002 recruitment indices have remained below average.

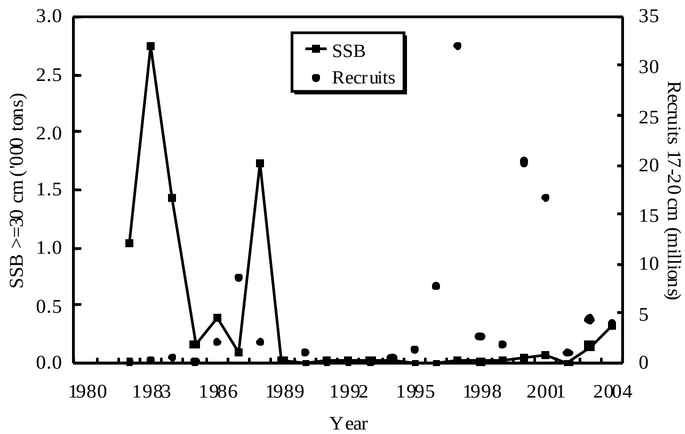


Fig. 4.6. Deep-sea redfish in Subarea 1: SSB and recruitment indices as derived from the Germany groundfish survey in the given years.

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.

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 improvement in 1997, 2000 and 2001. However, since 2002 recruitment indices have remained low.

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. The application of obligatory sorting grids since 1 Oct 2000 should help to reduce by-catches of young redfish.

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 stocks in Subarea 1.

f) **Research Recommendation**

STACFIS **recommended** that *the species composition and quantity of redfish discarded in the shrimp fishery in Subarea 1 be quantified.*

5. **Other Finfish in Subarea 1** (SCR Doc. 05/20, 33, 39, 41; SCS Doc. 05/9, 14, 15)

a) **Introduction**

Fisheries for other finfish such as, Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*), thorny skate (*Raja radiata*), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus hippoglossus*) and sharks have been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. These stocks are also taken as by-catch in offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut. From 1 October 2000, sorting grids are obligatory for the shrimp fisheries and is expected to reduce the amount of by-catches of young finfish.

Nominal reported catches of other finfish in 2003 and 2004 amounted to roughly 10 000 tons, representing an increase of 2 000 tons compared to the 2002 catch. This was mainly caused by an increase in catch of lumpfish from 5 800 tons in 2002 to roughly 8 000 tons in both 2003 and 2004. 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	1995	1996	1997	1998	1999	2000[1]	2001[1]	2002[1]	2003[1]	2004[1]
Greenland cod	2 526	2 117	1 729	1 717	1 899	931	1 152	939	1 288	963
Wolffishes	51	47	68	30	33	59	75	118	393	334
Atlantic halibut	23	34	22	22	45	9	1	1	0	4
Lumpsucker	447	425	1 158	2 143	3 058	1 211	3 216	5 795	8 832	8 199
Sharks	46	135	nd	nd	nd	nd	nd	nd	nd	3
Non-specified finfish	618	609	1 269	588	nd	769	589	584	475	663
Sum	3 711	3 367	4 246	4 500	5 035	2 979	5 033	7 437	10 988	10 162

[1] Provisional

b) **Input Data**

i) **Commercial fishery data**

A Spanish experimental fishery in NAFO Subarea 1 main catches were Greenland halibut (73%), northern prawn (9%) and cod (5%), but also a minor catch of 5 tons American plaice was reported. Small fish less than 25 cm dominated the American plaice catch.

For other finfish fishery no data on length distribution or CPUE were available. Also no quantitative information on the amount of juvenile fish in the by-catches of the shrimp fishery was available.

ii) **Research survey data**

EU-German 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. In general, all stocks sizes have declined significantly until the early 1990s and remained low (Fig. 5.1). Since 2002 an increase in recruitment is observed in the stocks of American plaice, Atlantic and spotted wolfish. Juveniles as derived from length measurements dominated all stocks mentioned.

Greenland-Japan and Greenland groundfish surveys. During 1987-95, cooperative trawl surveys directed to Greenland halibut and roundnose grenadier have been conducted on the continental slope in Div. 1A-1D at depths between 400 and 1 500 m. This Greenland-Japan deep-water survey was discontinued in 1996. From 1997, a Greenland survey was initiated with another vessel and changed gear. In 1999, estimates of biomass indices for American plaice were very low and amounted to 135 tons. Very few American plaice has been recorded in the survey since 1999. Therefore, no biomass estimated is available from this survey.

Greenland groundfish/shrimp survey. 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, spotted wolffish and thorny skate were very low (Fig. 5.1). Juveniles as derived from length measurements dominated all stocks mentioned.

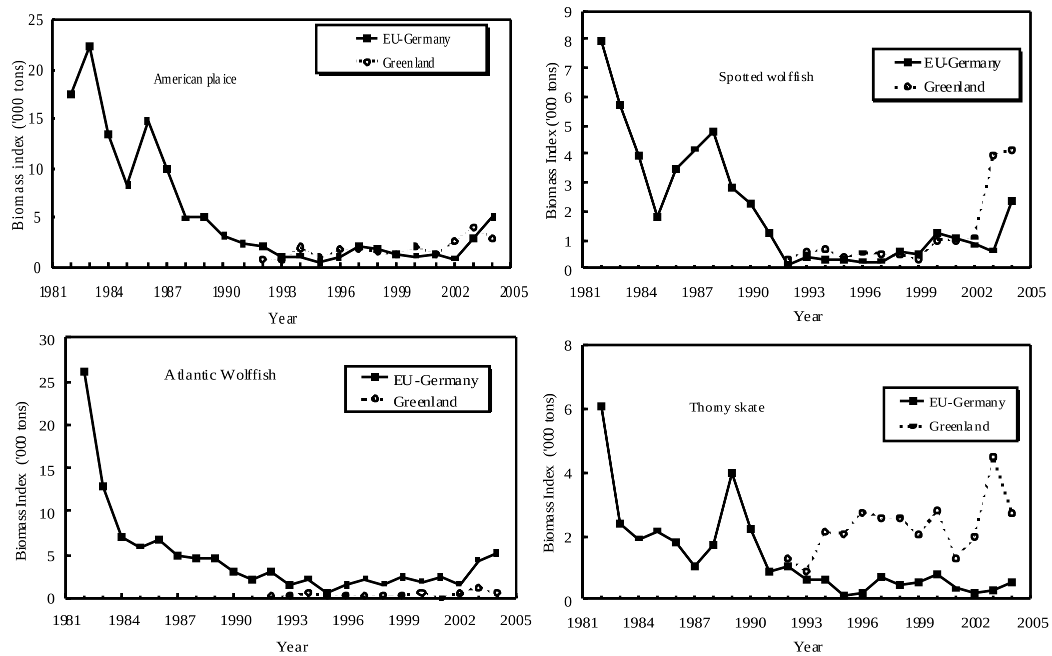


Fig. 5.1. Finfish in Subarea 1: survey biomass indices of various finfish species.

c) **Estimation of Parameters**

American plaice SSB was derived from German length disaggregated abundance indices to which a length-maturity ogive was applied. During 1982-91, the SSB decreased continuously and remained low until 2002 (Fig. 5.2). SSB increased in 2003 and 2004, but is still considered to be at low level compared to the early and mid-1980s. Recruitment is presented as abundance of small fish 15-20 cm representing age group 5 and indicates an increase above the average level in 2003 and 2004.

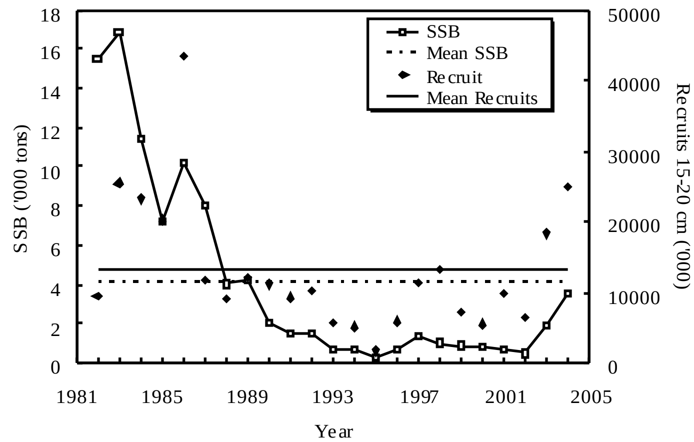


Fig. 5.2. American plaice in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey.

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 representing 3 year old recruits. Since 1982, the SSB decreased drastically and remains severely depleted since the early 1990s (Fig. 5.3). In contrast, until 1994 recruitment increased almost continuously. After a very low level in 1995, recruitment has varied considerably. Years with abundant recruit have yet not contributed significantly to the SSB.

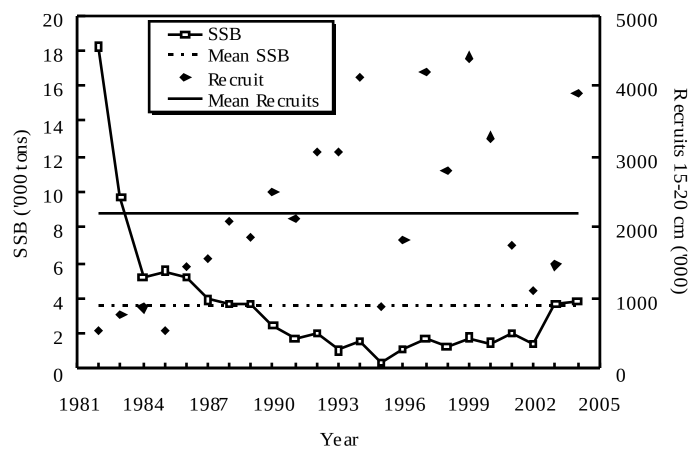


Fig. 5.3. Atlantic wolffish in Subarea 1. SSB and recruitment indices as derived from the EU-Germany groundfish survey.

Biomass indices for spotted wolffish derived from the German groundfish survey and the Greenland shrimp/groundfish survey, show a weak increase since 2000 (Fig. 5.1). The German groundfish survey biomass indices for thorny skate show a decrease since 2000, but data derived from the Greenland shrimp/groundfish survey fluctuated without trend since 1995. For thorny skate the German groundfish survey biomass indices show a decrease since 2000, but data derived from the Greenland shrimp/ groundfish survey fluctuated without trend since 1995.

d) **Assessment Results**

In general, stocks sizes of American plaice, Atlantic wolffish, spotted wolffish and thorny skate have declined significantly until the early 1990s and have remained at a low level. Based on the above STACFIS has concluded that the status of these stocks remains severely depleted.

The stocks of American plaice, Atlantic and spotted wolfish indicate significant recovery potential due to increased recruitment as well as the observed slight increases in biomass for the whole length range in the recent 2 years They are presently composed of small and mainly juvenile specimens. Taking the poor stock status of American plaice, Atlantic wolffish, spotted wolffish and thorny skate into account, even low amounts of fish taken and discarded by the shrimp fishery might be sufficient to retard the recovery potential of these stocks. The continued failure of the recruits to rebuild the spawning stocks indicates high mortality rates in excess of the sustainable level. Minimising the by-catch of finfish in SA1 to the lowest possible level would enhance the probability of stock recovery. The application of obligatory sorting grids since 1 October 2000 should help to reduce these by-catches.

e) **Reference Points**

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

f) **Research Recommendation**

STACFIS **recommended** that *the species composition and quantity of other finfish discarded in the shrimp fishery in Subarea 1 be quantified.*

B. STOCKS ON THE FLEMISH CAP: Subarea 3, Division 3M

Environmental Overview

The water mass characteristics of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3° to 4°C and salinities in the range of 34 to 34.75. The general circulation in the vicinity of the Flemish Cap consists of the offshore branch of the Labrador Current which flows through the Flemish Pass on the Grand Bank side and a jet that flows to the east, north of the Cap which then flows southward east of the Cap. To the south, the Gulf Stream flows to the northeast to form the North Atlantic Current and influences waters around the southern areas of the Cap. In the absence of strong wind forcing the circulation over the central Flemish Cap is dominated by a topographically induced anticyclonic gyre. The stability of this circulation pattern may influence the retention of ichthyoplankton on the bank and is probably a factor in determining the year-class strength of various fish and invertebrate species, such as cod, redfish and shrimp. Recent trends in temperature on the Flemish Cap indicate cold periods during the 1970s, mid-1980s and the late 1980s to the mid-1990s.

During the summer of 2003, temperatures directly over the Cap were highly variable while adjacent areas showed significant positive anomalies and during 2004 they increased to above normal values. Near bottom temperatures on the Cap during 2004 were >4°C, which was above normal by 0.5°C. Salinities over most of the upper water column during the summer of 2002 to 2004 were generally saltier-than-normal (0.25-0.5). In the deeper water (>200-m depth) both temperature and salinity values were about normal. In general, during the summers of 2003 and 2004 most areas of the water column experienced an increase in both temperature and salinity. During 2004 and throughout most of the 1990s and early 2000s summer chlorophyll levels in the upper 100 m of the water column over the Cap were higher compared to the adjacent Grand Bank indicating enhanced production in the waters of the Flemish Cap. Both measured currents and geostrophic estimates confirm the existence of a general anticyclonic circulation around the Flemish Cap during most summers, however during the summer of 2004 the circulation was dominated by the southward flowing Labrador Current to the east of the Cap with very weak northward flow, indicating a reduced gyre circulation.

6. Cod (*Gadus morhua*) in Division 3M (SCR Doc. 05/29, 35, 38)

Interim Monitoring Report

a) Introduction

The fishery is in moratorium since 1999. Estimated catches in 2004 have been 5 tons (Fig. 6.1).

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	11	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	2.3	1.5	0.5	0.0	0.0[1]	0.1[1]	0.0[1]	0.0[1]	0.0[1]	
STACFIS	2.6	2.9	0.7	0.4	0.1	0.0	0.0	0.0	0.0	

[1] Provisional.
ndf No directed fishery.

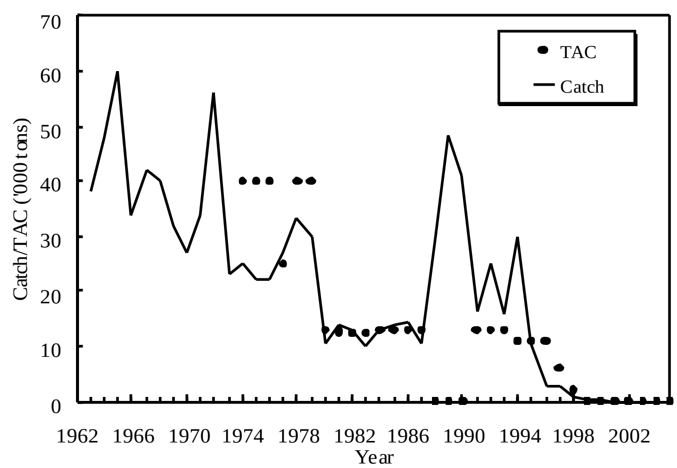


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch figures include estimates of misreported catches since 1988.

b) Data Overview

The EU-bottom trawl survey was conducted in 2004 and data of the survey series from 1988 to 2002 were converted to the scale of the new vessel *Vizconde de Eza* introduced in 2003 (Fig. 6.2). Survey results indicate that no new abundant recruitment has been recruited to the fishery.

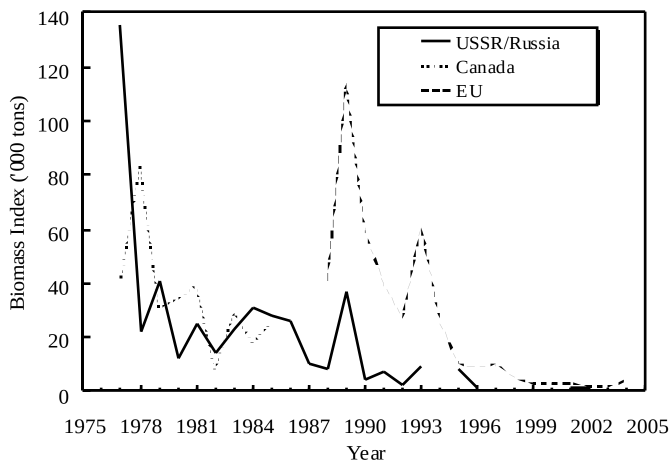


Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

c) **Conclusion**

The SSB estimate for 2004 remains much lower than the B_{lim}. Consequently, there is nothing to indicate a change in the status of the stock.

7. **Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Division 3M** (SCR Doc. 05/4, 29, 35, 47; SCS Doc. 05/5, 6, 8).

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 as 'redfish' in the commercial fishery. All stocks have both pelagic and demersal concentrations as well as a long recruitment process to the bottom, extending to lengths up to 30-32 cm. All redfish species are long lived with slow and very similar growth. Female sexual maturity is reached at a median length of 26.5 cm for Acadian redfish, 30.1 cm for deep-sea redfish and 33.8 cm for golden redfish.

i) **Description of the fishery**

The redfish fishery in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, falling continuously since then until 1998-99, when a minimum catch around 1 000 tons was recorded mostly as by-catch of the Greenland halibut fishery. There was a relative increase of the catch on 2000-2002 to a level above 3 000 tons but in 2003 the overall catch didn't reach 2 000 tons. In 2004, catch raised again near 3 000 tons.

The drop in the Div. 3M redfish catches from 1990 until 1999 was related both to the decline of the stock biomass and the abrupt decline of fishing effort deployed in this fishery by the fleets responsible for the high level of catches in the late 1980s-early 1990s (former USSR, former GDR and Korean crewed non-Contracting Party vessels). An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. However in 2003 Russian catch fell by 90% and in 2004 Portugal consolidated its major role in the present fishery, while Russia recorded a catch near zero.

The start in 1993 and further development of a shrimp fishery on Flemish Cap led to high levels of redfish by-catch in 1993-94. Since 1995 this by-catch in weight fell to apparent low levels but in 2001-2003 redfish by-catch increased significantly to an average of 840 tons, the highest level observed since 1994. Translated to numbers this represented an increase from a level of 3.4 million redfish (1999-2000) to 21.9 million (2001-2003), decreasing to an intermediate level of 9.9 million fish in 2004. In 2001-2003 the redfish by-catch in numbers from the Flemish Cap shrimp fishery was 78% of the total catch numbers and 44% in 2004.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	20	20	20	20	20	10	5	5	5	5
STATLANT 21A	1.1	0.4	1.0	0.8	3.8[1]	3.2[1]	3.0[1]	2.0[1]	3.1[1]	
STACFIS Catch	5.8	1.3	1.0	1.1	3.7	3.2	2.9	1.9	2.9	
By-catch[2]	0.55	0.16	0.19	0.10	0.10	0.74	0.77	1.00	0.47	
Total catch[3]	6.4	1.5	1.2	1.2	3.8	3.9	3.8	2.9	3.4	

[1] Provisional.
[2] In shrimp fishery (D.Kulka, and J. Firth pers. comm.).
[3] Total STACFIS + by-catch.

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

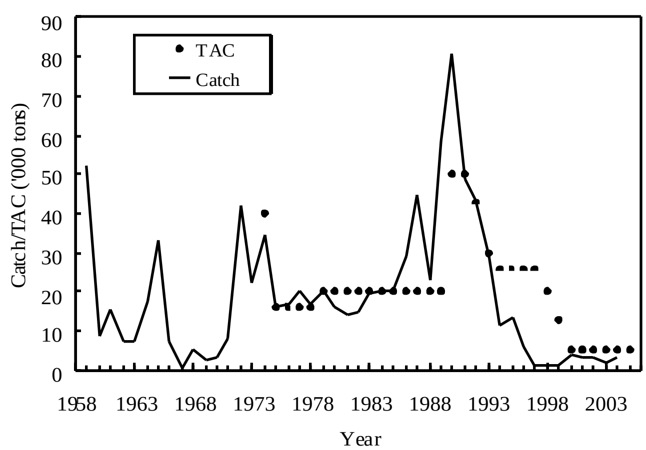


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

b) **Input Data**

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

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

Sampling data. Most of the commercial sampling data available for the Div. 3M redfish stocks since 1989 are from the Portuguese fisheries. Length sampling data from Russia (1989-91, 1995, 1998-2002) and from Japan (1996 and 1998) were used to estimate the length composition of the commercial catches for those fleets and time periods. The 1989-2004 length composition of the Portuguese trawl catch was applied to the rest of the commercial catches. These length compositions have been combined with the Div. 3M beaked redfish length-weight relationships from 1998-2004 Portuguese commercial catch, to estimate the catch in numbers at length of the Div. 3M redfish commercial catch for the same period.

Redfish by-catch in numbers at length for the Div. 3M shrimp fishery were available for 1993-2004 based on data collected on board of Canadian and Norwegian vessels. These numbers at length were recalculated in order to fit by-catch in weight with the annual length weight relationships derived from EU-survey data.

The commercial and by-catch length frequencies were then summed to establish the total removals at length. These were converted to removals at age using the *S. mentella* age-length keys from the 1990-2004 EU surveys. The 1990 year-class dominated catches until 2002, but was replaced in 2003-2004 by the 1998 and 1999 year-classes. Annual length weight relationships derived from Portuguese commercial catch were used for determination of mean weights-at-age.

ii) **Research survey data**

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 EU bottom trawl survey for the period 1988-2004 and on the Div. 3M beaked redfish length weight relationships from 1988-2004 EU survey data. Female spawning biomass was calculated applying length maturity ogives derived from data collected during the 1992-94 and 1999 EU surveys.

In June 2003 a new Spanish research vessel, the RV *Vizconde de Eza* replaced the RV *Cornide de Saavedra* that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 survey indices available the original time series needed to be converted to the new RV units. The original mean catch per tow, biomass and abundance at length distributions for beaked redfish have been converted to the new vessel units so that each former time series could be comparable with the correspondent new indices obtained since 2003 with the RV *Vizconde de Eza*.

The results of the calibration shown that the new RV *Vizconde de Eza* is 12% more efficient than the former RV *Cornide de Saavedra* as regards redfish and this difference is raised to 44% if only the smaller sizes up to 15 cm are considered. These results for redfish also showed a decrease of efficiency of the new vessel against the old one for fish larger than 26 cm.

Age compositions for Div. 3M beaked redfish EU survey stock and mature female stock in 1989-2004 were obtained using the *S. mentella* age length keys from the 1990-2004 EU surveys with both sexes combined. Mean weights-at-age were determined using the EU survey annual length weight relationships.

Survey results. Biomass indices (swept area method) from EU surveys are presented in the following table ('000 tons):

Year	Beaked redfish	*S. mentella*	*S. fasciatus*	Juveniles
1988	160.4	-	-	-
1989	127.8	-	-	-
1990	89.1	-	-	18.1
1991	72.3	-	-	4.5
1992	118.9	80.5	6.0	32.4
1993	77.7	21.6	5.0	51.1
1994	104.7	40.1	8.8	55.8
1995	72.5	66.5	5.6	0.4
1996	100.2	87.3	12.4	0.5
1997	83.7	62.9	19.6	1.2
1998	59.7	50.9	7.2	1.6
1999	82.5	73.2	8.9	0.4
2000	117.7	100.2	14.5	3.0
2001	64.0	43.3	12.9	7.8
2002	107.2	46.0	26.0	35.2
2003	65.7	28.8	15.0	21.9
2004	157.0	46.0	76.2	34.8

Total survey biomass, spawning biomass and abundance. The period covered by EU surveys (1988-2004) started with a continuous decline of bottom biomass until 1991, followed by a period of biomass fluctuation with no apparent trend between 1992 and 1996. A further decline occurred in 1997 and 1998, when the lowest biomass index was recorded. Survey bottom biomass increased in 1999 and 2000 to the former level of 1992. However, between 2001-2004 this index returned to wide oscillations that culminate with a 2.4 fold from 2003 to 2004, reaching the biomass level of the beginning of the EU survey series (Fig. 7.2). Female spawning biomass (SSB) presents less noise inter annually, declining until 1994 and being kept at low level most of the years since then, despite an isolated peak in 2000 (Fig. 7.3). Abundance declined by half in 1990 from the 1988-89 level, reaching the minimum of the series. The index was pushed up to a peak in 1992 by the strong 1999 year-class, declining afterwards until 1998. A steady increase is observed since then driven by one or two above average cohorts from the turn of the decade. In 2004 survey abundance was at an historical maximum, well above the level at the beginning of the series. The EU survey abundance suggest that despite the apparent recovery of the Flemish Cap beaked redfish, the population is now dominated by young fish with an age/length structure much narrower than on the late 1980s, shifted towards small lengths/young ages when compared to the population structure 16-17 years ago.

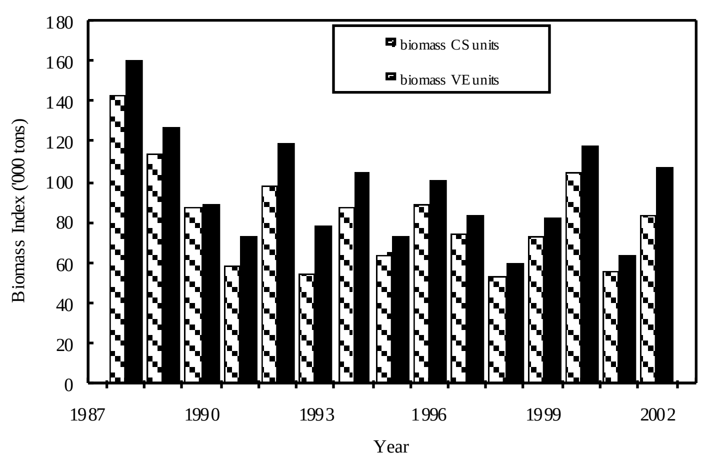


Fig. 7.2. Beaked redfish in Div. 3M: survey biomass in original R/V *Cornide Saavedra* units (CS) and transformed R/V *Vizconde de Eza* units (VE), 1988-2004.

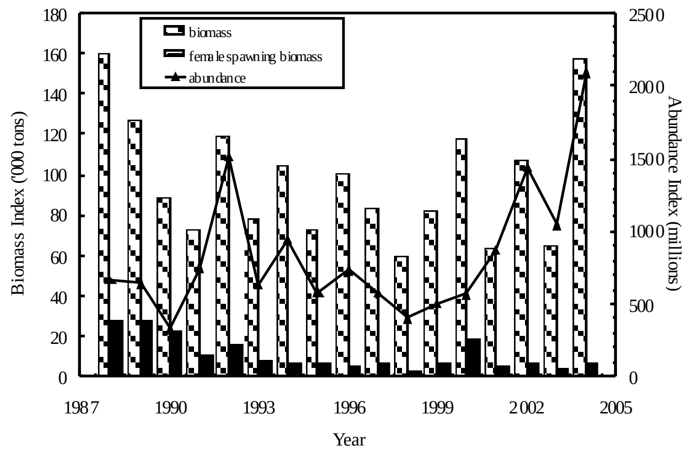


Fig. 7.3. Beaked redfish in Div. 3M: survey biomass, female spawning biomass and abundance from EU (1988-2004) surveys.

c) **Estimation of Parameters**

The expected proportion of mature females found at each age for Div. 3M beaked redfish was calculated using the mean proportion of mature females found in survey stock abundance-at-age. This female "maturity ogive" was used in the Extended Survival Analysis to get female spawning biomass estimates.

An Extended Survivors Analysis (XSA) (Shepherd, 1999)[1] for the period 1989-2004 was run. Natural mortality was assumed constant at 0.1. The input catch-at-age was as described above as was the observed female mature proportion at age. The month of peak spawning (larval extrusion) for Div. 3M *S. mentella*, was taken to be February, and was used for the estimate of the proportion of fishing mortality and natural mortality before spawning. The first age group considered was age 4 and a plus group was set at age 19. EU survey abundance at age was used for calibration.

It should be noted however that according to the data of Russian researches for 1983-2002 (SCR Doc. 05/4) the peak of larvae extrusion took place in March-April.

d) **Assessment Results**

The XSA results were used for illustrative purposes only to indicate trends in the resource over time.

[1] SHEPHERD, J. G. 1999. Extended survivors analysis: an improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci.*, **56**(5): 584-591.

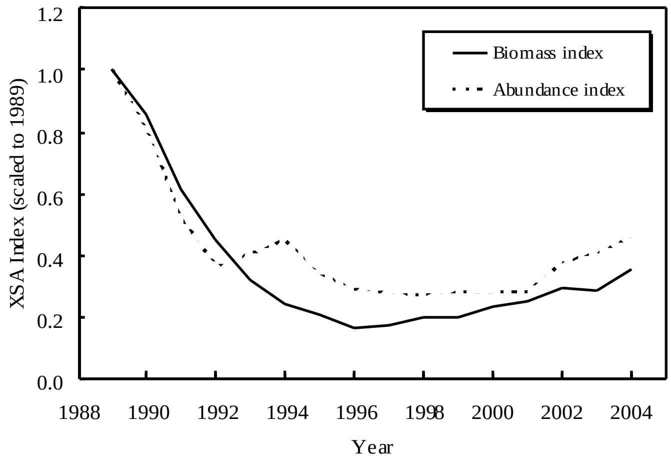


Fig. 7.4. Beaked redfish in Div. 3M: age 4+ biomass and Age 4+abundance trends from XSA.

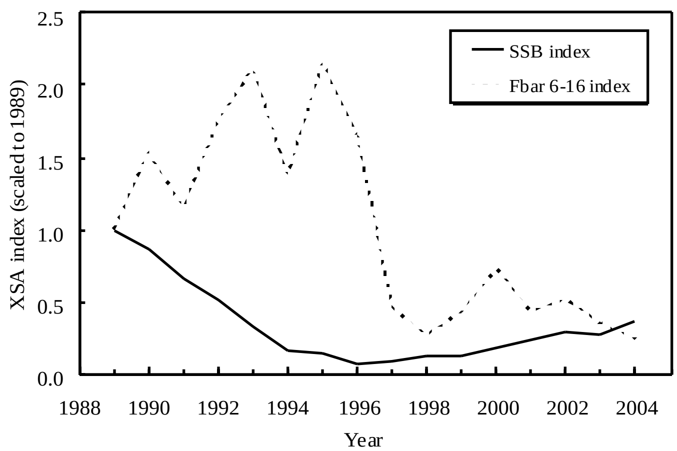


Fig. 7.5. Beaked redfish in Div. 3M: female spawning biomass and fishing mortality trends from XSA.

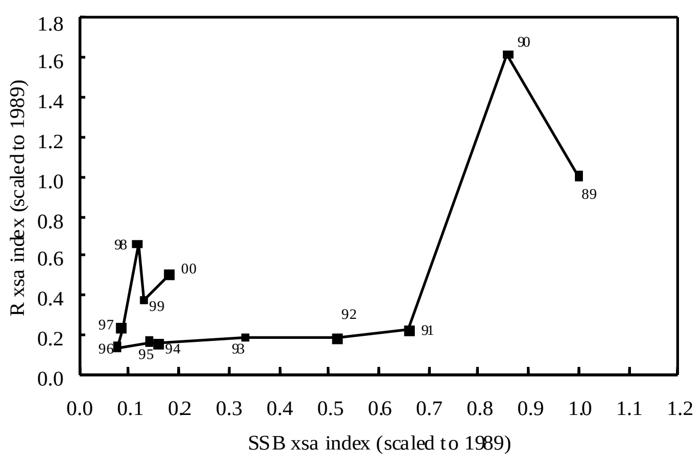


Fig. 7.6. Beaked redfish in Div. 3M: relative recruitment from XSA (year-classes indicated).

