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NORTHWEST ATLANTIC FISHERIES ORGANIZATION

Scientific Council Reports 2005

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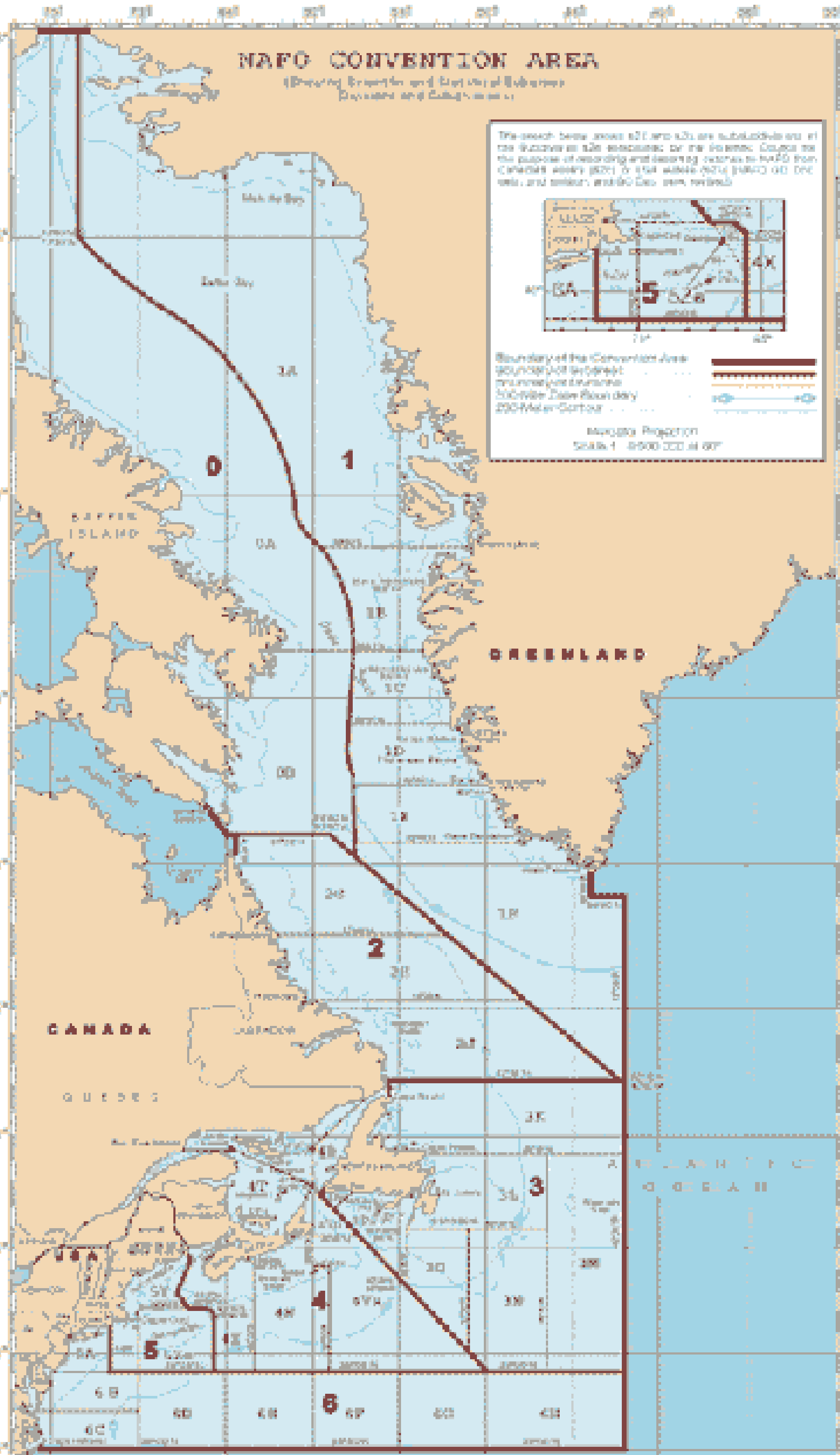
PREFACE

This twenty-fourth issue of *NAFO Scientific Council Reports* containing reports of Scientific Council Meetings held in 2005 is compiled in four sections: **Part A –** Report of the Scientific Council Meeting during 2-16 June 2005, which addressed most of the annual requests for scientific advice on fisheries management, **Part B** – Report of the Scientific Council Annual Meeting during 19-23 September 2005, **Part C –** Report of the Scientific Council Meeting during 26 October-3 November 2005, which addressed the requests for scientific advice on northern shrimp in Division 3M, Divisions 3LNO, Subareas 0 and 1 and Denmark Strait and off East Greenland, and ICES Stocks, and **Part D** contains the Agendas, Lists of Research and Summary Documents, List of Representatives and Advisers/Experts, and List of Recommendations relevant to Part A, B and C.


NAFO CONVENTION AREA
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GREENLAND
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Boundary of the Convention Area
Mercator Projection

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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.

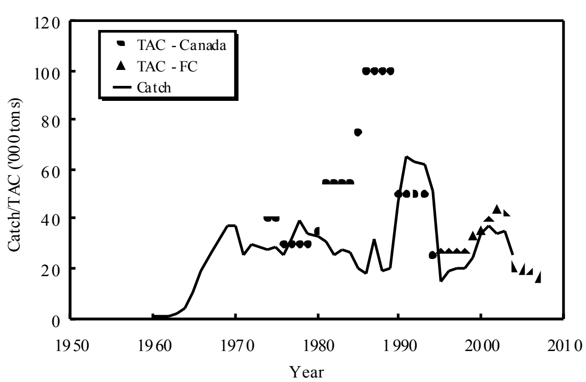
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 2 and Divisions 3KLMNO

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

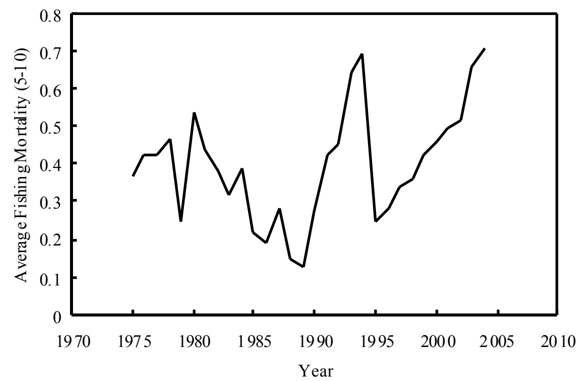
[1] Provisional.
[2] STACFIS could not precisely estimate the catch.



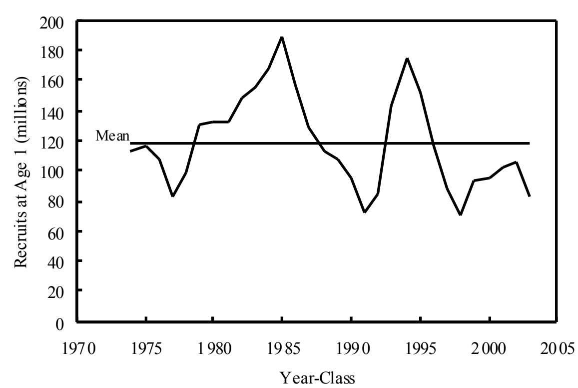
Data: CPUE data throughout the stock area were available from Canadian, and EU-Portugal fisheries. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2J+3KLMNO (1978-2004), EU in Div. 3M (1988-2004) and EU-Spain in Div. 3NO (1995-2004). Commercial catch-at-age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

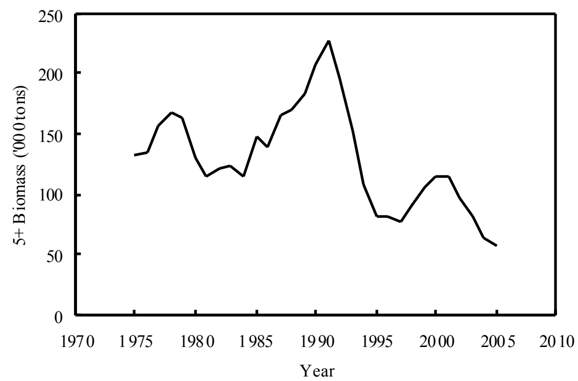
Fishing Mortality: High catches in 1991-94 resulted in F_{5-10} exceeding 0.50. F_{5-10} then dropped to about 0.20 in 1995 with the substantial reduction in catch. F_{5-10} increased in recent years with increased catch, and the 2003 and 2004 estimates are substantially higher; F_{5-10} in 2004 is estimated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



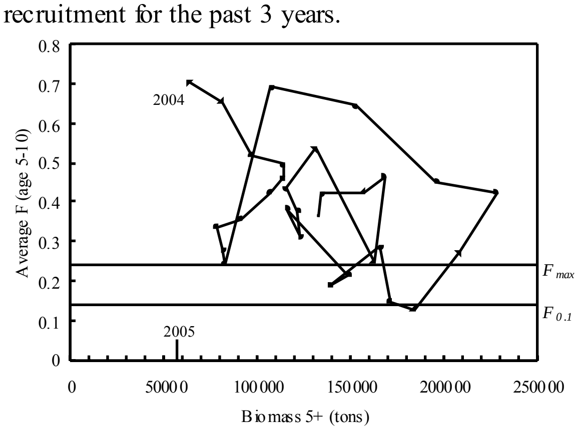
Biomass: The exploitable biomass (age 5+) was reduced to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. However, increasingly higher catches and fishing mortality 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.

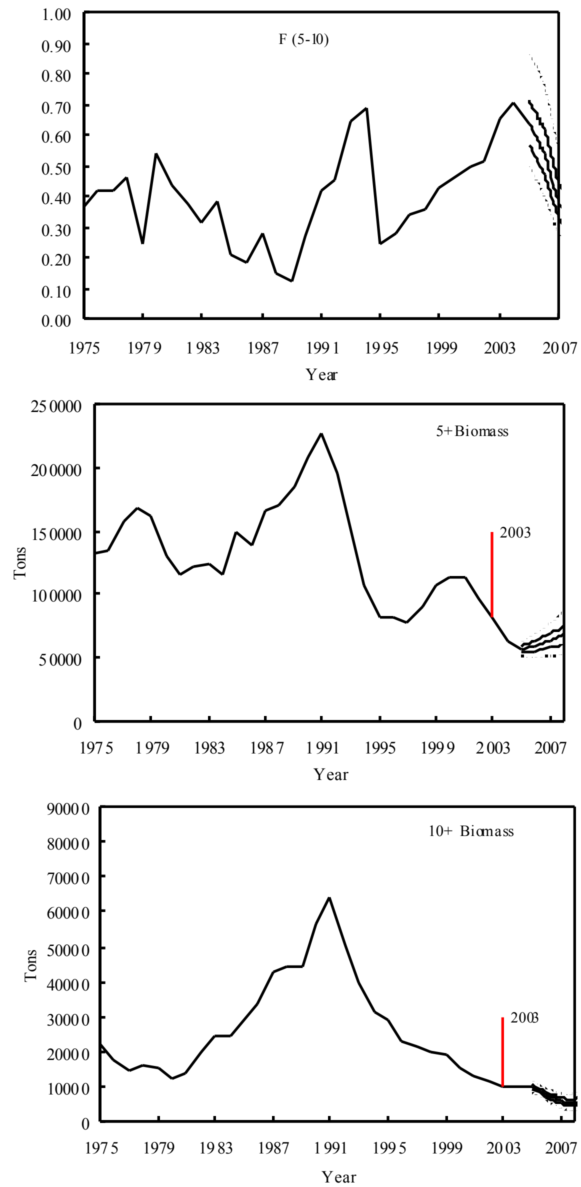
Scientific Council noted that the 2004 catch of 25 500 tons exceeded the 2004 rebuilding plan TAC by 27%. The projected 2008 5+ biomass in the current assessment is 15% lower than that predicted in the 2004 assessment. This discrepancy is consistent with the fact that the 2004 catch exceeded the TAC. 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.

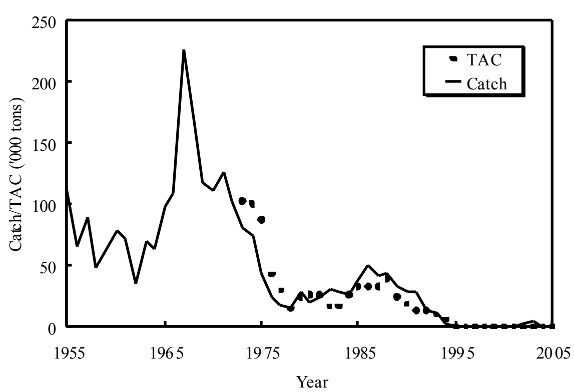
Cod (Gadus morhua) in Divisions 3N and 3O

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

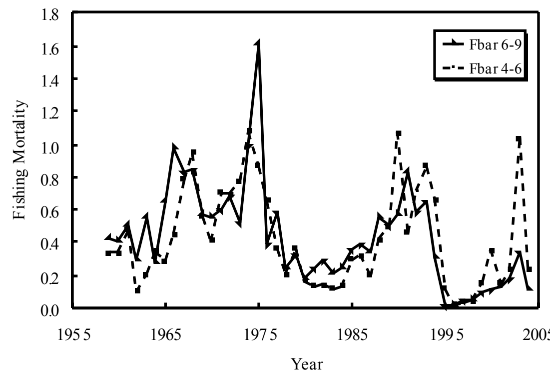
[1] Provisional.
[2] STACFIS could not precisely estimate the catch.
ndf No directed fishing.



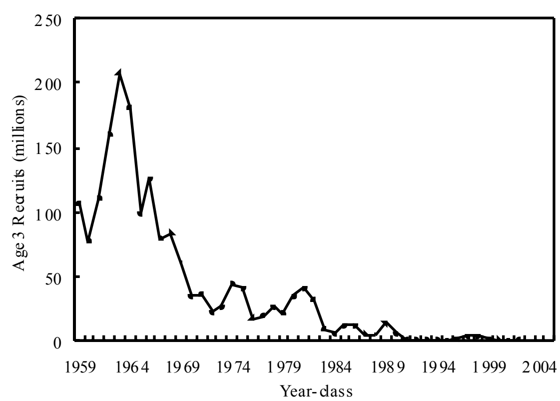
Data: Length and age composition were available from the 2003 and 2004 fisheries to estimate the total removals at age. Canadian spring (1984-2004) and autumn (1990-2004) survey data provided abundance, biomass and age structure information. Canadian juvenile research survey data were available up to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

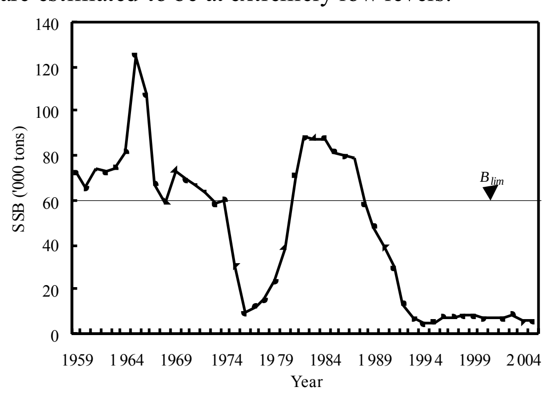
Fishing Mortality: Has increased since the moratorium, particularly on younger fish (ages 4-6).



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.

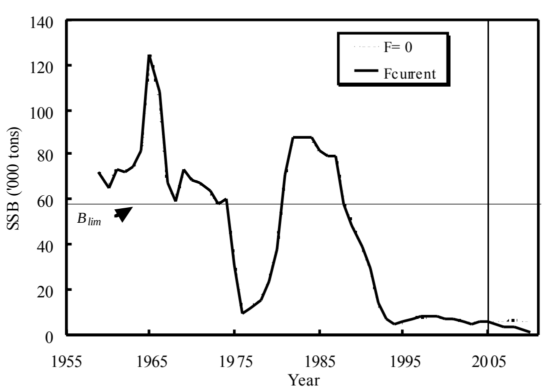


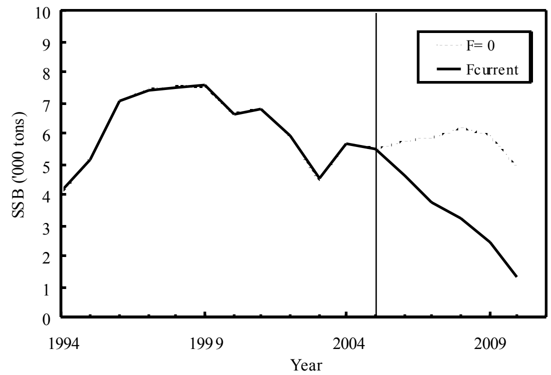
State of the Stock: The stock remains close to its historical low with weak representation from all year-classes.

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.

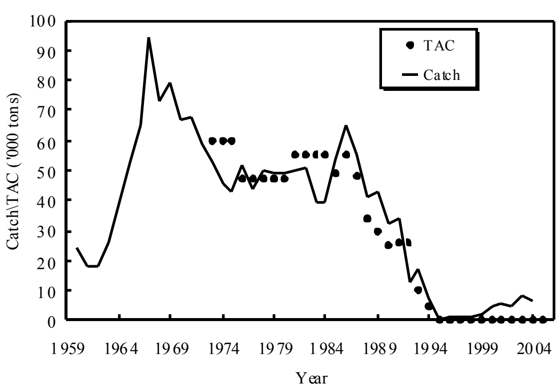
American Plaice (Hippoglossoides platessoides) in Divisions 3L, 3N and 3O

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

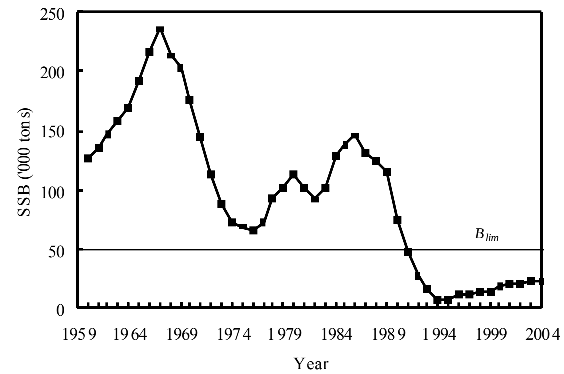
[1] Provisional.
[2] STACFIS could not precisely estimate the catch.
ndf No directed fishing.



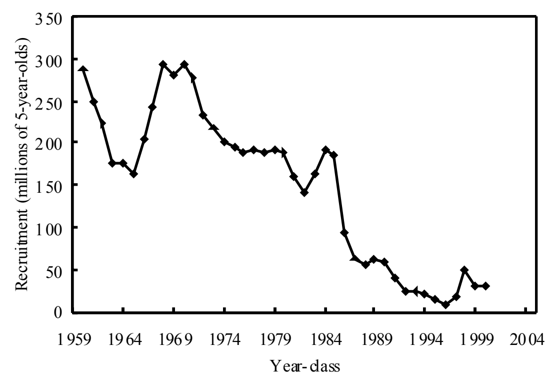
Data: Biomass and abundance data were available from several surveys. Age data from Canadian by-catch as well as length data from by-catch from Russia, EU-Spain and EU-Portugal were available.

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.

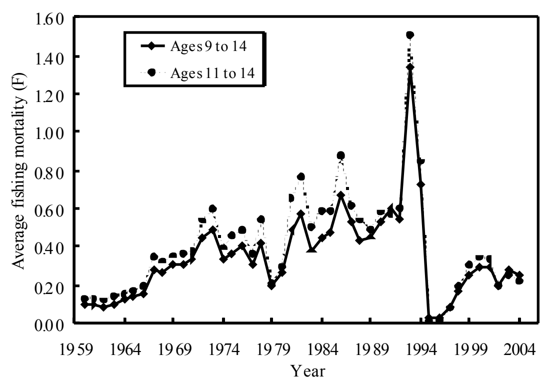
Biomass: Biomass and SSB are very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. It has increased since then but still remains very low at just over 23 000 tons.



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



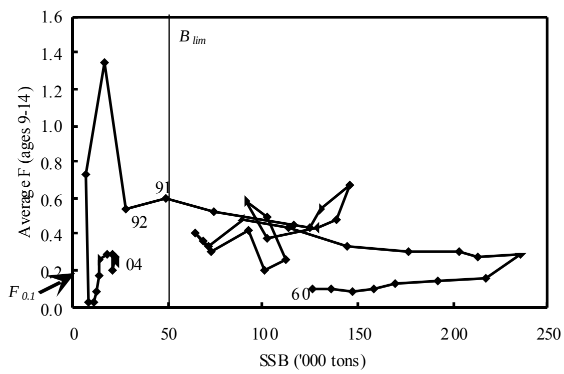
Fishing mortality: The average fishing mortality on ages 9 to 14 was 0.28 from 1999-2001 and decreased slightly to 0.24 from 2002-2004.



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.

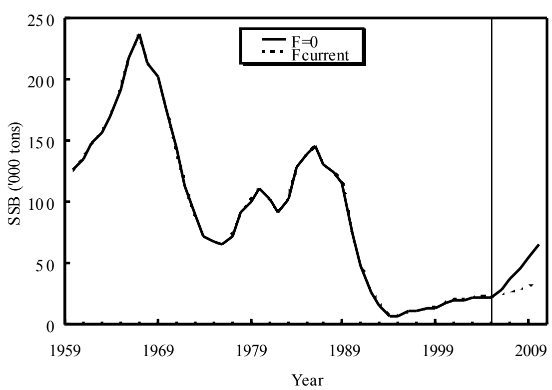
Reference Points: Good recruitment has not been observed in this stock when SSB has been below 50 000 tons and this is currently the best estimate of B_{lim}. The stock is currently below B_{lim}.

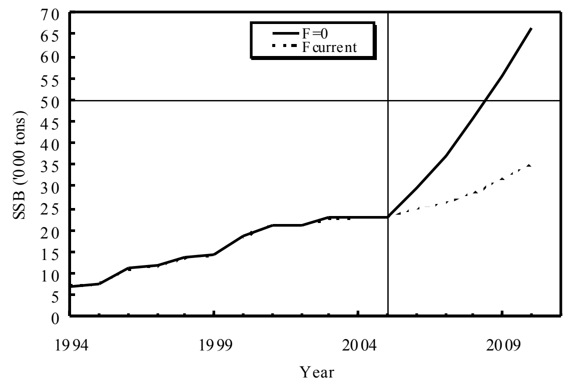


Medium term considerations: Deterministic projections were conducted to examine stock biomass over the next 5 years. Projections were limited to 5 years as extended projections are increasingly driven by recruitment assumptions. Spawner biomass was projected assuming F = 0 and under recently observed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

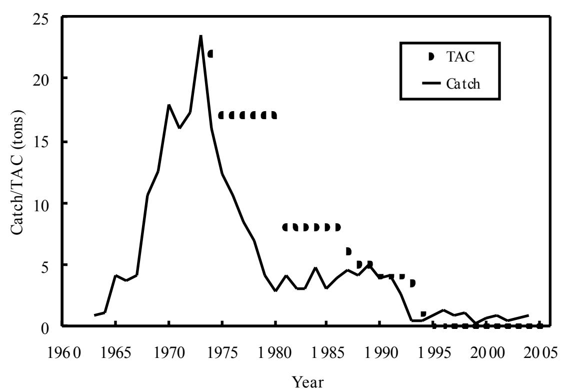
Witch Flounder (Glyptocephalus cynoglossus) in Divisions 2J, 3K and 3L

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

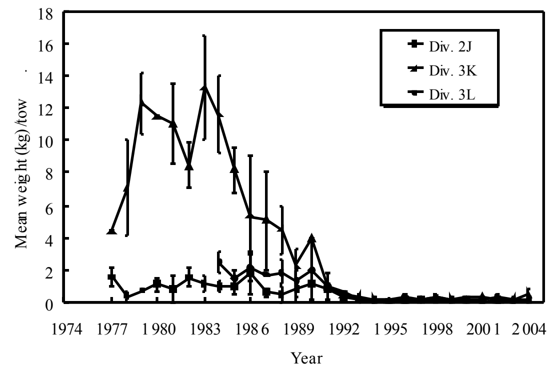
[1] Provisional and includes estimates from Div. 3M from 1998 onwards.
ndf No directed fishing.



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.

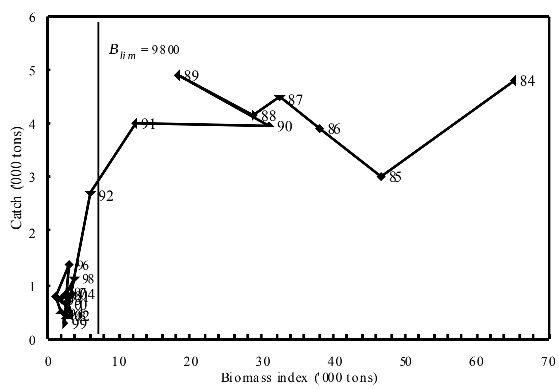


Recruitment: No information was available to this meeting.

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.

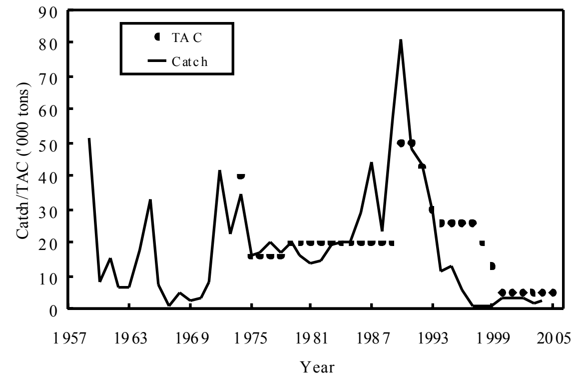
Redfish (Sebastes spp.) in Division 3M

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.

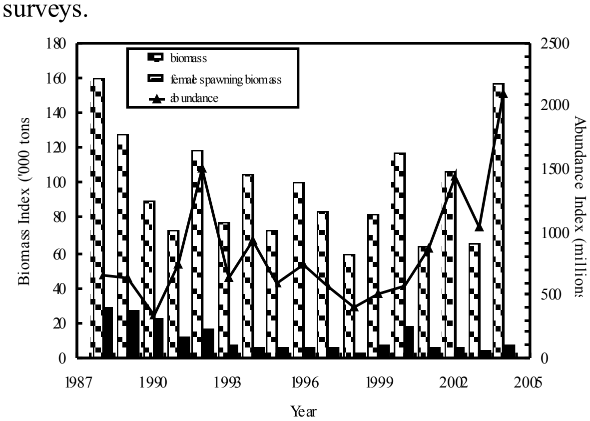


Data: Catch-at-age data were available from 1989-2004, including by-catch information from the shrimp fishery.

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.

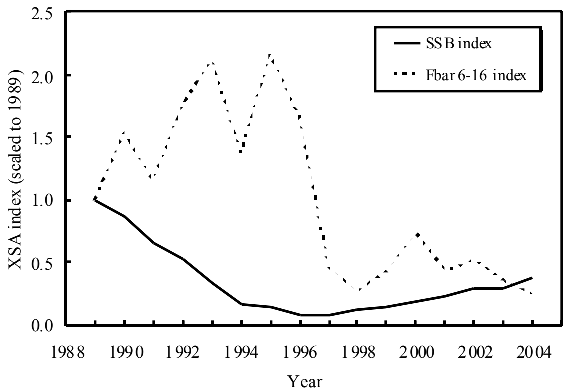
In June 2003 a new Spanish research vessel, the RV *Vizconde de Eza* replaced the RV *Cornide de Saavedra* that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 survey indices available the original time series of 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.

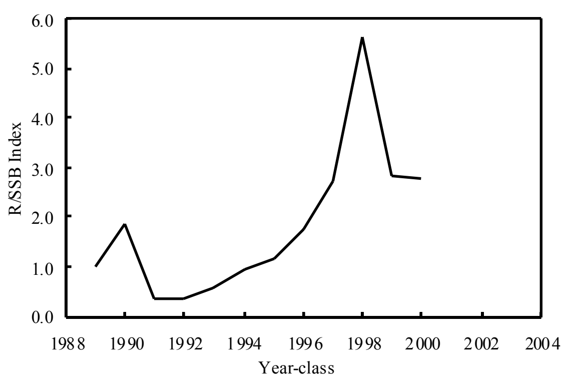


A virtual population analysis (XSA) was carried out for 1989-2004, providing indicators of stock biomass, female spawning biomass and fishing mortality trends.

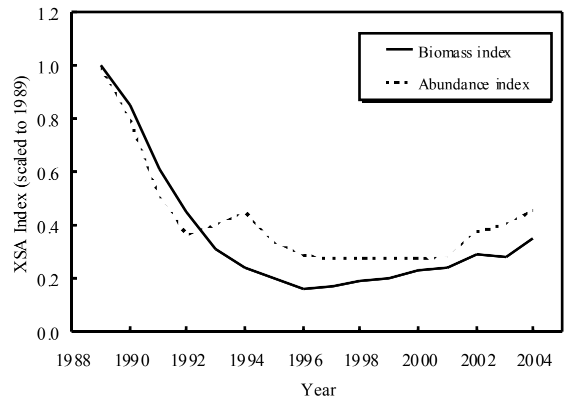
Fishing Mortality: Fishing mortality was at very high levels until 1996 and then dropped to relatively very low levels since 1997.



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.

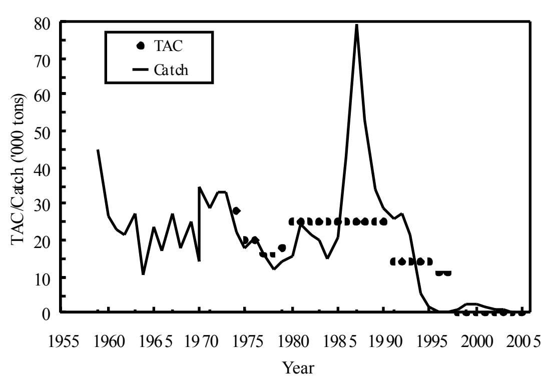
Redfish (Sebastes spp.) in Divisions 3L and 3N

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

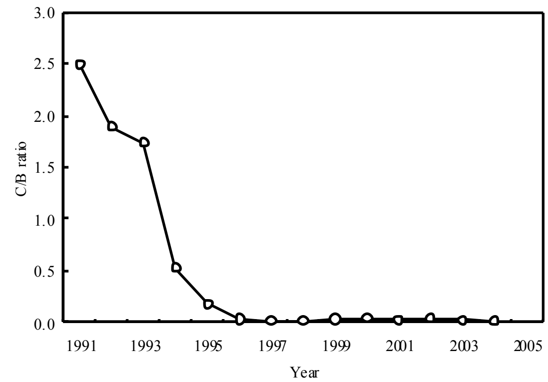
[1] Provisional.
ndf No directed fishing.



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

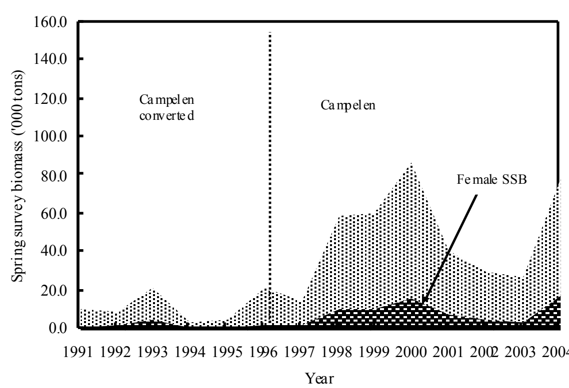
Assessment: No analytical assessment was possible.

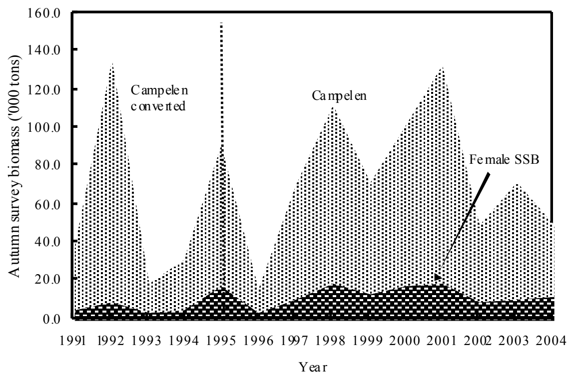
Fishing Mortality: Ratios of catch to spring survey biomass were calculated for Div. 3L and 3N combined and are considered a proxy of fishing mortality. Catch/Biomass ratio declined continuously from 1991 to 1996, with a dramatic drop between 1993 and 1994. From 1996 onwards the proxy of fishing mortality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

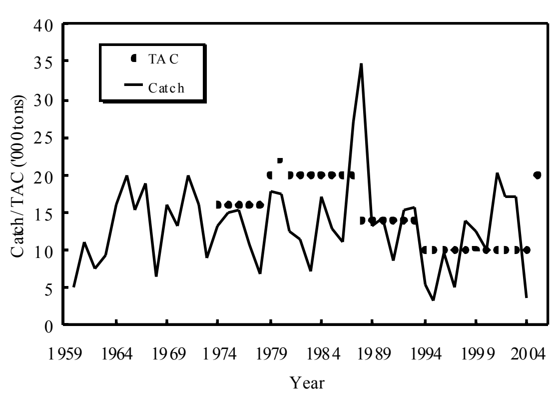
Redfish (Sebastes spp.) in Division 3O

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

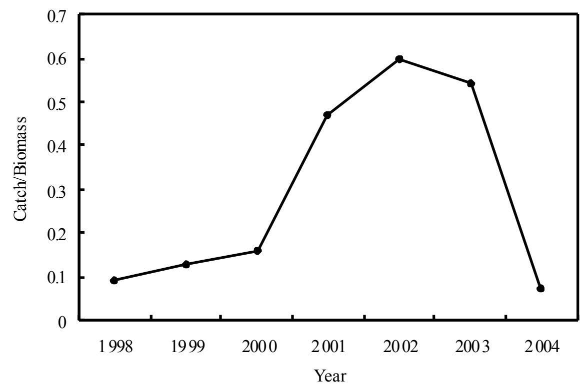
[1] Provisional.



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.

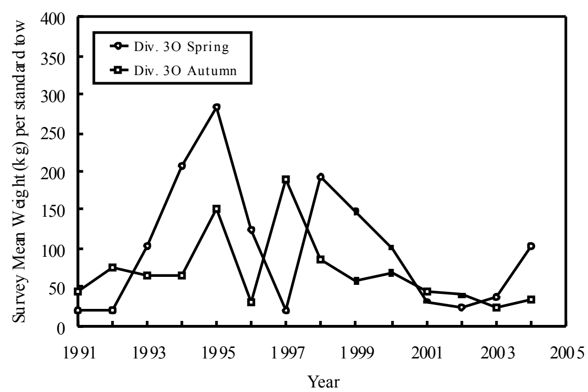
Assessment: No analytical assessment was possible.

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*.

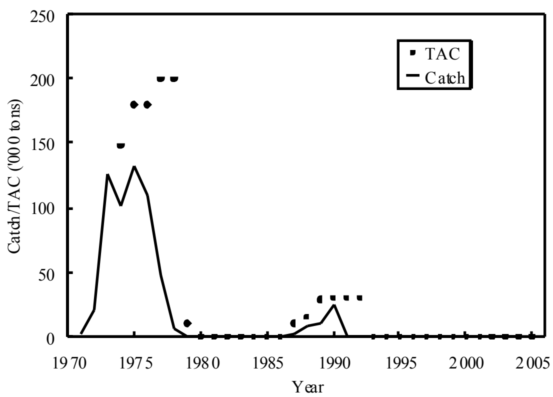
The next assessment will be in 2007.

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

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

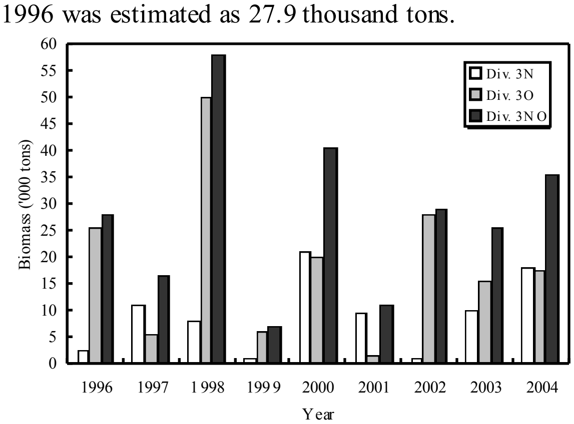
Fishery and catches: There has not been a directed fishery since 1993 when a moratorium was established, and no commercial catches have been reported since then.

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

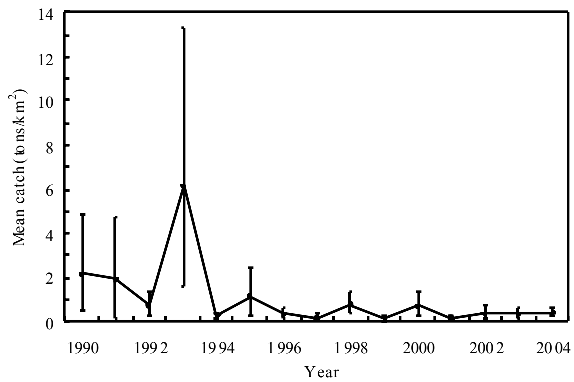


Data: Capelin catches from Canadian bottom trawl surveys conducted in 1990-2004, as well as historical data sets from Russian and Canadian trawl acoustic surveys directed to capelin.

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

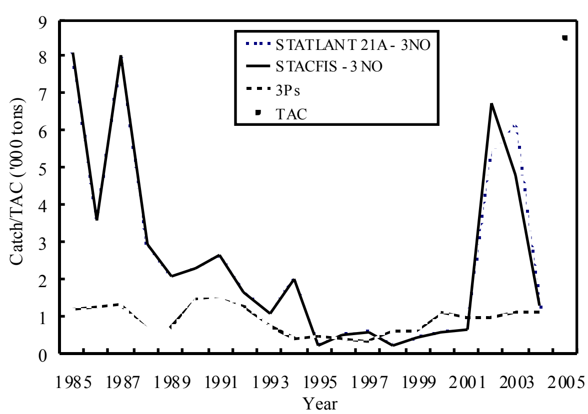
Background: The stock area is defined by Scientific Council as Div. 3NOPs, and is mainly concentrated in southern Subdiv. 3Ps and on the southwestern Grand Bank. Scientific Council is asked to provide advice on the portion of the stock in Div. 3NO only.

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]

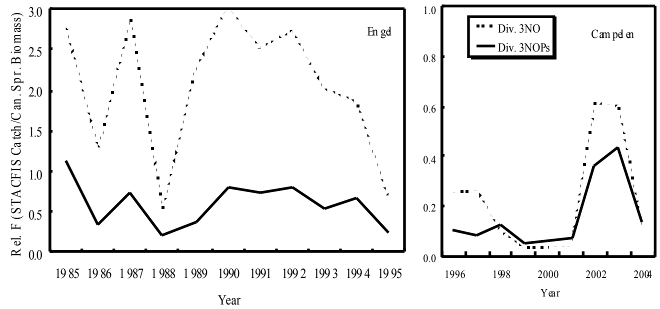
[1] Provisional.
[2] Set by Fisheries Commission at 8 500 tons for Div. 3NO for 2005-2007.



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).

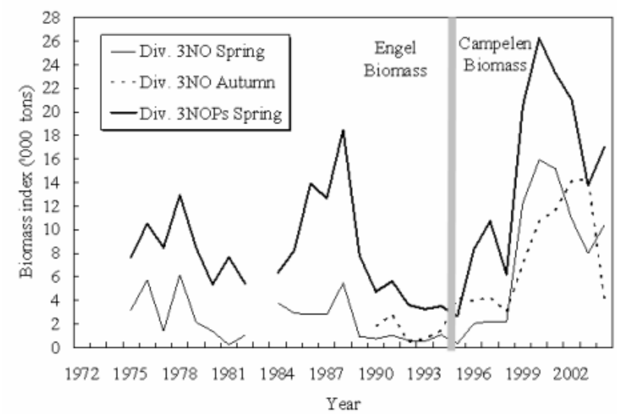
Assessment: No analytical assessment was possible.

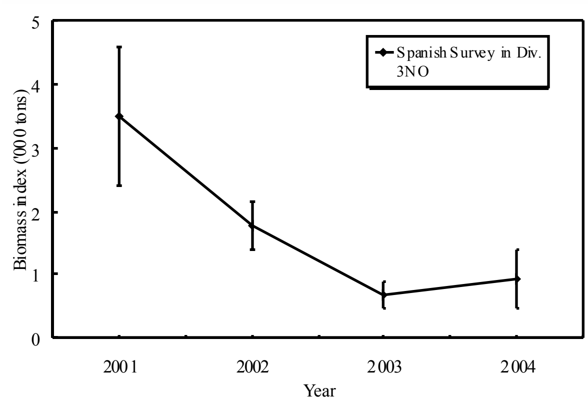
Fishing Mortality: STACFIS catch/Canadian spring survey biomass ratio fluctuated in the 1980s then declined in the 1990s. The index then increased in 2002-2003, and declined in 2004.



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**

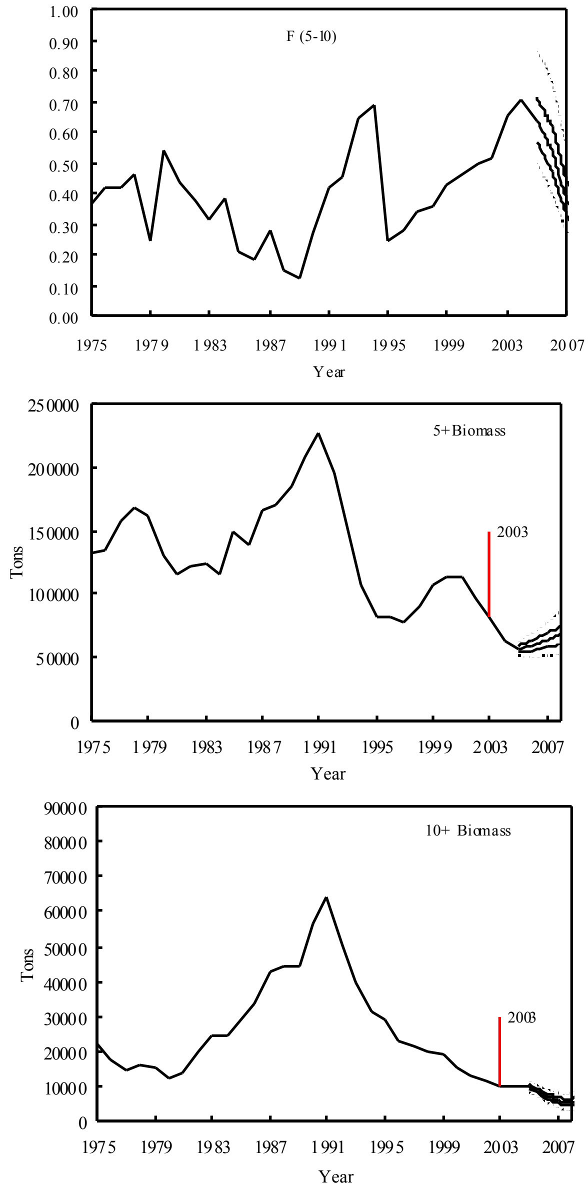
i) **Greenland halibut in Subarea 2 and Div. 3KLMNO rebuilding strategy** (Appendix 5, Annex 1, Item 5)

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.

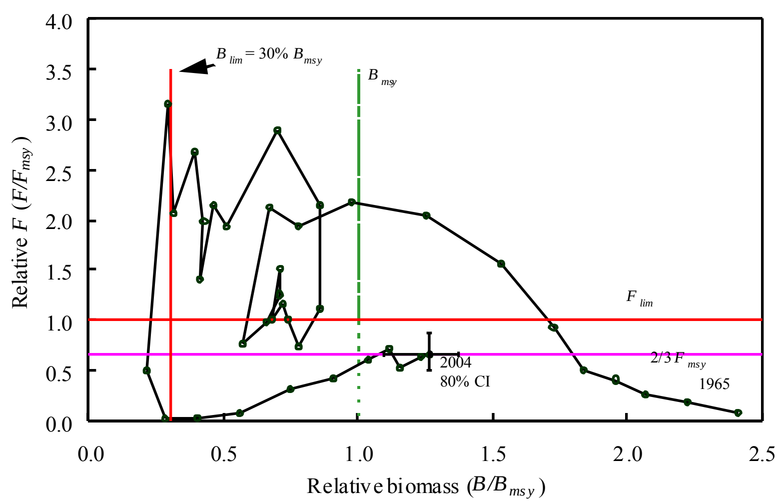
d) a description of the advise using the Precautionary Framework differs from advice provided in the traditional manner.

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.

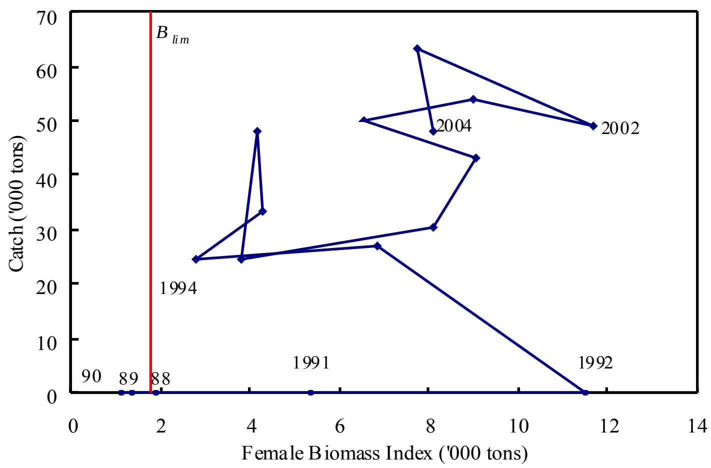


Currently the stock is estimated to be above B_{lim} and F below F_{lim}, so the stock is in the safe zone as defined in the Scientific Council's Precautionary Approach Framework (SCS Doc. 04/12). Maintaining F at or below 2/3 F_{msy} is projected to maintain the resource within the safe zone, at least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

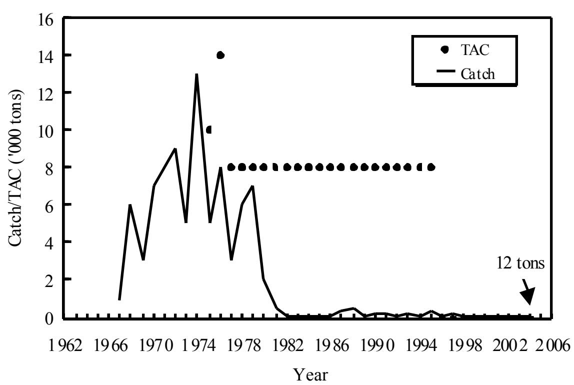
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 0 + 1

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.

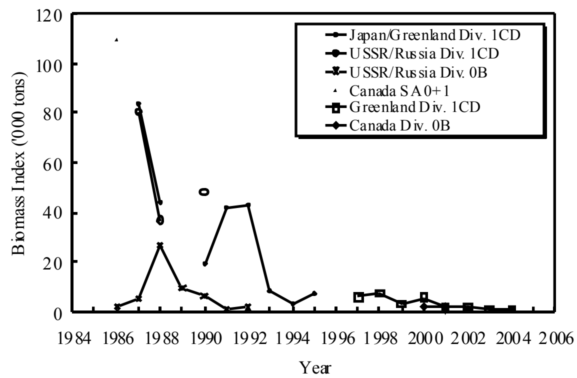


Data: Biomass estimates of roundnose grenadier from surveys in Div. 0B during the period 1986-92, from Div. 1CD during the period 1987-95, from Div. 1CD in 1997-2004 and Div. 0B in 2000-2001 were available.

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:

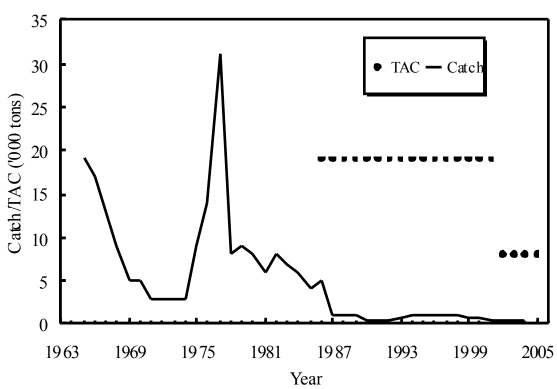
*Demersal Redfish (*Sebastes *spp.) in Subarea 1*

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.

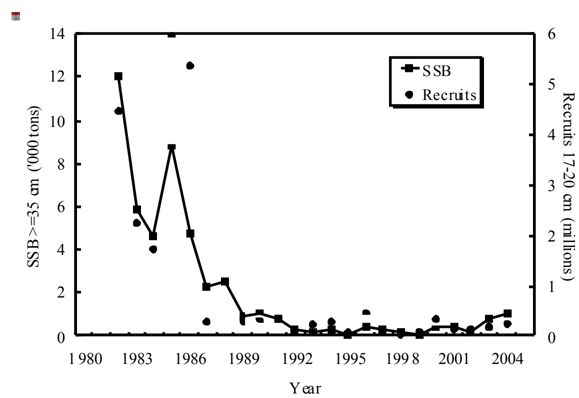


Data: Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland. Spawning stock biomass and recruitment indices for both redfish stocks were derived from EU-German survey data. No data on CPUE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

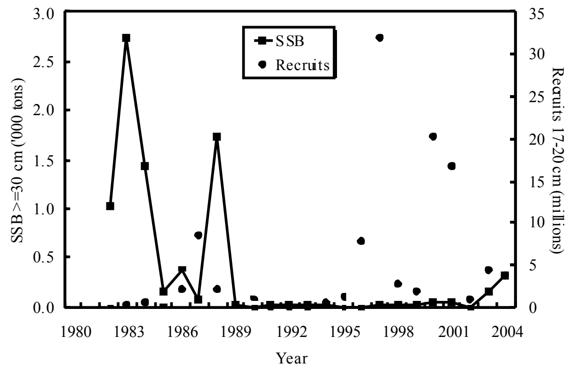


State of the Golden Redfish Stock: The stock of golden redfish in Subarea 1 remains severely depleted. There are indications that the probability of future recruitment is reduced at the current low SSB. Short-term recovery is very unlikely.

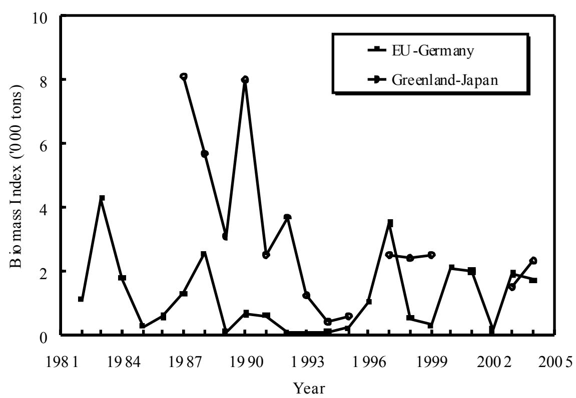
Assessment of Deep-sea Redfish: No analytical assessment of *S. mentella* was possible.

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

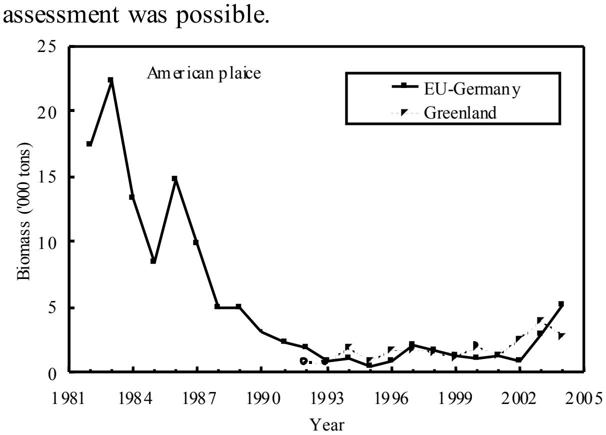
Background: The resources of other finfish in Subarea 1 are mainly Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffishes (*Anarhichas lupus* and *A. minor*), thorny skate (*Raja radiata*), lumpsucker (*Cyclopterus lumpus*), Atlantic halibut (*Hippoglossus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

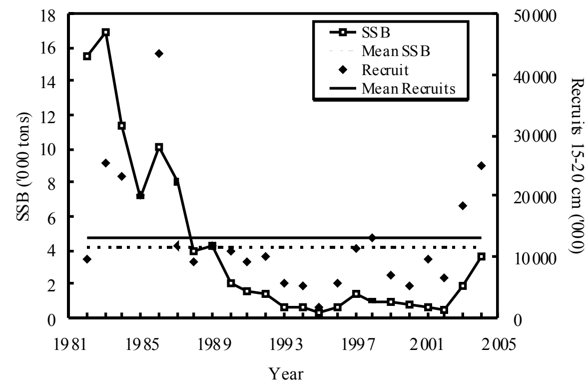
Data: Assessments of recent stock abundance, biomass, and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland. Spawning stock biomass and recruitment indices for American plaice and Atlantic wolffish were derived from EU-German survey data. 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.



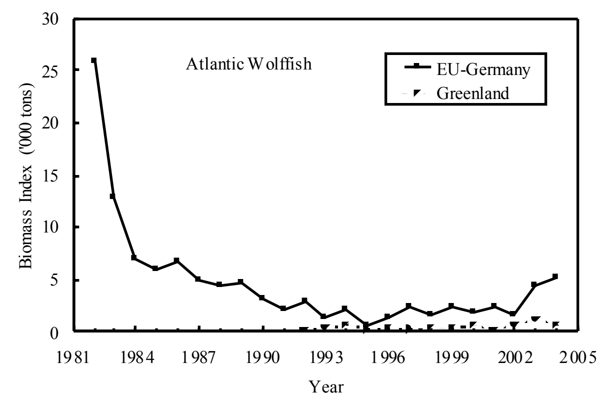
Recruitment: Indices from 2003 and 2004 are above the average level.

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



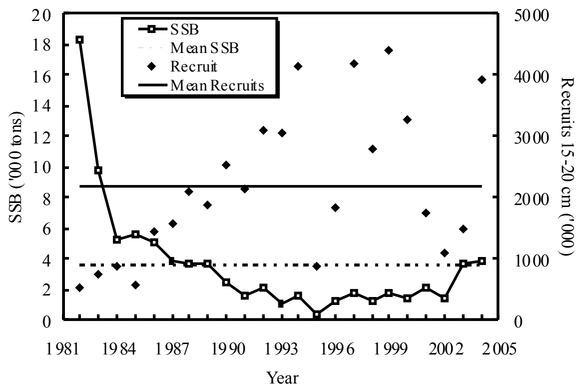
State of the American plaice stock: The stock remains severely depleted.

Assessment of Atlantic wolffish: No analytical assessment was possible.



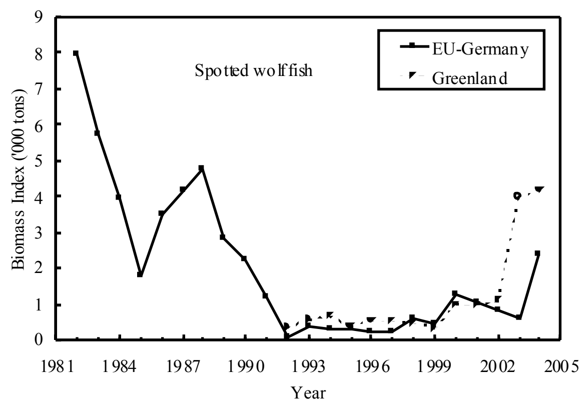
Recruitment: Index increased steadily up to 1995, but varied considerably thereafter.

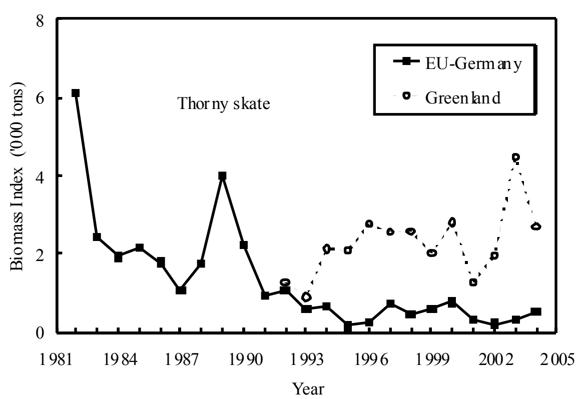
SSB: Since 1982, the SSB index decreased drastically and remained severely depleted since the early 1990s. SSB in 2003 and 2004 is at average.



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.*

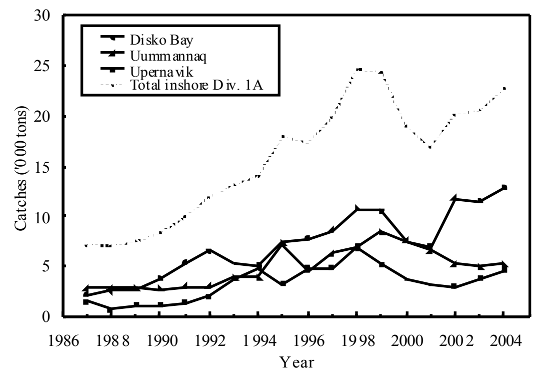
Greenland Halibut (Reinhardtius hippoglossoides) in Division 1A inshore

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.

		Catch ('000 tons)	Advice ('000 tons)
Area	Year	STACFIS	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]

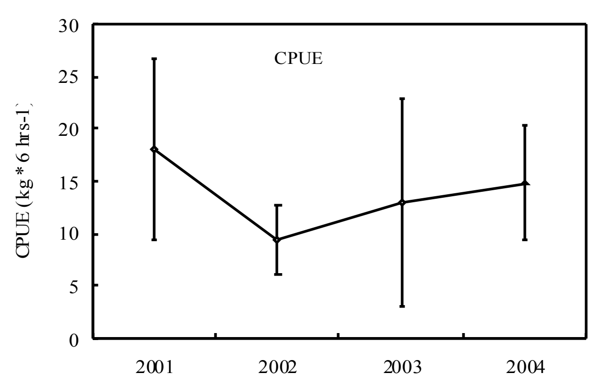
[1] No advice
[2] No increase in effort



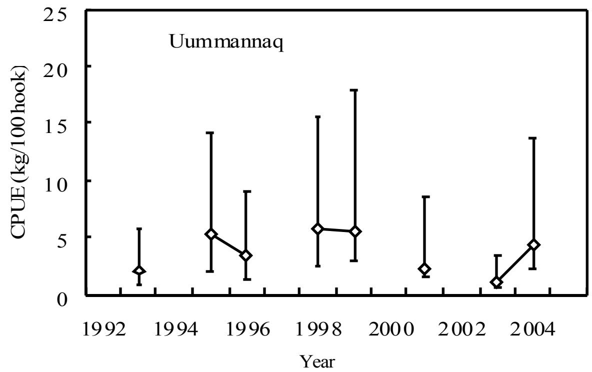
Data: Data on length frequency from commercial sampling were available for all three areas, and individual weight data were available for Upernavik. Catch rate and length frequency data were available from the longline survey in Uummannaq and a longline and gillnet survey in Disko Bay. A biomass estimate 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.

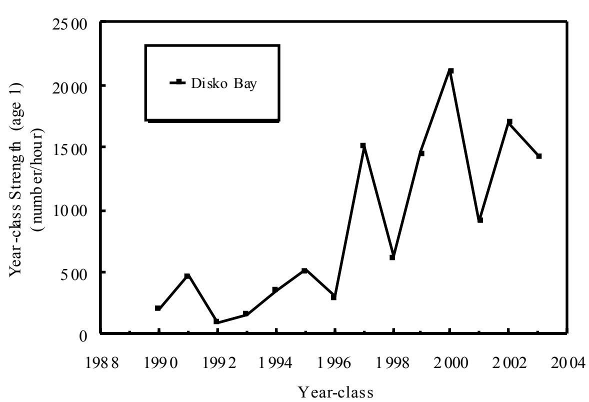


Uummannaq. Longline-survey abundance indices and landings decreased significantly from 1999 to 2003, but both survey index and landings increased slightly in 2004 compared to 2003. Mean lengths from both the surveys and in the fishery are relatively stable over the entire period, indicating that the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

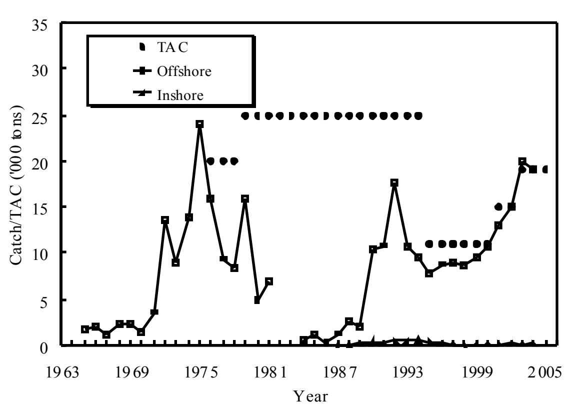
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 0 + Division 1A Offshore and Divisions 1B-1F

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.

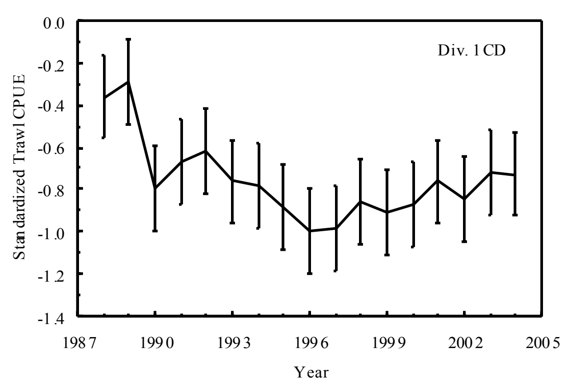
	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	15	15[1]	15[2]	15
2003	20	15[1]	19[2]	19
2004	19	7[1]	19[2]	19
2005			19[2]	19

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



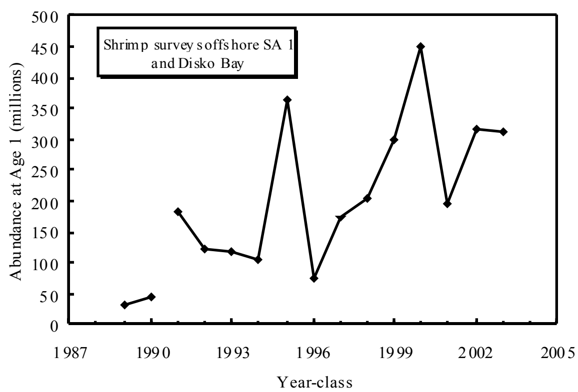
Data: Length distributions were available for assessment from SA0 and SA1. Standardized and unstandardized catch rates were available from Div. 1A and Div. 1CD. Biomass estimates from deep sea surveys in 2004 were available from Div. 0A, Div. 1A (73°N-77°N) and Div. 1CD. Further, biomass and recruitment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

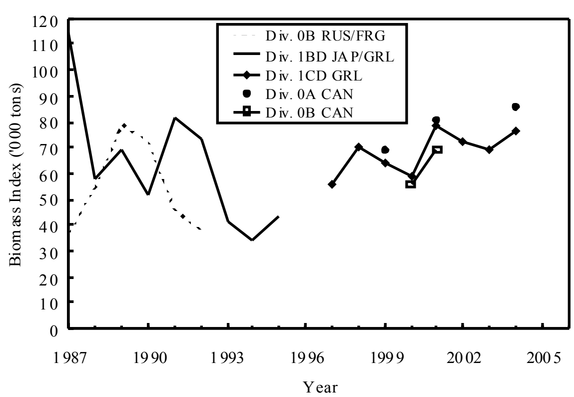


Fishing Mortality: Level not known.

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:

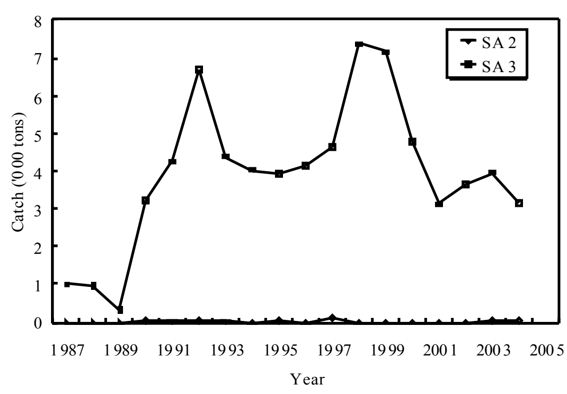
Roughhead Grenadier (Macrourus berglax) in Subareas 2 and 3

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		

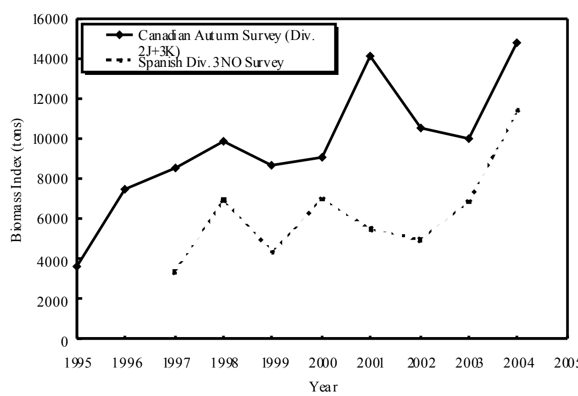
[1] Provisional
[2] STACFIS could not precisely estimate the catch.



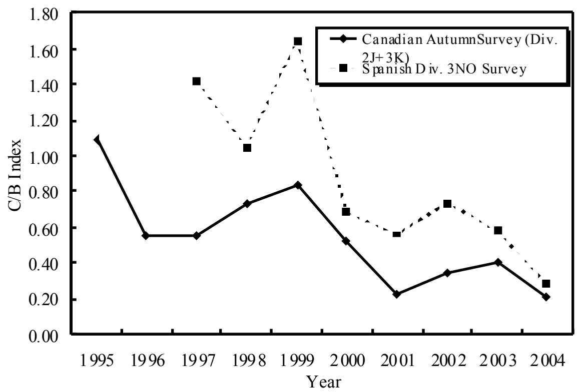
Data: Biomass indices were derived from: the Canadian stratified bottom trawl autumn surveys in Div. 2J and 3K since 1978, the Canadian stratified random bottom trawl spring surveys in Div. 3LNO since 1971, the Canadian stratified deepwater bottom trawl surveys in Div. 3KLMN in 1991, 1994 and 1995, the 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.