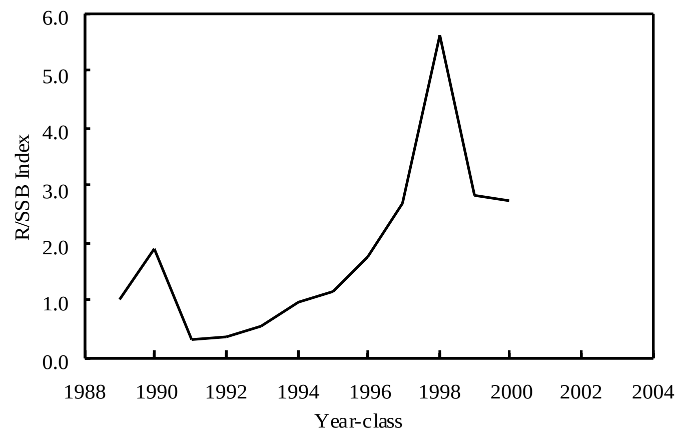


Fig. 7.7. Beaked redfish in Div. 3M: recruitment per thousand tons of SSB trend from XSA (recruits at age 4 four years later than SSB).

Very high fishing mortalities until 1996 forced a rapid and steep decline of abundance, biomass and female spawning biomass of the Div. 3M beaked redfish stock. From 1997 onwards, low fishing mortalities allowed a slow but continuous growth of both 4+ Biomass and female SSB. Abundance was kept stable at a low level from 1996 to 2001, increasing afterwards with the recruitment of the above average 1998-2000 year-classes to the 4+stock (Fig. 7.4 and 7.5).

There was a general increase of the stock reproductive potential from 1992 to 1998. Despite the decline from the 1998 peak the reproductive potential of the stock at the turn of the decade was kept at high level when compared to the former 1989-1997 interval (Fig. 7.6). In 2004 female spawning stock biomass was still well bellow the SSB that produced the pulse of strong recruitment in 1990. However the appearance in 1998 of the first abundant year-class after 1990, suggest that above average recruitments may occur at much lower SSB levels (Fig. 7.7).

STACFIS concluded that the decline in stock biomass has been halted and stock and female spawning biomass have been gradually increasing since the late 1990s. However total stock and spawning stock are still at a low level compared to the earlier period in the time series. At the low fishing mortalities of the most recent years, with growth of the relatively strong 1998 and 2000 year-class biomass should gradually increase.

At present stock growth in biomass and in abundance is dependent upon the appearance and survival of cohorts past their early life stage so they recruit to the SSB and commercial fishery. As such it is important to keep catch and fishing mortality at a low level by ensuring that by-catch of very small redfish is kept to a minimum. In this regard, STACFIS has concerns regarding the sharp increases seen in by-catch of small redfish in 2001-2003.

STACFIS noted that measures must be taken to reduce significantly the actual proportion of very small redfish (<12 cm) in the by-catch of the Div. 3M shrimp fishery. In order to assist in developing possible approaches to achieve this, STACFIS **recommended** that *information on the distribution on shrimp and small redfish (<12 cm) in Div. 3M be compiled for review during the June 2006 Meeting of Scientific Council.*

STACFIS **recommended** that *an update of the Div. 3M redfish by-catch information be compiled on an annual basis, including the estimated weights and numbers of redfish caught annually in the Div. 3M shrimp fishery as well as tables showing their size distribution.*

e) **Reference Points**

No updated information on biological reference points was available.

8. **American Plaice (*Hippoglossoides platessoides*) in Division 3M** (SCR Doc. 05/29, 35; SCS Doc. 05/6, 8)

Interim Monitoring Report

a) **Introduction**

A total catch of 81 tons was estimated for 2004 (Fig. 8.1).

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.1	0.1	0.2	0.2	0.3[1]	0.2[1]	0.2[1]	0.1[1]	0.1[1]	
STACFIS	0.3	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.1	

[1] Provisional.
ndf No directed fishing.

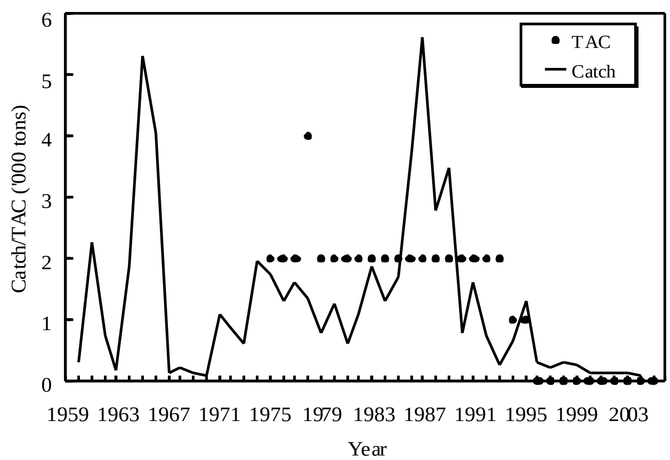


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs.

b) **Data Overview**

The EU bottom trawl survey on Flemish Cap was conducted during 2004. The survey estimates did not alter the perception of the stock status by STACFIS (Fig. 8.2 and 8.3). Recruitment has been poor since the 1990 year-class

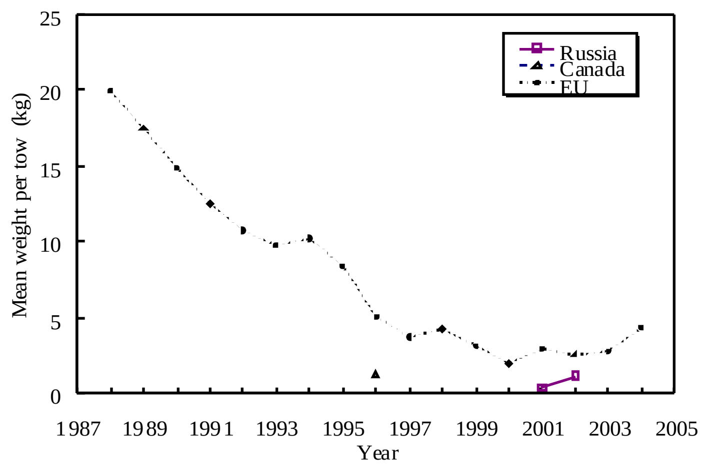


Fig. 8.2. American plaice in Div. 3M: mean weight per tow in the surveys.

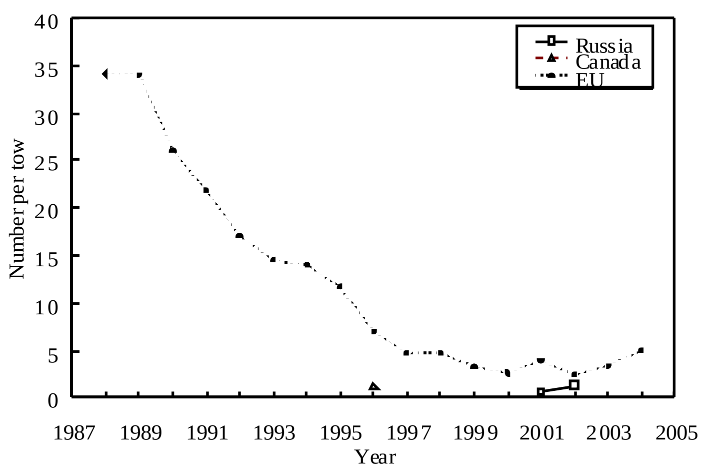


Fig. 8.3. American plaice in Div. 3M: mean number per tow in the surveys.

c) **Conclusion**

STACFIS noted that this stock continues to be in very poor condition, with only poor year-classes expected to recruit to the SSB for at least five years. Although the level of catches and fishing mortality since 1992 appear to be relatively low, survey data indicate that the stock biomass and the SSB are at a very low level. Due to the consistent year to year recruitment failure since the beginning of the 1990s there is no sign of recovery of this stock.

C. STOCKS ON THE GRAND BANK: Subarea 3, Divisions 3LNO

Environmental Overview

The water mass characteristics on the Grand Banks are typical cold-intermediate-layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0°C during spring through to autumn. The winter formed CIL water mass is a reliable index of ocean climate conditions in this area. Bottom temperatures increase to 1° to 4°C in southern regions of Div. 3NO due to atmospheric forcing and along the slopes of the banks below 200-m depth due to the presence of Labrador Slope Water. On the southern slopes of the Grand Banks in Div. 3O bottom temperatures may reach 4°C-8°C due to the influence of warm slope water from the south. The general circulation in this region consists of the relatively strong offshore Labrador Current at the shelf break and a considerably weaker branch near the coast in the Avalon Channel. Currents over the banks are very weak and the variability often exceeds the mean flow. The areal extent of the bottom covered by water in 1°C temperature ranges during spring for the Div. 3LNO indicate that in this region from 1975 to 1983 most of the bottom was covered by water >0°C with approximately 20% covered by <0°C water. From 1984 to 1997 there was a large increase in the area of <0°C water reaching near 60% in some years.

On the Grand Bank the summer CIL area was below the 1971-2000 normal in 2004, (implying warm conditions) a significant decrease over the previous 5-years and the lowest value since 1970. Spring bottom temperatures in Div. 3L ranged from <0°C in the inshore regions of the Avalon Channel, from 0.5°C to 1°C over most of the shallow northern Grand Bank to >3°C at the shelf edge. Over the central and southern areas bottom temperatures ranged from 1°C to 3.5°C and generally >3.5°C along the southwest slopes of the Grand Bank in Div. 3O. In general, bottom temperatures were above normal in all areas of the Grand Banks by 1°C to 1.5°C. During the spring of 2001 to 2003, the spatially averaged bottom temperature decreased over the 2000 value to about 1°C in 2003, the 11th coldest in the 28 year record. In 2004 temperatures increased by 1°C to near 2.5°C, the highest since 1983. Recently there was a significant decrease in the percentage area of the bottom covered by <0°C water and a corresponding increase in the area covered by warmer water. During 1999 the area of <0°C water on the Grand Bank decreased to about 10%, the lowest since 1978. During 2000 to 2003 the area of cold water began to increase reaching 40% by 2003, however, the spring of 2004 had the lowest area of <0°C water in Div. 3L since the surveys began in the early 1970s. After a year of temperature extremes in 2003, ocean temperatures on the Grand Banks set record highs in some areas during 2004.

9. Cod (*Gadus morhua*) in Divisions 3N and 3O (SCR. Doc. 05/9, 26, 67; SCS Doc. 05/5, 6, 8)

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 the decline in catches to a level of about 10 000 tons in 1993 (Fig. 9.1). Directed fisheries on this stock ceased about mid-year 1994. This stock has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. Since the moratorium was introduced, the catch increased from 170 tons in 1995 and peaked at about 4 800 tons in 2003. The 2003 catch could not be precisely estimated but is believed to be between the range of 4 300-5 450 tons. The 2004 catch was estimated to be about 900 tons. This is the first year since 1999 that the catch was below 1 000 tons.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	6	nf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.1	0.4	0.5	0.5	0.5[1]	0.9[1]	1.2[1]	1.6[1]	0.8[1]	
STACFIS	0.2	0.4	0.5	0.9	1.1	1.3	2.2	4.3-5.5[2]	0.9	

1 Provisional.
2 STACFIS could not precisely estimate the catch. Figures are the range of estimates.
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.

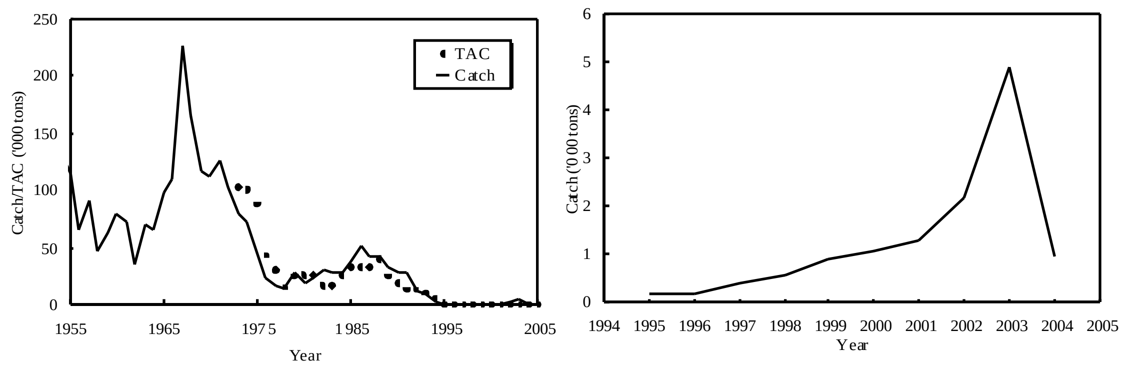


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) **Input Data**

i) **Commercial fishery data**

Catch rates. There was no catch rate information from cod directed fisheries since 1994.

Catch-at-age. Length and age sampling was available for Canada for 2003 and 2004. Age sampling was sparse for the Canadian fleet for 2003 (400 otoliths) and 2004 (500 otoliths) compared to 1 300 otoliths sampled for each of 2001 and 2002. Length sampling was available for 2003 and 2004 from EU-Portugal and Russia and for 2004 from EU-Spain. Catch-at-age from 2003 and 2004 for EU-Portugal, Russia and EU-Spain was obtained by applying Canadian survey age length keys to length frequencies collected each year. The catch in 2003 was dominated by ages 4-6 while in 2004 it was dominated by ages 6 and 7.

ii) **Research survey data**

Canadian spring surveys (SCR Doc. 05/67). Stratified-random research vessel surveys have been conducted in spring by Canada in Div. 3N during the 1971-2004 period, with the exception of 1983, and in Div. 3O for the years 1973-2004 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 assessments prior to the conversion should be approached with caution.

The Canadian spring mean number per tow series declined from 1984 to 1989, with the exception of 1987, when the largest value in the time series was observed. The 1991 and 1993 spring surveys indicated increased catches of cod. Over the period from 1994 to 1997, the Canadian spring index was the lowest observed in the series, showed improvement from 1998 to 2000 then subsequently declined to 2004. The 2004 survey estimate is the fourth lowest in the time series (Fig. 9.2).

Canadian autumn surveys (SCR Doc. 05/67). Additional stratified-random surveys have been conducted by Canada during autumn since 1990. Results from 1990 to 1992 surveys were the largest in the time series (Fig 9.2). The trend since 1993 is similar to the spring series. The period from 1996-1997 was the lowest in the series showing an increase to 2000 then a subsequent decline to 2004. The 2004 survey estimate is the third lowest in the time series.

Canadian juvenile surveys (SCR Doc. 05/67). Canadian autumn juvenile survey data were available for the period 1989-94. The index increased from 1989 to 1991, and declined steadily from 1992 to 1994 (Fig. 9.2).

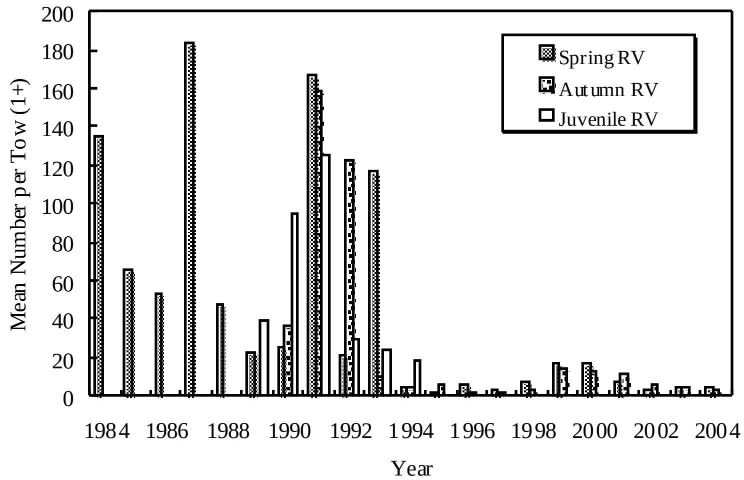


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian RV surveys.

Canadian Cooperative Industry surveys (SCR Doc. 05/9). Fixed station grid surveys conducted in July by a Canadian based fishing company in cooperation with the Canadian Department of Fisheries and Oceans were available for the period 1996 to 2004 for Div. 3NO. These surveys were designed to gather information for yellowtail flounder but also record information for cod. The area of coverage is about 9 500 square nautical miles or approximately 27% of the area of Div. 3NO less than 200 fathoms. The surveys conduct one hour tows at the stations with the same trawl and configuration throughout the series. Catch rate of cod (kg/hour) increased from about 70 kg in 1997 to 193 kg in 1999, declined sharply to about 70 kg in 2000 and was stable to 2002. Catch rate declined to 2004 at the lowest level in the time series at about 36 kg (Fig. 9.3).

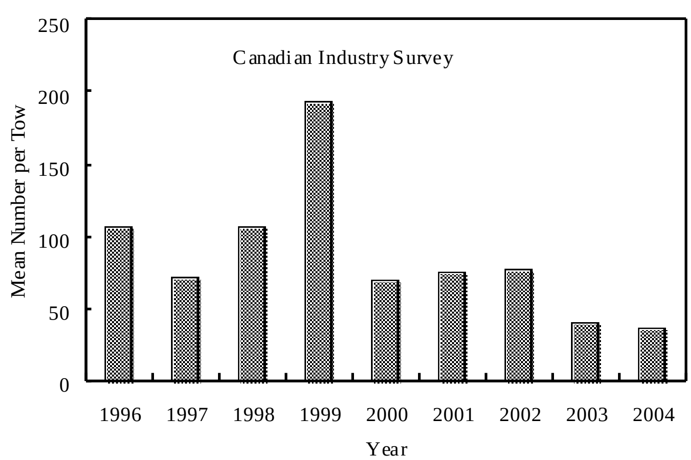


Fig. 9.3. Cod in Div. 3NO: mean number per tow from Canadian Industry surveys conducted in July.

Spanish spring surveys (SCR Doc. 05/26). Stratified-random surveys were conducted by Spain in the NRA area of Div. 3NO from 1995-2004. The series began utilizing a Pedreira trawl on the C/V *Playa de Menduiña* then converted to a Campelen 1800 trawl on the R/V *Vizconde de Eza* in 2001. The 1997-2000 data were converted into Campelen units by modeling data collected during comparative fishing trials in 2001. The data for 1995-96 were not presented because the deeper strata in the area of coverage were not sampled. The mean weight per tow increased from 2.5 kg in 1997 to 19.5 kg in 1998 then declined to 3.5 kg in 1999 (Fig. 9.4). The index increased again to 37 kg in 2001 then declined rapidly to 11 kg in 2002 followed by successive declines to 4 kg in 2004. The peaks in 1998 and 2001 were influenced by large single tows in those years.

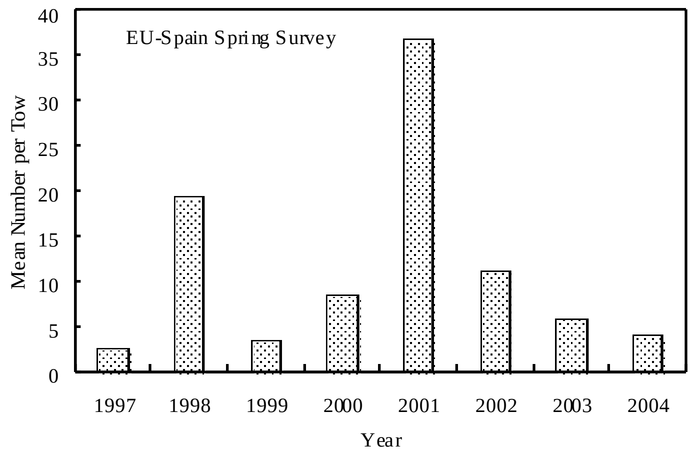


Fig. 9.4. Cod in Div. 3NO: mean number per tow from EU-Spain spring surveys.

c) **Estimation of Parameters**

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

An ADAPT was applied to catch-at-age calibrated with the Canadian spring, autumn and juvenile survey data (ages 2-10) to estimate population numbers in 2005. Numbers at age 12 were also estimated from 1994-2004. In the estimation, an *F*-constraint was applied to age 12 from 1959-93 by assuming that fishing mortality was equal to the average fishing mortality over ages 6-9. Natural mortality was assumed fixed at 0.2 for all years and ages.

d) **Assessment Results**

The SPA results calibrated with the three survey indices indicate that the stock is estimated to be at an extremely low level. The estimated spawner biomass for 2005 is 5 500 tons (Fig. 9.5).

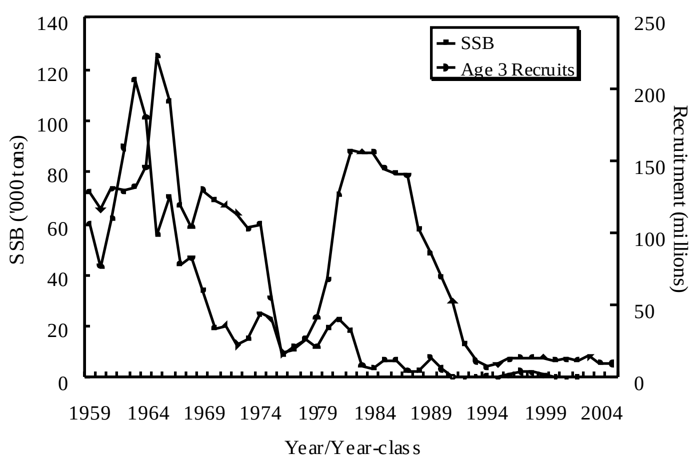


Fig. 9.5. Cod in Div. 3NO: time trend of spawner stock biomass (SSB) and corresponding recruitment from the SPA.

Prior to 1990, fishing mortality was usually higher on older ages (6-9). Since then, F has generally been higher on younger ages (4-6) (Fig. 9.6). The fishing mortality averaged over 2002 to 2004 for ages 4 to 6 is 0.504. This level of fishing mortality is comparable to that in earlier time periods during which substantial fisheries existed. The population abundance was reduced by about 50% in 2003 as a result of the increased catch (a 4 800 tons catch was used in the SPA which was the midpoint in a range that could not be precisely estimated). Estimates of recent year-class size indicate that recruitment has been very low since the 1990 year-class. Low spawner biomass, low recruitment and high fishing mortality point to poor prospects for this stock in the future. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

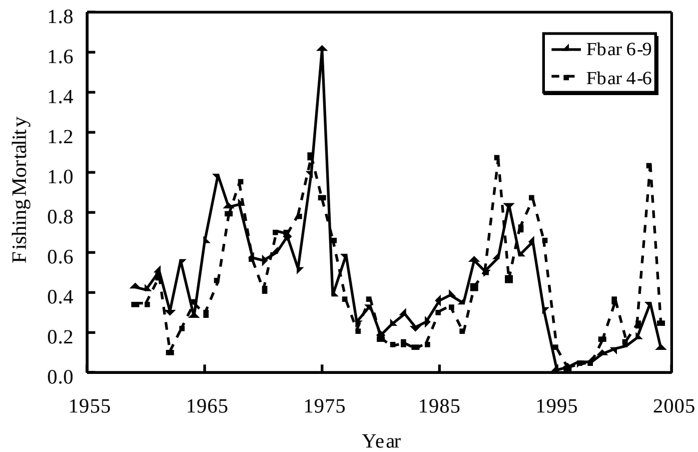


Fig. 9.6. Cod in Div. 3NO: time trend of average fishing mortalities from the SPA.

e) **Reference Points**

In April 2003 the Scientific Council re-iterated that 60 000 tons is the current best estimate of B_{lim} (Fig. 9.7). In the recent period of low productivity (since 1982), there is an indication of even further reduction in recruitment at about half the B_{lim} level. In view of the difficulty in determining if the current low productivity will persist in the immediate future, it was **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}. The current estimate of SSB is 5 500 tons which is 9% of B_{lim}.

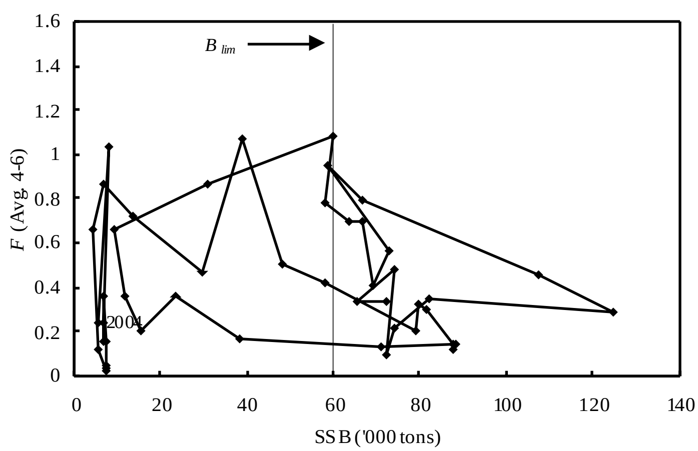


Fig. 9.7. Cod in Div. 3NO: stock trajectory 1959-2004.

Medium-term considerations

Deterministic projections were carried out to project spawning stock biomass over 5 years assuming fixed recruits-per-spawner rate, weight-at-age, natural mortality, and current fishing mortality (all averages over final three years of SPA) as well as F = 0. Input data for the projections are tabled below. The partial recruitment vector was computed by averaging the PR vector over the last three years, then re-scaling this vector by the mean values over ages 4 to 6. The average R/S from 1999-2001 is about 0.12 compared to a historical average of 0.74 from 1959-2001.

TABLE 9.1. Cod in Div. 3NO: input data for Deterministic Projections.

	Age	3	4	5	6	7	8	9	10	11	12
M		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Avg. wt (3yrs)		0.56	0.78	1.2	1.75	2.57	3.91	5.58	7.01	7.76	8.62
Mats at age	2006	0.01	0.04	0.34	0.89	0.99	1	1	1	1	1
	2007	0.01	0.04	0.34	0.89	0.99	1	1	1	1	1
	2008	0.01	0.04	0.34	0.89	0.99	1	1	1	1	1
	2009	0.01	0.04	0.34	0.89	0.99	1	1	1	1	1
	2010	0.01	0.04	0.34	0.89	0.99	1	1	1	1	1
Projection PR		0.68	1.11	1.01	0.88	0.57	0.42	0.25	0.21	0.12	0.1
$F_{current}$ (3 yrs)		0.5									
Avg. R/S (3 yrs)		0.12									

The projections indicate that even under the scenario of no removals, spawner biomass is expected to decline by 11% to 4 900 tons by 2010 (Fig 9.8). If the stock continues to be fished at current rates, spawner biomass will decrease by 76% to about 1 300 tons. This projection is more pessimistic than the projection provided in 2003 because of the subsequent high catches that have reduced the population and recent low recruitment rate.

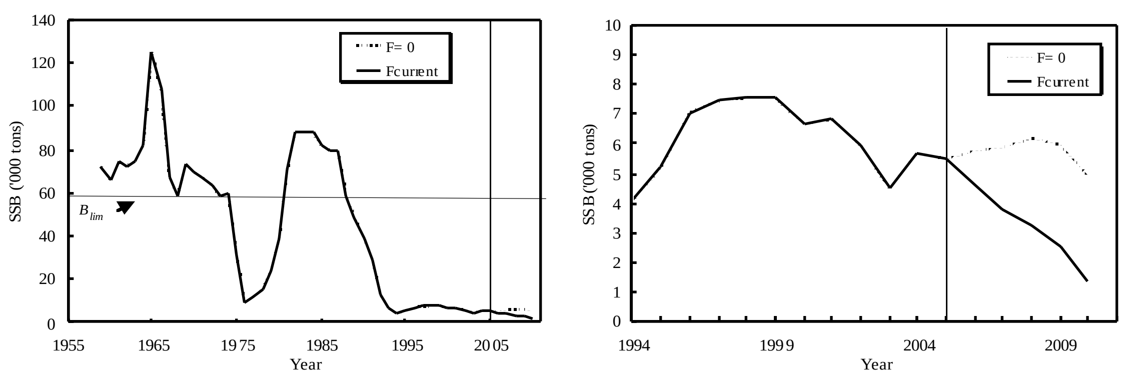


Fig. 9.8. Cod in Div. 3NO: deterministic projections under F = 0 (dashed line) and $F_{current}$. Panel at right highlight trends since 1994.

e) **Recommendations**

STACFIS noted the poor model fit in the SPA to the Canadian juvenile survey series and considered that an improvement may be realized by excluding the index from the ADAPT, accordingly, STACFIS **recommended** that *a sensitivity analysis be conducted to investigate the impact of excluding the Canadian juvenile survey index from the SPA.*

STACFIS noted the availability of the converted Spanish spring survey data from the NRA area of Div. 3NO and **recommended** that *the utility of the converted mean per tow at length data from the spring survey series conducted by EU-Spain in the NRA of 3NO since 1997 be explored as an additional index in the SPA calibration.*

10. **Redfish *(Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N** (SCR Doc. 05/50, 52; SCS Doc. 05/5, 6, 8)

a) **Introduction**

There are two species of redfish 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.

The average reported catch from Div. 3LN from 1959 to 1985 was about 22 000 tons ranging between 10 000 tons and 45 000 tons (Fig. 10.1). 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 450 tons in 1996. Catch increased to 900 tons in 1998, the first year under a moratorium on directed fishing, with a further increase to 2 600 tons in 2000 and declined again to 600 tons in 2004.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC	11	11	ndf[1]	ndf[1]	ndf[1]	ndf[1]	ndf[1]	ndf[1]	ndf[1]	ndf[1]
STATLANT	0.5	0.6	0.9	1.8	1.5[2]	0.9[2]	1.0[2]	1.3[2]	0.7[2]	
STACFIS	0.5	0.6	0.9	2.3	2.6	1.4	1.2	1.3	0.6	

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

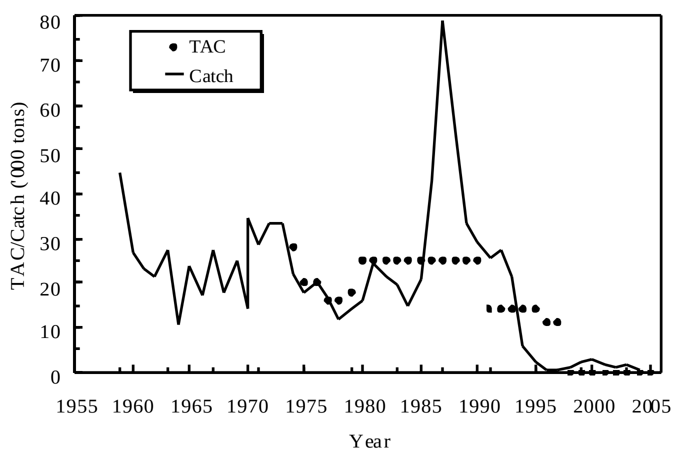


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Most of the commercial length sampling data available for the Div. 3LN beaked redfish stocks came, since 1990, from the Portuguese fisheries. Length sampling data from EU-Spain and from Russia were used to estimate the length composition of the by-catch for those fleets in 2003 and 2004. The overall mean length of the 1990-2004 catch was used to derive the anomalies of the mean length on the Div. 3LN beaked redfish commercial catch over this period. The proportion of small redfish in the catch (less than 20 cm) was calculated as well. The shift from most negative to most positive length anomalies, when passing from the first years to the middle years of the 1990-2004 period, suggest that the cohorts entering the exploitable Div. 3LN redfish stock were allowed to grow and appear in the commercial catch and by-catch for several years. As for the proportion of small redfish in the catch, besides 1991-1992 and again 2003, this proportion is close to zero.

ii) **Research survey data**

Stratified-random surveys have been conducted by Canada in Div. 3L in various years and seasons from 1978 to 2002 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. 3LN indicated a considerable amount of variability. This occurred between both seasons and years. From 1978 till 2004 several stratified-random bottom trawl surveys have been conducted by Canada in various years and seasons in Div. 3L. Although it is difficult to interpret year to year changes in the estimates, in general, the spring survey index for Div. 3L from 1992 to 1995 suggests the stock was at its lowest level relative to the time period prior to 1986 for surveys conducted in the first half of the year. A similar contrast occurs in the autumn survey index for Div. 3L from 1992 to 1995 relative to a time period prior to 1986 for surveys conducted in the second half of the year.

However only since 1991 two Canadian series of annual stratified-random surveys covered both Div. 3L and Div. 3N on an annual basis in which strata down to a maximum of 732 m (400 fathoms) were regularly sampled: a spring survey (May-June) and an autumn survey (Sep.-Oct. Div. 3N/November-December Div. 3L for most years). Up until the autumn of 1995 the Canadians surveys were conducted with an Engels otter trawl gear and tows planned for 30-minute duration. Starting with the autumn 1995 survey in Div. 3LN, a Campelen survey gear was adopted and tows were reduced to 15 minute. Only Campelen data and Engel data converted into Campelen equivalents were used in this assessment.

Survey biomass and survey female spawning biomass of Div. 3LN beaked redfish were calculated as sum of products (SOP) based on the abundance at length from the Canadian spring and autumn survey for the period 1991-2004 and on the Div. 3M beaked redfish length weight relationships from 1991-2004 EU survey data. Female spawning biomass was calculated applying sex ratio and maturity ogives at length derived from Canadian spring and autumn Div. 3LN survey data. For each spring and autumn series the proportion of SSB in the biomass calculated as sum of products was finally applied to the swept area survey biomass to give an estimate of the 1991-2004 swept area survey female spawning biomass in Div. 3LN.

The anomalously high magnitude of the 1992 autumn survey indices when compared to the neighbouring indices of the 1991-1994 period and of the standard error associated with the mean weight per tow (the highest for the two series and Divisions) justified the exclusion of that year from the analysis of stock trends.

When Div. 3L and Div. 3N spring and autumn survey biomass and abundance are summed up to give a picture of the relative size of this redfish management unit as a whole, both surveys suggest an increase in the size of the stock after 1996 despite the wide inter annual fluctuations of the indices (Fig. 10.2).

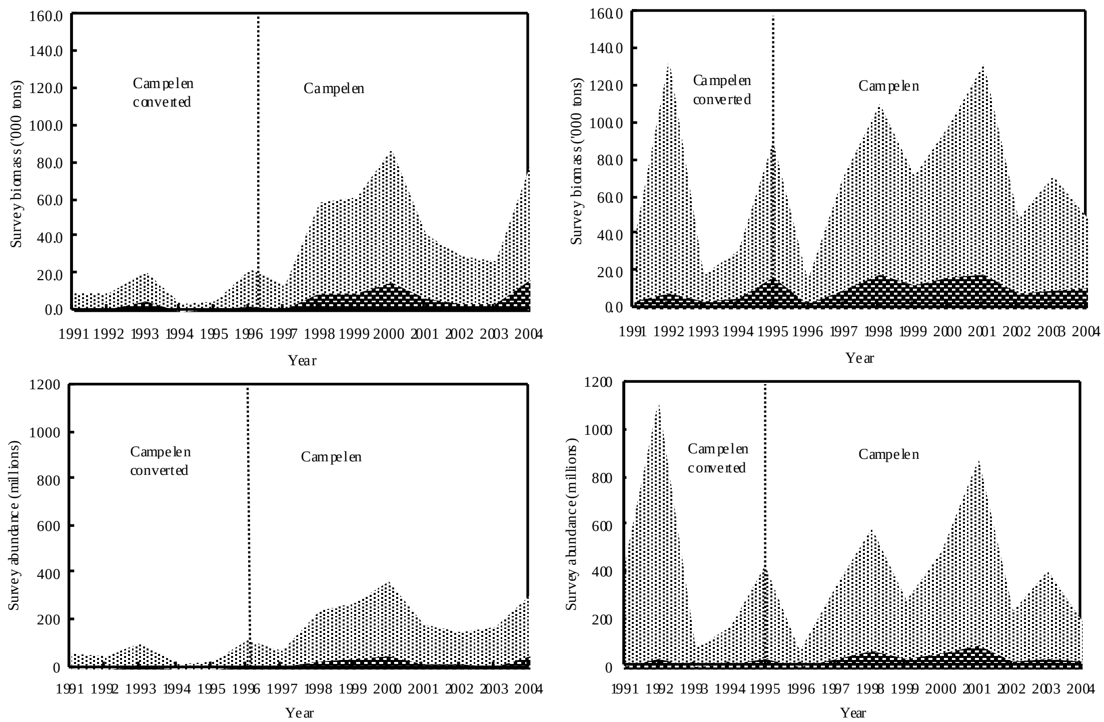


Fig. 10.2. Redfish in Div. 3LN: survey biomass, female spawning biomass and abundance, 1991-2004 (darker portion = female SSB/female spawners).

The overall 1991-2004 mean length for each survey abundance at length matrix was used to derive the spring and autumn length anomalies for the Div. 3LN beaked redfish stock over this period (Fig. 10.3). On either survey series almost all length anomalies during the first half of the 1990s were negative and most were positive 1995 onwards. However, apart from the years of 1991 and 1992 on the autumn survey, no signs of a pulse on recruitment are detected.

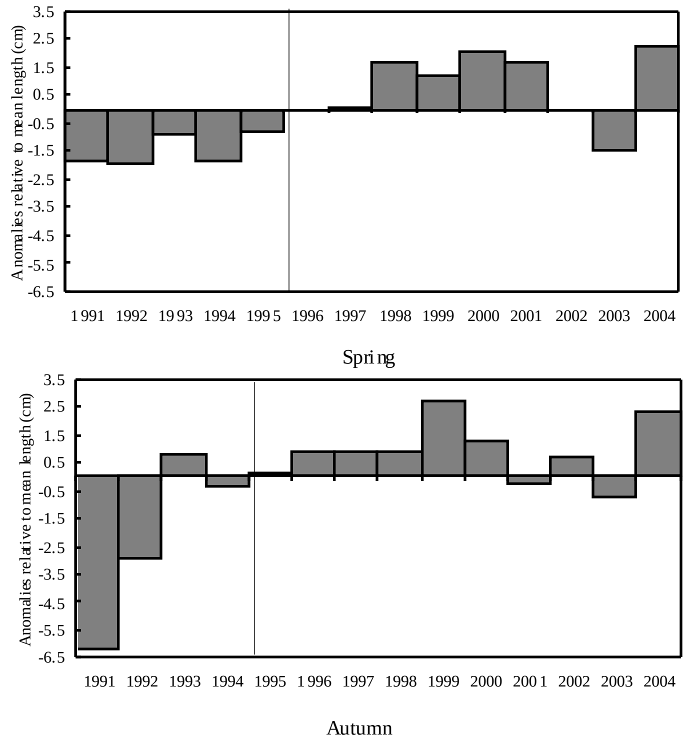


Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2004.

iii) **Recruitment**

There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div. 3LN in the range of 12-14 cm for 1991 and 15-18 cm for 1992. There is no sign of any good year-classes since then.

c) **Estimation of Stock Parameters**

i) **Relative exploitation**

Ratios of catch to spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy of fishing mortality. Spring survey series was chosen since is usually carried out on Div. 3L and Div. 3N during May till the beginning of June, and so can give an index of the average biomass at the middle of each year. The Div. 3LN STACFIS catch was used together with a spring survey biomass series smoothed by 3-year interval moving averages (Fig. 10.4).

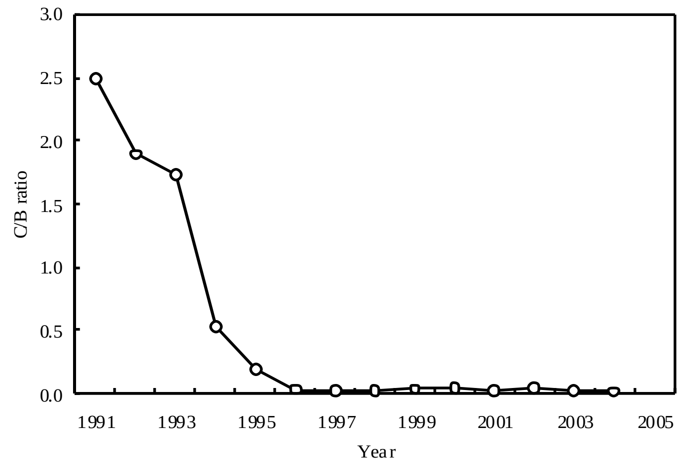


Fig. 10.4. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (moving average biomass, 1991-2004).

Catch/Biomass ratio declined continuously from 1991 to 1996, with a dramatic drop between 1993 and 1994. From 1996 onwards the proxy of fishing mortality is kept at a level close to zero.

ii) **Size at maturity**

Maturity ogives indicate L_{50} for females in Div. 3L is 30.5 cm and in Div 3N is 30.2 cm. Males mature at a much smaller size than females and there are differences between Div. 3L (L_{50} = 23.9) and Div. 3N (L_{50} = 20.3 cm).

d) **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. Nonetheless, estimates from recent surveys in Div. 3L are considerably lower than those from the 1980s indicating a reduced stock size at least in this Division.

The assemblage of Div. 3L and 3N survey indices suggests that stock was higher in the mid-2000s than in the early 1990s in terms of, biomass, female spawning biomass and abundance. However the considerable inter-annual variability of the survey indices, together with generally high (or very high, for some years) associated errors, makes difficult to quantify the relative magnitude of this increase. Stock length structure has been improving from small to medium size fish as well, confirming the survival of recent year-classes regardless their low sizes and the lack of good recruitment for more than a decade.

Estimates of exploitation rate suggest that fishing mortality should be at a very low level when compared to the first half of the 1990s and that recent level of catches have not altered the upward trend of the stock, as shown by both spring and autumn surveys.

e) **Reference Points**

At present, it is not possible to determine limit or other reference points for either fishing mortality or biomass for redfish in Div. 3LN.

11. **American Plaice (*Hippoglossoides platessoides*) in Divisions 3L, 3N and 3O** (SCR Doc. 05/3, 9, 25, 30, 34, 61; SCS Doc. 05/5, 6, 8)

a) **Introduction**

This fishery was under moratorium since 1995. Total catch in 2004 was 6 158 tons, mainly taken in the Regulatory Area and as by-catch in the Canadian yellowtail flounder fishery (Fig. 11.1). There has been an increasing trend in catch since 1995.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	nf	nf	nf	nf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.9	1.4	1.6	2.4	2.6[1]	3.0[1]	3.1[1]	3.8[1]	2.9[1]	
STACFIS	0.9	1.4	1.6	2.6	5.2	5.7	4.9	6.9-10.6[2]	6.2	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
nf No fishing.
ndf No directed fishing.

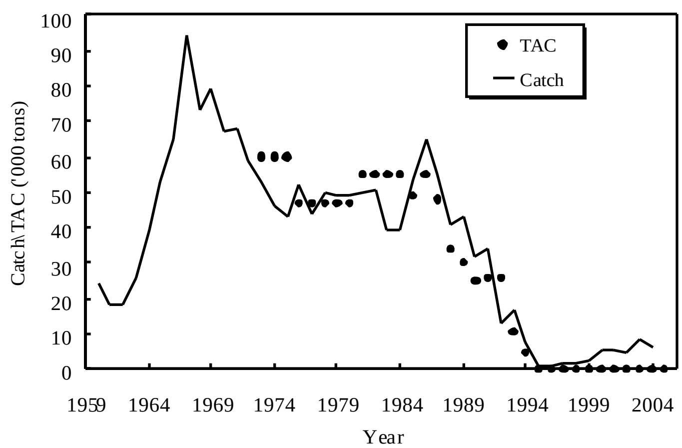


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch per unit effort. There were no recent CPUE data available.

Catch-at-age. There was age sampling of the 2003 and 2004 by-catches in the Canadian fishery and length sampling of by-catch in the Portuguese, Spanish and Russian fisheries. Catch-at-age in the Canadian by-catch was mainly age 6 to 10 with a peak at age 8 (2003) and a peak at age 7 (2004). For the Spanish by-catch the peak in Div. 3L was 37-46 cm while in Div. 3NO it was 31-39 cm, and a lower peak at 44-51 (SCS Doc. 05/8). For the Portuguese trawler fleet most of the by-catch in Div. 3L was 36-44 cm, in Div. 3N 30-44 cm (130 mm mesh) and two peaks were present in the 280 mm mesh catch, 32-38 mm and 46-48 mm. In Div. 3O the peak was at 32-38 cm and one at 44 cm (SCS Doc. 05/6). In the Russian by-catch in Div. 3L the bulk of the catch was made up of fish 20-60 cm in length, two peaks of 36-38 cm and 54-56 cm in Div. 3N and from 18 to 54 cm in Div. 3O (SCS Doc. 05/5). Total catch-at-age for 2003 and 2004 was produced by applying Canadian survey age-length keys to length frequencies collected each year by EU-Spain, EU-Portugal and Russia and adding it to the catch-at-age calculated for Canada. This total was adjusted to include catch for which there were no sampling data. Overall, ages 8-10 dominated the 2003 catch and ages 5-8 dominated the 2004 catch.

ii) **Research survey data**

Canadian stratified-random bottom trawl surveys. Data from spring surveys in Div. 3L, 3N and 3O were available from 1985 to 2004. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 2004, the depth range has been extended to at least 731 m in each survey.

In the spring survey 2004 the biomass (mean weight per tow) estimates for Div. 3L, 3N and 3O were 3.5, 26.8 and 23.2 weight (kg) per tow, respectively. The values for all Divisions are slightly lower than 2003. From 1996 to 1998 the estimate for Div. 3N biomass was approximately half of the estimate for Div. 3O while from 1999 to 2004 the estimates in the two Divisions are similar. Biomass in Div. 3LNO combined has increased somewhat since 1996 but is only 20% (Campelen estimates compared to Campelen equivalents) of that of the mid 1980s (SCR Doc. 05/61; Fig. 11.2).

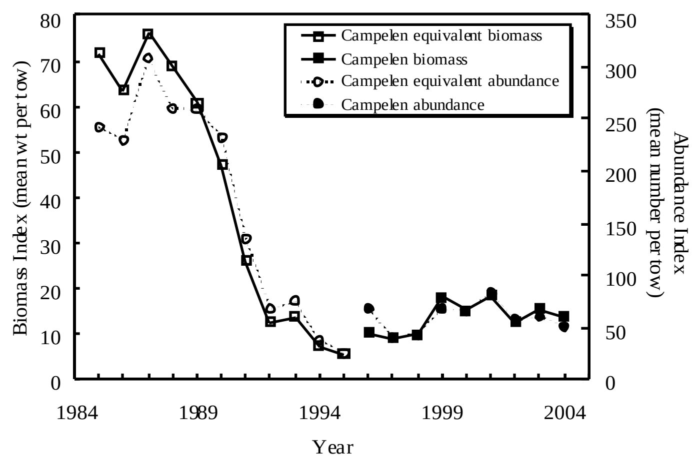


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys.

Abundance (mean number per tow) for Div. 3LNO declined during the late 1980s-early 1990s. Abundance has fluctuated since 1996 with perhaps a slight increase over the period (Fig. 11.2). As with the biomass estimate, mean number per tow has shown the greatest decline in Div. 3L. Although the proportion of fish that are ages 0 to 5 was lower in 2004, in recent years has been amongst the highest in the time series. However, these ages are probably 'under converted' in the 1985 to 1995 data (SCR Doc. 98/69).

Canadian spring and autumn surveys conducted prior to autumn 1995 were conducted using an Engel bottom trawl. There is no conversion of the data series prior to 1985. However, the index from the spring survey using the Engel indicates that the biomass level in the mid-1980s was slightly lower than that in the late 1970s (Fig. 11.3).

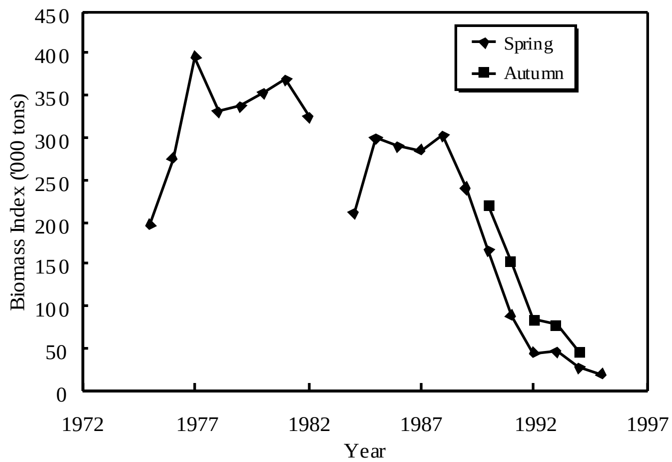


Fig 11.3. American plaice in Div. 3LNO: biomass index as swept area estimates from Canadian spring and autumn surveys using the Engel groundfish trawl.

From Canadian autumn surveys the biomass (mean weight per tow) index for Div. 3LNO in the autumn has shown a slight increasing trend since 1995 but remains well below the level of the early-1990s with the average of the 2003-2004 being 36% of the level of 1990 (Fig. 11.4). Mean weight-per-tow has shown the largest decline in Div. 3L and has been increasing since 1997 in Div. 3N. During 1995 to 1997, Div. 3N constituted on average 40% of the Div. 3NO total while in 2003 and 2004 it averaged more than 65% of the Div. 3NO total.

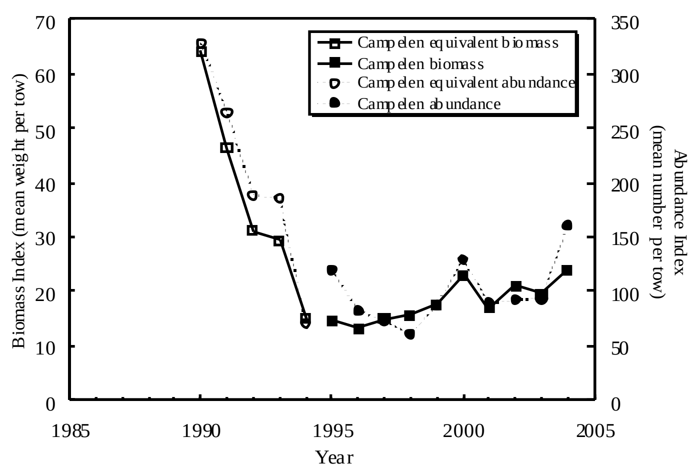


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys.

Abundance showed a substantial decline from 1990 to 1998 but has been somewhat higher since 1998 and from 2003 to 2004 shows the largest increase in the time series (Fig. 11.4). The largest decline was once again in Div. 3L. Ageing was not available for 2004. The age composition has been rather stable over the 1990-2003 time period.

Survey by EU-Spain. Surveys have been conducted annually from 1995 to 2004 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 462 m (since 1998). In 2001, the trawl vessel (C/V *Playa de Menduiña*) and gear (*Pedreira*) were replaced by the R/V *Vizconde de Eza* using a *Campelen* trawl (SCR Doc. 05/25). Canadian spring RV age length keys were applied to Spanish length frequency data (separate sexes, mean number per tow) from 1997-2000 converted data and 2001-2004

Campelen data (SCR Doc. 05/61). The age composition for this survey was similar to the Canadian RV spring survey. The biomass value was highest in 2000 and abundance index in 2004 from this survey (Fig. 11.5).

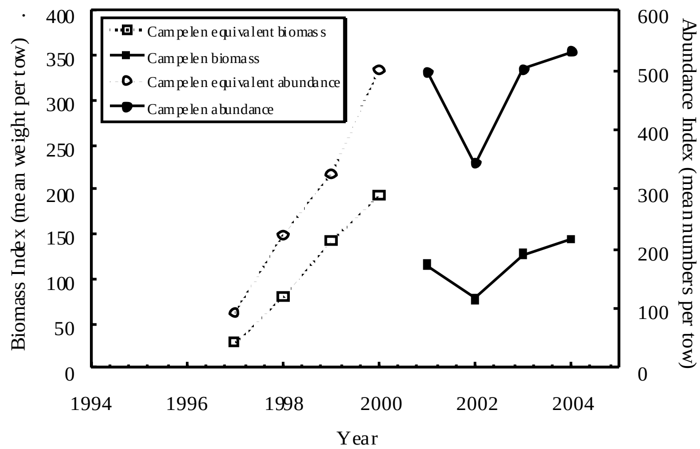


Fig. 11.5. American plaice in Div. 3LNO: biomass and abundance indices from the survey by EU-Spain.

Joint DFO-Industry surveys. Since 1996 grid surveys (grid was expanded in 2000) directed at yellowtail flounder have been conducted jointly by the Canadian Department of Fisheries and Oceans and the Canadian fishing industry in Div. 3NO. Information has also been collected on American plaice. Catch rates of American plaice in the expanded grid in July (the most frequent time of the survey) showed an increase from 1996 to 1997 and then no trend over the remainder of the period (SCR Doc. 05/9). By-catch of American plaice in this survey has increased since the start of the series. The joint DFO-Industry surveys ended in 2004.

iii) **Biological studies**

Maturity. Age (A_{50}) and length (L_{50}) at 50% maturity were produced from spring research vessel data. For males, A_{50} has been declining for all cohorts since 1953 increased to the 1996 cohort, but A_{50} for recent cohorts has declined since. For females, estimates of A_{50} have been declining for all cohorts since 1950. The A_{50} for males in recent cohorts is about 4 years compared to 6 years in the 1960s. For females the A_{50} for recent cohorts is about 7.5 years compared to 11 years for cohorts in the 1960s. L_{50} has declined for both sexes but recovered in recent cohorts. The current L_{50} for males of about 20 cm is similar to the earliest cohorts estimated (1966). The L_{50} of most recent cohorts for females is in the range of 34-37 cm, somewhat lower than the 39 cm of the earliest cohorts (1962).

Size-at-age. Mean weights-at-age were calculated for male and female American plaice for Div. 3LNO using spring survey data from 1990 to 2004 and mean lengths-at-age using data from 1985-2004. Means were calculated accounting for the length stratified sampling design. There is little indication of any trend over the time period in either mean length or weight-at-age, although a slight increase in size-at-age has been noted for 2000-2004.

Recruitment studies. A multiplicative model incorporating data (ages 2-5) from Canadian spring and autumn surveys was used to estimate the relative year-class strength produced by the spawning stock. Predicted year-class strength generally has been declining since the 1978 year-class. However, the model estimate of the 1998 year-class strength shows marginal improvement over the seven previous cohorts (Fig. 11.6).

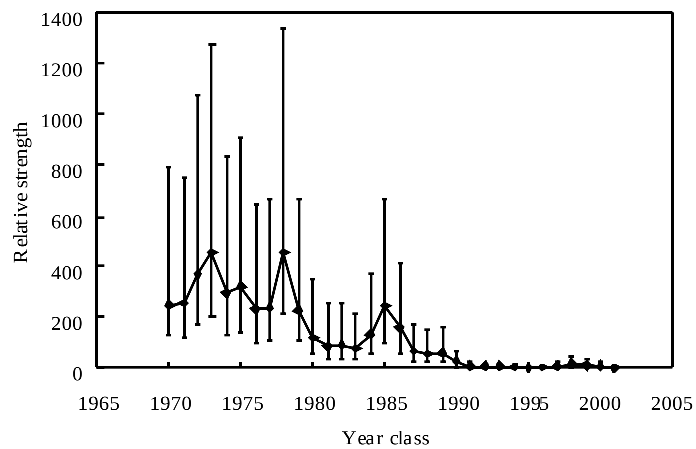


Fig. 11.6. American plaice in Div. 3LNO: estimates of relative cohort strength from Canadian surveys.

Mortality from surveys. Estimates of total mortality (*Z*) from the Campelen or equivalent, spring and autumn survey data were calculated for ages 1 to 16. Both surveys indicate an increase in mortality up to the mid-1990s. Mortality on younger (less than 5) ages has remained high throughout the time series, particularly in the spring survey data. For older ages mortality declined after the mid-1990s but has increased in the last few years on most ages over 6 in both surveys. Averages of the estimates of total mortality show the large increase during the early to mid-1990s. The late 1990s showed a drop in mortality. Since then mortality has increased for most ages, although it is generally still less than the mortality experienced during the early 1990s.

c) **Estimation of Parameters**

Virtual population analysis (VPA) was conducted using the ADAPTive framework with catch-at-age and survey information up to 2004 (SCR Doc. 05/61). The same formulation of the model was used as in the last assessment. Canadian spring (1985-2004) and autumn (1990-2003) survey data for ages 5 to 14 were used. There was a plus group at age 15 in the catch-at-age and the ratio of *F* on the plus group to *F* on the last true age was set at 1.0. *M* was assumed to be 0.2 on all ages except 0.53 on all ages from 1989 to 1996.

d) **Assessment Results**

The VPA analyses showed that population abundance and biomass declined fairly steadily from the mid-1970s to 1995. Biomass and abundance have been relatively stable over the last number of years (Fig. 11.7). Average *F* on ages 9 to 14 and ages 11 to 14 showed an increasing trend from about 1965 to 1985. There was a large unexplained peak in F in 1993. *F* increased from 1995 to 2000 and then declined. Average *F* on ages 9-14 in 2004 was 0.25, lower than the average *F* in 2003 (0.27) and consistent with a decline in catch between those two years (Fig. 11.8). Assessment results indicate an apparent shift in partial recruitment patterns from a flat-topped pattern, to a more domed pattern.

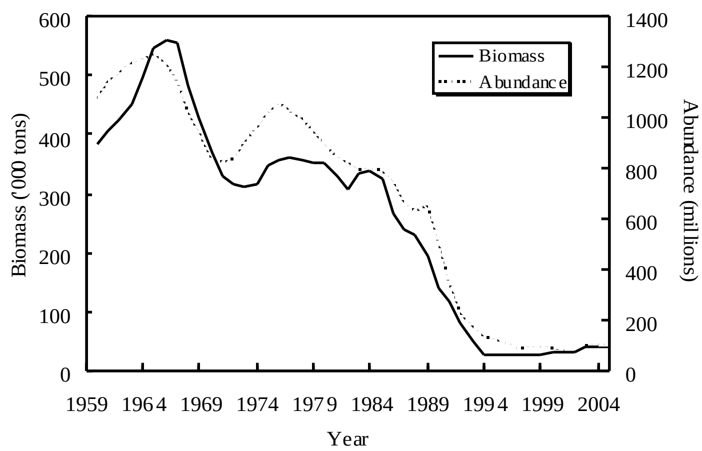


Fig. 11.7. American plaice in Div. 3LNO: population abundance and biomass from VPA.

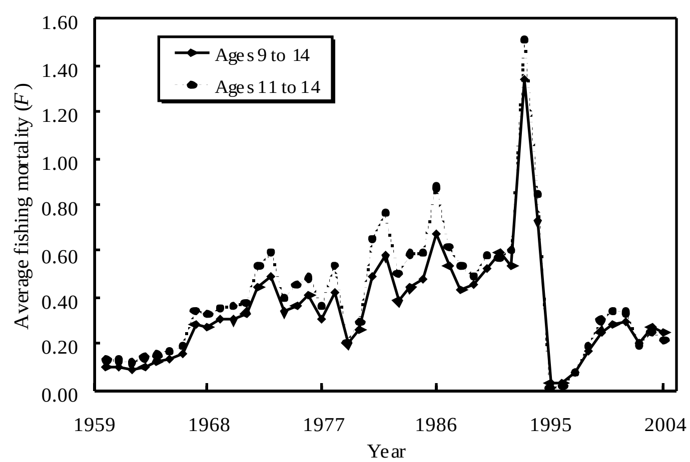


Fig. 11.8. American plaice in Div. 3LNO: average fishing mortality from VPA.

Spawning stock biomass has shown 2 peaks, one in the mid-1960s and another in the early to mid-1980s. Since then it declined to a very low level (less than 10 000 tons) in 1994 and 1995 (Fig. 11.9). It has increased since then but still remains at a very low level at just over 23 000 tons. This is only 11% of the level in the mid-1960s and 17% of the level in the mid-1980s. Recruitment has been steadily declining since the 1986 year-class and there has been no good recruitment since then (Fig. 11.9), except for a small increase due to the 1998 year-class.

Biomass: The biomass is very low compared to historic levels.

Spawning stock biomass: SSB declined to the lowest observed levels in 1994 and 1995. It has increased since then but remains very low at just over 23 000 tons.

Recruitment: There has been no good recruitment since the mid-1980s.

Fishing mortality: The average fishing mortality on ages 9 to 14 was 0.28 from 1999-2001 and decreased slightly to 0.24 from 2002-2004. Considering the stock is under moratorium, average *F* remains high.

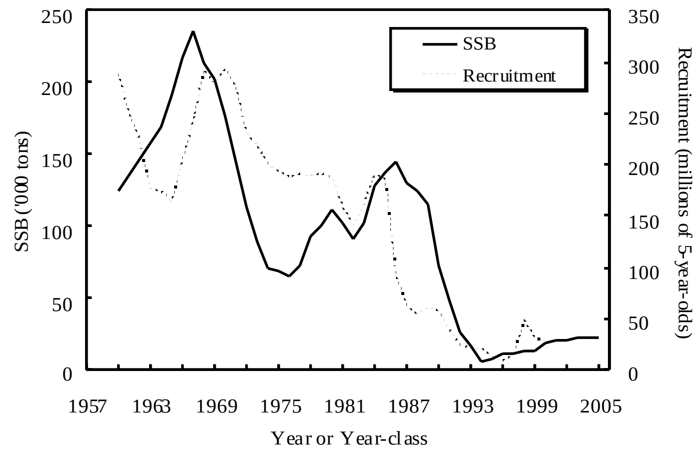


Fig. 11.9. American plaice in Div. 3LNO: spawning stock biomass and recruitment from VPA.

e) **Precautionary Reference Points**

An examination of the stock recruit scatter shows that there has been no good recruitment observed at SSB below 50 000 tons (Fig. 11.10). 50 000 tons of SSB is the current best estimate of B_{lim} for this stock (SCR Doc. 05/61). There is also an indication that since the mid-1980s recruitment has been depressed at SSB above this level, which may indicate that the stock has been in a period of low productivity.

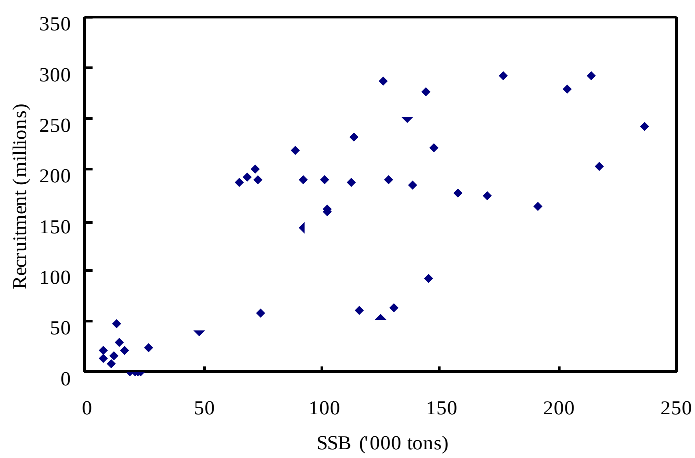


Fig. 11.10. American plaice in Div. 3LNO: stock recruitment scatter-plot.

SSB increased at a low fishing mortality (F) from 1960 to 1967. SSB then declined under rising F and some years of poor recruitment. SSB has been below B_{lim} since 1991. Since 1998, F has been at or above $F_{0.1}$ (Fig. 11.11).