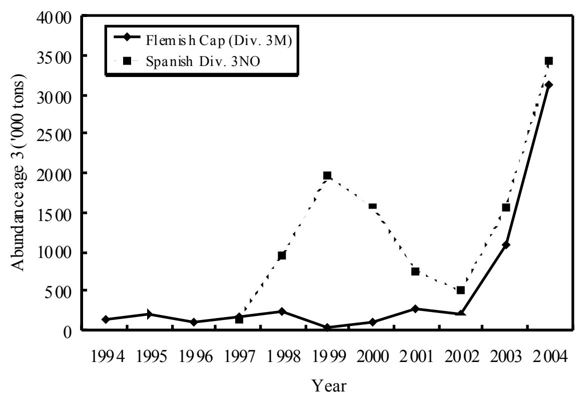
Biomass: Although the Canadian autumn survey series (Div. 2J+3K) and the Spanish survey in Div. 3NO do not cover the entire distribution of the stock, they are considered as the best survey information to monitor trends is resource status because their depth coverage is going down to 1 500 m. According 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.

[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 1.5ºC 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) Cuba EU-France (M) EU-Netherlands Korea	Canada (C&A) Cuba EU-France (M) EU-Netherlands EU-Spain Faroe Islands Greenland Korea	Greenland Canada (C&A)	Canada (C&A) Cuba Greenland Lithuania	Canada (C&A) Cuba EU-Germany EU-Netherlands Greenland Lithuania	Canada (C&A) Canada (M) (partial) Canada (Q) Cuba EU-Denmark EU-France (M) EU-Netherlands Greenland Korea Lithuania Norway	Due date 30 June, 4 received to date.

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.

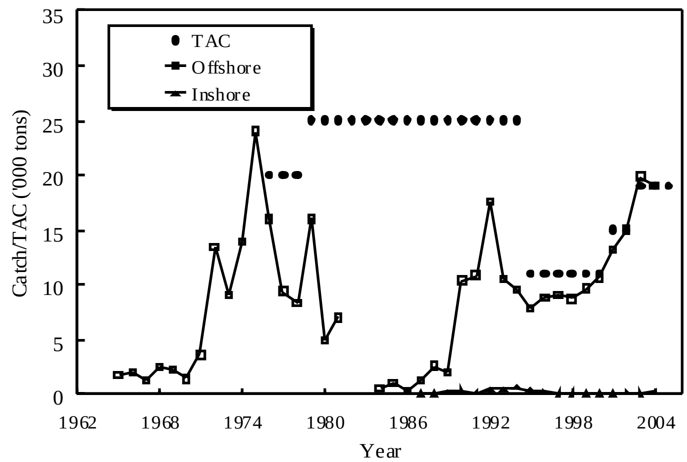


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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.

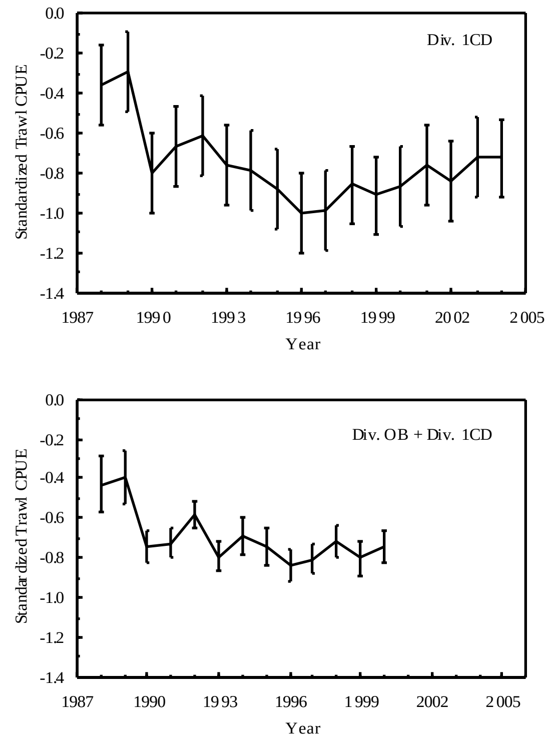


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawl CPUE from SA0 and Div. 1CD. B: Standardized trawl CPUE from Div. 1CD with ± S.E.

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).

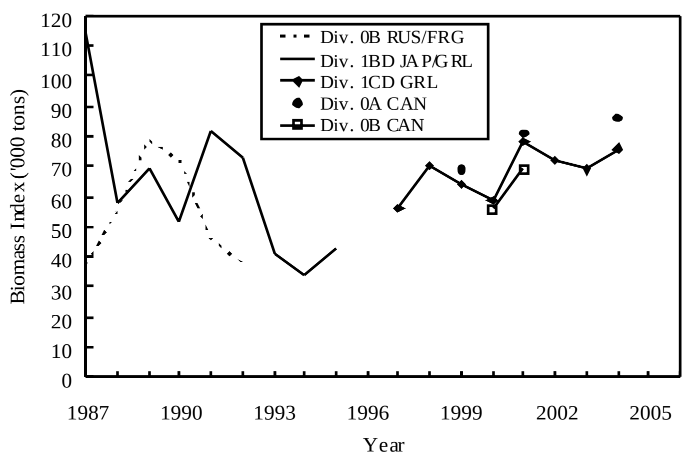


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from surveys.

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.

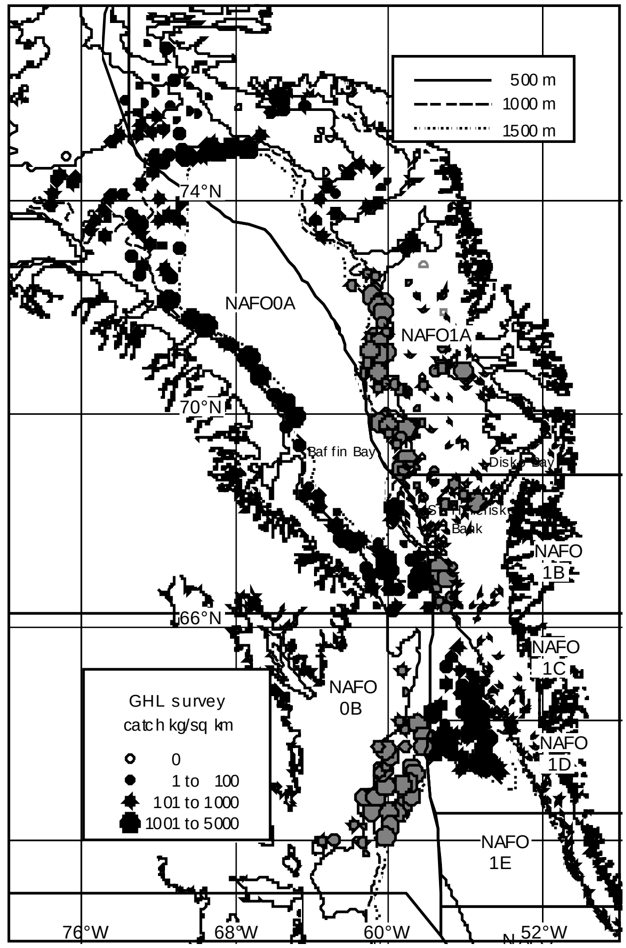


Fig. 1.4. Distribution of catches in deep sea surveys conducted by Canada and Greenland in 2001 (grey) and 2004 (black). Further the position of the hauls in the 2004 Greenland shrimp survey are shown as stars (This survey is using a different gear and the catches are not directly comparable to the catches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

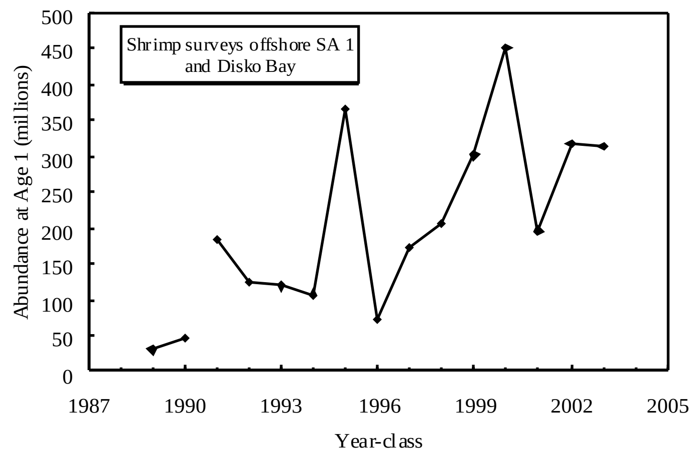


Fig. 1.5. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (The 1989 and 1990 year-classes are poorly estimated as age 1).

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.

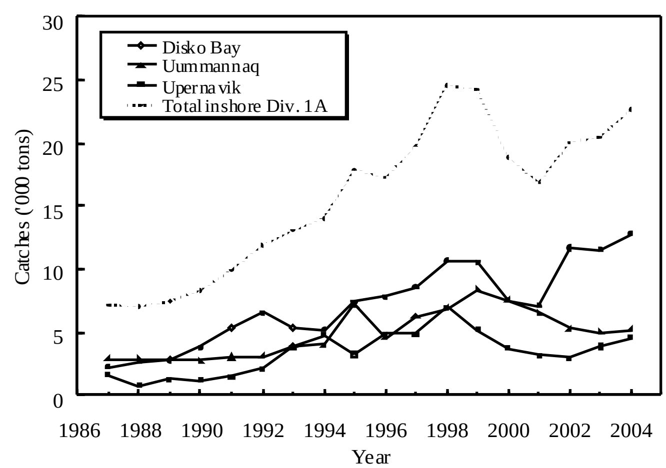


Fig. 2.1. Greenland halibut in Div. 1A inshore: landings by area.

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.

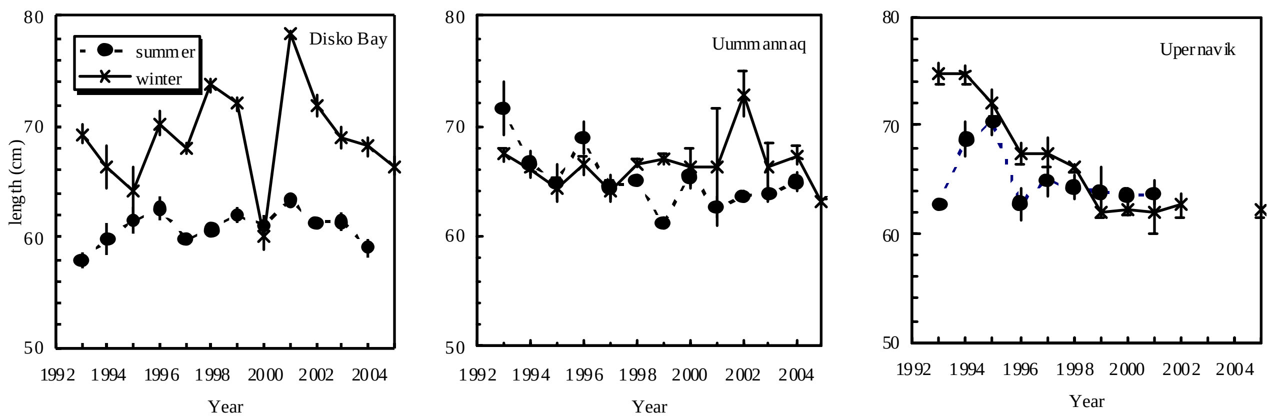


Fig. 2.2 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik with 95% conf. Int.

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.

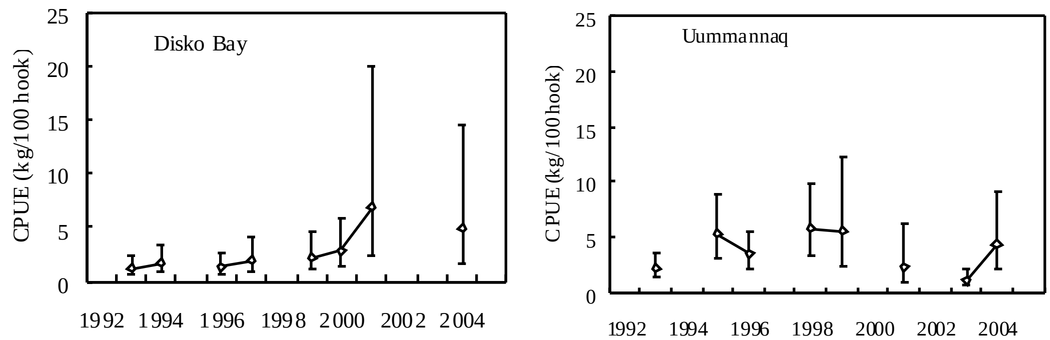


Fig. 2.3 Greenland halibut in Div. 1A inshore: standardised CPUE from longline surveys in Disko Bay and Uummannaq 1993-2004, re-transformed values given as kg/100 hooks, while in the 2004 report it was presented as relative re-transformed values

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.

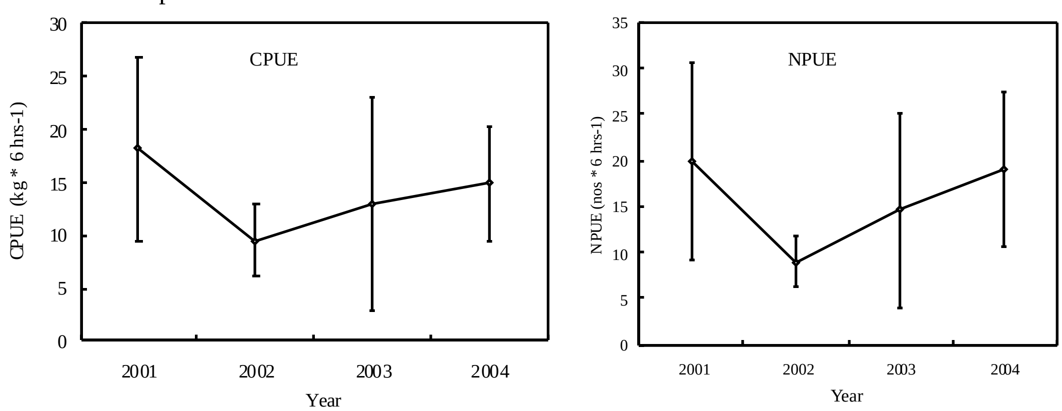


Fig. 2.4. Greenland halibut in Div. 1A inshore: CPUE and NPUE from gillnet survey Disko Bay 2001-2004

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.

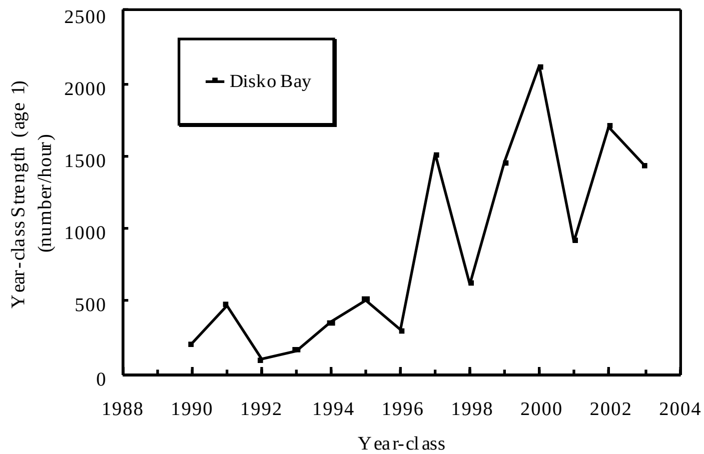


Fig. 2.5 Greenland halibut in Disko Bay: recruitment at age 1 from Greenland shrimp trawl survey.

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).

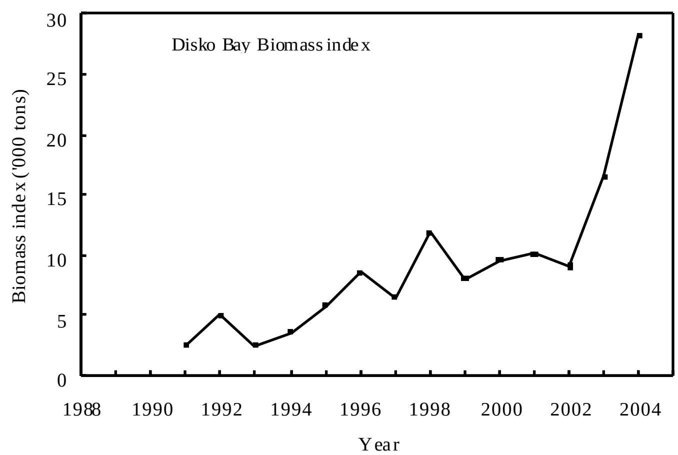


Fig. 2.6 Greenland halibut in Disko Bay: biomass indices from Greenland shrimp trawl survey.

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.

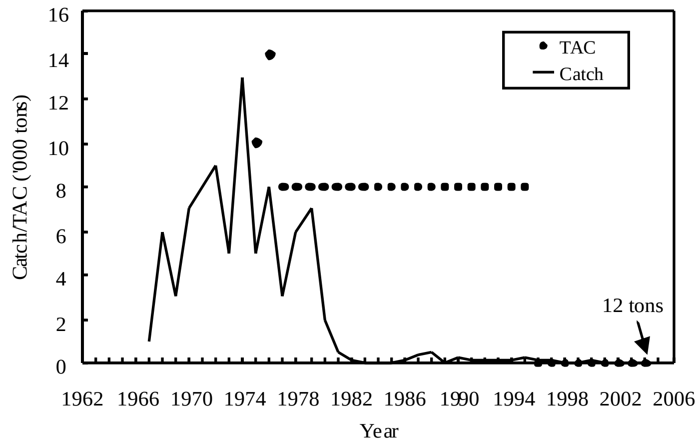


Fig. 3.1. Roundnose grenadier in Subareas 0+1: catches and TACs.

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).

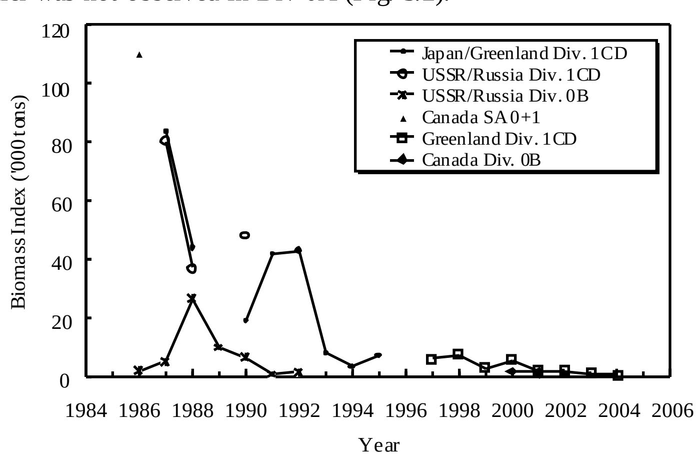


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland and Greenland surveys in Div. 0B and Div. 1CD.

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.

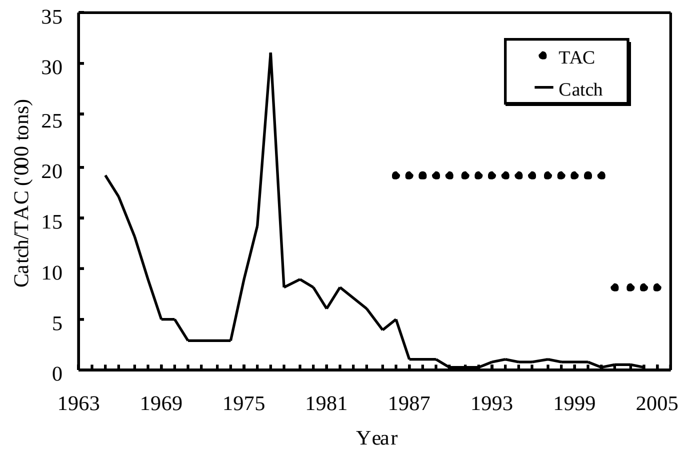


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

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.

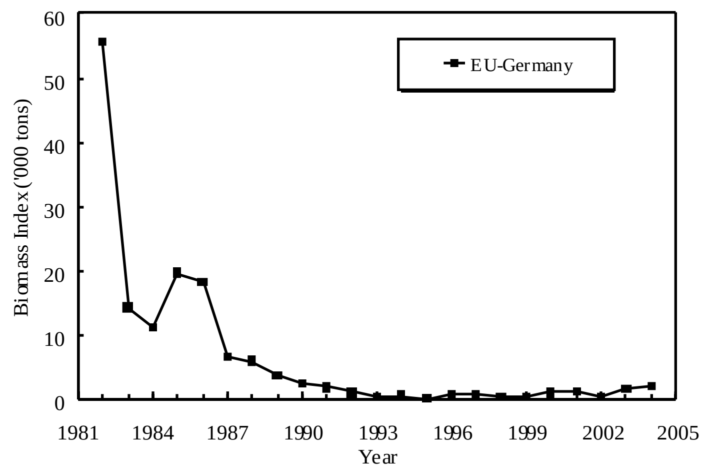


Fig. 4.2. Golden redfish in NAFO Subarea 1: survey biomass index.

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.

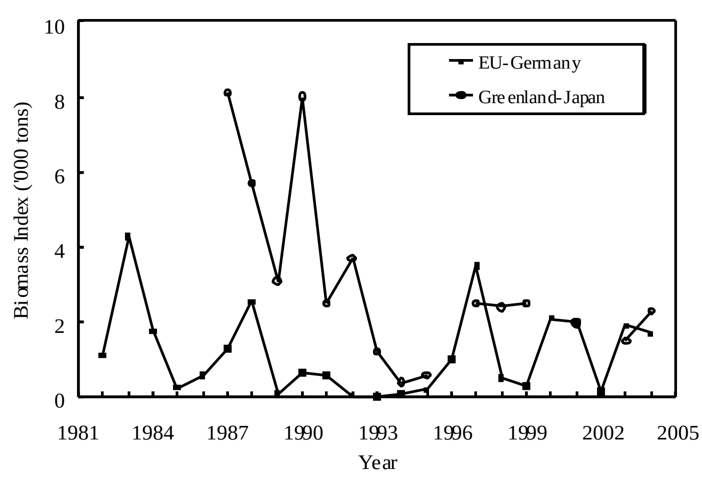


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass indices.

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).

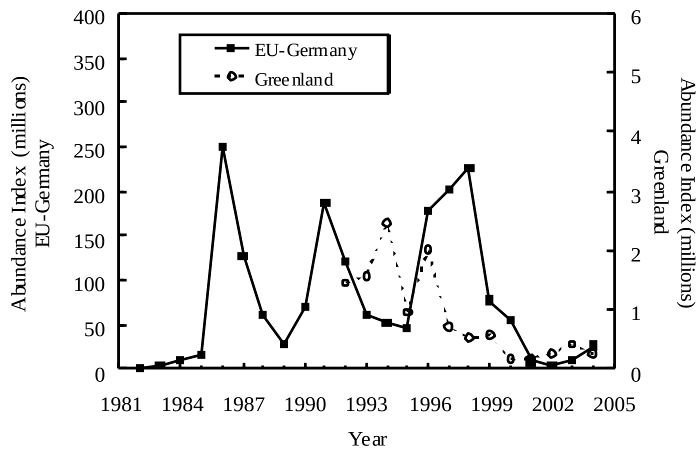


Fig.4.4. Juvenile redfish (deep-sea redfish and golden redfish combined) in Subarea 1: survey abundance indices.

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.

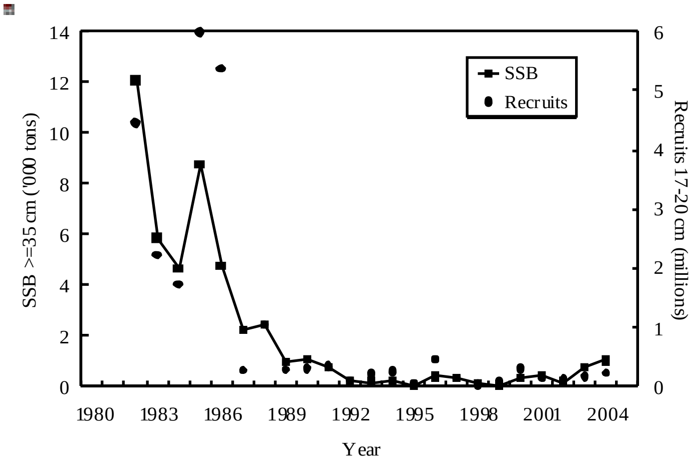


Fig. 4.5. Golden redfish Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

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.

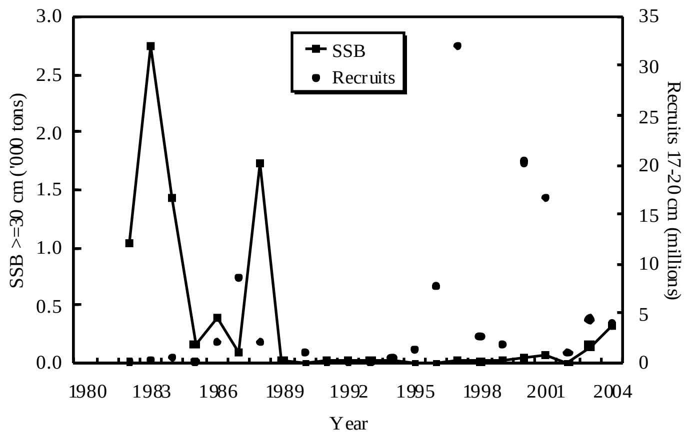


Fig. 4.6. Deep-sea redfish in Subarea 1: SSB and recruitment indices as derived from the Germany groundfish survey in the given years.

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.

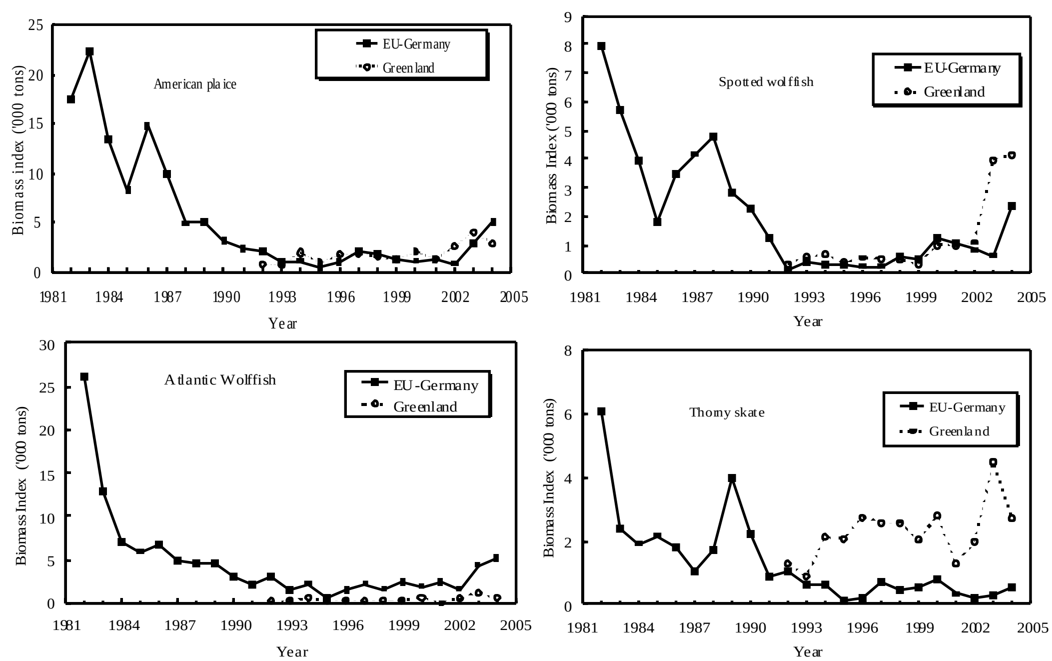


Fig. 5.1. Finfish in Subarea 1: survey biomass indices of various finfish species.

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.

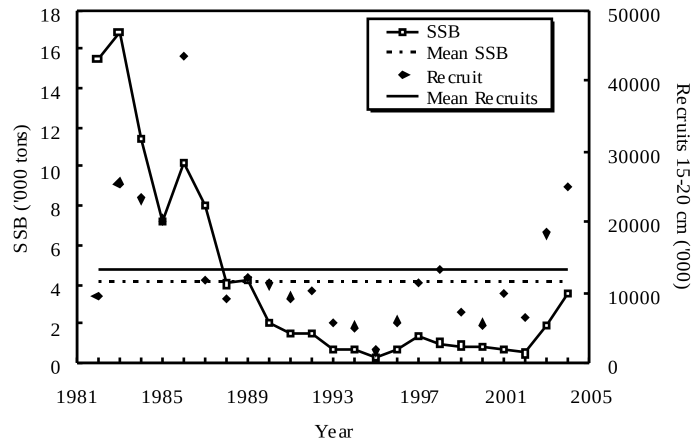


Fig. 5.2. American plaice in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey.

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.

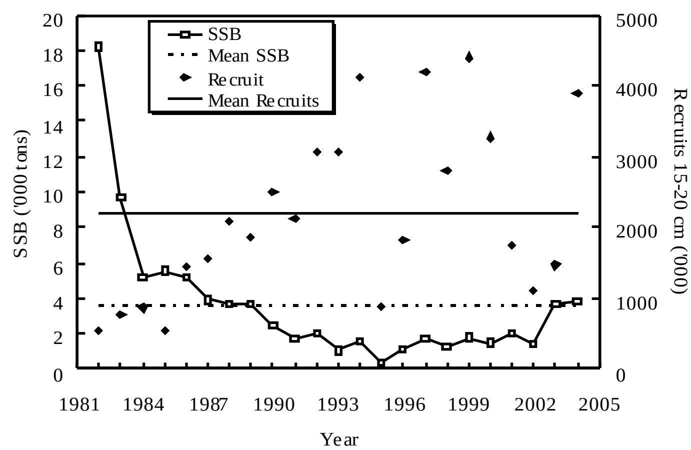


Fig. 5.3. Atlantic wolffish in Subarea 1. SSB and recruitment indices as derived from the EU-Germany groundfish survey.

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.

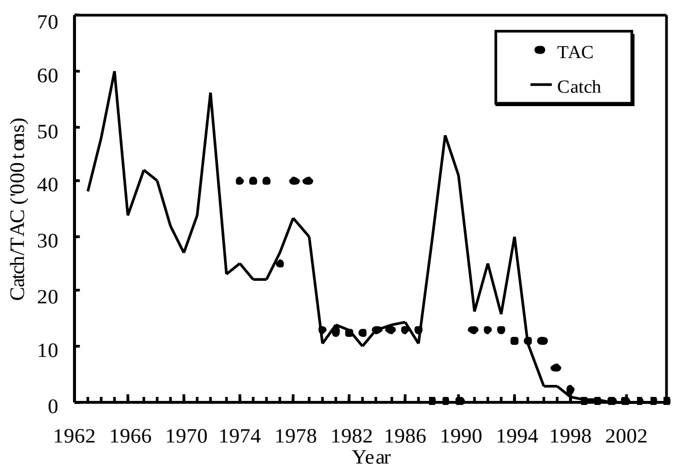


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch figures include estimates of misreported catches since 1988.

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.

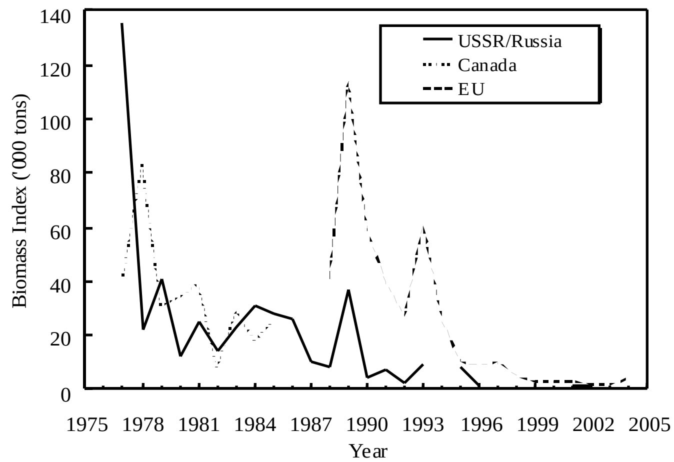


Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

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.

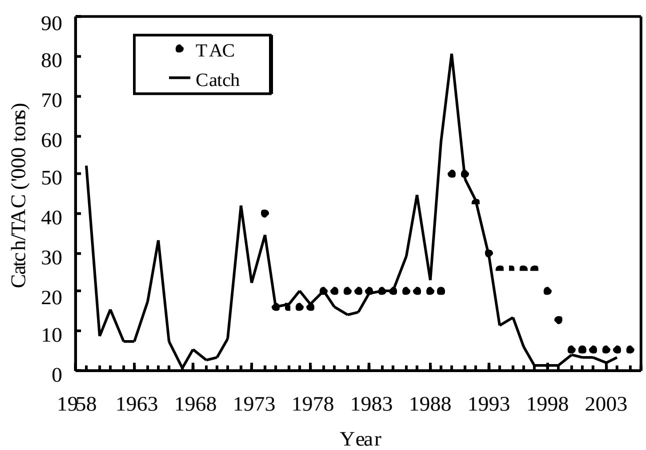


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

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.

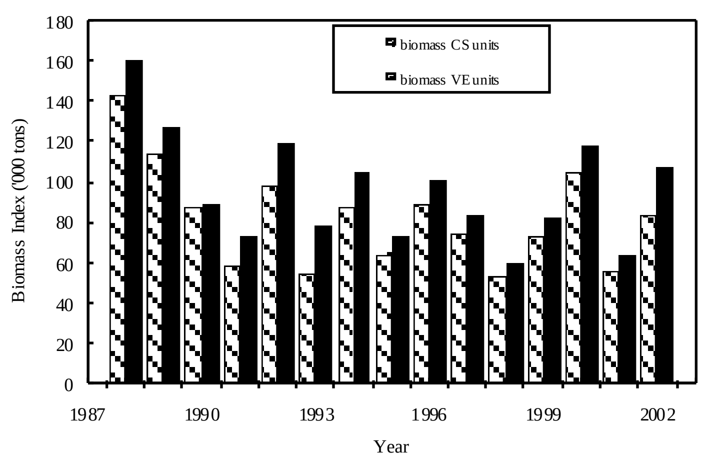


Fig. 7.2. Beaked redfish in Div. 3M: survey biomass in original R/V *Cornide Saavedra* units (CS) and transformed R/V *Vizconde de Eza* units (VE), 1988-2004.

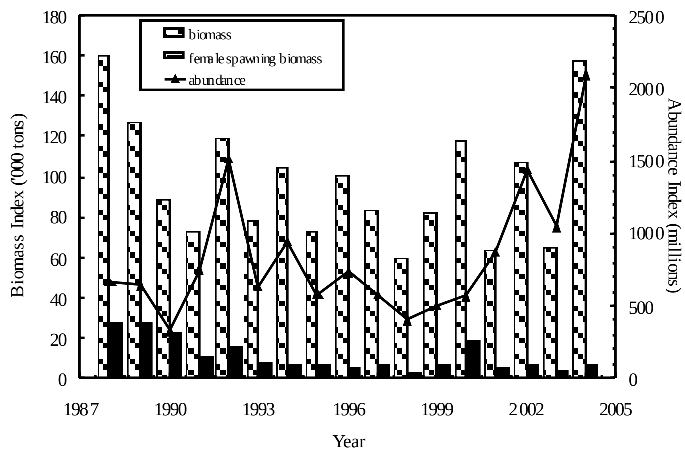


Fig. 7.3. Beaked redfish in Div. 3M: survey biomass, female spawning biomass and abundance from EU (1988-2004) surveys.

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.

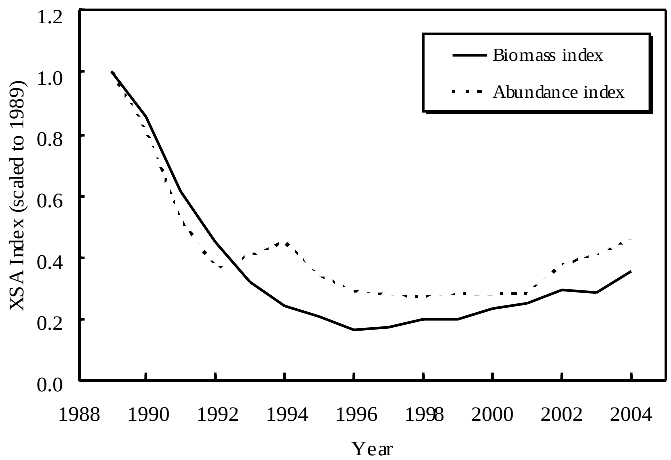


Fig. 7.4. Beaked redfish in Div. 3M: age 4+ biomass and Age 4+abundance trends from XSA.

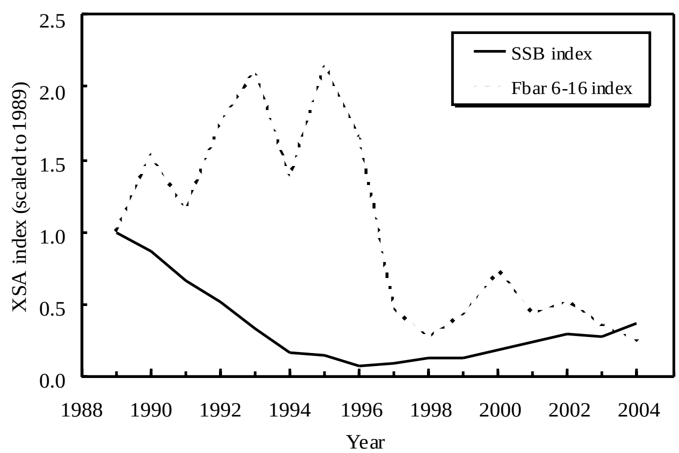


Fig. 7.5. Beaked redfish in Div. 3M: female spawning biomass and fishing mortality trends from XSA.

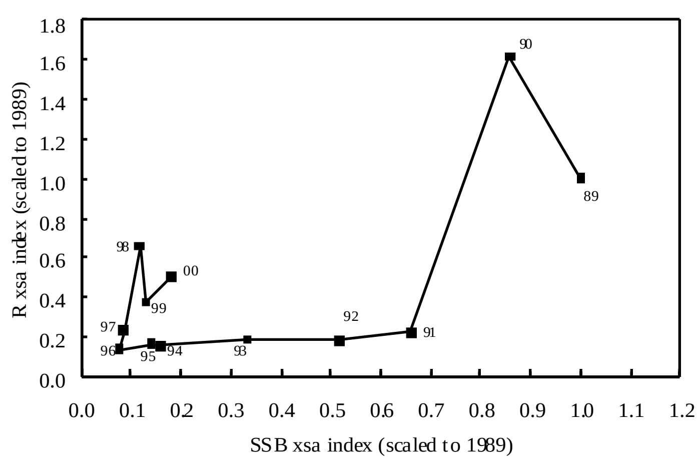


Fig. 7.6. Beaked redfish in Div. 3M: relative recruitment from XSA (year-classes indicated).

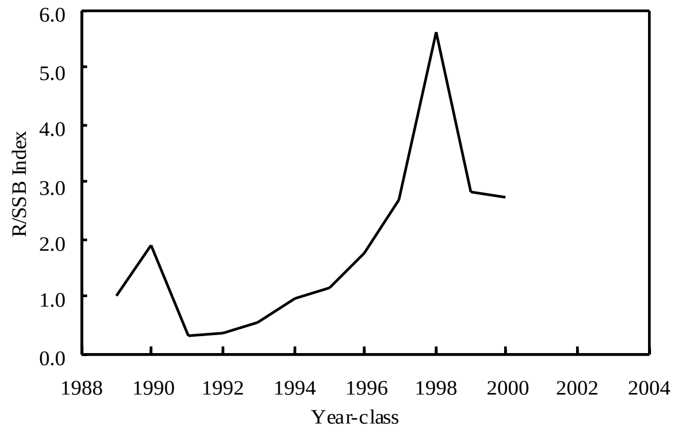


Fig. 7.7. Beaked redfish in Div. 3M: recruitment per thousand tons of SSB trend from XSA (recruits at age 4 four years later than SSB).

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.

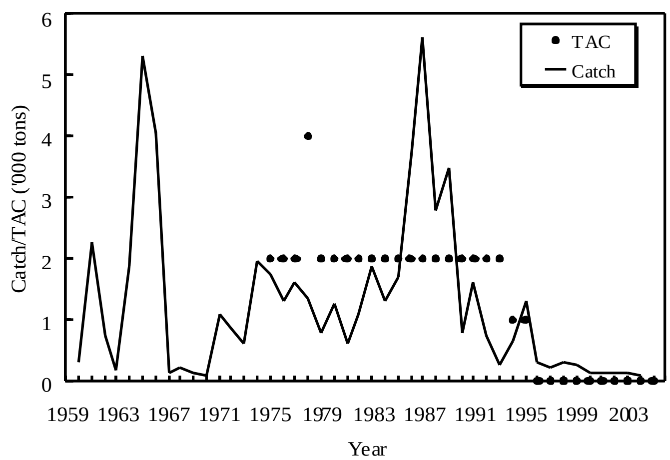


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs.

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

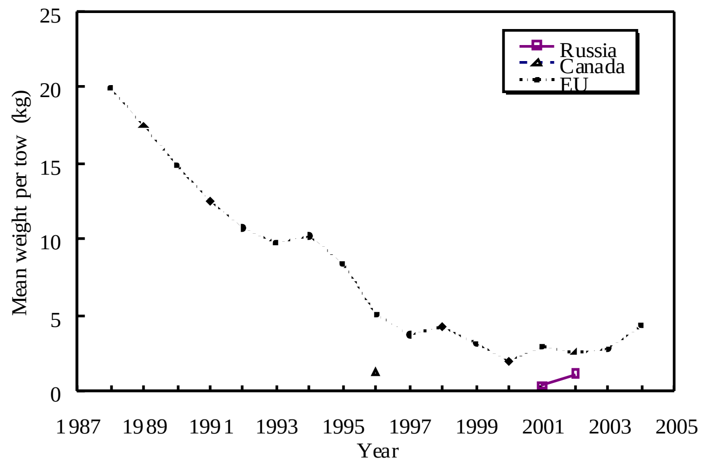


Fig. 8.2. American plaice in Div. 3M: mean weight per tow in the surveys.

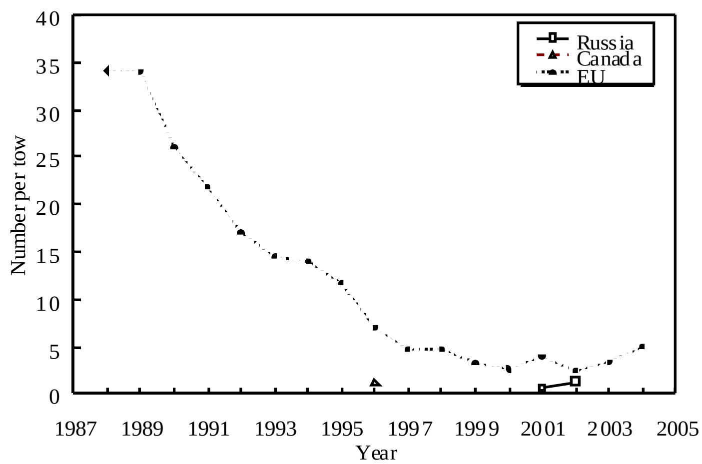


Fig. 8.3. American plaice in Div. 3M: mean number per tow in the surveys.

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.

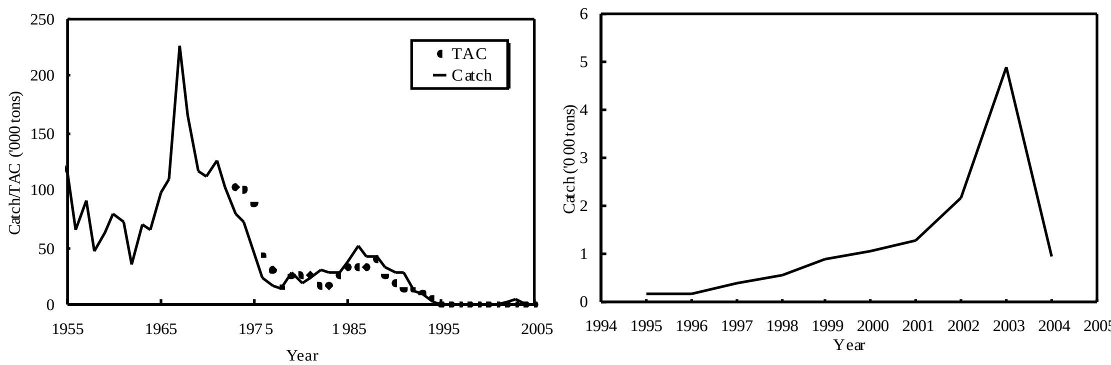


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

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).

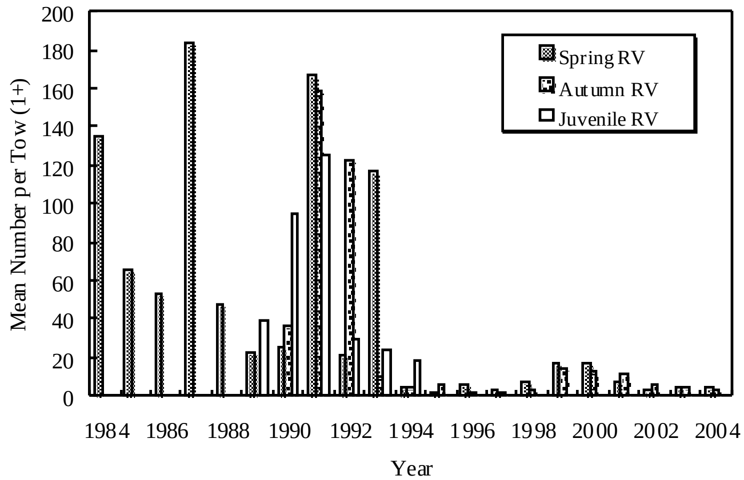


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian RV surveys.

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).

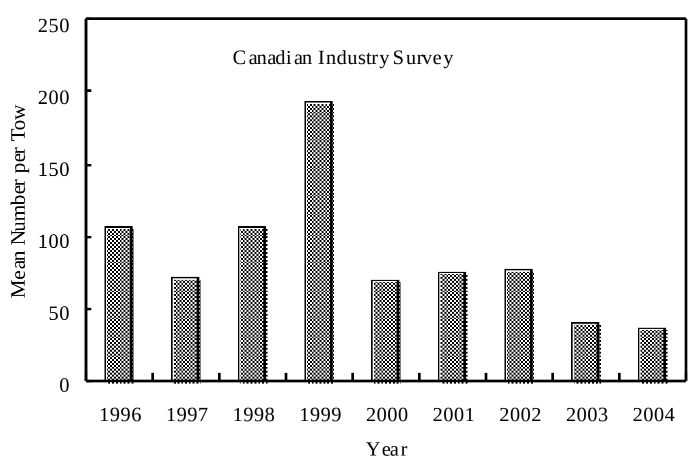


Fig. 9.3. Cod in Div. 3NO: mean number per tow from Canadian Industry surveys conducted in July.

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.

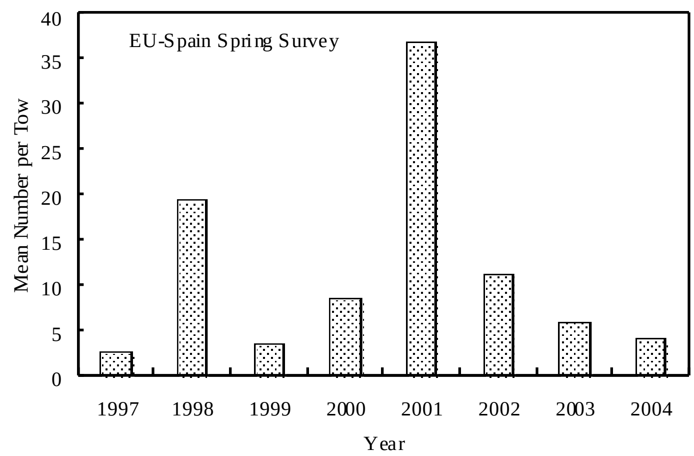


Fig. 9.4. Cod in Div. 3NO: mean number per tow from EU-Spain spring surveys.

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).

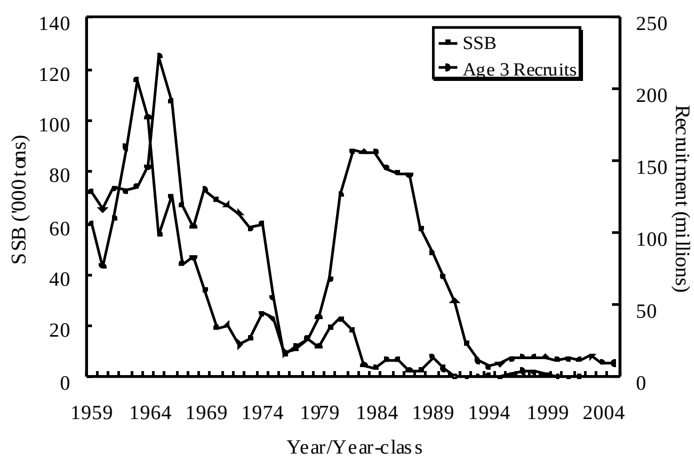


Fig. 9.5. Cod in Div. 3NO: time trend of spawner stock biomass (SSB) and corresponding recruitment from the SPA.

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.

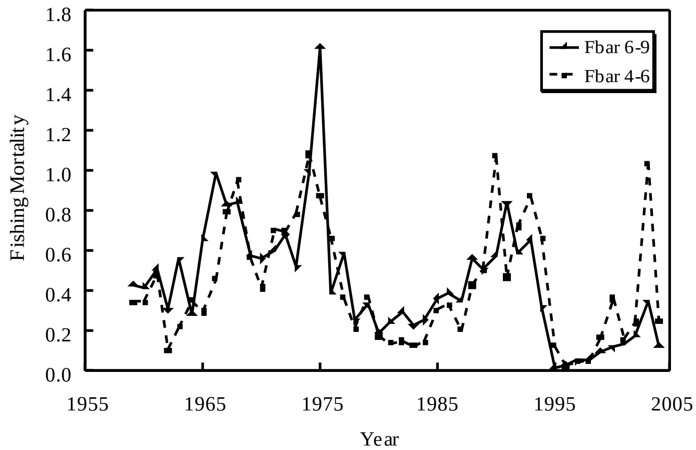


Fig. 9.6. Cod in Div. 3NO: time trend of average fishing mortalities from the SPA.

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}.

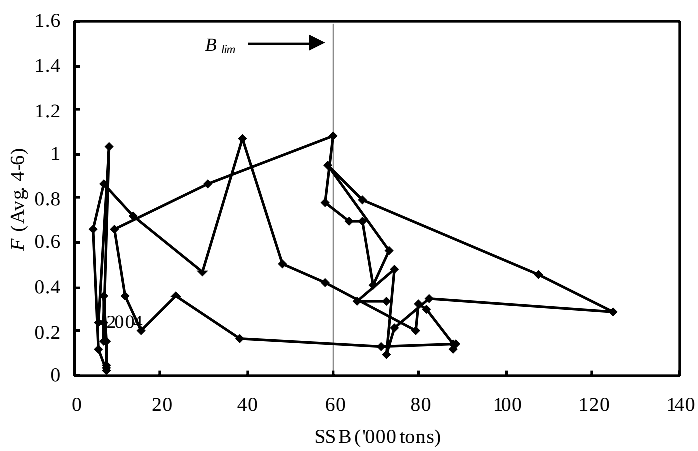


Fig. 9.7. Cod in Div. 3NO: stock trajectory 1959-2004.

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.

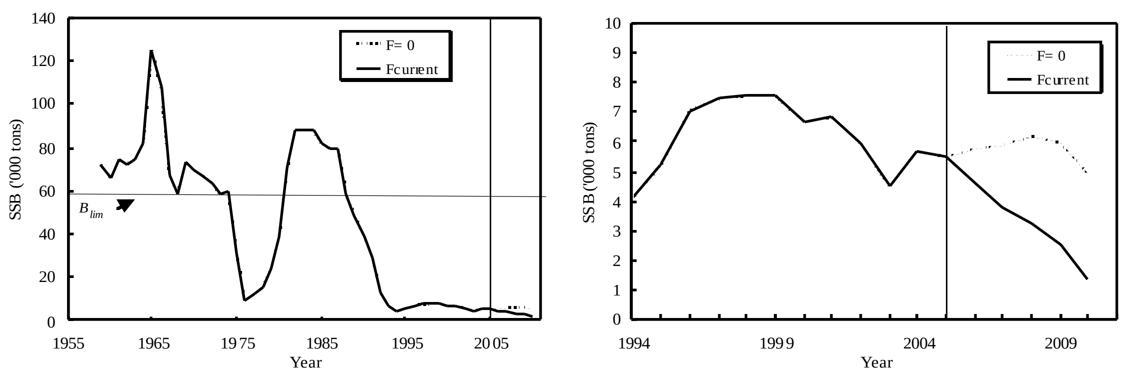


Fig. 9.8. Cod in Div. 3NO: deterministic projections under *F* = 0 (dashed line) and $F_{current}$. Panel at right highlight trends since 1994.

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.

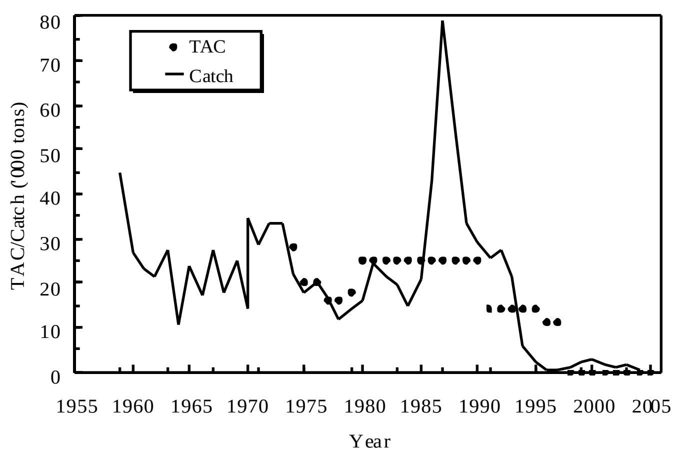


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

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).

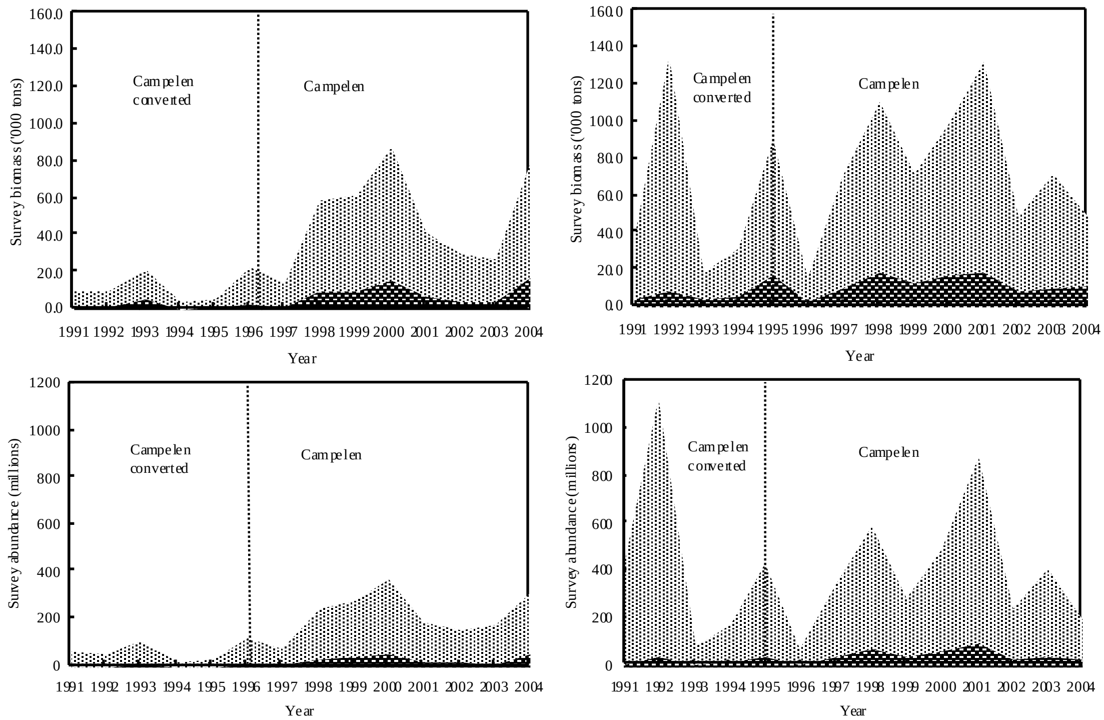


Fig. 10.2. Redfish in Div. 3LN: survey biomass, female spawning biomass and abundance, 1991-2004 (darker portion = female SSB/female spawners).

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.

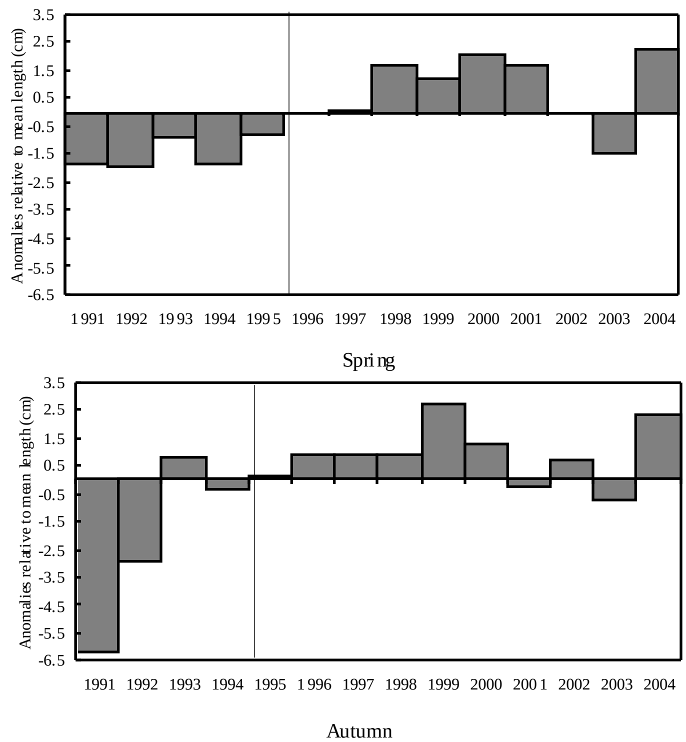


Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2004.

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).

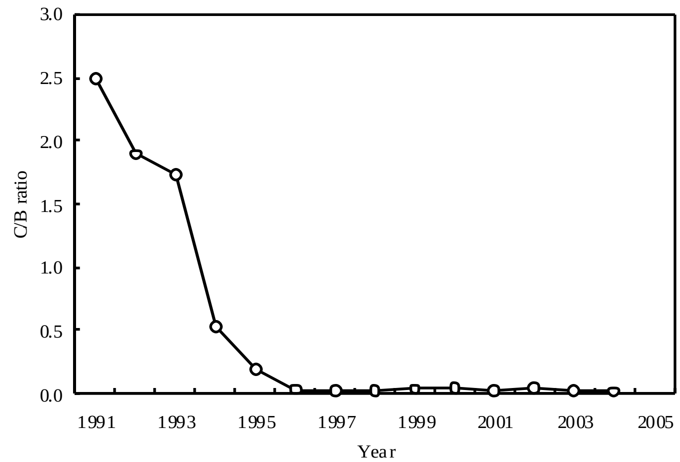


Fig. 10.4. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (moving average biomass, 1991-2004).

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.

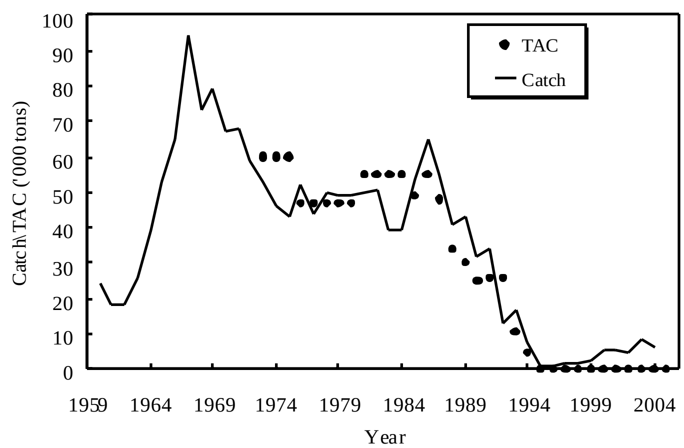


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs.

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).

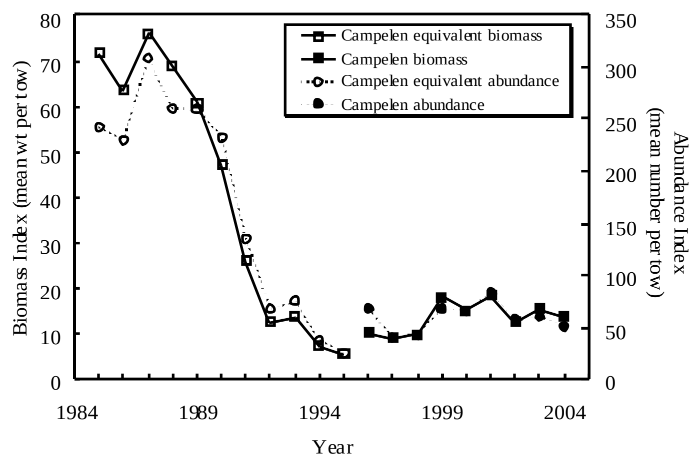


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys.

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).

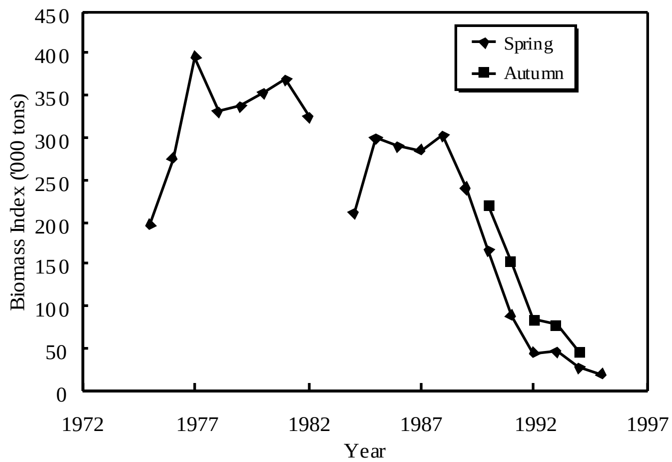


Fig 11.3. American plaice in Div. 3LNO: biomass index as swept area estimates from Canadian spring and autumn surveys using the Engel groundfish trawl.

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.

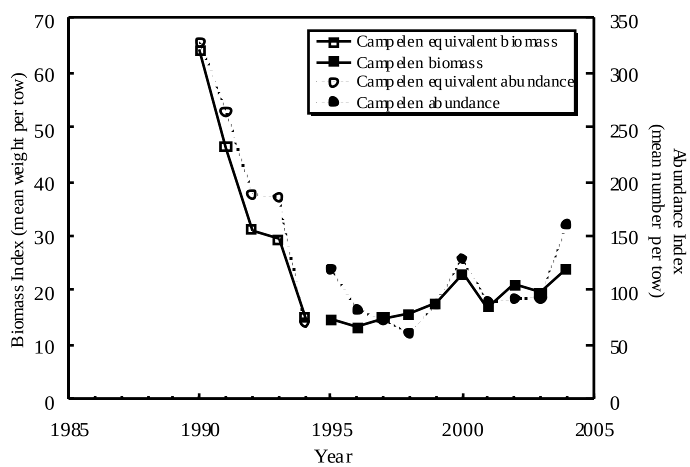


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys.

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).

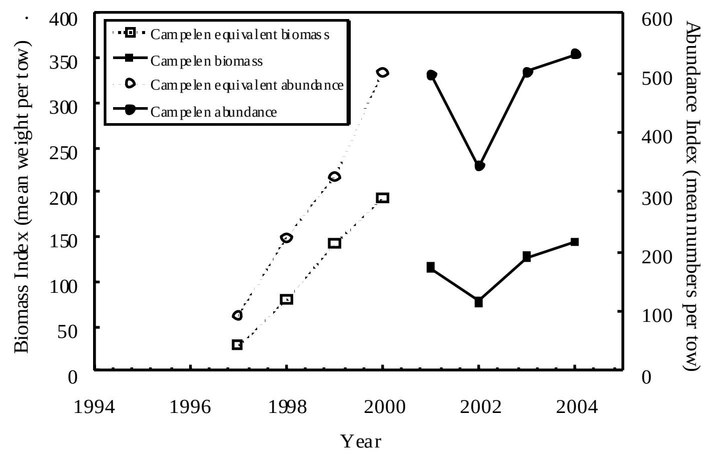


Fig. 11.5. American plaice in Div. 3LNO: biomass and abundance indices from the survey by EU-Spain.

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).

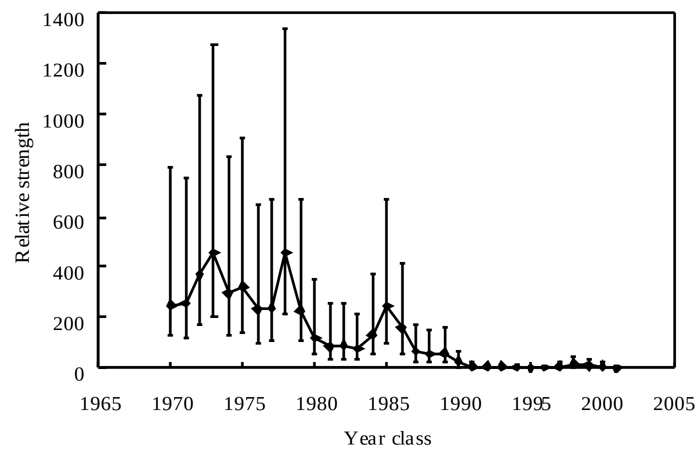


Fig. 11.6. American plaice in Div. 3LNO: estimates of relative cohort strength from Canadian surveys.