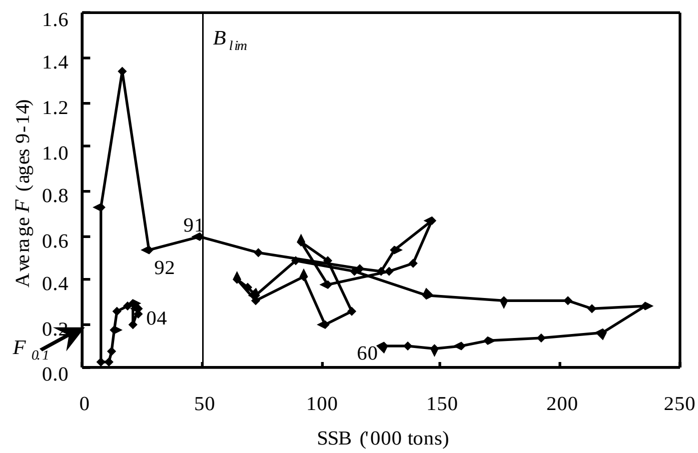


Fig. 11.11. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework.

f) **Medium-term Considerations**

Deterministic projections were carried out for 5 years to examine the trajectory of the spawning stock biomass under 2 scenarios of fishing mortality: F = 0, $F = F_{current}$. For these deterministic projections the results of the VPA were used. $F_{current}$ was set as the average F on age 9 (the fully recruited age in the VPA) over the last 3 years and was 0.30. PR and weights were averaged over the last 3 years. Recruitment was the average R/S for the last 3 year-classes and was equal to 2.41. In addition the following values were used:

Age	5	6	7	8	9	10	11	12	13	14	15+
M	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PR	0.07	0.21	0.49	0.89	1	0.87	0.92	0.90	0.66	0.59	0.59
Stock Weight	0.19	0.27	0.37	0.45	0.54	0.64	0.77	0.95	1.18	1.45	1.87
Maturities											
2004	0.03	0.13	0.43	0.74	0.96	0.99	1.0	1.0	1.0	1.0	1.0
2005	0.03	0.13	0.43	0.79	0.91	0.99	1.0	1.0	1.0	1.0	1.0
2006	0.03	0.13	0.43	0.79	0.95	0.98	1.0	1.0	1.0	1.0	1.0
2007	0.03	0.13	0.43	0.79	0.95	0.99	0.99	1.0	1.0	1.0	1.0
2008	0.03	0.13	0.43	0.79	0.95	0.99	1.0	1.0	1.0	1.0	1.0

The stock is estimated to increase under both $F = F_{current}$ and F = 0. The increase under current conditions of F is only about 12 000 tons over the 5 year period and the stock does not exceed B_{lim}. The spawning stock reaches the B_{lim} of 50 000 tons by 2009 with F = 0 (Fig. 11.12). The average R/S has been considerably higher in recent years and thus the assumed recruitment value used in projections is higher than in 2003 projections.

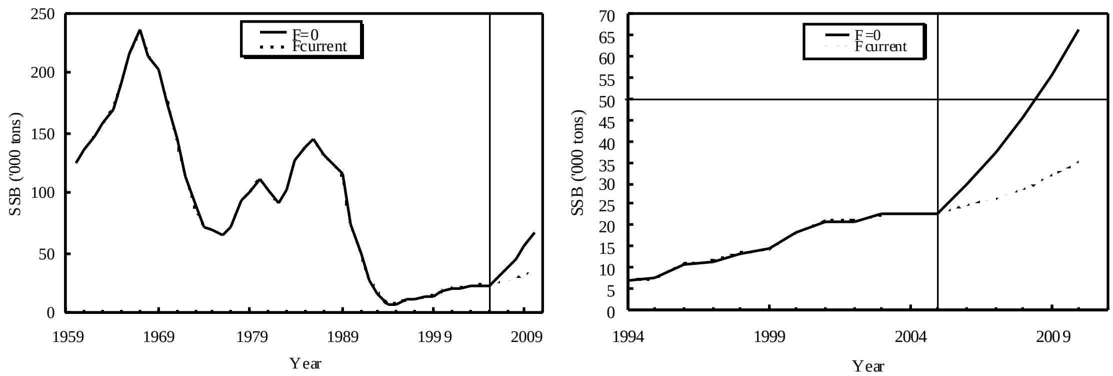


Fig. 11.12. American plaice in Div. 3LNO: projected spawning stock biomass at $F_{current}$ and $F = 0$.

g) **Recommendations**

STACFIS noted that it had been some time since alternative formulations of the population model for this stock had been explored. Therefore STACFIS **recommended** that *a number of ADAPT formulations be explored for Div. 3LNO American plaice, including shortening or splitting the tuning indices in conjunction with varying natural mortality that is included in the current model*. In addition, further comparisons between the Canadian surveys of Div. 3LNO and the survey by EU-Spain in the NRA of Div. 3NO should be carried out, including comparisons of trends in overall abundance, age by age abundance and a comparison of retrospective patterns for VPA formulations including and excluding the survey by EU-Spain.

$F_{lim} = F_{msy}$ was suggested as a possible reference point for this stock by the Limit Reference Point Study Group (SCS Doc. 04/12). However, STACFIS noted that an estimate of F_{msy} greatly depends on exploitation pattern (PR), stock recruitment model and natural mortality rate to be used in the computation. As the stock is under moratorium, the actual PR may not be appropriate as it differs considerably from the PR observed in the former period when the fishery was open. Natural mortality has been estimated to have changed from the assumed 0.2 figure to a value of 0.53 over the period (1989 to 1996). For the stock recruitment model, if a smoother is used, assumptions have to be made for recruitment when SSB values fall outside the observed data. Therefore, before adopting a F_{lim} value based on F_{msy}, STACFIS **recommended** that *investigation be carried on the sensitivity of the estimation of F_{msy} to these parameters.*

12. **Yellowtail Flounder (*Limanda ferruginea*) in Divisions 3L, 3N and 3O**. (SCR Doc. 05/9, 25, 55; SCS Doc. 05/5, 6, 8)

Interim Monitoring Report

a) Introduction

During the moratorium (1994-97), by-catches ranged from about 280 to 2000 tons (Fig. 12.1). Since the fishery re-opened in 1998, catches increased from 4 400 tons to peak at 14 100 tons in 2001. Catches in 2004 declined by 452 tons, from 2003.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	ndf	4	6	10	13	13	13	14.5	14.5	15
STATLANT 21A	0.2	0.7	4.4	7.0	10.6[1]	12.8[1]	10.4[1]	13.8[1]	13.4[1]	
STACFIS	0.3	0.8	4	7	11	14.1	10.8	13.5-14[2]	13.4	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishing.

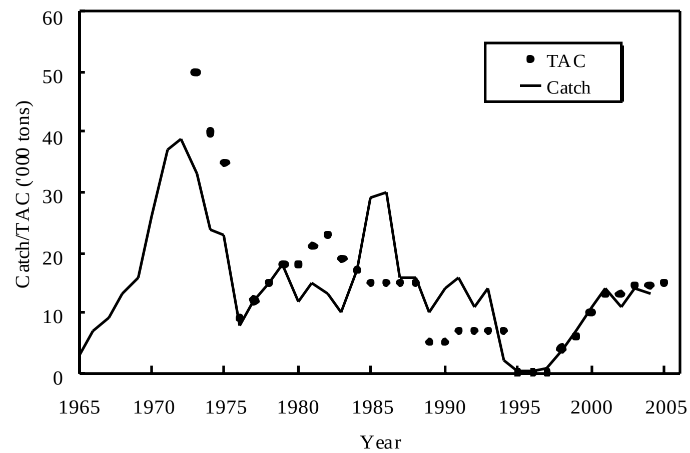


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) **Data Overview**

i) Research survey data

Canadian stratified-random bottom trawl surveys (SCR Doc. 05/55). In 2004, most of the biomass of this stock continued to be found in Div. 3N; however, the stock shows a widespread distribution into Div. 3O and 3L. The index of the spring biomass for Div. 3LNO in 2004 was 20% lower than in 2003 (Fig 12.2) while the 2004 autumn index of biomass was 2% higher than in 2003 (Fig 12.3).

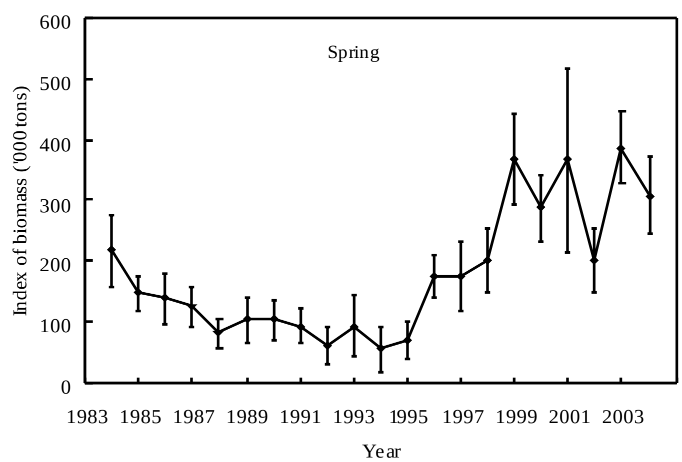


Fig. 12.2. Yellowtail flounder in Div. 3LNO: index of biomass from Canadian spring surveys. Error bars are approximate 95% confidence limits.

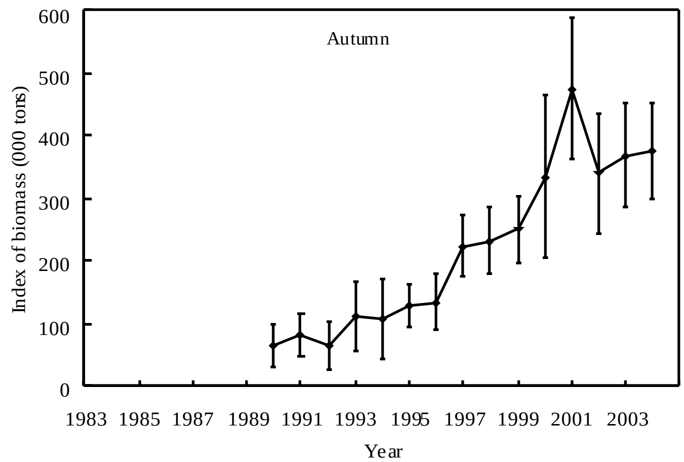


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from Canadian autumn surveys. Error bars are approximate 95% confidence limits.

Cooperative DFO/fishing industry seasonal surveys (SCR Doc. 05/9). Cooperative grid surveys between Canadian Department of Fisheries and Oceans (DFO) and the Canadian fishing industry in Div. 3NO have been carried out since 1996 using a commercial fishing gear without a codend liner. The CPUE for the indexed grid blocks for July surveys from 1996-2004 has shown an increasing trend since 2001 with the 2004 CPUE value being the highest in the time series. This survey series will be discontinued in 2005.

Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO. (SCR Doc. 05/25) Data from the surveys in 1995-2004 were converted to be comparable to the surveys from 2001 onward, which were done with a different vessel and gear. The biomass indices showed an increasing trend between 1995 and 1999, before declining thereafter to 2003 (Fig. 12.4). In 2004, the survey index of biomass showed a 25% increase over that estimated in 2003.

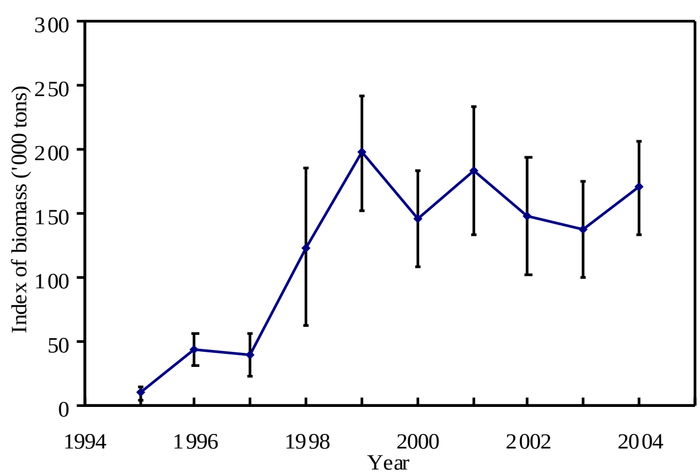


Fig. 12.4. Yellowtail flounder in Div. 3LNO: index of biomass from the Spanish spring surveys in the NRA in Div. 3NO. Error bars are ± 1 S.D.

c) **Conclusion**

Based on overall indices for the current year, there is nothing to indicate a change in the status of the stock.

13. **Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 3N and 3O** (SCS Doc. 05/3, 5, 9)

Interim Monitoring Report

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 by-catch from other fisheries, 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.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.3	0.5	0.6	0.9	0.7[1]	0.5[1]	0.7[1]	0.9[1]	0.6[1]	
STACFIS	0.3	0.5	0.6	0.8	0.5	0.7	0.4	0.85-2.24[2]	0.6	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
Ndf No directed fishery.

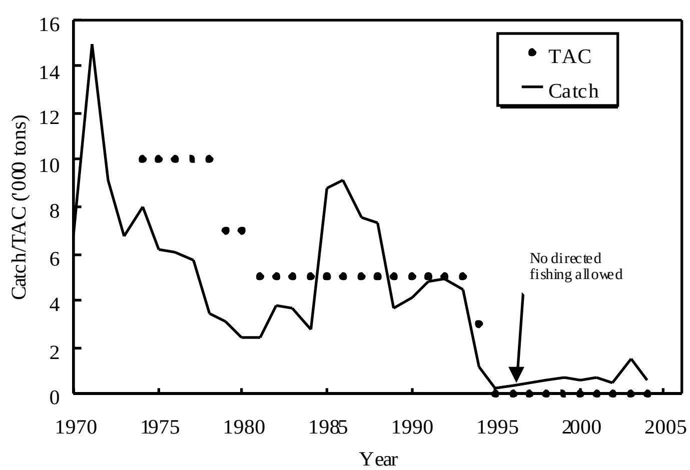


Fig. 13.1. Witch flounder in Div. 3N and 3O: catches and TAC.

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 1997-2002 catch estimates ranging from 400-800 tons. Catches by Canada ranged from 1 200 tons to 4 300 tons from 1985 to 1993 (about 2 650 tons in 1991 and 4 300 tons in 1992) and were mainly from Div. 3O. Only very small amounts of by-catch by Canada have been 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 there has been little or no catch since then. Catch for 2003 was estimated to be between 844 and 2 239 tons. In 2004 the catch was estimated to be around 630 tons.

b) Data Overview

i) Research survey data

Mean weight (kg) per tow. For Div. 3N, mean weights (kg) per tow in the Canadian spring survey ranged from as high as 0.96 kg per tow in 1984 to a low of 0.07 kg per tow in 1996 and a marginal increase to 0.23 kg per tow in 2003 (Fig 13.2). Mean weights (kg) per tow in the autumn survey in Div. 3N ranged from 1.22 kg per tow in 1992 to a low of 0.07 kg per tow in 1996. Estimates have been variable throughout the series, showing little or no trend, and in 2003 is 0.64 kg per tow. In Div. 3O, the spring survey estimates are variable, but show a decreasing trend from 9.67 kg per tow in 1985 to 0.83 kg per tow in 1998. Since then mean weights per tow have remained variable but have increased slightly and in 2003 the estimate is 6 kg per tow. Although the index in Div. 3NO appeared higher in 2003 than in recent years, it was driven by one large set. The mean weight per tow estimate in 2004 was 4.5 kg per tow with wide confidence limits.

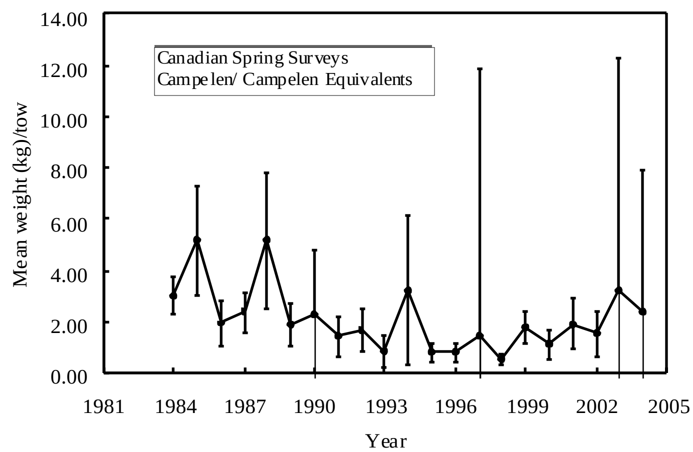


Fig. 13.2. Witch flounder in Div. 3NO: mean weights (kg) per tow from Canadian spring surveys (with 95% confidence limits).

Length Frequency data: The frequencies taken in the Canadian surveys ranged from 8-64 cm with modal length around 40 cm. Smaller fish were evident in the Canadian research vessel frequencies from 1995-2000 and in 2002, which may be contributing to the apparent improvement in the stock, but this peak was not evident in the 2001, 2003 or 2004 surveys.

c) Conclusion

Based on overall indices for the current year, there is nothing to indicate a change in the status of the stock.

14. Capelin (*Mallotus villosus*) in Divisions 3N and 3O (SCR Doc. 05/17)

a) Introduction

The fishery for capelin started in 1971 and total catch was maximal in mid-1970s with the highest catch of 132 000 tons in 1975. The directed fishery was closed in 1992 and the closure has continued through 2005 (Fig. 14.1). No catches have been reported for this stock since 1993.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	ndf	na	na	na	na	na	na	na	na	na
Catch[1]	0	0	0	0	0	0	0	0	0	

[1] No catch reported or estimated for this stock.
ndf No directed fishing.
na No advice possible.

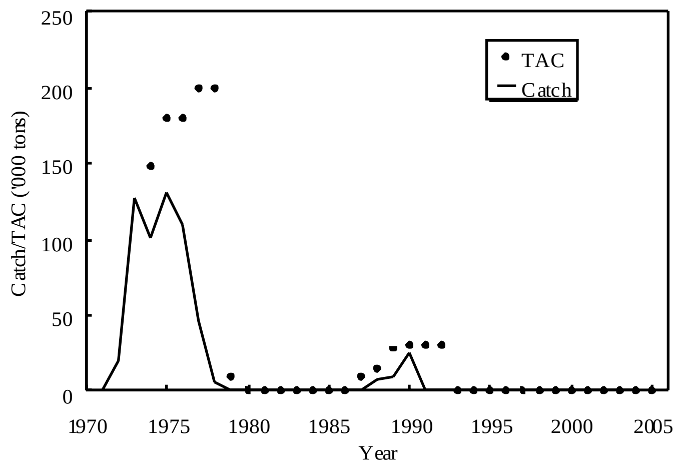


Fig. 14.1. Capelin in Div. 3NO: catches and TACs.

b) **Input Data**

Trawl acoustic surveys of capelin on the Grand Bank previously conducted by Russia and Canada on a regular basis have not been undertaken since 1995. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random bottom trawl surveys.

In 1996-2004, when Campelen was used as sampling gear, trawlable biomass of capelin in Div. 3NO varied from 7.2 to 58.1 thousand tons (Fig. 14.2). In 2003-2004, this parameter was 25.3 and 35.5 thousand tons, respectively, when the average for the period from 1996 was estimated as 27.9 thousand tons.

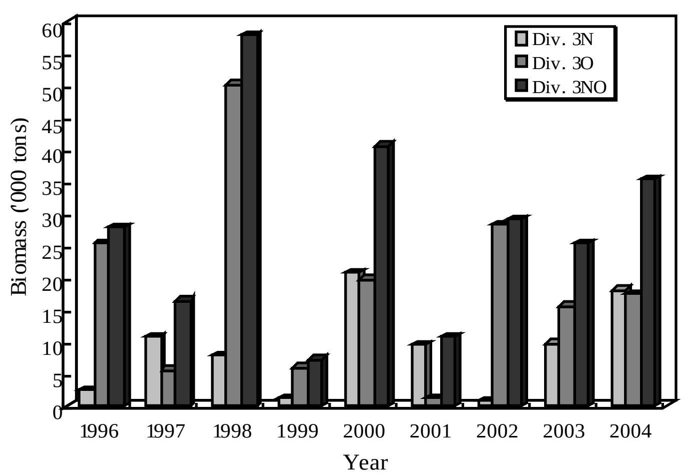


Fig. 14.2. Capelin in Div. 3NO: trawl biomass estimates in 1996-2004.

Besides, a standardised catch per area unit (tons/km^2) calculated as an average of all non-zero catches was used to evaluate the stock dynamics in 1990-2004. Since capelin was not included in the comparison investigations of catch rates of Engel and Campelen trawls, the conversion factor for capelin was not calculated. Previously, in order to compare the results of surveys conducted with different trawls, it was assumed that catch rate for equal-in-size capelin and cod of 14 cm in length was the same. Based on this assumption, catching efficiency of capelin by Campelen was approximately 49 times higher than that of Engel. According to data from 1996-2004, the mean catch per km^2 varied between 0.13 and 0.76 with 0.38 as the average for these years. In 2003 and 2004, this parameter was 0.37 and 0.42, respectively (Fig. 14.3). The actual estimates of 2003-2004 correspond to a low level of stock size that was observed in 1996, 2002-2003.

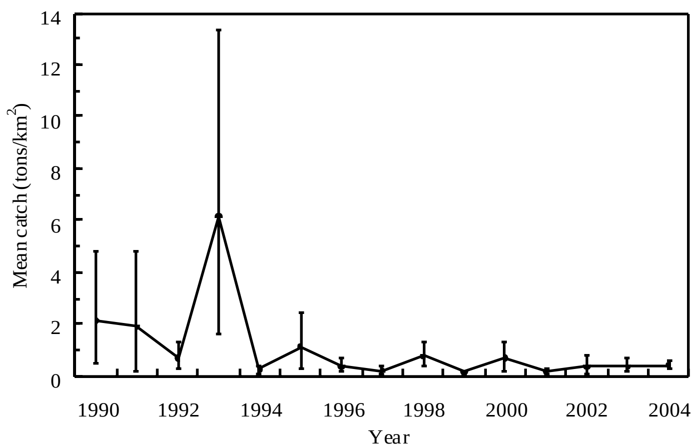


Fig. 14.3. Capelin in Div. 3NO: mean catch (tons/km^2) in 1990-2004.

c) **Assessment Results**

It is not clear how the data reflects the real stock distribution and stock status. Nevertheless, STACFIS considered that the stock is still at a low level relative to that of the late 1980s.

d) **Precautionary Reference Points**

STACFIS is not in a position to determine biological reference points for capelin in Div. 3NO at this time.

e) **Research Recommendation**

STACFIS reiterated its **recommendation** that *initial investigations to evaluate the status of capelin in Div. 3NO utilize trawl acoustic surveys to allow comparison with the historical time series.*

15. **Redfish *(Sebastes mentella* and *Sebastes fasciatus*) in Division 3O** (SCR Doc. 05/11, 59; SCS Doc. 05/5, 6, 8)

a) **Introduction**

There are two species of redfish that have been commercially fished in Div. 3O; 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. Within Canada's fishery zone redfish in Div. 3O have been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, whereas catch was only regulated by mesh size in the NRA of Div. 3O. In September 2004, the Fisheries Commission adopted

TAC regulation for redfish in Div. 3O, implementing a level of 20 000 tons per year for 2005-2007. This TAC applies to the entire area of Div. 3O.

Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960 (Fig. 15.1). Up to 1986 catches averaged 13 000 tons, increased to 27 000 tons in 1987 with a further increase to 35 000 tons in 1988, exceeding TACs by 7 000 tons and 21 000 tons, respectively. Catches declined to 13 000 tons in 1989, increased gradually to about 16 000 tons in 1993 and declined further to about 3 000 tons in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 14 000 tons by 1998, declined to 10 000 tons by 2000 then doubled to 20 000 tons in 2001. From 2002-2003 catches averaged 17 200 tons then declined dramatically to about 3 800 tons in 2004.

The large catches in 1987 and 1988 were due mainly to increased activity in the NRA non-Contracting parties (NCPs), primarily by Panama and at that time South Korea. There hasn't been any activity in the NRA by NCPs since 1994. Estimates of under-reported catch have ranged from 200 tons to 23 500 tons. There have also been estimates of over-reported catch in the recent period since 2000. Over this time period, over-reported catch has ranged ranged from 1 800 tons (2001) to 4 300 tons (2003). Although most fleets directing for redfish in the NRA reduced their catch from 2003 to 2004, the decline was primarily accounted for by the Russian fleet which reduced its activity of because of problems with catches of small redfish (<21 cm). Canada has had limited interest in a fishery in Div. 3O because of small sizes of redfish encountered in areas suitable for trawling.

In general, the fishery has occurred primarily from May to October since 1990. The prominent means of capture is the bottom otter trawl which generally accounts for greater than 90% of the catch. The catch by midwater trawls is predominantly by Russia. Canadian, Portuguese and Spanish fleets utilize bottom trawling.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC[1]	10	10	10	10	10	10	10	10	10	20
STATLANT 21A	9.6	5	13.3	12.6	12.8[2]	22[2]	19.4[2]	21.5[2]	6.4[2]	
STACFIS	9.8	5	14	12.6	10	20.3	17.2	17.2	3.8	

[1] 1996-2004 only applied within Canadian fishery jurisdiction.
[2] Provisional.

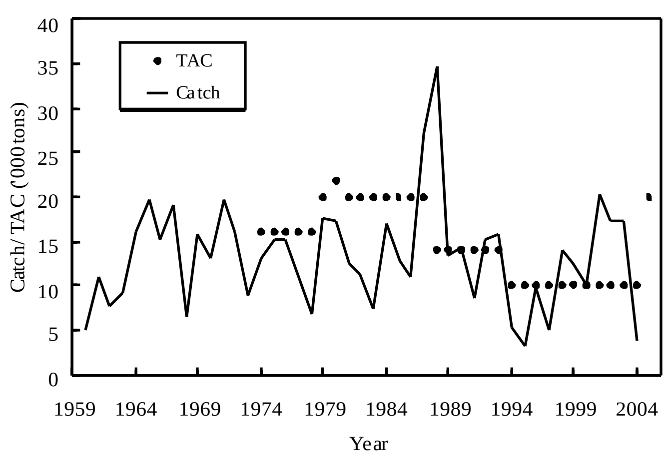


Fig. 15.1. Redfish in Div. 3O: catches and TACs (from 1974 to 2004 applied to Canadian fisheries jurisdiction; for 2005 for entire Div. 3O area).

b) **Input Data**

i) **Commercial fishery data**

A catch rate database with effort measured in days fished was standardized using a multiplicative model.

The catch rate index (Fig. 15.2) shows much within year variability. There are also only short periods of sustained directed effort prior to 1996. During a period of sustained activity from 1976-81 catch rates were stable and comparable to catch rates at the beginning of the series. The next onset of a sustained directed fishery began in 1996 which shows a general increase to 2004. The index in recent years is at the same level it was in the late 1970s as well as the early 1960s.

The catch rate index of the Canadian fleet may at best be simply reflecting fishing success rather than stock trends. Canada has not accounted for a major portion of the reported catches from Div. 3O and has only fished within its 200-mile fisheries jurisdiction. The interpretation of commercial catch rates as an indicator of stock abundance in Div. 3O remains difficult. Redfish tend to form patchy aggregations at times very dense. In Div. 3O there is a limited amount of fishable area in deeper waters along the steep slope of the southwest Grand Bank where larger fish tend to be located.

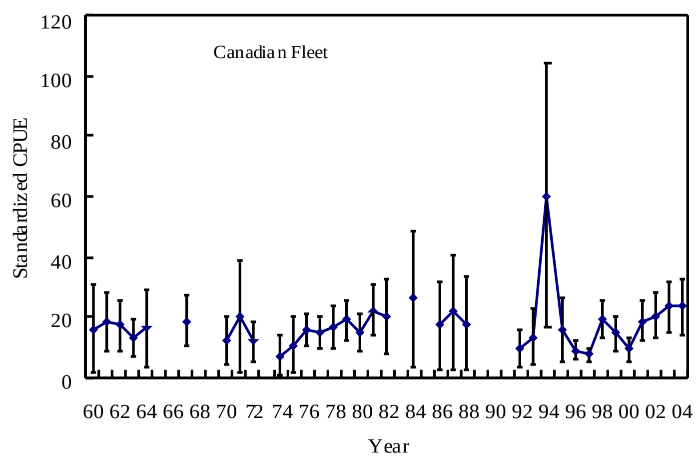


Fig. 15.2. Redfish in Div. 3O: standardized CPUE by fleet.

Sampling of the redfish was conducted by Canada, Portugal and Russia from the 2004 trawl fishery. Sampling indicates the Portuguese fleet fished between 140-966 m while the Russian fleet fished from 300-600 m. Logbook information from the Canadian fleets indicated most of the catch was taken at depths <300 m. The compilation of annual catch at length derived as number per thousand suggested fish between 21-27 cm generally dominated the catches. Lengths between 21-26 cm (range 7-42 cm) dominated the Portuguese catch. The dominant size range in the Russian catch was 22-29 cm (range 17-42 cm), which was sampled for total length. Fish between 22-26 cm from a length range between 18-37 cm dominated the Canadian catch.

A compilation of catch at length from various fleets from 1995 to 2004 suggests that the size composition has changed over the time period with fleets catching a larger portion of fish >25 cm prior to 1998.

ii) **Research survey data**

Stratified-random surveys have been conducted by Canada in Div. 3O in spring and autumn from 1991 to 2004. The surveys cover to depths of 732 m (400 fathoms) in spring and to 1 464 m (800 fathoms) in autumn. 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.

Results of bottom trawl surveys for redfish in Div. 3O indicated a considerable amount of variability. This occurred between seasons and years. Although it is difficult to interpret year to year changes in the estimates, in general, the spring survey index (Fig. 15.3) suggests the stock may have increased from an average of 19 kg/tow in 1991-92 to an average of 205 kg/tow between 1994-96 and subsequently declined to an average of 31 kg/tow between 2002-2003. The index shows a large increase in 2004 to 103 kg/tow that was influenced by one large set in a stratum that represented 40% of the biomass index. The autumn surveys, while more stable in the early 1990s, generally supports the pattern of the spring survey index to 2002. However, the autumn index suggests stability to 2004. Research vessel surveys do not appear to adequately sample fish greater than 25 cm which up to 1997 have generally comprised the main portion of the fishery.

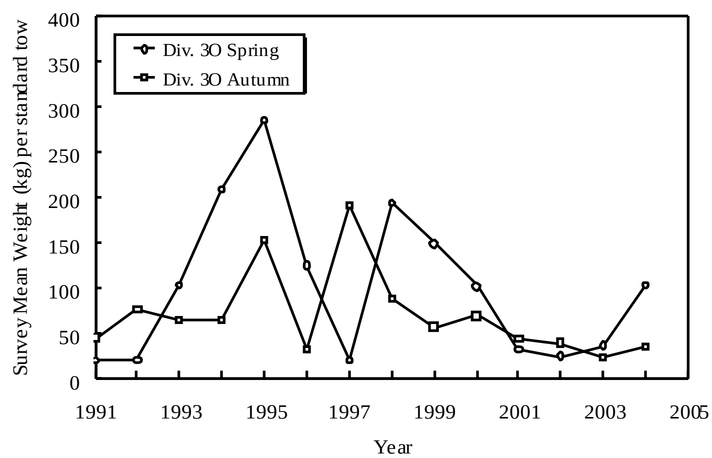


Fig. 15.3. Redfish in Div. 3O: survey biomass indices from Canadian surveys in Div. 3O in Campelen equivalent units for surveys prior to autumn 1995.