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.

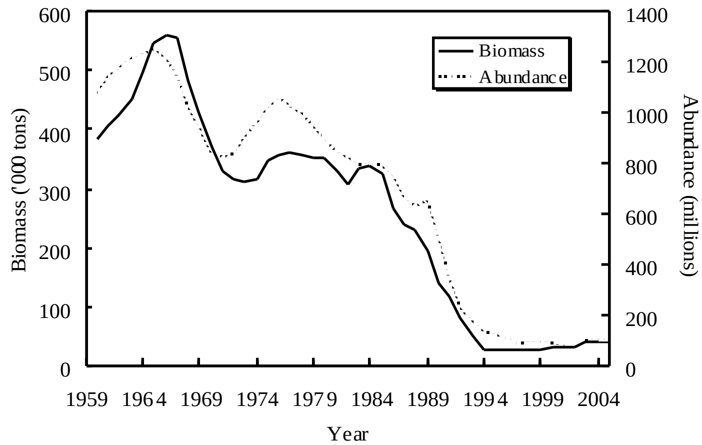


Fig. 11.7. American plaice in Div. 3LNO: population abundance and biomass from VPA.

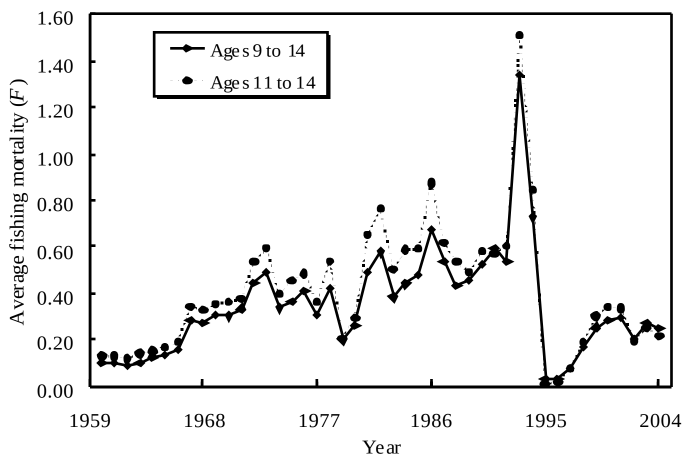


Fig. 11.8. American plaice in Div. 3LNO: average fishing mortality from VPA.

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.

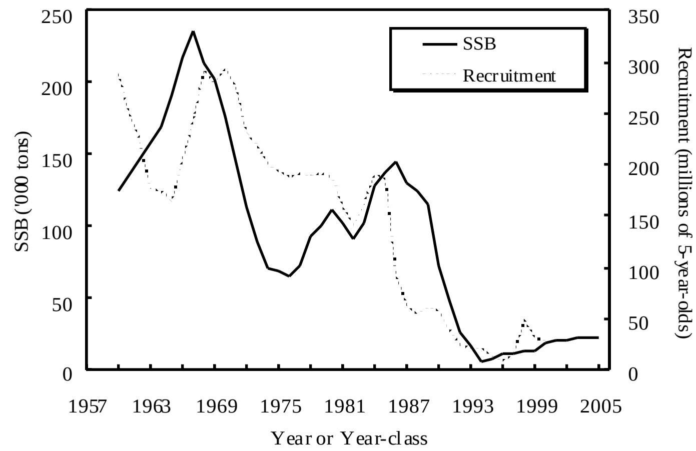


Fig. 11.9. American plaice in Div. 3LNO: spawning stock biomass and recruitment from VPA.

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.

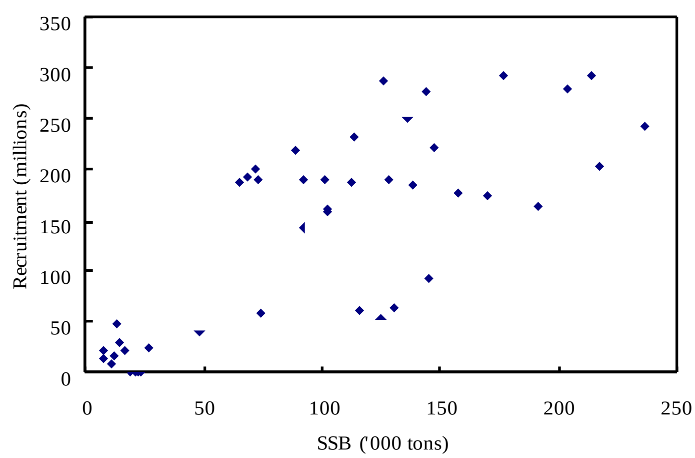


Fig. 11.10. American plaice in Div. 3LNO: stock recruitment scatter-plot.

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).

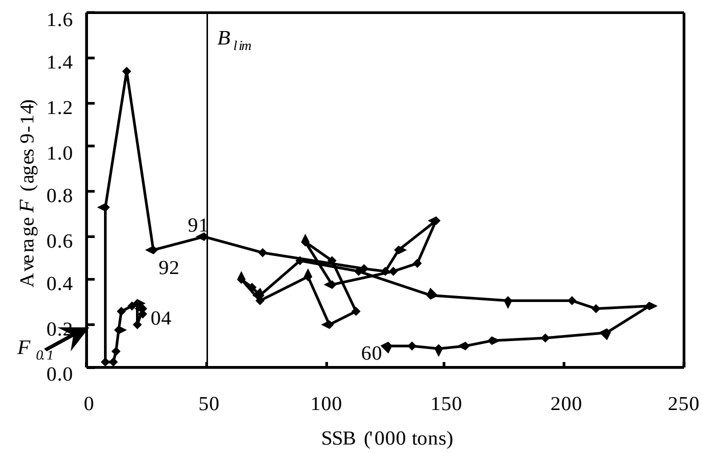


Fig. 11.11. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework.

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.

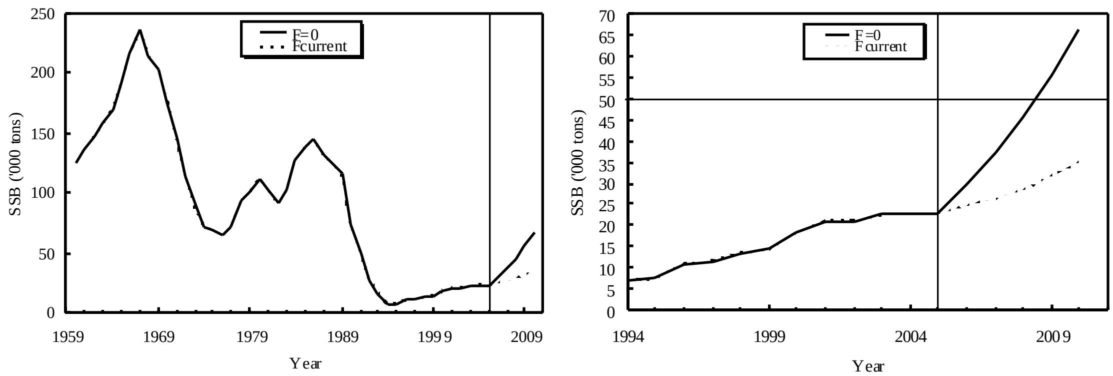


Fig. 11.12. American plaice in Div. 3LNO: projected spawning stock biomass at $F_{current}$ and $F = 0$.

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.

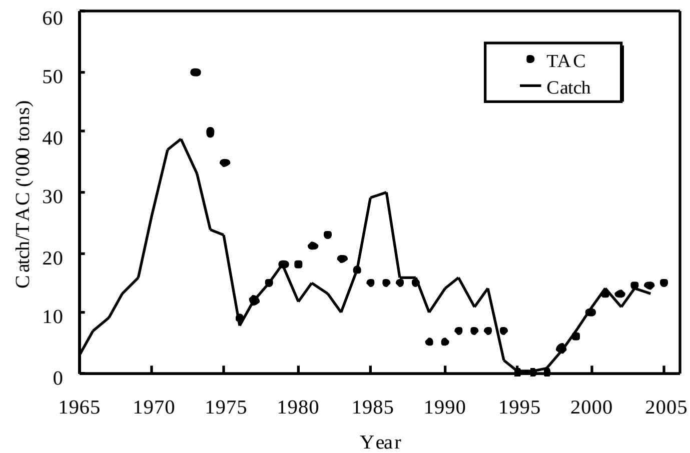


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

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).

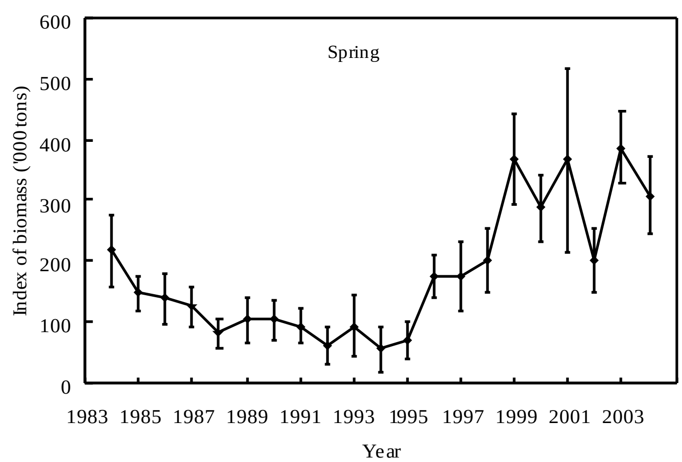


Fig. 12.2. Yellowtail flounder in Div. 3LNO: index of biomass from Canadian spring surveys. Error bars are approximate 95% confidence limits.

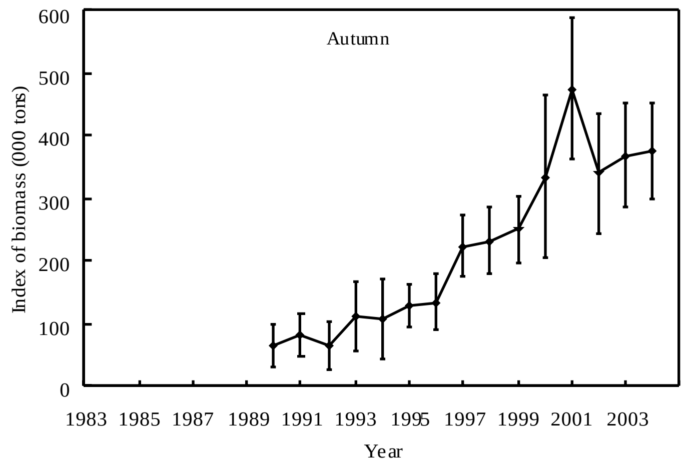


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from Canadian autumn surveys. Error bars are approximate 95% confidence limits.

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.

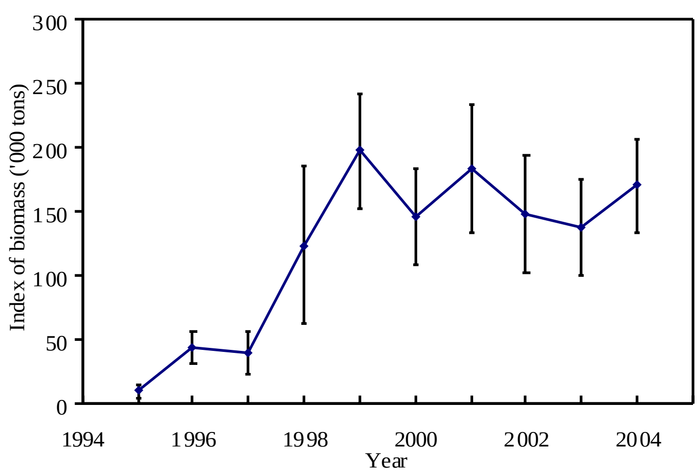


Fig. 12.4. Yellowtail flounder in Div. 3LNO: index of biomass from the Spanish spring surveys in the NRA in Div. 3NO. Error bars are ± 1 S.D.

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.

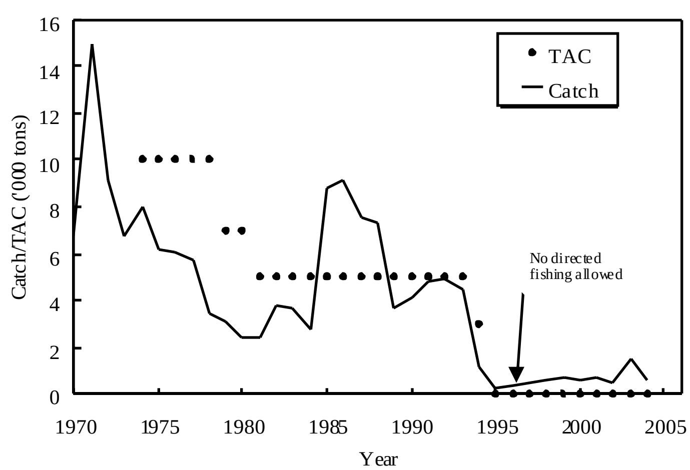


Fig. 13.1. Witch flounder in Div. 3N and 3O: catches and TAC.

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.

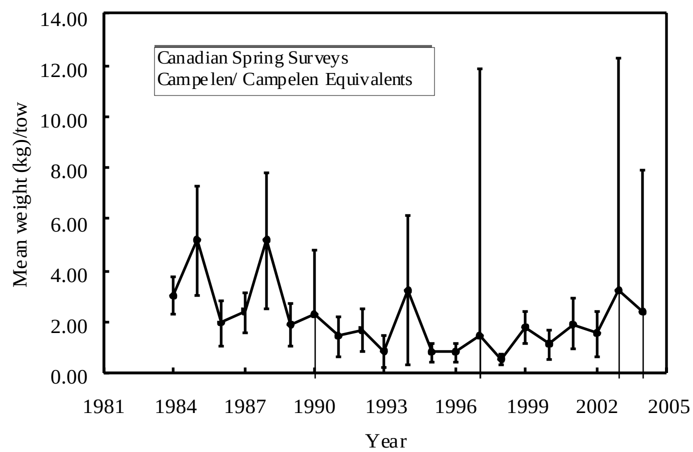


Fig. 13.2. Witch flounder in Div. 3NO: mean weights (kg) per tow from Canadian spring surveys (with 95% confidence limits).

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.

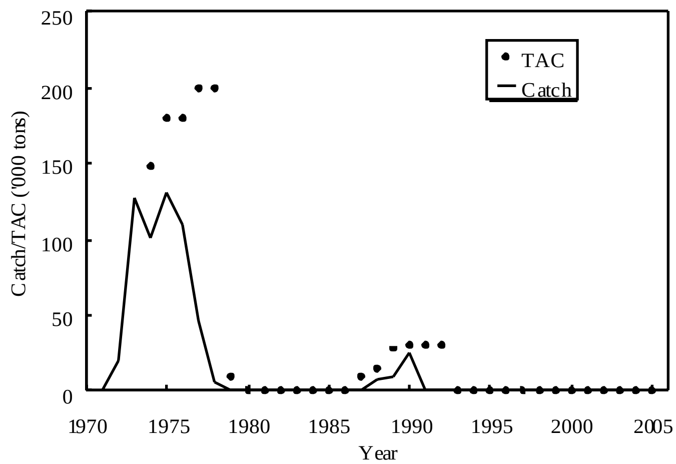


Fig. 14.1. Capelin in Div. 3NO: catches and TACs.

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.

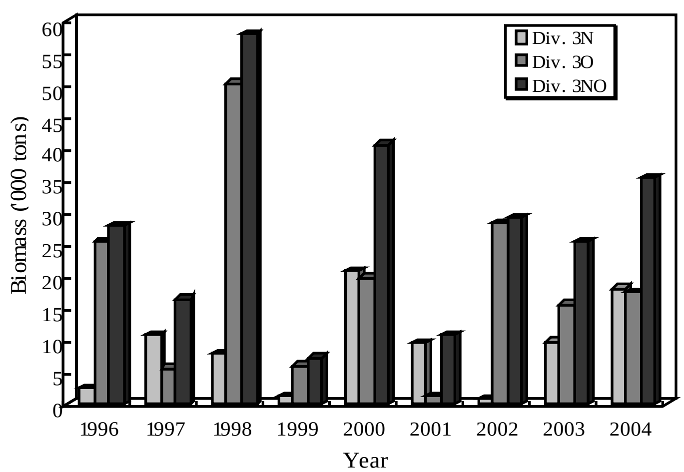


Fig. 14.2. Capelin in Div. 3NO: trawl biomass estimates in 1996-2004.

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.

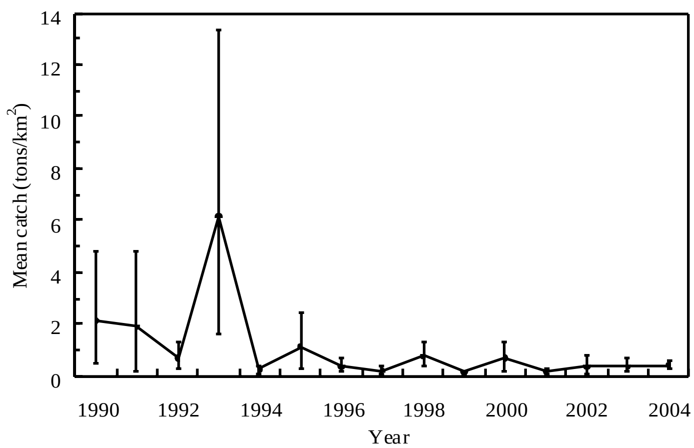


Fig. 14.3. Capelin in Div. 3NO: mean catch (tons/km^2) in 1990-2004.

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.

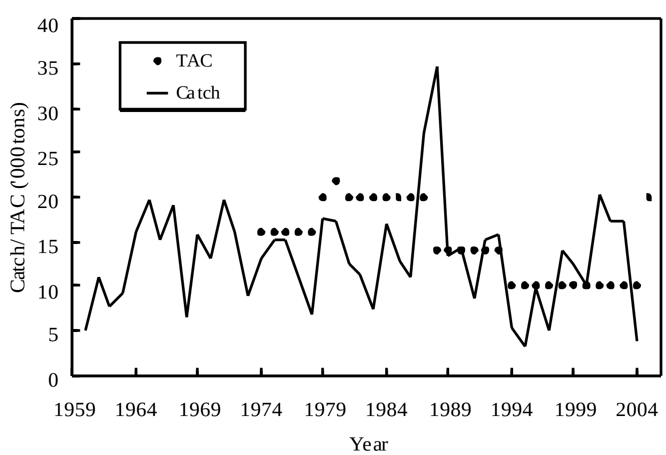


Fig. 15.1. Redfish in Div. 3O: catches and TACs (from 1974 to 2004 applied to Canadian fisheries jurisdiction; for 2005 for entire Div. 3O area).

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.

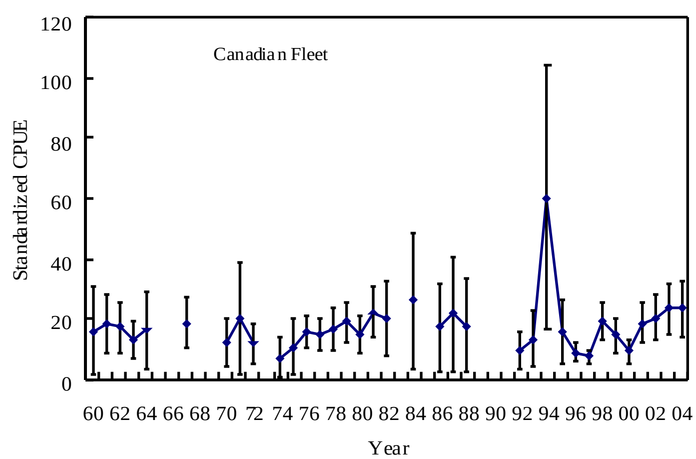


Fig. 15.2. Redfish in Div. 3O: standardized CPUE by fleet.

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.

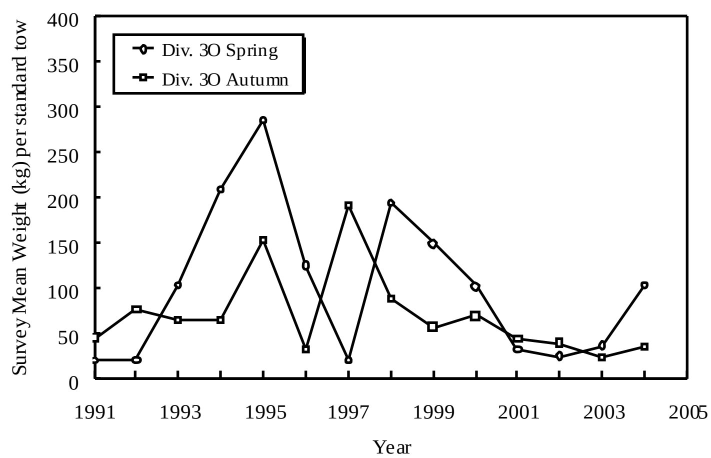


Fig. 15.3. Redfish in Div. 3O: survey biomass indices from Canadian surveys in Div. 3O in Campelen equivalent units for surveys prior to autumn 1995.

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.

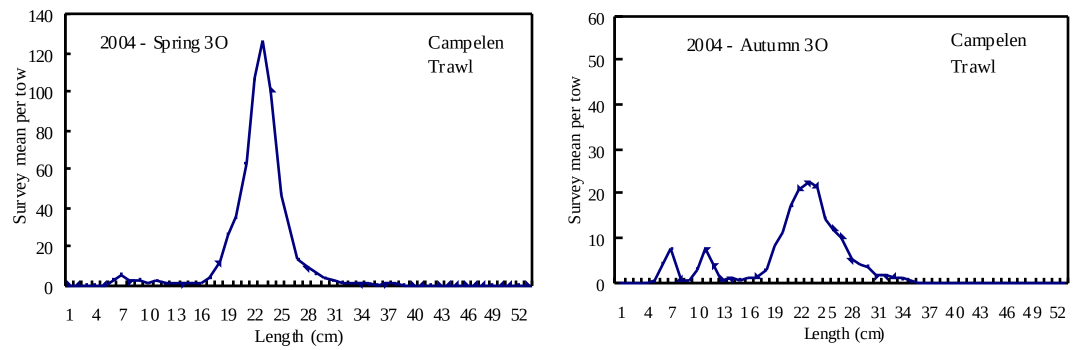


Fig. 15.4 Redfish in Div. 3O: Size distribution (stratified mean per tow) from Canadian spring and autumn surveys for 2004.

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.

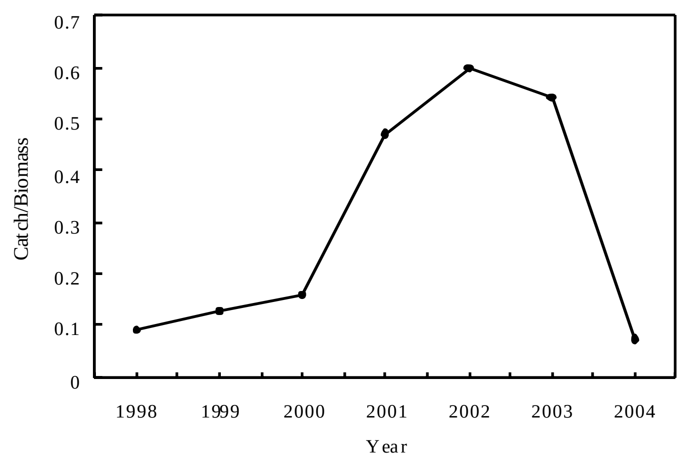


Fig. 15.5. Redfish in Div. 3O: catch/survey biomass ratios for Div. 3O.

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.

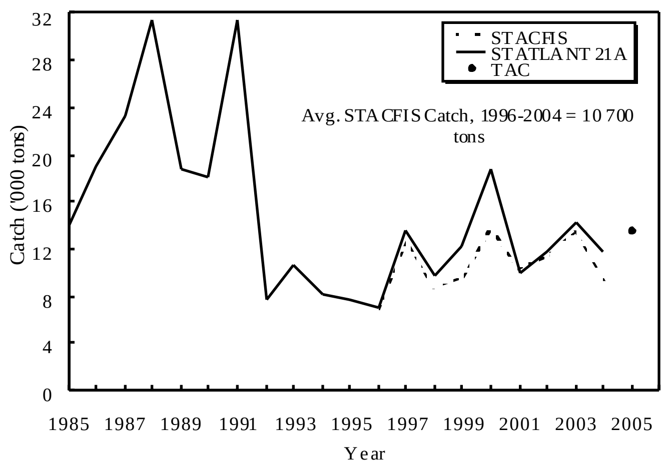


Fig. 16.1. Thorny skate in Div. 3LNO: total catches, 1985-2004.

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.

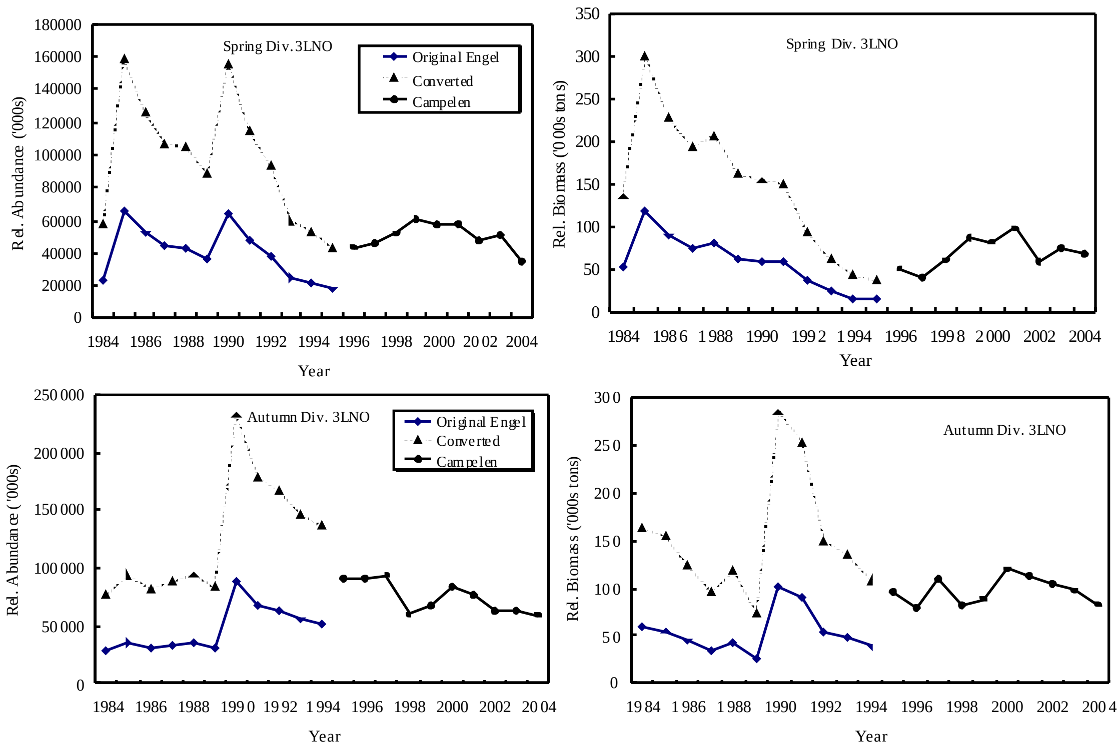


Fig. 16.2. Thorny skate in Div. 3LNO: estimates of biomass and abundance from Canadian spring (upper) and autumn (lower) surveys. Unconverted Engel trawl series are plotted separately. Engel data, converted to Campelen by the Robson method (dotted line) are also plotted for 1984-1995 and can be considered 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).

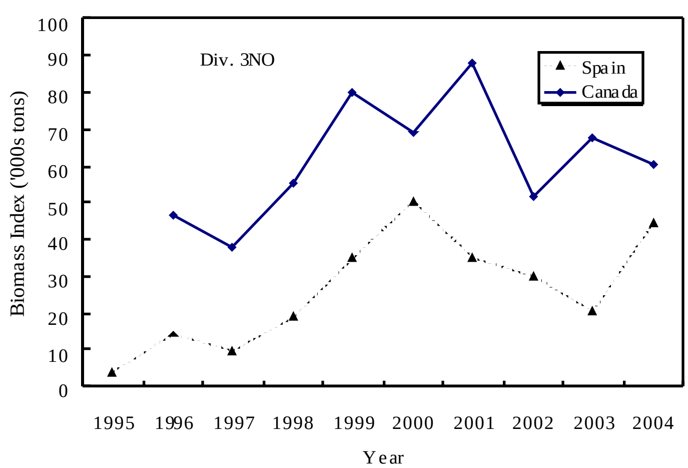


Fig. 16.3. Thorny skate in Div. 3NO: estimates of biomass from Spanish spring survey compared to Canadian spring surveys.

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.

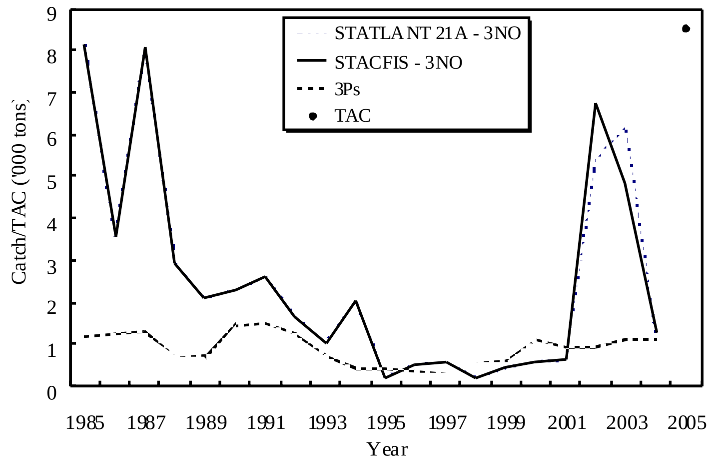


Fig. 17.1. White hake in NAFO Div. 3NO and Subdiv. 3Ps: total catches and TACs.

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).

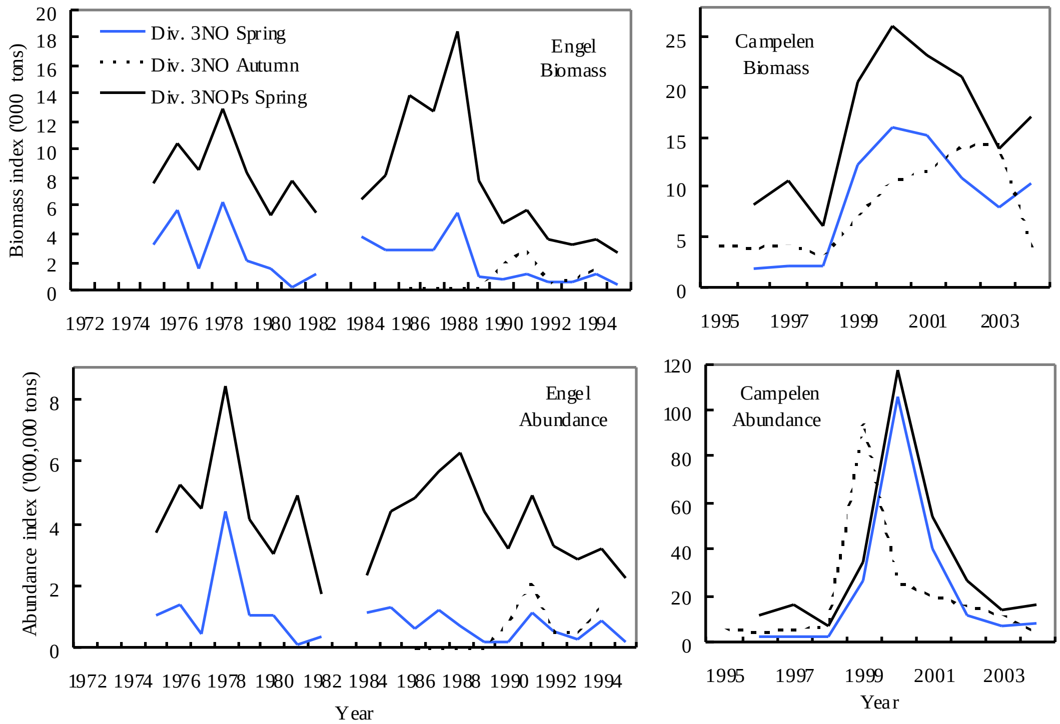


Fig. 17.2. White hake in Div. 3NO and Subdiv. 3Ps: biomass and abundance indices from Canadian spring and autumn surveys, 1972-2004. Both time series are unstandardized.

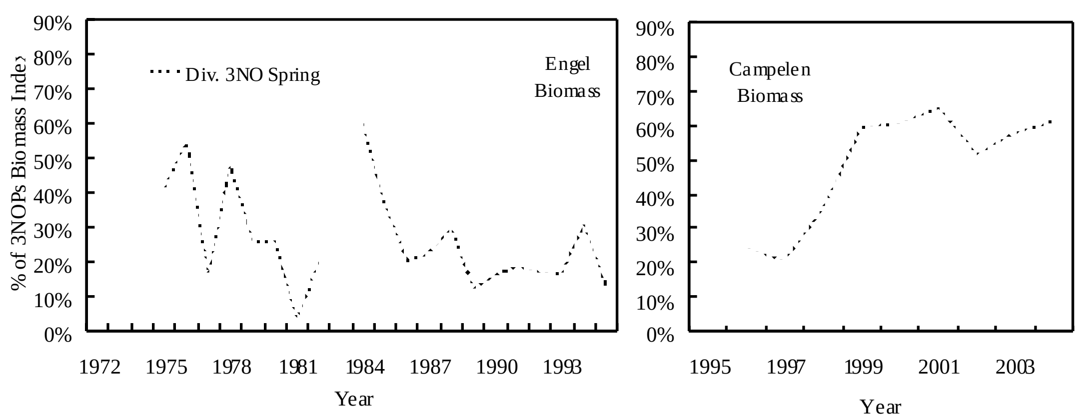


Fig. 17.3. White hake in Div. 3NO: percent of the Div. 3NOPs biomass index that is in Div. 3NO from Canadian spring surveys, 1972-2004.

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.

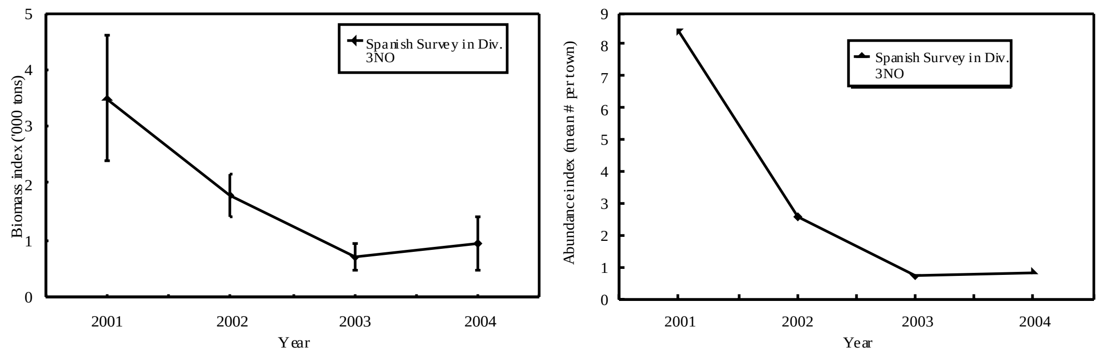


Fig. 17.4. White hake in the NRA of Div. 3NO: Biomass indices from Spanish Campelen spring surveys in 2001-2004. Error bars represent ± S.D.

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.

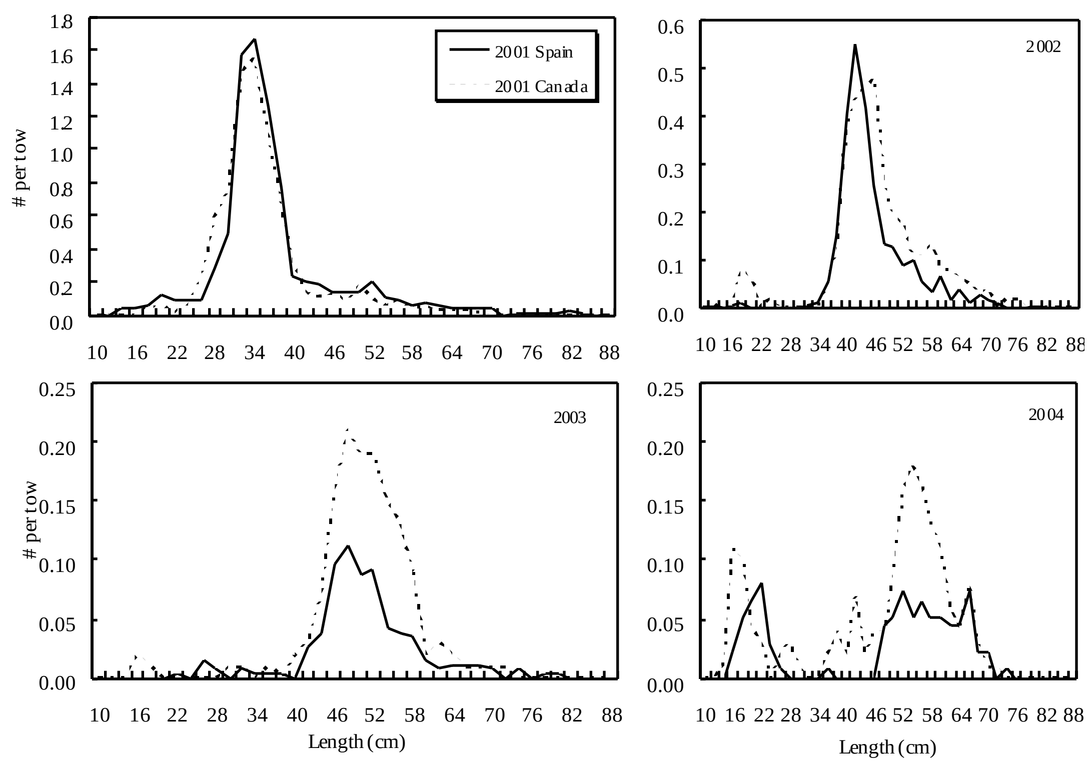


Fig. 17.5. White hake in Div. 3NO: Abundance at length from Canadian Campelen and Spanish Campelen spring surveys in 2001-2004. Number per tow was calculated using mean catches.

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).

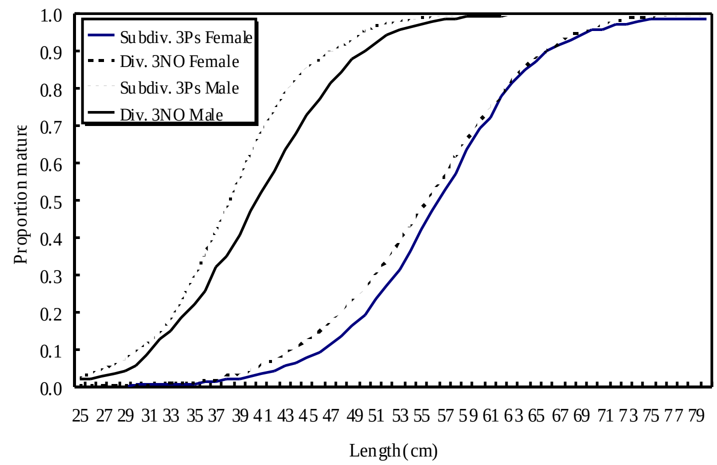


Fig. 17.6. White hake in Div. 3NO and Subdiv. 3Ps: ogives calculated for each sex from Canadian spring surveys and averaged over 1997-2004.

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.

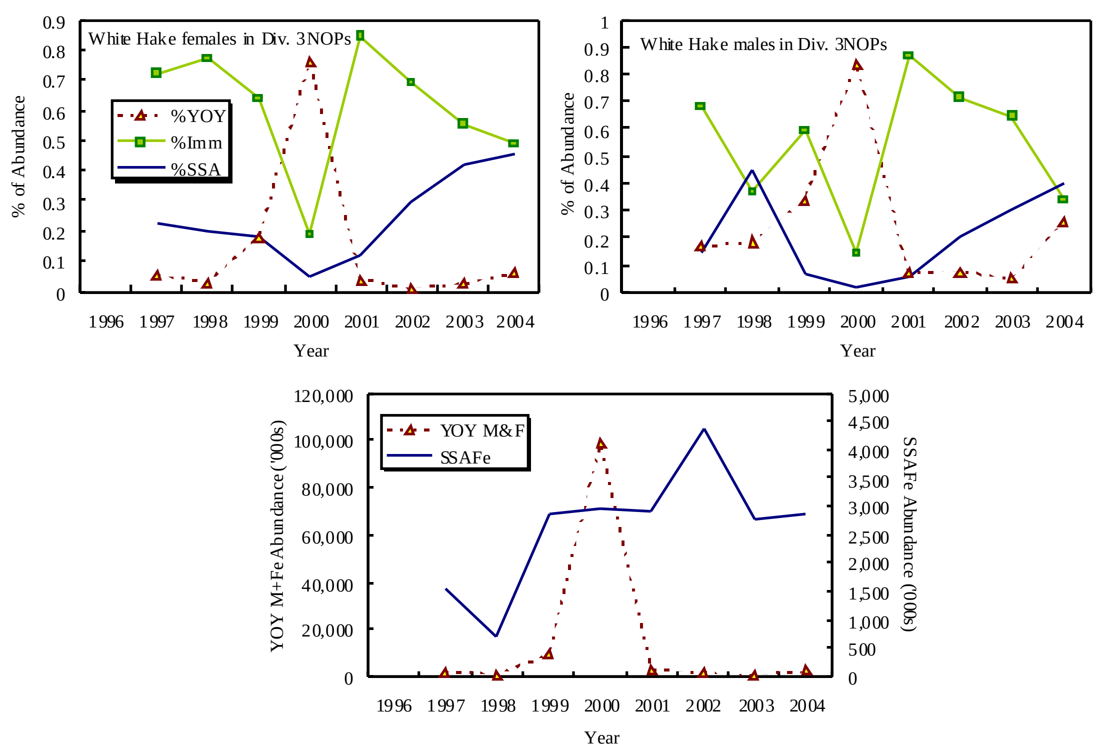


Fig. 17.7. White hake in Div. 3NO and Subdiv. 3Ps: staged trends in abundance by sex from Canadian Campelen spring survey data in 1996-2004.

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.

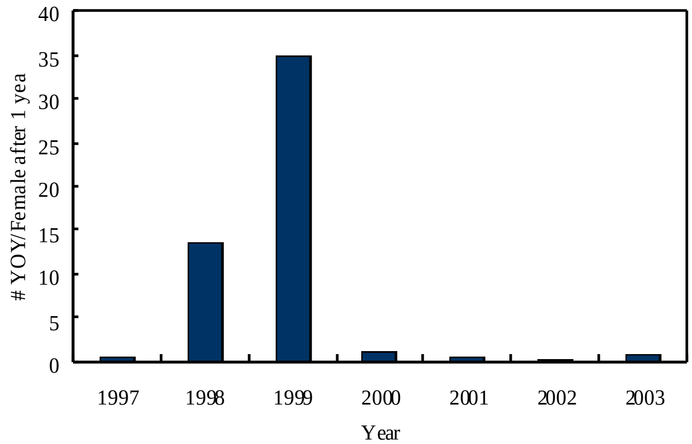


Fig. 17.8. White hake in Div. 3NO and Subdiv. 3Ps: recruit per spawner from Canadian Campelen spring surveys in 1997-2003.

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 (= 1st 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.

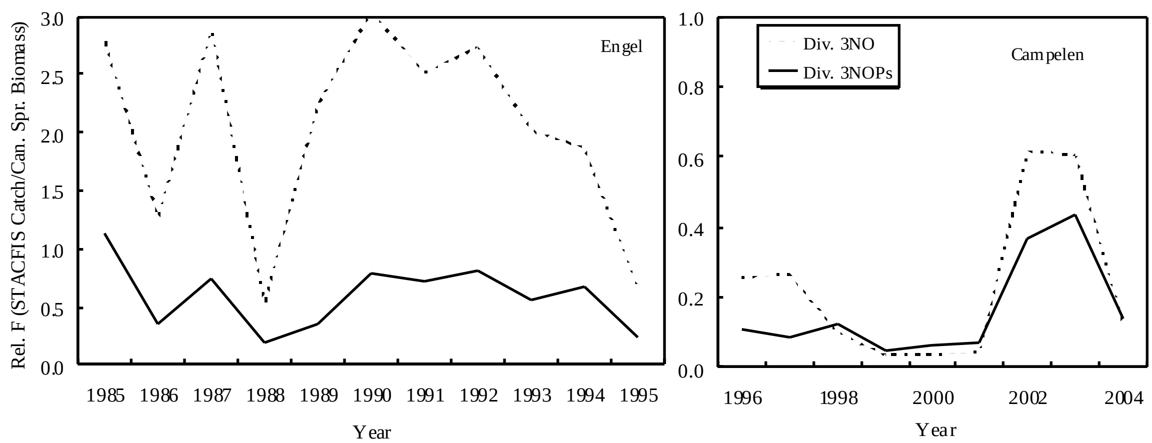


Fig. 17.9. White hake in Div. 3NO and Subdiv. 3Ps: estimates of relative *F* from STACFIS agreed commercial catches and Canadian spring surveys.

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.

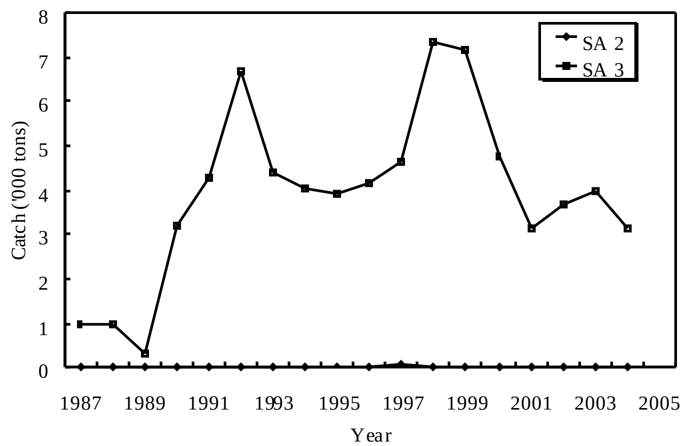


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

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.

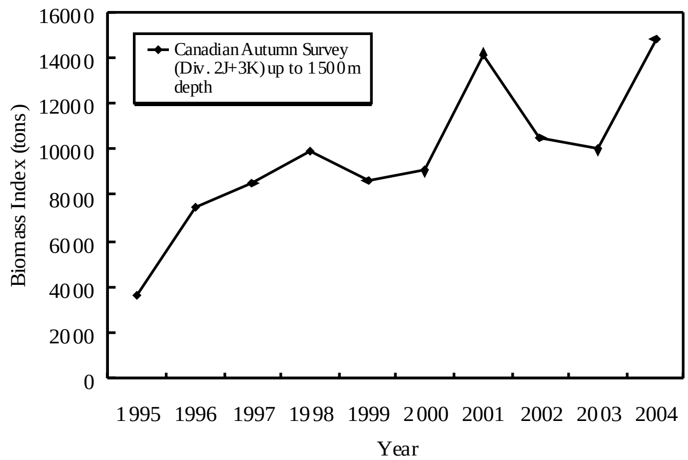


Fig. 18.2. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian autumn (Div. 2J+3K) survey.

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.

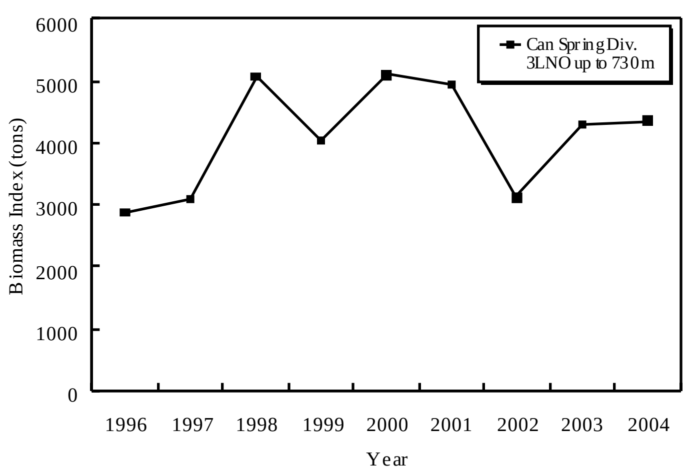


Fig. 18.3. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

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 Ez*a (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).

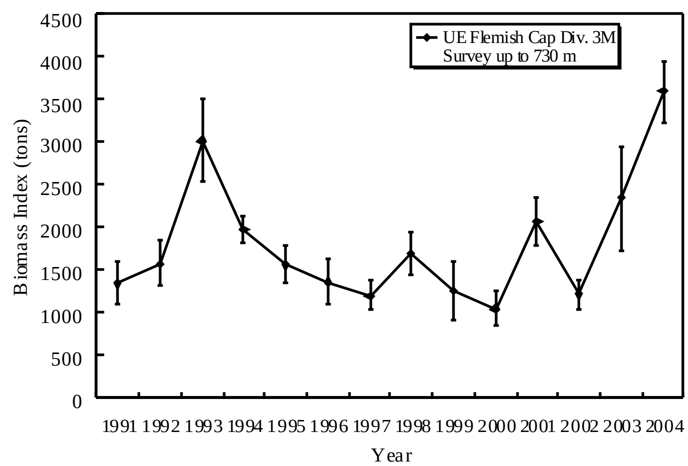


Fig. 18.4. Roughhead grenadier in Subareas 2+3: biomass indices (±SE) from the EU Flemish Cap (Div. M) survey.

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).

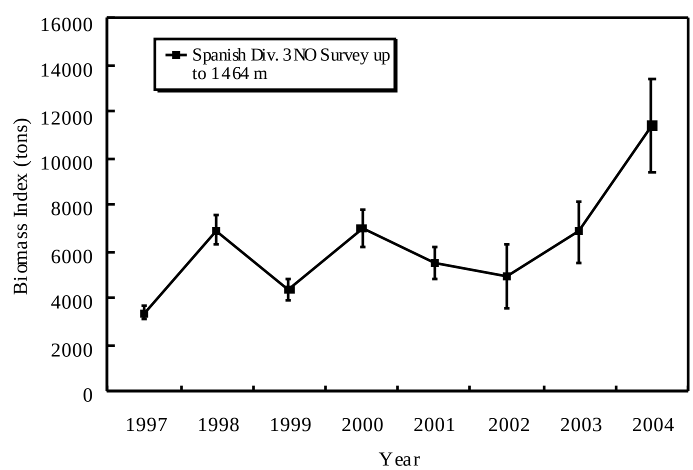


Fig. 18.5. Roughhead grenadier in Subareas 2+3: biomass indices (± SE) from the Spanish survey in Div. 3NO.

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.

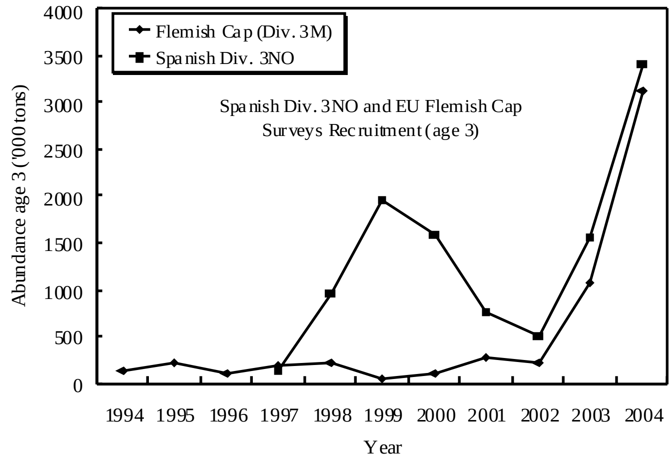


Fig. 18.6. Roughhead grenadier in Subareas 2+3: Spanish survey in Div. 3NO and EU Flemish Cap survey abundance age 3.

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.

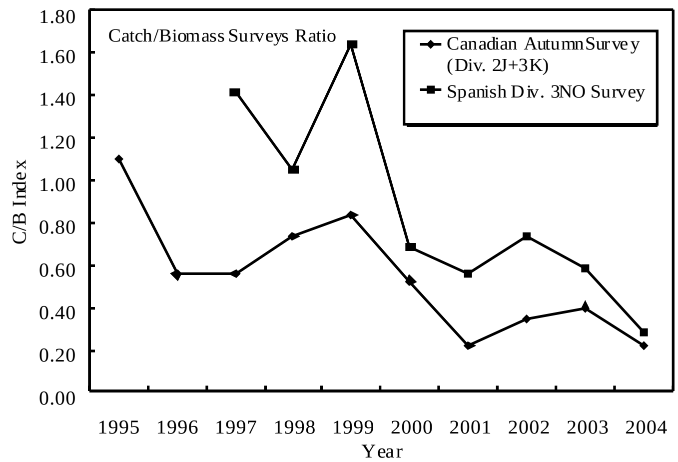


Fig. 18.7. Roughhead grenadier in Subareas 2+3: catch/biomass index based upon Canadian autumn survey and Spanish survey in Div. 3NO.

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.

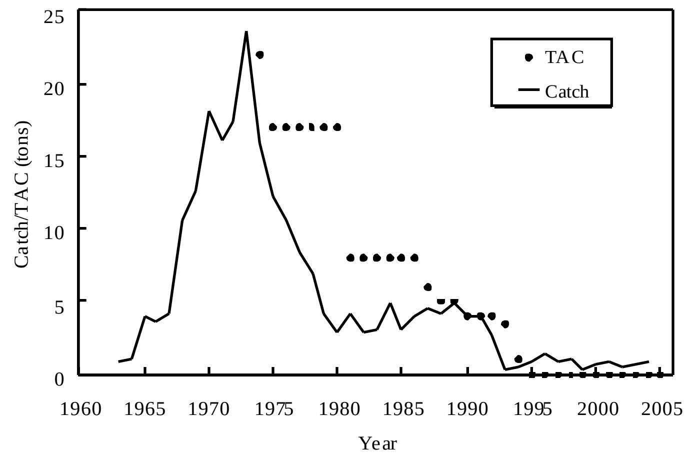


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

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.

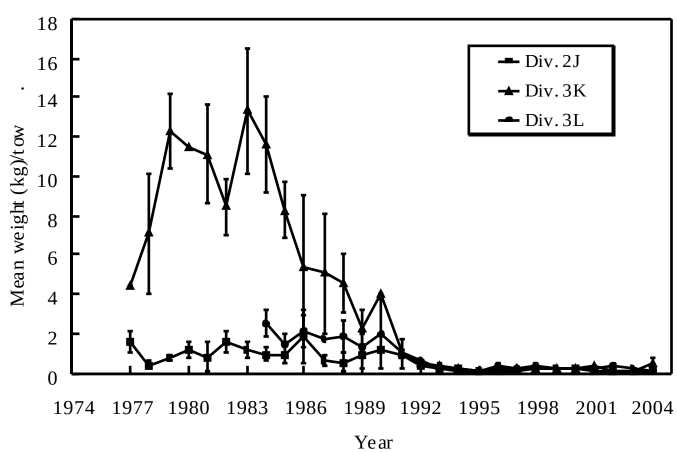


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow from Canadian autumn surveys.

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).

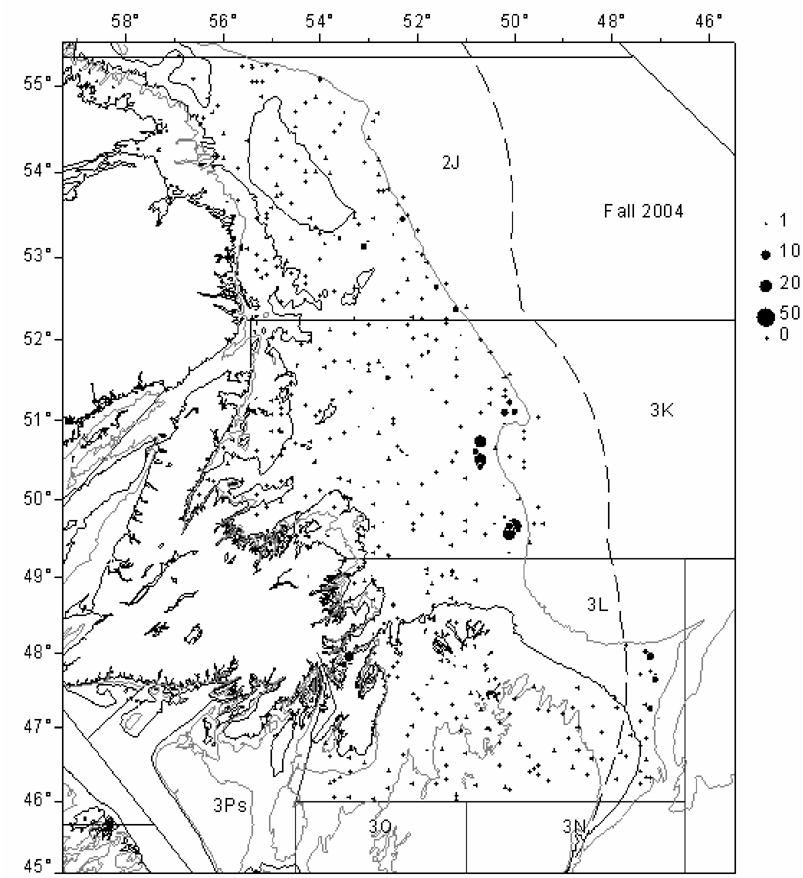


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per set from Canadian surveys during autumn 2004.

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.

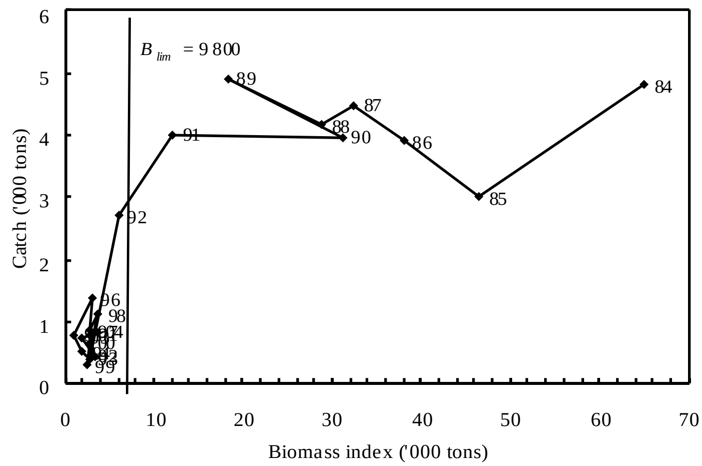


Fig. 19.4. Witch flounder in Div. 2J, 3K and 3L: Catch ('000 tons) and biomass index ('000 tons) from Canadian autumn surveys.

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).

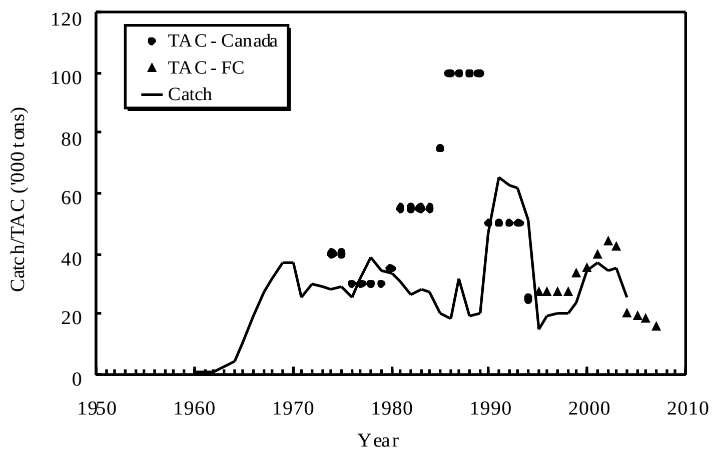


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

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).

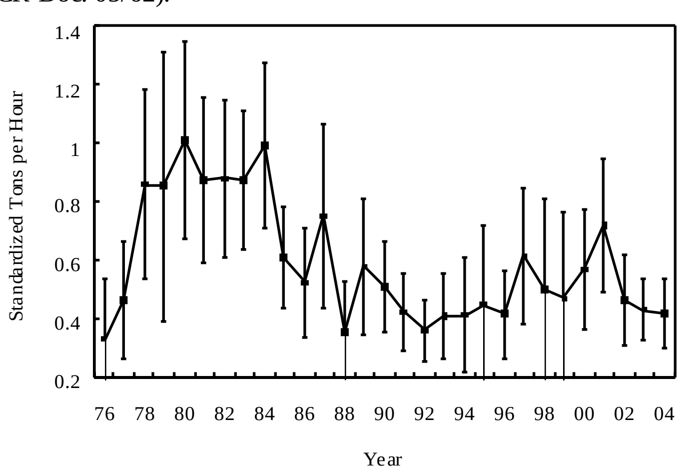


Fig. 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) based on hours fished from the Canadian fishery in Div. 2HJ+3KL.

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.

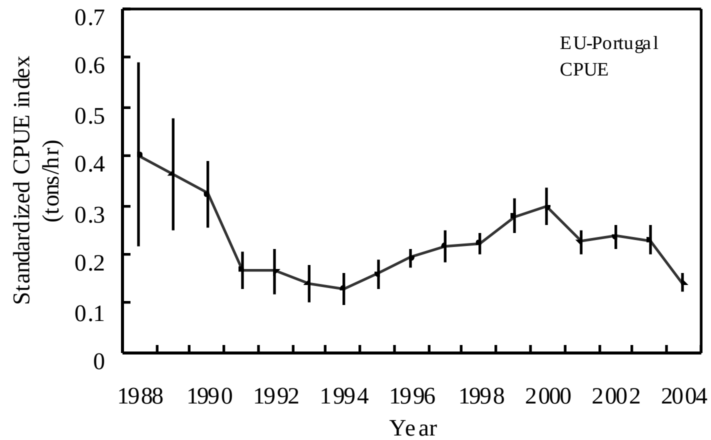


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) from the EU-Portugal trawlers with scientific observers in Div. 3LMN.

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.

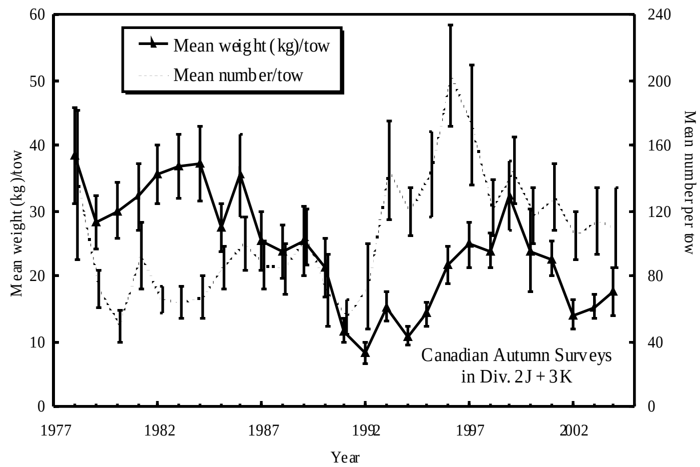


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

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).

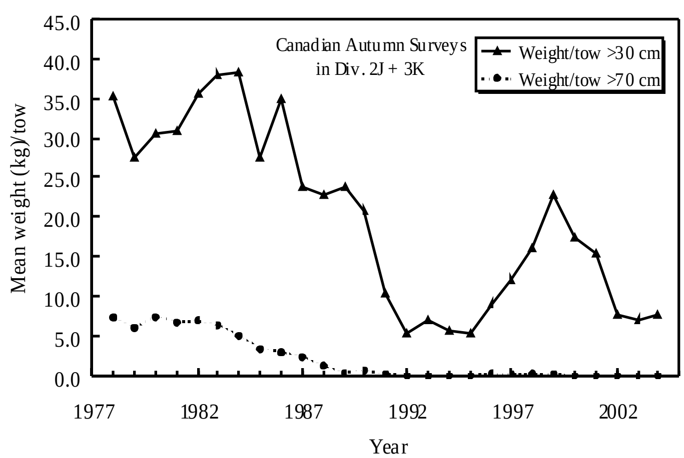


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass indices (mean weight (kg) per tow) for fish >30 cm and >70 cm from Canadian autumn surveys in Div. 2J and 3K.

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).

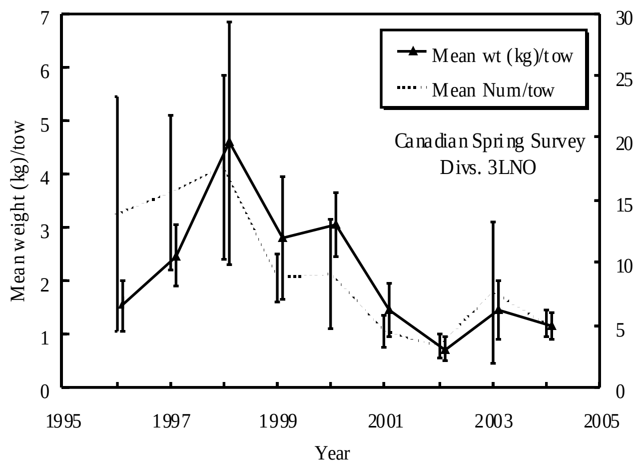


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

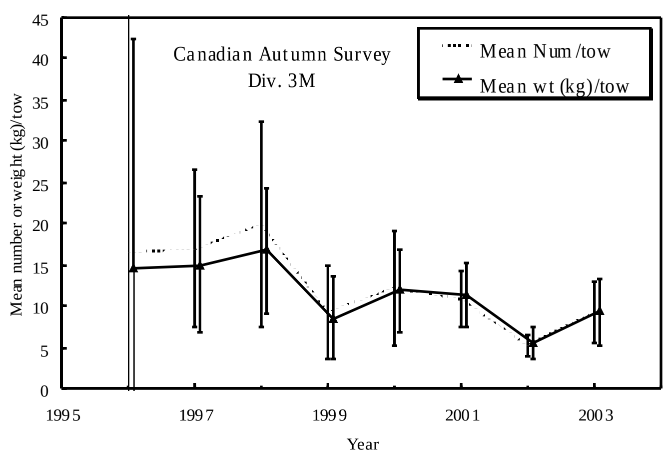


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 3M.

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.

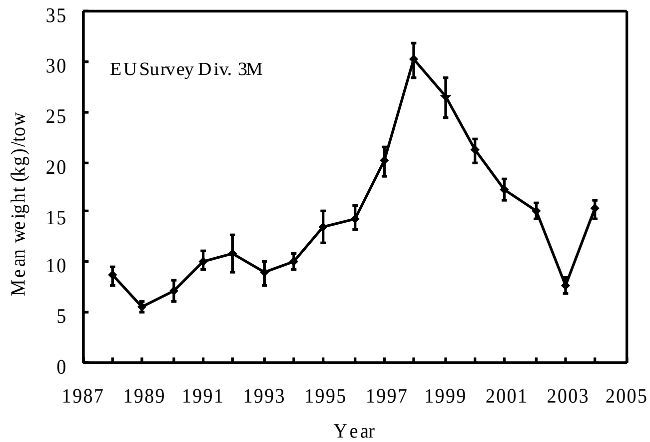


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (mean catch per tow ±1 S.E.) from EU summer surveys in Div. 3M.

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.

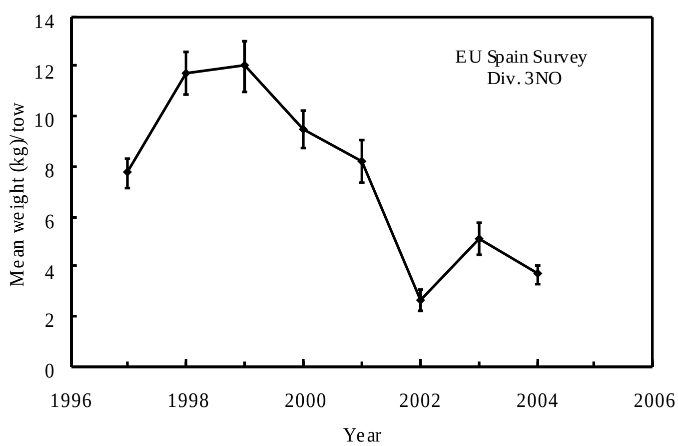


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (± SE) from EU-Spain spring surveys in Div. 3NO.

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.

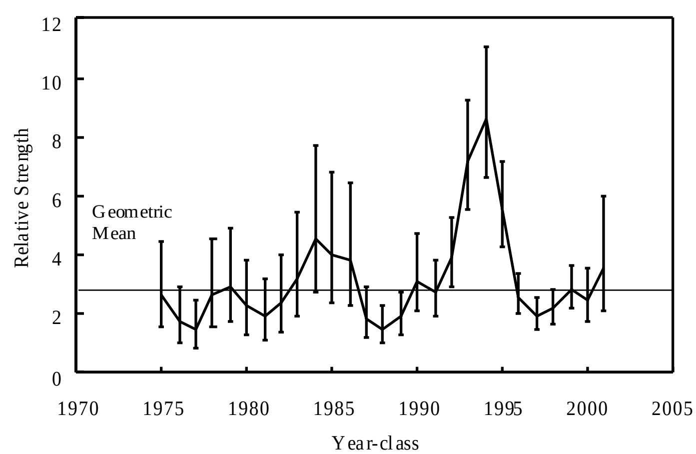


Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: recruitment index from four research vessel survey series.

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).

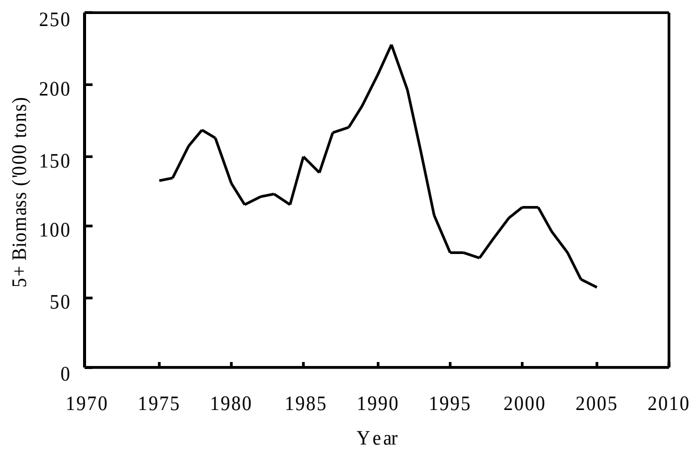


Fig. 20.11. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated 5+ biomass from XSA analysis.

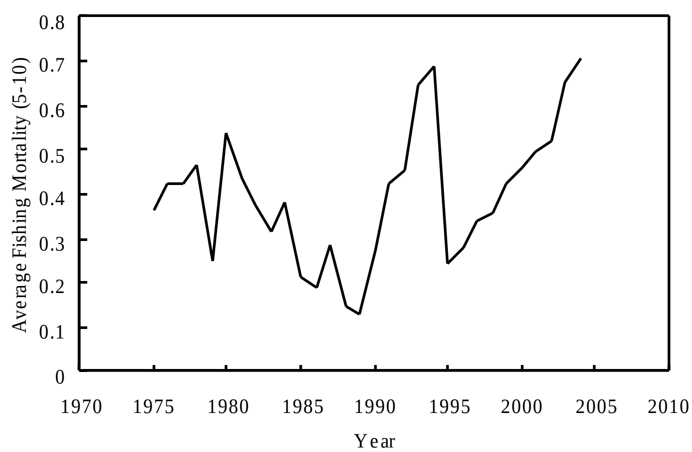


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated fishing mortality (5-10) from XSA analysis.

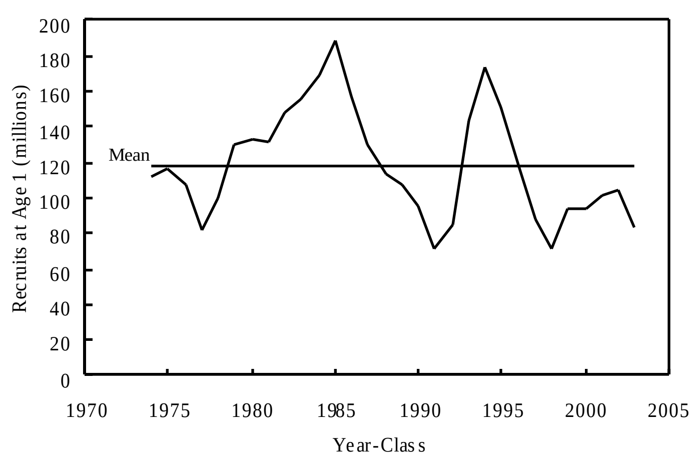


Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA analysis.

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.

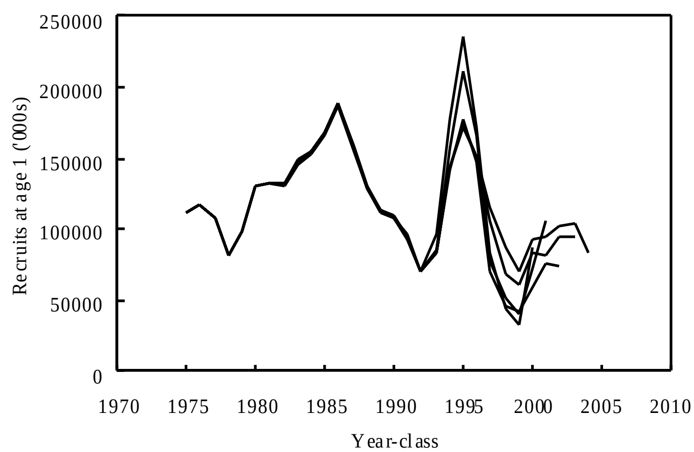


Fig. 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

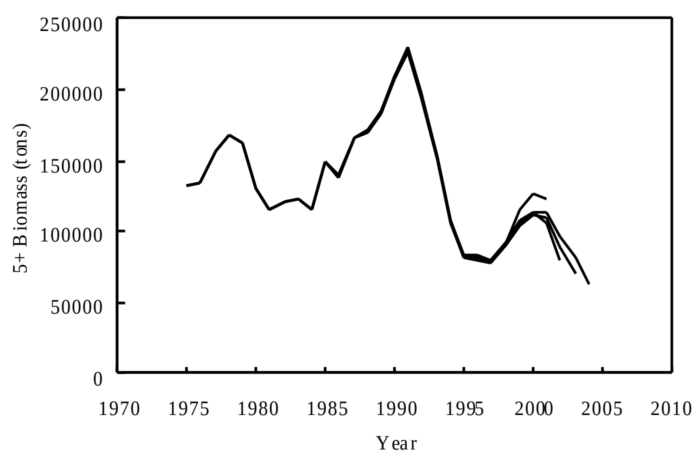


Fig. 20.15. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; 5+ biomass.

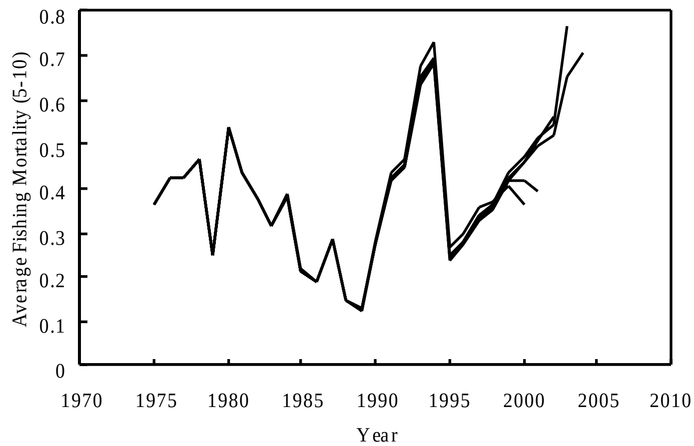


Fig. 20.16. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

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}.

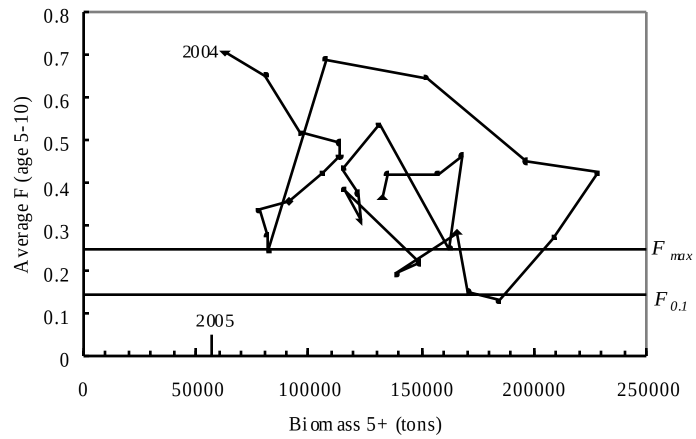


Fig. 20.17. Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory with relation to biometric reference points. The 2005 estimate of biomass (57 000 tons) is indicated on the biomass axis.

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.

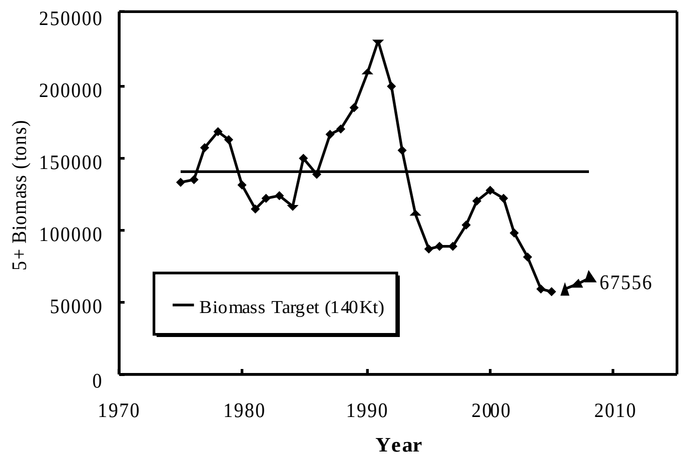


Fig. 20.18. Greenland halibut in Subarea 2 + Div. 3KLMNO: deterministic projection of 5+ biomass to 2008 (triangles) under FC rebuilding plan.

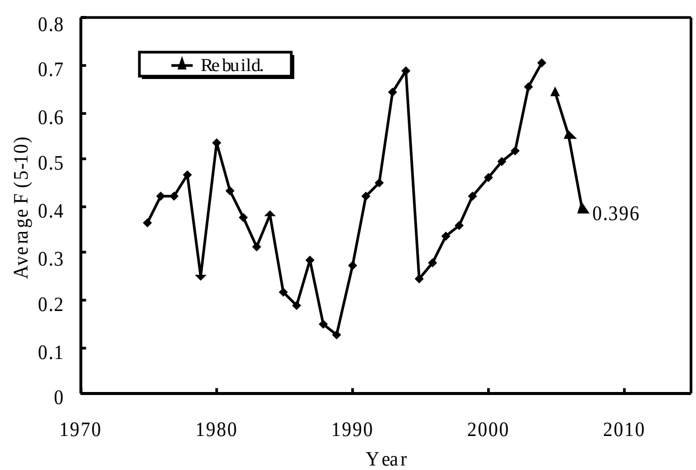


Fig. 20.19. Greenland halibut in Subarea 2 + Div. 3KLMNO: deterministic projection of average fishing mortality to 2007 (triangles) under FC rebuilding plan.

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**

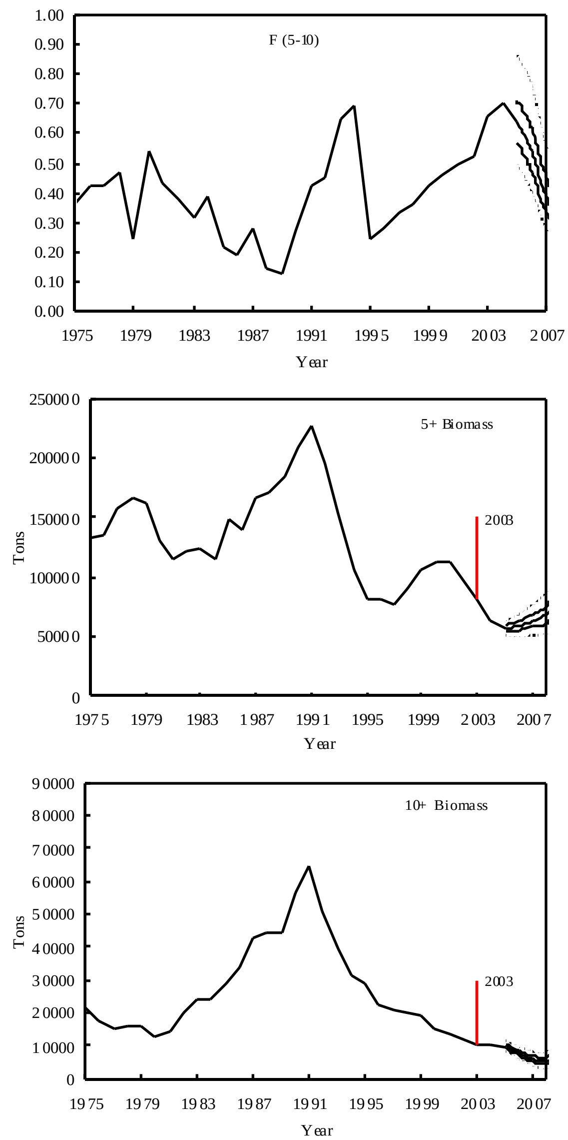


Fig. 20.20. Greenland halibut in Subarea 2 + Div. 3KLMNO: projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2005-2008 under Fisheries Commission rebuilding plan. The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (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.

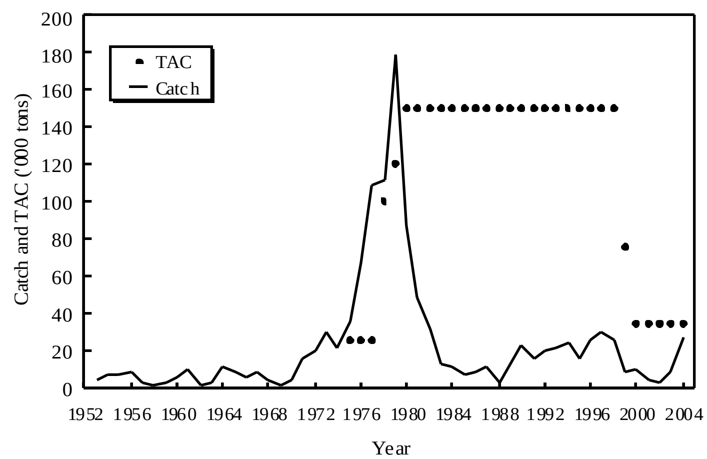

Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

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).

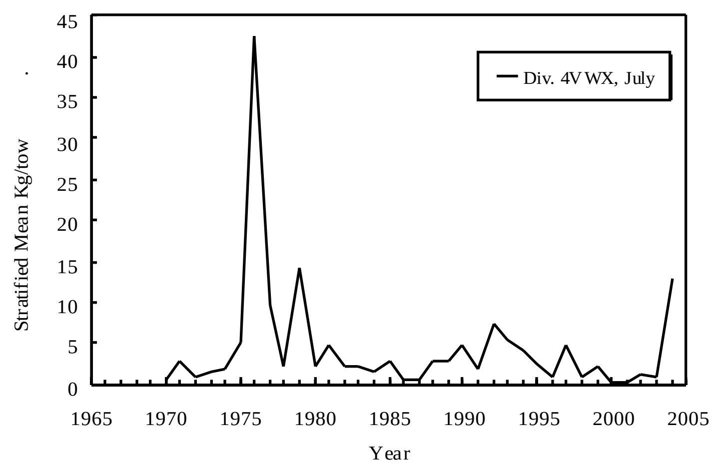

Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices from the July survey in Div. 4VWX.

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).

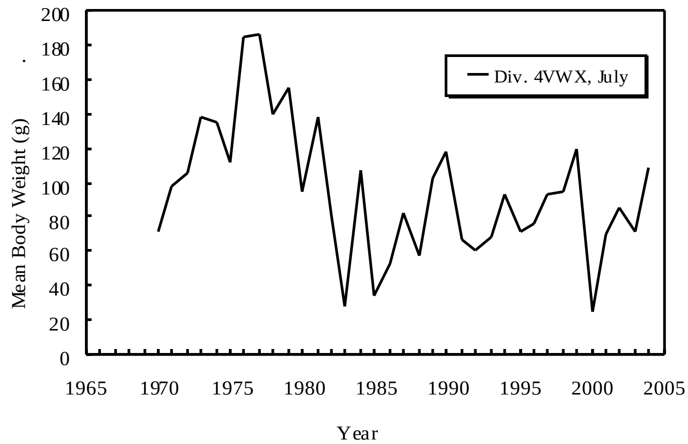

Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX

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

- From AZTI Tecnalia, Food and Fisheries Technological Institute, Herrera kaia, Portualde z/g 20110 Pasaia (Basque Country), Spain [Phone: +34 943 004800 – Fax: +34 943 004801 –E-mail: hmurua@pas.azti.es]

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.

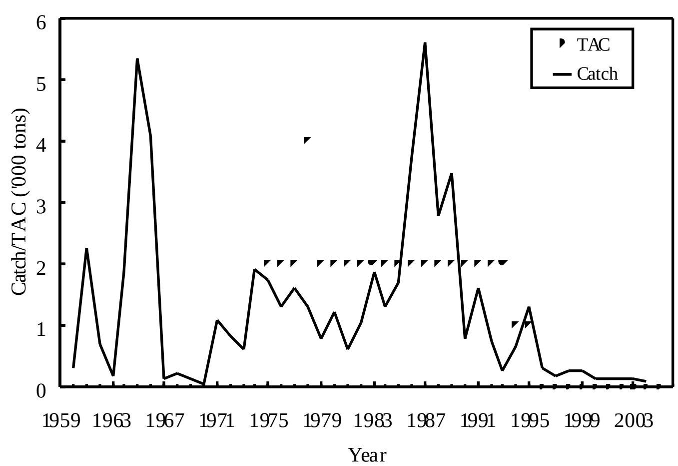

Fig. x.x. Stock Name: nominal catches and agreed TACs.

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).

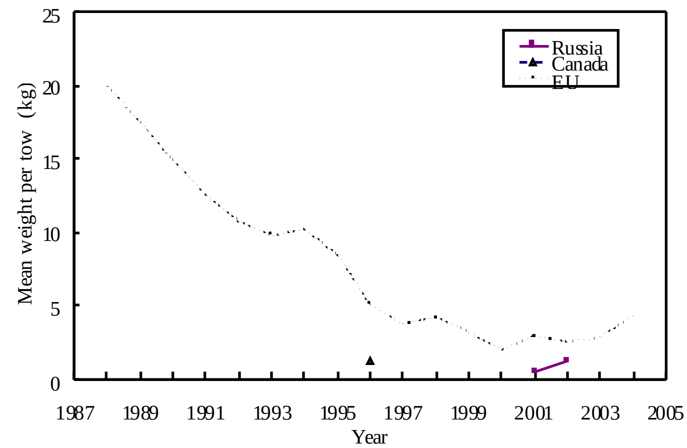

Fig. x.x. Name of stock: mean weight per tow in the surveys.

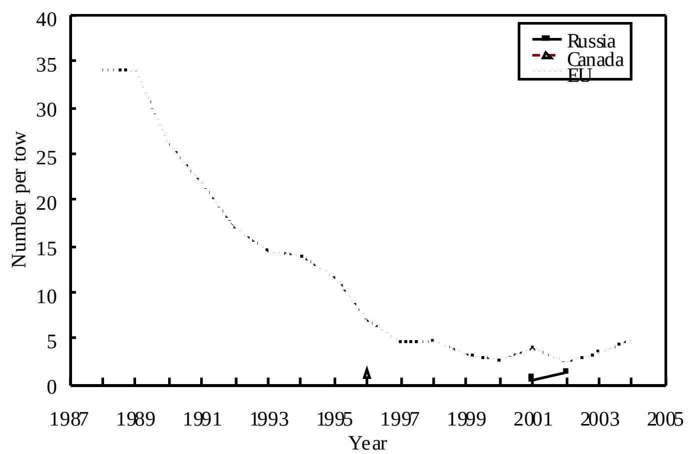

Fig. x.x. Name of stock: mean number per tow in the surveys.

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.

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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.

PART B

Scientific Council Meeting, 19-23 September 2005

CONTENTS

SCIENTIFIC COUNCIL MEETING, 19-23 SEPTEMBER 2005

Chair: M. Joanne Morgan Rapporteur: Barbara Marshall

I. PLENARY SESSIONS

The Scientific Council met at the Radisson SAS, Tallinn, Estonia during 19-23 September 2005. Representatives attended from Canada, European Union (Estonia, France, Germany, Latvia, Lithuania, Poland, Portugal and Spain), Iceland, Republic of Korea, Russian Federation and United States of America. Members of the NAFO Secretariat 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 0930 hours on 19 September 2005.

The Chair welcomed everyone to Tallinn, Estonia and to this venue for the Meeting. Barbara Marshall, NAFO Secretariat was appointed rapporteur.

The Provisional Agenda was **adopted** as presented (Part D, Agenda II, this volume), noting some items that would normally be discussed by STACPUB will be discussed by Scientific Council under "Other Matters". Additional items may be addressed subject to Fisheries Commission requests during the course of this meeting.

The Council noted the Provisional Agenda for the Scientific Council Meeting on shrimp during 26 October-3 November 2005 in Dartmouth, Nova Scotia, Canada, was circulated in accordance with the Rules of Procedures on 29 August 2005.

The Council and its Standing Committees met through 19-23 September 2005 as needed. At its sessions on 22 September 2005, the Council considered and **adopted** the reports of the Standing Committees (STACFIS, STACREC).

The concluding session was called to order at 1000 hours on 23 September 2005 when the Council addressed other outstanding agenda items. The Scientific Council then considered and **adopted** its report of this meeting.

The meeting was adjourned at 1015 hours on 23 September 2005.

The Reports of the Standing Committees as **adopted** by the Council are appended as follows: Appendix I - Report of Standing Committee on Fisheries Science (STACFIS) and Appendix II - Report of Standing Committee on Research Coordination (STACREC).

The Agenda, List of Research (SCR) and Summary (SCS) Documents, List of Representatives and Advisers/Experts of this meeting 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-XIII.

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS FROM JUNE 2005

The Council reviewed the following:

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.*

The Chair of Scientific Council wrote a letter about this matter to the Chair of Fisheries Commission on 12 July 2005. The matter was also highlighted by the Chair of Scientific Council during her presentation of scientific advice to the Fisheries Commission.

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.*

This matter was addressed in Section VI below.

III. 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 I.

IV. 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 STACREC is at Appendix II.

The recommendation made by STACREC as **endorsed** by the Council is as follows:

1. *the digitization of observer data be carried out and that these data then be made available to Scientific Council.*

V. SPECIAL REQUESTS FROM FISHERIES COMMISSION

1. Update on Advice for Northern Shrimp in Division 3M

Scientific Council reviewed the EU multi-species bottom trawl survey index and the commercial catch data for Div. 3M northern shrimp (*Pandalus borealis*). The female biomass index in the 2005 EU survey was similar to that of 2003 and 2004.

Scientific Council concluded that there was no basis for change in the 2006 advice for this stock.

2. Update on Advice for Northern Shrimp in Divisions 3LNO

Scientific Council reviewed the Div. 3LNO northern shrimp (*Pandalus borealis*) biomass and abundance indices from the autumn 2004 and spring 2005 Canadian Research Vessel bottom trawl surveys. The autumn survey was incomplete in 2004, but this index has been stable at a high level since 2000. Biomass from the spring 2005 survey was similar in magnitude to the high values seen in 2002-2004.

Based on this review, Scientific Council concluded that there is no basis to change its 2006 advice for this stock.

VI. WORKING GROUP REPORTS

1. **Report of WGHARP** (SCS Doc. 05/17)

The document "The Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals" was reviewed. The NAFO Scientific Council had requested that the WGHARP review the recent assessment of Northwest Atlantic harp seals and the results of other ongoing studies on harp and/or hooded seals in the NW Atlantic, in particular any available results from tagging studies using satellite telemetry tracking. The Working Group reviewed the methods used during the 2004 pup production survey of harp seals and the data used to assess current abundance of NW Atlantic harp seals. It concluded that the methods used were appropriate, consistent with previous recommendations of WGHARP and comparable to those used in the past. As a result, WGHARP considered the estimates obtained from the reproductive, survey and modeling studies to be the best approximations of our current knowledge on this population.

WGHARP reviewed the results of current research on harp and hooded seals in the Northwest Atlantic. These studies included the use of satellite tags in stock structure studies, for both harp and hooded seals. The Working Group noted that although these studies will provide us with significant new information on these populations, many of these studies are still underway and that final results were not available. However, it is anticipated that many of these studies will be completed within the coming year and results presented at the next meeting of WGHARP. It anticipated that this meeting will focus on comparative studies of hooded seals and will provide a major advancement of our knowledge on this species.

During its meeting, the Working Group continued discussions on the implementation of Biological Reference Points for harp and hooded seals. WGHARP requested that NAFO Scientific Council review the progress made and provide comments on the appropriateness of the approach proposed. Scientific Council noted the progress made by the WG on the biological reference points for harp and hooded seals. It noted the similarities between this approach and the biomass limit reference points used for groundfish and shrimp. Although a detailed review of this report was not possible at this Scientific Council meeting, implementation of this framework should aid in the management of these seal species.

VII. REVIEW OF FUTURE MEETING ARRANGEMENTS

1. Scientific Council Meeting on Shrimp, 26 October-3 November 2005

The Council noted that the dates of the meeting are 26 October-3 November 2005 and the meeting will be held at the NAFO Secretariat Headquarters in conjunction with the ICES WGPAND. With respect to the Scientific Council work, the Council noted its Provisional Agenda for this meeting was circulated on 29 August 2005.

2. Scientific Council Meeting, June 2006

The Scientific Council reconfirmed that its meeting of 1-15 June 2006 will be held at Alderney Landing, Dartmouth, Nova Scotia, Canada.

3. Annual Meetings, September 2006-2008

The NAFO Annual Meeting is scheduled for 18-22 September 2006, preceded by the Scientific Council Symposium "*Environmental and Ecosystem Histories in the Northwest Atlantic - What Influences Living Marine Resources?*" to be held 13-15 September. The venue will be Holiday Inn, Dartmouth, NS, Canada.

The Council noted that the dates of this and the 2007 meeting are causing conflicts for scientists who wish to attend the ICES Annual Science Conference and Council may have to look at alternative arrangements for Scientific Council Symposia and workshops in the future. The dates for 2007 Annual Meeting are 24-28 September and for 2008, 23-27 September. If Scientific Council symposia continue to be held in conjunction with the Annual Meeting they will be held in the week following.

4. Scientific Council Meeting on Shrimp, 2006

The dates and venue of the shrimp assessment meeting will be decided at the October-November 2005 Meeting. The decision will be based on possible future working arrangement with ICES WGPAND.

5. Scientific Council Meeting, June 2007

The Council agreed to the tentative dates of 31 May-14 June 2007 for this meeting to be held at the Alderney Landing, Dartmouth, Nova Scotia, Canada. Exact dates and length of meeting will be decided in June 2006.

VIII. FUTURE SPECIAL SESSIONS

1. Progress on Special Session for 2006

The Scientific Council reviewed progress for its 2006 Symposium entitled "*Environmental and Ecosystem Histories in the Northwest Atlantic - What Influences Living Marine Resources?*" This Symposium is to be held in conjunction with the NAFO 28th Annual Meeting, at the Holiday Inn Harbourview, in Dartmouth, Nova Scotia, Canada, 13-15 September 2006. The Symposium will be co-convened by Bill Brodie (Canada), Jason Link (USA), Helle Siegstad (Denmark/Greenland), and Manfred Stein (EU-Germany), and organized by the NAFO Secretariat.

A poster with the Symposium announcement has been developed and will be circulated shortly after the current Annual Meeting. A web page will also be established on the NAFO website. Invited keynote speakers will be sought for some of the theme sessions.

Council was pleased with the progress to date and thanked the co-conveners for their work.

2. Topics for Special Session 2007

A proposal for a Symposium entitled "*Reproduction and Recruitment in Marine Fish Stocks*" was presented.

The continuance of reduced fish stock sizes, and the attention given to their plight has raised concerns that stock rebuilding will be a lengthy process with uncertain results. Reproduction is inherent to stock rebuilding in the degree to which its many facets influence recruitment levels. Parental stock composition has been demonstrated to be a key governing factor shaping recruitment and recently led managers to recognize that levels of spawning stock biomass can be an imperfect measure of stock reproductive potential when used to predict year-class strength. Size-selective harvesting over generations has also possibly contributed to altering the genetic composition and growth potential of fish. Environmental factors influencing growth and reproduction combined with the effects of exploitation on population structure will generate yearly changes in reproductive potential and survivorship of gametes and larvae. Hence, a wide suite of variables spanning a significant portion of the ontogeny interact to influence recruitment variability. Forecasting trends in recruitment and potential stock rebuilding will assist managers to make appropriate decisions for stock closures, openings or implementation of cautious harvesting regimes.

The objective of this proposed Symposium is to have presentations made on the science of reproduction and recruitment in marine fish stocks, with application to fishery resource management. The Symposium will have a broad application as it will principally attract scientists spanning the areas of reproduction, early life history and recruitment. The Symposium should also be of interest to resource managers given the focus on identifying factors that may inhibit stock rebuilding. It will build on previous accomplishments of NAFO that were published in the Journal of Northwest Atlantic Fishery Science. Specifically, the 1998 Symposium "*Variations in Maturation, Growth, Condition and Spawning Stock Biomass Production in Groundfish*" and the 2003 volume of the NAFO Working Group on Reproductive Potential entitled "*Reproductive Potential of Fish Stocks of the North Atlantic*".

The following topics would be used to develop Symposium Sessions: Maturation, fecundity, gamete quality, spawning behaviour, reproductive strategies, larval characteristics, genetics, effects of size-selective harvesting, spawner characteristics, demography, condition, maternal and paternal factors, stock reproductive potential, progeny growth and survivorship, environmental factors, recruitment variability, individual and population modelling, management advice.

Scientific Council considers this an excellent Symposium topic and agreed that it should form the basis for a Special Session to be held in 2007. It is suggested that the addition of topics covering invertebrate reproduction be considered. In addition consideration should be given to including co-convenors that work on species other than cod. Scientific Council looks forward to a progress report for consideration at its June 2006 Meeting.

IX. SCIENTIFIC COUNCIL WORKING PROCEDURES AND PROTOCOL

1. Timetable and Frequency of Assessments

The following schedule of Scientific Council assessments reflects decisions that some stocks should be reviewed on a multi-year basis, with monitoring during the interim years. The frequency of assessments will be reviewed at the June 2006 Meeting of Scientific Council.

Since 1999, the Scientific Council has agreed to the following overall schedule (+ is assessment year, *i* is interim monitor, - is no assessment) subject to the Fisheries Commission and Coastal State requests for advice and concurrence:

Stock	2001	2002	2003	2004	2005	2006	2007
Multi-year Assessments							
American plaice in Div. 3LNO	+	+	+	*i*	+	*i*	+
Cod in Div. 3NO	+	*i*	+	*i*	+	*i*	+
Redfish in Div 3LN	+	*i*	+	*i*	+	*i*	+
Witch flounder in Div. 2J+3KL	+	*i*	+	*i*	+	*i*	+
Redfish in Div. 3M	+	+	+	*i*	+	*i*	+
Roughhead grenadier in SA 2+3	*i*	-	+	*i*	+	*i*	+
Redfish in Div. 3O	-	-	+	*i*	+	*i*	+
Redfish in SA1	+	*i*	+	*i*	+	*i*	+
Other finfish in SA1	+	*i*	+	*i*	+	*i*	+
Cod in Div. 3M	*i*	+	*i*	+	*i*	+	*i*
American plaice in Div. 3M	*i*	+	*i*	+	*i*	+	*i*
Witch flounder in Div. 3NO	*i*	+	*i*	+	*i*	+	*i*
Yellowtail flounder in Div. 3LNO	+	+	*i*	+	*i*	+	*i*
Squid (*Illex*) in SA 3+4	+	+	*i*	+	*i*	+	*i*
Capelin in Div. 3NO	+	+	+	*i*	+	*i*	+
Thorny skate in Div. 3LNO	-	-	-	+	*i*	+	*i*
White hake in Div. 3NOPs	-	-	-	-	+	*i*	+
Roundnose grenadier in SA 0 +1	*i*	+	*i*	*i*	+	*i*	*i*
Annual Assessment							
Greenland halibut in SA2 + Div. 3KLMNO	+	+	+	+	+	+	+
Greenland halibut in SA0 + 1 offshore and Div. 1B-F	+	+	+	+	+	+	+
Greenland halibut in Div. 1A inshore	+	+	+	+	+	+	+
Northern shrimp in Div. 3M	+	+	+	+	+	+	+
Northern shrimp in Div. 3LNO	+	+	+	+	+	+	+
Northern shrimp in SA 0+1	+	+	+	+	+	+	+
Northern shrimp in Denmark Strait	+	+	+	+	+	+	+

2. Proposals to Shorten June Meeting

Council held a productive discussion on proposals to make more efficient use of the time allocated to the June Scientific Council meetings. The aim of these proposals was both to allow the meetings to be shortened and to free more time during the meeting for full discussion of some issues related to assessments. It was agreed that one of the most important steps in this would be to try to arrive at catch estimates in advance of the meeting. This will involve discussions among a small working group. In addition the deadline for the submission of catch statistics would need to be advanced. In order to enhance Scientific Council's ability to produce catch estimates in advance of the June meeting, Scientific Council **recommends** that *the deadline for submission of STATLANT 21A data be set at 1 May in each year starting in 2006*.

Interim monitoring reports should be sent to the chair of STACFIS two weeks prior to the start of the meeting in the format agreed in June 2005. Only issues that Designated Experts think need to be highlighted would be discussed during the June meeting, other discussion would focus on editorial aspects of the STACFIS report.

Many assessments can probably be conducted less frequently than every 2 years. Ricardo Alpoim and Bill Brodie will develop a tentative schedule of assessments to be reviewed in June 2006.

It was agreed that the time allotted to the discussion of assessments should not be limited. However, the Chair of STACFIS should remind Designated Experts to highlight only the main results of the assessment and any changes from the previous assessment of the stock.

There was considerable discussion of the possibility of rescheduling some of the Standing Committee work. It was agreed that only a single day needs to be scheduled for STACFEN. A portion of the STACREC agenda has already been moved to the September meeting. An attempt can be made to table most SCS documents instead of presenting them in plenary. Purely technical items of STACREC and STACPUB can be merely tabled or discussed by a smaller group.

The meeting work schedule was also discussed. The Chair of Scientific Council should consider extending the work day to 1830 h. In addition most of the Executive Committee meeting can be conducted via email prior to the meeting. The Chair of Scientific Council should also consider starting the meeting in the afternoon of the first day to allow registration and meeting set up to occur in the morning.

X. ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT

A joint session of the Scientific Council, Fisheries Commission and General Council was held to hold preliminary discussions on this issue. This included a presentation by FAO.

Council then held its own discussion of this issue. It was noted that it will be important that the roles of Scientific Council and the Fisheries Commission are clearly delineated very early in the process as NAFO moves forward with an Ecosystem Approach to Fisheries Management. This may require the participation of some members of the Fisheries Commission in Scientific Council meetings where the issue is addressed.

XI. OTHER MATTERS

1. Fahay Monograph

Council discussed the most appropriate format of this book and decided that a 2 volume hard cover version was the best. Scientific Council **recommends** that *the Monograph by M. Fahay entitled 'Early Stages of Fishes in the Western North Atlantic Ocean North of 35°N and West of 40°W' be published in 2 volumes and be in hard cover*. The cost of each volume to readers should be discussed with the author by the Secretariat. The price should ensure cost recovery and be reasonable/affordable but perhaps be able to generate some income to support other publication initiatives.

It was noted during this discussion that there is a need for a general policy for NAFO publication costs. It was also noted that Council is still concerned about the lack of historical publications on the NAFO website. It is anticipated that the hiring of a network administrator will result in the ability of NAFO to host its own website and provide sufficient space for all issues of the Journal and all years of SCR documents and other reports to remain available on the website.

2. Editorial Board

In June 2005 STACPUB **recommends** 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.* As there were strong objections to eliminating the printed version of the Journal, the status quo will remain in effect and the matter will be discussed again in June 2006.

Three Associate Editors have stepped down from the Journal. The Chair thanked James Weinberg, Fred Serchuk and Peter Shelton for their service as Associate Editors. Bo Bergstrom from Greenland was suggested as a potential associate editor in the field of invertebrate fisheries biology. The Chair of STACPUB will write to thank the former Associate Editors and to invite Dr. Bergstrom to join the Editorial Board. The positions of biomathematics and the need for 3 vertebrate fish Associate Editors will be reconsidered.

3. **Provision of Monthly Catch Statistics by Secretariat**

For stock assessment purposes it is important to have catch data by country instead of by Contracting Party. Some difficultly was encountered at this meeting in obtaining monthly catch statistics by country for shrimp for 2005. Noting that data for provisional letters are submitted pursuant to Conservation and Enforcement Measures, Scientific Council **recommends** that *Fisheries Commission revise the Conservation and Enforcement Measures to require submission of data by country for the monthly letters on provisional catch statistics.*

Many people are still not clear about the reporting of catch under charter or quota transfer arrangement. Therefore, Scientific Council **recommends** that *the Secretariat provide a clear explanation of the reporting of catch statistics under charter and quota transfer arrangements.* It was noted that the Excel spreadsheet designed by the Secretariat and available on the website was useful and Scientific Council **recommends** that *the spreadsheet of catch statistics be updated to expedite access to these data by Designated Experts.*

4. **Questions from the Fisheries Commission**

The Fisheries Commission requested the Scientific Council to provide: *information on the by-catch of juvenile Greenland halibut in the shrimp fishery in Division 3M.*

By-catch information is available from the Icelandic fishery but it is not clear how representative this is of the fishery as a whole. There are data available for several other fleets but analyses were not possible at this meeting. Scientific Council can not advise on the magnitude of any impact of the Div. 3M shrimp fishery on juvenile Greenland halibut at this time.

Scientific Council reiterates its recommendation from the September 2004 Meeting that Contracting Parties provide all available data on by-catch and discards of Greenland halibut in Subarea 2 and Divisions 3KLMNO shrimp fishery for consideration in future assessments. Scientific Council further **recommends** that *data collected by Contracting Parties on species taken as by-catch in or discarded from the shrimp fishery be made available for consideration in future assessments.*

The Scientific Council was also asked: *to evaluate the impact of increased levels of TAC for shrimp in Divisions 3LNO on the juvenile component of the Greenland halibut stock in Divisions 2J+3KLMN stock.*

Catch in the Canadian shrimp fishery in Div. 3L averaged 2 kg/ton of shrimp. As this fishery constitutes the bulk of the catch in the area this can be considered representative of the fishery as a whole. A 9 000 ton increase in quota would therefore be expected to result in an 18 ton increase in the by-catch of juvenile Greenland halibut.

The Fisheries Commission also requested: *noting that prospects for rebuilding this stock are poor; can SC advise how the original expected results of the Greenland halibut Rebuilding Plan can be achieved?*

The Fisheries Commission rebuilding plan for Greenland halibut has never been evaluated in its entirety by Scientific Council. Council is uncertain of the intent of the plan beyond the TACs established for 2004 to 2007 and the stated biomass target of 140 000 tons of 5+ biomass. In order to address this question specific information on how the Fisheries Commission intends to reach this target over the term of the rebuilding plan is required.

It was agreed that STACTIC would forward the following requests through the Fisheries Commission to the Scientific Council at its September 2005 Meeting.

- *Is there a scientific justification for reducing the mesh size in Division 3O and what would be the effect of a reduction of mesh size on the level of mortality?*

- *Would a harmonization of mesh size with NEAFC in Divisions 1F2GJH3K have a detrimental effect on the target species and other fisheries in the area?*

When considering such questions, the Scientific Council should assess the implications for by-catch, the need for minimum fish sizes and the relevance of introducing technical conservation measures, such as square mesh gear.

Scientific Council is unable to address these questions at this time.

The Fisheries Commission requested the Scientific Council to examine: *the utility of introducing a scientific observer programme run by NAFO and aimed at enhancing the collection of data on the status of stocks. In this respect, a scientific observer programme is understood as meaning that the observer be tasked only to collect data/information for stock assessment to be used by the Scientific Council. Scientific observers will not conduct any activity related to control/enforcement and compliance.*

The Scientific Council is specifically asked: *to provide advice on the possible structure and coverage of such a programme. The Scientific Council should in this respect take into account the scientific observer programme which is being run by CCAMLR and assess if a similar system could be implemented in NAFO.*

While Scientific Council recognizes the usefulness of scientific data from commercial fisheries it is not able to advise on the question at this time. As the nature of any such program 'run by NAFO' is unclear, further guidance on this is required from the Fisheries Commission.

5. Administrative Issues

Council discussed 3 issues relevant to the administration of NAFO.

The first issue related to changes in personnel supporting the work of Scientific Council without prior communication with Council. Scientific Council Chair is asked to transmit to the Executive Secretary the need to enhance communication between the Council and the Executive Secretary. Council urges the Chair of Scientific Council and the Executive Secretary to engage in a constructive dialogue to review past problems in order to improve future communications.

The second issue related to the proposed modernization of NAFO. Any change in the structure and functioning of NAFO is of importance to all constituent bodies. Council asks the Chair of Scientific Council to write to the Chairs of General Council and Fisheries Commission to suggest that all constituent bodies including Scientific Council be fully involved in modernization initiatives.

The development of performance evaluation indicators for Secretariat support was discussed. The Chairs of Scientific Council and its Standing Committees are asked to develop a short list of items that are important to Scientific Council in terms of support for its work. This list should be submitted to the Chair of General Council, the Chair of STACFAD and the Executive Secretary as part of the process of developing overall criteria.

6. Appreciation for Dedicated Service of Mr. Tissa Amaratunga, Former Deputy Executive Secretary

The former Deputy Executive Secretary of NAFO, Mr. Tissa Amaratunga is no longer in the employ of NAFO. During his 17 years of service, Mr. Amaratunga's main role was in support of the work of Scientific Council. His work included aid in the preparation for meetings, assistance during meetings and with the finalization of meeting reports. He played a key role in the work of both the Standing Committee on Research Coordination and the Standing Committee on Publications. He was technical editor of the Journal of Northwest Atlantic Fishery Science. Over the years Mr. Amaratunga carried out his duties effectively and efficiently and was committed to facilitating the work of Scientific Council and NAFO. Scientific Council has been fully satisfied with his support and gratefully acknowledges his many years of dedicated service.

XI. ADOPTION OF REPORTS

1. **Committee Reports STACFIS, STACREC**

The Council at its session on 22 September 2005 considered and **adopted** the reports of its Standing Committees, STACFIS and STACREC. These reports are given in Appendix I and II, respectively.

2. **Report of Scientific Council**

The Council at its concluding session on 23 September 2005 considered and **adopted** its own Report.

XII. ADJOURNMENT

The Chair thanked members of Scientific Council for their contributions during this meeting and the various meetings over the course of her tenure. The Chair also thanked the Standing Committee Chairs for their outstanding contributions during the last 2 years. Appreciation was extended to the NAFO Secretariat for their dedicated support during the meeting. Ron Myers and Forbes Keating of the Secretariat will soon retire. The Chair thanked them for their many years of dependable service to NAFO and in particular their efforts in support of the work of Council.

The Chair wished all incoming and returning Committee Chairs all the best. Thanks were also extended for the local support offered during this annual meeting in Tallinn.

The incoming Chair then thanked Joanne Morgan for her contribution to the Scientific Council in the last two years and for her efforts in creating a cohesive group that worked well together.

There being no other business, the meeting was adjourned at 1015 hours on 23 September 2005.

Scientific Council Meeting, 19-23 September 2005

Standing (left to right): Manfred Stein, Toomas Saat, Enrique De Cárdenas, Fernando Gonzalez-Costas, Chris Allen, Antonio Vázquez, Hilario Murua, Dave Orr, Bill Brodie, Fred Serchuk, Ricardo Alpoim, Eugene Colbourne, Aleksandrs Kozlovskis, Vladimir Babayan, Romas Statkus

Kneeling (left to right): Silver Sirp, Unnur Skúladóttir, Joanne Morgan, Seok-Gwan Choi

Missing: Konstantin Gorchinsky, Jerzy Janusz, Suzanna Junquera, Jean-Dominique LeGarrec, Barbara Marshall

STACFIS in session

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

Chair: Hilario Murua Rapporteurs: Various

I. OPENING

The Committee met at the Radisson SAS, Tallinn, Estonia during 20-22 September 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 finfish and invertebrate marine stocks. Representatives attended from Canada, European Union (Estonia, Germany, Latvia, Lithuania, Poland, Portugal and Spain), Iceland, Republic of Korea, Russian Federation and United States of America.

The Chair, Hilario Murua (European Union), opened the meeting by welcoming participants. The provisional agenda was reviewed and **adopted** with no modifications.

II. 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	Joanne Morgan	Tel: +709-772-2261	morganj@dfo-mpo.gc.ca
	Redfish Div. 3O	Dawn Maddock Parsons	Tel: +709-772-2495	parsonsda@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 Healey	Tel: + 709-772-8674	healeybp@dfo-mpo.gc.ca
	Northern 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

- From AZTI Tecnalia, Food and Fisheries Technological Institute, Herrera kaia, Portualde z/g 20110 Pasaia (Basque Country), Spain [Phone: +34 943 004800 – Fax: +34 943 004801 –E-mail: hmurua@pas.azti.es]

  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	Michael Kingsley	mcsk@natur.gl
	Northern shrimp in Denmark Strait	Helle Siegstad	helle@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: sergegol@pinro.ru]

for	Capelin in Div. 3NO	Serge Golovanov

- 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	Northern Shortfin Squid in SA 3+4	Lisa Hendrickson

III. OTHER MATTERS

1. **Review of SCR and SCS Documents** (SCR Doc. 05/71)

STACFIS reviewed a paper entitled "A PA-compliant rebuilding plan for 2+3KLMNO Greenland halibut based on the 2005 NAFO assessment". Stochastic long-term projections were conducted based on the results of the June 2005 assessment of Greenland halibut in SA2+Div.3KLMNO. Projections were conducted from 2005 to 2020 at different levels of fishing mortality: $F = 0.5 \times F_{0.1}$, $F = 0.8 \times F_{0.1}$, $F = F_{0.1}$, $F = F_{MAX}$, $F = F_{current}$ and F_{vary} which is defined as: $F = 0.5 \times F_{0.1}$ when $B \leq 80\ 000$ tons, $F = 0.8 \times F_{0.1}$ when 80 000 tons $< B \leq 140\ 000$ tons and $F = F_{0.1}$ when $B > 140\ 000$ tons. Summary performance statistics in terms of biomass and catch are provided at 5, 10 and 15 year intervals. Substantial reductions in F from its current level are required to allow this stock to rebuild to the stated target of 140 000 tons of 5 + biomass. Only at F_{vary} or at $F_{0.1}$ or less is there a high probability (>70%) of reaching or exceeding 140 000 tons of 5+ biomass by 2020.

STACFIS considered the methods of this paper to be sound and the results clear. Additional analyses incorporating the TACs set by the Fisheries Commission Greenland halibut rebuilding plan to end of 2007 would be useful.

2. **Other Business**

There being no other business, the Chair extended particular gratitude to the Secretariat for their assistance and support not only for work at the meetings but throughout the year. Noting that his term was ending the STACFIS Chair gave special thanks to Mr. Tissa Amaratunga for his help during the last two years. Acknowledgements were also given to the Chair of Scientific Council for her overall leadership during the past two years and all participating members for their cooperation in conducting their assessments. The meeting was adjourned.

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

Chair: Antonio Vázquez Rapporteur: W. Bill Brodie

The Committee met at the Radisson SAS, Tallinn, Estonia during 21-22 September 2005 to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, European Union (Estonia, Germany, Latvia, Lithuania, Poland, Portugal and Spain), Iceland, Republic of Korea, Russian Federation and United States of America.

1. Opening

The Chair opened the meeting by welcoming the participants and appointed Bill Brodie (Canada) as rapporteur. The Provisional Agenda as presented was **adopted**.

2. Fisheries Statistics

a) Progress Report on Secretariat Activities

i) Acquisition of STATLANT 21 Data

There was considerable improvement in data acquisition since June 2005. Most Contracting Parties have reported, although some data remain outstanding. STACREC reiterates the importance for Contracting Parties to submit STATLANT data in due time to allow Scientific Council to produce stock assessments.

ii) Publication of statistical information

When catch information arrives at the NAFO Secretariat, the NAFO website is updated promptly. The last Statistical Bulletin was the one for 1999, and there is a need to revisit the Scientific Council's decision re publication of these Bulletins, and the criteria to decide when catch statistics are no longer considered to be provisional. Criteria should perhaps be final submission of all data for a given year by Contracting Parties, or confirmation from Contracting Parties that no fishing activity occurred in the reporting period.

b) Revision of the North Atlantic Format (NAF) for Position and Catch Reporting

At the last CWP Meeting, a proposal was made to harmonize VMS and daily catch reporting between NAFO and NEAFC. STACREC reviewed the data tables in question, and discussed a number of items. Several points were clarified, such as data fields for various species, discards, regulated *vs* non-regulated species, etc. Data are entered into the NAFO database, and are available from NAFO, although there may be confidentiality issues with respect to release of data. STACREC concluded that there were no problems identified with this format.

3. Research Activities

a) Surveys Planned for 2004 and Early-2005 (SCS Doc. 05/16)

Participants were asked to please check these lists of data and to give corrections to Secretariat at this meeting.

4. NAFO Observer Program

a) Digitization of Available Data

The Chair introduced the item and provided the backgrounds, noting that there was no consensus in the June 2005 STACREC Meeting. It was noted that Scientific Council members generally have access to NAFO observer data from their own country, and if NAFO digitizes these observer reports, this would allow sharing with other Scientific Council members. There was no objection to this proposal, and STACREC **recommends** that *the digitization of observer data be carried out and that these data then be made available to Scientific Council*.

5. Stock Assessment Database

a) Evaluation of the Current Procedure

The Chair noted that data for only 3 stocks have been added to the database since May, and that these results are not satisfactory. STACREC agreed that this process is a good one, and that the benefits of data sharing and archiving are numerous. STACREC encourages Designated Experts to submit the 2005 assessment data. If necessary, the STACREC chair should contact DE's requesting a set of data for each stock.

6. Other Matters

a) Review of SCR and SCS Documents

There were no documents to be reviewed.

b) Other Business

There being no other business, the Chair thanked the rapporteur, all meeting participants, the NAFO Secretariat for their valuable support, and closed the meeting.

PART C

Scientific Council Meeting, 26 October-3 November 2005

CONTENTS

Scientific Council Meeting, 26 October-3 November 2005 at NAFO Headquarters, Dartmouth, N.S., Canada

Back (left to right): Korzun Yuriy, Sergey Bakanev, Eugene Colbourne, Carsten Hvingel, Bo Bergstrøm, Peter Koeller, Sten Munch-Petersen, Mats Ulmestrand, Bill Brodie, Miguel Casas, Ricardo Federizon

Middle (left to right): Barbara Marshall, Knut Sunnanå, Katherine Skanes, Michaela Aschan, Michael Kingsley, Helle Siegstad, Dorothy Auby, Antonio Vazquez, Don Power

Front (left to right): Dave Orr, Unnur Skuladottir, Guldborg Søvik, Kai Wieland, Don Stansbury

STACFIS, 26 October-3 November 2005: In Session.

Participants enjoying a Traditional Holiday Dinner at the Cole Harbour Heritage Farm in Cole Harbour, Nova Scotia, Canada

REPORT OF SCIENTIFIC COUNCIL MEETING

26 October-3 November 2005

Chair: Antonio Vazquez Rapporteur: Barbara Marshall

I. PLENARY SESSIONS

The Scientific Council met at NAFO Headquarters, Dartmouth, Nova Scotia, Canada, during 26 October-3 November 2005, in conjunction with the Pandalus Working Group of ICES (WGPAND) in accordance with decisions of November 2004. Representatives attended from Canada, Denmark (in respect of Greenland), European Union (Spain and Sweden), Iceland, Norway, Russian Federation, and Ukraine.

The Executive Committee and Chair of WGPAND met briefly before the opening to discuss the plan of work.

The opening session was called to order at 1000 hours on 26 October 2005. The Chair welcomed participants to this second Joint Meeting with ICES WGPAND. He noted that the purpose of the joint meeting was to better coordinate and foster interrelationships and share experiences. He hoped the meeting would be productive and offer participants a good time.

The Executive Secretary welcomed delegates to the NAFO Secretariat and Dartmouth and reiterated hopes that the meeting would be fruitful and promote cooperation between ICES and NAFO.

As was laid out in the Rules of Procedure the Executive Secretary was designated as the official rapporteur. To this end the task was delegated to Barbara Marshall of the NAFO Secretariat.

The Council noted that STACFIS would undertake the assessments of the stocks (see Appendix I), while the prognoses and advice would be undertaken by the Council.

The Provisional Agenda was considered and **adopted** (see Agenda III, Part D, this volume).

The session was adjourned at 1100 hours.

The Council welcomed STACFIS to conduct its business throughout the meeting, noting most of the Council's work would be addressed during 2-3 November 2005.

The concluding session was convened at 1500 hours on 3 November 2005. The Council addressed the requests of the Fisheries Commission and the Coastal States and considering the results of the assessments, provided advice and recommendations.

The Council then considered and **adopted** the STACFIS Report, and considered its own report and **adopted** the report of this meeting of 26 October-3 November 2005.

The meeting was adjourned at 1630 hours on 3 November 2005.

The Report of Standing Committee on Fisheries Science (STACFIS) as **adopted** by the Council is given at Appendix I.

The Report of ICES Working Group on Pandalus (WGPAND) is given at Appendix II.

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

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

II. FISHERIES SCIENCE

The Council **adopted** the Report of Standing Committee on Fisheries Science (STACFIS) as presented by the Chair, Don Power. The full report is given at Appendix I and it includes detailed analysis of the shrimp stocks considered by both NAFO.

The Council's summary sheets and conclusions on Northern shrimp in Div. 3M, Northern shrimp in Div. 3LNO, Northern shrimp in Subareas 0 and 1 and Northern shrimp in Denmark Strait and off East Greenland are presented in Section III of this report. The recommendations with respect to stock advice appear therein.

The research **recommendations** from this meeting as **endorsed** by the Council are as follows:

1. **For Northern Shrimp in Division 3M**

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to Designated Experts by 1 September 2006.*

- *indices of female stock size be presented with error bars where possible.*

- *the relationship between the recruitment index and fishable biomass be investigated further.*

2. **For Northern Shrimp in Divisions 3LNO**

- *Ogmap should be reviewed further to determine whether it is an appropriate method to determine Div. 3LNO shrimp biomass/abundance indices from stratified random surveys.*

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to the Designated Expert, in the standardized format, by 1 September 2006.*

3. **For Northern Shrimp in Subareas 0 and 1**

- *sampling of catches by observers - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - should be re-established in Subarea 1.*

- *ways to include the exploration of the effects of future trajectories of the cod stock on assessment predictions should be investigated and presented in 2006.*

- *the impact of other predators on the stock should also be considered for inclusion in the assessment model.*

- *the age-2 abundance index and its link to subsequent fishable biomass should be considered for inclusion in the shrimp assessment model.*

4. **For Northern Shrimp in Denmark Strait and off East Greenland**

- *a survey be conducted, to provide fishery independent data of the stock throughout its range*

- *as a minimum requirement: sampling of catches by observers is required - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - and be re-established in the Greenland EEZ and improved in the Icelandic EEZ.*

III. FORMULATION OF ADVICE

1. Advice for Northern Shrimp

a) Request from Fisheries Commission

The Scientific Council reviewed the STACFIS assessments of Northern shrimp in Div. 3M and Div. 3LNO, and the agreed summaries are as follows:

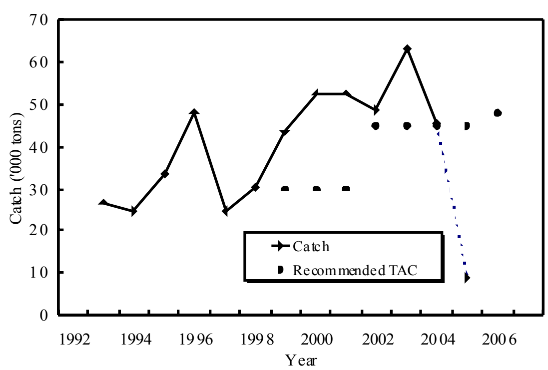
Northern Shrimp (Pandalus borealis) in Division 3M

Background: The shrimp fishery in Div. 3M began in 1993. Initial catch rates were favourable and, shortly thereafter, vessels from several nations joined. Between 1993 and 2004 the number of vessels ranged from 40-110. To date in 2005 there were approximately 26 vessels fishing shrimp in Div. 3M compared to 50 last year.

Fishery and catches: This stock is under effort regulation. Recent catches were as follows.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	49	47[1]	45	er
2003	63	63[1]	45	er
2004	45	44[1]	45	er
2005	9[2]		45	er
2006			48	er

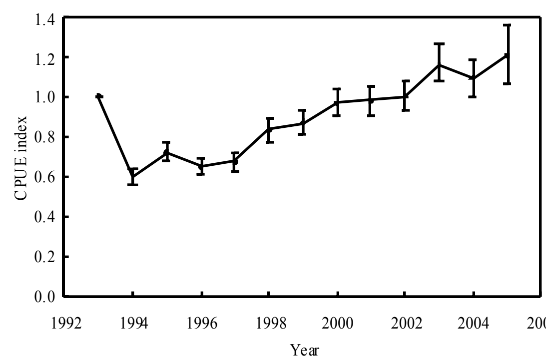
[1] Provisional.
[2] Preliminary to 1 September.
er Effort regulations.



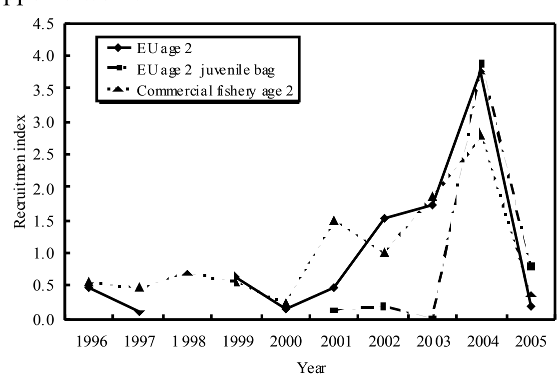
Data: Catch, effort and biological data were available from some, but not all Contracting Parties. A standardized CPUE index was developed. Time series of size and sex composition data were available mainly from two countries and survey indices were available from EU research surveys (1988-2005). A new research vessel was introduced in the EU survey in 2003. The biomass indices have now been converted for the whole series.

Assessment: No analytical assessment is available. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

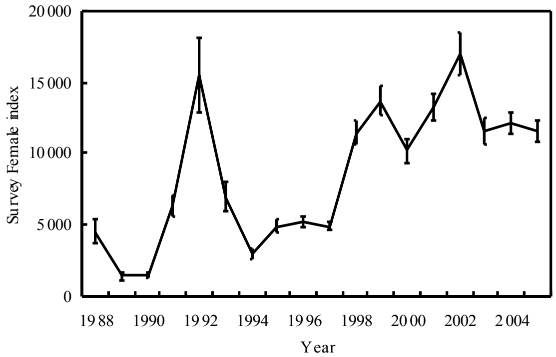
CPUE: Standardized CPUE declined between 1993 and 1994, varied without a trend to 1997 and increased to 2005.



Recruitment: Both the 2001 and 2002 year-classes appear to be above average, but 2003 year-class appears weak.



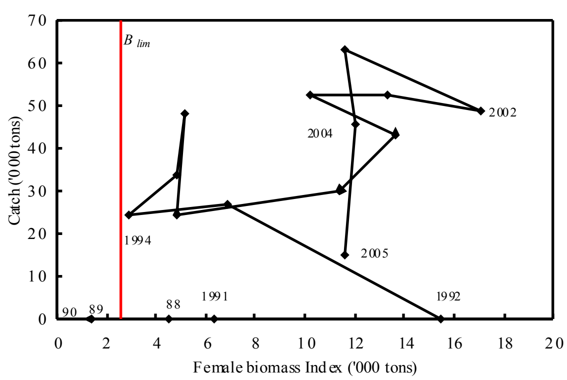
SSB: All indices of female biomass increased from 1997 and have fluctuated without a trend since then.



State of the Stock: The indices of CPUE and biomass are at relatively high levels but there are indications of a decline in recruitment, which may affect the 2007 fishery.

Recommendations: The stock appears to have sustained an average annual catch of about 48 000 tons since 1998 with no detectable effect on stock biomass. The Scientific Council advises a catch of 48 000 tons for 2007.

Reference Points: 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. Currently, the biomass is estimated to be well above B_{lim}.



Special comments: This advice will be reviewed based on updated information in September 2006.

Sources of Information: SCR Doc. 05/78, 79, 89, 94.

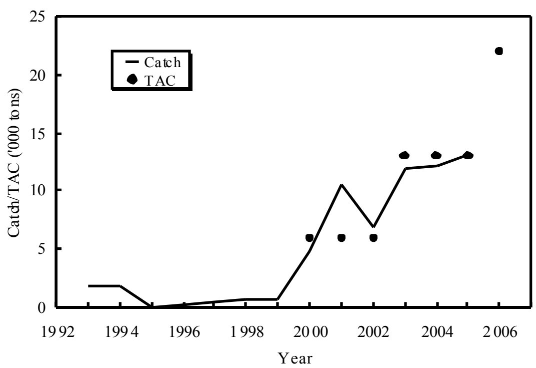
Northern Shrimp (Pandalus borealis) in Divisions 3L, 3N and 3O

Background: Most of this stock is located in Div. 3L and exploratory fishing began there in 1993. The stock came under TAC regulation in 2000, and fishing has been restricted to Div. 3L.

Fishery and catches: Several countries participated in the fishery in 2005. The use of a sorting grid to reduce by-catches of fish is mandatory for all fleets in the fishery. Recent catches from the stock are as follows:

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2002	7	6[1]	6	6
2003	12	11[1]	13	13[3]
2004	13	12[1]	13	13[3]
2005	13[2]		13	13[3]
2006			22	22

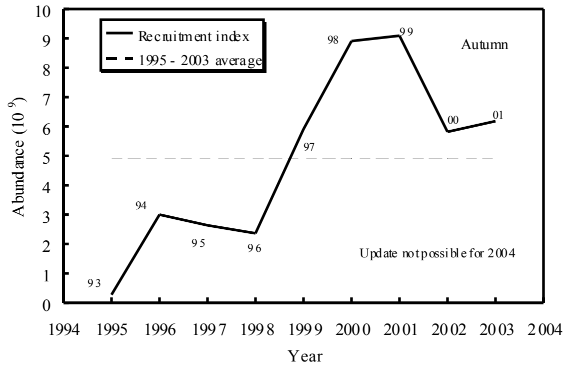
1 Provisional.
2 Preliminary to 19 October 2005.
3 Denmark in respect of Greenland and Faroe Islands set an autonomous TAC of 1 344 tons for 2003 to 2005.