Stratified random surveys were conducted by Russia in Div. 3O from 1983 to 1993. These surveys also demonstrate large fluctuation and within year variability with the estimates sometimes highly influenced by large sets. The survey index of biomass declined from 40 000 tons in 1983 to 806 tons in 1989 and remained relatively low to 1993.

iii) **Recruitment**

Size distribution from the Canadian spring and autumn surveys in terms of mean number per tow at length indicates a bimodal distribution in 1991 corresponding to the 1988 and 1984 year-classes, respectively. The 1984 year-class progressed at about one cm per year up to 1994 and cannot be traced any further. The 1988 year-class remains dominant at 22-23 cm from 2001-2004 surveys. Recruitment pulses detected in both surveys in 1999 were greatly diminished by 2002. There are new pulses detected in the 2003 and 2004 surveys but it is too early to determine what their relative contribution will be to the population. The 1988 year-class was the last good recruitment to the population (Fig. 15.4).

Size distribution from the Russian spring/summer surveys from 1983 to 1993 indicated pulses of recruitment that first appeared in the surveys of 1983, 1988 and 1991 between 10-13 cm. These correspond to the year-classes of 1978, 1984 and 1988, respectively. The relative strength of these in the surveys suggests 1978 was the strongest of these year-classes.

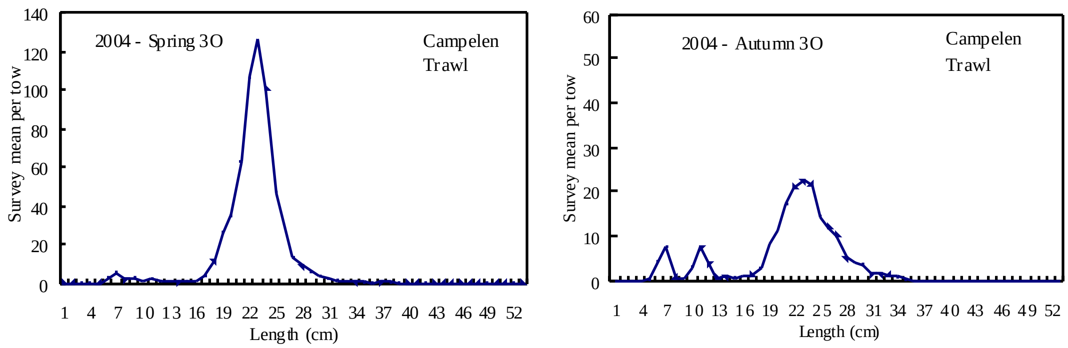


Fig. 15.4 Redfish in Div. 3O: Size distribution (stratified mean per tow) from Canadian spring and autumn surveys for 2004.

c) **Estimation of Stock Parameters**

i) **Relative exploitation**

A fishing mortality proxy was derived from catch to biomass ratios. As most of the catch of the 1990s was taken in the last three quarters of the year, the catch in year "*n*" was divided by the average of the Canadian Spring (year = *n*) and Autumn (year = *n*-1) survey biomass estimates to better represent the relative biomass at the time of the year before the catch was taken. Survey catchability (*q*) for redfish is not known but assumed less than one. Prior to 1998 the catch was composed of fish greater than 25 cm which are not well represented in the survey catch. From 1998 to 2004, the fishery size composition more resembled the survey size composition. Accordingly, catch/biomass ratios were only calculated for the surveys from 1998-2004. The results (Fig. 15.5) suggest that relative fishing mortality increased steadily from 1998 to 2002 remained high in 2003 but declined substantially in 2004.

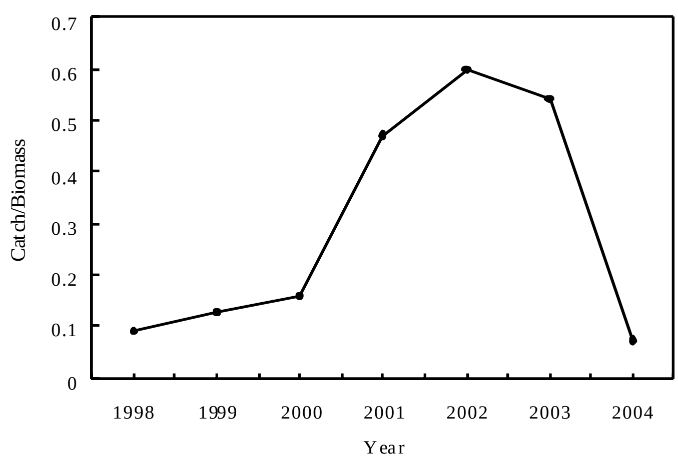


Fig. 15.5. Redfish in Div. 3O: catch/survey biomass ratios for Div. 3O.

ii) **Size at maturity**

A size at maturity analysis presented in 2002 based on an analysis of Canadian survey data for redfish suggested L_{50} is about 28 cm for females and 21 cm for males. These results were obtained from an analysis of *S. fasciatus* and *S. mentella* combined. Information presented to this meeting

(SCR Doc. 05/11) estimated size at maturity for *S. fasciatus* with the species identified by meristic characters. The data suggest for *S. fasciatus* L_{50} for males is 21 cm and for females is 20 cm. STACFIS noted these results were unusual in that typically L_{50} values are larger for females than males.

d) **Assessment Results**

It is not possible to determine current fishing mortality rate or absolute size of the stock. It is difficult to accept that the Canadian CPUE series is representative of the trends in the stock. Surveys indicate general trends over the time period. The Canadian spring and autumn survey estimates have remained relatively stable since 2001 but at a much lower level than the mid-1990s. Given the stable biomass indices the increase in catches from 2001-2003 which averaged about 18 000 tons, suggests that fishing mortality increased during this time period. The reduction in catch to about 4 000 tons in 2004 suggests a reduction in fishing mortality. What is of particular concern is the poor recruitment since the relatively strong 1988 year-class. Given that the bulk of the catches in recent years are comprised of fish less than 27 cm, these fisheries may be targeting predominantly immature fish, particularly if the catches comprise a greater proportion of *S. mentella*.

e) **Reference Points**

At present it is not possible to determine limit or other reference points for either fishing mortality or biomass for redfish in Div. 3O.

f) **Recommendations**

STACFIS noted estimates of size at maturity from various recent studies was not precise because species mixtures could be a confounding factor, accordingly, due to the importance of size at maturity for assessment purposes, STACFIS **recommended** that *future studies should be continued and be analyzed by species.*

16. **Thorny Skate (*Amblyraja radiata*) in Divisions 3L, 3N and 3O** (SCR Doc. 05/5, 8, 26, 49; SCS Doc. 05/5, 6, 8, 12)

Interim Monitoring Report

a) **Introduction**

Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skates taken in the Canadian catches. EU-Spain reported that 96% of the skates taken in Div. 3NO comprised thorny skate. Thus, the skate fishery on the Grand Banks can be considered as a directed fishery for thorny skate.

Nominal catches increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this fishery are EU-Spain, Canada, Russia and EU-Portugal. Some thorny skate continue to be taken as a by-catch in other fisheries. Reported catches peaked at about 31 500 tons in 1991 (STATLANT 21A). During the period from 1985 to 1991, catches averaged 22 300 tons, lower during 1992-1995 (8 600 tons). There are substantial uncertainties in the catch levels prior to 1996. Catch levels after 1995 as estimated by STACFIS averaged 10 700 tons (Fig. 16.1). This species came under quota regulation in September 2004, when the Fisheries Commission set a TAC of 13 500 tons for 2005-2007.

Recent catches (000 tons) are as follows:

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC										13.5
STATLANT 21A	7.0	13.7	9.7	12.2	18.7[1]	10.0[1]	11.7[1]	14.3[1]	11.8[1]	
STACFIS	6.6	12.6	8.8	9.5	13.7	10.4	11.5	13.3-13.5[2]	9.3	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.

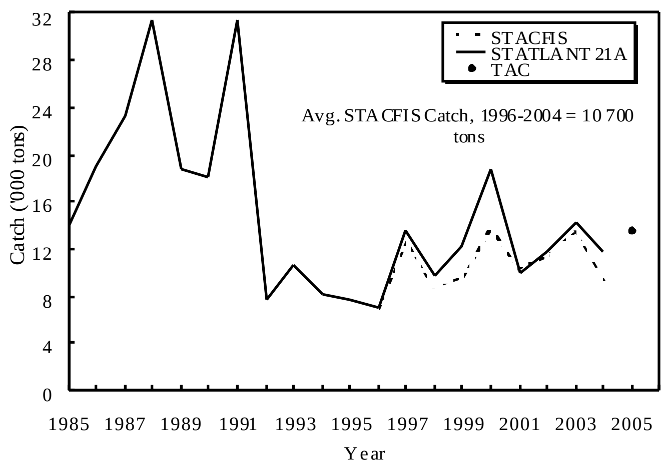


Fig. 16.1. Thorny skate in Div. 3LNO: total catches, 1985-2004.

b) **Data Overview**

i) **Research survey data**

STACFIS **recommended** that *standardization of the two research survey series (Engel and Campelen) be carried out for thorny skate in Div. 3LNO.*

Based on this recommendation, various conversion methods were investigated, such as comparison between mean CPUE and the Robson method, from comparative trawl experiments. Lack of size-based differential catchability between the two trawls, as determined from length frequency data from comparative trawl experiments, eliminated the necessity of a length based conversion factor. STACFIS adopted the Robson's multiplicative model for conversion of thorny skate Engel trawl data to Campelen equivalents from 1984 to 1995 to derive a standardized time series for thorny skate.

Canadian spring surveys. Stratified-random research vessel surveys have been conducted in spring 1984-2004 by Canada in Div. 3L, 3N and 3O using the Engel bottom trawl prior to 1996 and employing the Campelen 1800 trawl since. Maximum depth surveyed was 366 m before 1991 and ~750 m since. The Canadian spring survey biomass declined between 1985 and 1995. From 1996 to 2004, the biomass has been relatively stable (Fig.16.2).

Canadian autumn surveys. Stratified-random surveys have been conducted by Canada during autumn since 1990 in Div. 3LNO using the Engel bottom trawl prior to 1995 and employing the Campelen 1800 trawl since, to depths of ~1 450 m. As for the spring series, survey biomass and abundance declined rapidly during the early 1990s, stable since (Fig. 16.2). The autumn estimates of both biomass and abundance were on average higher than the spring estimates. This is expected since the thorny skate are found at depths exceeding the maximum depths surveyed in the spring (~750 m) and are more deeply distributed during the winter/spring.

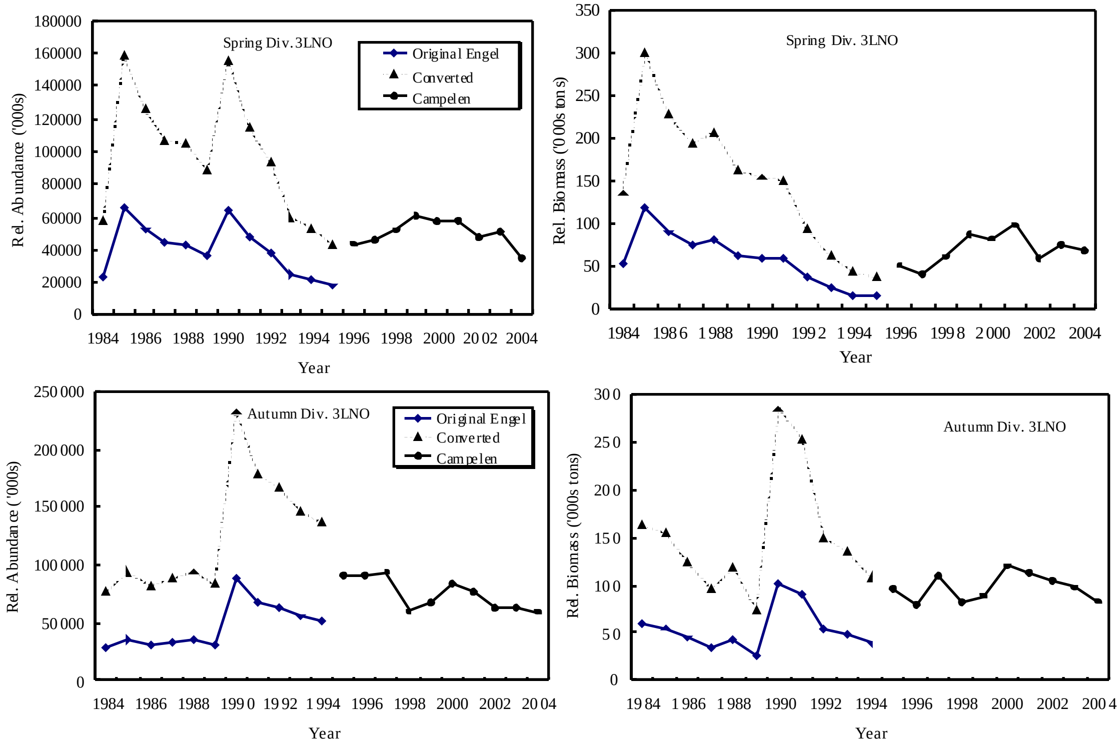


Fig. 16.2. Thorny skate in Div. 3LNO: estimates of biomass and abundance from Canadian spring (upper) and autumn (lower) surveys. Unconverted Engel trawl series are plotted separately. Engel data, converted to Campelen by the Robson method (dotted line) are also plotted for 1984-1995 and can be considered contiguous with the Campelen series.

Spanish surveys. Spanish survey biomass indices in Div. 3NO were available for the period 1997-2004. The Spanish survey was conducted in the NRA portion of Div. 3NO to a depth of 1 400 m, while the Canadian spring survey covered the entire extent of Div. 3NO to 750 m. The biomass trajectory from the Spanish survey was very similar to that of the Canadian spring survey (Fig. 16.3).

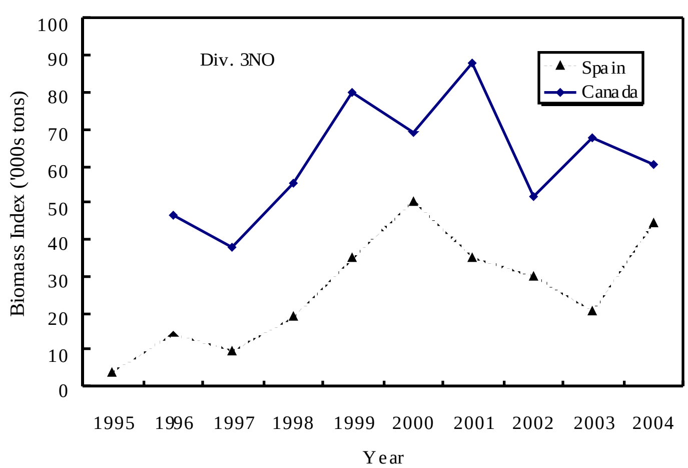


Fig. 16.3. Thorny skate in Div. 3NO: estimates of biomass from Spanish spring survey compared to Canadian spring surveys.

c) **Conclusion**

With the addition of indices for the current year, there is nothing to indicate a significant change in the status of the stock.

17. **White hake (*Urophycis tenuis*) in Divisions 3N, 3O and Subdivision 3Ps** (SCR Doc. 05/21, 26, 60, 66; SCS Doc. 05/5, 6, 8, 12)

a) **Introduction**

The advice requested by Fisheries Commission for this stock is for Div. 3NO. The Canadian management unit for white hake, Div. 3NO and Subdiv. 3Ps was previously established based on an observed continuum in distribution over Div. 3NOPs; an area of similar physical conditions and no evidence of any biological separation at the 3Ps/3O line. A spatial analysis of stages of white hake showed that fish younger than 1 year, 2+ juveniles, and mature adults distribute at different locations within Div. 3NO and Subdiv. 3Ps. This movement of fish between areas must be considered when assessing the status of white hake in Div. 3NO; therefore, an assessment of Div. 3NOPs white hake is conducted.

Catches of white hake in Div. 3NO peaked in 1987 at approximately 8 000 tons (Fig. 17.1), then declined from 1988 to 1994; with an average of 2 090 tons. With the restriction of fishing by other countries to areas outside Canada's 200-mile limit in 1992, non-Canadian landings fell to zero. Average catch was at its lowest in 1995-2001 (455 tons); then increased to approximately 6 700 tons in 2002 and 4 800 tons in 2003. Total catch decreased to 1 267 tons in 2004.

Catches of white hake in Subdiv. 3Ps were at their largest in 1985-93; with an average of 1 114 tons. Average catch then decreased to 436 tons in 1994-99. Subsequently, catches in Subdiv. 3Ps increased to an average of 1 036 tons in 2000-2004.

Canada commenced a directed fishery for white hake in 1988 in Div. 3NO and Subdiv. 3Ps. All Canadian landings prior to 1988 were as by-catch in various groundfish fisheries. EU-Spain and EU-Portugal commenced a directed fishery in 2002 in Div. 3NO in the NRA. There was no directed fishery by EU-Spain in 2004.

Recent nominal catches and TACs ('000 tons) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005-7
Div. 3NO:											
Recommended TAC	-	-	-	-	-	-	-	-	-	-	8.5
STATLANT 21A	0.3	0.3	0.4	0.3	0.4	0.6[1]	0.6[1]	5.4[1]	6.2[1]	1.9[1]	
STACFIS	0.2	0.5	0.6	0.2	0.4	0.6	0.6	6.7	4.8	1.3	
Subdiv. 3Ps:											
STATLANT 21A	0.4	0.4	0.3	0.6	0.6	1.1[1]	0.9[1]	0.9[1]	1.1[1]	1.1[1]	

[1] Provisional.

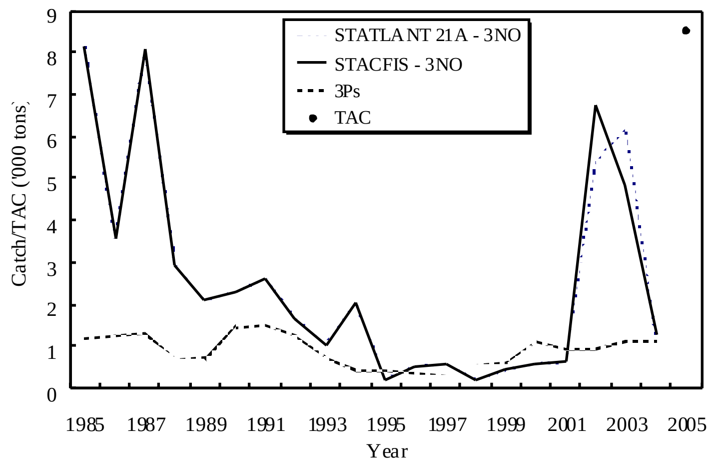


Fig. 17.1. White hake in NAFO Div. 3NO and Subdiv. 3Ps: total catches and TACs.

b) Input Data

i) Commercial fishery data

Length composition. Length frequencies are available for Canada (1994-2005 preliminary), EU-Spain (2002, 2004), EU-Portugal (2003-2004), and Russia (2000-2004). In the Canadian fishery in 2004, peak lengths caught by longlines in Div. 3O were 58-69 cm; by gillnets in Div. 3O and Subdiv. 3Ps were 68-78 cm; and preliminary 2005 trawl data from Subdiv. 3Ps indicated peak lengths of 67-77 cm.

ii) Research survey data

Canadian stratified-random bottom trawl surveys. Data from spring and autumn surveys in Div. 3N, 3O and Subdiv. 3Ps (the latter in spring only) were available from 1975 to 2004. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 2002, the depth range has been extended to at least 731 m in each survey; although white hake is recorded only occasionally at depths >700 m. Canadian spring and autumn surveys conducted prior to autumn 1995 used an Engel bottom trawl. There is no conversion of the data series to Campelen equivalents for white hake prior to 1995; which makes comparison of both survey series difficult.

Biomass and abundance trends were similar between Div. 3NO and Subdiv. 3Ps over the spring surveys time series for both Engel and Campelen years (Fig. 17.2). The biomass index (mean weight per tow) of Div. 3NOPs white hake from spring surveys using the Engel trawl peaked at approximately 9 000 tons in 1975-78 and at about 14 000 tons in 1986-88; undergoing substantial declines after each peak. The average index of spring biomass for 1992-95 was 23% of the biomass estimated for 1986-88. Following the second observed decline, the biomass index from spring surveys using the Campelen trawl increased rapidly from 1999-2000 to approximately 26 000 tons; but has sharply declined since then. However, the percentage of Div. 3NOPs biomass observed in Div. 3NO steadily increased since 1997 to an average of 60% in 1999-2004 (Fig. 17.3). Abundance indices of Div. 3NOPs white hake from spring surveys followed trends similar to those of Div. 3NOPs biomass indices (Fig. 17.2).

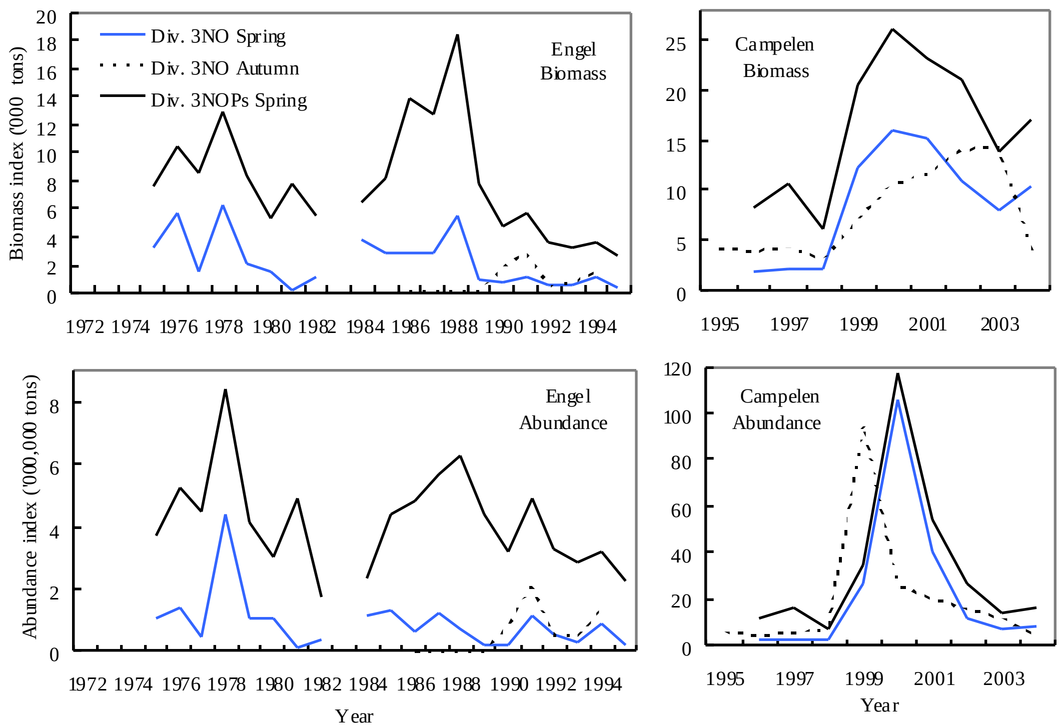


Fig. 17.2. White hake in Div. 3NO and Subdiv. 3Ps: biomass and abundance indices from Canadian spring and autumn surveys, 1972-2004. Both time series are unstandardized.

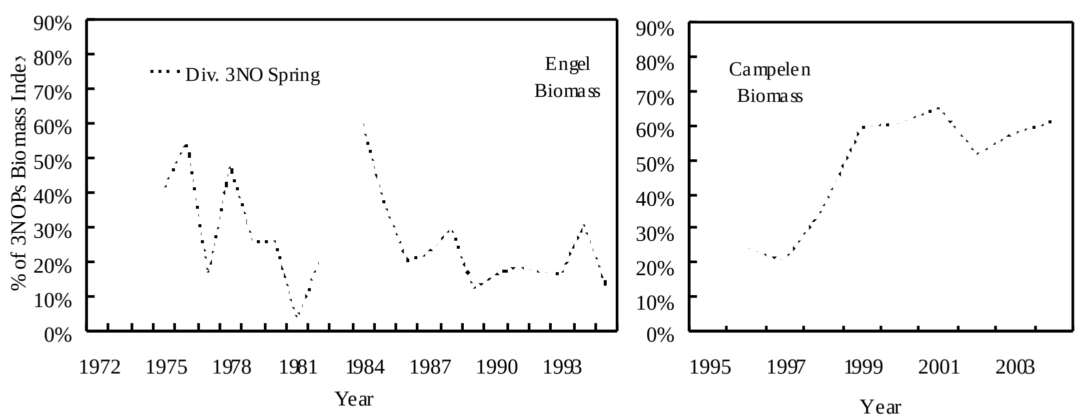


Fig. 17.3. White hake in Div. 3NO: percent of the Div. 3NOPs biomass index that is in Div. 3NO from Canadian spring surveys, 1972-2004.

From Canadian autumn surveys, the Engel biomass indices for white hake in Div. 3NO follow a similar trend to that observed in the Div. 3NOPs spring surveys at that time (Fig. 17.2). Campelen abundance indices in autumn indicate a similar trend: the large peak of 1999 occurs just prior to the large increase observed in the spring survey of 2000. This time shift of several months corresponds to the apparent growth of small one-year-old white hake in Div. 3O; which are caught by the Campelen trawl, but not by Engel gear. Similar to trends observed in the Engel series, both biomass and abundance indices in autumn sharply decline after the large peak.

Spanish stratified-random bottom trawl surveys in the NRA. Biomass indices in the NAFO Regulatory Area of Div. 3NO were available for white hake from 2001 to 2004. Spanish surveys were conducted with Campelen gear (identical to that used in Canadian surveys) in the spring to a depth of 1 400 m. Spanish biomass indices peaked in 2001, then declined to 2003; at which the index was one fifth of that in 2001 (Fig. 17.4). In 2004, a stable trend relative to 2003 was observed.

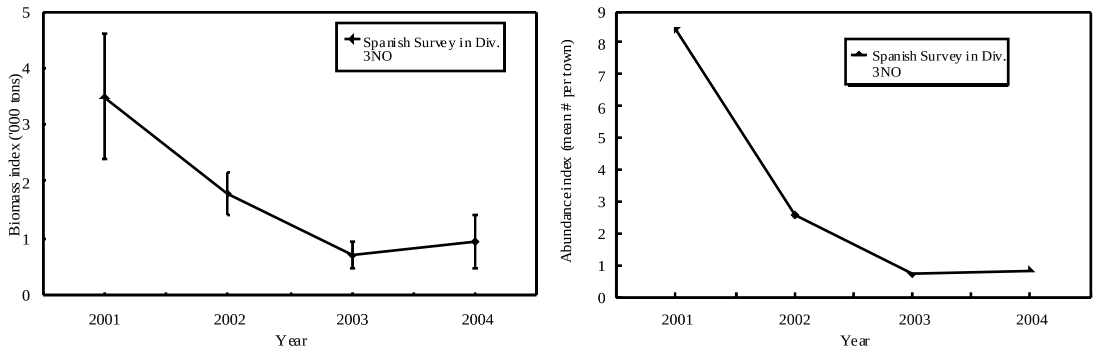


Fig. 17.4. White hake in the NRA of Div. 3NO: Biomass indices from Spanish Campelen spring surveys in 2001-2004. Error bars represent ± S.D.

Research surveys conducted in spring by both countries have tracked progression of the large 1999 year-class through 2001-2004 (Fig. 17.5). In 2001, a large number of white hakes with an average length of 34 cm were observed; this proportion decreased in subsequent years. Average length of the majority of fish in both surveys increased through this time period; with 43 cm in 2002, 48 cm in 2003, and 53 cm in 2004. In 2004, there was also a signal of small white hakes in Div. 3NO between 15 and 26 cm in both surveys.

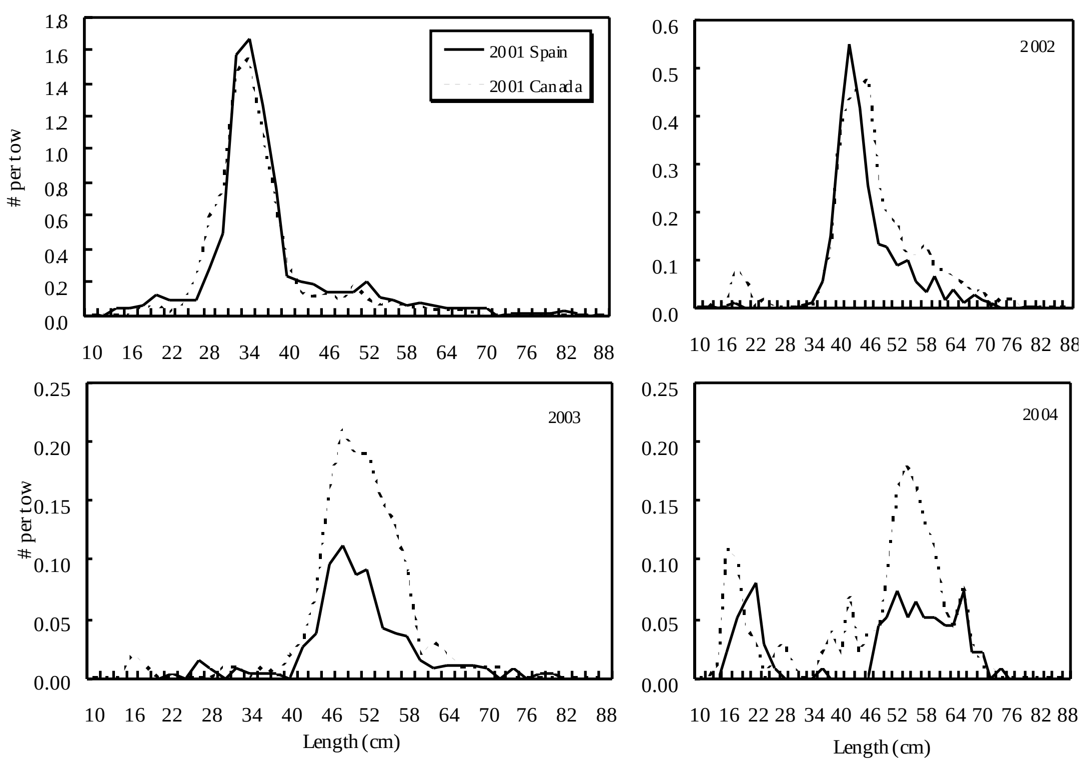


Fig. 17.5. White hake in Div. 3NO: Abundance at length from Canadian Campelen and Spanish Campelen spring surveys in 2001-2004. Number per tow was calculated using mean catches.

iii) **Biological studies**

Maturity. Maturity at size was estimated for each sex separately, using Canadian spring survey data from 1997-2004. Length (L_{50}) at 50% maturity is different between the sexes; with fifty percent of males maturing at 39 cm, and fifty percent of females maturing at 57 cm. However, L_{50} was very similar for each sex between Div. 3NO and Subdiv. 3Ps (Fig. 17.6).

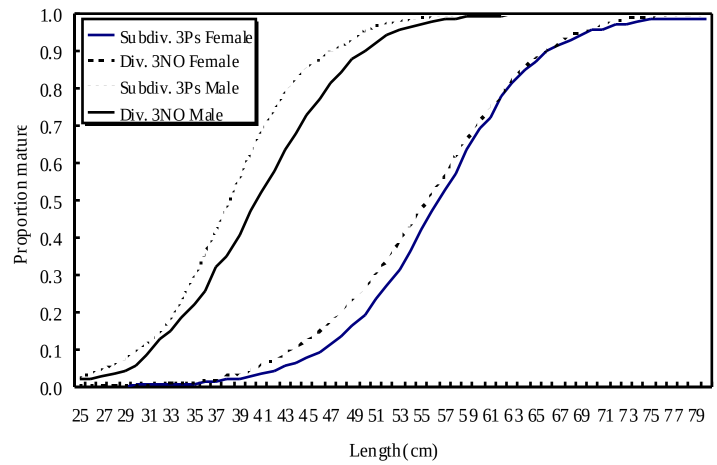


Fig. 17.6. White hake in Div. 3NO and Subdiv. 3Ps: ogives calculated for each sex from Canadian spring surveys and averaged over 1997-2004.