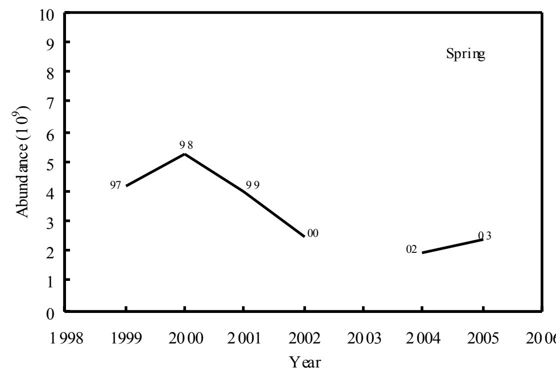


Data: Catch, effort and biological data were available from the commercial fishery. Biomass and recruitment indices and size and sex composition data were available from research surveys conducted in Div. 3LNO during spring (1999 to 2005) and autumn (1995 to 2003). The Canadian survey in autumn 2004 was incomplete.

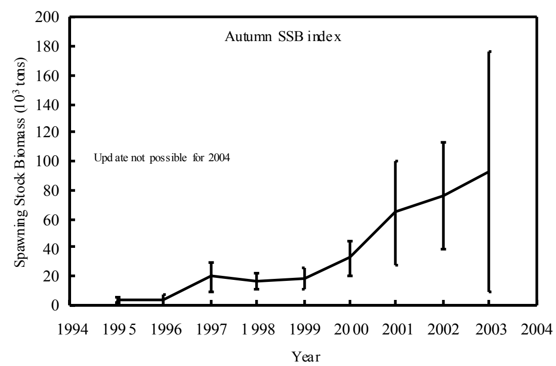
Assessment: No analytical assessment is available. Evaluation of the status of the stock is based upon interpretation of commercial fishery and research survey data.

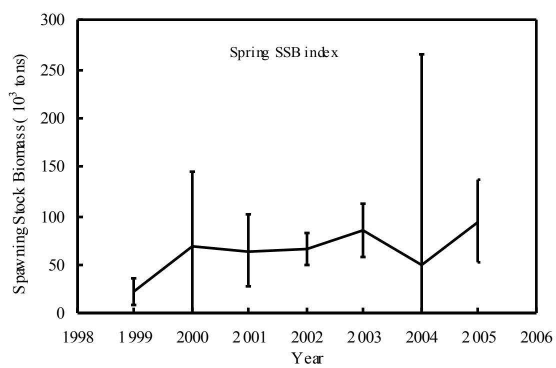
Recruitment: The 1997-2001 year-classes are above average, while the 2002 and 2003 year-classes are lower.



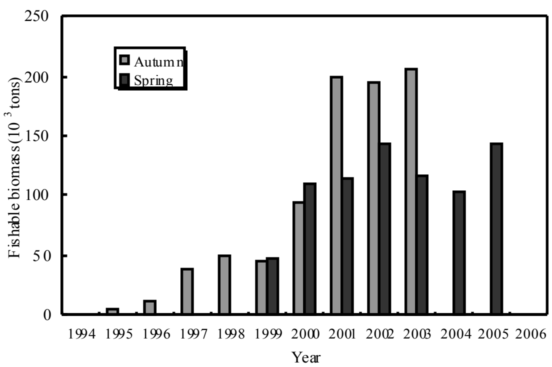


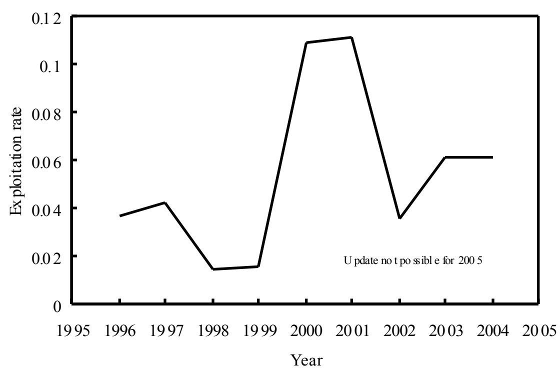
Biomass: There was a significant increase in SSB and total biomass between 1995 and 1997 followed by a period of stability between 1997 and 1999. SSB and total biomass have been at a higher level since 1999.





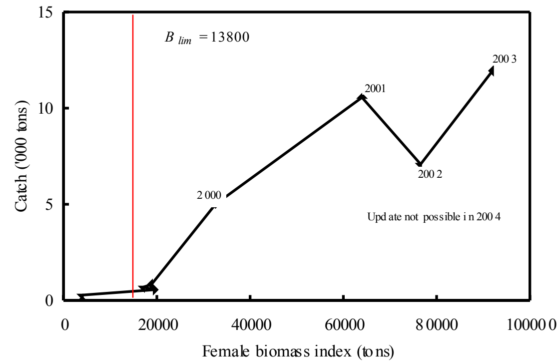
Fishable biomass and exploitation: Fishable biomass has increased from 1995-2001 and remained stable since then. The exploitation index (catch/autumn fishable biomass from previous year) increased during 2000-2001, at the beginning of the fishery, and has decreased since then.





State of the Stock: SSB and total biomass have increased since 1999. The stock appears to be well represented by a broad range of size groups, and the exploitation index is low. Recruitment is anticipated to decline.

Precautionary Approach Reference Points: Scientific Council considers that 15% of the maximum female biomass index is a limit reference point for biomass (B_{lim}) for northern shrimp in Div. 3LNO. It is not possible to calculate a limit reference point for fishing mortality. Currently, the biomass is estimated to be well above B_{lim}.



Recommendation: The Scientific Council advises a TAC of 22 000 tons for 2007. Scientific Council could not update its recent estimate of stock size due to an incomplete survey in 2004. Scientific Council repeats its previous recommendation that the TAC should not be raised for a number of years to allow time to monitor the impact of the fishery upon the Div. 3LNO shrimp stock.

Scientific Council reiterated its recommendations that the fishery be restricted to Div. 3L and that the use of a sorting grate with a maximum bar spacing of 22 mm be mandatory for all vessels in the fishery.

Special Comments: Advice for the 2007 fishery will be reviewed at the September 2006 Scientific Council meeting, when results from the 2005 autumn and 2006 spring surveys will be available.

Sources of Information: SCR Doc. 05/76, 77, 79, 88, 91, 95; SCS Doc. 04/12.

b) **Responses to the Coastal States**

The Scientific Council reviewed the STACFIS assessments for Northern shrimp in Subareas 0 and 1 and in Denmark Strait and off East Greenland, and the agreed summaries are as follows:

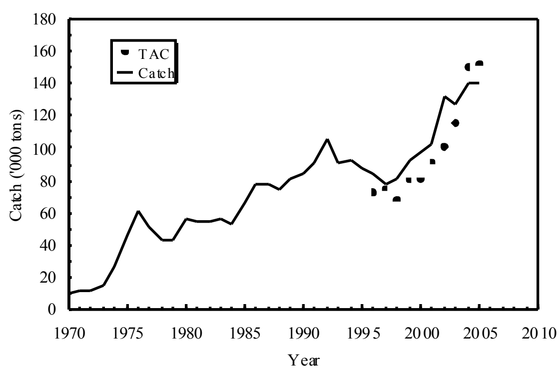
Northern Shrimp (Pandalus borealis) in Subareas 0 and 1

Background: A small-scale inshore fishery began in SA 1 during the 1930s. Since 1969 an offshore fishery has developed. The shrimp stock off West Greenland is distributed in Subarea 1 and Div. 0A east of 60°30'W.

Fishery and Catches: The fishery is prosecuted mostly by Greenland and Canada; since 2004 the EU has had a 4 000 ton quota in SA 1. Recent catches from the stock are as follows:

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A[2]	Recommended	Actual[4]
2002	132.2[1]	105.9	85	101.0
2003	126.5[1]	138.1	100	115.7
2004	141.8	141.8	130	150.0
2005	140.5[3]		130	152.4

[1] Corrected for overpacking.
[2] Provisional.
[3] Estimated to the end of 2005.
[4] Total of TACs set by Greenland and Canada.



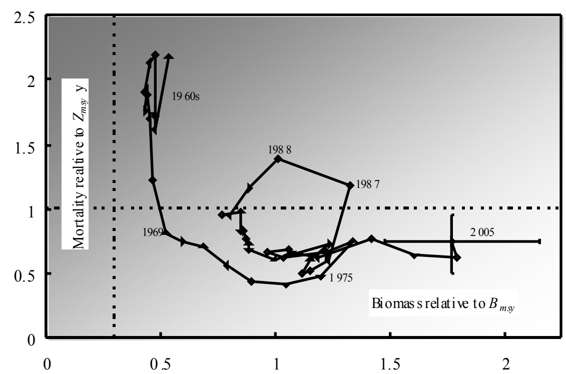
Data: Catch and effort data were available from all vessels. Series of biomass and recruitment indices and size- and sex-composition data were available from research surveys. Series of cod biomass and cod consumption were also available.

Assessment: An analytical assessment framework was used to describe stock dynamics in terms of biomass (B) and mortality (Z) relative to biological reference points.

The model used was a stochastic version of a surplus-production model including an explicit term for predation by Atlantic cod, stated in a state-space framework and fitted by Bayesian methods.

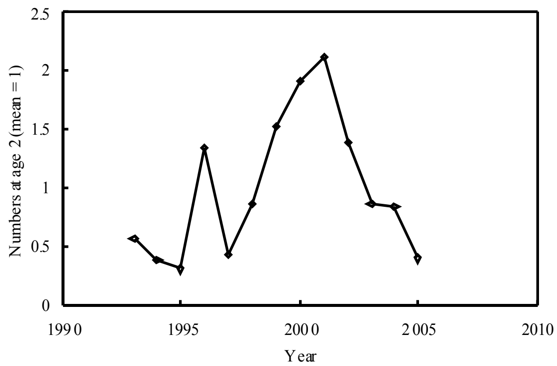
MSY (Maximum Sustainable Yield) defines maximum production, and B_{MSY} is the biomass level giving *MSY*. A precautionary limit reference point for stock biomass (B_{lim}) is 30% of B_{MSY} and the limit reference point for mortality (Z_{lim}) is Z_{MSY}.

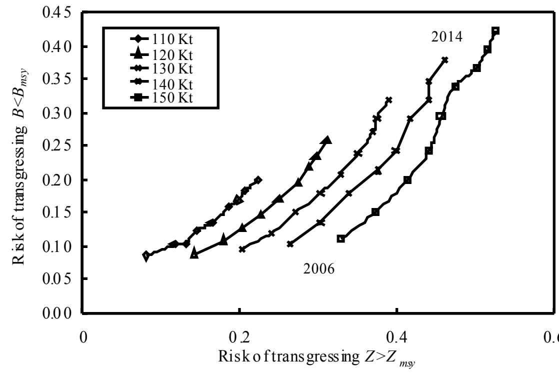
Mortality: The mortality caused by fishing and cod predation (Z) has been stable below the upper limit reference (Z_{msy}) since 1997. With catches in 2005 projected at 140 500 tons the risk that total mortality exceeded Z_{msy} was estimated at about 20%.



Biomass: Since the late 1990s the stock has increased and the survey index reached high levels in 2003 and 2004. This index then decreased in 2005, but CPUE continued to increase. The modelled stock biomass reached its hitherto highest value in 2005; the estimated risk of stock biomass being below B_{msy} at end 2005 was 8%, but less than 1% of being below B_{lim}.

Recruitment: Prospects for recruitment to the fishable biomass in 2006 are still highly favourable. However, the estimated number of age-2 shrimp decreased in 2002, was below average in 2003 and 2004 and decreased again in 2005 to near a 10-year low value. Recruitment to the fishable stock is likely to decrease after 2006.





State of the Stock: The stock biomass has increased substantially since the late 1990s to historically high levels. Biomass at the end of 2005 is estimated to be well above B_{msy} and mortality by fishery and cod predation well below Z_{msy}.

The abundance of recruited males (between 17 and 22 mm CL) in 2005 is estimated to be high and should sustain good catch rates of larger shrimp in 2006. However, both model simulations of stock development and indices of future recruitment indicate that fishable biomass can be expected to follow a decreasing trend.

Recommendations: If catches exceed 130 000 tons in 2006 the risk of exceeding a mortality that is considered to be a limit reference point is greater than 20%. However, given that stock biomass is now estimated considerably above B_{MSY}, risk of its falling below this level within a one-year horizon is low. Scientific Council concludes that a total catch of around 130 000 tons in Div. 0A and SA 1 in 2006 will have a high probability of maintaining the stock within the safe zone.

Risk associated with five optional catch levels for 2006 are as follows:

Catch option ('000 tons)	110	120	130	140	150
Risk of falling below B_{MSY}	9%	9%	10%	11%	11%
Risk of falling below B_{lim}	<1%	<1%	<1%	<1%	<1%
Risk of exceeding Z_{MSY}	8%	14%	20%	27%	38%

Medium-term Considerations: Ten-year projections of stock development were made using the assumption that the cod stock will remain at its 2005 level. Five levels of annual catch: 110, 120, 130, 140 and 150 thousand tons were investigated.

With a catch of 130 000 tons/yr there is a 15% risk of stock biomass falling below B_{MSY} and less than 1% of falling below B_{lim} in the first three years. However, this level of exploitation will not be sustainable in the longer term, as the estimated risk of falling below optimum biomass continues to increase through time.

Special Comments: The Scientific Council advice is for catch weight, correctly reported, without overpacking.

Both stock development and the rate at which changes might take place depend heavily on the abundance of predators (in particular cod) present within the shrimp habitat. In the most recent years increases in cod abundance have been registered, and present levels of cod biomass could consume significant quantities of shrimp. However, these estimates are still well below those of the late 1980s and certainly those of the 1950s and 1960s.

If the cod stock were to increase rapidly above the current level, as it did in the late 1980s, predation could reach the same level as the current catches within a 3-4 year period. Such an event should, however, be detected by routine survey programs and management options can, in that case, be evaluated.

Sources of Information: SCR Doc. 02/158, 04/73, 75, 76, 05/73, 74, 75, 83, 85; SCS Doc. 04/12.

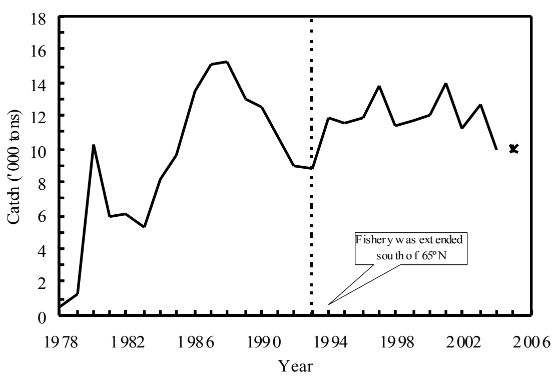
Northern shrimp (Pandalus borealis) in Denmark Strait and off East Greenland

Background: The fishery began in 1978 in areas north of 65°N in Denmark Strait, where it occurs on both sides of the midline between Greenland and Iceland. Areas south of 65°N in Greenlandic waters have been exploited since 1993.

Fishery and Catches: Five nations participated in the fishery in 2005. Recent catches and recommended TACs are as follows:

	Catch ('000 tons)		TAC ('000 tons)		
Year	STACFIS	21A[1]	Recom.	GR EEZ	ICE EEZ[2]
2002	11.2[1]	9.2	9.6	10.6	-
2003	12.6[1]	9.8	9.6	10.6	-
2004	10.0	10.0	12.4	15.6	-
2005	10.0[3]		12.4	12.4	-

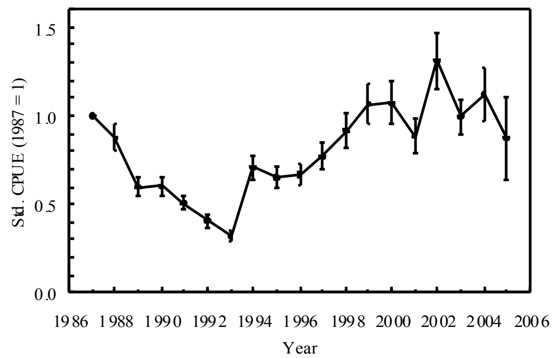
[1] Provisional catches.
[2] Fishery unregulated in Icelandic EEZ
[3] Projected to the end of 2005.

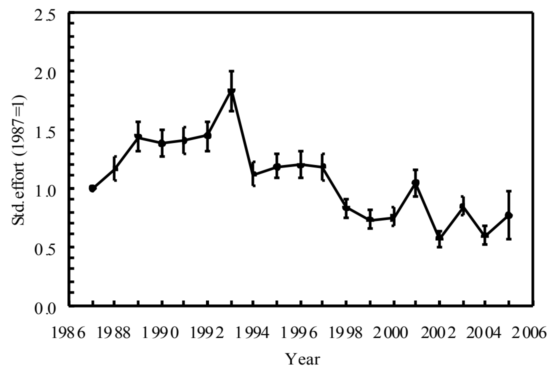


Data: Catch and effort data were available from trawlers of several nations. Surveys have not been conducted since 1996.

Assessment: No analytical assessment is available. Evaluation of the status of the stock is based on interpretation of commercial fishery data.

CPUE: Combined standardized catch-rate index for the total area decreased steadily from 1987 to 1993, showed an increasing trend until the late 1990s, and fluctuated at this level thereafter.





Recruitment: No recruitment estimates were available.

Biomass: No direct biomass estimates were available.

Exploitation rate: From 1998 through 2005 the exploitation rate index (catch/CPUE) has been at its lowest levels in the 19-year series.

State of the Stock: Standardized CPUE data for all the areas combined indicate an increasing trend from 1993 to 2000 in the fishable biomass and has fluctuated at this level thereafter. However, changes in the fishing pattern in 2004 and 2005 leaves some uncertainty as to whether the 2005 value is a true reflection of the stock biomass.

Recommendation: There were no indications that catches in the range of 12 400 tons adversely affect the stock. Scientific Council therefore advises that catches of shrimp in Denmark Strait and off East Greenland should remain at this level in 2006.

Special Comments: The apparent increase in the advised TACs after 2003 is based on a revision of catch estimates to account for overpack and not on a comparable increase in stock production. The advice after 2003 may therefore not be interpreted as if actual removals by the fishery should be increased comparatively. The Scientific Council advice is based on catches in 2005 being reported correctly, accounting for overpack.

Sources of Information: SCR Doc. 03/74, 05/93.

IV. OTHER MATTERS

1. Scientific Council Meeting, October/November 2006

The Scientific Council agreed to the dates 25 October to 2 November 2006 for this meeting to be held jointly with the ICES *Pandalus* Assessment Working Group (WGPAND) at the ICES Headquarters, Copenhagen, Denmark.

It was noted that the nature of the joint NAFO/ICES meeting made the duration of the meeting acceptable. The meeting had been extended to allow time for the ICES stocks to be assessed.

2. Scientific Council Meeting, October/November 2007

The Scientific Council agreed to the dates 24 October to 1 November 2007 for this meeting to be held jointly with the ICES *Pandalus* Assessment Working Group (WGPAND) at the NAFO Headquarters, Dartmouth, Nova Scotia, Canada.

3. Coordination with ICES Working Groups on Shrimp Stock Assessments

Participants all agreed that having the joint meeting was fruitful.

Therefore participants agreed to the dates 25 October to 2 November 2006 for this meeting to be held jointly with NAFO Scientific Council and ICES *Pandalus* Assessment Working Group (WGPAND) at the ICES Headquarters, Copenhagen, Denmark.

In order to facilitate the 2006 meeting the following proposal was agreed:

The schedule and agenda will be developed by the Chairs of Scientific Council, STACFIS, ACFM and WGPAND. The STACFIS agenda will explicitly incorporate the assessments generally addressed by WGPAND. The advice will be provided as requested by NAFO Fisheries Commission and ICES ACFM.

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.

Intersessionally the Chairs will communicate to work out the details regarding the arrangements of the meeting, in consultation with the NAFO and ICES Secretariats. The goal is to have a joint report prepared.

4. Other Business

a) New Possibilities to Improve Catch Information Available

The Fisheries Commission Request for Scientific Advice (FC Doc. 05/14) enables the Scientific Council to obtain information from VMS data from the Secretariat. The VMS data may be a possible source of information regarding position, particularly in the shrimp fishery.

The Scientific Council **recommends** that *approval be sought from the Fisheries Commission to obtain catch information from VMS to be used in assessments.*

Any information available on "overpack" and how to quantify it should also be made available to Scientific Council.

b) By-catch Information

At the September Annual Meeting the Scientific Council was requested by the Fisheries Commission to provide information on by-catch in the Div. 3M shrimp fishery.

Having observed that there is much relevant information contained in documentation presented to it, and in order to determine the impact of the shrimp fishery upon commercially important groundfish species, Scientific Council recommended that information on groundfish by-catch in the shrimp fishery for the NAFO Subarea 2 and Divisions 3KLMNO should be summarized and updated by the authors. This summary should be presented to Scientific Council at the June Meeting.

c) **Assessment Database**

Scientists at this meeting were shown the web-page for the stock assessment database. Designated Experts were encouraged to submit their information to the Secretariat.

d) **Time Needed for the Meeting**

The Council noted that the meeting utilized the full eight days scheduled. The joint group for the meeting considered that this was an appropriate amount of time to complete the proposed agenda. However, to maintain the eight days it will be necessary to improve the efficiency, by making all relevant documentation available well in advance of the meeting.

e) **Proposal for Shrimp Working Group**

A proposal was made to establish a Northern Shrimp Working Group within NAFO Scientific Council. The working group will be used to stimulate concerted studies on the description of life history characteristics of shrimp and the comprehension of life cycle key processes. The main objectives of the working group would be to:

- Review availability of information and existing data on life history characteristics of northern shrimp by areas;
- Develop standard coordinated research protocols to monitor life history characteristics;
- Analyze and document demographic parameter variations in line with the investigation of hypotheses on life cycle key processes including the effect of variable environmental conditions.

Scientific Council agreed that it would be a good idea to establish such a working group, and suggested that a Convenor should be identified and that clear Terms of Reference be established and reviewed by the Council.

Scientific Council expressed their best wishes for the group and **recommends** that *the Working Group submits their progress report to the Council regularly.*

f) **Shrimp and Remotely-sensed Indicators of Marine Production**

A presentation was made by Cesar Fuentes-Yaco, Peter Koeller and Trevor Platt.

Information on a project proposal was presented. The project aims to link changes in shrimp biology, such as growth and recruitment, to remotely-sensed indicators of phytoplankton, specifically chlorophyll a. Results illustrating the potential usefulness (Koeller *et al.*, in press) were presented. The presentation ended with an open invitation to the shrimp research community to expand the above project to a larger geographical area in co-operation with remote-sensing expertise housed at the Bedford Institute of Oceanography.

Scientific Council encouraged the authors to bring their proposal to fruition.

Further reading:

Koeller, P., C. Fuentes-Yaco and T. Platt. (in press). Decreasing shrimp (*Pandalus borealis*) sizes off Newfoundland and Labrador – environment or fishing? *Fisheries Oceanography.*

Fuentes-Yaco, C., P. Koeller, T. Platt and S. Sathyendranath (in press). Shrimp (*Pandalus borealis*) growth and timing of the spring phytoplankton bloom. *Fisheries Oceanography.*

g) **Workshop on Bayesian Methods of Assessments**

Scientific Council was informed by the Greenland Institute of Natural Resources that a workshop on Bayesian methods of assessments is to be held in Nuuk in March-April of 2006. The Council welcomed the information and draws it to the attention of interested scientists.

V. ADOPTION OF REPORTS

The Council at its session on 3 November 2005 considered and adopted the Report of STACFIS (see Appendix I). The recommendations made by STACFIS and endorsed by the Scientific Council are given therein in Sections II and III above. The Council then considered and adopted its own Report of this 26 October-3 November 2005 Meeting.

VI. ADJOURNMENT

It was noted that Ron Myers has already retired and Forbes Keating was due to retire this year. Recognition for their hard work and best regards for their future were extended. Thanks were extended to the Secretariat for their usual efficient work, particularly to Barbara Marshall for her work in the meeting. Best wishes and safe traveling were given to all participants.

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

Chair: Don Power Rapporteur: Various

I. OPENING

The Committee met at NAFO Headquarters, Dartmouth, Nova Scotia, Canada, during 26 October-3 November 2005, in conjunction with the WGPAND of ICES in accordance with decisions of November 2004, to consider and report on matters referred to it by the Scientific Council and ICES, particularly those pertaining to the provision of scientific advice on certain Northern shrimp stocks. Representatives attended from Canada, Denmark (in respect of Greenland), European Union (Spain), Iceland, Norway, Russian Federation and Ukraine.

The Chair, Don Power (Canada), opened the meeting on 26 October 2005 welcoming the participants. The Agenda was reviewed and a plan of work developed for the meeting.

II. GENERAL REVIEW

1. Review of Recommendations in 2004 and in 2005

The recommendations from last year were reviewed on a stock-by-stock basis.

Recommendations in November 2004

STACFIS **recommended** that, for shrimp in Div. 3M:

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to Designated Experts by 1 September 2005.*

STATUS: Some progress has been made.

- *indices of female stock size be presented with error bars where possible.*

STATUS: Error bars were presented for the surveys. No progress on error bars for CPUE indices of females.

STACFIS **recommended** that, for shrimp in Div. 3LNO:

- *sensitivity analyses be conducted to determine whether OGMAP is an appropriate method to determine Div. 3LNO shrimp biomass/abundance indices and population adjusted length frequencies from stratified random surveys.*

STATUS: This was completed and presented at this meeting (see Section III.2.iii). Work is ongoing.

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to the designated expert, in the standardized format, by 1 September 2005.*

STATUS: Some progress has been made.

For the shrimp stock in Subarea 1 and Div. 0A east of 60°W, STACFIS **recommended** that:

- *sampling of catches by observers - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - be re-established in Subarea 1.*

STATUS: There has been no sampling and no biological data recently collected from the commercial fishery.

- *the time series of cod biomass used as input in the shrimp assessment model be re-evaluated.*

STATUS: Implemented. Information is included in this year's assessment.

- *time series of recruitment (index of age 2 abundance) and its link to the fishable biomass in a later year be considered for inclusion in the shrimp assessment model*

STATUS: No progress has yet been made on modifying the assessment model.

STACFIS **recommended** that, for shrimp in Denmark Strait and off East Greenland:

- *sampling of catches by observers - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - be re-established in the Greenland EEZ and improved in the Icelandic EEZ.*

STATUS: There has been no sampling and no biological data recently collected from the commercial fishery.

Recommendations in June 2005

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.*

STATUS: This was addressed in Scientific Council. (see section SC Report IV.4.b)

Summary Discussion

STACFIS noted the general recommendation for each stock of submitting data to the Designated Experts by 1 September 2005 for use in assessments was not completely fulfilled for all data. The committee agreed that such recommendations should continue to be stated as a procedural item, but in practical terms, it was suggested that the Designated Experts should send a detailed communication to representatives of Contracting Parties requesting the various information with sufficient notice to enable compliance by 1 September.

2. **Review of Catches**

STACFIS reviewed and agreed on the catch figures available for all stocks being assessed at this meeting during consideration of each relevant stock.

3. **General Environmental Review**

Subarea 3

Stocks on the Flemish Cap, Division 3M: (SCR Doc. 05/87). 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 Flemish Cap, which then flows southward. To the south, the Gulf Stream flows to the northeast merging with the Labrador Current to form the North Atlantic Current which influences waters around the southern areas of the Flemish 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 shrimp on the Flemish Cap. During the summer of 2005, it appears that the circulation pattern around the Flemish Cap was again dominated by the southward flowing Labrador Current, however there appeared to be a slight increase in the northward component compared to the previous year, indicating a possible strengthening of the gyre circulation. In general, the colder-than-normal temperatures experienced over the continental shelf and on the Flemish Cap from the late 1980s up to the mid-1990s moderated by the summer of 1996 and continued to warm until 1999 after which they decreased slightly until 2002. From 2003 to 2005 most areas of the water column again experienced an increase in both temperature and salinity with near bottom temperatures over and around the Flemish Cap exceeding 4°C, which were above normal by 1°C in some areas.

Stocks on the Grand Bank: Divisions 3LNO: (SCR Doc. 05/91, 23). 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 most of the year. Bottom temperatures generally increase to 2° to 4°C in southern regions of Div. 3NO due to atmospheric forcing in shallow regions and along the slopes of the banks below 200-m depth due to the presence of warmer 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 winter formed CIL water mass which is a robust index of ocean climate conditions, was below-normal (implying warm conditions) across the Grand Bank for the 7th consecutive year in 2005. Time series of the spatially average bottom temperatures for Div. 3LNO region shows large inter-annual variations and a downward trend that started in 1984 which continued until the early 1990s. Recently, temperatures have increased over the sub-zero values of the early 1990s with the average bottom temperature during the spring of 2004 reaching near 2.5°C, the highest since 1983. The 2005 value decreased slightly to just under 2°C.

Subarea 1

Stocks off West Greenland: Divisions 1A-1F: (SCR Doc. 05/2, 19, 74) The recent northward extension of pure Irminger Water as far north as Fylla Bank indicates high inflow of warm water of Atlantic origin to the West Greenland area. 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. 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 2°C warmer than normal during 2004. Bottom temperatures measured on the summer 2005 bottom trawl survey ranged from 1°C in the shallow (<200 m) parts of Disko Bay to about 6°C in the southern offshore areas. Values >4°C were found in large parts of offshore area south of 63°45'N whereas bottom temperatures between 2° to 3°C prevailed in the remaining parts of the survey area. It is further noteworthy that the change from a cold to a warm period has affected all different depth layers of the survey area. The overall area-weighted mean bottom temperature amounted to 3.11°C, which corresponds to the average observed since 1997 and indicates that the recent relatively warm period has continued into 2005.

III. STOCK ASSESSMENTS (from NAFO Area)

1. **Northern Shrimp (*Pandalus borealis*) in Division 3M** (SCR Doc. 05/78, 79, 89, 94)

a) **Introduction**

The shrimp fishery in Div. 3M began in late April 1993. Initial catch rates were favourable and, shortly thereafter, vessels from several nations joined. Since 1993 the number of vessels ranged from 40-110, and in 2005 there were approximately 26 vessels fishing shrimp in Div. 3M compared to 50 in 2004.

Catches increased from about 27 000 tons in 1993 to 48 000 tons in 1996, declined to 25 000 tons in 1997 then increased gradually to a peak of 63 000 tons in 2003 (Fig. 1.1). In 2004 the catch declined to 44 000 tons and provisional information to 1 September 2005 indicate removals of about 9 000 tons. Supplementary information from the fishery suggests that economic considerations (price of fuel and market prices for shrimp) may be affecting participation in the fishery.

Recent catches and TACs (tons) are as follows:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	-	-	30 000	30 000	30 000	45 000	45 000	45 000	45 000	48 000
STATLANT 21A	23 916	30 035	42 041	50 471[1]	53 793[1]	47 299[1]	63 198[1]	43 953[1]		
STACFIS	25 211	30 308	43 438	52 664	52 671	48 704	63 206	45 486	9 000[2]	

[1] Provisional.
[2] Preliminary to 1 September 2005.

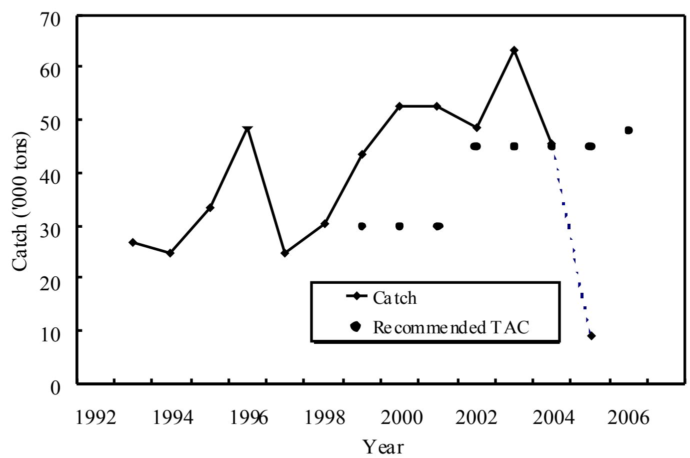


Fig. 1.1. Shrimp in Div. 3M: catches (2005 preliminary).

b) Input Data

i) Commercial fishery data (SCR Doc. 05/79, 94)

Effort and CPUE. Data from logbooks of Canadian, Greenlandic, Icelandic, Faroese, Norwegian and Russian vessels were available. A standardized CPUE series was produced to address differences due to seasonality, fishing power and gear (single, double and triple trawl). CPUE decreased from 1993 to 1994, varied without a trend to 1997 and increased until 2005 (Fig. 1.2). Due to few observations there is considerable uncertainty regarding the 2005 point.

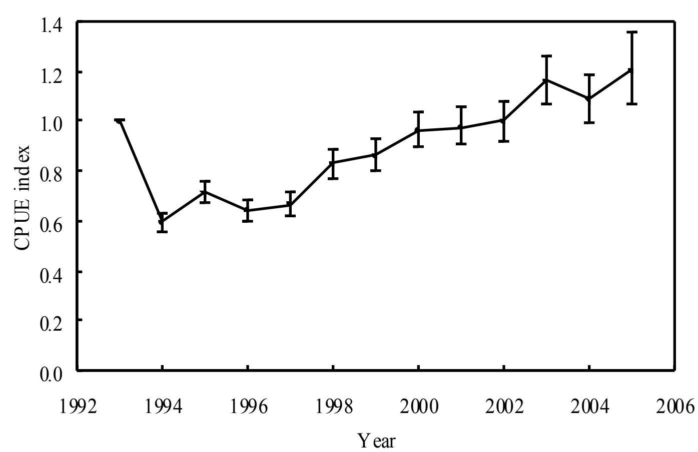


Fig. 1.2. Shrimp Div. 3M: the standardized CPUE of shrimp on Flemish Cap, 1993-2005.

Standardized CPUE female SSB. It has been shown for this stock that transitionals will be functional females at spawning time in the same year (SCR Doc. 04/64). Accordingly a spawning stock index was calculated from the standardized CPUE as kg/hr of all females (transitionals and females). The spawning stock declined from 1993 to 1997, and had shown an increasing trend to 1998. It was stable between 1998 and 2004, then increased in 2005 (Fig. 1.3). The increase in 2005 may however be questionable, as noted for the standardized CPUE above.

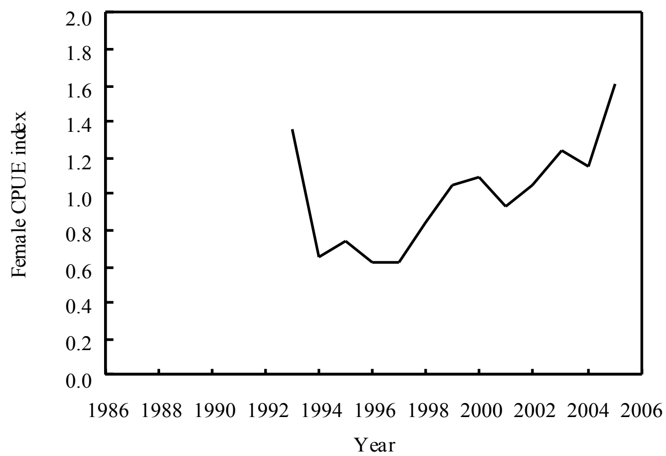


Fig. 1.3. Shrimp Div. 3M: standardized female CPUE index, 1993-2005. The series was standardized to the mean of the series.

Biological data. Age composition was assessed from commercial samples obtained from Iceland from 2003 to 2005 and from Canada, Greenland, Russia and Estonia in previous years. Number/hour was calculated for each year-class by applying a weight/age relationship and the total number as calculated from the nominal catch and the standardized CPUE data.

The results in the Table below indicate that ages 3, 4 and 5 generally dominate the commercial catch in numbers. The 2000 year-class appeared weak as 3 and 4 year olds in the 2003 and 2004 fisheries. Both the 2001 and 2002 year-classes seem to be well above average as 3 and 4 year olds in 2005 and shall be important in the fishery in 2006 as well as in the fishery in 2007 in case of the 2002 year-class.

Numbers per hours at age in the commercial fishery.

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Mean
1				5			23	660			71
2	2 524	2 125	3 195	2 561	1 069	6 922	4 598	8 556	12 784	1 717	4 251
3	26 427	16 338	18 689	15 243	22 366	9 271	38 786	9 444	30 033	26 591	19 127
4	8 051	16 953	21 863	17 631	26 012	29 673	13 200	34 446	10 749	37 500	19 003
5	2 329	3 330	6 974	14 184	15 381	15 028	15 996	14 723	22 725	15 198	11 082
6	1 216	675	2 594	5 107	3 227	4 433	3 268	5 796	4 425	2 773	3 240
7		58	279	59	157	599	129	86	24		312
Total	40 547	40 692	53 594	54 790	68 212	65 926	76 000	73 711	80 740	83 779	63 799

ii) **Research survey data** (SCR Doc. 05/78)

EU bottom trawl surveys. Stratified-random surveys have been conducted on Flemish Cap in July from 1988 to 2005. A new vessel was introduced in 2003 which continued to use the same trawl employed since 1988. In addition, there were differences in codend mesh sizes utilized in the 1994 and 1998 surveys that have likely resulted in biased estimates of total survey biomass. Nevertheless, for this assessment, the series prior to 2003 were converted into comparable units with the new vessel based on the methodology accepted by STACFIS in 2004 (*NAFO Sci. Coun. Rep.*, 2004, SCR Doc. 04/77). The revised index of female shrimp biomass reveals a rapid increase from the lowest observed level in 1990 to a 10 fold increase in 1992 followed by an equally dramatic decline to 1994. The index was stable at a relatively low level between 1994 and 1997; then increased to a higher level with fluctuation between 1998-2005 (Fig.1.4).

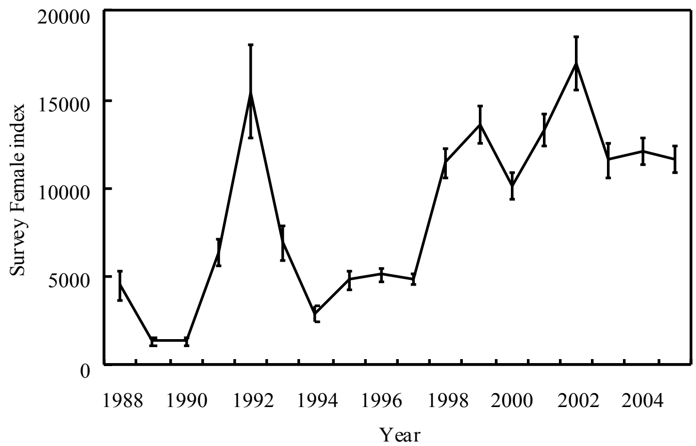


Fig. 1.4. Shrimp in Div. 3M: female biomass index from EU trawl surveys, 1988-2005.

iii) **Recruitment indices**

EU bottom trawl surveys. From 1988 to 1995 shrimp age 2 and younger were not captured by the survey. Beginning in 1996 the presence of this component increased in the surveys and it is believed that the introduction of the new vessel in 2003 greatly improved the catchability of age 2 shrimp due to technological advances in maintaining consistent performance of the fishing gear. In addition, since 2001, a small mesh juvenile bag was also attached to the net which was designed to provide an index of juvenile shrimp smaller than that typically retained by the survey codend. Both indices do not show a good relationship with the 3+ survey index either 2 or 3 years later. This may be because there are only limited data points for a valid comparison.

Commercial fishery. Although the commercial fishery is conducted with larger mesh size than the survey indices, two year olds are frequently detected in the fishery. An index of two year old shrimp from 1996 to 2005, based on standardized number per hour, correlated well (R^2= .74, Fig. 1.5) with a similar index derived for 3+ year olds (a proxy for the fishable biomass) from the fishery two years later.

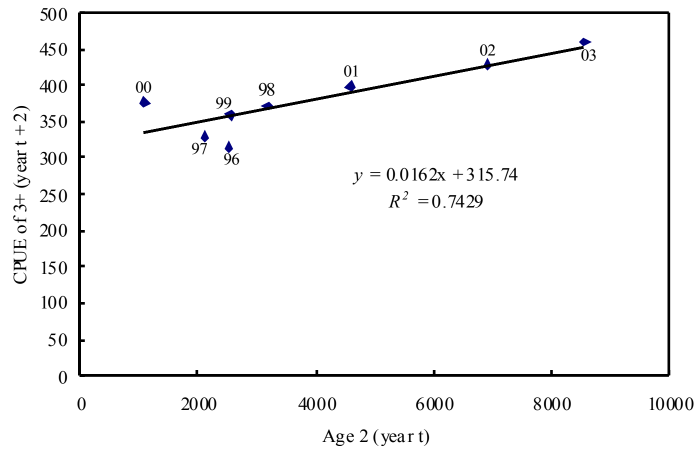


Fig. 1.5. Shrimp in Div. 3M: regression between CPUE of age 2 (year t) shrimp from samples from the commercial fisheries and CPUE of age 3+ (year t+2), 2 years later.

In the future it is perhaps possible to predict the fishable biomass to some extent 2 years ahead using the number of age 2.

The index from the commercial fishery suggests that the 2001 and 2002 year-classes are above average and the 2003 year-class was amongst the lowest since 1994 (Fig.1.6). These results correspond well with estimates from the Faroese surveys and the EU surveys.

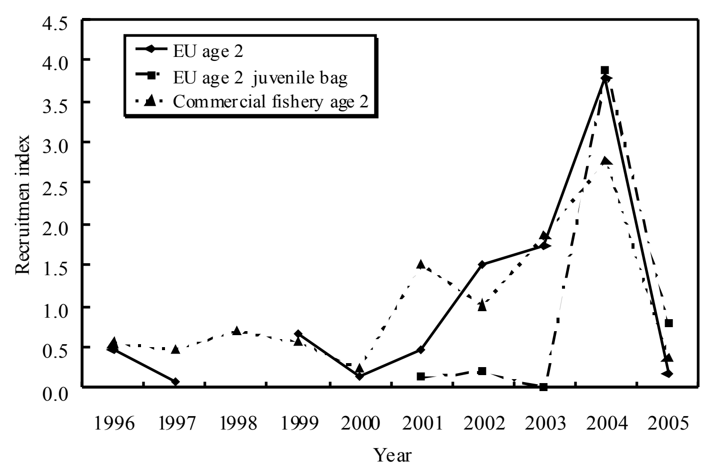


Fig. 1.6. Shrimp in Div. 3M: abundance indices at age 2 from the EU survey and from the commercial fishery. Each series was standardized to its mean.

STACFIS agreed that this was the only possible source of prediction currently available.

c) **Assessment Results**

Commercial CPUE. Standardized catch rates declined between 1993 and 1994, varied without a trend to 1997 and increased to 2005.

Recruitment. Both the 2001 and 2002 year-classes appear to be above average, but 2003 year-class appears weak.

Spawning Stock Biomass. All indices of female biomass increased from 1997 and have fluctuated without a trend since then.

State of the Stock. The indices of CPUE and biomass are at relatively high levels but there are indications of a decline in recruitment, which may affect the 2007 fishery.

STACFIS considers it important to recognize that its ability to assess the resource will improve with the continuation of a series of research surveys directed for shrimp, especially if appropriate measures to sample juvenile shrimp are applied.

d) **Precautionary Approach**

STACFIS noted that the Scientific Council Study Group on Limit Reference Points, recommended that survey biomass indices could be used to indicate a limit reference point for biomass, in situations where other methods were not available (SCS Doc. 04/12). In such cases, "the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim}". B_{lim} is defined as a biomass level, below which stock productivity is likely to be seriously impaired, that should have a very low probability of being violated.

Last year the limit reference point for the Flemish Cap shrimp stock was taken from the EU survey where the biomass index of female shrimp was used. The EU survey of Div. 3M provides an index of female shrimp biomass from 1988 to 2005 which has now been converted to the new vessel, with a maximum value of 17.1 in 2002, (and a similar value of 15.5 in 1992). An 85% decline in this value would give a B_{lim} = 2.6. Due to the conversion the reference level was revised from 1.7 to 2.6. The female biomass index was below this value in only 1989 and 1990, before the fishery, and in 2004-05 was about 30-32% below the maximum. If this method is accepted to define B_{lim}, then it appears unlikely that the stock is below B_{lim} at the present time (Fig. 1.7).

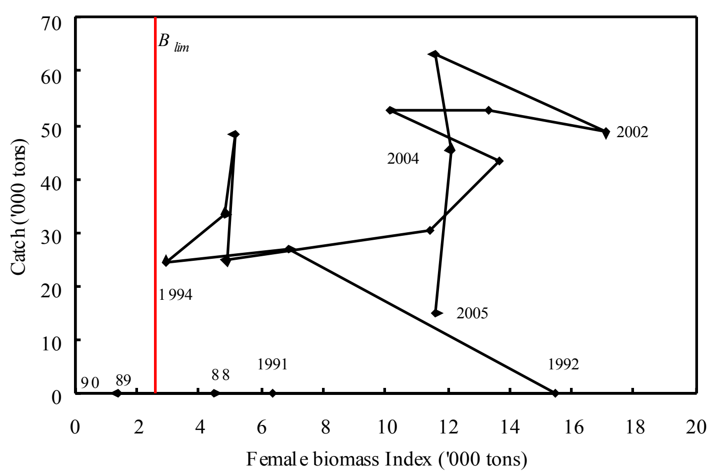


Fig. 1.7. Shrimp in Div. 3M. Catch plotted against female biomass index from EU survey. Line denoting B_{lim} is drawn where biomass is 85% lower than the maximum point in 2002.

e) **Research Recommendations**

STACFIS **recommends** that, for shrimp in Div. 3M:

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to Designated Experts by 1 September 2006.*

- *indices of female stock size be presented with error bars where possible.*

- *the relationship between the recruitment index and fishable biomass be investigated further.*

2. Northern Shrimp (*Pandalus borealis*) in Divisions 3L, 3N and 3O (SCR Doc. 05/76, 77, 79, 88, 91)

a) **Introduction**

This shrimp stock is distributed around the edge of the Grand Banks mainly in Div. 3L. The fishery began in 1993 with catches around 1 800 tons. Exploratory fishing from 1996-99 resulted in catches ranging from 179-795 tons. In 2000, the fishery came under TAC control and fishing was restricted to Div. 3L. In 2000, 4 896 tons of shrimp were taken from an annual TAC of 6 000 tons. Catches of 10 566 tons and 6 977 tons were taken in 2001 and 2002, respectively. Annual TACs were raised to 13 000 tons over the next 3 years resulting in annual catches of 11 947, 12 620 and 13 219 tons, respectively (Fig. 2.1).

Since this stock came under TAC regulation Canada has been allocated 83% of the TAC. The Canadian allocation is split between a small vessel (less than 500 tons and less than 63 ft) and large vessel fleet. By October 2005, the small and large vessel fleets had taken 7 113 and 4 037 tons of shrimp respectively in Div. 3L. In all years, most of the Canadian catch occurred along the northeast slope in Div. 3L.

Fifteen contracting parties have fished in the NRA since 2000. The annual quota within the NRA is 17% of the total TAC and is meant to be split evenly among these nations; however, since 2003, Denmark (in respect of the Faroe Island and Greenland) set autonomous annual TAC of 1 344 tons.

The use of a sorting grid to reduce by-catches of fish is mandatory for all fleets in the fishery. The sorting grid cannot have a bar spacing greater than 22 mm.

Recent catches and TACs (tons) for shrimp in Div. 3LNO (total) are as follows:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
TAC	-	-	-	6 000	6 000	6 000	13 000	13 000[1]	13 000[1]	22 000[1]
STATLANT 21A	485	567	795	4 930	5 323[2]	5 697[2]	11 016[2]	11 660[2]		
STACFIS	485	567	795	4 896	10 566[3]	6 977[3]	11 947	12 620	13 219[4]	

[1] Denmark (in respect of Faroe Islands and Greenland) set an autonomous TAC of 1 344 tons for 2003-2005.

[2] Provisional catches.

[3] Reliable catch reports were not available for all countries therefore estimates were made using other sources (Canadian surveillance, observer datasets, STACFIS estimation, etc.)

[4] Total catch estimated from NAFO provisional data and Canadian Atlantic Quota Reports up to October.

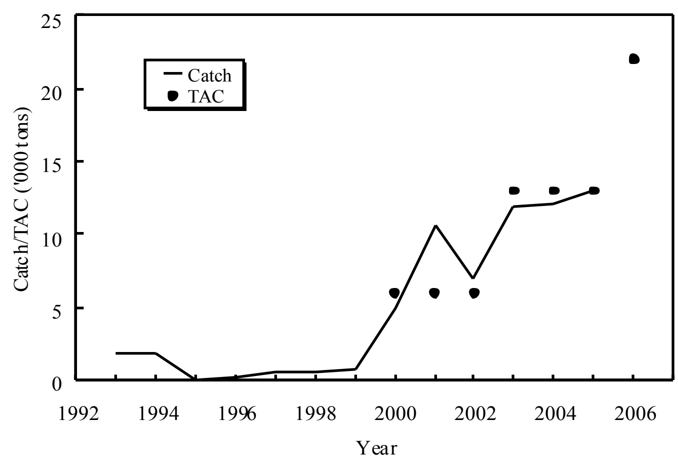


Fig. 2.1. Shrimp in Div. 3LNO: catches and TAC (to October 2005).

b) **Input Data**

i) **Commercial fishery data** (SCR Doc. 05/76, 79, 88)

Effort and CPUE. Catch and effort data have been available from Canadian fishing vessel logbooks and observer records since 2000. Standardized catch rates for large vessels decreased significantly by 34% from 2003 to 2005 (Fig. 2.2). Information provided by the large vessel fleet indicates that this drop in CPUE may have been due to targeting female shrimp, which are less abundant than male shrimp. However, Canadian small vessel standardized CPUE increased 86% between 2003 and 2005.

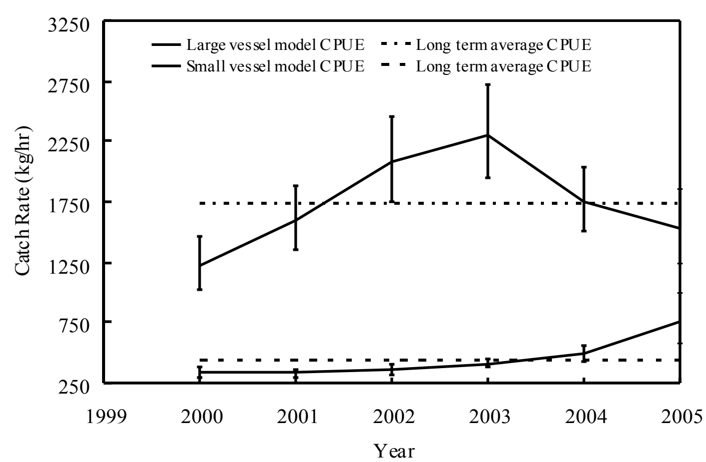


Fig. 2.2. Shrimp in Div. 3LNO: standardized CPUE for Canadian vessels fishing shrimp within the Div. 3L EEZ.

Data were available from other nations fishing in the NRA (Iceland, Greenland, Norway and Spain), although the data were insufficient to produce a standardized CPUE model.

Catch composition. Sampling was available from the Canadian, Icelandic and Norwegian fleets. Catch composition was derived from sampling of Canadian catches in Div. 3L. In 2005, the 1999-2001 year-classes dominated the catch and the female portion was still well represented (year-classes from before 2000).

ii) **Research survey data** (SCR Doc. 05/77, 88, 91)

Canadian multi-species trawl survey. Canada has conducted stratified-random surveys in Div. 3LNO, using a Campelen 1800 shrimp trawl, during spring (1999-2005) and autumn (1995-2004). The autumn survey in 2004 was incomplete and therefore had limited use in the assessment.

Spanish multi-species trawl survey. Spain has been conducting a spring stratified-random survey within the Div. 3NO NRA since 1995. From 2001 onwards data were collected with a Campelen 1800 trawl.

Biomass and abundance. Based on Canadian surveys, over 90% of the biomass was found in Div. 3L, distributed mainly along the northeast slope in depths from 185-550 m. There was a significant increase in autumn shrimp biomass indices between 1995 and 2001 and this index has since remained stable at a high level (Fig. 2.3).

Analyses, from past surveys, indicated that 25-61% of the biomass/abundance was accounted for in strata that were not surveyed in autumn 2004. An index from strata consistently surveyed, showed that the 2004 survey biomass index (97 000 tons) was the second highest in this series.

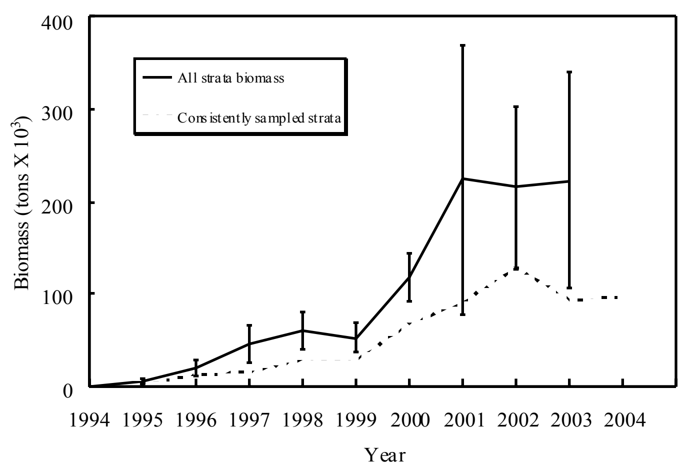


Fig. 2.3. Shrimp in Div. 3LNO: biomass estimates from Canadian autumn multi-species surveys (±95% confidence intervals).

The Canadian spring 2005 survey estimate at 156 000 tons, was the third highest in that time series (Fig. 2.4).

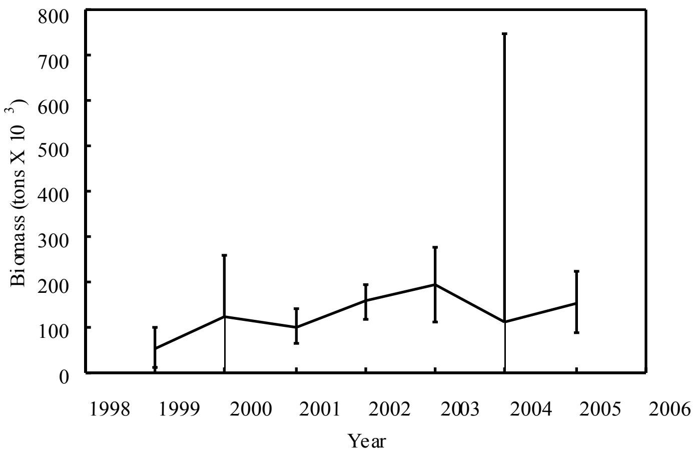


Fig. 2.4. Shrimp in Div. 3LNO: biomass estimates from Canadian spring multi-species surveys (±95% confidence intervals).

The biomass index of the Spanish survey within Div. 3NO in the NRA fluctuated between 1 600 and 2 600 tons over the period 2002-2005.

Sex and age composition

The Canadian spring and autumn surveys showed an increase in the abundance of female (transitionals + females) shrimp over the full-time series. There was a decline in the abundance of male shrimp from 2001 to 2003 in the autumn index, and from 2002 to 2003 then stability to 2005 in the spring index (Fig. 2.5).

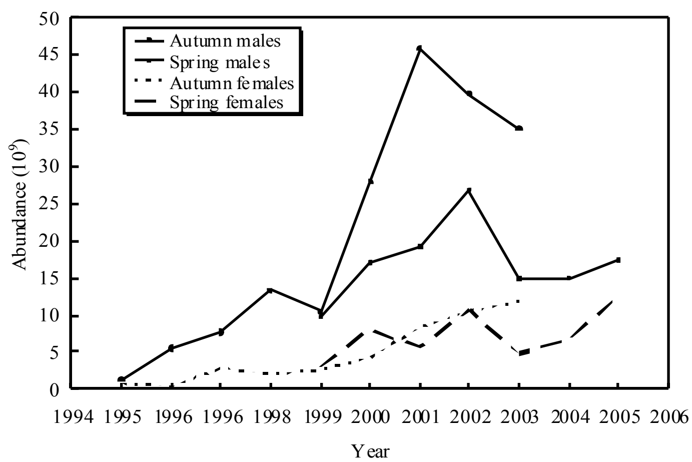


Fig. 2.5. Shrimp in Div. 3LNO: abundances of male and female shrimp within Div. 3LNO as estimated from Canadian multi-species survey data, using areal expansion calculations.

Abundance estimates from the autumn 2003 Canadian survey were dominated by males with a modal length of 19.8 mm CL (1999 year-class). This was corrected from last year's report. Shrimp aged 3 and 4 dominated the male component of the length frequencies in spring 2004 and 2005 surveys (Fig. 2.6).

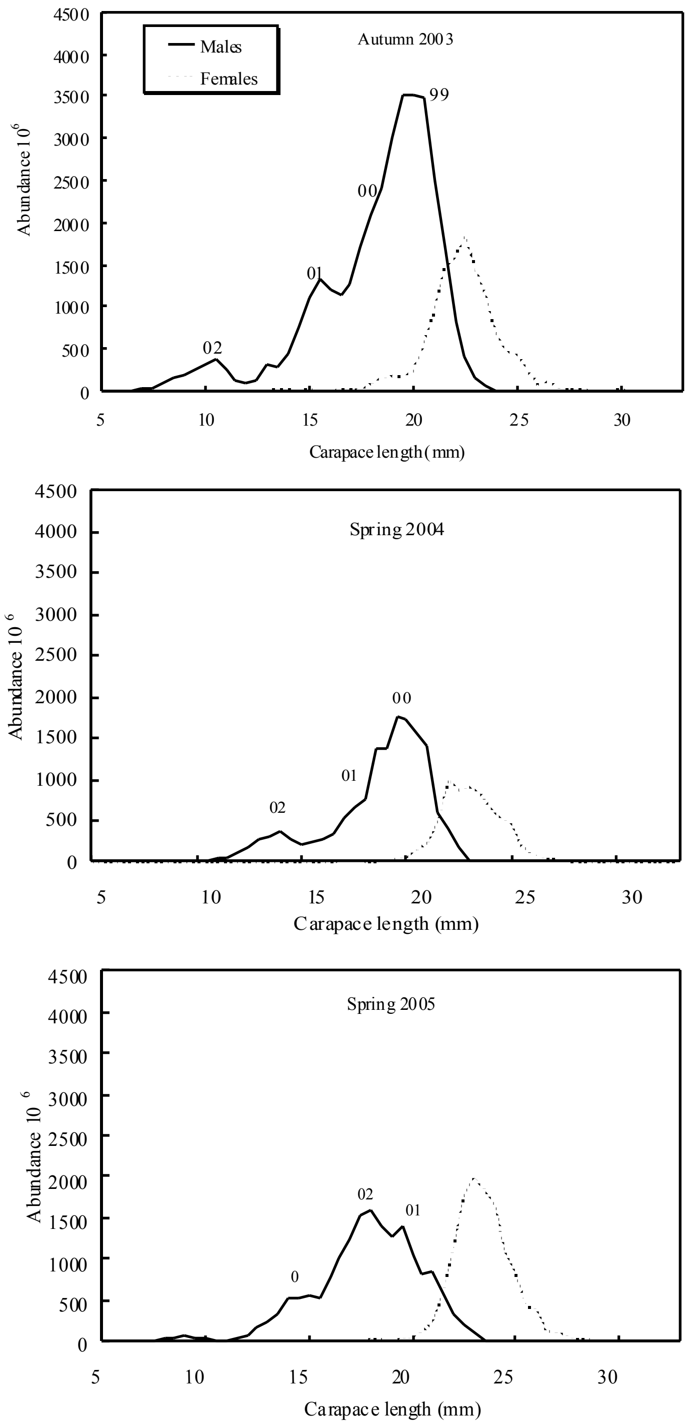


Fig. 2.6. Shrimp in Div. 3LNO: abundance at length for northern shrimp estimated from Canadian multi-species survey data using stratified areal expansion calculations.

Spawning Stock Biomass (SSB). In general, the SSB (transitionals and all females) index from both Canadian surveys increased from 1999-2003 (Fig. 2.7 and 2.8). The spring survey index varied without trend thereafter.

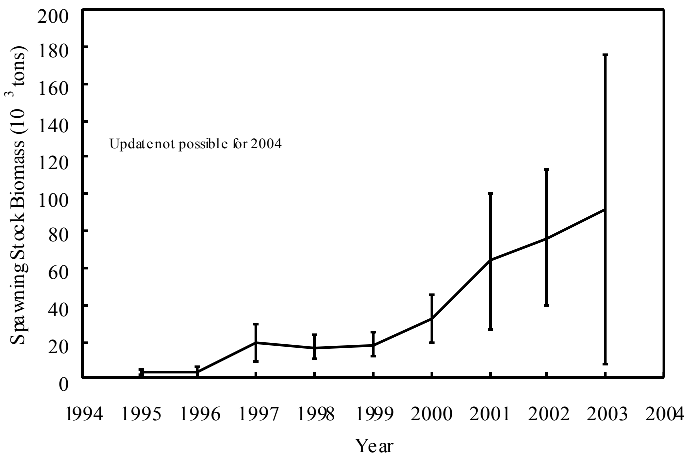


Fig. 2.7. Shrimp in Div. 3LNO: spawning stock biomass (SSB) estimates from Canadian autumn multi-species surveys (±95% confidence intervals).

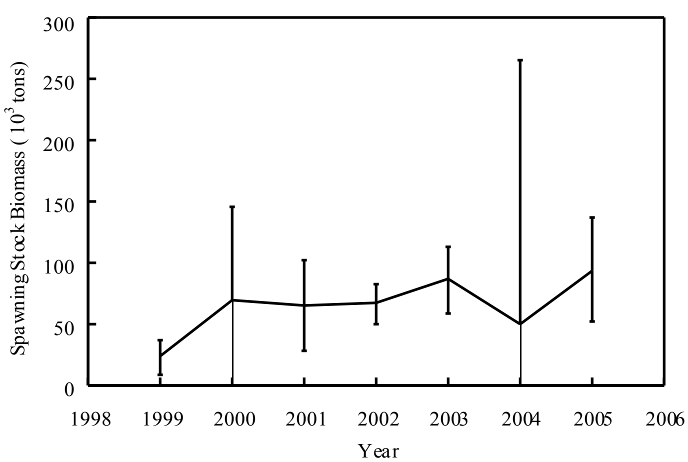


Fig. 2.8. Shrimp in Div. 3LNO: spawning stock biomass (SSB) estimates from Canadian spring multi-species surveys (±95% confidence intervals).

Recruitment index. A recruitment index (shrimp considered to be age 2) was constructed from the Canadian autumn surveys of 1995-2003. Due to the incomplete survey in autumn 2004, a recruitment index from Canadian spring surveys of 1999-2005 was examined. Recruitment indices were based upon modal analysis of length frequencies. The autumn index increased from 1997 to 2001, decreased in 2002, and increased in 2003. The last five points (1997-2001 year-classes) in this index have been above average (Fig. 2.9). The spring index also showed that the 1997-1999 year-classes were the most abundant, but the 2002 and 2003 year-classes are lower.

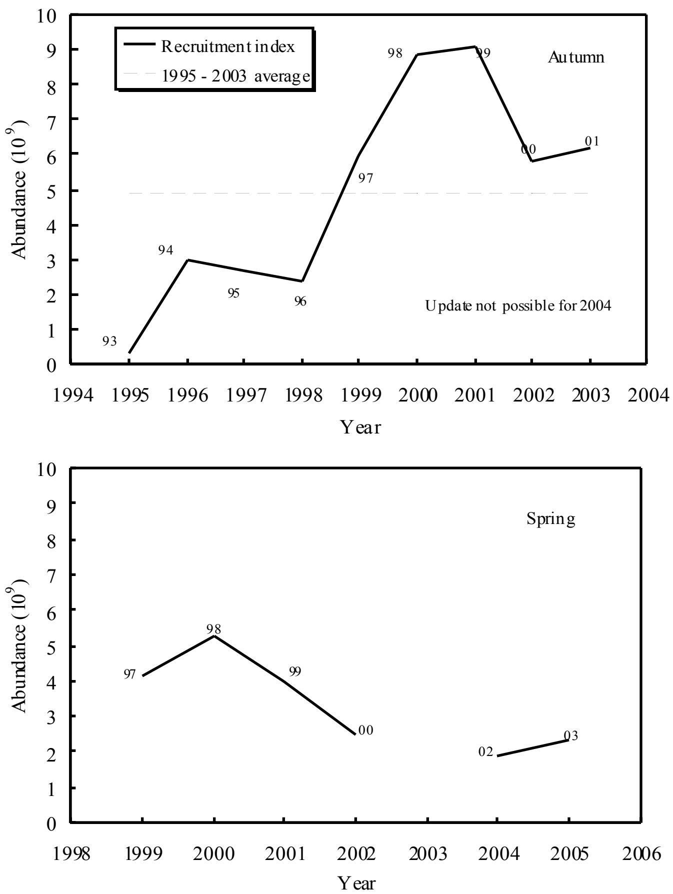


Fig 2.9. Shrimp in Div. 3LNO: age 2 recruitment indexes as determined from Canadian autumn and spring multi-species surveys (numbers indicate year-classes).

Fishable biomass and exploitation. In general, a fishable biomass index (all shrimp ≥17 mm carapace length) from the Canadian autumn survey (1995-2003) and Canadian spring survey (1999-2005) increased from 1995-2001 and remained stable since then (Fig. 2.10). An index of exploitation was derived by dividing the catch in a given year by the fishable biomass index from the previous year's autumn survey. The exploitation index was less than 4% during 1996-99, but increased to 11-12% in 2000-2001; the first two years of TAC regulation. Even though catches increased to 12 620 tons in 2004, the exploitation index is estimated to be less than 7% due to the increase in fishable biomass (Fig. 2.11). Due to an incomplete survey in autumn 2004 it was not possible to update the autumn index of fishable biomass and exploitation in this assessment.