Life stages. Canadian spring survey trends in abundance for 1996-2004 were staged as 1-year-olds (YOY), 2+ juveniles (IMM), and mature adults (SSA) (Fig. 17.7). Recruitment was very high in 1999. Year-classes since then have been extremely low, as compared to the 1999 year-class.

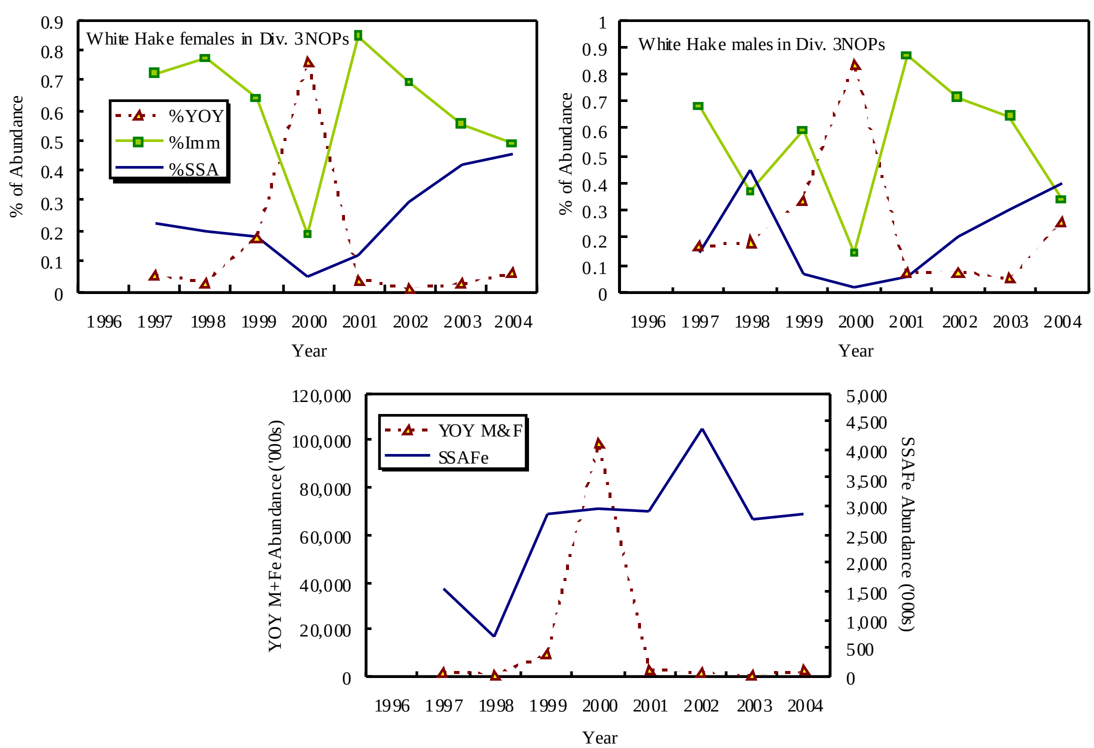


Fig. 17.7. White hake in Div. 3NO and Subdiv. 3Ps: staged trends in abundance by sex from Canadian Campelen spring survey data in 1996-2004.

Recruit per spawner varied between 0.4 and 35 fish for each adult female in 1997-2003 (Fig. 17.8). Two significant values were observed in this short time series: 13.5 fish in 1998 and 35 in 1999.

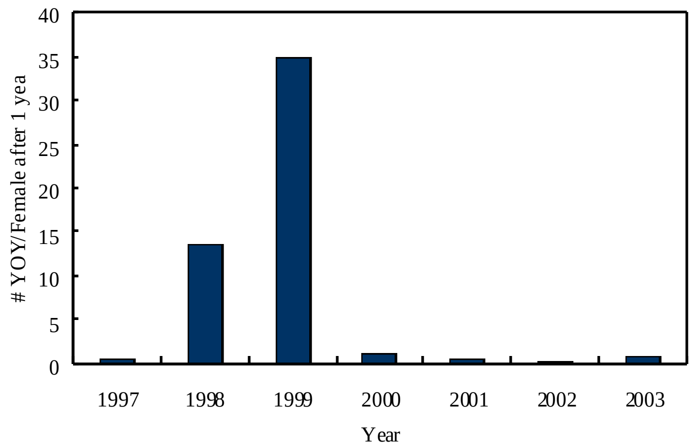


Fig. 17.8. White hake in Div. 3NO and Subdiv. 3Ps: recruit per spawner from Canadian Campelen spring surveys in 1997-2003.

Distribution. White hake in Div. 3NO and Subdiv. 3Ps are confined largely to an area associated with the warmest bottom temperatures (4-8°C) along the southwest fringe of the Grand Banks. Detailed maps on distribution by sex, season, temperature, and depth are presented in SCR Doc. 05/60.

In addition, white hake distributes at different locations during various parts of its life cycle. Fish <25 cm in length (= 1^{st} year) occur almost exclusively on the Grand Bank in shallow water (nursery ground). Juveniles (= 2+ years) are spread out, and a high proportion of white hake in the Laurentian Channel part of Subdiv. 3Ps are juveniles. Mature adults concentrate on the southwest slope of the Bank (spawning grounds) in both Subdiv. 3Ps and Div. 3NO.

c) **Assessment Results**

Biomass. The biomass of this stock increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has substantially decreased.

Recruitment. The 1999 year-class was large. Year-classes since then have been extremely low, as compared to the 1999 year-class.

Relative *F* index (= commercial catch/Canadian spring survey biomass). Using STACFIS agreed commercial catch and Canadian spring survey biomass index, estimates of relative *F* were calculated for white hake in Div. 3NO and Div. 3NOPs. Relative *F* fluctuated in the 1980s; then declined in the 1990s (Fig. 17.9). The index then increased in 2002-2003, and declined in 2004.

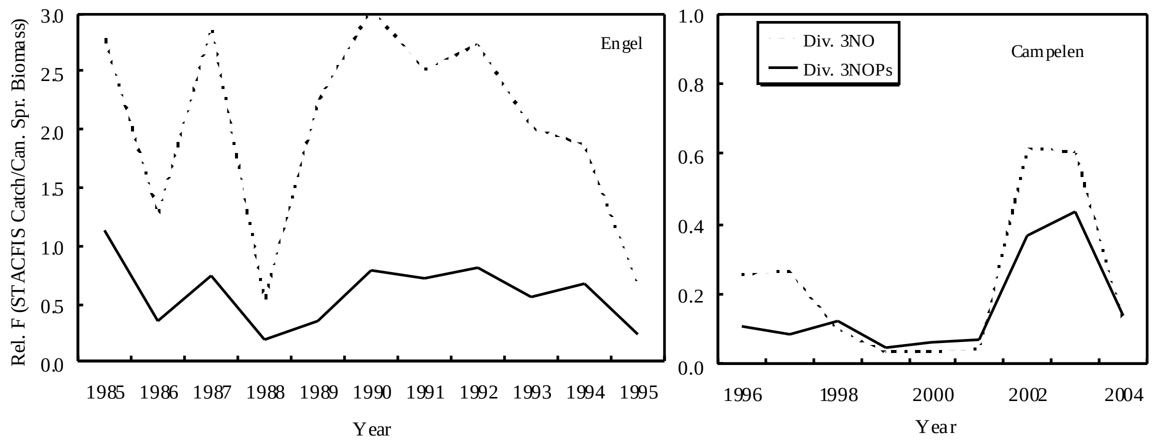


Fig. 17.9. White hake in Div. 3NO and Subdiv. 3Ps: estimates of relative *F* from STACFIS agreed commercial catches and Canadian spring surveys.

State of the stock. Following the dominance of 1999 fish in 2000, a progression of this year-class is observed through subsequent years; leading to increased catches in the white hake fishery in 2002-2003, when fish reached harvestable sizes. Overall, survey biomass indices were lower in 2004 relative to 2001.

d) **Reference Points**

Reference Points with respect to a Precautionary Approach for this species have not been determined.

e) **Research Recommendations**

STACFIS **recommended** that *the genetic analyses in 2003 of Div. 3NO versus Subdiv. 3Ps samples be continued; in order to help determine whether Div. 3NOPs white hakes comprise a single breeding population.*

STACFIS **recommended** that *the collection of information on commercial catches of white hake be continued; and now include sampling for age and sex.*

STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2005+); thereby allowing age-based analyses of this population.*

D. WIDELY DISTRIBUTED STOCKS: Subareas 2+3+4

Environmental Overview

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1º to 2°C and salinities of 32 to 33.5. Labrador Slope Water flows southward along the shelf edge and into the Flemish Pass region, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3° to 4°C and salinities in the range of 34 to 34.75. On average bottom temperatures remain <0°C over most of the northern Grand Banks but increase to 1° to 4°C in southern regions and along the slopes of the banks below 200 m. North of the Grand Bank, particularly in Div. 3K, bottom temperatures are generally warmer (1° to 3°C) except for the shallow inshore regions where they are mainly <0°C. In the deeper waters of the Flemish Pass and across the Flemish Cap bottom temperatures generally range from 3° to 4°C. Throughout most of the year the cold relatively fresh water overlying the shelf is separated from the warmer higher density water of the continental slope region by a strong temperature and density front. This winter-formed water mass is generally referred to as the cold intermediate layer (CIL) and is considered a robust index of ocean climate conditions. In general, shelf water masses undergo seasonal modification in its properties due to the seasonal cycles of air-sea heat flux, wind forced mixing and ice formation and melt leading to intense vertical and horizontal gradients particularly along the frontal boundaries separating the shelf and slope water masses. Temperature and salinity conditions over the Scotian Shelf are largely determined by advection of water from southern Newfoundland and the Gulf of St. Lawrence as well as offshore slope waters. In the northeast regions of the Scotian Shelf the bottom tends be covered by relatively cold waters (1° to 4°C) whereas the basins in the central and southwestern regions have bottom temperatures that typically are 8°-10°C.

Ocean temperatures on the Newfoundland and Labrador Shelf during 2004 remained above normal, reaching record highs in some areas thus continuing the warming trend experienced during the past several years. The cross-sectional area of <0°C (CIL) shelf water during the summer of 2004 decreased over 2003 values remaining below the long-term mean along all sections from Labrador to Southern Newfoundland. In some areas the CIL was below normal for the 10th consecutive year and off eastern Newfoundland it was the lowest (warmest) since 1965. Further south on the Scotian Shelf however, a broad area of cold-intermediate layer water mass was present during 2004. As a result ocean temperatures in this area were below normal (except for the deep basins) and in some areas they decreased to the lowest values since the cold period of the early 1990s. Upper layer salinities throughout the waters of eastern Canada increased to the highest observed in over a decade during 2002 and remained above normal in 2003 and 2004. The overall stratification, which may have important implication for marine production, was slightly below normal during 2004 from Newfoundland to the Scotian Shelf region. In the offshore areas of Subarea 4, the Shelf-Slope front and the Gulf Stream were about 20 km south of their mean positions during 2004.

18. **Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3** (SCR Doc. 98/28, 05/8, 28, 29, 34, 36, 46, 54; SCS Doc. 05/5, 6, 8, 12)

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. From 1993 to 1997 the level of the catches was around 4 000 tons. In 1998 it was reached the highest level of the catches observed (7 231 tons), since then, it has continued decreasing steadily up to 2004 (3 182 tons). Roughhead grenadier is taken as by-catch in the Greenland halibut fishery, mainly in Div. 3LMN Regulatory Area (Fig. 18.1).

The revised recent catches ('000 tons) are as follow:

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
STATLANT 21A	1.5	4.1	4.7	7.2	7.1	2.7[1]	1.6[1]	1.9[1]	1.5[1]	1.7[1]
STACFIS	4.0	4.1	4.7	7.4	7.2	4.8	3.1	3.7	4.2-3.8[2]	3.2

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.

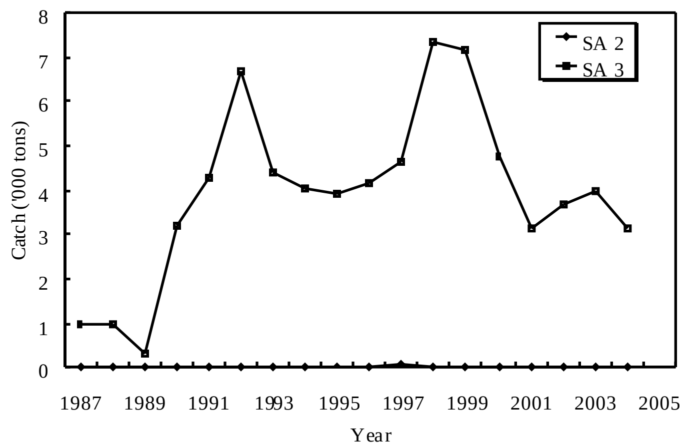


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

b) **Input Data**

i) **Commercial fishery data**

Length frequencies from the Spanish, Russian and Portuguese trawl catches in Div. 3LMNO are available since 1992 (SCS Doc. 05/5, 6, 8 and SCR Doc. 05/46). In the commercial fishery catches females attain larger lengths than males. Catch-at-age data from the total catches (applying annual age-length key (ALK) of Spanish commercial catches in 1999, 2000 and 2002-2004 and a combined ALK for the rest of the years) in Div. 3LMNO are available since 1992 (SCR Doc. 05/46). Most of catches are composed between ages 4 and 13, with a mode at age 8.

ii) **Research survey data**

Canadian autumn surveys. Stratified random bottom trawl surveys have been conducted, usually in October-November, in Div. 2J and 3KL since 1978. Div 2G and 2H have only been covered occasionally. Since 1990 the survey also covered Div. 3NO. Until 1995 an Engel trawl was used, changed since then to a Campelen 1800. Surveys depth is up to 1 500 m in Div. 2J and 3K and to 730 m in Div. 3LNO, extended to 1463 m after 1995. In 2004 operational difficulties lead to incomplete coverage of the survey in NAFO Divisions (SCR Doc. 05/8 and 05/34).

The estimates from 1995 onwards are not directly comparable with the previous time series because of the change in the survey gear. Taking into account the incomplete coverage of some strata in Div. 2GH and 3LMNO from 1995-2004, only the indices of Div. 2J and 3K are comparable from 1995 onwards. From 1995, the biomass of this survey in Div. 2J and 3K shows an increase trend, reaching its maximum in 2004 as shows Fig. 18.2.

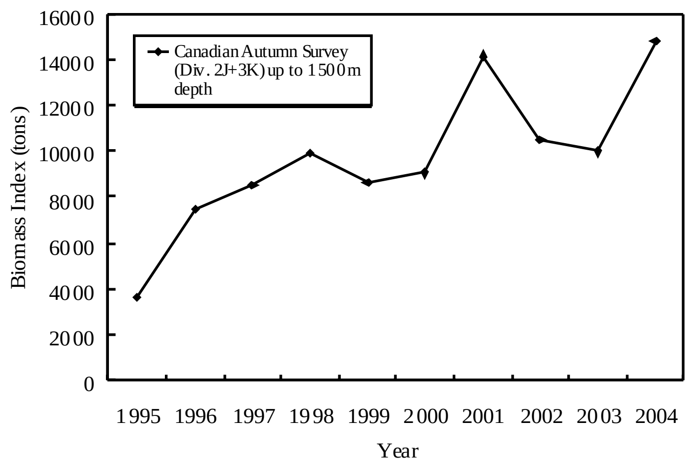


Fig. 18.2. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian autumn (Div. 2J+3K) survey.

Canadian spring surveys. Stratified random bottom trawl surveys have been conducted in Div. 3L, 3N and 3O in spring since 1978. Until 1996 an Engel trawl was used, changed to a Campelen 1800 since then. The depth range of the surveys is up to 731 m.

In this survey, a direct comparison of the biomass levels through the whole time series is not possible due to the change in the survey gear in 1995. Figure 18.3 shows the biomass of this survey since 1996. From 1998 the biomass level does not present a clear trend and is largely concentrated in Div. 3L. Biomass estimates from the spring survey series are considerably lower than the ones obtained in the autumn series, as the first surveys cover only the southern Divisions and the shallower depths, where according to the other results this species is less abundant.

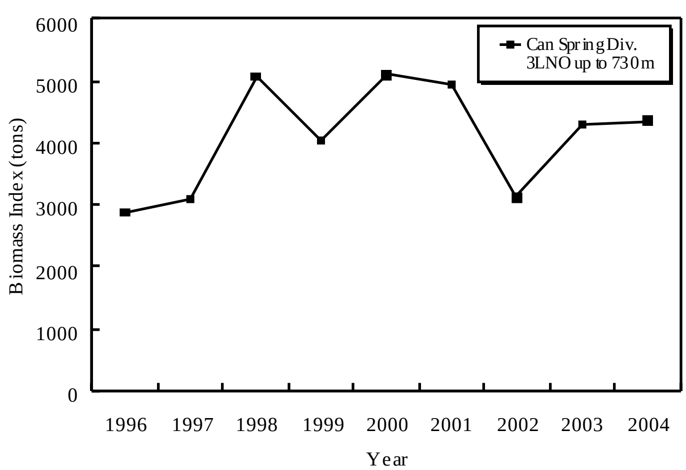


Fig. 18.3. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

Canadian deepwater surveys. Stratified deepwater bottom trawl surveys (750-1 500 m) in 1991, 1994 and in 1995 in Div. 3KLMN was carried out. The biomass estimates increased from 16 215 tons in 1991 to 46 668 tons in 1995. Most of the biomass was taken in Div. 3L and 3M, at depths beyond 1 000 m. However the increase could be related in part to the increased survey coverage.

EU (Spain and Portugal) Flemish Cap survey. EU conduct a stratified bottom trawl survey in Div. 3M since 1988, up to depths of 730. Since 1991, the survey was made with the R/V *Cornide de Saavedra*. In 2003 this vessel was replaced by the R/V *Vizconde de Eza*. The former series of *Cornide de Saavedra* was transformed to the new R/V *Vizconde de Eza* (SCR Doc. 05/29). The roughhead grenadier biomass index from this survey series (SCR Doc. 05/36) is presented in Fig. 18.4. A peak biomass of 3 021 was observed in 1993, but since then has been somewhat stable up to 2002, at between 1 000 and 2 000. From 2002 onwards the biomass showed an increasing trend, reaching the historical maximum of 3 597 tons in 2004 (Fig. 18.4).

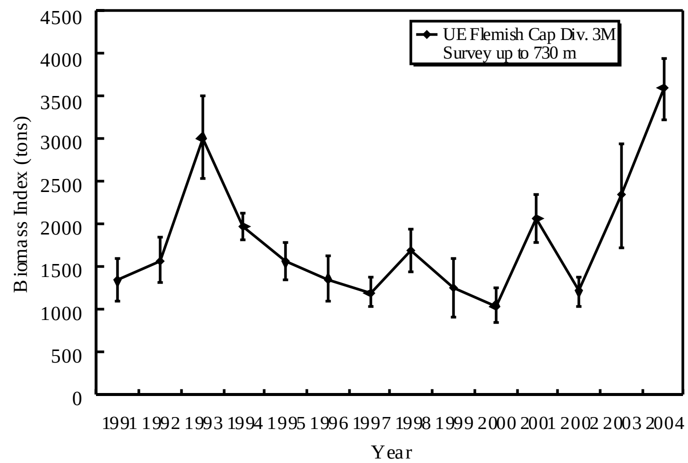


Fig. 18.4. Roughhead grenadier in Subareas 2+3: biomass indices (±SE) from the EU Flemish Cap (Div. M) survey.

EU (Spain) Div. 3NO survey. EU-Spain conduct a stratified random spring bottom trawl survey in the NAFO Regulatory Area Div. 3NO since 1995. In 2001 the vessel and the trawl gear were replaced. The transformed entire series of mean catches, biomass, length and age distributions for roughhead grenadier were presented in SCR Doc. 05/28 and SCR Doc. 05/46. From 1997 to 2002 the biomass indices of this survey did not show a clear trend, however, since then the biomass increase and in 2004 reached the historical maximum (11 402 tons) (Fig. 18.5).

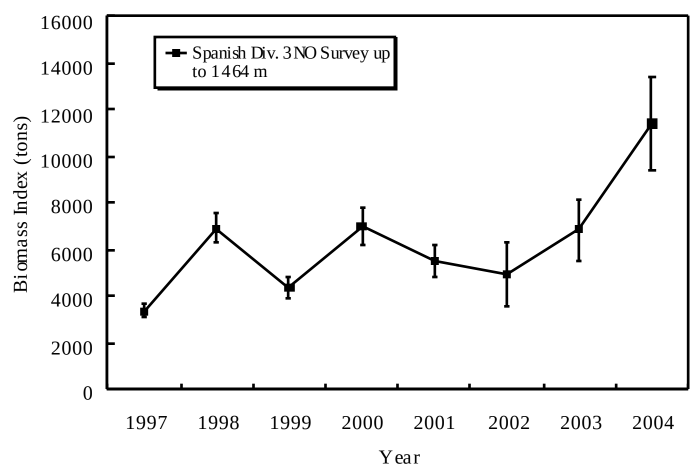


Fig. 18.5. Roughhead grenadier in Subareas 2+3: biomass indices (± SE) from the Spanish survey in Div. 3NO.

iii) **Recruitment**

Figure 16.6 presents the abundance series for age 3 of the EU Flemish Cap survey and Spanish survey in Div. 3NO from 1994 to 2004, where a strong upcoming 2001 year-class can be clearly seen in 2004 during last two years in both surveys.

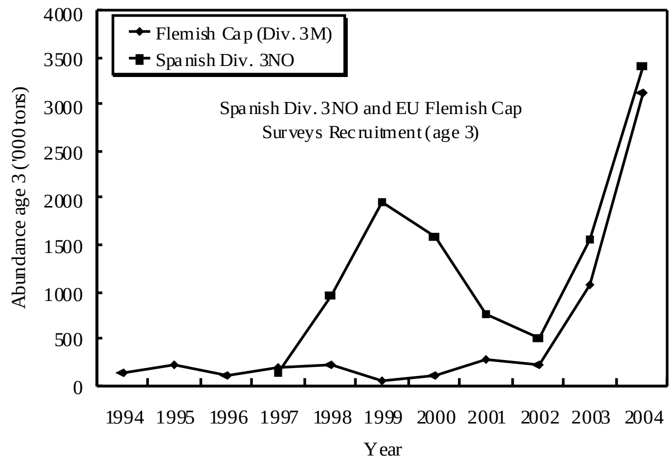


Fig. 18.6. Roughhead grenadier in Subareas 2+3: Spanish survey in Div. 3NO and EU Flemish Cap survey abundance age 3.

iii) **Biological studies**

SCR Doc. 05/36 provides information on age and length structure in Div. 3M based on results from the EU-summer survey series. Age and length composition of the catches show clear differences between sexes. The proportion of males in the catches decrease progressively, as length increases and there are sexual differences in growth. Male growth rates declines when reaching a pre-anal fin length of 18 cm, around 9 years old, while female growth rate does not slow until reaching 34-35 cm, around 20 years old.

c) **Assessment Results**

The Z estimate from the catch curve based upon commercial catch at age data (1992-2004) was 0.36 for ages 8 to 20 compared to 0.39 in the 2003 assessment of this stock. The value estimate from the catch curve of the EU Flemish Cap survey (1994-2004) was 0.511 for the same ages and 0.394 for the catch curve of the Spanish survey in Div. 3NO data (1997-2004). However, the value based on Flemish Cap survey is likely to be an overestimate since this survey covers only the shallowest distribution of the resource.

The catch/biomass (C/B) indices obtained using the Canadian autumn survey and the Spanish Div. 3NO survey biomass index in the period 1995-2004 show a clear decrease trend from 1995 to 2004, due to an increasing trend in the survey biomass and a decreased of catches (Fig. 18.7). The recruitment at age 3 from surveys in 2004 is one of the best in the survey series and it is expected that this good year-class will be incorporated to the fishable biomass in the next years.

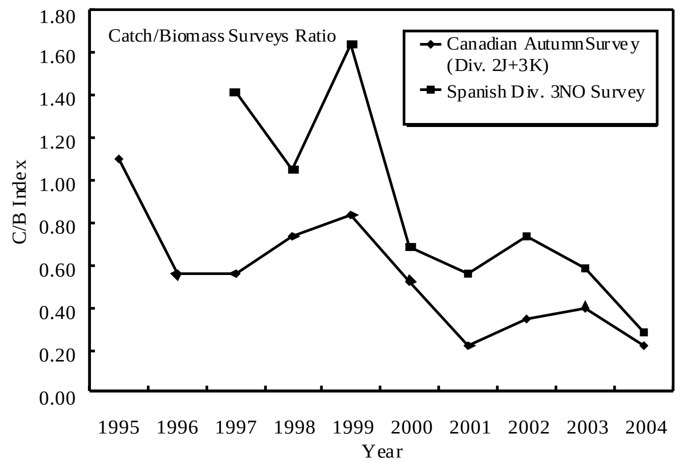


Fig. 18.7. Roughhead grenadier in Subareas 2+3: catch/biomass index based upon Canadian autumn survey and Spanish survey in Div. 3NO.

d) **Reference Points**

STACFIS is not in the position to provide references points at this time.

19. **Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 2J, 3K and 3L** (SCR Doc. 05/53; SCS Doc. 05/5, 6, 8, 12)

a) **Catches**

The fishery for witch flounder in this area began in the early 1960s and increased steadily from about 1 000 tons in 1963 to a peak of over 24 000 tons in 1973 (Fig. 19.1). Catches declined rapidly to 2 800 tons by 1980 and subsequently fluctuated between 3 000 and 4 500 tons to 1991. The catch in 1992 declined to about 2 700 tons, the lowest since 1964; and further declined to around 400 tons by 1993. Until the late 1980s, the fishery was conducted by Poland, USSR and Canada mainly in Div. 3K. Since then, the regulated fishery had been mainly Canadian although EU (Portugal and Spain) has taken increased catches in the Regulatory Area of Div. 3L since the mid-1980s. Although a moratorium on directed fishing was implemented in 1995, the catches in 1995 and 1996 were estimated to be about 780 and 1 370 tons, respectively. However, it is believed that these catches could be overestimated by 15-20% because of misreported Greenland halibut. The catches in 1997 and 1998 were estimated to be about 850 and 1 100 tons, respectively, most of which was reported from the Regulatory Area of Div. 3L. From 1999 to 2003 catches were estimated to be between 300 and 800 tons, and in 2004 catch was estimated at about 830 tons.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	1.4	0.9	0.4	0.4	0.5[1]	0.6[1]	0.7[1]	0.5[1]	0.3[1]	
STACFIS	1.4	0.8	1.1	0.3	0.7	0.8	0.4	0.7	0.8	

[1] Provisional.
ndf no directed fishing.

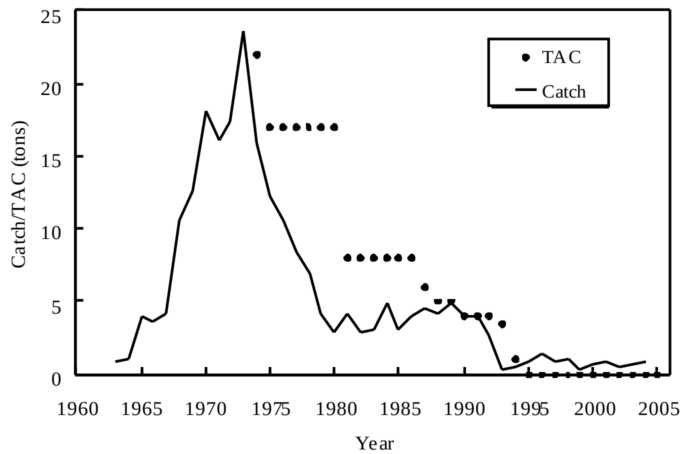


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) **Input Data**

ii) **Research survey data**

Mean weight (kg) per tow. Research vessel surveys have been conducted in autumn by Canada since 1978 in Div. 2J and 3K and since 1984 in Div. 3L. Mean weights (kg) per tow for witch flounder in Div. 2J+3KL were estimated from the Canadian autumn surveys. For Div. 2J, mean weights (kg) per tow ranged from as high as 1.82 kg per tow in 1986 to a low of 0.05 kg per tow in 2003 and increased slightly in 2004 to 0.14 kg per tow (Fig. 19.2). In Div. 3K, during 1979-85, there was a period of relative stability where most survey sets averaged 7-13 kg. Since that time estimates have declined considerably to less than 0.09 kg per tow in 1995. Values increased slightly after 1995 ranging from 0.17 to 0.28 kg per tow between 1996-2001, but declined in 2002 to 0.09 kg per tow, the lowest value in the series and remained low at 0.13 kg per tow in 2003. In 2004 the estimate increased slightly to 0.52 kg per tow. For Div. 3L, mean weights per tow varied generally between 2.5 and 1.31 kg per tow from 1984 to 1990 but declined rapidly since then to a low of 0.08 kg per tow in 1995. Values have remained low since then, and in 2004 are estimated to be 0.10 kg per tow.

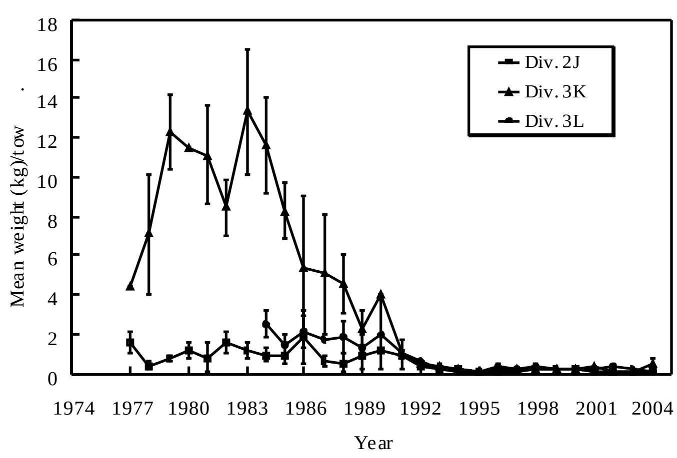


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow from Canadian autumn surveys.

Distribution. Survey distribution data from the late 1970s and early 1980s indicated that witch flounder were widely distributed throughout the shelf area in deeper channels around the fishing banks primarily in Div. 3K. By the mid-1980s, however, they were rapidly disappearing and by the early 1990s had virtually disappeared from the area entirely except for some very small catches along the slope and more to the southern area. They now appear to be located only along the deep continental slope area, especially in Div. 3L both inside and outside the Canadian 200-mile fishery zone (Fig. 19.3).

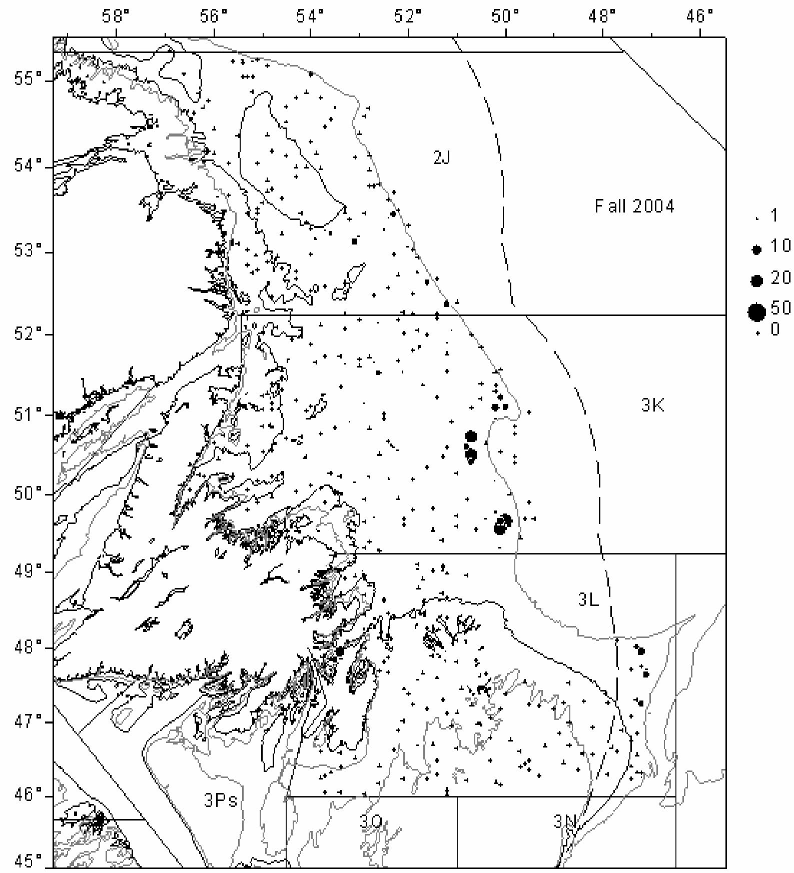


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per set from Canadian surveys during autumn 2004.

c) Assessment Results

Exploratory investigations using ASPIC to model the catch and biomass indices for this stock indicate poor model fit.

Based on the most recent data, STACFIS considers that the overall stock remains at a very low level.

d) Reference Points

In the absence of an analytical assessment for this stock, B_{lim} was calculated as 15% of the highest observed biomass estimate (B_{lim} = 9 800 tons; Fig. 19.4). Since the highest observed biomass estimates are in the early part of the time series when the survey did not cover the entire stock area, B_{lim} may be underestimated using this method. Nevertheless, the stock has been below this limit reference point since 1992.

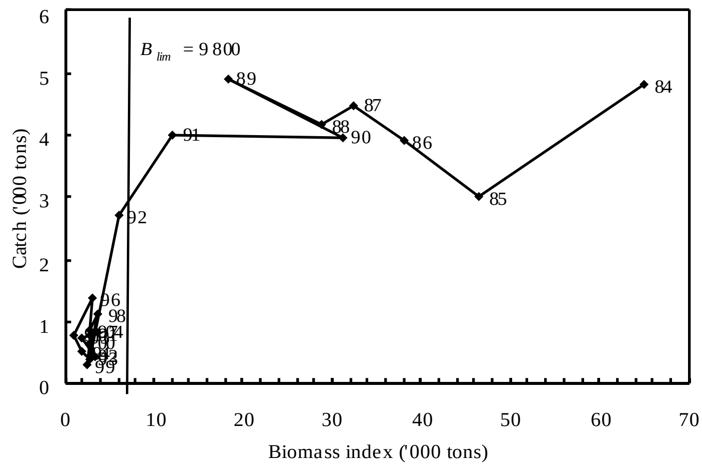


Fig. 19.4. Witch flounder in Div. 2J, 3K and 3L: Catch ('000 tons) and biomass index (‘000 tons) from Canadian autumn surveys.

20. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO** (SCR Doc. 05/8, 10, 27, 29, 34, 35, 37, 43, 62, 63, 64, 65; SCS Doc. 05/5, 6, 8, 12)

a) **Introduction**

Catches increased from low levels in the early 1960s to over 36 000 tons in 1969, and ranged from less than 20 000 tons to 39 000 tons until 1990 (Fig. 20.1). In 1990, an extensive fishery developed in the deep water (to at least 1 500 m) in the NAFO Regulatory Area (NRA), around the boundary of Div. 3L and 3M and by 1991 extended into Div. 3N. The total catch estimated by STACFIS for 1990-94 was in the range of 47 000 to 63 000 tons annually, although estimates in some years were as high as 75 000 tons. Beginning in 1995, TACs for the resource were established by the Fisheries Commission, and the catch declined to just over 15 000 tons in 1995, a reduction of about 75% compared to the average annual catch of the previous 5 years. The catch from 1996-98 was around 20 000 tons per year. Subsequently catches increased and by 2001 had reached 38 000 tons before declining to 34 000 tons in 2002. The total catch for 2003 was believed to be within the range of 32 000 tons to 38 500 tons; for assessment purposes, STACFIS used a catch of 35 000 tons. The 2004 catch was estimated to be 25 500 tons.

Prior to the 1990s Canada was the main participant in the fishery followed by USSR/Russia, Denmark (Faroe Islands), Poland and EU-Germany (GDR before 1989) fishing primarily in Subarea 2 and Div. 3K. Since then the major participants in the fishery are EU-Spain, Canada, EU-Portugal, Russia and Japan. All except Canada fish the NRA mainly in Div. 3LM and to a lesser degree in Div. 3NO.

In 2003, Scientific Council noted that the outlook for this stock was considerably more pessimistic than in recent years, and that catches were generally increasing despite declines in all survey indices. At its 2003 annual meeting the Fisheries Commission implemented a fifteen year rebuilding plan for this stock (FC Doc. 03/13). It established TACs of 20 000, 19 000, 18 500 and 16 000 tons, respectively, for the years 2004 to 2007. Subsequent TAC levels shall not be set at levels beyond 15% less or greater than the TAC of the preceding year until the Fisheries Commission rebuilding target of 140 000 tons of age 5+ biomass has been achieved. The estimated catch for 2004 exceeds the rebuilding plan TAC (20 000 tons) by 27%.

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC	27	27	27	33	35	40	44	42	20[3]	19[3]
STATLANT 21A	19	20	20	23	32[1]	29[1]	29[1]	27[1]	16[1]	
STACFIS	19	20	20	24	34	38	34	32-38[2]	25	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
[3] Fisheries Commission rebuilding plan (FC Doc. 03/13).

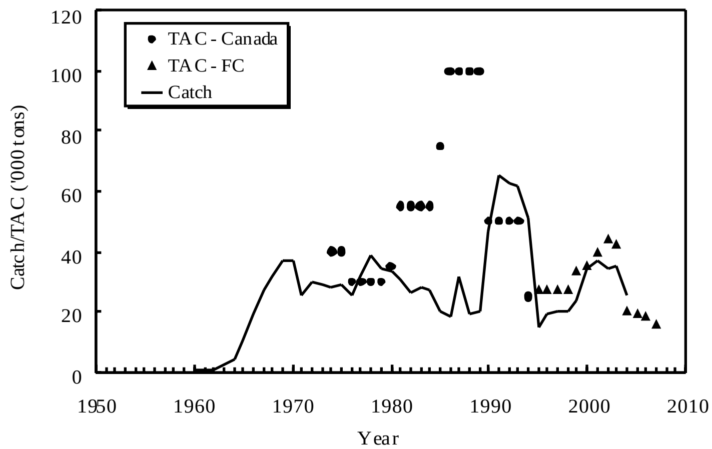


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch and effort. Analyses of otter trawl catch rates from Canadian vessels operating inside of the Canadian 200-mile limit (Fig. 20.2), using hours fished as the measure of effort, indicated a declining trend since about the mid-1980s, stabilizing at a low level during the mid-1990s. The standardized catch rate increased from 1997-2001 then declined over 2002-2004 to the low levels of the mid-1990s (SCR Doc. 05/62).

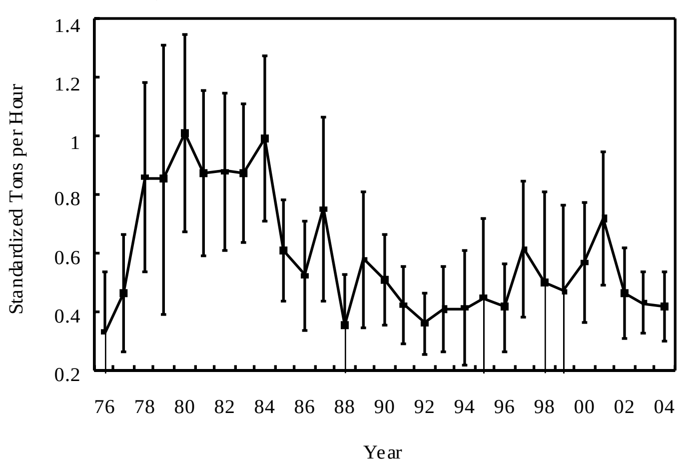


Fig. 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) based on hours fished from the Canadian fishery in Div. 2HJ+3KL.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN from 1988-2004 (Fig. 20.3) declined sharply from 1988 to 1991, and remained around this low level until 1994 (SCS Doc. 05/6). CPUE gradually increased until 1999-2000 when it was almost double the low values in 1991-94, but still below the CPUE in 1988-90. The CPUE declined in 2001 and remained at this level since that time. CPUE declined substantially between 2003 and 2004, currently estimated to be amongst the lowest in the time series.

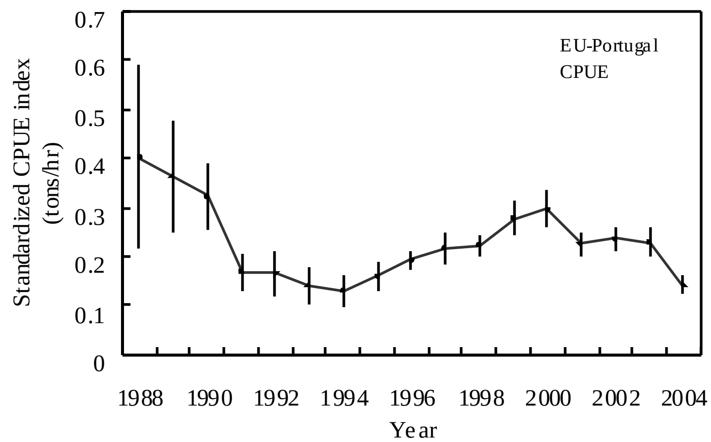


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) from the EU-Portugal trawlers with scientific observers in Div. 3LMN.

Information was not available to STACFIS on the distribution of fishing effort from all fleets.

Catch-at-age and mean weights-at-age. The methods used for constructing the catch-at-age and mean weights-at-age (kg) from 1975-2000 fisheries are described in detail in SCR Doc. 00/24.

The catch-at-age data from the Canadian fisheries since 2000 are documented in SCR Doc. 02/39, 03/36, 04/33, and 05/62. Length samples for the 2004 fishery were provided by EU-Spain (SCS Doc. 05/8), EU-Portugal (SCS Doc. 05/6), Russia (SCS Doc. 05/5) and Canada (SCR Doc. 05/62). Aging information was provided by EU-Spain (SCS Doc. 05/8), Russia (SCS Doc. 05/5), and Canada (SCR Doc. 05/62). Due to aging inconsistencies (Alpoim *et al.*, MS 2002; NAFO, 2003; see also SCR Doc. 05/43), a Canadian age-length key was used to calculate catch-at-age for all catches in 2004 as in previous assessments.

Ages 6-8 dominated the catch throughout the entire time period; with ages 12+ contributing less than 15% on average to the annual catch biomass. Mean weights-at-age exhibit variable patterns in the earliest period likely due to poor sampling. Mean weights-at-age for age groups 5-9 during the recent period were relatively stable. For older fish they were variable and show a declining trend since 1998 (SCR Doc. 05/63).

ii) **Research survey data**

A single survey series which covers the entire stock area is not available. A subset of standardized (depth and area) stratified random survey indices have been used to monitor trends in resource status. STACFIS noted that the Canadian autumn multi-species survey was not completed in Div. 3LMNO in 2004 (SCR Doc. 05/8, 34).

Canadian stratified-random autumn surveys in Div. 2J and 3K (SCR Doc. 05/64)

For Div. 2J+3K combined, the biomass index (Fig. 20.4; mean weight (kg) per tow) declined from relatively high estimates of the early 1980s to reach an all time low in 1992. Over the next several years it increased to a peak in 1999 approaching the levels recorded in the early 1980s. Since then, however, it declined substantially to 2002 but seems to have increased slightly over 2002 to 2004. Mean numbers per tow were stable through the 1980s, but increased substantially in the mid-1990s, due to the presence of the 1993-95 year-classes. After this, abundance declined to the late 1990s and has been relatively stable since.

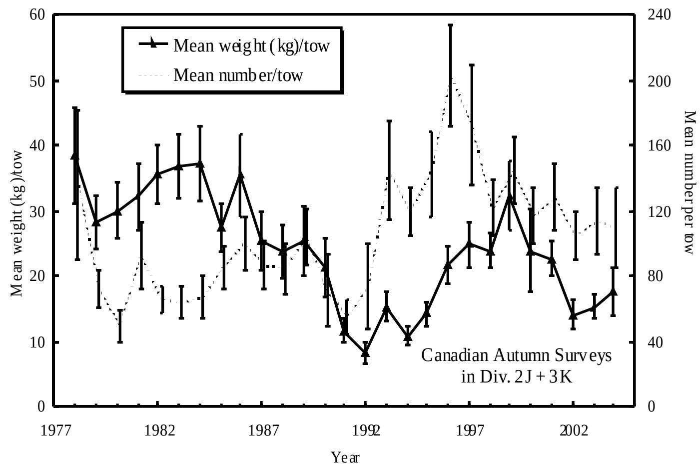


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

Mean weight-per-tow in Div. 2J and 3K combined of fish greater than 30 cm (minimum size limit in commercial fishery) was lowest in 1992; remained the same until 1995 after which it increased steadily until 1999 when it approached levels of the late-1980s (SCR Doc. 05/64) (Fig. 20.5). The index has declined from 1999 to 2002, and has increased to some extent in the past two years. During the late 1970s and early 1980s large Greenland halibut (greater than 70 cm) contributed almost 20% to the estimated biomass. However, after 1984 this size category declined and by 1988 virtually no Greenland halibut in this size range contributed to the index (Fig. 20.5). Since then, the contribution to the index from this size group been extremely low, often zero (SCR Doc. 05/64).

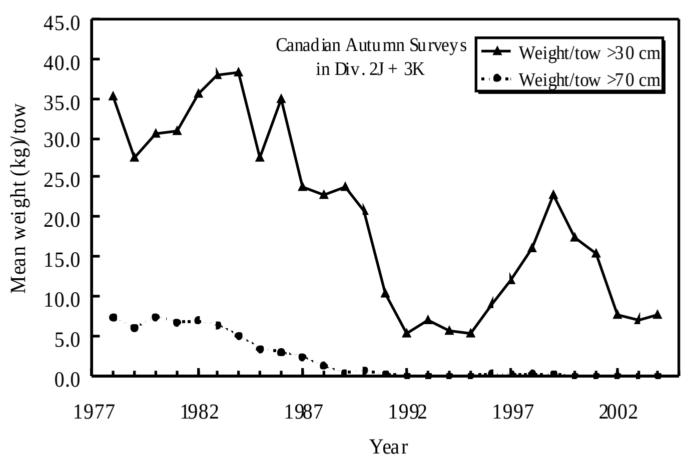


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass indices (mean weight (kg) per tow) for fish >30 cm and >70 cm from Canadian autumn surveys in Div. 2J and 3K.

STACFIS previously noted (NAFO, 1993) an apparent redistribution of the resource in the early 1990s. Thus, the declining trend in the Canadian autumn surveys in Div. 2J and 3K from the mid-

1980s to the early 1990s may be more a reflection of Greenland halibut emigrating from the survey area to the deep waters of the Flemish Pass as opposed to a severe decline in the stock. Here they have been exploited by what has become the main component of the commercial fishery. Since the mid-1990s, survey indices both in the Regulatory Area and in Div. 2J and 3K show similar trends suggesting that emigration does not appear to be a significant contributing factor to the overall trends in the indices since then. Given these observations, STACFIS concluded that it is inappropriate to use the Canadian autumn Div. 2J and 3K survey index prior to the mid-1990s as a calibration index in a VPA based assessment.

Canadian stratified-random surveys in Div. 3LNO and 3M (SCR Doc. 05/64)

The biomass index (mean weight (kg) per tow) from the Canadian spring surveys in Div. 3LNO using the Campelen trawl increased from 1996 to 1998. Since 1998, the index has declined to low levels from 2001 to 2004 (Fig. 20.6). Canadian autumn surveys in Div. 3M indicated a decline from 1998 to 2002, which is the lowest value in the series (Fig. 20.7). The 2003 value increased to about the 2001 level. Div. 3M was not surveyed in the autumn of 2004 (SCR Doc. 05/8).

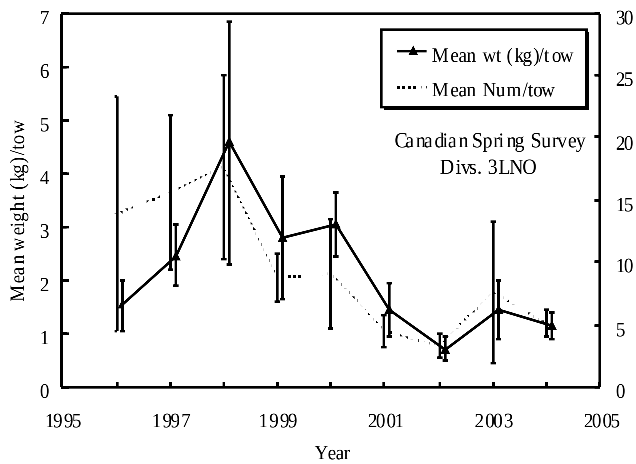


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

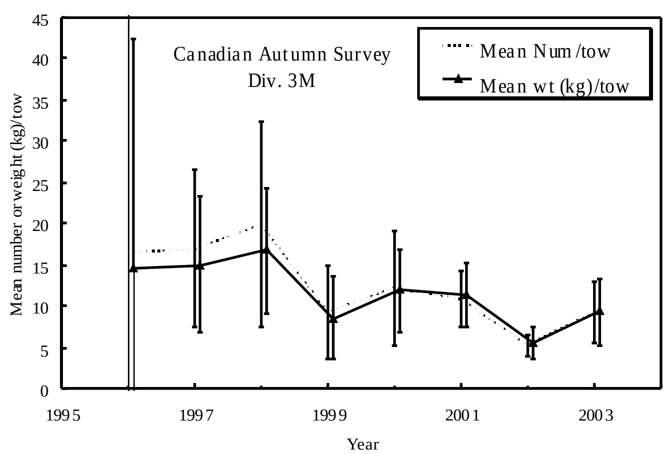


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 3M.

EU stratified-random surveys in Div. 3M (SCR Doc. 05/29, 35)

The EU 3M surveys were revised to account for a vessel change in the time series (SCR Doc. 05/29). Results indicated that the Greenland halibut biomass index (mean weight (kg) per tow) on Flemish Cap in July in depths to 730 m, increased in the 1988 to 1998 period (Fig. 20.8) to a maximum value in 1998. The biomass index has consistently declined over 1998-2003. In 2004 the index increased to a level consistent with the level measured in 2002.

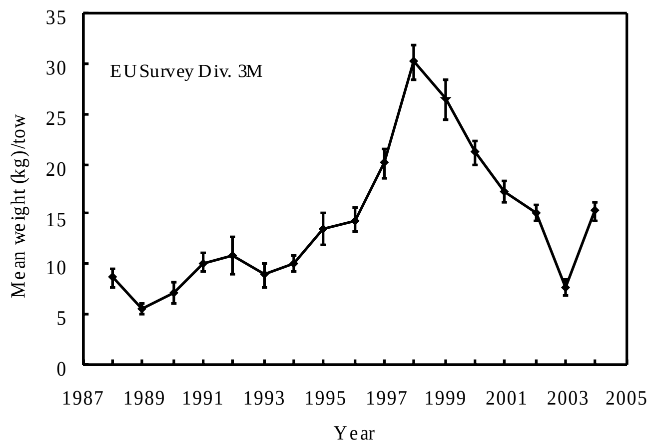


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (mean catch per tow ±1 S.E.) from EU summer surveys in Div. 3M.

EU-Spain stratified-random surveys in Div. 3NO Regulatory Area (SCR Doc. 05/27)

The biomass index (mean weight (kg) per tow; converted to Campelen trawl equivalents) for this survey of the NRA increased from 1996 to 1998, but declined since then through 2002, the lowest in the time series (Fig. 20.9). The 2003 index increased relative to the 2002 value, but declined again in 2004.

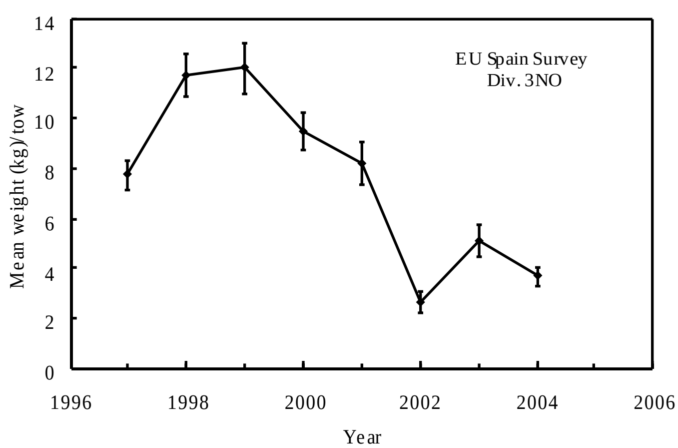


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (± SE) from EU-Spain spring surveys in Div. 3NO.

Summary of research survey data trends

In the recent time period, indices from the majority of the surveys provide a consistent signal as to the dynamics of the stock biomass. Following an increase from 1996 to 1998, they have decreasing trends and are currently at or below 1996 levels. The surveys provide coverage of the majority of the spatial distribution of the stock and the area from which the catches are taken. Few fish above 70 cm were caught in any of the surveys.

iii) **Recruitment indices**

A mixed log-linear model was applied to provide an index of year-class strength from several research vessel survey series (SCR Doc. 05/65). Four independent data series were used as follows: EU 3M (1991-2004), Canadian autumn Div. 2J+3K (1978-2004), Canadian autumn Div. 3L (1995-2003), and Canadian spring Div. 3LNO (1996-2004). All Canadian data were from surveys using Campelen survey gear or converted to Campelen equivalents.

In the current assessment (SCR Doc. 05/65) survey estimates for ages 3-5 were used in the analysis. Estimates of these ages were considered to better indicate year-class strengths as they appeared in the fishery in subsequent years.

Model results showed that for year-classes prior to 1990 only the year-classes of the mid-1980s were above the long term average (Fig. 20.10). The 1993-95 year-classes were estimated to be well above average (about twice the strength of those of the mid-1980s) despite wide confidence intervals. The 1996-2000 year-classes are all below the long term geometric mean; the estimate for 2001 (based only upon age 3 data from 2004 surveys) is slightly above average, although estimated with poor precision.

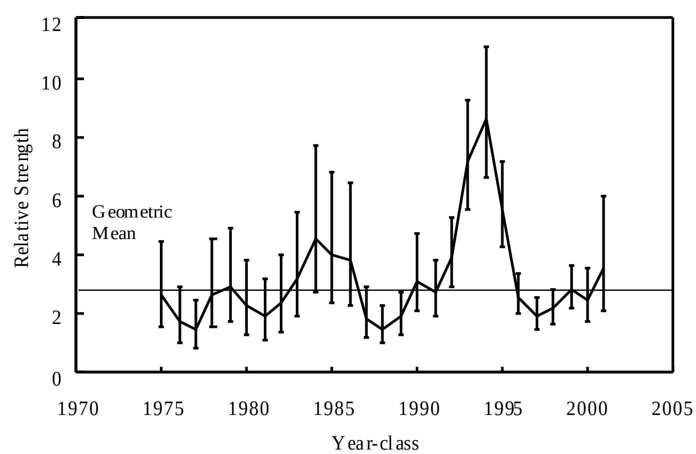


Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: recruitment index from four research vessel survey series.

c) **Estimation of Parameters**

At the June 2005 Meeting STACFIS reviewed several alternate XSA (SCR Doc. 05/63; Shepherd 1999; Darby and Flatman, MS 1994) formulations. In addition to the XSA analyses, several formulations of the ADAPTive framework (Gavaris, MS 1988) were explored. STACFIS noted that these results were generally consistent with those from the XSA, and that provision of advice is based upon the results of the XSA analyses.

STACFIS reviewed the diagnostics from a fit of the 2004 XSA formulation to the 2005 catch at age and survey data sets. STACFIS concluded that the XSA formulation used in 2004 was still appropriate for fitting the model to the data and therefore retained the 2004 formulation. The previously included Canadian autumn data from 1995 was excluded based upon diagnostic analyses (see SCR Doc. 05/37, 63). In addition, due to the noted problems with the 2004 Canadian autumn survey in Div. 3LMNO, the Canadian autumn Div. 2J+3KL index used in previous assessments was replaced with the Canadian Div. 2J+3K index. Sensitivity analysis to the change in tuning indices conducted on the accepted 2004 XSA run (SCR Doc. 04/55, 63) indicated that differences were minimal and that the resulting advice would remain unchanged. The XSA model specifications are given below:

Catch data from 1975 to 2004, ages 1 to 14+

Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1995	2004	1	12
Canadian autumn survey (Div. 2J+3K)	1996	2004	1	13
Canadian spring survey (Div. 3LNO)	1996	2004	1	8

Natural Mortality is assumed 0.2 for all years, ages.
Tapered time weighting not applied
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 11
Terminal year survivor estimates shrunk towards the mean F of the final 5 years
Oldest age survivor estimates shrunk towards the mean F of ages 10-12
S.E. of the mean to which the estimates are shrunk = .500
Minimum standard error for population estimates from each cohort age = .500
Individual fleet weighting not applied

d) **Assessment Results**

Biomass (Fig. 20.11): The fishable biomass (age 5+) declined to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. However, increasingly higher catches and fishing mortality since then accompanied by poorer recruitment has caused it to decline again, and the 2004 and 2005 estimates are the lowest in the series. Estimates of 2005 survivors from the XSA are used to compute 2005 biomass by assuming the 2005 stock weights are equal the 2002-2004 average. The 2005 5+ biomass is estimated to be 57 000 tons.

Fishing Mortality (Fig. 20.12): High catches in 1991-94 resulted in $F_{5\text{-}10}$ exceeding 0.50. $F_{5\text{-}10}$ then dropped to about 0.20 in 1995 with the substantial reduction in catch. $F_{5\text{-}10}$ has been increasing in recent years with increased catch. The 2003 and 2004 estimates are substantially higher, and despite the reduction in catch levels from 2003 to 2004; $F_{5\text{-}10}$ in 2004 is estimated to be 0.71.

Recruitment (Fig. 20.13): The above average 1993-95 year-classes have comprised most of the fishery in the recent past although their overall contribution to the stock was less than previously expected. The most recent year-classes are estimated to be below average strength. The result confirms the low abundance of the recruitment (1997-2001 year-classes) about to enter the exploitable biomass as estimated in the previous assessment (SCR Doc. 04/55).

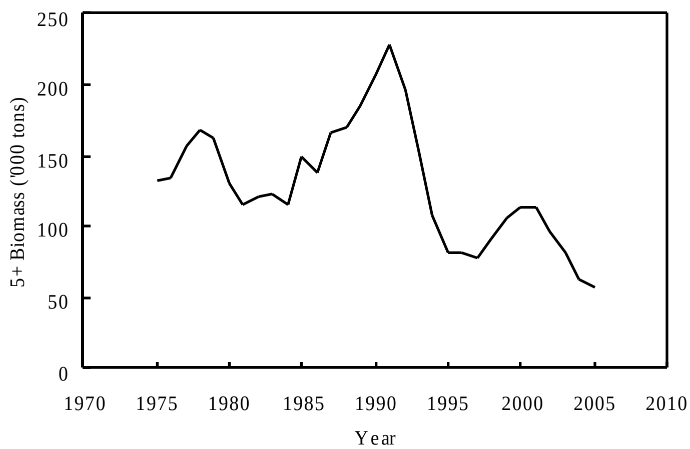


Fig. 20.11. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated 5+ biomass from XSA analysis.

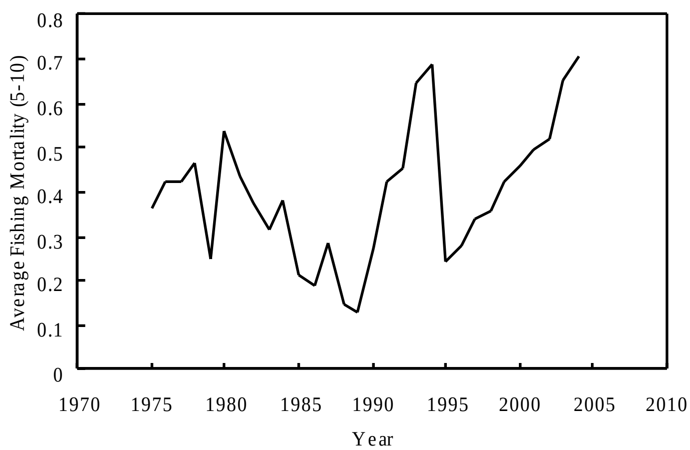


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated fishing mortality (5-10) from XSA analysis.

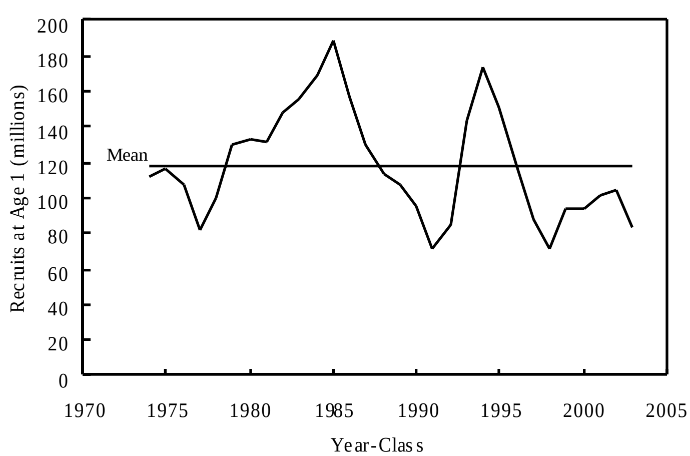


Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA analysis.

e) **Retrospective Analysis**

A retrospective analysis of the XSA was conducted. Fig. 20.14-20.16 present the age 1 recruitment, 5+ biomass and average fishing mortality at ages 5-10. The analysis indicates that aged based assessment models have difficulty in estimating of the abundance of the 1993-95 year-classes. The year-classes were initially estimated, using survey information at younger ages, to be the strongest in the time series. The year-classes have not contributed to the catch at age data or survey indices at older ages in the same proportions and their estimated abundance has been revised downwards with each subsequent assessment. The reasons for the change in relative abundance are unknown but could result from higher natural mortality or discarding, etc. The current assessment has estimated the 1998-99 year-classes to be more abundant than in previous assessments but they are still estimated to be amongst the lowest in the recorded time series. These year-classes are about to enter the exploitable biomass.

The influence of the downwards revision of the 1993-95 year-classes on the estimates of the 5+ biomass is seen in Fig. 20.15. The recent trend in biomass has been substantially revised downwards, yet the estimates from the last three assessments are more consistent. The fishing mortality retrospective pattern does not exhibit any consistent trends.