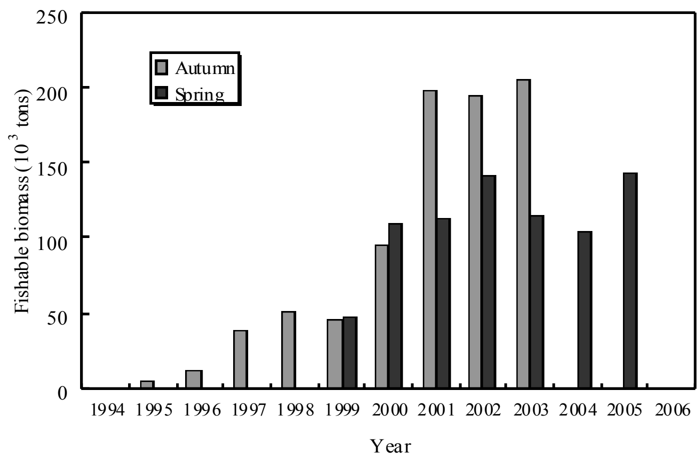


Fig. 2.10. Shrimp in Div. 3LNO: fishable biomass index from Canadian spring and autumn surveys. Values were estimated using strap calculations.

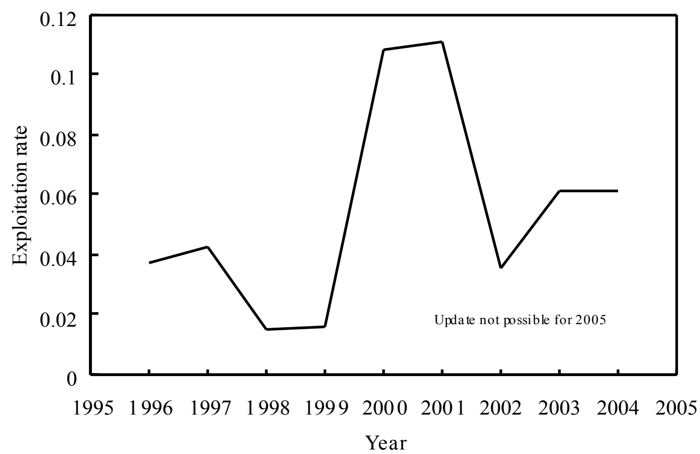


Fig 2.11. Shrimp in Div. 3LNO: exploitation rates as derived by catch divided by the previous year's Canadian autumn fishable biomass index.

iii) **Other biological studies** (SCR Doc. 05/77, 88, 91)

As requested during the 2004 NAFO Scientific Council meeting on shrimp assessment, sensitivity testing was conducted on OGive MAPping (OGMAP) to determine whether it is an appropriate method to estimate shrimp biomass/abundance indices. To address this question, OGMAP analyses from autumn surveys were used as reference populations. Survey points from other autumn surveys were used to take random samples from the reference populations. Results of sensitivity testing were acceptable with many of the simulated confidence intervals containing the biomass estimate. Those that did not; came within 1-2 standard deviations of doing so. The biomass estimates of OGMAP are very similar to those of stratified aerial expansion calculations with much tighter confidence intervals. STACFIS noted that more research is required on bandwidths, which determine the characteristic distance of influence by nearby survey points, and OGMAP's sensitivity to different bandwidths. In addition, questions were raised as to which survey design may be optimal for the OGMAP method. Scientific Council considered the results of sensitivity testing, noted that the method had advantages over areal expansion techniques but because there was insufficient expertise at this meeting to address methodological questions, requested that OGMAP should be thoroughly reviewed in a scientific forum such as a methodology working group (i.e. ICES WKSAD) to determine whether it is an appropriate method to determine Div. 3LNO shrimp biomass/ abundance indices from stratified random surveys.

Length weight relationships for live animals are provided in both SCR Doc. 05/77 and 05/88.

The spatial distributions and abundance of northern shrimp were examined in relation to their thermal habitat for NAFO Div. 3LNO during spring surveys from 1998-05 and for autumn surveys from 1995-2004. The data indicate that the highest numbers of shrimp are generally found in the 2°-4°C temperature range during the spring with lower numbers in water with temperatures <2°C and >4°C. During the autumn most shrimp are found in a colder temperature range of 1°-3°C. Cumulative frequency distribution of the number of shrimp caught and temperature indicates that <5% of the catches are associated with temperatures <1°C in the spring and up to 30% are associated with temperatures <1°C in the autumn. About 90% of the shrimp were caught in the 2°-4°C temperature range during the spring, while only about 50% appeared in this temperature range during the autumn. In terms of available thermal habitat, about 30% of the surveyed region was covered with water in the 2°-4°C temperature range during the spring, while about 40% was covered by water in this temperature range in the autumn. In 2004 the average spring bottom temperature increased significantly over 2003 to >2°C, the highest since the early 1980s but decreased to slightly <2°C in the spring of 2005. An apparent shift in the shrimp distribution towards colder temperatures further upon the Grand Bank and towards the inshore regions occurred during the autumn and as a result, a greater proportion (30%) of the catch shifted into the 0°-1°C temperature range. Very low numbers of shrimp were found in temperatures <0°C and >4°C during both spring and autumn. Shrimp catches were mostly zero in all surveys in the shallow waters (<100 m) of the southeast Grand Bank, where temperatures generally range from 2°-7°C. In general, during the spring most of the large catches were found in the warmer water along the slopes of Div. 3LN, while in the autumn, larger catches were found in most areas of Div. 3L including the inshore areas of the bays along the east coast of Newfoundland. During the spring of 2005 most of the shrimp catches (>70%) were found in temperatures >3°C with an apparent increase in the overall catches over the previous year. Preliminary results indicate that the larger shrimp are associated with temperatures >3°C while smaller shrimp on average are found in temperatures <2°C. The total number of shrimp in sets dominated with small shrimp show a general association with bottom temperature with the higher numbers occuring in years with low bottom temperatures while the opposite seems to be the case for larger size shrimp. Finally, it is not known if the observed changes in the distribution from spring to autumn are environmentally driven, feeding behaviour or due to other factors, such as changes in trawl catchability (SCR Doc. 05/91).

c) **Assessment Results**

Recruitment. The 1997-2001 year-classes are above average, while the 2002 and 2003 year-classes are lower.

Biomass. There was a significant increase in SSB and total biomass between 1995 and 1997 followed by a period of stability between 1997 and 1999. SSB and total biomass have been at a higher level since 1999.

Fishable Biomass and Exploitation. Fishable biomass has increased from 1995-2001 and remained stable since then. The exploitation index (catch/autumn fishable biomass from previous year) increased during 2000-2001, at the beginning of the fishery, and has decreased since then.

State of the Stock. SSB and total biomass have increased since 1999. The stock appears to be well represented by a broad range of size groups, and the exploitation index is low. Recruitment is anticipated to decline.

d) **Precautionary Approach Reference Points** (SCS Doc. 04/12):

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} for northern shrimp in Div. 3LNO. It is not possible to calculate a limit reference point for fishing mortality. Currently, the biomass is estimated to be well above B_{lim} (Fig. 2.12).

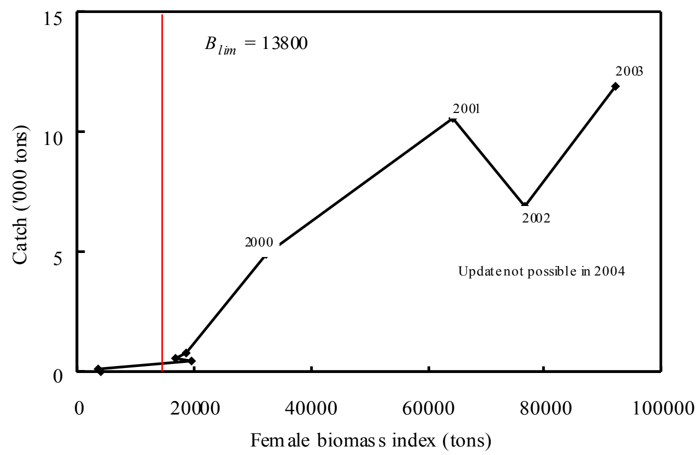


Fig 2.12. Shrimp in Div. 3LNO: Catch plotted against female biomass index from Canadian autumn survey. Line denoting B_{lim} is drawn where biomass is 85% lower than the maximum point in 2003.

e) **Research Recommendations**

STACFIS **recommended** that, for shrimp in Div. 3LNO:

- *OGMAP should be reviewed further to determine whether it is an appropriate method to determine Div. 3LNO shrimp biomass/abundance indices from stratified random surveys.*

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to the Designated Expert, in the standardized format, by 1 September 2006.*

3. **Northern Shrimp (*Pandalus borealis*) in Subareas 0 and 1** (SCR Doc. 02/158, 04/73, 75, 76, 05/73, 74, 75, 83, 85; SCS Doc. 04/12)

a) **Introduction**

The shrimp stock off West Greenland is distributed in Subarea 1 and Div. 0A east of 60°30'W (Canadian SFA1) and within this area is assessed as a single population. The Greenland fishery exploits the stock in Subarea 1 (Div. 1A-F). Since 1981 the Canadian fishery has been limited to Div. 0A.

Three fleets, one from Canada and two from Greenland (vessels above and below 80 GRT) have participated in the fishery since the late 1970s. The Canadian fleet and the Greenland large-vessel fleet have been restricted by areas and quotas since 1977. The Greenland small-vessel fleet has privileged access to inshore areas (primarily Disko Bay); its fishing was unrestricted until January 1997, when quota regulation was imposed. Pursuant to a revised fishery agreement, Greenland now allocates a quota to EU vessels in Subarea 1. Mesh size is at least 44 mm. Sorting grids to reduce by-catch of fish are required in the Greenland large-vessel fleet (max. bar spacing 22 mm) and the Canadian fleet (28 mm). Discarding of shrimp is prohibited.

Until 2003 catches of shrimp taken in SA 1 were reported without accounting for either a prevalent practice of overpacking or the difference between product weight and live weight. On 1 January 2004 new legislation came into force requiring removals by fishing to be reported as live (catch) weight. To maintain consistency of management advice the annual catches from 1978 through 2003 were corrected upwards, by 22.8-25.7%; this was fully reported in the 2004 advisory document.

The advised TAC for the entire stock for 2005 was 130 000 tons; the Greenland authorities set a TAC for Subarea 1 of 134 000 tons, of which 74 100 tons was allocated to the offshore fleet, 55 900 tons to the inshore and 4 000 tons to EU vessels; Canada set a TAC for SFA1 for 2005 of 18 417 tons.

Overall annual catch increased from about 10 000 tons in the early 1970s to more than 105 000 tons in 1992 (Fig. 3.1). Moves by the Greenlandic authorities to reduce effort and fishing opportunities elsewhere for the Canadian fleet caused catches to decrease to about 80 000 tons by 1998. Since then total catches have increased. Logbook-reported catches in Greenland in the early part of 2005 were unusually high and the total for 2005 is expected to be near 140 500 tons assuming that the Greenland catch equals the TAC and the Canadian catch is near the level of the last three years at about 6 500 tons (Fig. 3.1).

Recent nominal catches, projected figures for 2005 and recommended TACs (tons) for shrimp in Div. 0A east of 60°W and Subarea 1 are as follows:

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Recommended TAC[1]	60 000	60 000	55 000	65 000	65 000	85 000	85 000	100 000	130 000	130 000
Enacted TAC	72 422	74 800	68 379	80 350	80 350	91 350	101 000	115 667	150 019	152 417
STATLANT SA 1	66 736	60 325	65 080	73 961	79 738	82 126	102 572	135 465	135 000	134 000[5]
STATLANT Div. 0A	2 617	517	914	2 093	841	2 958	3 300	2 617	6 000	6 500[5]
Total STATLANT	69 353[2]	60 842[2]	65 994[2]	76 054[2]	80 579[3]	85 084[3]	105 872[3]	138 082[3]	141 754[3]	
Total STACFIS[4]	84 095	78 128	80 495	92 191	97 206	102 781	132 206	126 462	141 000	140 500[5]

[1] Until 2003 recommended TACs were given in the units of the STATLANT reporting.

[2] Data updated to be consistent with STATLANT 21A

[3] Provisional catches.

[4] Estimates 1995-2003 corrected for overpack.

[5] Catches projected to end of 2005.

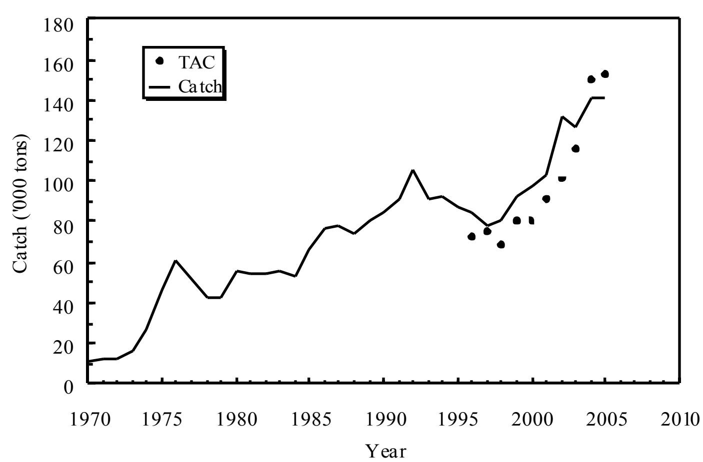


Fig. 3.1. Shrimp in Subareas 0 and 1: total catches (2005 projected to the end of the year; 1996-2003 values have been corrected to live (catch) weight and enacted TACs.

Until 1988 the fishing grounds in Div. 1B were the most important. The offshore fishery subsequently expanded southward, and after 1990 catches in Div. 1C-D, taken together, began to exceed those in Div.

1B. At the end of the 1980s Div. 1E-F began to attract fishing effort, and catches from these areas accounted for 15% of the total catch by 1997 and 20% by the turn of the century. Catch and effort in Div. 1E-F now appears to be decreasing. From low levels in the late 1990s and at the turn of the century, the Canadian catch in SFA1 has stabilised at 6 000 to 6 500 tons in 2002-2004, about 5% of the total.

b) **Input Data**

i) **Commercial fishery data**

Fishing effort and CPUE. Catch and effort data from the shrimp fishery were available from fishing records from Canadian vessels in Div. 0A east of 60°30'W and from Greenland logbooks for Subarea 1 (SCR Doc. 05/83).

Multiplicative models were used to calculate fleet-specific annual catch-rate indices. From these individual indices one unified series was derived for 1976-2005. All the fleets included in the analysis mainly exploit shrimp ≥17 mm carapace length (CL). The CPUE indices are therefore indicative of the combined biomass of older males and females.

The standardized CPUE series showed an increasing trend since 1990 (Fig. 3.2). The 2005 value is the highest in the series.

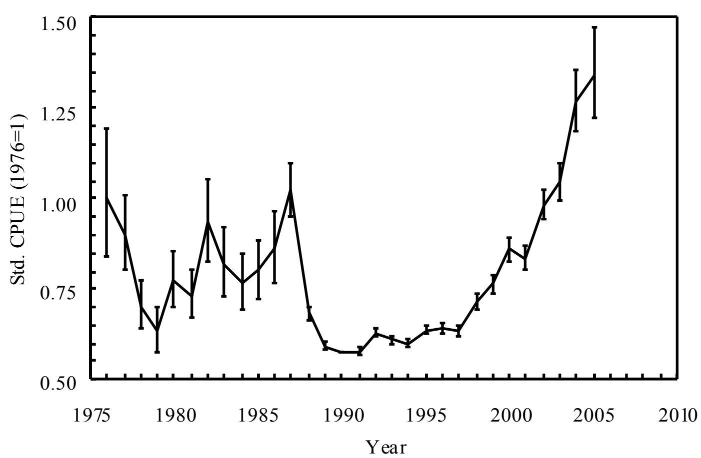


Fig. 3.2 Shrimp in Subareas 0 and 1: standardized CPUE index. Error bars are upper and lower quartiles.

Catch composition. Catch composition was assessed from samples obtained by observers in the commercial fishery in Div. 0A from 1981 to 2001, and in Subarea 1 from 1991 to 2001 (SCR Doc. 04/75). The mean size of shrimp caught declined since 1991. In spite of these changes, the proportions of female to male shrimp in the catches seemed relatively stable until the late 1990s. In 2002 and 2003 STACFIS recommended that "sampling of catches by observers - essential for assessing stock age, size and sex composition - be re-established". However, the sampling program has remained inadequate and sparse sampling prevented an analysis of catch composition for the years 2002-2005 (SCR Doc. 05/83).

ii) **Research survey data**

Greenland trawl survey. Stratified random trawl surveys have been conducted since 1988 in offshore areas (Subarea 1 and Div. 0A east of 60°30'W) and since 1991 also inshore in Subarea 1 (SCR Doc. 05/74). From 1993, the survey was extended southwards into Div. 1E and 1F. From its inception until 1998 the survey only used 60-min. tows, but experiments in the late 1990s and early 2000s showed that shorter tows gave as accurate results, and tows in the survey have since been progressively shortened until in 2005 all were 15 min. No adjustment to previous data has been considered necessary.

The *Skjervøy* trawl with steel-sphere bobbin ground gear used from 1988 through 2004 has been replaced in 2005 by a *Cosmos* trawl with rubber-disk rock-hopper ground gear so that the survey can fish a wider range of bottoms. Calibration trawling was carried out in 2004 and 2005, and length-specific corrections have been applied to the earlier survey data. (SCR Doc. 05/75)

Biomass. The survey biomass indices indicated a fairly stable stock size from 1988 to 1997. Since then an increasing trend has been observed. The 2003-2004 values were the hitherto highest of the series. The estimate for 2005 was 21-24% lower than these two, but larger than that for 2002 (by 13%) and all earlier years (Fig. 3.3).

Within the survey area, large year-to-year variations in the distribution of biomass have been observed geographically as well as over depth zones. Some areas account for a large proportion of the variances of the estimated biomasses. During the recent period of increasing biomass indices, an increased proportion of the biomass has been seen both in depths between 200 and 300 m and in more northerly areas, and the proportion of biomass in Div. 1E-F appears to be decreasing.

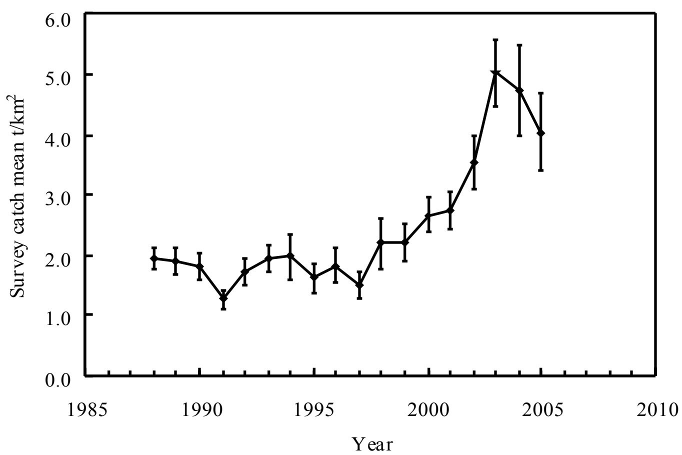


Fig. 3.3. Shrimp in Subareas 0 and 1: survey indices of stock biomass density; error bars are 1 s.e. (SCR Doc. 05/74)

Abundance. Indices of total abundance (× 10^9) of shrimp in Subarea 1 and Div. 0A east of 60°30'W from 1988 to 2005 are as follows (SCR Doc. 05/74):

Year	Males	Females	Total	Males (%)	Females (%)
1988[1]	30.8	10.7	41.5	74.2	25.8
1989[1]	44.8	7.9	52.7	85.0	15.0
1990[1]	33.6	10.2	43.8	76.7	23.3
1991	22.5	5.9	28.4	79.2	20.8
1992	33.7	7.3	41	82.2	17.8
1993	39.9	9.6	49.5	80.6	19.4
1994	36.8	10.2	47	78.3	21.7
1995	31.8	7.5	39.3	80.9	19.1
1996	43.8	7.6	51.4	85.2	14.8
1997	31.3	7.3	38.6	81.1	18.9
1998	47.1	11.4	58.5	80.5	19.5
1999	48.8	11.3	60.1	81.2	18.8
2000	71.6	12.7	84.3	84.9	15.1
2001	65.0	13.6	78.6	82.7	17.3
2002	97.9	17.1	115	85.1	14.9
2003	114.2	28.6	142.8	80.0	20.0
2004	102.7	30.2	132.9	77.3	22.7
2005	91.3	24.2	115.5	79.0	21.0

[1] No inshore survey in 1988–90. The numbers in 1988 to 1990 represent an average of the estimated numbers of shrimp inshore from 1991-97 added to the actual estimates from the offshore area.

The index of total abundance of shrimp in 2005 is 13% lower than in 2004 and 19% lower than the peak reached in 2003, but similar to that of 2002. The proportion of females in 2005 was above average.

Length composition. A strong 1999 year-class that was clearly visible in the length frequency distributions at 17.5 mm CL in 2002 and at about 19 mm CL in 2003 is apparently followed by weaker year-classes that are not so easy to trace (Fig. 3.4). (SCR Doc. 05/75).

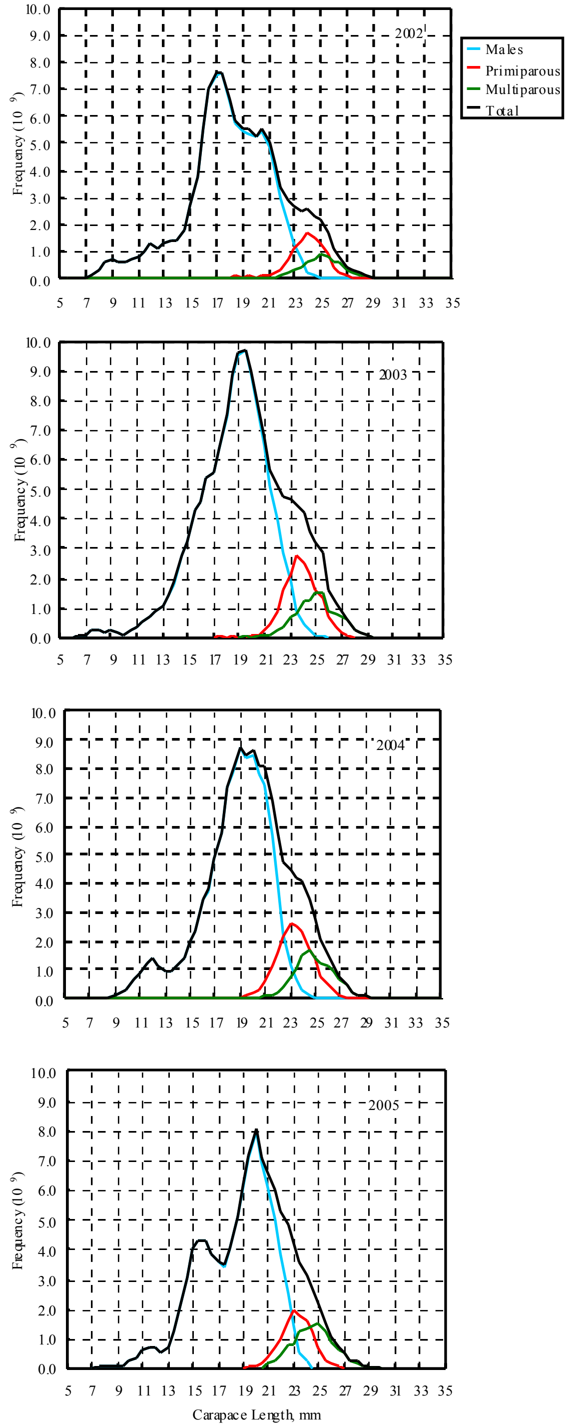


Fig. 3.4. Shrimp in Subareas 0 and 1: length frequencies of northern shrimp in the total survey area (offshore and Disko Bay/Vaigat combined), 2002 to 2005 (Data from 2002 to 2004 converted from *Skjervøy* to *Cosmos* trawl).

Index of recruitment. Numbers at age 2 correlate with indices of fishable biomass two and three years later and may therefore be regarded as a short-term predictor of recruitment to the fishery (SCR Doc. 05/74). This index was high in 2001, but decreased in 2002, was below average in 2003 and 2004, and decreased again in 2005 to a value near the lowest of the 13-year series (Fig. 3.5).

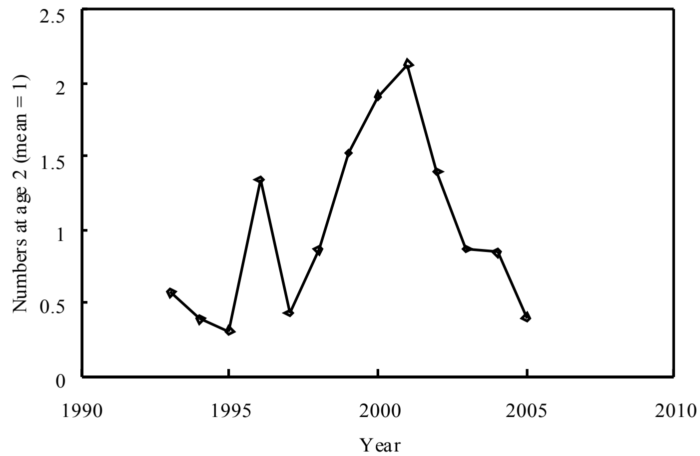


Fig. 3.5. Shrimp in Subareas 0 and 1: index of numbers at age 2 from survey scaled to the mean of the series).

Index of spawning stock biomass. The survey index of female biomass (SCR Doc. 05/74), stationary from 1988 to about 1997, has doubled since 1997. While the estimate for 2005 is high in historic terms, the high estimates of 2003 and 2004 have not been repeated (Fig. 3.6).

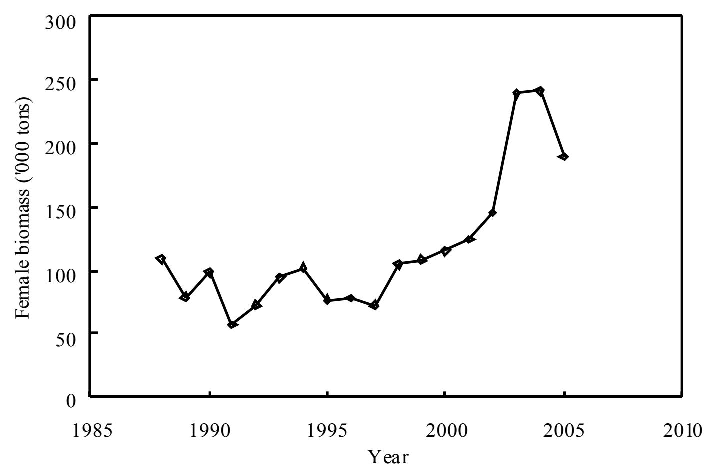


Fig. 3.6. Shrimp in Subareas 0 and 1: female spawning stock biomass index.

iii) **Other studies**

The West Greenland trawl survey, carried out annually to provide a fishery-independent index of stock biomass, has used a *Skjervøy* 3000/20 trawl with bobbin ground gear. In 2005 this was replaced by a *Cosmos* 2000/20 with rubber disk ground gear. Calibration studies were carried out in 2004 and 2005, by fishing twice consecutively over the same track. Sets were of four types, either repeating the same trawl or using the two different trawls in one order or the other. A 'disturbance effect' could be calculated from the results of repeating a set with the same gear and used to correct the differences in catch when two different gears were used consecutively. Correction factors between the two trawls, with appropriate measures of uncertainty, were calculated for each length-class of shrimp. The historic trawl series was adjusted to the *Cosmos* trawl by disaggregating the data by length and correcting each length-class (SCR Doc. 05/75, 05/92)

Estimates of cod biomass from the German groundfish survey at West Greenland are used in the assessment of the shrimp stock in SA 1 and Div 0A east of 60°30'W to estimate consumption of shrimp. The comparative study of cod catches at West Greenland from the German groundfish survey and the Greenland survey for fish and shrimp carried out in 2004 was updated (SCR Doc. 05/73). The correlation between the cod biomass estimates obtained in the two surveys was found to be maintained ($r^2 = 0.85$, $P < 0.001$) and used to generate an updated estimate of cod (predator) biomass for use in the stock assessment. The 2005 biomass estimate at 39.6 Kt was several times higher than those of recent years, but was associated with a wide confidence interval.

c) **Estimation of Parameters**

Parameters relevant for the assessment and management of the stock were estimated, based on a stochastic version of a surplus-production model that included an explicit term for predation by cod. The model was formulated in a state-space framework and Bayesian methods were used to construct "posterior" likelihood distributions of the parameters (SCR Doc. 02/158).

The model synthesized information from input priors and the following data: an 18-year series of survey biomass indices of shrimp ≥17 mm CL; a 30-year series of combined CPUE indices; a 51-year series of catches by the fishery; a 51-year series of cod biomass estimates; and a short series (4 years) of estimates of the shrimp biomass consumed by cod (SCR Doc. 04/76, 05/85).

Absolute biomass estimates had relatively high variances. For management purposes it was therefore desirable to work with biomass on a relative scale in order to cancel out the uncertainty of the "catchability" parameters (the parameters that scale absolute stock size). Biomass, B, was thus measured relative to the biomass that would yield Maximum Sustainable Yield, B_{msy}. The estimated mortality, Z, refers to the removal of biomass by fishing and cod predation and is scaled to Z_{msy} - the mortality at *MSY*.

d) **Assessment Results**

The model estimated the median annual consumption by cod 1956-2005 in the range of 200 tons to about 120 000 tons. The estimated consumption declined since 1960 as a result of a decline in cod abundance at West Greenland (Fig. 3.7). A short-lived resurgence of the cod stock in the late 1980s caused consumption to increase. The cod disappeared in the beginning of the 1990s and estimates of consumption went to zero. Recent estimates of cod have shown increases and the estimate for 2005 - 39 550 tons - is about 5 times that for 2004. The parameters of the predation function estimated by the model showed that cod predation could be a significant burden on the stock and further increases in the cod stock could have significant impacts on the amount of surplus production that would be available to the fishery. The question is, however, complicated by uncertainty as to the overlap between high-shrimp-density areas and the areas where cod are showing their most significant increase.

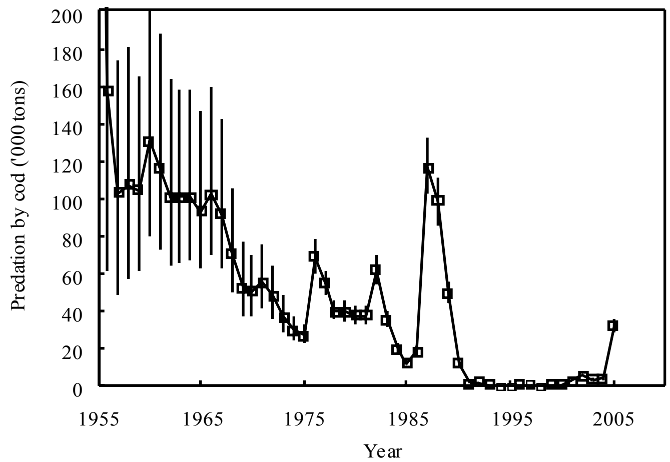


Fig. 3.7. Shrimp in Subareas 0 and 1: estimated consumption of shrimp by cod (error bars are upper and lower quartiles).

The trajectory of the median estimate of 'biomass-ratio' (B_t/B_{msy}) plotted against 'mortality-ratio (Z_t/Z_{msy}) (Fig. 3.8) started in 1956 at about half the optimum biomass ratio and at a mortality ratio well above 1. The stock maintained itself in this region during the years when cod were abundant. When the cod stock declined in the late 1960s (Fig. 3.7) and predation pressure was lifted, shrimp stock biomass increased and eventually began cycling in the left upper corner of the graph (Fig. 3.8) during the current regime of low cod abundance (SCR. Doc. 05/85).

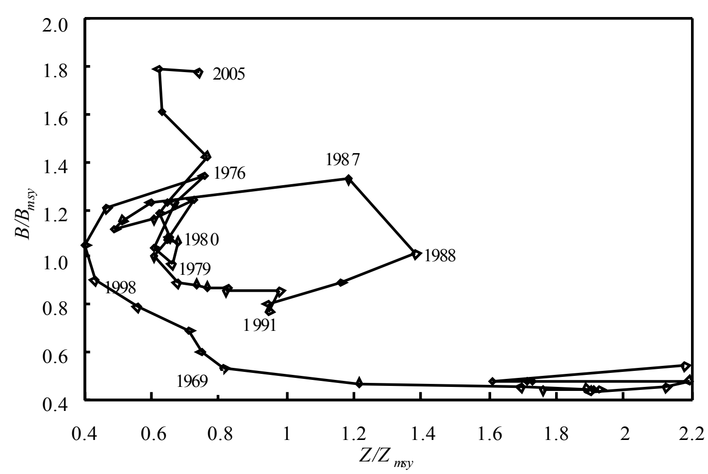


Fig. 3.8. Shrimp in Subareas 0 and 1: estimated annual median biomass-ratio (B/B_{msy}) and mortality-ratio (Z/Z_{msy}) 1956–2005.

Since the early 1970s when the fishery started expanding to offshore areas, the estimated median biomass ratio ranged between about 0.7 and about 1.4 (Fig. 3.8). The probability that it had been below the optimum level was small for most years (Fig. 3.9). However, stock biomass was probably driven below B_{msy} in the late 1980s to mid-1990s associated with a short-lived resurgence of the cod stock. The shrimp stock has increased since then, and reached its highest level in 2004 with a median estimate of biomass ratio of 1.81, corresponding to about 79% of estimated median carrying capacity. The estimated risk of stock biomass being below B_{msy} at the end of 2005 was 8% (Fig. 3.9).

The mortality ratio (Z-ratio, which includes mortality by fishing and predation by cod) has been below 1 for most of the time since 1974, except for the period of high cod predation in the late 1980s to early 1990s (Fig. 3.8). Since 1997, annual median Z-ratio has been stable in the neighbourhood of 0.7, i.e. well below the value that maximizes yield. The median estimate for 2005 (with catches assumed 140 500 tons) is 0.74 with a 20% risk of being above 1 (Fig. 3.9).

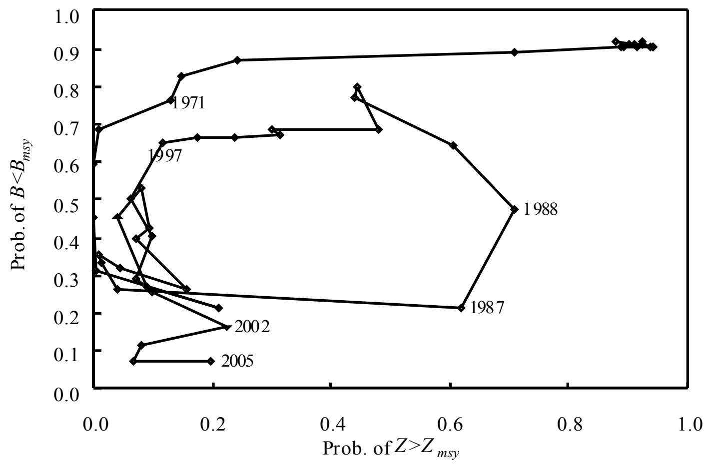


Fig 3.9. Shrimp in Subareas 0 and 1: risk of annual biomass being below B_{msy} and of mortality caused by fishing and cod predation being above Z_{msy} 1956-2005.

The median estimate of the maximum annual production surplus, available to the fishery and the cod (*MSY*) was estimated at 150 000 tons (Fig. 3.10). The risk function relating the probability of exceeding *MSY* to the combined removal by fishery and cod predation is given in Fig. 3.10.

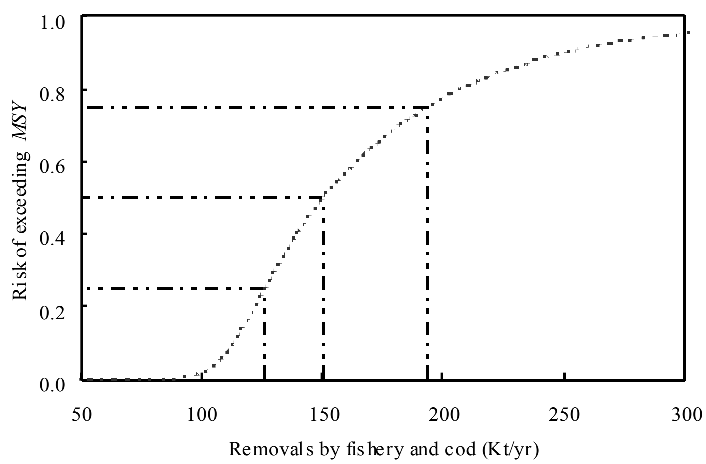


Fig. 3.10. Shrimp in Subareas 0 and 1: cumulative probability distribution of the maximum annual production surplus, available to the fishery and to cod (*MSY*). The median estimate (150 Kt/yr) and quartiles (126 and 193 Kt/yr) are shown.

Given the high probabilities that the stock is considerably above B_{msy}, risk of stock biomass falling below this optimum level within a one-year perspective is low. Risks associated with five optional catch levels for 2006 are as follows:

Catch option ('000 tons) in 2006	110	120	130	140	150
Risk of exceeding Z_{msy} in 2006	8.2%	14.3%	20.4%	26.6%	37.5%
Risk of falling below B_{msy} by end 2006	8.6%	8.9%	9.5%	10.5%	11.1%

Predation by cod can be significant (Fig. 3.7) and have a major impact on shrimp stock size. In spite of recent increases, the cod stock at West Greenland is now still at a low level. A large cod stock that would significantly increase shrimp mortality could be established in two ways: either by a slow rebuilding process or by immigration of one or two large year-classes from areas around Iceland as seen in the late 1980s.

An increase in cod abundance through growth of the existing stock would, however, be noted in an early phase during routine monitoring programs and fisheries management would have at least two years to respond before the shrimp stock is driven below optimal levels, given the current good condition of the stock.

Although there are indications of an increasing cod stock, absolute estimates are still well below those of the late 1980s and certainly those of the 1950s and 1960s.

Given the apparent importance of predation in determining the trajectory of shrimp stocks, STACFIS **recommends** that *ways to include the exploration of the effects of future trajectories of the cod stock on assessment predictions should be investigated and presented in 2006.* STACFIS also **recommends** that *the impact of other predators on the stock should also be considered for inclusion in the assessment model.*

Ten-year projections of stock development were made under the assumption that the cod stock will remain at its present level. Annual catches of 110 000, 120 000, 130 000, 140 000 and 150 000 tons were investigated (Fig. 3.11).

At the investigated catch option of 110 000 t/yr the stock is likely to remain above B_{msy} during the ten years of projection (Fig. 3.11). The combined relative fishing and cod predation mortality, Z_t, has a 77% probability of remaining below Z_{msy} within this period (Fig. 3.12).

Annual catches of 120 000 tons/yr are not likely to drive the stock below B_{msy} in the short to medium term (Fig. 3.11); by the end of 2008 the risk is 12½% and after 10 years, 26% (Fig. 3.12). However, this level of exploitation might not be sustainable in the longer term (>10 years), as uncertainties compound over time and the risk of exceeding B_{msy} continues to increase. The risk of exceeding to Z_{msy} is about 32% after 10 years.

A catch option of 130 000 tons/yr is below the estimated median *MSY* but when combined with predation is likely to drive the stock down, although not below B_{msy} in the short term (Fig. 3.11). By end 2008 the risk is estimated at 15% and is over 30% after 10 years (Fig. 3.12). The risk of exceeding Z_{msy} increases from about 20% to 40% over a 10-year projection.

Fishing at 140 000 tons/yr bears a 27%, and 150 000 tons a 33% risk, of being immediately above *MSY* (Fig. 3.11), so these catch levels are unlikely to be sustainable. Owing to the current high stock level and the high *MSY* the risk of transgressing B_{msy} is no more than 20% by end 2008 at 150 000 tons/yr, although after 10 years it is over 40% with a concomitant 53% risk of exceeding Z_{msy} (Fig. 3.12).

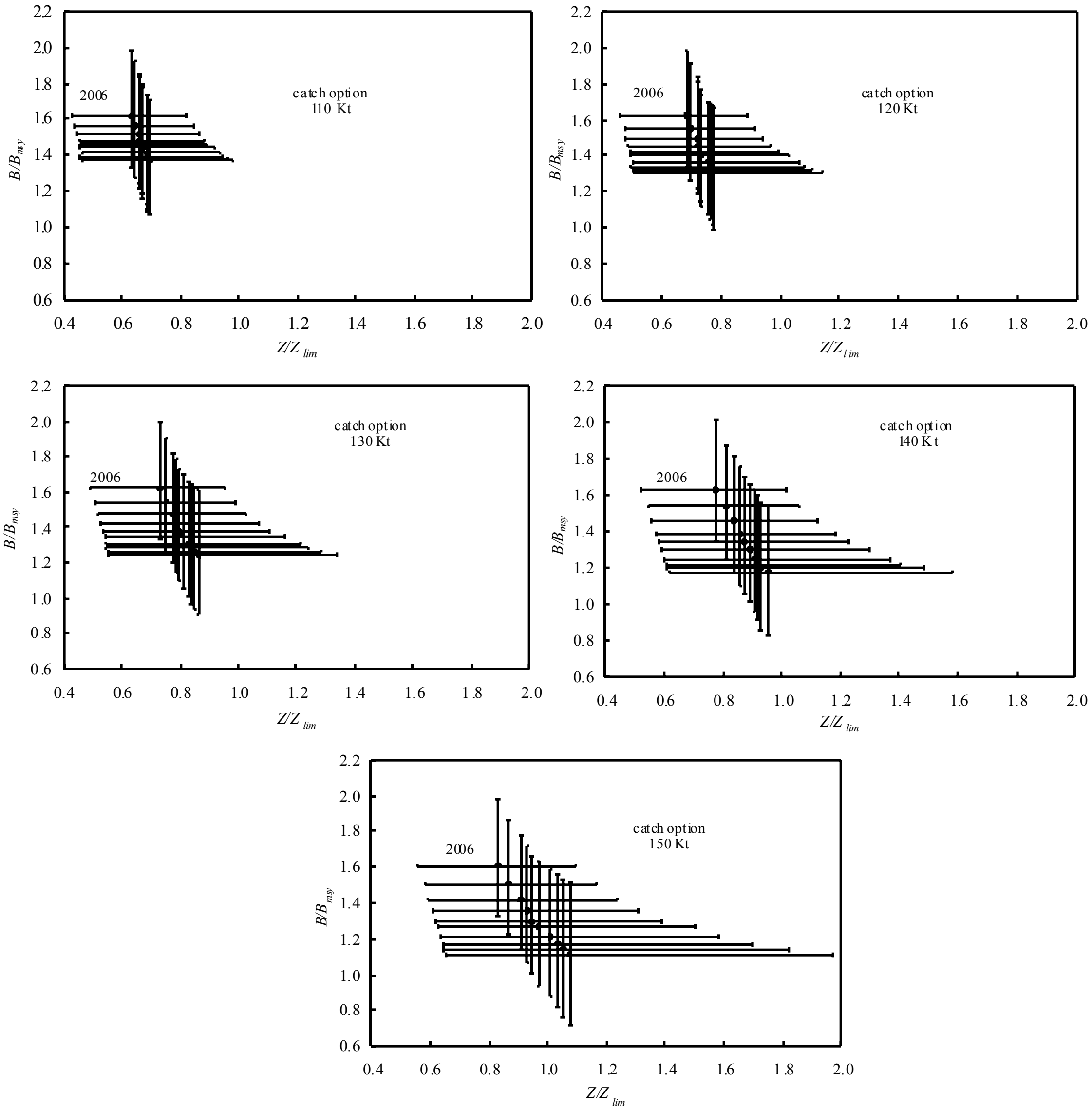


Fig. 3.11. Shrimp in Subareas 0 and 1: estimates of stock development for the period 2005-2015 quantified in a biomass (B/B_{msy})-mortality (Z/Z_{msy}) continuum. Dynamics at 110, 120, 130, 140 and 150 thousand tons of fixed annual catch levels are shown as medians with error-bars at the 25th and 75th percentiles.

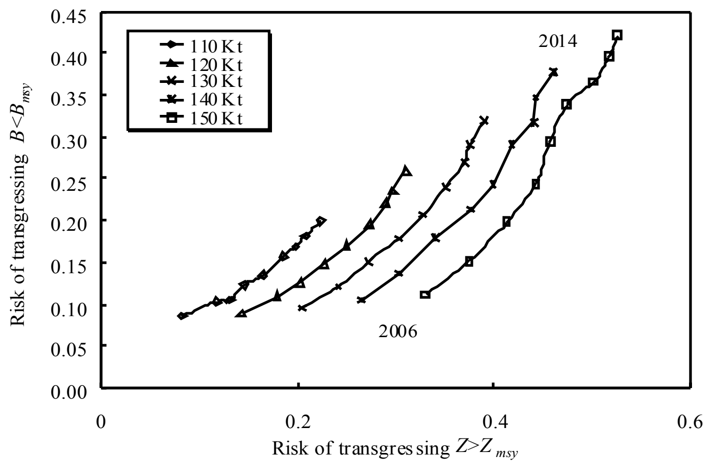


Fig.3.12. Shrimp in Subareas 0 and 1: risk of exceeding Z_{msy} and of driving the stock below B_{msy} by maintaining optional annual catch levels of 110-150 000 tons/yr during the period 2006-2014.

If on the other hand there is an abrupt increase in cod biomass resulting from immigration from other areas changes of shrimp stock condition may be much more rapid. The effect of an immigration of two large year-classes of cod was investigated in 2004 (SCR Doc. 04/76) and it was shown that predation could within a 3-4 year period go from negligible to between 88 000 and 163 000 tons.

Mortality. The mortality caused by fishing and cod predation (*Z*) has been stable below the upper limit reference (Z_{msy}) since 1997. With catches in 2005 projected at 140 500 tons the risk that total mortality exceeded Z_{msy} was estimated at about 20%.

Biomass. Since the late 1990s the stock has increased and the survey index reached high levels in 2003 and 2004. This index then decreased in 2005, but CPUE continued to increase. The modelled stock biomass reached its hitherto highest value in 2005; the estimated risk of stock biomass being below B_{msy} at end 2005 was 8%, but less than 1% of being below B_{lim}.

Recruitment. Prospects for recruitment to the fishable biomass in 2006 are still highly favourable. However, the estimated number of age-2 shrimp decreased in 2002, was below average in 2003 and 2004 and decreased again in 2005 to near a 10-year low value. Recruitment to the fishable stock is likely to decrease after 2006.

State of the Stock. The stock biomass has increased substantially since the late 1990s to historically high levels. Biomass at the end of 2005 is estimated to be well above B_{msy} and mortality by fishery and cod predation well below Z_{msy}.

The abundance of recruited males (between 17 and 22 mm CL) in 2005 is estimated to be high and should sustain good catch rates of larger shrimp in 2006. However, both model simulations of stock development and indices of future recruitment indicate that fishable biomass can be expected to follow a decreasing trend.

Both stock development and the rate at which changes might take place depend heavily on the abundance of predators (in particular cod) present within the shrimp habitat. In the most recent years increases in cod abundance have been registered, and present levels of cod biomass could consume significant quantities of shrimp. However, these estimates are still well below those of the late 1980s and certainly those of the 1950s and 1960s.

e) **Precautionary Approach**

Scientific Council has developed limit reference points for stock size (B_{lim}) at 30% of B_{msy} and for mortality (Z_{lim}) at 100% of Z_{msy} (SCS Doc. 04/12).

	Catch option for 2006 ('000 t)				
	110	120	130	140	150
Risk of falling below B_{lim} by end 2006	<<1%	<<1%	<<1%	<<1%	<<1%

Estimated median biomass has been above B_{lim} throughout the time series (Fig. 3.13). The mortality ratio (relative Z, which is the total mortality caused by fishing and predation by cod) has been below 1 for most of the time since the early 1970s when the modern fishery developed, except for the period of high cod predation from the late 1980s to the early 1990s. At the end of 2005 there is less than 1% risk that the stock would be below B_{lim}, while the risk that Z_{lim} was exceeded is 20%. Therefore there is only a small risk of the stock being outside the safe zone.

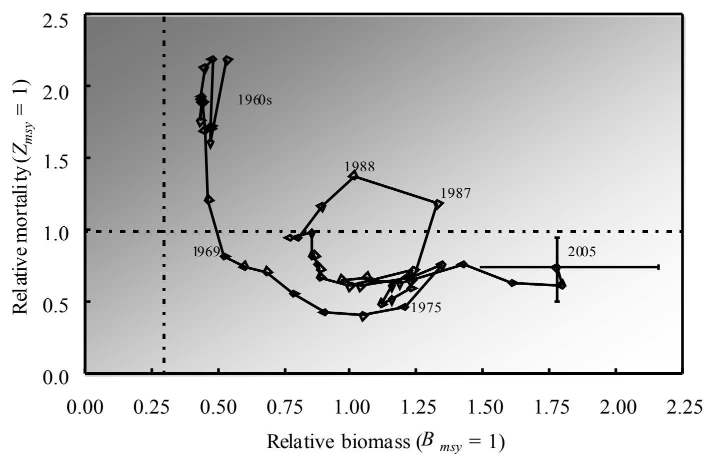


Fig.3.13. Shrimp in Subareas 0 and 1: estimated stock-dynamic trajectory 1957 to 2005 in a mortality–biomass continuum. Points are the median values of estimated biomass and mortality ratio. Limit reference points are shown. Error bars for 2005 are upper and lower quartiles.

f) **Research Recommendations**

For the shrimp stock in Subarea 1 and Div. 0A east of 60°W, STACFIS **recommends** that:

- *sampling of catches by observers - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - should be re-established in Subarea 1.*
- *ways to include the exploration of the effects of future trajectories of the cod stock on assessment predictions should be investigated and presented in 2006.*
- *the impact of other predators on the stock should also be considered for inclusion in the assessment model.*
- *the age-2 abundance index and its link to subsequent fishable biomass should be considered for inclusion in the shrimp assessment model.*

4. **Northern Shrimp (*Pandalus borealis*) in Denmark Strait and off East Greenland** (SCR Doc. 03/74, 05/93)

a) **Introduction**

Northern shrimp off East Greenland in ICES Div. XIVb and Va is assessed as a single population. The fishery started in 1978 and, up to 1993, occurred primarily in the area of Stredebank and Dohrnbank as well as on the slopes of Storfjord Deep, from approximately 65°N to 68°N and between 26°W and 34°W.

In 1993 a new fishery began in areas south of 65°N down to Cape Farewell. Access to all these fishing grounds depends heavily on ice conditions. From 1996 to 2003 catches in the area south of 65°N accounted for more than 60% of the total catch. Catches and effort in the area south of 65°N now appears to be decreasing, as the 2004 catches only account for 29% of the total catch.

A multinational fleet exploits the stock. During the recent ten years, vessels from Greenland, Denmark, the Faroe Islands and Norway have fished in the Greenland EEZ. Only Icelandic vessels fish in the Icelandic EEZ.

In the Greenland EEZ, the minimum permitted mesh size in the codend is 44 mm, and the fishery is managed by catch quotas allocated to national fleets. In the Icelandic EEZ, the mesh size is 40 mm and there are no catch limits. In both EEZs, sorting grids with 22-mm bar spacing to reduce by-catch of fish are mandatory. Discarding of shrimp is prohibited in both areas.

Catches of shrimp taken in the Greenland EEZ until 2003 have been reported without accounting for "overpacking" - the amount of surplus weight in packaging - or the difference between the product weight and live weight, all catches in the Greenland EEZ have therefore been adjusted for overpacking (SCR Doc. 03/74).

Total catches increased rapidly to about 15 500 tons in 1987 and 1988, but declined thereafter to about 9 000 tons in 1992 and 1993. Following the extension of the fishery south of 65°N catches increased again to about 13 800 tons in 1997. Catches from 1998 to 2004 have been between 10-14 000 tons (Fig. 4.1) and the 2005 catches are projected to be at the same level (projected from October)

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

	1996[3]	1997[3]	1998[3]	1999[3]	2000[3]	2001[3]	2002[3]	2003[3]	2004	2005[1]
Recommended TAC	5 000	5 000	5 000	9 600	9 600	9 600	9 600	9 600	12 400	12 400
North of 65°N, Greenland EEZ	2 924	1 622	3 943	4 058	4 288	2 227	1 344	4 143	6 736	5 808
North of 65°N, Iceland EEZ	566	2 856	1 421	769	132	10	1 144	635	380	21
North of 65°N, total	3 490	4 478	5 364	4 827	4 420	2 237	2 488	4 778	7 116	5 829
South of 65°N, Greenland EEZ	8 453	9 276	6 057	6 893	7 632	11 674	8 753	7 858	2 869	4 171
Total STATLANT 21A	9 713	11 589	9 321	9 467	9 594	11 052	9 196	9 763	9 985[2]	
Total STACFIS[3]	11 944	13 754	11 442	11 719	12 053	13 911	11 242	12 637	9 985	10 000

[1] Provisional.
[2] Estimates 1995-2003 corrected for overpack.
[3] Catches projected to end of 2004.

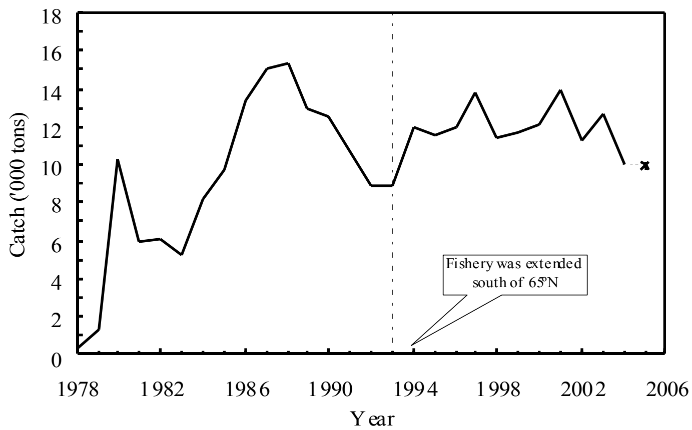


Fig. 4.1. Shrimp in Denmark Strait and off East Greenland: total catches (2005 projected to the end of the year based on January to 1 October data).

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Catch and effort (hours fished) from logbooks were available from Greenland, Norway, Iceland, Faeroe Islands and EU-Denmark since 1980 and from EU-France for 1980 to 1991. Norwegian fishery data from 2000-2005 did not include information on different area fished and therefore data was not included in the standardized catch rates calculations.

Standardized catch rates based on logbook data from Danish, Faroese, Greenlandic and Icelandic vessels in the northern area declined continuously from 1987 to 1993 - showed a significant increase between 1993 and 1994 and fluctuated with a slightly increasing trend thereafter (Fig. 4.2). For 2005 available data for the northern area was too sparse to be included in the model. In the southern area a standardized catch-rate series for the same fleets (Iceland excluded) increased until 1999, and fluctuated with a slightly decreasing trend thereafter (Fig. 4.3).

A combined standardized catch-rate index for the total area decreased steadily from 1987 to 1993, showed an increasing trend until the late 1990s, and fluctuated at this level thereafter (Fig. 4.4).

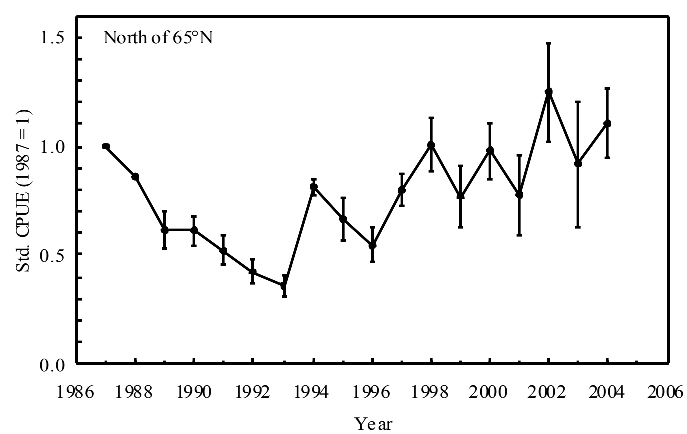


Fig. 4.2. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1987 = 1) with ±1 SE calculated from logbook data from Danish, Faroese, Greenlandic and Icelandic vessels fishing north of 65°N (insufficient data for 2005).

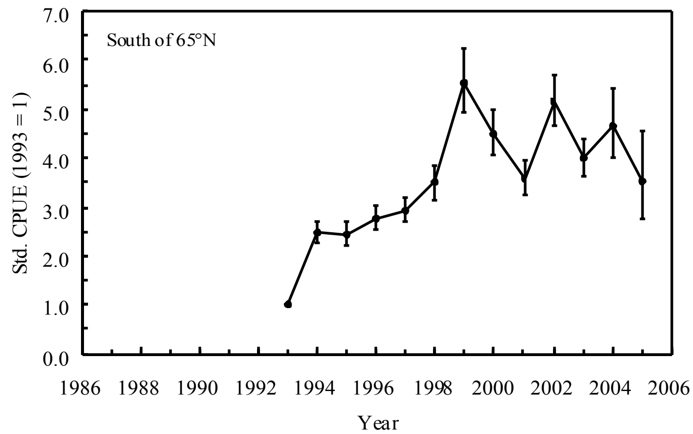


Fig. 4.3. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1993 = 1) with ±1 SE calculated from logbook data from Danish, Faroese and Greenlandic vessels fishing south of 65°N.

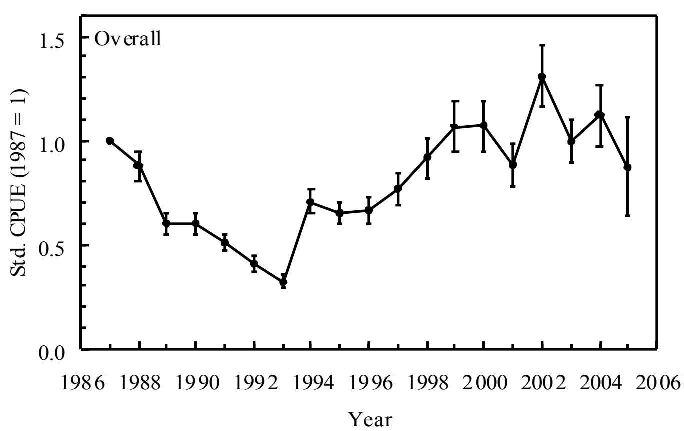


Fig. 4.4. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE-indices (1987 = 1) with ±1 SE combined for the total area.

Standardized effort indices (catch divided by standardized CPUE) as a proxy for exploitation rate for the total area showed a decreasing trend since 1993. Recent levels are the lowest of the time series (Fig. 4.5).

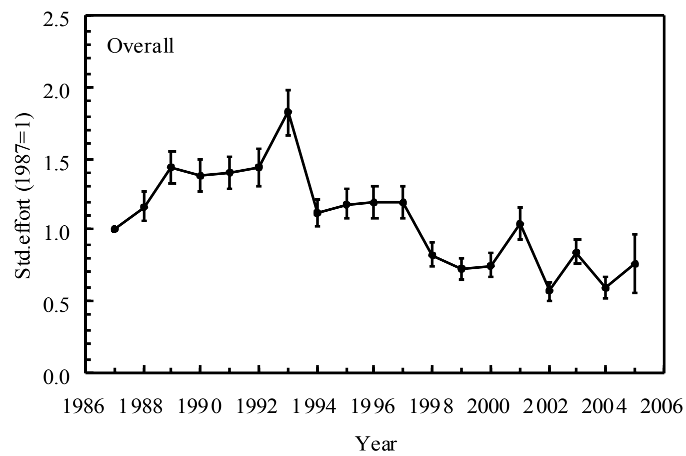


Fig. 4.5. Shrimp in Denmark Strait and off East Greenland: annual standardized effort indices, as a proxy for exploitation rate (±1 SE; 1987 = 1), combined for the total area.

Biological data. Since 2002 STACFIS has recommended that, "sampling of catches by observers - essential for assessing stock age, size and sex composition - should be re-established". However, sampling of the commercial fishery in recent years has been insufficient to obtain annual estimates of catch composition.

ii) **Research survey data**

No surveys have been conducted since 1996.

c) **Assessment Results**

CPUE. Combined standardized catch-rate index for the total area decreased steadily from 1987 to 1993, showed an increasing trend until the late 1990s, and fluctuated at this level thereafter.

Recruitment. No recruitment estimates were available.

Biomass. No direct biomass estimates were available.

Exploitation rate. From 1998 through 2005 the exploitation rate index (catch/CPUE) has been at its lowest level in the 19-year series.

State of the stock. Standardized CPUE data for all the areas combined indicate an increasing trend from 1993 to 2000 in the fishable biomass and has fluctuated at this level thereafter. However, changes in the fishing pattern in 2004 and 2005 leaves some uncertainty to whether the 2005 value is a true reflection of the stock biomass.

d) **Research Recommendations**

STACFIS **recommends** that, for shrimp in Denmark Strait and off East Greenland:

- *a survey be conducted, to provide fishery independent data of the stock throughout its range.*

- *as a minimum requirement: sampling of catches by observers is required - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - and be re-established in the Greenland EEZ and improved in the Icelandic EEZ.*

IV. STOCK ASSESSMENTS (ICES Area)

The assessments of the shrimp stocks in the ICES areas for:

- Northern shrimp in Skagerrak and Norwegian Deep (ICES Divisions IIIa & IVa East)
- Northern shrimp in Fladen Ground (ICES Division IVa)
- Northern Shrimp in Barents Sea and Svalbard area (ICES Sub-areas I & II)

were presented in plenary to the joint STACFIS/WGPAND group. Due to time constraints and differences in the format of reports between NAFO and WGPAND, it was not possible to review the entire WGPAND report in plenary. It was decided that for each of the stocks reviewed, drafts would be prepared and discussed in plenary for only those sections of the report that would be used to support the conclusions about stock status and the development of subsequent advice. The group acknowledged that it would be useful to make every effort to develop a joint report in the future and cited the report of the ICES/NAFO Working Group on Harp and Hooded Seals as a good example. Accordingly, the entire WGPAND report is found in Appendix II.

V. OTHER BUSINESS

1. Adjournment

There being no other business, the Chair expressed his gratitude to the members of the Committee for their valuable contributions. The Chair especially noted the particular effort of the NAFO Designated Experts and the ICES stock coordinators for their roles in providing timely assessments and excellent peer-review during plenary discussions. The Chair considered this joint meeting with ICES WGPAND a successful venture which should be continued in future. The Chair acknowledged and was grateful for the great support he received from the Chair of WGPAND (Sten Munch-Petersen). The Chair thanked the NAFO Secretariat for their exemplary support during the meeting, in particular to Barb Marshall for providing in-situ report editing.

The Chair of WGPAND also thanked the Committee for the good experience of the joint meeting and agreed this was well worth supporting in the future. He noted his chairmanship is ending this year. The Chair of WGPAND thanked the NAFO Secretariat for very good support preparing documents and drafts and providing real time support.

The report was adopted and the meeting was adjourned.

APPENDIX II. ICES WGPAND 2005 REPORT

(*ICES C.M. Doc*., No. 2006/ACFM:10 Ref. G)

Executive Summary

ToR

The ICES *Pandalus* Assessment Working Group [WGPAND] met in Halifax, 26 October-3 November 2005. The WG participants represented Denmark, Norway, Sweden and Russia (Section 2). The terms of reference for the Working Group were: to carry out assessments of the stock of *Pandalus* in Skagerrak and the Norwegian Deeps (Divisions IIIa and Iva East) and the stock in the Barents Sea and Svalbard area (I and II) and to provide advice (catch options) for these stocks in 2006, see Section 1.

This year's meeting was organized as a joint meeting between WGPAND and NAFO STACFIS annual shrimp meeting with common participation in all sessions by both WGPAND and STACFIS members.

The *Pandalus* Stocks Included in WGPAND

The WG deals with the *Pandalus* stock in the Barents Sea and two *Pandalus* stocks in the North Sea area: the stock in the Skagerrak and Norwegian Deep and the stock in the Fladen Ground, see Section 3.

Assessments and State of Stocks

***Pandalus* in the Skagerrak and Norwegian Deep** (Divisions IIIa and IVa East)

This year' assessment is based on a (new) stock production assessment model (described in WP, Annex 3) together with observed trends in LPUEs. The model does not provide a basis for forecasts but gives some relative information on the state of the stock relative to a *MSY* based reference point.

The state of this *Pandalus* stock in 2005 and 2006 is presented in Section 4.5. It is based on the stock production assessment model and the recent trends in LPUE. The stock seems to be on the same, rather high, level as in recent years. Stock level seems to be well above the suggested reference point (30% B_{msy}).

***Pandalus* in the Fladen Ground** (Division IVa)

The most recent analytical assessment of this stock was presented in the 1992 ACFM Report (ICES, 1993). Landings have declined gradually from 1999 to 2003, but in 2004 nearly no catches were recorded (23 tons). No monitoring of this stock has taken place, but it cannot be ruled out that the dramatic drop in 2004 also reflects a serious decline in the stock, see Section 5.3.

***Pandalus* in the Barents Sea and Svalbard Area** (Subareas I and II)

Several models have been applied for assessment of this stock. However in recent years, the views on the state of the stock have been based on survey indices combined with trends in CPUE. SSB appears to have been declining in recent years, see Section 6.4.

By-catch in the *Pandalus* Fisheries

Sections 7 and 8 give overviews of the by-catch based on mainly available logbook information.

Working Procedures Joint ICES-NAFO Meetings

Comparing with the 2004 joint meeting, the 2005 ICES-NAFO Meeting saw considerable improvements. The advantages and disadvantages of these joint meetings have become clearer. Disregarding the problems of adapting the ICES and NAFO meeting procedures it is obvious that (Section 2.1):

A major advantage is the improved opportunities and obligations to discuss scientific and other topics of common interest concerning assessment of *Pandalus* stocks along with the increased number of scientists at the joint meetings.

However, integrated management advice including ecosystem considerations in relation to management, is better discussed on a regional basis.