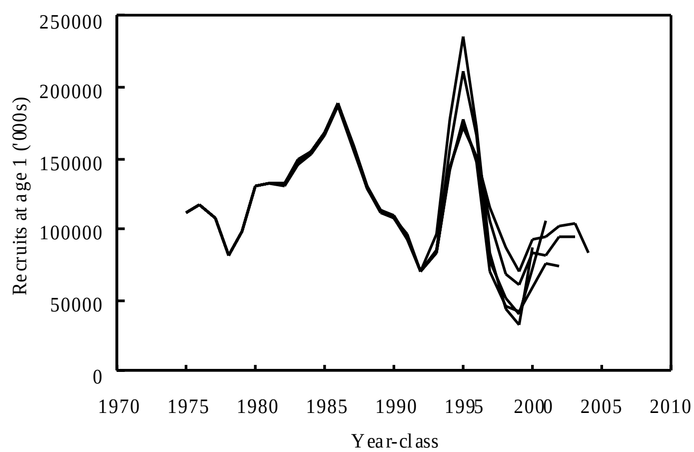


Fig. 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

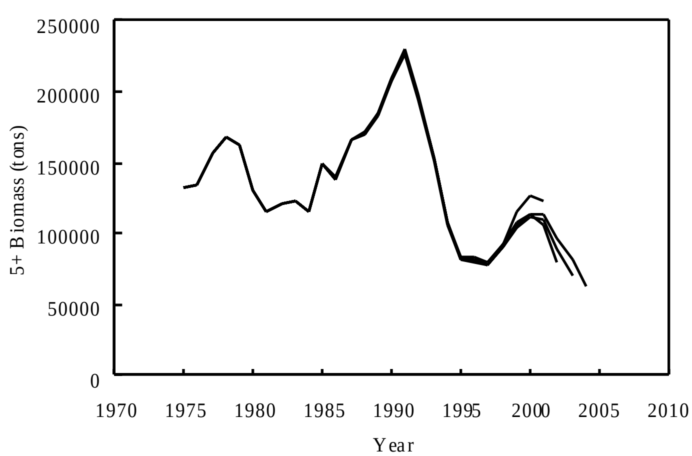


Fig. 20.15. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; 5+ biomass.

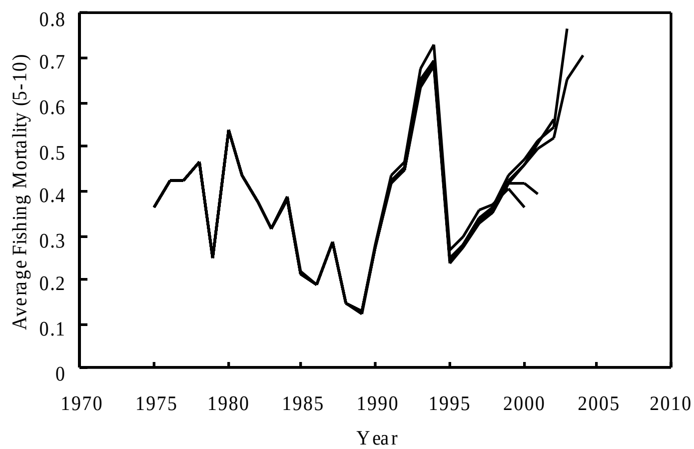


Fig. 20.16. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

f) **Sensitivity Analysis of the XSA Estimates**

Alternative model formulations were used to examine the robustness of the XSA estimated trends in the population dynamics of the stock. In the previous assessment of this stock (SCR Doc. 04/55), extensive sensitivity analyses were considered. The effect of (a) tuning using single fleets, (b) including the Canadian autumn data prior to 1995, (c) the plus group age used in the assessment, and (d) the level of the 2003 total catch were evaluated. STACFIS concluded that the 2004 assessment was robust.

In the current assessment (SCR Doc. 05/63), STACFIS evaluated the impact of varied shrinkage settings and also inclusion of the Spanish survey series in the NAFO Regulatory Area of Div. 3NO, and found the assessment conclusions in all analyses were unchanged.

g) **Reference Points**

i) **Precautionary approach reference points**

Precautionary approach reference points have not previously been defined for this stock. Several of the standard approaches typically available for age-disaggregated assessments are not applicable for this stock given the difficulties in determining the spawner biomass (or appropriate proxy). Limit reference points could not be determined for this stock at this time.

ii) **Biometric reference points**

For this stock F_{max} is computed to be 0.24 and $F_{0.1}$ is 0.14 based upon average weights and partial recruitment for the past 3 years. A plot of these reference levels of fishing mortality in relation to stock trajectory (Fig. 20.17) indicates that the average fishing mortality is currently greater than F_{max}.

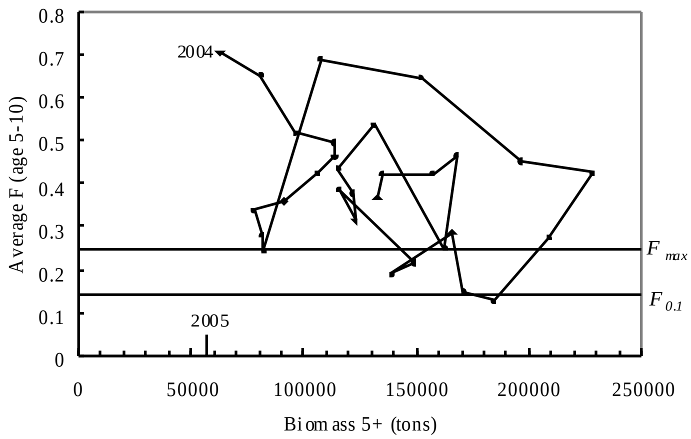


Fig. 20.17. Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory with relation to biometric reference points. The 2005 estimate of biomass (57 000 tons) is indicated on the biomass axis.

h) **Projections under Fisheries Commission Recovery Plan**

The Fisheries Commission has implemented a 15-year rebuilding plan for this resource by instituting an exploitable biomass target (ages 5+) of 140 000 tons (FC Doc. 03/13). As an initial step, the Fisheries Commission established TACs of 20 000, 19 000, 18 500, and 16 000 tons for 2004-2007, respectively. In order to evaluate the population trends under the established TACs, deterministic and stochastic projections were conducted assuming average exploitation pattern and weights-at-age from 2001 to 2003, and with natural mortality fixed at 0.2.

Attention is to be drawn on the fact that, as discussed by Patterson *et al*. (MS 2000), current bootstrapping and stochastic projection methods generally underestimate uncertainty. The percentiles are therefore presented as relative measures of the risks associated with the current harvesting practices. They should not be taken as representing the actual probabilities of eventual outcomes.

The projection inputs are summarized in Table 20.1 with the variability in the projection parameters for the stochastic projections described by the coefficients of variation (column CV in the table). Numbers at age 2 and older at 1st of January 2005 and corresponding CVs are computed from the XSA output. Recruitment was bootstrapped from the 1975-2001 age 1 numbers from the XSA. Scaled selection pattern and corresponding CVs are derived from the 2002 to 2004 average from the XSA. Weights at age in the stock and in the catch and corresponding CVs are computed from the 2002-2004 average input data. Natural mortality was assumed to be 0.2 with a CV of 0.15 and a CV of 0.05 was assumed for the implementation of the management plan. The stochastic distributions were generated using the @Risk software. The distribution was assumed lognormal for the numbers at age and normal for the other input data.

Deterministic projections were conducted assuming a future recruitment value of the 1996-2001 geometric mean from XSA estimates. Results indicate that although there is improvement in the 5+ biomass from the 2005 estimate (Fig. 20.18), the projected biomass for 2008 remains below the level of 2003, when the FC rebuilding plan was implemented. Projected average fishing mortality (Fig. 20.19) indicates a reduction in average F under the rebuilding plan TACs from 2005 to 2007.

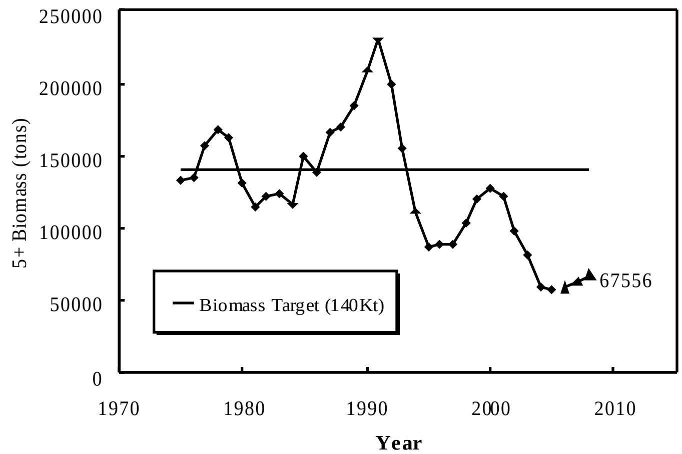


Fig. 20.18. Greenland halibut in Subarea 2 + Div. 3KLMNO: deterministic projection of 5+ biomass to 2008 (triangles) under FC rebuilding plan.

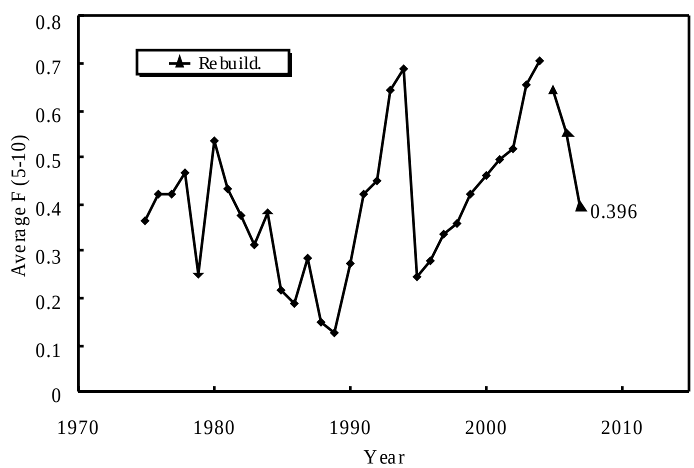


Fig. 20.19. Greenland halibut in Subarea 2 + Div. 3KLMNO: deterministic projection of average fishing mortality to 2007 (triangles) under FC rebuilding plan.

The results of the stochastic projection (average fishing mortality, 5+ biomass and 10+ biomass) are plotted in Fig. 20.20, and projection results are in Table 20.2. The trend in ages 10+ biomass is presented to illustrate the short term development of older portion of the population and should not be considered to represent SSB which is not precisely known.

Under the current management plan, the population 5+ biomass is expected to slowly increase until 2008. The deterministic projections suggest that the projected 2008 biomass (68 000 tons) will have not recovered to the level estimated in 2003 (approximately 80 000 tons). Further, the stochastic projections indicate that there is a low probability (less than 15%) of the 5+ reaching the 2003 level by 2008. The exploitable 10+ biomass is expected to decrease by 45% (Table 20.2).

TABLE 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: inputs data for stochastic projections.

Name	**Value**	**Uncertainty (CV)**	**Name**	**Value**	**Uncertainty (CV)**
Population at age in 2005			**Selection pattern**		**(2002-2004)**
N1	Bootstrap (1975-2001)		sH1	0.000	0.00
N2	68365	0.30	sH2	0.000	0.00
N3	70529	0.23	sH3	0.000	0.00
N4	55719	0.19	sH4	0.033	0.27
N5	41621	0.15	sH5	0.175	0.48
N6	29650	0.14	sH6	0.655	0.31
N7	10289	0.13	sH7	1.862	0.10
N8	2896	0.17	sH8	1.643	0.08
N9	1764	0.20	sH9	0.925	0.13
N10	1558	0.20	sH10	0.740	0.24
N11	927	0.20	sH11	0.777	0.26
N12	415	0.20	sH12	0.856	0.38
N13	253	0.20	sH13	0.807	0.26
N14	245	0.22	sH14	0.807	0.260
Weight in the catch		**(2002-2004)**	**Weight in the stock**		**(2002-2004)**
WH1	0.000	0.00	WS1	0.000	0.00
WH2	0.000	0.00	WS2	0.000	0.00
WH3	0.195	0.10	WS3	0.000	0.00
WH4	0.249	0.01	WS4	0.000	0.00
WH5	0.378	0.03	WS5	0.378	0.03
WH6	0.552	0.03	WS6	0.552	0.03
WH7	0.823	0.02	WS7	0.823	0.02
WH8	1.196	0.00	WS8	1.196	0.00
WH9	1.680	0.04	WS9	1.680	0.04
WH10	2.196	0.03	WS10	2.196	0.03
WH11	2.776	0.04	WS11	2.776	0.04
WH12	3.508	0.03	WS12	3.508	0.03
WH13	4.388	0.00	WS13	4.388	0.00
WH14	6	0.03	WS14	5.528	0.027
TAC					
2005	19 000	0.05			
2006	18 500	0.05			
2007	16 000	0.05			

TABLE 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: results of deterministic and stochastic projections assuming the catches follow the rebuilding plan TACs.

Deterministic	2005	2006	2007	2008
Catch (tons)	19000	18500	16000	
5+B (tons)	57000	59000	64000	68000

Stochastic (median values)	2005	2006	2007	2008
F (5-10)	0.64	0.53	0.39	0.31
5+B (tons)	56910	59271	63805	68911
10+B (tons)	9810	7808	6047	5482

1 000 iterations
@Risk -Risk analysis software
Bootstrapped Recruitment (75 - 01) **Uncertainties on all parameters taken into account**

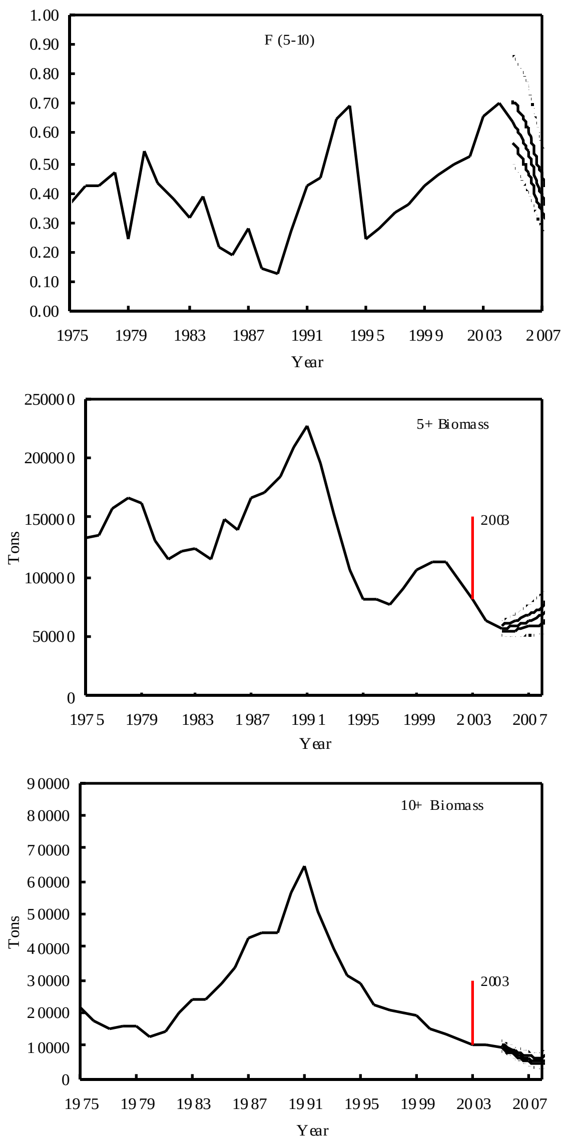


Fig. 20.20. Greenland halibut in Subarea 2 + Div. 3KLMNO: projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2005-2008 under Fisheries Commission rebuilding plan. The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

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SHEPHERD, J. G. 1999. Extended survivors analysis: An improved method for the analysis of catch-at-age data and abundance indices *ICES J. Mar. Sci*., 56(5): 584-591.

j) **Research Recommendation**

STACFIS **recommended** that *all available information on by-catch and discards of Greenland halibut in Subarea 2 and Divisions 3KLMNO be presented for consideration in future assessments.*

STACFIS **recommended** that *age-readers of Greenland halibut in Subarea 2 and Divisions 3KLMNO participate in a 2006 workshop to reach agreement upon common age reading practices and eliminate biases in age interpretation.*

21. **Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4** (SCR Doc. 05/45)

Interim Monitoring Report

a) **Introduction**

The Subareas 3+4 catch in 2004 (2 300 tons) was higher than the catch in 2003 (1 100 tons) but remained below the average for the low productivity period (3 400 tons, Fig. 21.1).

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TAC SA 3+4	150	150	150	75	34	34	34	34	34	34
STATLANT 21A SA 3+4	8.8	15.7	1.9	0.3	0.3[1]	<0.1[1]	0.2[1]	1.1[1]	2.3[1]	
STATLANT 21A SA 5+6	17.0	13.6	23.6	7.4	9.0[1]	3.9[1]	2.7[1]	6.4[1]	25.2[1]	
STACFIS SA 3+4	8.7	15.6	1.9	0.3	0.4	<0.1	0.2	1.1	2.3	
STACFIS SA 5+6	17.0	13.6	23.6	7.4	9.0	3.9	2.8	6.4	25.2	
STACFIS Total SA 3-6	25.7	29.2	25.5	7.7	9.4	4.0	3.0	7.5	27.5	

[1] Provisional.

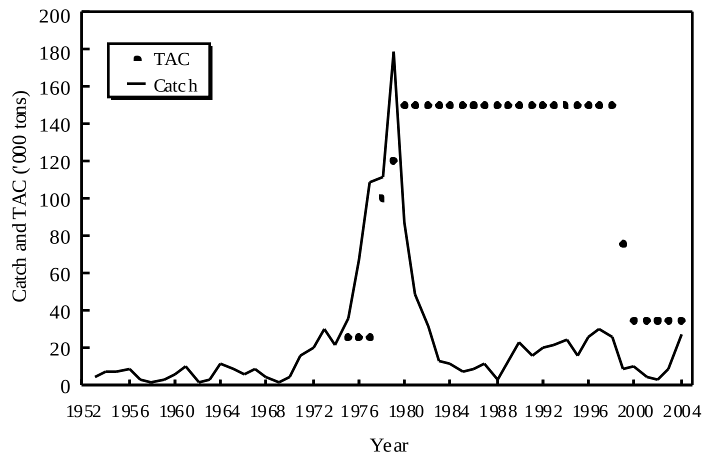

Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

b) **Data Overview**

During 2004, indices of relative abundance (119.3 squid per tow) and biomass (12.9 kg per tow) were the third highest on record. Although these values could not be standardized against the rest of the time series, due to a change in the survey vessel, the ten-fold increase in relative abundance that occurred between 2003 and 2004 has also been observed during other years within the low productivity period (Fig. 21.2).

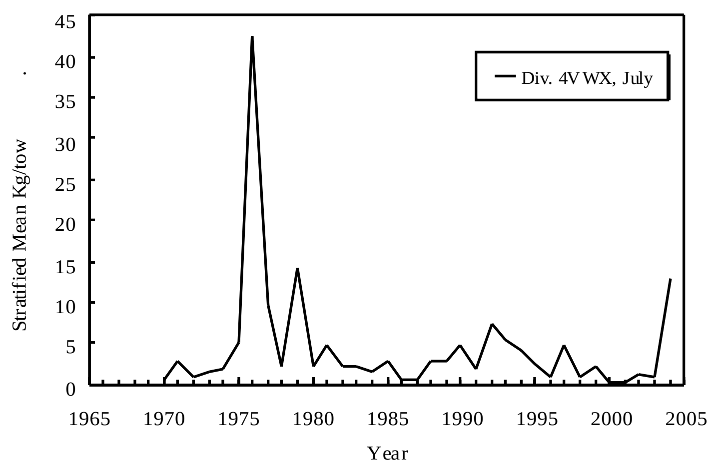

Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices from the July survey in Div. 4VWX.

During 2004, the mean weight of squid from the Div. 4VWX survey (108 g) was within the range observed during the low productivity period (Fig. 21.3).

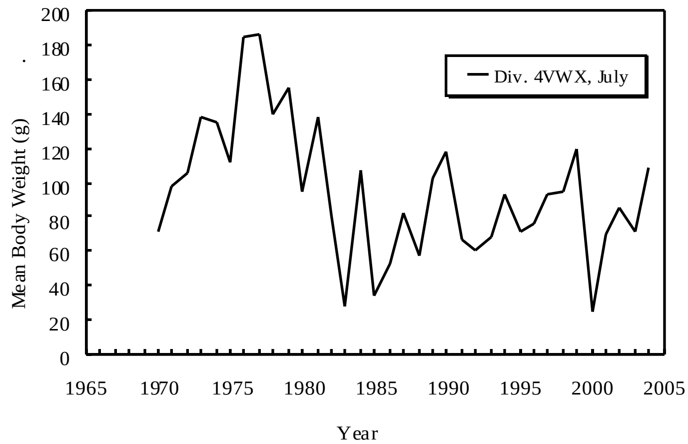

Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX

c) **Conclusion**

In summary, the survey biomass index and mean body weight of squid caught in the July Div. 4VWX survey were within the range of values observed during the 1982-2003 low productivity period. Therefore, there is no compelling evidence to suggest a change in stock status during 2004.

IV. OTHER MATTERS

1. Nomination of Designated Experts

STACFIS reviewed the list of Designated Experts for the stocks which would be assessed and for which management advice is requested by the Fisheries Commission and Coastal States. The final nomination of the Designated Experts will be conducted through the normal confirmation process between the various national institutes and Secretariat. The nominations to date by STACFIS for the 2006 assessment are:

- From the Science Branch, Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans, P. O. Box 5667, St. John's, NL A1C 5X1, Canada [Telephone: listed below – Fax: + 709-772-4188 – E-mail: listed below]

for	Cod in Div. 3NO	Don Power	Tel: +709-772-4935	powerd@dfo-mpo.gc.ca
	Redfish Div. 3O	Don Power	Tel: +709-772-4935	powerd@dfo-mpo.gc.ca
	American Plaice in Div. 3LNO	Karen Dwyer	Tel: +709-772-0573	dwyerk@dfo-mpo.gc.ca
	Witch flounder in Div. 3NO	Dawn Maddock Parsons	Tel: +709-772-2495	parsonsda@dfo-mpo.gc.ca
	Witch flounder in Div. 2J+3KL	Dawn Maddock Parsons	Tel: +709-772-2495	parsonsda@dfo-mpo.gc.ca
	Yellowtail flounder in Div. 3LNO	Steve Walsh	Tel: +709-772-5478	walshs@dfo-mpo.gc.ca
	Greenland halibut in SA 2+3KLMNO	Brian Healy	Tel: + 709-772-8674	healeybp@dfo-mpo.gc.ca
	Shrimp in Div. 3LNO	David Orr	Tel: +709-772-7342	orrd@dfo-mpo.gc.ca
	Thorny skate in Div. 3LNO	David Kulka	Tel: + 709-772-2064	kulkad@dfo-mpo.gc.ca
	White hake in Div. 3NO	David Kulka	Tel: + 709-772-2064	kulkad@dfo-mpo.gc.ca

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for	Cod in Div. 3M	Hilario Murua

- From the Instituto Español de Oceanografia, Aptdo 1552, E-36280 Vigo (Pontevedra), Spain [Telephone: +34 9 86 49 2111 – Fax: +34 9 86 49 2351 – E-mail: fernando.gonzalez@vi.ieo.es]

for	Roughhead grenadier in SA 2+3	Fernando Gonzalez-Costas
	Roundnose grenadier in SA 2+3	Fernando Gonzalez-Costas

- From the Instituto Nacional de Investigacao Agrária e das Pescas (INIAP/IPIMAR), Av. de Brasilia, 1449-006 Lisbon, Portugal [Telephone: +351 21 302 7000 – Fax: +351 21 301 5948 – E-mail: listed below]

for	American plaice in Div. 3M	Ricardo Alpoim	ralpoim@ipimar.pt
	Redfish in Div. 3M	Antonio Avila de Melo	amelo@ipimar.pt
	Redfish in Div. 3LN	Antonio Avila de Melo	amelo@ipimar.pt

- From the Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk, Greenland [Telephone: +299 36 1238 – Fax: +299 39 1200 – E-mail: listed below]

for	Redfish in SA1	Helle Siegstad	helle@natur.gl
	Other Finfish in SA1	Helle Siegstad	helle@natur.gl
	Greenland halibut in Div. 1A	Bjarne Lyberth	bjly@natur.gl
	Northern shrimp in SA 0+1	Carsten Hvingel	hvingel@natur.gl
	Northern shrimp in Denmark Strait	Carsten Hvingel	hvingel@natur.gl

- From the Danish Institute for Fisheries Research, Charlottenlund Slot, DK-2920, Charlottenlund, Denmark [Telephone: +45 33 96 33 00 – Fax: +45 33 96 33 33 – E-mail: olj@dfu.min.dk]

for	Roundnose grenadier in SA 0+1	Ole Jørgensen
	Greenland halibut in SA 0+1	Ole Jørgensen

- From the Marine Research Institute, Skulagata 4, P. O. Box 1390, 121 - Reykjavik, Iceland [Telephone: +354 552 0240 – Fax: +354 562 3790 – E-mail: unnur@hafro.is]

for	Shrimp in Div. 3M	Unnur Skúladóttir

- From Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk, 183763, Russia [Telephone: +7 8152 45 0568 – Fax: +7 8152 47 3331 – E-mail: gorch@pinro.ru]

for	Capelin in Div. 3NO	Konstantin V. Gorchinsky

- From the National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543 [Telephone: +508-495-2285 – Fax: +508-495-2393 – E-mail: lisa.hendrickson@noaa.gov]

for	Squid in SA 3+4	Lisa Hendrickson

2. Other Business

i) STACFIS Working Procedures - Interim Monitoring Report Format

Many of the stocks assessed by Scientific Council are evaluated on a bi-annual cycle, and advice is provided to Fisheries Commission and Coastal States for the two-year period following the assessment. Currently, the level of assessment detail included in the interim monitoring report has been left to the Designated Expert (DE) of each stock. In the interest of both expediting the review of these stocks during interim monitoring years and standardizing the format of these reports, a framework for presenting the interim monitoring report was discussed and agreed (see the example below).

Provided that the DE is satisfied that there are no items of concern needing review from SC, a monitoring of the status of the stock would be presented as a draft of the stock summary for the STACFIS report. The SCR Document could be issued to document the interim monitoring assessment report. In the absence of any significant changes in stock status, it was agreed that details included in interim monitoring reports be kept to a minimum.

Should the DE judge that there are items of concern, a WP or SCR Document would be presented to STACFIS outlining the issue. For example, substantial change in survey results, catches, or in other biological parameters would likely warrant discussion within STACFIS. STACFIS as a body should then decide whether there is a need for full assessment or the level of detail to be included in STACFIS/SC reports, which would include amending the multi-year advice produced from the last assessment.

E X A M P L E

This proposed format is giving as an example:

x. **Species Name (*Latin Name*) in Division XX** (list of ancillary SCR Documents)

Interim Monitoring Report

a) **Introduction**

Short history of catches… A total catch of XXX tons was estimated for 2004 (Fig. x.x).

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

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.1	0.1	0.2	0.2	0.3	0.2[1]	0.2[1]	0.1[1]	0.1[1]	
STACFIS	0.3	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.1	

[1] Provisional.
ndf No directed fishing.

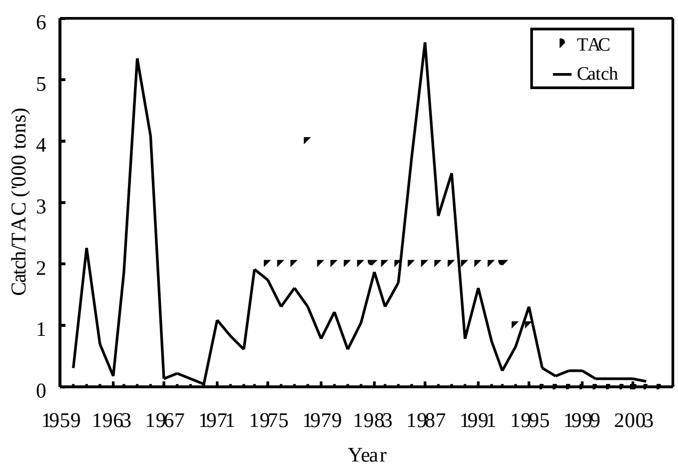

Fig. x.x. Stock Name: nominal catches and agreed TACs.

b) **Data Overview**

Surveys

The "*name of survey*" was conducted during 2004. The survey estimates did not alter the perception of the stock status by STACFIS (Fig. x.x and x.x).

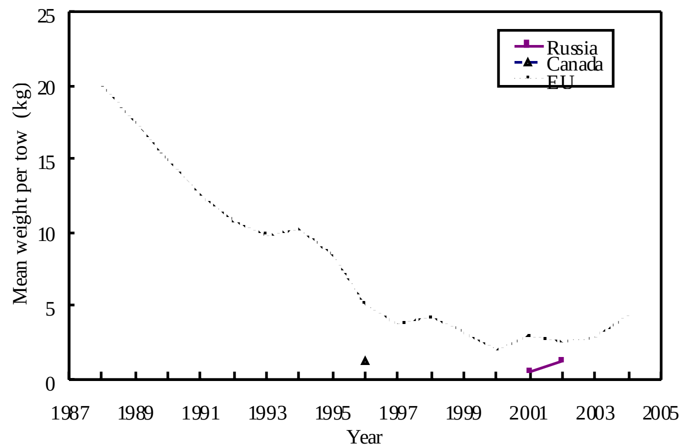

Fig. x.x. Name of stock: mean weight per tow in the surveys.

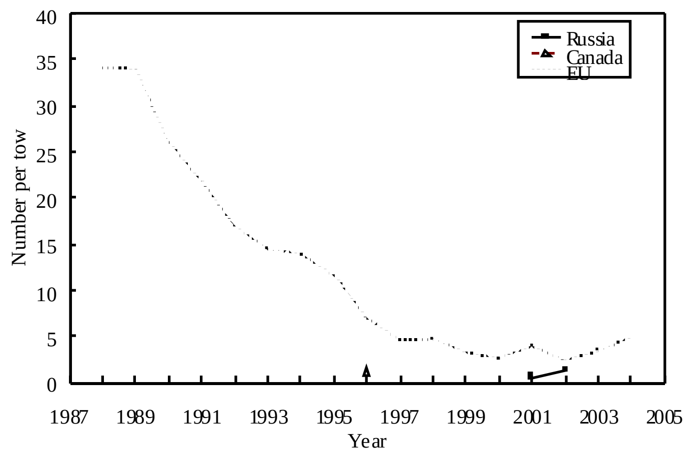

Fig. x.x. Name of stock: mean number per tow in the surveys.

Any other necessary biological description to assess the situation of the stock. For example: "*Recruitment has been poor since the 1990 year-class. STACFIS noted that this stock continues to be in a very poor condition, with only poor year-classes expected to be recruited to the SSB for at least five years. Although the level of catches and fishing mortality since 1992 appear to be relatively low, survey data indicate that the stock biomass and the SSB are at a very low level. Due to the consistent year to year recruitment failure since the beginning of the 1990s there is no sign of recovery of this stock*".

c) **Conclusion**

Bases on overall indices for the current year, there is nothing to indicate a change.

iii) **Acknowledgements**

The Chair thanked the participants for their valuable contributions to the Committee. Special thanks were extended to the Deputy Executive Secretary and staff of the NAFO Secretariat for their invaluable assistance in preparation and distribution of documents. There being no other business, the Chair closed the June 2005 STACFIS Meeting.