1. Terms of Reference

2ACFM15 The ***Pandalus* Assessment Working Group** [WGPAND] (Chair: S. Munch-Petersen, Denmark) will meet 26 October to 4 November 2005 in Halifax, Canada to:

a) assess the status of and provide management options for 2006 for the stocks of *Pandalus borealis* in the Barents Sea, the North Sea, Skagerrak, and Kattegat and, taking predation mortality on *Pandalus* stocks into account;

b) for the stocks mentioned in a) perform the tasks described in C.Res. 2ACFM01[*)]. *WGNSSK, WGSSDS, WGHMM, WGMHSA, WGBFAS, WGNSDS, WGNPBW, AFWG, HAWG, NWWG,* ***and WGPAND*** *will, in addition to the tasks listed by individual group, in 2005:*

1) for stocks where it is considered relevant, review limit reference points (and come forward with new ones where none exist) and develop proposals for management strategies including target reference points if management has not already agreed strategies or target reference points (or HCRs) - following the guidelines from SGMAS (2005) and AMAWGC (2004 and 2005);
2) comment on the outcome of existing management measures including technical measures, TACs, effort control and management plans;
3) based on input from WGRED incorporate (where appropriate) existing knowledge on important environmental drivers for stock productivity and management into assessment and prediction, and important impacts of fisheries on the ecosystem;
4) update the description of fisheries exploiting the stocks, including major regulatory changes and their potential effects. The description of the fisheries should include an enumeration of the number, capacity and effort of vessels prosecuting the fishery by country;
5) where misreporting is considered significant provide information on its distribution on fisheries and the methods used to obtain the information;
6) provide for each stock information on discards (its distribution in time and space) and the method used to obtain it. Describe how it has been considered in the assessment;
7) provide on a national basis an overview of the sampling of the basic assessment data for the stocks considered;
8) provide specific information on possible deficiencies in the 2005 assessments including, at least, any major inadequacies in the data on landings, effort or discards; any major inadequacies in research vessel surveys data, and any major difficulties in model formulation; including inadequacies in available software. The consequences of these deficiencies for both the assessment of the status of the stocks and the projection should be clarified.

WGPAND will report by 21 November 2005 for the attention of ACFM.

2. Participants

Aschan, Michaela - Norway
Bakanov, Sergei - Russia
Hvingel, Carsten - Norway
Munch-Petersen, Sten (Chair) - Denmark
Sunnanå, Knut - Norway
Søvik, Guldborg - Norway
Ulmestrand, Mats - Sweden

2.1. Working Procedures in Joint ICES-NAFO Meetings

Comparing with the 2004 Joint Meeting, the 2005 ICES-NAFO Meeting saw considerable improvements. The advantages and disadvantages of these joint meetings have become clearer. The purpose of such joint meeting is to exchange views and experience in data and methodologies in assessments *Pandalus* stocks.

Advantages of NAFO-ICES Joint Assessment Meetings

Before 2004 the WGPAND was a very small group focusing on the stocks in the North Sea only. The assessment of the *Pandalus* stock in the Barents Sea was carried out in the ICES Arctic Working Group. However, the few *Pandalus* scientists considered them selves very isolated here and not integrated in the fish stock assessments.

The obvious and major advantage is the opportunities and obligations to discuss scientific and other topics of common interest concerning assessment of *Pandalus* stocks. This holds for both the NAFO and the ICES scientists.

Meeting Procedures

The disadvantages of the routines of the joint meetings (as experienced in 2005) are relating to the (at least formal) obligations of all participants to take part in the management advice for all stocks. It is the opinion of the WGPAND members, that some of the meeting time could be better spent dealing with regional management aspects relating to the particular stocks, e.g. advice taking into account the fisheries in the particular areas.

The WGPAND has followed the NAFO meeting procedures, resulting in extra workload for the WGPAND, because of the required separate ICES WG Report to be delivered to ICES.

The current time of the meeting (following the NAFO STACFIS meeting schedule) in relation to the requested ICES advice further increases the work pressure.

In order to optimize meeting time some of current NAFO procedures should be changed (adapted) to such joint ICES-NAFO meetings.

Integrated Management Advice

WGPAND notes that ecosystem considerations in relation to management are better discussed on a regional basis.

Presently there is a general aim of the ICES management advice to focus on regional integrated advice, e.g. to consider all the stocks within an area together as well as the environment, e.g. the Baltic, North Sea, Northern Shelf, Arctic etc. Therefore, keeping the *Pandalus* stocks outside this process seems somewhat inconsistent with the current aim of ICES advice.

3. Definition of Stock/Assessment Units

3.1. The North Sea and Skagerrak

The distribution of *Pandalus* in the Entire North Sea area is shown in Fig. 3.1. The WG has, so far, maintained the view that shrimp caught on the Fladen constitute a stock separated from the *Pandalus* in the Norwegian Deeps and Skagerrak. The main arguments for this separation were presented in ICES (1990):

- Geographical separation combined with hydrographical considerations.
- The Fladen shrimp are normally characterized by fewer age groups. This difference was quantified by multivariate analyses of length frequency distributions (LFD) from the three areas, these suggested that especially the Fladen LFDs deviate from the other two (ICES, 1990).

A close connection between the shrimp in the two areas has, however, been postulated by earlier investigations (e.g. Poulsen, 1970). It was done based on trends in size distribution of the shrimp in various parts of the entire North Sea-Skagerrak area and on probable larval drift with surface currents in the northern North Sea. The WG has, furthermore, observed that:

- Norwegian Survey data on recruitment for Div. IIIa and IVa East and LPUE in the Danish Fladen fishery is correlated.

- Pattern in LPUE fluctuations in the fisheries exploiting the two stocks have frequently been similar

This could indicate a close connection between the two stock units.

Improvements in genetic separation technologies in recent years could elucidate this particular stock separation problem. Norwegian samples for such genetic analyses have been collected in 2005 from the Skagerrak and Norwegian deeps, but have not been analyzed yet. Samples from the Fladen stock will be collected in 2006.

3.2. The Barents Sea and Svalbard Area

The *Pandalus* stock in the Barents Sea and Svalbard area is distributed as shown in Fig. 3.2. Genetic investigations, allozyme electrophoresis and DNA-fingerprinting have been conducted in attempts to identify potential sub populations of shrimp in the Northeast-Atlantic including the Jan Mayen area, the Norwegian coast, the Barents Sea and the Svalbard area (Kartavtsev *et al.,* 1991, Rasmussen *et al.,* 1993, Drengstig *et al.,* 2000 and Martinez *et al.*, 1997). The latter analyses showed that there are no distinct sub-populations in the open sea, and that there is a high degree of genetic variance between individuals within each location. However, genetic gradients related to geographic distance and sea currents have been identified. The transport pattern produced by the currents, varies between years, and results in annually different dispersion patterns of settled shrimp larvae. This may have a strong influence on the year-class strength in Sub-areas as well as in the entire Barents Sea.

The shrimp in the Barents Sea should be considered as one population, where female shrimp produce settling larvae in the whole distribution area. The transport of larvae secures genetic Flow within the population. The abundance of reproducing females in each Sub-area is of great importance for the annual recruitment and therefore management has to secure the spawning females throughout the Barents Sea (Pedersen *et al.,* 2003).

4. The *Pandalus* Stock in Divisions IVa East and IIIa

4.1. The *Pandalus* Fisheries in the North Sea and Skagerrak

4.1.1. The Danish *Pandalus* Fishery

Historically, the Danish *Pandalus* fishery has targeted both the shrimp stock in the Sub-area IVa East and Div. IIIa and the stock on Fladen Ground. In the period 1994 to 1999 the fisheries in the two areas were of about the same size, but since 2000 the Fladen fishery has declined and landings from Div. IVa East and IIIa have gradually become more important. In 2005 the Fladen Ground fishery was practically non-existing with total recorded landings of only 23 tons. Interview information from the fishing industry obtained in 2004 gives the explanation that this decline in recent years is caused partly by low abundance of shrimp on the Fladen Ground combined with low prices on especially the small Fladen shrimp and high prices on fuel. The latter condition has further favoured fishing in waters close to landing harbours (Skagerrak) in order to minimize fuel costs.

During recent years an increasing number of vessels have started processing (boiling) the shrimp aboard and landing them in Sweden thus obtaining a better price. The majority of the catches are however still landed in Danish fishing ports. Most of these shrimp are landed directly to a few large factories processing almost all sizes of shrimp.

The Fishing Vessels

In a study performed by Ulrich and Andersen (2004) all Danish fishing vessel were grouped in categories based on similarities in catch composition, gear used and area fished. According to their analyses of logbook data on catch, effort as well as landings from all the Danish fishing trips in 1999, a total of 14 vessels could be identified as being trawlers targeting *Pandalus* in the North Sea and/or Skagerrak in 1999. They accounted for the majority of the total landings and had an average of 68 yearly trips targeting *Pandalus*. A larger poorly defined vessel group occasionally took part in the *Pandalus* fishery, but only accounted for small catches of *Pandalus*.

According to the above mentioned study the smaller trawlers (<24 meters) formerly made up a substantial part of the fleet (app. 50% in numbers) but during the 5 most recent years almost all of the smaller vessels have disappeared from the *Pandalus* fishery leaving only the large vessels (>24 meters) located in Skagen, Hirtshals and Hanstholm.

This development in fleet structure agrees well with the 2004 interview information (from the industry) where Skagen, Hirtshals and Hanstholm were pointed out as being the major harbours of *Pandalus* trawlers in 2004, Skagen being the home harbour of 6-7 vessels of approximately 100-200 GRT and Hirtshals and Hanstholm each having 2-3 somewhat larger *Pandalus* trawlers of between 200 and 300 GRT. The major landing harbours were the same.

Fishing Gear

The largest net manufacturer in Denmark (Cosmos Trawls) provides shrimp trawls to many of the Danish vessels. At present the two most common trawls are the "Sputnik" (or "Skagerrak") trawl and the "Fladen shrimp" trawl differing mostly with respect to the height of their trawl opening. The Sputnik trawl has almost twice the height as that of the Fladen shrimp trawl but only a slightly larger width. The two trawls are chosen by turn depending on fishing area and time. The mesh size in the cod ends used is almost exclusively 40 mm whole-mesh with a 70 mm square mesh window in the top panel.

Of particular interest is the information from this net manufactory, that within the last 5-10 years almost all trawlers had been equipped with twin trawls. This change had allowed the individual vessels to increase the swept area (wing end to wing end) with approximately 50% without increased demands to the vessels engine capacity or in any noticeably increase in fuel consumption.

The Influence of Twin Trawls on Fishing Effort

The official Danish logbook record do not provide any information on single/trawl riggings, but based on the information described in the section above a preliminary simple model for the development of true effort is suggested based on the following assumptions for the introduction of twin trawls in the Danish *Pandalus* fleet:

- a simple linear introduction pattern over a 10 year period starting in 1994
- a final (2003) introduction among the *Pandalus* trawlers of app. 72% (10/14)
- a 100% application to *Pandalus* fishing operations after purchase
- a resulting 50% increase in swept area and catch rates

Standardization of effort (and subsequently of LPUE) is carried out by the following conversion:

$$Effort_{hypothetical}(t) = Effort_{nominal}(t) + (0.5 * Effort_{nominal}(t) * I_{factor}(t))$$

Where the introduction factor (I_{factor}) = 1/14, 2/14, …..10/14, for t = 1994 to 2003

The resulting values for the standardized LPUE's are shown in Fig. 4.1 (Section 4.2.3) together with the trends for the nominal Danish-LPUE's and the nominal Swedish LPUE's. In Sweden the use of twin trawls in the *Pandalus* Fishery is not yet common. In 2004 only 3 vessels applied this gear in the fishery. For assessment purposes the estimated total international LPUE and effort have been adjusted accordingly, see Section 4.5.

4.1.2. **The Norwegian *Pandalus* Fishery** (SCR Doc. 05/80)

The Norwegian fishery is conducted by multi-purpose fishing vessels (20-100 GRT) largely trawling south of 62°N. In 2002, a total of 143 trawlers were registered in three categories of shrimp trawlers. There were 45 vessels being less that 50 GRT and smaller than 13 m in length delivering 980 t of shrimp from this area, there were 69 trawlers less than 50 GRT and longer than 13 m, delivering 2 770 tons of shrimp and finally, there were 29 trawlers being larger than 50 GRT delivering 2 330 tons of shrimp. Vessels belonging to other categories also land some shrimp. According to the Norwegian logbook records for 2003, 38 vessels have reported shrimp catches and these vessels are all longer than 13 m. Of the 18 vessels less than 50 GRT, 4 vessels deliver less than 10 tons, 10 vessels between 10 tons and 50 tons, and 4 vessels more than 50 tons. Of the 20 vessels larger than 50 GRT, 2 delivered less than 10 tons, 3 between 10 tons and 50 tons, 5 between 50 tons and 100 tons and 10 more than 100 tons.

In the Norwegian fishery for shrimp in this area the minimum mesh is 35 mm. It is not allowed to fish in waters shallower than 60 m. It is allowed to have 50% by-catch of other market species. For cod and haddock combined there is a limitation that the number of undersized specimens may not exceed 8 per 10 kg of shrimp. It is allowed to have up to 10% undersized shrimp (<6 cm - 15 mm carapace length) in the catch. Discarding is prohibited in the Norwegian waters. Due to these regulations, the trawlers fish a considerable by-catch of market fish. They also conduct other fisheries during the year, e.g. mackerel trolling. The larger vessels (>50 GRT) also conduct trawl fishery for sandeel and herring.

In 1999 a general quota regulation system was initiated in the Norwegian fishery. The total Norwegian quota is divided into periods of four months each with app. 1/3 of the quota each period. The vessels have a maximum quota each for each period, a trip-quota for each trip to sea and a mandatory number of days of no fishing between each trip. There is some variation depending on whether they are fishing for boiled landings or for shrimp to be landed fresh.

Two categories of shrimp dominate the market: Approximately 35% of the total landings is delivered as boiled or fresh large shrimp (140-150 individuals per kg) for the Norwegian inland market (app. 60%) and the Swedish market (app. 40%) and app 65% of the total as raw (smaller) shrimp for factory processing (mostly 180-250 individuals per kg). A price and quota regulation is in work to regulate the available shrimp for the Swedish market, for which there is an export quota free of toll. The fisher gets app. 55 NOK/Kg for boiled shrimp and app. 10 NOK for the raw shrimp. Some high grading and discarding is assumed to take place. Especially shrimp sized below 15 mm carapace length are probably all discarded and may account for 5-10% of the catches.

4.1.3. **The Swedish *Pandalus* Fishery**

In 2004, a total of 74 trawlers reported landings of *Pandalus* in the Swedish logbooks. Of these 50 landed more than 10 tons *Pandalus* and can be considered active in this fishery.

The size of the vessels ranges between 11-34 m (length) with an average of 21 m. GRT varies from 18 to 235, with an average of 103 GRT. The average engine effect is around 355 kW (92 Kw-720 kW). The larger trawlers are normally fishing in the eastern and central part of Skagerrak. The smaller trawlers are mostly fishing in the Swedish coastal zone inside a 'trawling border' where special regulations apply for the use of trawls: Trawling is restricted to waters deeper than 60 m and there are special limits in the length of ground rope and in the size of the trawl and trawl doors. Furthermore, the trawls to be used inside this boarder must be equipped with a species selective Nordmøre grid of 19 mm bar space and an unblocked fish opening in the trawl roof. This has resulted in very clean landings from these trawls (99% *Pandalus*). The Nordmøre grid may also be used outside the trawling boarder as an alternative to the EU legislated 70 mm square mesh panel in shrimp trawls.

This particular *Pandalus* trawl with grid can be distinguished from other shrimp trawls in the log books since 1997 and the effort of this gear has had an increasing trend and was 16% (10 khrs) of total Swedish *Pandalus* trawl effort in 2004 (63 khrs).

There are two different Swedish markets for *Pandalus:* a) higher value boiled larger sized shrimps, sorted by a 10.5 mm sieve and constituting around 50% of the landings, b) lower value smaller sized shrimps, sorted by 8.5 mm sieve, landed fresh and sold to the industry for further processing. The boiled *Pandalus* landings are cooked onboard before landed. Since the shrimp loses weight when boiled, these landings must be raised by a factor of 1.13 to obtain fresh weight for the landings statistics.

The TACs are limiting the Swedish *Pandalus* fishery and in order to distribute landings over the year the fishers have voluntarily introduced rations per fisher per week. This has resulted in high-grading of the catch, increasing the discarding of less valuable smaller *Pandalus* to increase the proportion of the more valuable boiled shrimp in the individual landings ration. The discard of small *Pandalus* was this year estimated to around 800 tons based on comparison of the size compositions in the Swedish and Danish catches.

4.2. Landings, Catch and Effort Data

4.2.1. Landings

Landings are given in Table 4.1 by area (Div. IIIa and Subarea IV) as officially reported to ICES. In Skagerrak the landings for 2004 increased approximately 15% compared to 2003. Landings increased in all 3 countries. In Subarea IV total landings have decreased due to a drastic decrease in the Danish Fladen Ground fishery in 2004. The combined total landings from Div. IIIa and Subarea IV were 7% higher in 2004 than in 2003.

Table 4.2 presents the landings and estimated discards for the assessment unit 'Skagerrak and the Norwegian Deeps' i.e. Div. IIIa and the eastern part of Div. IVa. The landings in 2004 were around 15 000 tons, an increase of almost 2 000 tons compared to landings in 2003.

Landings from Norway and Sweden (and to a very small extent from Denmark) consist of a fraction of larger shrimp that are boiled on board and a remaining portion of smaller shrimp landed fresh. The boiling causes the shrimp to loose weight. The conversion factor to obtain live weight is 1.13. Official reported figures from Norway are given as landed weight. Sweden has adopted the same procedure for the last few years. In the amounts used by Working Group, the Swedish landings of large shrimp have, however, always been converted to live weight. The amount added for 2003 was 164 tons. The Working Group has applied no conversion on the Norwegian landings. The underestimate of total landings by this omission was for 2000 roughly estimated to about 300 tons. The Working Group felt that this estimate was too inaccurate to include in the assessment figures. When more reliable data for estimations become available, the landings for all years should be updated.

4.2.2. Discards

In the Norwegian and Swedish fisheries one may distinguish two categories of discarded shrimp, 1) all small or low quality shrimp are discarded either at sea (Sweden) or at shore (Norway) and 2) discards because of high grading:

The smallest size fractions (from the grading procedure are not accepted by the canning industry and are discarded. This practice is traditional in the Norwegian and Swedish fisheries. This is probably also the case for the Danish catches. The proportions below 15 mm carapace length are considered to be discarded.

Estimates of the Norwegian high grading discards for 1996 and 1997 were 400 and 1 000 tons respectively or approximately 5 and 12% of the catches. Estimates for other years are not available. Instead Norwegian discards were estimated by the difference in length distribution in commercial landings and in the unprocessed catches of a research survey vessel using commercial-type trawling gear, see Table 4.2.

Quota restrictions and the substantial price difference between large, boiled shrimp and medium sized fresh ones together with a voluntary system of weekly rations (different for medium and large shrimp) have resulted in high grading at sea by discarding the medium sized ones. In recent years several Danish shrimp vessels landing boiled shrimp in Sweden have probably been following this practice. The amounts of discards in this category in the Swedish fisheries were estimated to around 800 tons in 2004 based on comparison of size distributions in Swedish and Danish landings. However, the total annual amount of this type of discards could be more than 1 000 tons. However, at present such estimates are considered too inaccurate to be included in assessments, but the working group expects that better data on discards will available through the current EU funded discard sampling programmes. According to qualitative information from the Danish fishing industry, the amounts of discarded shrimp in the Danish *Pandalus* fishery are rather small.

4.2.3. Effort Data

Annual national figures for landings per unit of effort (LPUE) and estimated effort are shown in Table 4.3 and Fig. 4.2. Total national effort values have been estimated from LPUE data based on logbook records. The Danish and Norwegian LPUE increased in 2004, while the Swedish LPUE remained at the same level, possibly due to the discarding practices described above. The technological creeping in the Danish *Pandalus* fishery described in Section 4.1.1 has been taking into account in the figures for Danish LPUE. The Swedish shrimp trawls are still mainly single trawls. No quantitative information on the development in the Norwegian shrimp gear for Skagerrak and the Norwegian Deeps was available.

In order to obtain the same effort unit for all 3 countries, i.e. 'fishing hours', the Danish unit 'fishing days' was converted to 'hours' on basis of functional regressions between Danish-Norwegian and Danish-Swedish LPUE. These two regression coefficients were averaged to get Danish kg/hr as well as the total Danish effort in hours (unit = 1 000 hours). The missing Norwegian data from 1984-85 were estimated by functional regression Norway-Sweden and the factor 1.12 applied. The estimated time series of total international effort (Khrs) and LPUE (Kg/hr) are shown in Table 4.4 and Fig. 4.3.

4.3. Biological Sampling of Landings

4.3.1. Sampling Frequency, Intensity

Information of the size and subsequently age distribution distributions in the landings are obtained by sampling the landings. The biological samples also provide information on sex distribution and maturity.

National sampling effort is presented in Table 4.5. The overall sampling level 2004 was around 14 kg per 1 000 tons landed or 2 400 specimen. Variations in the intensities between countries and between seasons indicate that improvements could be made.

4.3.2. Catch in Numbers at Age

The length data are pooled by quarter, and these national quarterly length distributions have then been partitioned into age compositions by the method of Bhattacharya (1967) (software: FISAT). As in previous years the mean lengths by age group are used as a check of the consistency of the estimates, see Fig. 4.4. Due to lack of Norwegian length data for 2003 and 2004 the Norwegian total landings were age distributed according to the combined Danish and Swedish age data.

Table 4.6 gives the "catch-at-age" data. While previous years' tables also tabulated landings at age, this year's tables have included discarded 0 and I-Group shrimp. Catches are dominated by shrimp of ages 1 and 2. The numbers of age 3 and older are likely to be underestimates, due to the way the Bhattacharya method operates. In general, the WG doubts the reliability of estimates of the older age groups, i.e. those > age 3. This doubt is also reflected in the pooling of ages >3 in to a 'plus-group' in the XSAs performed in previous years.

4.3.3. Mean Weights at Age

Weights-at-age for the Danish catches were derived from the length samples of the catches, where the weights of the measured shrimp in each sample are recorded by length group. The corresponding Norwegian and Swedish weights-at-age figures are based on quarterly length-weight relationships obtained from the Swedish length samples in which all shrimp are weighted individually. The mean weights-at-age in the catch is given in Table 4.7. In some years there were no records 0-group shrimp in the catches, then averages for the other years were used. The same procedure was applied for the +group (+gp) in 2004.

4.3.4. Estimation of SSB, Maturity Ogives

For estimation of SSB for the *Pandalus* stocks in the North Sea area the 0- and 1-groups are assumed to be immature, and age group 3 (all females) and older groups are fully mature. In the cohort based assessments (XSA) the mature part of the 2-group or potential spawners was taken as the sum of intersexes and females in the first quarter of the year. These proportions are available from 1985. The text table below gives the figures for the 10 recent years:

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0.51	0.58	0.51	0.60	0.65	0.76	0.51	0.52	0.74	0.89

This method was not appropriate in connection with the SPP model used for 2001-2003, where stock size estimates were based on survey data from October-November. At the time of the survey it is assumed, that the spawning stock consists of the females in the stock, and estimates of SSB were based on the proportion of females (by weight) in the survey catch. They were then applied on the estimates of average biomass, $(B_y + B_{y+1})/2$.

The WG recommends, that in future assessments the procedures for estimating SSB be standardised for all *Pandalus* stocks in the North Atlantic.

4.4. Trawl Survey Data

4.4.1. The Norwegian Trawl Surveys (SCR Doc. 05/82)

Norwegian Trawl surveys for northern shrimp in Skagerrak and the Norwegian Deeps (ICES Div. IIIa and IVa East) have been conducted annually since 1984 with the objective of assessing the size and demographic composition of the stock and hydrographical conditions in its distributional area. From 1984-2002 the R/V *Michael Sars* was used. However in 2003 and 2004 significant changes took place, and from 2004 a 'new' survey, taking place in the spring, has been conducted. Further description of gear and design for the 'old' survey is found in ICES (2005a).

At present the Norwegian survey data consist of: 1.) One series based on a survey conducted in October-November 1984 to 2002 using R/V *Michael Sars*; 2.) A point estimate for 2003, as the survey vessel and trawl previously used was changed; 3.) A start of a potential new series as the survey in both 2004 and 2005 was conducted in May-June with R/V *Håkon Mosby* using the same shrimp trawl as in the ‘old’ survey (Campelen 1800/35 bottom trawl). Mesh size in the cod-end is 22 mm with a 6 mm lining. A fixed trawl geometry is assumed.

The design of the 'new' survey is similar to that of the 'old' one (Hvingel, 2005). The survey area covers depths of 100 to 500 m in ICES Div. IIIa and IVa East. It is stratified by depth zones of 100-200 m, 200-300 m and 300-500 m, and area (Fig. 4.5). The total survey area is hereby divided in 16 strata covering 13 128 nm².

The survey is a fixed station design with 100 stations evenly distributed over the survey area (Fig. 4.6). The hauls are repeated annually on the 100 stations, giving a coverage of 1 haul per 1 312 nm². Haul duration is 30 min. No compensation for diurnal vertical migrations is made.

Due to weather and time constraints and a number of invalid tows only 58 tows from the 2004 survey and 83 tows from the 2005 survey were available for analyses.

4.4.2. Analysis of Survey Data

4.4.2.1. Shrimp: Swept Area Estimates of Numbers-at-age

The width of the trawl opening, used for calculating swept area estimates, is 11.7 m. (Teigsmark and Øynes, 1983). The average speed is 3 nm/hour and thus the trawl covers 0.019 nm^2 in 1 hour. The catch in each tow divided by the swept area represents a sample of shrimp density in a stratum. From these samples the mean and standard error of the density in each stratum was calculated and multiplied by the area of the stratum to give an estimate of stratum biomass and abundance. Standard error was calculated as $B * 0.985$ (Cochran, 1977) for strata with only one tow. The means and their standard errors for the 16 strata were summed to give the overall values for the survey area.

Samples of 250-300 specimens are taken from each trawl haul, sorted by sexual characteristics, and measured to the nearest mm below (carapace length, CL). The length and sex frequency distribution in the samples was weighted by total catch and stratum area to obtain estimates of the overall distribution. The length distribution was then split into age groups by modal analysis using the NormSep software MIX (Macdonald and Pitcher, 1979) to produce indices of abundance by age group. Note, that the method of partitioning of the length distributions in the Norwegian survey catches into assumed age groups differs from the method used for the Danish and Swedish length data.

The mean length at sex change was estimated by fitting a logistic function to the percentage of females in 1mm length intervals.

4.4.2.2. Shrimp: Swept Area Estimates of Total Biomass

Figure 4.7 and Table 4.8 show the estimated biomass (indices) from both the 'old' and 'new' survey. The biomass indices increased in the late 1980s to early 1990s, was stable until the mid-1990s after which it began fluctuating at a slightly higher level (Fig. 4.7). The indices from the 'new' survey are of the same magnitude as those from the 'old' one. The 2005 index value is lower than that for 2004, but not statistically different.

Size, Age and Sex Distribution

The estimated size distribution of 2004 showed a large mode of mainly males at 15 mm CL (Fig. 4.8) in 2005 which was assigned to age-group 1 in the modal analyses. These shrimp may be recognised as a large mixed male and female mode at around 18-19 mm CL in 2005. This might indicate a high abundance of large female shrimp in 2006 as these shrimp grow into age-group 3.

However the abundance of the lengths around 15 mm (age 1) is considerably lower in 2005 than in 2004 (Fig. 4.8) and the estimated mean abundance of age 1 shrimp in the survey in 2005 is only half of the 2004 mean indicating a possible reduced recruitment of mid-sized shrimp to the fishery in 2006.

4.4.2.3. Fish Biomass

The index of shrimp predator biomass increased from 58 in 2004 to 115 in 2005 (Table 4.9).

4.5. Assessment of the *Pandalus* Stock in Divisions IIIa and IVa East

4.5.1. Previous Assessment Models

The *Pandalus* stock in Div. IIIa and IVa East was assessed by cohort analyses (VPA/XSA) from 1987 to 2000.

However, several features characteristic to the shrimp stocks reduce the applicability of the XSA:

- Few age groups in the stock.
- Uncertainties in the ageing of especially the older age groups.
- A variable natural mortality much higher than the fishing mortality.

From 2001 to 2003 a Stock production model taking predation into account was applied. The main input to this was recruitment and total biomass indices of shrimp and predators available from the 'old' Norwegian trawl survey.

However, because of the break in the time series of this survey in Skagerrak and the Norwegian Deeps in 2003, as well as severe limitations of the model, this approach was abandoned in 2004 (ICES, 2005a). An analysis (see Annex 3) in 2005 showed that the previously used model was inappropriate and that the available data was uninformative with respect to the parameters of this model. Thus the model cannot be used to make predictions. An alternative approach using a stochastic version of the logistic production model and Bayesian inference to estimate the status of the stock and risks of transgressing the suggested reference point was introduced to the WG this year.

4.5.2. State of Stock in 2005 and 2006

This year's assessment of the current state of stock is based on 1) evaluation of LPUE from the fishery 1984-2005 and the 2004-2005 survey indices of biomass, and 2) model based estimates using the 1985-2002 survey and catch data (1984-2005):

1. *The trend in commercial LPUEs presented in Tables 4.3 and 4.4 and Fig. 4.2 and 4.3 as indicator of the development of the stock up to 2005: The combined LPUEs (Fig. 4.3) show an increasing long term trend from 1989 to a peak in 1997-98, declined again in 1999 to 2001 and increased in the recent 3 years and LPUE in 2004 is the highest observed during the period of available data. The combined effort shows a decreasing long term trend, even after the Danish effort figures have been adjusted. The similar pattern in LPUE between Denmark and Norway indicate that the exploitable stock biomass has followed the same pattern, i.e. increased until 1998, decreased in 1999 to 2001 and increased again in recent 3 years. The trend in Swedish LPUEs is slightly different, probably due to not including discards due to high-grading in the LPUEs. It is recognized however that raw CPUE data is affected by changes in fishing practices and does not always accurately reflect changes in stock.*

   The biomass index provided by the Norwegian survey in May 2005 is 10% lower than the index for 2004. Compared with previous variations this change is small (Table 4.9, Fig. 4.7), thus the survey indices contribute to the overall impression of a stable stock.

Both these sets of stock indicators point to the perception of a stable stock at a high level with no signs of over-exploitation.

The model indicated a high probability of the stock having been above both B_{msy} and B_{lim} between 1984 and 2005 (B_{lim} = 30% B_{msy} as currently used by NAFO: SCS Doc. 04/12). For those years the risk of the stock being below B_{msy} range from 1.5 to 8.2% and from 0.1 to 2.2% for being below B_{lim} (Table 4.10). The risk of the fishing mortality being above F_{lim} (= F_{msy})(SCR Doc. 04/12) was not estimated due to the inability to estimate the full probability distribution of *MSY*, however, an index of harvest rate (landings/estimated survey biomass) showed a slightly declining trend since the late 1980s (Fig. 4.9). A series of estimated median stock sizes relative to Precautionary Approach reference points are shown in Fig. 4.10.

This model indicates a stable stock at a level well above B_{msy} *The model also shows that there is a high probability that catches have been below MSY throughout the period 1984-2005 and that the stock could likely sustain larger catches than the current TAC.*

The WG concludes that catches at the recent TAC level of around 15 000 tons are not likely to have an impact on stock status provided that the abundance of predators remains within the recent ranges. The stock might be able to sustain higher catches, but the WG was not able to estimate *MSY*.

4.5.3. Biological Reference Points

The view of the WG is that, the data on the stock-recruitment relationship, from previous assessments, did not support establishment of a SSB reference value for this *Pandalus* stock based on this relationship (ICES, 2002b). In 1998 ICES (ICES, 1999) pointed out that there was not basis for establishment of a B_{lim} on basis of the available S-R data. Considering the major impact from predation, such a poor relationship is likely.

According to previous assessments, predation accounts for at least twice as much removal from the *Pandalus* stock compared to fishery removals from 1985-2002. Such dynamics also render it problematic to establish a reference value for *F* (or Y/B), at least if the relative magnitudes of *F* and *M* (predation) are independent of stock size.

Following the current NAFO definition (SCS Doc. 04/12), 30% B_{msy} could be used as a limit reference point (B_{lim}).

5. The *Pandalus* Stock on Fladen Ground (Division IVa)

5.1. Catch and Effort

Table 5.1 shows the landings from the Fladen Ground since 1972. Since 1991 total landings have fluctuated between a low of around 23 tons (2004) to a high of more than 5 000 tons. Denmark accounts for the majority of landings while the Scottish fleet takes only a minor part of the catches. Since 1999 total Fladen landings have declined, in 2004 there was a drop to almost no catches. No monitoring of this stock has taken place, and it cannot be ruled out that this drop could reflect a decline in the stock. However, the most likely explanation for this dramatic drop, which is confirmed by the fishing industry, is the low price for Fladen shrimp combined with the rather high fuel costs.

In general, the shrimp fisheries on Fladen take place mainly during the first half of the year, mainly in the second quarter.

Total effort for the Danish and Scottish Fladen fisheries is estimated from logbook based LPUE data from these fisheries (Table 5.2). In 2004 the Danish LPUE was at half the level as in 2003. Estimated total Danish effort in 2004 was insignificant. No effort data for 2001, 2002 and 2003 have been reported from U.K.

5.2. Previous Assessments

The shrimp stock on Fladen has not been assessed since 1992, due to scarcity of assessment data (ICES, 1992).

The existing data on age composition for later years have been compiled at the national laboratories (Denmark and Scotland) and are available to the Working Group. However, due to the frequent large fluctuations in the Fladen fishery, the data do not always cover the entire year. Furthermore, they are lacking for the most recent years.

Catches from Fladen consist mainly of two age groups. During the first two quarters of the year age groups 2 and 3 normally dominate the catches. During the 4^{th} quarter age group 3 usually disappears from the catches, while age group 1 adds to the catches.

5.3. State of the Stock

Since no assessment is available, the WG cannot give any advice on the current status of the stock. However, it must be pointed out that the development in the 2004 fishery, as described above, could indicate a low stock level. For the Fladen stock such events have occurred previously, notably in 1987-88. However, a recovery of the stock after that decline was observed already in 1989-90 without any management actions.

6. The *Pandalus* Stock in the Barents Sea and Svalbard Area

6.1. Description of the Fishery

Norwegian vessels began to exploit the shrimp fisheries in the Barents Sea and Svalbard area in 1970. Russian vessels entered the shrimp fishery in 1974. The yield increased continuously until 1984 when the total yield reached a maximum of 128 000 tons. By that time vessels from other countries had entered the fishery. Since then, biomass and yield levels have fluctuated because there were different recruitments, cod consumption and effort in the fisheries due to price of shrimp. The yield peaked above 80 000 tons in 1990 and in 2000 but has decreased since to approximately 40 000 tons 2003 and 2004. The most important fishing ground is the Hopen area in the central Barents Sea.

The first vessels using double trawls entered the fishery in 1996. Since then the efficient effort has increased continuously and in 2002 approximately 35 Norwegian vessels had the technology to use double trawl or even triple trawl. Since 2002 the majority of the yield is taken by double trawl.

In the Svalbard area the shrimp fisheries are regulated by number of effective fishing days and number of vessels by country. In the Barents Sea and Svalbard area, Norwegian rules are that the fisheries be regulated by fishing licenses and since 1985 by smallest allowable shrimp size (maximum 10% of catch weight may be <15 mm carapace length, CL). However, the regulation by smallest allowable shrimp size is not considered to be an efficient management tool in the Russian Economic Zone (REZ) due to the high predation of shrimp. In the REZ, a TAC is established each year by Russian authorities. Fishing grounds are closed if by-catch limits given as number of individuals of fish by species group or shrimp in 10 kg of shrimp are exceeded. In 2004 the values of allowed by-catch are set at eight for the sum of cod and haddock, ten for redfish and three for Greenland halibut per catch of 10 kg shrimp.

Sorting grids in the shrimp trawls first became mandatory operating within the Norwegian 12-miles zone in February 1990. In October 1991 this rule was extended to apply to shrimp trawls used in all of the Norwegian EZ. Finally, in 1993 the Joint Norwegian Russian Fisheries Commission agreed that the sorting grid was to be mandatory for all vessels conducting shrimp fishery in the Barents Sea and the Svalbard area.

6.2. Catch and Effort Data

6.2.1. Landings

Preliminary reported landings for all countries show a substantial decrease of landings from 82 816 tons in 2000 to approximately 60 000 tons in 2002 and 2001 and a further decrease to approximately 40 000 tons in 2003 and 2004 (Table 6.1, Fig. 6.1). Thereby the total landings have decreased to 50% in three years. The 2005 landings are believed to stay at the level of the last two years on approximately 42 000 tons.

6.2.2. Discards

Since there is no TAC in the Barents Sea it is believed that all catches are landed and that there are no discards of shrimp in the area.

6.2.3. Effort and CPUE

The Norwegian CPUE has been standardized to vessels 1 000-1 500 hp with single trawls by using a GLM model including year, region, vessel and gear. The Russian CPUE represents only vessels of 1 300 hp using one type of single trawl. Catch, effort, and annual CPUE series for Norway (un-standardized and standardized) and Russia are presented in Table 6.2. The CPUE series for Russia and standardized CPUE for Norway are given in Fig. 6.2. The Norwegian shrimp fleet has since late 1990s been upgraded both concerning vessels and the use of double and triple trawls. The Norwegian data show a peak in the effort in 2000 at the same level as the earlier peaks in 1985 and 1990. Both the Russian and Norwegian effort decreased in 2001 with a slight increase in 2002 followed by a further decrease in 2003 and 2004. The CPUE of the Russian fleet has fluctuated in accordance with the shrimp biomass and the standardized Norwegian CPUE series show the same pattern. It should, however, be noted that the Russian fleet is also under development.

6.2.4. Sampling of landings

In 2002, 2003 and 2004 observers collected samples on board commercial Spanish vessels in the Svalbard EZ (Casas, 2005). Length and sex distribution data and data on by-catch of young fish were obtained. These data show a reduction of females from 33% in 2002 to 18% in 2003 and increased to 38% in 2004.

Monitoring of the shrimp catches is required due to the regulation protecting juvenile fish and shrimp through area closures. The Directorate of Fisheries in Norway has, during surveillance cruises conducted by hired commercial shrimp trawlers, collected data on length distributions in the shrimp catch since 1995. The Norwegian Coast Guard also samples some length data during inspections of shrimp catches. In 2002 the Institute of Marine Research established a reference fleet where fishermen take samples of the catch. One of the vessels included in the reference fleet is a part time shrimp trawler. The carapace length is measured on 300 individuals of shrimp in each sample. The sampling frequency will be further increased by more inspections conducted by the Coast Guard.

The catch in 2000 was dominated by shrimp aged four and five years (Fig. 6.3). The catch pattern moved towards three year olds in 2001. The catches in 2003 were again dominated by four-year-old shrimp of the 1999 year-class. The 1999 year-class entered the spawning stock in 2004.

6.3. Research Vessel Data

6.3.1. Trawl Surveys

In the Barents Sea and the Svalbard area, surveys were conducted by Norway in the period 1982-2004 and by Russia from 1984 to 2002 and in 2005 (Fig. 6.4.). The Russian survey is a stratified random swept area survey. So was the Norwegian survey until 1989. Since 1990 the Norwegian survey has been using fixed grid stations. The CV of the Norwegian survey index has been less than 10% since 1990. During the 1990s, both surveys have suffered from reductions in survey time and in 2003 and 2004 no Russian shrimp survey was conducted while no Norwegian shrimp survey was conducted in 2005. However, a joint Norwegian-Russian ecosystem survey, also recording shrimp, was conducted in August-September covering the whole Barents Sea. This survey will be conducted annually, but it will take three to four years before a new time-series reliable for the shrimp stock assessment is established. Resources for calibrating the spring shrimp survey to the autumn ecosystem survey are not available. Evaluations of previous surveys, sampling strategies etc are reported in the ICES reports from AFWG 2002, AFWG 2003 and WGPAND 2004 (ICES, 2002a, 2003b, 2005a Tilføjet af Michala).

6.3.2. Analysis of Survey Data

6.3.2.1. Swept Area Estimates of Biomass

There is a strong correlation between the Norwegian and the Russian survey results (Fig. 6.5). Biomass indices were highest during 1984, and have since fluctuated between 30% and 60% of this level with peaks in 1991 and 1998 and low values below the long term mean in 1987-1988, 1994-1995 and 2001-2004. Norwegian bottom trawl surveys indicate a decrease in shrimp biomass in the Barents Sea and Svalbard of 29% from 2003 to 2004. The Russian surveys indicate a reduction of 36% from 2002 to 2005 (Bakanev *et al.,* 2005). Especially the important Hopen Deep and the Thor Iversen Bank area show a strong reduction in biomass.

The recruitment index from the Norwegian surveys for one-year-old shrimp was low in 2004 and the number of two and three year old shrimp reduced dramatically since 2003 (Fig. 6.6, Table 6.5).

6.3.2.2. Natural Mortality and Predation

Predation by cod is a large source of natural mortality. However, it should be noted that other fish species such as Greenland halibut (*Reinhardtius hippoglossoides*), long rough dab (*Hippoglossoides platessoides*), thorny skate (*Raja radiata*) and blue whiting (*Micromesistius poutassou*) also prey on shrimp (Dolgov, 1997; Dolgova and Dolgov, 1997). The methods used in estimating cod consumption are described by Bogstad and Mehl (1997), and dos Santos and Jobling (1995). In the Barents Sea, the recorded annual consumption of shrimp was estimated to be above 280 000 tons throughout the period 1994-2001 (Fig. 6.7, Table 6.6). Shrimp consumption may, however, have been overestimated by as much as 50% (Johannesen and Aschan, 2005). Future shrimp assessments have to include cod as predator, although it is still important to identify and further study the reasons for the overestimated cod consumption. It is advised that new estimates for shrimp consumed by cod are presented in 2006.

6.4. Assessment of the Pandalus Stock in the Barents Sea

6.4.1. Background

The great plasticity in growth of shrimp and age at sex change, as well as a lack of biological data and length distributions from the catches, make it difficult to apply traditional analytical fishery assessment methods to the data.

Several models have been attempted unsuccessfully in assessing shrimp in the Barents Sea and some of these are listed below:

Production models: Shaefer and Fox stock models and stock production model including predation (Stefánsson *et al.,* 1994, Berenboim and Korzhev, 1997). Catch at age analysis (cohort models): Single species virtual population analysis (VPA) and multi species virtual population analysis (Sparre, 1984, Bulgakova *et al.,* 1995)). A length based biomass model for shrimp in the North-east Atlantic has been developed in 2005 (Sunnanå, 2005). The assessment is still based on an evaluation on the available CPUE time series and incomplete survey series.

6.4.2. Status of the Stock

- Standardized Norwegian CPUE and Russian CPUE show a decrease from 2002 to 2004 of 22% and 40%, respectively (Table 6.2, Fig. 6.2).

- The Russian survey in 2005 shows a 36% decrease in the biomass index from the previous survey conducted in 2002 (Table 6.4). From 2003 to 2004 the Norwegian survey index decreased by 29%, to the lowest level observed since 1987 (Table 6.3).
- The spawning stock number has decreased 32% from 2002 to 2004 (Table 6.5). The strong 1999 and 2000 year-classes seem to have been reduced by predators and the fishery, and did not contribute to an increase in fishable biomass in 2004 and 2005.
- The abundance of one-year-old shrimp is low and two- and three-year-old shrimp show a reduction from 2003 to 2004 (Table 6.5 and Fig. 6.6).

As the time series of surveys has ceased it is not possible to give a prediction for the stock. As the recruitment indices were low in 2004, the stock is expected to remain at a low level in 2006. It is recommended that a TAC should be implemented for 2006 and set no higher than the current catch level of 40 000 tons.

6.4.3. Recommendations on Further Work

- It is strongly recommended that the Russian and Norwegian shrimp surveys should be re-instituted;
- If the shrimp surveys can not be re-instituted, the existing ecosystem survey should be calibrated by conducting a directed survey for shrimp in spring in a limited area in two consecutive years.
- Scientists should further investigate procedures for estimating the shrimp consumed by cod and give reliable estimates of biomass consumed;
- Licensing of vessels participating in the shrimp fishery must include an obligation for all nations active in the fishery to report length and sex distributions from commercial catches;
- Authorities should enforce the submission of accurately completed logbooks; it is especially important that the use of single, double or triple trawls should be recorded;
- Work on developing and evaluating assessment methods should be continued;
- Catch and effort statistics should be submitted to ICES by all countries active in the shrimp fishery in the Barents Sea and the Svalbard area by 1 September.

7. The By-catch in the *Pandalus* Fisheries in Subarea IV and Division IIIa

7.1. Available Data

In recent years there has been increasing focus on mixed fisheries or fisheries, where species from stocks subject to recovery plans or under special surveillance. The fisheries for *Pandalus* in the North Sea area cannot be classified as mixed fisheries as for instance some of the fisheries for *Nephrops*. The current by-catch regulations in force for the gears used in the fisheries for *Pandalus* restrict the amounts of by-catch, but nevertheless are several valuable fish species, e.g. cod, anglerfish, taken and landed as by-catch. Since the *Pandalus* fisheries are classified as 'small mesh fisheries' for 'human consumption (h.c.) species' there has for a long time been concern on the by-catches in these fisheries, and the WGPAND has since the 1980s regularly compiled and presented relevant information on by-catch in the WG reports.

Tables 7.1A-G give for the recent 10 years period the available Danish, Norwegian and Swedish data on by-catch of the main species in the *Pandalus* fisheries landed for h.c. In the some years quantities of Norway pout and Blue whiting have been specified. For all 3 countries the data are from log book records and are only recording landings, i.e. not the discarded by-catch. Both the Danish and Swedish log book records cover nearly all the recorded *Pandalus* landings. No Norwegian by-catch data for 2004 was available records for 2004

These tables also give cod as well as total h.c. by-catch as the percentage of *Pandalus* landings. It is believed that these are better estimators than % of total catch, since log-book recordings probably not always are consistent in recordings of e.g. Norway pout and/or Blue whiting. In Skagerrak the percentages of landed total h.c. by-catch are similar for all 3 countries (excluding trawls with selective grids). Considering cod only, it is noted that the percentage is highest in the Danish fisheries. However, for the Norwegian log-book records it is likely that the rather low percentages of recorded cod is because some of the cod by-catch has not been specified as cod, but merely as unspecified h.c. by-catch. Note that for the Norwegian data the category 'other market fish' is very high compared to this category in the Danish and Swedish data. Note that the Danish by-catches from the Norwegian Deep are higher than the Norwegian. A minor fraction of the Swedish *Pandalus* fishery is conducted with trawls equipped with a selective grid, and judging from the logbook records of landings by this gear type, it seems to be very efficient in reducing by-catch, see Table 7.1C and Section 7.3.

It cannot be ruled out, that some times in some areas by-catch of valuable species, for instance angler fish, cod and witch flounder is considered a positive contribution to the total landings from a fishing trip for *Pandalus*.

The current 'at-sea-sampling' programme has provided sporadic samples of discarded by-catch in the Danish and Swedish *Pandalus* fisheries. However, these data are presently considered to scanty to base any assessments of the amount of e.g. discarded cod on.

7.2. The Magnitude of Cod Landings from the *Pandalus* Fisheries

The historic data given in Tables 7.1A-G indicate minor fluctuations without any trends in the amount of cod as by-catch. They do not seem to follow the trend in the development of the cod stock in the North Sea and Skagerrak. However, the relative high by-catch figures of Saithe in recent years in contrast to low values for the first half of the 1990s (Denmark and Sweden) could reflect the increase in size of this stock.

These historic cod by-catch figures indicate for instance that in recent years the total of amount of cod landed by the *Pandalus* fisheries in the North Sea and Div. IIIa by Denmark, Norway and Sweden has fluctuated around 300 tons. Since the U.K. shrimp fishery on Fladen Ground has been small in recent years, the overall picture would not change by adding this component. The overall conclusion on the total annual landed by-catch of cod in the *Pandalus* fisheries in these areas is that it contributes less than 1% of total annual landings of cod in the North Sea and Skagerrak. This amount could probably be reduced further, if the shrimp-trawls were equipped with selective grids, as described below.

7.3. Improved Species Selection in Shrimp Trawls Equipped with Selective Grids

The current legal minimum mesh size of 35 mm (stretched mesh) in shrimp (*Pandalus* sp.) trawls implies the catch of also other unwanted undersized fish species and a resulting increase in mortality due to discards. Experiments with species selective grids installed in the trawl started in Norway 1988, and the Nordmøre grid with 20 mm bar space is now mandatory in Norwegian *Pandalus* trawls in the Norwegian zone. Recent experiments on shrimp fishing grounds in the Norwegian Deeps have shown that the by-catch of cod, haddock, saithe and whiting is low when targeting shrimp at depths deeper than 240-250 meters, which are the common fishing depths in this area. Particularly juveniles of such species are absent in shrimp trawl catches in this fishing area. (Valdemarsen and Misund, 2003). Similar species selective shrimp trawls have been tested in the North Sea and the Skagerrak in an EU Study project by Denmark and Sweden (Madsen *et al.*, 1998). The Swedish experimental fishing was performed both inshore and offshore with identical rigging as in the Norwegian legislation. The results shows that the total proportion of fish in the inshore catch was reduced by 85% when the Nordmøre grid was used and the remaining fish by-catch consisted almost solely of Norway pout. No significant loss of shrimp could be seen, but average catch of shrimp per trawling hour decreased by about 7% when using the grid. Even in the offshore fishery the by far largest by-catch was Norway pout, which also is the most difficult species to sort out because of its small size. All other fish species were sorted to 97%, and commercial fish species to 99% efficacy.

The conclusions from these studies are that an introduction of the equivalent grids in the shrimp trawl fishery will drastically reduce the by-catch of fish in general, and commercial fish species in particular and according to published results, a comparable selection efficacy is unlikely to be achieved using techniques that depend solely on mesh selection.

Detailed description of Nordic experiments with grids in shrimp trawls is found in (Anon., 1996) and an extensive reference list is presented in (ICES, 1998).

8. The By-catch in the *Pandalus* Fisheries in the Barents Sea

Young cod, haddock, redfish and Greenland halibut of the Northeast Arctic stocks are caught as by-catch in Norwegian shrimp fisheries. The cod and red-fish by-catch is estimated based on commercial shrimp catch statistic, logbook data, surveys and surveillance data from 1983-2005 will be available in December 2005. Data on haddock by-catch will be available in April 2006 and reported to the AFWG.

Especially one and two year old cod are subject to the shrimp fishery due to overlapping in the distribution of shrimp and cod in the central area of the Barents Sea and around Svalbard. Cod by-catch in shrimp fishery is regulated by area closures since 1983 (Aschan, 1999, 2000). In 1983, 3 juvenile cod and haddock were allowed as by-catch pr 10 kg of shrimp. As a result of the introduction of the sorting grid in 1995 the number of cod and haddock allowed as by-catch increased to 10. The weight and number of individuals of other by-catch species are not believed to exceed the estimates for cod. However, strong year-classes of haddock may reach the same values as cod.

9. Environmental Considerations

9.1. The North Sea

Relevant information on the ecosystem of ecosystem/environment in the North Sea area related to the *Pandalus* stocks and fisheries are found in ICES ACFM and ACE reports.

The WG notes that many of the by-catch species in the *Pandalus* fisheries are considered deep sea species found in fragile environments. The amount of by-catch may be effectively reduced by the use of selective grids.

9.2. The Barents Sea and Svalbard Area

A general description of the ecosystem of ICES Areas I and II is found in the report of the ICES Arctic Fisheries Working Group (ICES, 2005b). Some highlights of importance to the North-east Arctic (ICES I and IIb) stock of Northern Shrimp (*Pandalus borealis)* are given here.

The Barents Sea (also containing the Svalbard Waters) is a shelf area of approx. 1.4 million km^2, which borders to the Norwegian Sea in the west and the Arctic Ocean in the north, and is part of the continental shelf area surrounding the Arctic Ocean. The extent of the Barents Sea is limited by the continental slope between Norway and Spitsbergen in west, the top of the continental slope against the Arctic Ocean in north, Novaja Zemlya in east and the coast of Norway and Russia in the south. The average depth is 230 m, with a maximum depth of about 500 m at the western entrance. There are several bank areas, with depths around 50-200 m.

Temperatures in the Barents Sea were relatively high during most of the 1990s. There was a continuous warm period from 1989-95, followed by a short period with below average conditions. Since 1998 the temperature has, with few exceptions, stayed well above average. In 2004 the temperature in the Barents Sea was well above the long-term average throughout the whole year, and this transferred into the beginning of 2005.

The Barents Sea is a relatively simple ecosystem with few fish species of potentially high abundance. These are the Northeast Arctic stocks of cod, haddock and northern shrimp, the Barents Sea capelin, polar cod, and the immature part of the Norwegian Spring-Spawning stock of herring. The last few years there has been an increase of blue whiting migrating into the Barents Sea. The composition and distribution of species in the Barents Sea depends considerably on the position of the polar front. Variation in the recruitment of some species, including cod and herring, has been associated with changes in the influx of Atlantic waters into the Barents Sea. Cod, capelin and herring are key species in this system. Cod is the most important predator and prey on capelin, herring, shrimp and cod, while herring prey on capelin larvae. As an indication of possible impact on the shrimp stock development the consumption from cod and the status of the pelagic system illustrated by the time series of capelin and zooplankton biomasses may be used (Fig. 3.2).

10. References

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TABLE 4.1. Nominal landings (tons) of *Pandalus borealis* in ICES Div. IIIa and Subarea IV as officially reported to ICES.

	Division IIIa				Sub-area IV					
Year	Denmark	Norway	Sweden †	Total	Denmark	Norway	Sweden	UK (Engl.)*	UK (Scotl.)*	Total
1970	757	982	2740	4479	3460	1107		14	100	4681
1971	834	1392	2906	5132	3572	1265			438	5275
1972	773	1123	2524	4420	2448	1216		692	187	4543
1973	716	1415	2130	4261	196	931		1021	163	2311
1974	475	1186	2003	3664	337	767		50	432	1586
1975	743	1463	1740	3946	1392	604	261		525	2782
1976	865	2541	2212	5618	1861	1051	136	186	2006	5240
1977	763	2167	1895	4825	782	960	124	265	1723	3854
1978	757	1841	1529	4127	1592	692	78	98	2044	4504
1979	973	2489	1752	5214	962	594	34	238	309	2137
1980	1679	3498	2121	7298	1273	1140	38	203	406	3060
1981	2593	3753	2210	8556	719	1435	31	1	341	2527
1982	2985	3877	1421	8283	1069	1545	92		354	3060
1983	1571	3722	988	6281	5724	1657	112	65	1836	9394
1984	1717	3509	933	6159	4638	1274	120	277	25	6334
1985	4105	4772	1474	10351	4582	1785	128	415	1347	8257
1986	4102	4811	1357	10270	4288	1681	157	458	358	6942
1987	3466	5198	1085	9749	9642	3145	252	526	774	14339
1988	2246	3047	1075	6368	2656	4614	220	489	109	8107
1989	2527	3156	1304	6987	3298	3418	122	364	579	7802
1990	2277	3006	1471	6754	2080	3146	137	305	365	6084
1991	3258	3441	1747	8446	747	2715	161	130	54	3807
1992	3293	4257	2057	9607	1880	2945	147	69	116	5157
1993	2451	4089	2133	8673	1985	3449	167	29	516	6146
1994	2001	4388	2553	8942	1362	2426	176	41	35	4040
1995	2421	5181	2512	10114	4698	2879	166	217	1324	9284
1996	3664	5143	1985	10792	4063	2772	82	97	1899	8913
1997	3617	5460	2281	11358	3314	3112	316	52	365	7159
1998	2933	6519	2086	11538	3297	3092	187	55	1364	7995
1999	1398	3987	2114	7499	1679	2761	182	46	479	5147
2000	1898	3556	1890	7344	1956	2562	184	0	378	5080
2001	1186	2959	1958	6103	2030	3952	154	0	465	6601
2002	1967	3709	2044	7720	1647	3612	143	0	70	5472
2003	2612	3736	2098	8446	1631	3979	144	0	0	5754
2004	3044	4638	2152	9834	884	4360	147	0	0	5391

* Includes small amounts of other Pandalid shrimp
† 1970 to 1974 includes subarea IV.
Total 1988 - 1990 includes19, 21 and 51 t. by the Netherlands
Note: 2004 figures are preliminary.

TABLE 4.2. *Pandalus borealis* landings from Div. IIIa (Skagerrak) and IVa (eastern part) as estimated by the Working Group.

Year	Denmark	Norway	Sweden	Total	Estimated discards*)	TAC	Catch
1970	1102	1729	2742	5573			
1971	1190	2486	2906	6582			
1972	1017	2477	2524	6018			
1973	755	2333	2130	5218			
1974	530	1809	2003	4342			
1975	817	2339	2003	5159			
1976	1204	3348	2529	7081			
1977	1120	3004	2019	6143			
1978	1459	2440	1609	5508			
1979	1062	3040	1787	5889			
1980	1678	4562	2159	8399			
1981	2593	5183	2241	10017			
1982	3766	5042	1450	10258			
1983	1567	5361	1136	8064			
1984	1800	4783	1022	7605	*200*		7805
1985	4498	6646	1571	12715	558		13273
1986	4866	6490	1463	12819	414		13233
1987	4488	8343	1322	14153	723		14876
1988	3240	7661	1278	12179	750		12929
1989	3242	6411	1433	11086	1107		12193
1990	2479	6108	1608	10195	1226		11421
1991	3583	6119	1908	11610	497		12107
1992	3725	7136	2154	13015	541	15000	13556
1993	2915	7371	2300	12586	889	15000	13475
1994	2134	6813	2601	11548	214	18000	11761
1995	2460	8095	2882	13437	275	16000	13713
1996	3868	7878	2371	14117	318	15000	14436
1997	3909	8565	2597	15071	1039	15000	16110
1998	3330	9606	2469	15406	348	18800	15753
1999	2072	6739	2445	11256	639	18800	11895
2000	2371	6118	2225	10714	687	13000	11401
2001	1953	6895	2108	10956	701	14500	11657
2002	2466	7321	2301	12088	254	14500	12342
2003	3244	7715	2389	13348	1253		14601
2004	3905	8998	2464	15203	1248		16451

*) see Sect. 4.2.2

TABLE 4.3. National LPUE and total effort as estimated by the Working Group, *Pandalus* Div. IIIa and IVa east.

Year	Denmark LPUE kg/day	Denmark Adjusted LPUE	Total effort days	Norway LPUE kg/hr	Total effort Khrs	Sweden LPUE kg/hr	Total effort Khrs
1984	452	452	3869			25	40
1985	743	743	6053			32	49
1986	556	556	8700	36	179	30	49
1987	499	499	9212	36	230	23	57
1988	432	432	7104	31	251	22	57
1989	441	441	7143	23	273	23	63
1990	591	591	4195	26	232	26	58
1991	645	645	5555	30	206	31	61
1992	641	641	5811	35	204	27	80
1993	571	571	5068	31	243	25	91
1994	677	655	3146	31	218	33	82
1995	801	747	3072	35	255	39	76
1996	860	782	4466	37	214	32	74
1997	1034	907	3770	42	212	33	78
1998	1023	868	3256	44	219	34	73
1999	833	682	2501	32	219	34	72
2000	870	699	2713	31	195	30	75
2001	840	656	2314	32	217	29	74
2002	1069	809	2306	39	186	35	65
2003	1073	793	3013	47	166	33	72
2004	1393	1032	2788	57	159	33	74

TABLE 4.4. Total international LPUE and effort as estimated by the Working Group.

Year	LPUE kg/hr	effort Khrs
1984	No Norwegian data	
1985	No Norwegian data	
1986	32.8	403
1987	31.5	473
1988	28.7	451
1989	25.4	480
1990	30.5	375
1991	31.9	379
1992	33.8	401
1993	30.9	436
1994	32.2	366
1995	34.5	397
1996	37.2	388
1997	42.8	377
1998	42.7	369
1999	33.8	352
2000	33.7	338
2001	33.2	351
2002	39.5	312
2003	45.6	320
2004	53.2	309

TABLE 4.5. Sampling of *Pandalus* in Div. IVaE and IIIa, 2004.

Denmark Quarter	Landing (ton)	N:o samples	Weight (kg)	Numbers Measured-sexed
1	1204	6	7.6	1350
2	1020	5	5.7	1197
3	863	2	2.3	488
4	818	3	3.6	813
Total	3905	16	19.3	3848

Norway Quarter	Landing (ton)	N:o samples	Weight (kg)	Numbers Measured-sexed
1		0		0
2		0		0
3		0		0
4		0		0
Total	0	0	0.0	0

Sweden Quarter	Landing (ton)	N:o samples	Weight (kg)	Numbers Measured-sexed
1	623	6	19	2856
2	698	5	17	3024
3	618	6	20	3409
4	523	4	13	1964
Total	2462	21	69.8	11253

Total Quarter	Landing (ton)	N:o samples	Weight (kg)	Numbers Measured-sexed	Sampling per 1000 ton landed Weight	Numbers
1	1827	12	27.1	4206	14.9	2301.9
2	1718	10	22.5	4221	13.1	2457.6
3	1481	8	22.5	3897	15.2	2630.8
4	1341	7	17.1	2777	12.8	2071.3
Total	6366.666118	37.0	89.2	15101	14.0	2371.9

TABLE 4.6. Catch in numbers at age. *Pandalus* Div. IIIa and IVa east.

Numbers*10**-6											
YEAR		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
	0	17.7	7.4	2.7	14.1	31.3	0.0	3.9	25.5	27.2	0.7
	1	1200.8	1146.4	1260.5	1086.6	2083.6	2250.1	1231.8	1071.4	1889.6	671.9
	2	1305.4	1029.7	1205.6	923.9	385.5	910.8	1035.8	1289.2	803.8	1380.4
	3	187.9	482.7	390.2	300.2	173.8	121.1	326.7	569.1	262.7	143.0
+gp		52.3	25.1	203.2	146.7	13.6	31.3	25.6	57.5	15.5	30.5
TOTALNUM		**2764.1**	**2691.3**	**3062.1**	**2471.5**	**2687.9**	**3313.3**	**2623.8**	**3012.7**	**2998.7**	**2226.4**
TONSLAND		13273	13233	14876	12929	12193	11421	12107	13556	13475	11761
SOPCOF%		89	97	105	102	106	88	97	88	93	0

YEAR		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
AGE											
	0	2.7	61.1	19.7	12.7	4.6	88.1	0.0	3.9	2.4	5.7
	1	646.0	1211.6	2175.6	903.4	1436.1	1270.7	1308.0	922.3	668.7	1062.9
	2	970.5	991.4	1181.9	1597.9	720.1	836.3	826.2	858.4	1466.5	1251.4
	3	851.5	454.6	295.6	468.1	318.3	199.3	382.5	581.8	283.8	477.6
+gp		42.0	69.5	29.8	48.2	43.3	39.2	80.8	101.8	0.0	50.4
TOTALNUM		**2512.5**	**2788.2**	**3702.6**	**3030.2**	**2522.4**	**2433.5**	**2597.5**	**2468.3**	**2421.4**	**2847.9**
TONSLAND		13713	14436	16110	15753	11895	11401	11657	12339	13338	15815
SOPCOF%		87	88	94	96	95	95	90	88	99	104

TABLE 4.7. Mean weight at age in catches. *Pandalus* Div. IIIa and IVa east.

Catch weights at age (kg)										
YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE										
0	0.0009	0.0012	0.0009	0.0009	0.0011	0.0009	0.0015	0.0010	0.0009	0.0009
1	0.0032	0.0032	0.0024	0.0030	0.0034	0.0030	0.0033	0.0035	0.0035	0.0034
2	0.0064	0.0054	0.0048	0.0054	0.0065	0.0053	0.0053	0.0052	0.0067	0.0060
3	0.0104	0.0083	0.0077	0.0090	0.0099	0.0083	0.0079	0.0078	0.0088	0.0093
+gp	0.0134	0.0140	0.0114	0.0117	0.0133	0.0106	0.0122	0.0095	0.0109	0.0117

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
AGE										
0	0.0009	0.0007	0.0009	0.0007	0.0007	0.0007	0.0006	0.0008	0.0014	0.0017
1	0.0033	0.0037	0.0031	0.0033	0.0033	0.0032	0.0031	0.0036	0.0035	0.0037
2	0.0057	0.0067	0.0061	0.0055	0.0063	0.0063	0.0056	0.0054	0.0060	0.0061
3	0.0089	0.0094	0.0094	0.0087	0.0088	0.0103	0.0086	0.0083	0.0082	0.0077
+gp	0.0116	0.0138	0.0119	0.0133	0.0112	0.0139	0.0117	0.0113	0.0121	0.0107

TABLE 4.8. Estimated biomass (tons) of shrimp by area (stratum), assuming catch efficiency = 1.0.

Survey		Stratum																Total area	
Year	Series	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Index	CV
1984	1	0	2441	-	2144	4048	3093	1313	-	336	346	316	[1)]556	605	1253	1305	1535	19291	
1985	1	0	4768	-	1162	3288	2607	2016	0	815	475	[1)]1900	794	840	4921	2664	4066	30316	
1986	1	0	2183	-	920	[1)]933	1940	663	-	389	177	[1)]857	540	618	1521	2073	733	13547	
1987	1	88	3765	-	2482	4103	3294	1237	0	1370	254	[1)]1470	584	419	2168	1350	964	23548	
1988	1	0	1126	-	720	373	1079	682	0	294	96	472	391	282	814	777	343	7449	
1989	1	-	932	-	2347	[1)]898	1722	1159	0	560	263	579	556	498	1375	1443	918	13248	
1990	1	0	705	187	3245	[1)]1067	2373	471	0	647	171	1044	559	564	2088	1895	907	15920	
1991	1	0	1903	1008	2612	189	2851	1053	152	725	189	740	526	716	2163	2683	1312	18821	
1992	1	0	615	717	585	136	5743	2299	0	568	527	2091	951	669	3567	2550	1211	22229	
1993	1	0	1481	401	4063	[1)]1487	1437	688	-	621	281	2596	758	728	2735	3823	1237	22336	
1994	1	0	1391	626	2321	345	2439	1992	-	461	255	1627	468	844	3004	2284	1320	19377	
1995	1	0	2794	-	1420	202	4042	953	-	818	236	1836	513	665	2950	2076	1714	20220	
1996	1	0	4901	-	1367	133	3576	1108	-	533	441	3590	616	921	4277	2456	1286	25205	
1997	1	0	7882	-	1995	416	3393	2406	-	764	349	1969	1530	1487	3199	3584	3169	32143	
1998	1	-	5069	-	3357	586	2223	1049	-	682	401	1105	451	529	3186	2439	1378	22455	
1999	1	0	5180	-	5360	3158	3254	1051	-	235	243	475	266	311	4560	2228	1596	27917	
2000	1	-	3436	-	2664	1121	2181	695	-	343	158	939	380	286	4159	2495	1497	20354	
2001	1	-	5180	0	5360	3158	3254	1051	-	307	245	512	266	311	4560	2228	1596	28028	
2002	1	-	[1)]3922	-	[1)]3104	459	3749	1847	-	1153	364	1403	496	411	5425	4470	3329	30133	
2003	2	-	-	-	1410	750	2770	840	300	1240	430	480	770	960	2210	1950	850	14960	
2004	3	-	3590	-	2830	-	3540	1530	-	690	400	120	1390	1230	11060	4650	2890	33920	34%
2005	3	0	3790	-	5460	0	3160	1900	-	1130	580	1580	570	910	3370	3150	4500	30100	37%

[1)] Estimated as an average of the stratum estimates scaled by overall biomass of the year.

TABLE 4.9. Indices of predators of *Pandalus*.

Species	2004	2005
Blue Whiting ≥30cm	5.4	12.7
Saithe	20.4	68.4
Cod	1.9	3.3
Roundnosed Grenadier	11.0	6.7
Rabbit fish	9.5	4.5
Haddock	0.8	3.3
Redfishes	0.2	0.4
Velvet Belly	1.5	7.5
Skates,Rays	1.9	0.2
Long Rough Dab	0.3	0.6
Hake	1.5	4.1
Angler	2.0	0.6
Witch	1.1	0.2
Dogfish	0.2	0.1
Whiting	0.0	1.0
Blue Ling	0.0	0.0
Ling	0.1	0.6
Fourbearded Rockling	0.0	0.1
Cusk	0.3	0.4
Halibut	0.0	0.6
Pollack	0.0	0.2
Greater Fork-beard	0.0	0.0
Total	58.1	115.38

TABLE 4.10. Shrimp in Skagerrak and Norwegian Deep: risk that the following reference points have been transgressed during 1990-2005: B_{msy} (biomass giving maximum production), B_{lim} (30% B_{msy} (Shelton, 2004), the biomass limit) F_{lim} (=F_{msy}, the limit fishing mortality) and that the catches were above the *MSY*.

Year	$P(B<B_{msy})$	$P(B<B_{lim})$	$P(F>F_{lim})$	$P(C>MSY)$
1990	8.2%	0.2%		1.6%
1991	5.4%	0.1%		2.4%
1992	4.1%	0.1%		2.5%
1993	3.7%	0.1%		1.7%
1994	3.4%	0.1%		2.4%
1995	3.0%	0.1%		3.2%
1996	2.4%	0.1%		4.6%
1997	2.0%	0.1%		4.8%
1998	2.2%	0.1%		2.0%
1999	2.1%	0.1%		1.3%
2000	2.2%	0.1%		1.4%
2001	1.7%	0.1%		1.7%
2002	1.5%	0.1%		2.3%
2003	6.4%	1.0%		2.2%
2004	5.1%	1.2%		2.2%
2005	7.7%	2.2%		1.6%

TABLE 5.1 Landings in tons of *Pandalus borealis* from the Fladen Ground (Div. IVa) as estimated by the Working Group.

Year	Denmark	Norway	Sweden	UK (Scotland)	Total
1972	2204			187	2391
1973	157			163	320
1974	282			434	716
1975	1308			525	1833
1976	1552			1937	3489
1977	425	112		1692	2229
1978	890	81		2027	2998
1979	565	44		268	877
1980	1122	76		377	1575
1981	685	1		347	1033
1982	283			352	635
1983	5729	8		1827	7564
1984	4553	13		25	4591
1985	4188			1341	5529
1986	3416			301	3717
1987	8620			686	9306
1988	1662	2		84	1748
1989	2495	25		547	3067
1990	1681	3	4	365	2053
1991	422	31		53	506
1992	1448			116	1564
1993	1521	38		509	2068
1994	1229	0		35	1264
1995	4659	15		1298	5972
1996	3858	32		1893	5783
1997	3022	9		365	3396
1998	2900	3		1365	4268
1999	1005	9		456	1470
2000	1482			378	1860
2001	1263	18		397	1678
2002	1147	9		70	1226
2003	999	8	1	0	1008
2004	23			0	23

Note: 2004 figures are preliminary.

TABLE 52. *Pandalus borealis*, Fladen Ground. Reported LPUE (shrimp trawlers), and estimated total effort.

Year	Recorded LPUE (ton./day)	Denmark Total effort (Days)	effort Index	LPUE (kg/hour)	UK (Scotland) Total effort (hours)	effort Index
1982	0.96	295	0.10	74	4757	0.31
1983	1.18	4855	1.61	89	20528	1.32
1984	0.97	4694	1.56	37	676	0.04
1985	1.21	3016	**1.00**	86	15593	**1.00**
1986	0.96	3558	1.18	71	4239	0.27
1987	1.24	5908	1.96	81	8469	0.54
1988	0.83	1298	0.43	44	1909	0.12
1989	0.99	2463	0.82	65	8415	0.54
1990	1.28	1313	0.44	106	3493	0.22
1991	1.50	281	0.09	124	429	0.03
1992	1.44	1006	0.33	69	1685	0.11
1993	1.83	831	0.28	90	5656	0.36
1994	1.93	637	0.21	91	386	0.02
1995	2.00	2331	0.77	130	9949	0.64
1996	1.79	2155	0.71	62	30532	1.96
1997	2.86	1078	0.36	202	1807	0.12
1998	2.20	1405	0.47	97	14145	0.91
1999	1.62	606	0.20	107	4263	0.27
2000	1.79	830	0.28	121	3128	0.20
2001	2.20	577	0.19	**)	-	-
2002	1.62	711	0.24	**)	-	-
2003	1.70	598	0.20	**)	-	-
2004	0.92	27	0.01	**)	-	0.01

*) average weighted by total landings

**) No directed shrimp fishery

TABLE 6.1. Nominal shrimp catches (t) by country (Sub-areas I and II combined). Data were provided by ICES and Working Group members.

Year	Norway	Russia	Others	Total
1970	5508	0	0	5508
1971	5116	0	0	5116
1972	6772	0	0	6772
1973	6921	0	0	6921
1974	8008	992	0	9000
1975	8197	0	2	8199
1976	9752	548	0	10300
1977	6780	12774	4854	24408
1978	20484	15859	0	36343
1979	25435	10864	390	36689
1980	35061	11219	0	46280
1981	32713	10897	1011	44621
1982	43451	15552	3835	62838
1983	70798	29105	4903	104806
1984	76636	43180	8246	128062
1985	82123	32104	10262	124489
1986	48569	10216	6538	65323
1987	31353	6690	5324	43367
1988	32021	12320	4348	48689
1989	47064	12252	3432	62748
1990	54182	20295	6687	81164
1991	39663	29434	6156	75253
1992	39657	20944	8021	68622
1993	32663	22397	806	55866
1994	20116	7108	1063	28287
1995	19337	3564	2319	25220
1996	25445	5747	3320	34512
1997	29079	1493	5164	35736
1998	44792	4895	6103	55790
1999	52612	10765	12292[2]	75669
2000	55333	19596	8241[3]	83170
2001	43021	5875	8136[4]	57032
2002	48799	3802	8105[5]	60706
2003	34652	2776	2340[5]	39768
2004[1]	36188	2400	5002[6]	43590

[1] Preliminary data.

[2] Catches reported by Estonia, Faroe Islands, Germany, Greenland, Iceland, Lithuania, Portugal Spain and UK(Eng.Wal.NI).

[3] Catches reported by Estonia, Faroe Islands, Iceland, Lithuania, Portugal, Spain and UK.

[4] Catches reported by Estonia, Faroe Islands, Lithuania, Portugal, Spain and UK.

[5] Catches reported by Estonia, Faroe Islands, Lithuania, Spain and UK.

[6] Catches reported by Estonia, Faroe Islands, Lithuania, Spain and Portugal.

TABLE 62. Catch (t), effort (h) and CPUE (kg/h) data in ICES Sub-areas I, IIa and IIb. Norwegian data based on log books from all vessels and scaled to the level of vessels fishing with single trawl at the size of between 1 000 hp and 1 500 hp. Russian data based on daily reports from vessels smaller than 1 300 hp.

	Norway					Russia		
Year	Catch	Effort	New effort	New CPUE	CPUE	Catch	Effort	CPUE
1980	20386	110931	97521	209	177			
1981	21408	99546	87840	244	195	2341	8100	289
1982	30051	151531	134066	224	210	4966	20400	243
1983	50403	219820	198459	254	264	13223	48000	276
1984	54555	222259	202629	269	230	33403	118900	281
1985	56589	249235	230428	246	204	27974	110900	252
1986	32212	208964	200133	161	139	7912	33500	236
1987	17192	155672	150964	114	101	3818	23900	160
1988	20803	188194	181581	115	118	9010	61600	146
1989	33775	242843	236601	143	131	7928	53500	148
1990	39722	267423	263021	151	160	17126	94500	181
1991	32922	193227	194172	170	152	15532	74100	210
1992	36449	173105	179101	204	187	13025	57000	229
1993	27376	131157	124522	220	178	11390	60000	190
1994	11655	70782	68551	170	136	4521	27500	164
1995	10448	71846	70901	147	145	3347	26100	128
1996	15221	83940	84941	179	169	5680	35300	161
1997	22460	105850	124851	180	154	1507	7600	198
1998	36642	126807	153809	238	256	4900	21212	231
1999	45137	155683	197202	229	257	6238	30900	202
2000	48462	173265	237431	204	238	12204	71784	170
2001	41175	117239	182490	226	256	2484	16609	150
2002	48321	118029	223616	216	265	3745	21773	172
2003	30200	79528	151352	200	270	2775	16390	127
2004	31661	77843	165394	191	296	2400	23301	103

TABLE 6.3. Indices of shrimp biomass from Norwegian surveys in the years 1982-2002 by main areas.

Main Area	A East Finnmark	B Tiddly Bank	C - Thor Iversen Bank	D - Bear Island Trench	E Hopen	F Bear Island	G Storfjord Trench	H Spits-bergen	Total	Sum. A,B,C, E
Strata	38078	6 - 7	10 - 12	5, 8, 9, 13	14 - 18, 24	19 - 22/ 31-40	41 - 50	51 - 70		
1982	35	34	44	53	66	56	17	22	327	179
1983	40	57	61	53	112	52	21	33	429	270
1984	40	51	64	60	141	66	20	29	471	296
1985	23	17	27	18	96	31	17	17	246	163
1986	10	7	13	25	57	34	10	10	166	87
1987	29	13	18	23	31	10	9	13	146	91
1988	26	18	18	36	32	24	13	14	181	94
1989	41	17	13	17	33	53	22	20	216	104
1990	31	13	25	42	58	43	27	23	262	127
1991	22	28	22	54	120	44	21	10	321	192
1992	18	22	33	37	62	38	14	15	239	135
1993	17	19	32	29	85	20	12	19	233	153
1994	19	8	13	15	52	33	9	12	161	92
1995	10	10	11	17	83	33	16	13	193	114
1996	21	8	26	26	110	42	21	22	276	165
1997	24	34	20	34	116	44	12	16	300	194
1998	18	24	41	26	120	72	12	28	341	203
1999	17	19	23	21	169	31	21	16	316	227
2000	14	29	25	26	102	29	10	12	247	170
2001	18	10	30	15	61	25	10	17	184	118
2002	11	18	28	16	86	18	9	10	196	143
2003	15	17	36	12	94	15	8	16	213	162
2004	14	24	22	13	46	14	7	11	151	106
% 03/02	34	-3	30	-22	9	-19	-12	60	9	14
% 04/03	-4	38	-39	6	-51	-3	-8	-33	-29	-35

TABLE 6.4. Indices of shrimp biomass (1 000 tons) from Russian survey in the 1984-2002 and 2005 by main areas. Catchability of 0.182 is used in the estimate.

Main Area	A East Finmark	B Tiddly Bank	C-Thor Iversen Bank	E Hopen	F Bear Island	G Storfiord Trench	H Spits-bergen	I Kola coast	K Goose Bank	Total	Sum. A,B,C,E
Strata	4-Jan	6,7,1s	10-12,25	14-18	38-40, 43-45	48-50	53-55,58-60, 63-65,58-70	2s-6s	7s-8s		
1984	38	137	99	254				133		661	528
1985	14	45	74	255		6	46	19	9	468	388
1986	9	19	44	140		42	127	9	9	399	212
1987	16	17	59	107	45	36	27	25	14	346	199
1988	14	31	39	49		22	29	36	13	233	133
1989	70	128	57	132	6	60	25	105	20	603	387
1990	90	195	119	259	14	110	30	196	15	1028	663
1991	90	153	104	541	9	70	27	155	43	1192	888
1992	80	153	92	409				65	77	876	734
1993	45	91	159	382	9		58	37	111	892	677
1994	4	35	48	255	21			14	27	404	342
1995	5	28	15	80	33	53		16	18	248	128
1996	20	98	127		21			67	108	441	245
1997	26	108	130	341				108	52	765	605
1998	14	106	136	172				108	41	576	427
1999	43	139	107	523				93	61	966	812
2000	29	73	109	328	9	39		72	141	800	539
2001	11	52	105	185	19	14	13	14	55	468	353
2002	30	129	198	353	15	39	51	70	105	980	710
2005	23	103	126	203	31	54	30	29	58	656	455
%02/01	173	148	89	91	-21	179	292	400	91	109	101
%05/02	-23	-20	-36	-42	107	38	-41	-59	-45	-33	-36

TABLE 6.5. Shrimp in the Barents Sea defined as index of numbers in size groups according to carapace length at age and number of egg bearing females contributing to the recruitment (SSN) in the Norwegian Barents sea survey (whole mm).

CL (mm)	<9	9<cl<13	13<cl<17	17<cl<19	>19mm	
Year	1	2	3	4	5+	SSN
1990		8	192	357	567	131
1991		59	213	391	756	123
1992		84	308	291	567	109
1993		44	355	316	405	101
1994		23	186	221	250	30
1995	0,4	20	238	233	307	9
1996	0,2	27	335	374	367	25
1997	0,5	22	372	511	440	47
1998	0,8	9	374	517	567	51
1999	1,3	12	192	357	510	111
2000	2,6	33	147	278	559	66
2001	2,1	20	138	138	410	61
2002	1,1	22	218	295	390	165
2003	0,5	19	254	249	362	110
2004	0,7	5	106	198	295	75

TABLE 6.6. Biomass indices for shrimp from the Norwegian surveys, biomass estimate for cod (age 3 years and older) and the shrimp consumed by the cod in the Barents Sea.

Year	Cod (3+)	Shrimp index	Shrimp consumed
1984	818	471	436
1985	957	246	155
1986	1292	166	142
1987	1120	146	191
1988	913	181	129
1989	891	216	132
1990	963	262	194
1991	1560	321	188
1992	1910	239	373
1993	2355	233	315
1994	2149	161	516
1995	1815	193	362
1996	1700	276	341
1997	1526	300	311
1998	1221	341	326
1999	1097	316	256
2000	1108	247	461
2001	1393	184	284
2002	1593	196	230
2003	1815	212	230
2004	1749	151	250

TABLE 7.1A-G.

Tables 7.1 A-B.

1995 - 2004

A:

Skagerrak, Sub-div. IIIA. **Danish log book records**

	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004	
Species:	Tons	% of total catch	Tons	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting	151.6	4.8	88.5	2.0	97.5	2.3	53.4	1.5	8.1	0.5	1.4	0.1	0.1	0.0	128.4	5.2	0.0	0.0	0.0	0.0
Norway lobster	28.3	0.9	65.5	1.5	38.8	0.9	31.0	0.9	22.1	1.3	18.6	0.8	14.4	1.0	13.9	0.6	31.8	1.0	13.9	0.4
Pandalus	2421.0	76.1	3664.2	82.1	3617.0	84.4	2933.0	83.0	1398.5	81.8	1897.6	83.9	1185.9	84.3	1966.6	79.2	2612.1	83.0	3044.3	84.7
Angler fish	12.3	0.4	28.5	0.6	18.7	0.4	12.5	0.4	8.0	0.5	12.4	0.5	10.0	0.7	13.2	0.5	6.7	0.2	7.3	0.2
Whiting	0.1	0.0	0.9	0.0	0.9	0.0	0.2	0.0	0.4	0.0	0.4	0.0	0.0	0.0	0.3	0.0	1.1	0.0	0.2	0.0
Haddock	10.8	0.3	19.8	0.4	9.3	0.2	17.8	0.5	9.7	0.6	11.3	0.5	13.1	0.9	72.1	2.9	81.0	2.6	36.7	1.0
Hake	3.9	0.1	7.3	0.2	6.2	0.1	2.9	0.1	2.8	0.2	3.8	0.2	7.5	0.5	4.7	0.2	5.0	0.2	4.0	0.1
Ling	0.7	0.0	1.1	0.0	0.4	0.0	0.7	0.0	0.6	0.0	0.5	0.0	0.4	0.0	0.5	0.0	1.0	0.0	1.2	0.0
Saithe	6.0	0.2	82.6	1.9	80.8	1.9	85.6	2.4	41.0	2.4	53.9	2.4	52.6	3.7	129.1	5.2	214.3	6.8	263.2	7.3
Witch flounder	39.8	1.3	32.5	0.7	33.8	0.8	66.6	1.9	56.1	3.3	104.5	4.6	32.6	2.3	37.6	1.5	43.6	1.4	50.1	1.4
Norway pout	144.3	4.5	114.6	2.6	83.9	2.0	29.9	0.8	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cod	159.0	5.0	179.5	4.0	187.8	4.4	188.4	5.3	100.9	5.9	84.7	3.7	51.6	3.7	72.6	2.9	89.1	2.8	113.2	3.1
Other market fish	203.0	6.4	179.2	4.0	111.7	2.6	111.7	3.2	61.4	3.6	71.7	3.2	37.9	2.7	45.2	1.8	62.2	2.0	61.3	1.7
Cod as % of shrimp:		6.6		4.9		5.2		6.4		7.2		4.5		4.4		3.7		3.4		3.7
Total H.C. as % of shrimp:		31.4		21.8		18.5		20.5		22.3		19.1		18.6		26.3		20.5		18.1

B:

Skagerrak, Sub-div. IIIA. **Swedish log book records**

	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004	
Species:	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	16.0	0.8	14.6	0.7
Norway lobster	23.0	0.9	24.0	1.1	19.0	0.8	30.0	1.3	27.0	1.2	23.0	1.1	13.0	0.6	10.0	0.5	10.1	0.5	5.9	0.3
Pandalus	2453.0	93.6	1978.0	89.2	2092.0	89.2	2044.0	86.1	2107.0	89.9	1885.0	88.6	1815.0	89.3	1836.0	85.0	1769.8	85.9	1754.4	80.0
Angler fish	3.0	0.1	2.0	0.1	4.0	0.2	3.0	0.1	3.0	0.1	3.0	0.1	5.0	0.2	4.0	0.2	2.6	0.1	2.6	0.1
Whiting	1.0	0.0	2.0	0.1	3.0	0.1	1.0	0.0	2.0	0.1	3.0	0.1	3.0	0.1	6.0	0.3	3.5	0.2	2.8	0.1
Haddock	17.0	0.6	11.0	0.5	15.0	0.6	40.0	1.7	11.0	0.5	18.0	0.8	29.0	1.4	55.0	2.5	18.4	0.9	13.8	0.6
Hake	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.1	2.0	0.1	2.0	0.1	1.6	0.1	4.8	0.2
Ling	2.0	0.1	3.0	0.1	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	2.0	0.1	1.2	0.1	1.9	0.1
Saithe	3.0	0.1	57.0	2.6	84.0	3.6	91.0	3.8	31.0	1.3	31.0	1.5	26.0	1.3	119.0	5.5	144.5	7.0	270.5	12.3
Witch flounder	16.0	0.6	11.0	0.5	23.0	1.0	38.0	1.6	58.0	2.5	71.0	3.3	46.0	2.3	51.0	2.4	39.8	1.9	51.1	2.3
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cod	69.0	2.6	95.0	4.3	70.0	3.0	89.0	3.8	74.0	3.2	65.0	3.1	51.0	2.5	59.0	2.7	34.5	1.7	44.7	2.0
Other market fish	33.0	1.3	34.0	1.5	35.0	1.5	36.0	1.5	28.0	1.2	25.0	1.2	41.0	2.0	15.0	0.7	17.4	0.9	25.4	1.2
Cod as % of shrimp:		2.8		4.8		3.3		4.4		3.5		3.4		2.8		3.2		1.9		2.5
Total H.C. as % of shrimp:		5.7		10.8		10.9		14.7		10.1		11.8		9.9		16.8		15.5		23.3

Table 7.1. C-D.

C:

Skagerrak, Sub-div. IIIA.					**Swedish log book records**				**Trawls with selective grids**											
	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004	
Species:	Tons	% of total catch	Tons	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting						0.0		0.0		0.0				0.0		0.0	0.0	0.0	0.0	0.0
Norway lobster					0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	1.0	0.6	0.4	0.2	0.9	0.3
Pandalus					1.0	100.0	35.0	100.0	1.0	100.0	0.0		21.0	100.0	177.0	99.4	232.7	98.5	274.3	98.3
Angler fish					0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Whiting						0.0		0.0		0.0				0.0		0.0	0.1	0.0	0.0	0.0
Haddock						0.0		0.0		0.0				0.0		0.0	0.4	0.2	0.2	0.1
Hake						0.0		0.0		0.0				0.0		0.0	0.0	0.0	0.0	0.0
Ling						0.0		0.0		0.0				0.0		0.0	0.0	0.0	0.0	0.0
Saithe					0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	2.0	0.8	2.5	0.9
Witch flounder						0.0		0.0		0.0				0.0		0.0	0.2	0.1	0.3	0.1
Norway pout						0.0		0.0		0.0				0.0		0.0	0.0	0.0	0.0	0.0
Cod						0.0		0.0		0.0				0.0		0.0	0.2	0.1	0.8	0.3
Other market fish						0.0		0.0		0.0				0.0		0.0	0.2	0.1	0.0	0.0
Cod as % of shrimp:								0.0								0.0		0.1		0.3
Total H.C. as % of shrimp:						0.0		0.0		0.0				0.0		0.6		1.5		1.7

D:

Skagerrak, Sub-div. IIIA.						**Norwegian logbook records (* new log book format)**														
	1995		1996		1997		1998		1999		2000		2001		2002*		2003*		2004	
Species:	Tons	% of total catch	Tons	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting							12.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Norway lobster							3.0	0.2	7.0	0.5	9.0	0.8	20.0	1.2	37.0	0.9	28.0	0.7		
Pandalus							1689.0	87.5	1328.0	87.9	1031.0	86.2	1461.0	88.3	3663.0	87.3	3700.0	86.3		
Angler fish							9.0	0.5	11.0	0.7	13.0	1.1	13.0	0.8	32.0	0.8	26.0	0.6		
Whiting							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.3	14.0	0.3		
Haddock							1.0	0.1	4.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Hake							1.0	0.1	1.0	0.1	2.0	0.2	2.0	0.1	6.0	0.1	6.0	0.1		
Ling							4.0	0.2	5.0	0.3	6.0	0.5	4.0	0.2	26.0	0.6	28.0	0.7		
Saithe							15.0	0.8	27.0	1.8	26.0	2.2	34.0	2.1	43.0	1.0	58.0	1.4		
Witch flounder							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.0	0.9	34.0	0.8		
Norway pout							41.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Cod							30.0	1.6	25.0	1.7	24.0	2.0	20.0	1.2	153.0	3.6	184.0	4.3		
Other market fish							126.0	6.5	103.0	6.8	85.0	7.1	101.0	6.1	187.0	4.5	208.0	4.9		
Cod as % of shrimp:								1.8		1.9		2.3		1.4		4.2		5.0		
Total H.C. as % of shrimp:								13.6		13.8		16.0		13.3		14.6		15.8		

Table 7.1. E-F

E:

Norwegian Deeps, Sub-div. IVA East — **Danish log book records**

	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004	
Species:	Tons	% of total catch	Tons	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1	2.4	0.2	7.2	1.1	2.7	0.3	0.6	0.1	0.4	0.0	0.1	0.0
Norway lobster	3.7	6.9	22.4	8.1	15.6	4.2	50.8	9.0	57.0	5.7	23.8	3.8	20.3	2.1	20.8	3.2	9.5	1.2	28.7	2.5
Pandalus	39.5	74.1	203.7	73.4	291.8	78.6	397.2	70.2	673.5	67.4	473.7	75.5	767.2	77.6	500.2	76.3	631.7	81.5	860.4	75.1
Angler fish	1.7	3.3	14.8	5.3	10.4	2.8	27.4	4.8	56.8	5.7	22.6	3.6	27.2	2.8	16.9	2.6	14.6	1.9	42.2	3.7
Whiting	0.0	0.0	0.1	0.0	0.6	0.2	1.0	0.2	0.9	0.1	0.2	0.0	0.8	0.1	0.4	0.1	1.8	0.2	2.2	0.2
Haddock	0.1	0.2	1.9	0.7	1.1	0.3	1.9	0.3	13.8	1.4	2.5	0.4	5.6	0.6	4.5	0.7	7.1	0.9	6.4	0.6
Hake	0.6	1.2	2.4	0.8	3.2	0.9	2.3	0.4	3.0	0.3	8.9	1.4	7.3	0.7	6.9	1.1	2.6	0.3	2.6	0.2
Ling	0.5	1.0	1.1	0.4	2.4	0.6	5.8	1.0	19.4	1.9	6.2	1.0	11.6	1.2	5.9	0.9	4.4	0.6	7.7	0.7
Saithe	0.9	1.7	8.1	2.9	18.1	4.9	28.5	5.0	81.1	8.1	36.8	5.9	81.7	8.3	52.8	8.1	59.6	7.7	137.7	12.0
Witch flounder	0.7	1.2	1.5	0.5	2.0	0.5	7.0	1.2	6.8	0.7	2.4	0.4	7.0	0.7	2.0	0.3	2.8	0.4	5.3	0.5
Norway pout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	4.5	0.5	1.0	0.1	1.7	0.2	0.2	0.0
Cod	2.5	4.7	13.9	5.0	17.8	4.8	28.2	5.0	56.2	5.6	29.2	4.7	34.5	3.5	30.1	4.6	29.1	3.8	42.3	3.7
Other market fish	3.1	5.7	7.9	2.8	8.0	2.2	15.1	2.7	28.8	2.9	13.7	2.2	18.6	1.9	13.3	2.0	9.5	1.2	10.1	0.9
Cod as % of shrimp:		6.4		6.8		6.1		7.1		8.3		6.2		4.5		6.0		4.6		4.9
Total H.C. as % of shrimp:		34.9		36.3		27.1		42.5		48.4		32.5		28.9		31.0		22.6		33.2

F:

Norwegian Deeps, Sub-div. IVA East — **Norwegian logbook records**

	1995		1996		1997		1998		1999		2000		2001		2002*		2003*		2004	
Species:	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch	Total	% of total catch
Blue Whiting							12.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Norway lobster							3.0	0.2	7.0	0.5	9.0	0.8	20.0	1.2	14.0	0.5	15.0	0.3		
Pandalus							1689.0	87.5	1328.0	87.9	1031.0	86.2	1461.0	88.3	3599.0	89.6	3927.0	85.6		
Angler fish							9.0	0.5	11.0	0.7	13.0	1.1	13.0	0.8	158.0	0.9	135.0	2.9		
Whiting							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	11.0	0.2		
Haddock							1.0	0.1	4.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Hake							1.0	0.1	1.0	0.1	2.0	0.2	2.0	0.1	12.0	0.3	13.0	0.3		
Ling							4.0	0.2	5.0	0.3	6.0	0.5	4.0	0.2	44.0	0.3	34.0	0.7		
Saithe							15.0	0.8	27.0	1.8	26.0	2.2	34.0	2.1	137.0	1.3	164.0	3.6		
Witch flounder							0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5.0	0.1		
Norway pout							41.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Cod							30.0	1.6	25.0	1.7	24.0	2.0	20.0	1.2	127.0	0.9	125.0	2.7		
Other market fish							126.0	6.5	103.0	6.8	85.0	7.1	101.0	6.1	127.0	6.4	158.0	3.4		
Cod as % of shrimp:								1.8		1.9		2.3		1.4		3.5		3.2		
Total H.C. as % of shrimp:								13.6		13.8		16.0		13.3		17.7		16.8		

Table 7.1. G.

G:

Fladen Ground, Sub_div. IVA. **Danish log book records**

Species:	1995 Tons	1995 % of total catch	1996 Tons	1996 % of total catch	1997 Total	1997 % of total catch	1998 Total	1998 % of total catch	1999 Total	1999 % of total catch	2000 Total	2000 % of total catch	2001 Total	2001 % of total catch	2002 Total	2002 % of total catch	2003 Total	2003 % of total catch	2004 Total	2004 % of total catch
Blue Whiting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Norway lobster	119.2	2.2	104.2	2.2	44.0	1.3	134.6	3.9	40.2	3.2	42.5	2.5	17.6	1.3	37.8	2.7	21.7	1.9	0.9	3.1
Pandalus	4658.5	85.5	3858.4	82.6	3022.2	89.0	2899.8	84.1	1004.6	80.5	1482.4	86.6	1263.3	92.5	1147.1	81.9	999.1	85.6	**23.3**	**77.0**
Angler fish	145.3	2.7	192.5	4.1	60.1	1.8	57.9	1.7	28.2	2.3	30.5	1.8	19.0	1.4	28.1	2.0	19.8	1.7	1.5	5.0
Whiting	9.3	0.2	6.0	0.1	0.6	0.0	2.1	0.1	0.5	0.0	2.5	0.1	0.2	0.0	2.7	0.2	0.6	0.0	0.0	0.0
Haddock	54.0	1.0	59.3	1.3	16.2	0.5	34.8	1.0	49.7	4.0	33.4	2.0	4.1	0.3	20.0	1.4	28.4	2.4	0.4	1.2
Hake	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Ling	6.2	0.1	3.2	0.1	1.1	0.0	1.0	0.0	0.4	0.0	0.8	0.0	0.1	0.0	0.5	0.0	0.2	0.0	0.0	0.0
Saithe	31.9	0.6	31.9	0.7	9.7	0.3	50.2	1.5	27.4	2.2	21.0	1.2	19.3	1.4	62.2	4.4	42.9	3.7	4.3	14.2
Witch flounder	1.2	0.0	4.1	0.1	0.4	0.0	1.0	0.0	0.2	0.0	0.8	0.0	0.0	0.0	0.1	0.0	1.7	0.1	0.0	0.0
Norway pout	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cod	378.5	6.9	371.9	8.0	223.5	6.6	235.3	6.8	85.6	6.9	84.8	5.0	34.3	2.5	93.9	6.7	47.4	4.1	2.5	8.2
Other market fish	43.1	0.8	41.1	0.9	17.9	0.5	31.2	0.9	10.8	0.9	12.2	0.7	7.2	0.5	8.1	0.6	5.7	0.5	0.5	1.6
Cod as % of shrimp:		8.1		9.6		7.4		8.1		8.5		5.7		2.7		8.2		4.7		10.6
Total H.C. as % of shrimp:		16.1		20.2		11.8		17.8		23.1		14.6		7.5		21.5		16.9		43.1

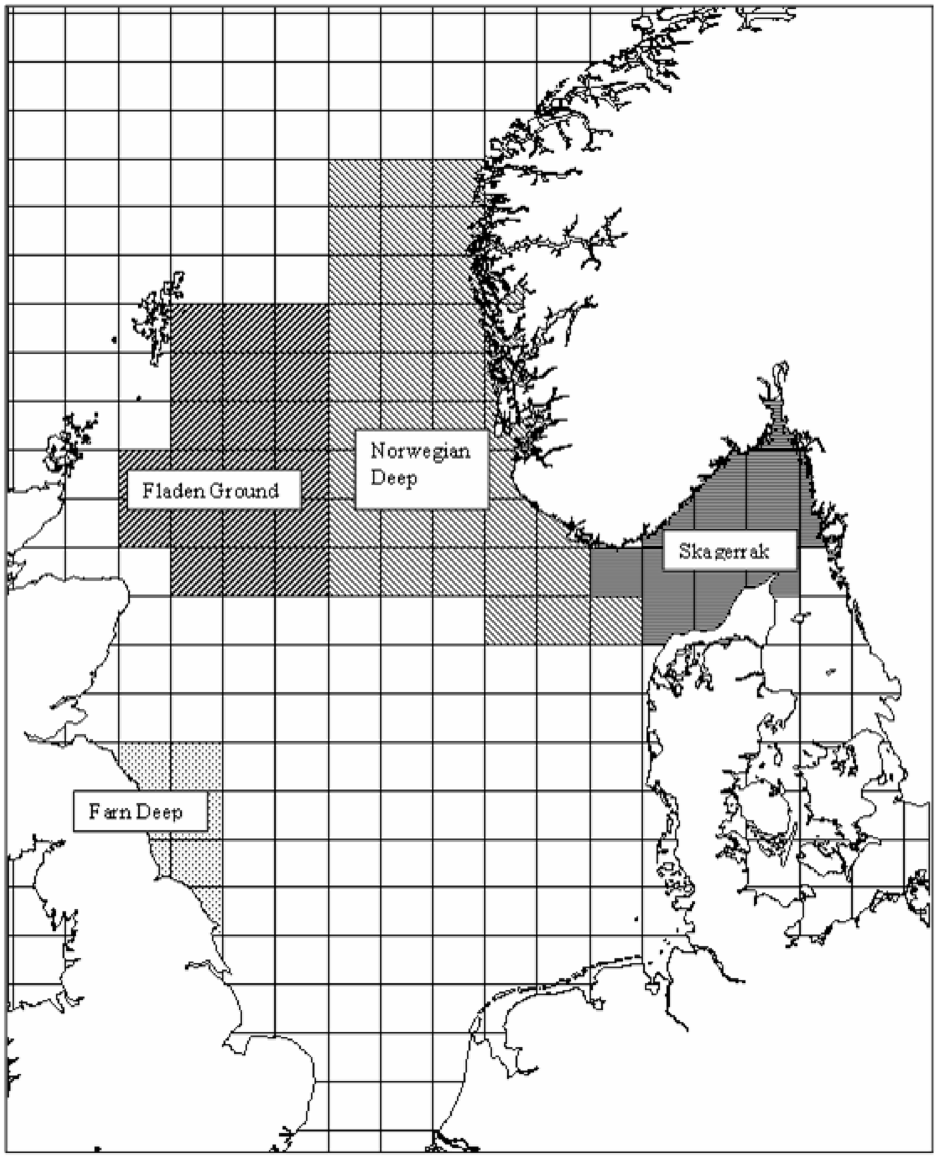

Fig. 3.1. The distribution of the *Pandalus* stocks in the North Sea area as defined by the ICES squares.

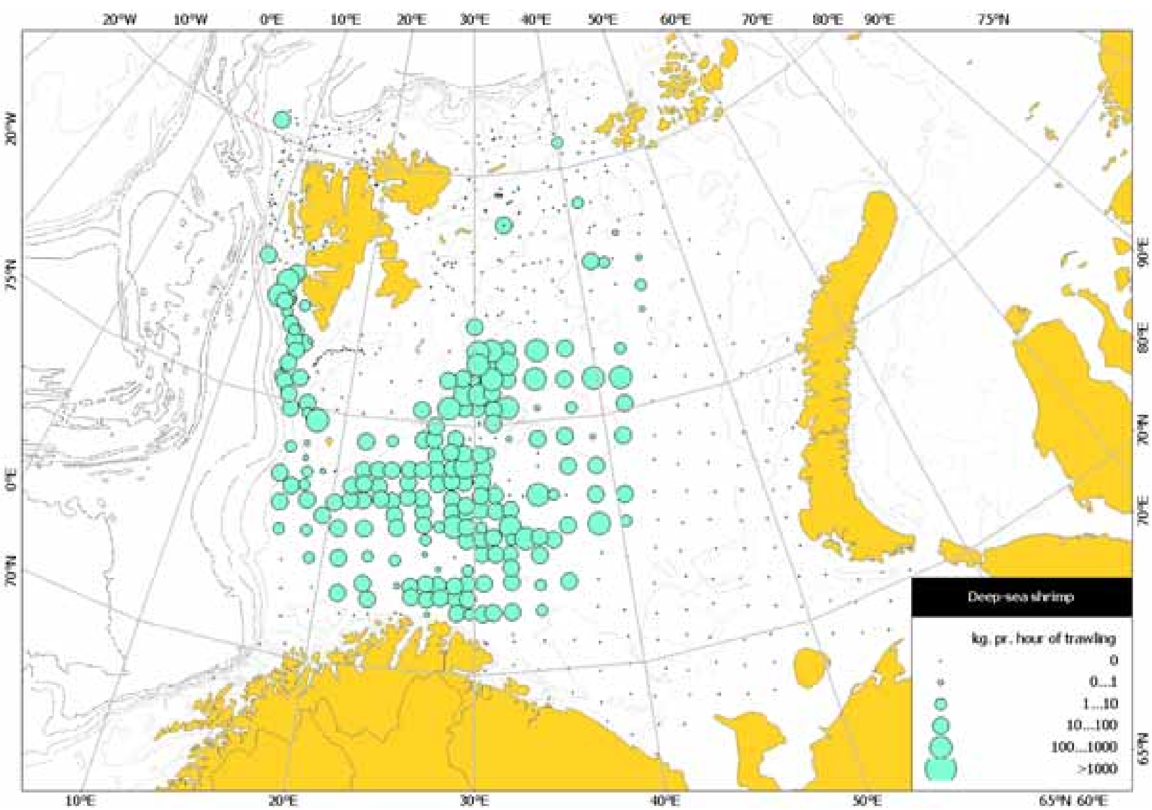

Fig. 3.2. Shrimp distribution in the Barents Sea according to Surveys conducted in the period August-October 2005.

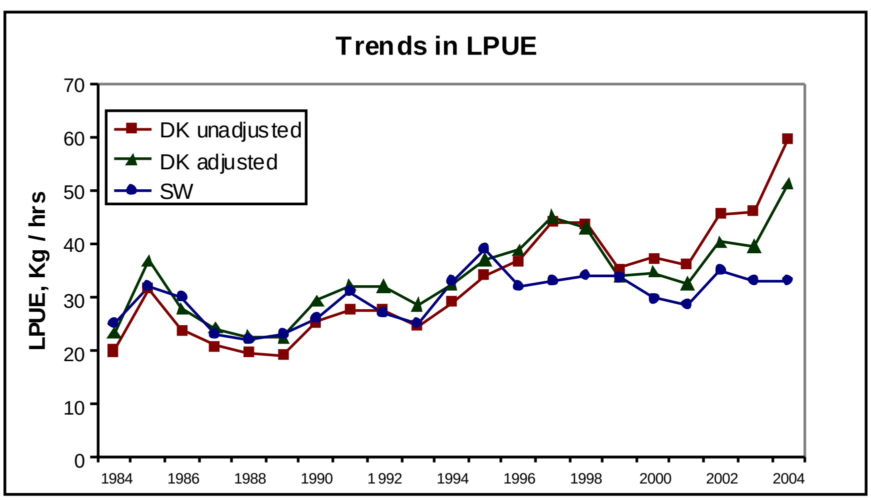

Fig. 4.1 Comparison of Danish LPUE, unadjusted and adjusted, with Swedish LPUE.

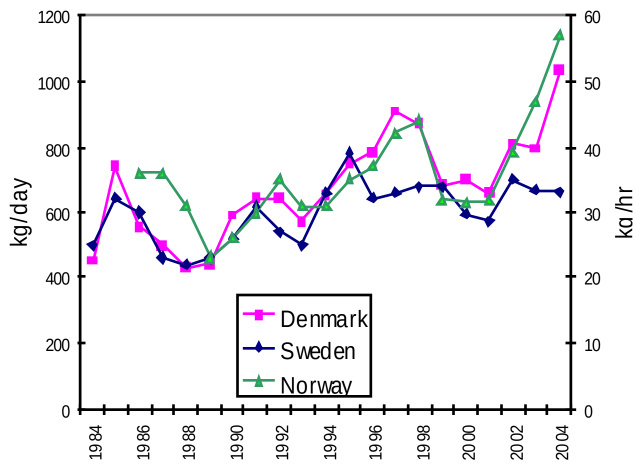

Fig. 4.2. *Pandalus* in Div. IIIa and Iva East trends in LPUE.

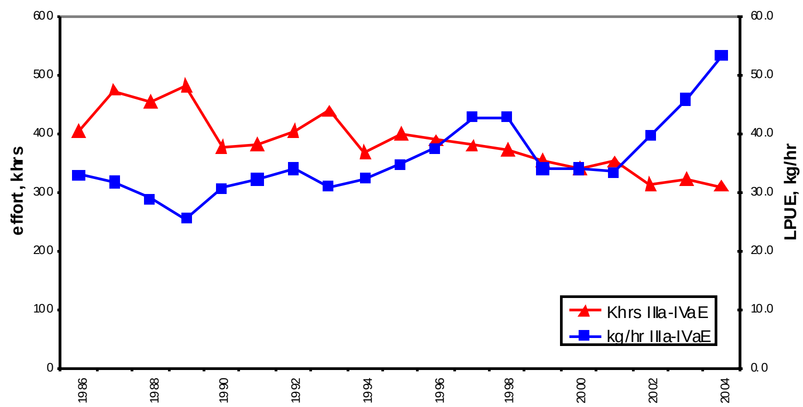

Fig. 4.3. Trends in international LPUE and total international effort, 1986-2004.

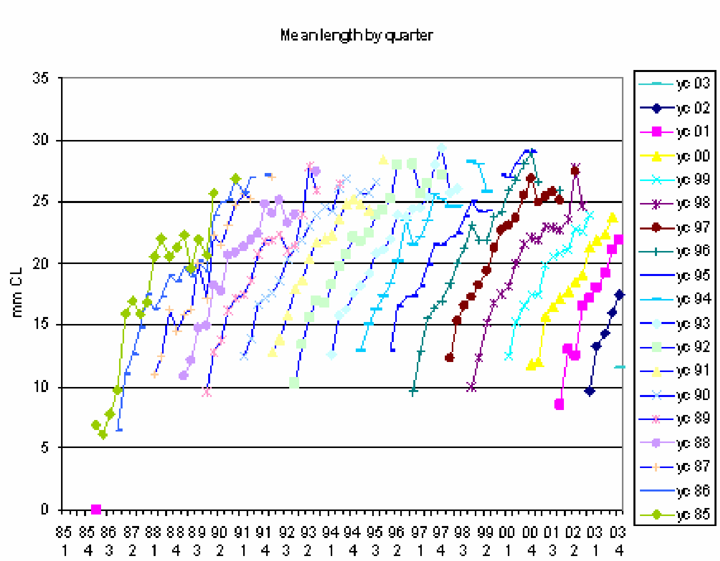

Fig. 4.4. Mean quarterly carapace length (mm) for *Pandalus* in Div. IIIa and Iva East.

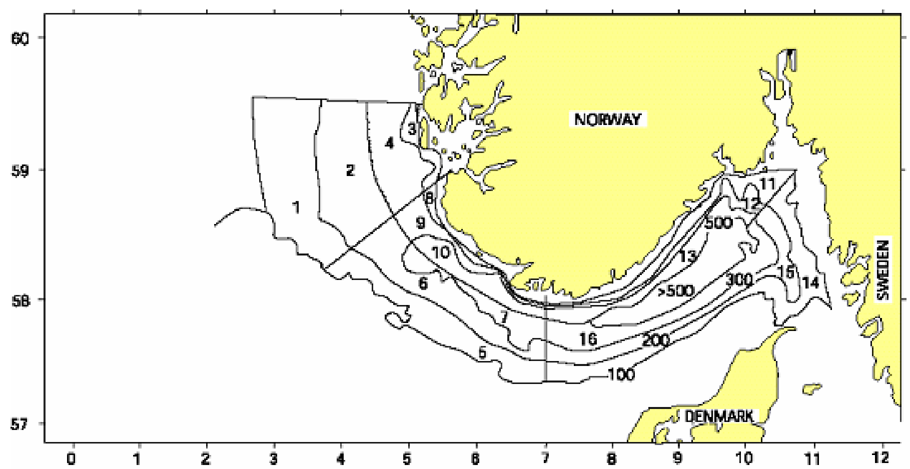

Fig. 4.5. Norwegian Trawl Survey Area. Strata 1-16 and depth contour lines.

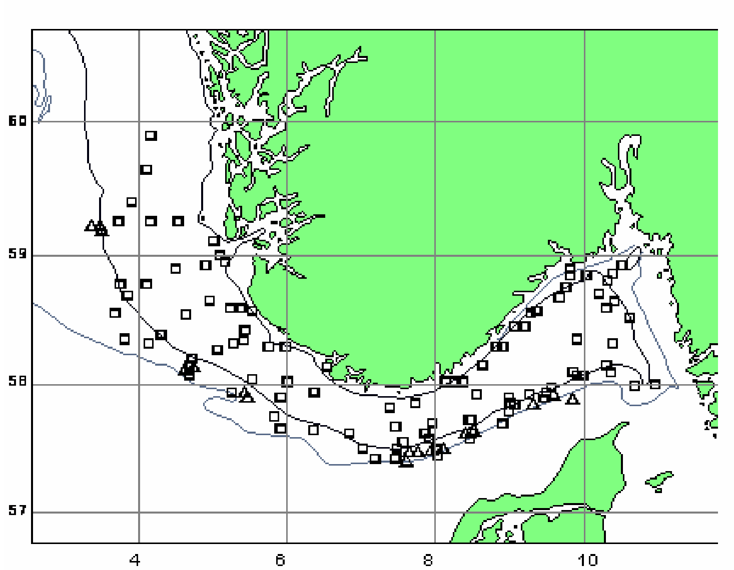

Fig. 4.6. Trawl stations of the Norwegian survey (squares are shrimp stations; triangles are Norway lobster stations).

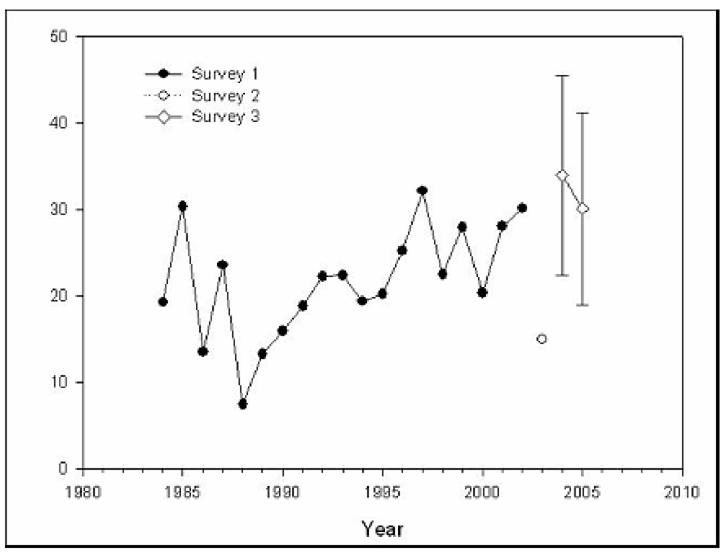

Fig. 4.7. Estimated survey biomass indices (1 000 tons) for *Pandalus* in IIIa and IVa East, see also Table 4.8. The three surveys are not calibrated to a common scale. Standard errors (error bars) were calculated for the 2004 and 2005 surveys

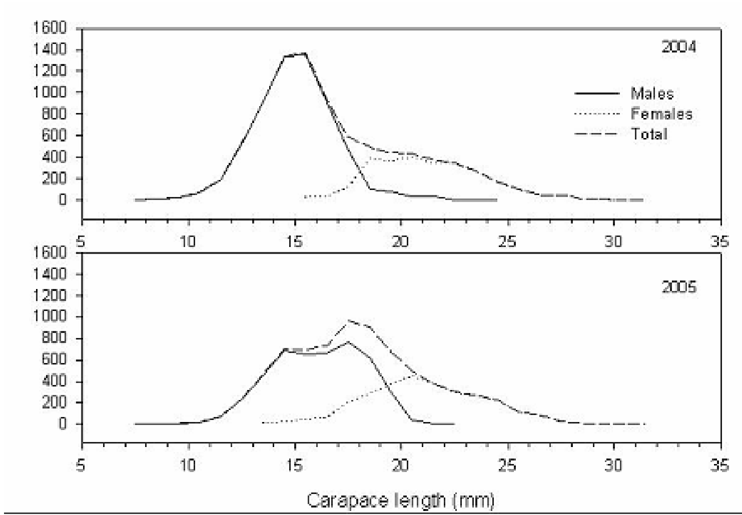

Fig. 4.8. Estimated length frequency distribution of shrimp in Skagerrak and the Norwegian deeps 2004 and 2005.

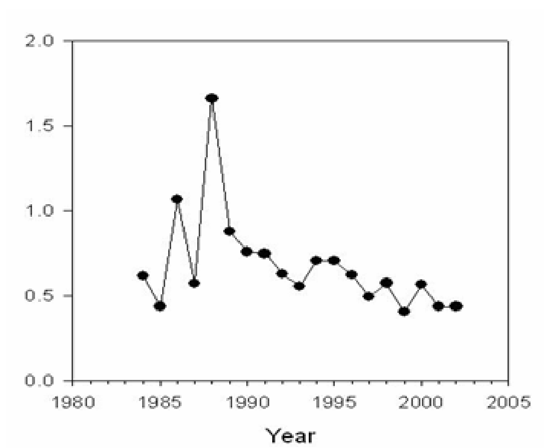

Fig. 4.9. Indices of harvest rate (survey biomasst/0.25*landingt+0.75*landingt+1t indices year).

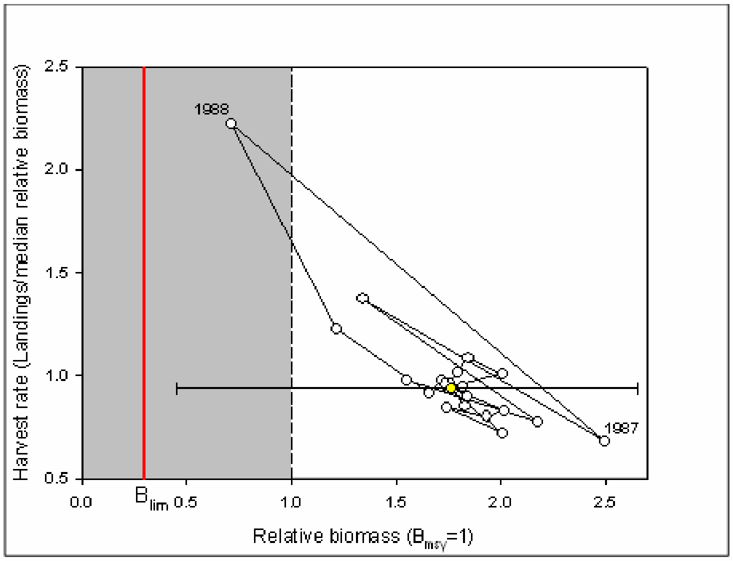

Fig. 4.10. Shrimp in Skagerrak and Norwegian Deep: Stock dynamics 1984 to 2005 in a fishing mortality/biomass continuum. Points are the median values of estimated biomass and harvest rate. Red line is limit reference point. Error bars for the 2005-value (yellow point) are 95% conf. interval.

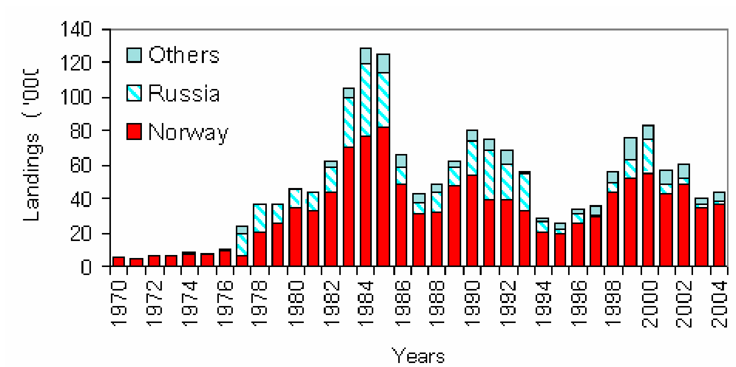

Fig. 6.1. Shrimp landings from ICES Areas I, IIa and IIb by Norway, Russia and other countries in the period 1970-2003.

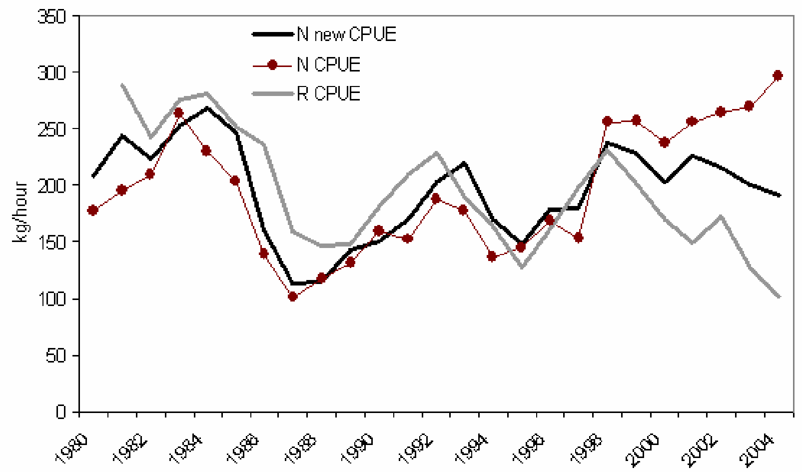

Fig. 6.2. Un-standardized Norwegian CPUE (N-CPUE), standardized CPUE to vessels with 1 000-1 550 hp and single trawl (N-new CPUE) and Russian CPUE (R-CPUE) for ICES Areas I, IIa and IIb.

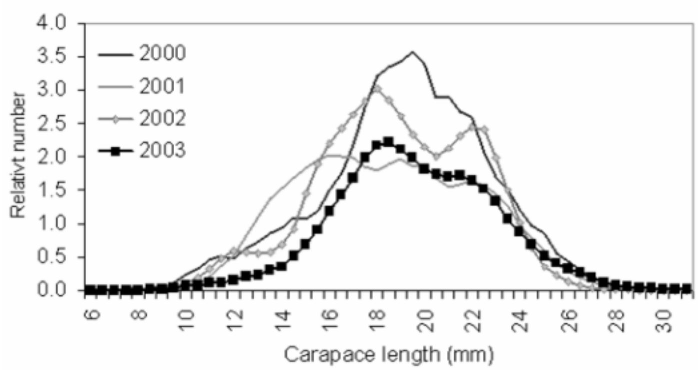

Fig. 6.3. Length distribution in Norwegian shrimp catches in 2000 to 2003.

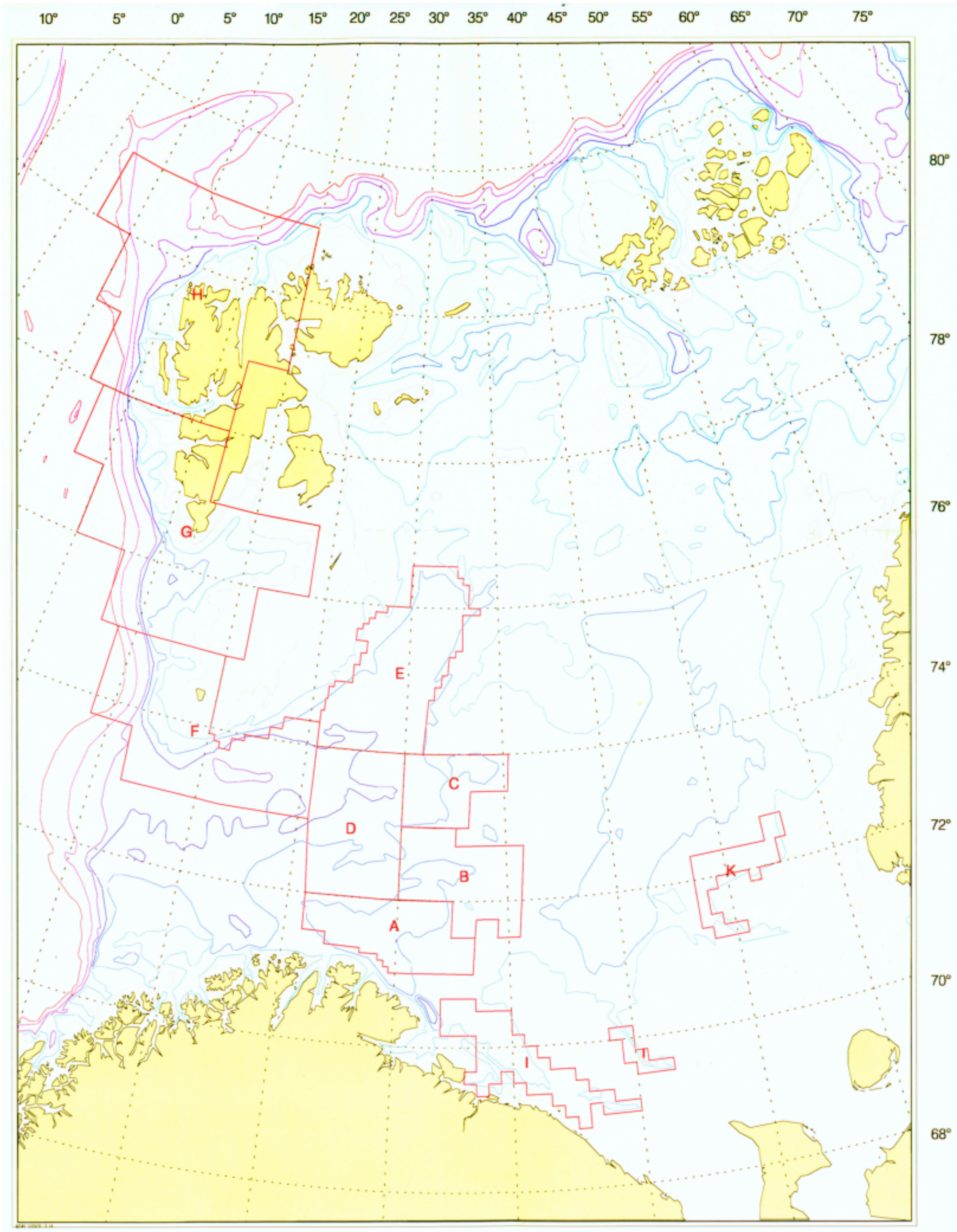

Fig. 6.4. Survey strata are combined to 9 larger areas marked with letters A to K. East Finnmark (**A**), Tiddly Bank (**B**), Thor Iversen Bank (**C**), Hopen (**E**), Bear Island (**F**), Storfjord Trench (**G**), Spitsbergen (**H**), Kola coast (**I**) and the Goose Bank (**K**) (Anon., 2003a).

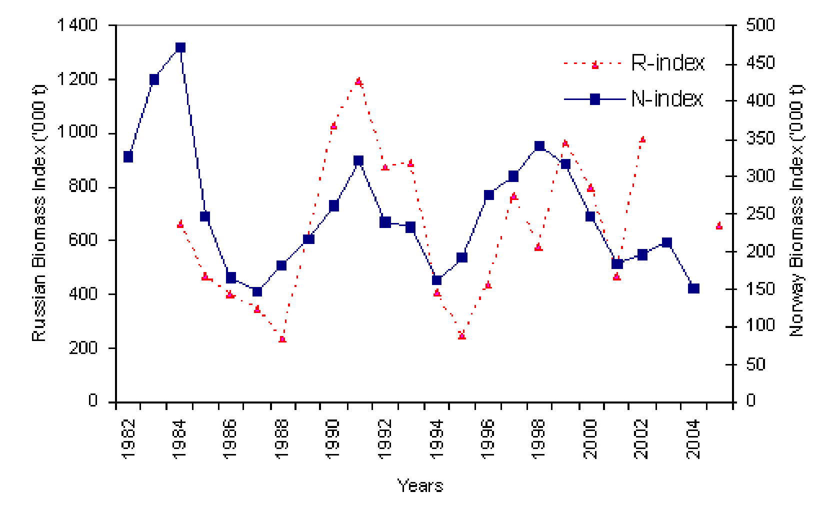

Fig. 6.5. Shrimp biomass indices from Norwegian and Russian surveys in the Barents Sea and Spitsbergen area in 1982-2005.

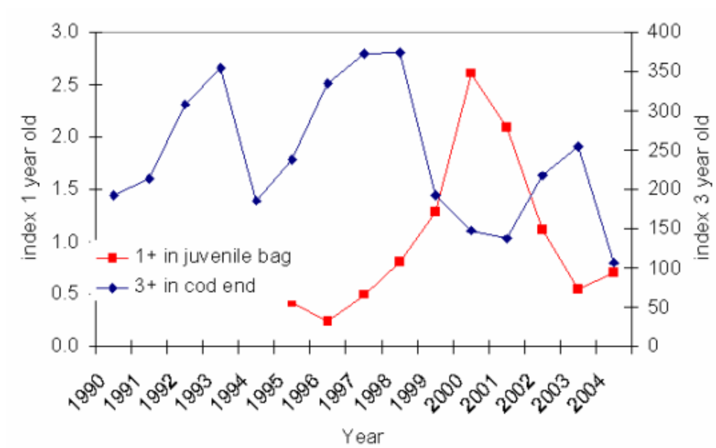

Fig. 6.6. Index for one and three year old shrimp in the Norwegian Survey 2003.

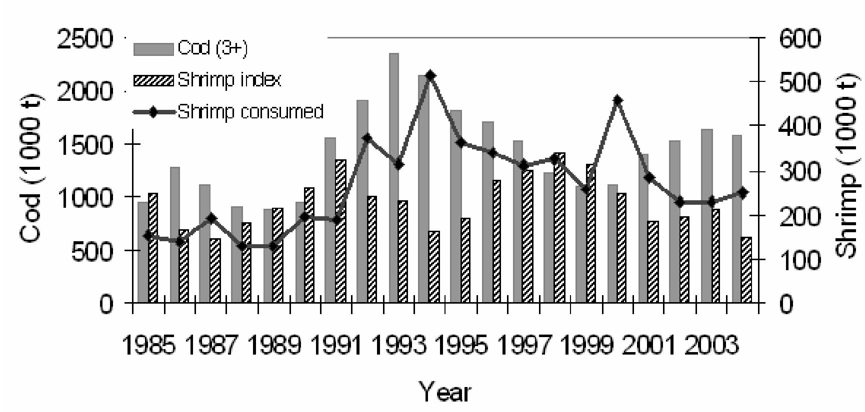

Fig. 6.7. Biomass indices for shrimp from the Norwegian surveys, biomass estimate for cod (age 3 years and older) and the shrimp consumed by the cod in the Barents Sea.

ANNEX 1: Participants

NAME	ADDRESS	PHONE	FAX	EMAIL
Michaela Aschan	Institute of Marine Research, P. O. Box 6404, 9294 Tromsø, Norway	+47 99 26 1458	+47 77 60 9701	michaela.aschan@imr.no
Sergei Bakanov	Knipovich Polar Research Institute of Marine Fisheries & Oceanography (PINRO), 6 Knipovich Street, Murmansk 183763 Russia	+81 52 47 2464	+47 789 10 518	bakanev@pinro.ru
Carsten Hvingel	Institute of Marine Research, Sykehusveien 23, PB 6404, N-9294 Tromsø Norway	+47 77 55 23 8500	+47 77 60 9701	carstenh@imr.no
Sten Munch-Petersen (Chair)	Danish Institute for Fishery Research (DIFRES) Charlottenlund Slot DK-2920 Charlottenlund Denmark	+45 33 96 3390	+45 33 96 3333	smp@dfu.min.dk
Knut Sunnanå	Institute of Marine Research, Sykehusveien 23, PB 6404, N-92494 Tromsø, Norway	+47 77 60 9735	+47 77 60 9701	knut.sunnanaa@imr.no
Guldborg Søvik	Institute of Marine Research, Sykehusveien 23, PB 6404, N-92494 Tromsø, Norway	+47 77 60 9753	+47 77 60 9701	guldborg.soevik@imr.no
Mats Ulmestrand	National Board of Fisheries Institute of Marine Research, P. O. Box 4, SE-45321 Lyseki, Sweden	+46 523 18727	+46 52313977	mats.ulmestrand@fiskeriverket.se

ANNEX 2: Technical Minutes for WGPAND 2005

Methods: The report does not always describe the methods used in sufficient detail to enable an evaluation. This applies especially to the model used to assess the stocks in Iva east and IIIa.

Stock identity issues: Last year the stock Fig. (3.1) included a stock called Farn Deep but there is no information on this year. The WG should comment on why it is not included in the report this year. The WG reports data for genetic analysis being collected. The WG need to set up a process for coordination of this data collection and analysis which also should guide the design of the sampling programme. Is the proper expertise available for this? Other WG's (redfish) have had problems here which required inputs from stock identity experts.

Stock in IVa East and IIIa

The main problem with the assessment is the discontinuity of the Norwegian survey data due to a change in vessel/gear in 2003 and change in timing in 2004. Different methods are used to partition lengths to age groups in diff countries. Are the results comparable?

The WG discusses earlier approaches and provides some rather startling comments that 'an analysis in 2005 showed that the previously used model was inappropriate and that the available data was uninformative with respect to the parameters of this model'. It would have been very appropriate if the WG had explained what the consequences of using this model were for the perception of the stock and the advice given at the time.

A new model is introduced and is described in a working document. The details of the analysis in terms of input data and diagnostics are not presented but the exploration demonstrates that this approach may be worthwhile extending in the future. Presently the model does not provide a basis for forecasts but gives some relative information on the state of the stock relative to *MSY* based reference points. This confirms the impression from the analysis of LPUE trends and gives a good basis for the advice.

The WG should continue the work with this approach in order to develop reference points and an extended basis for the advice in relation to those. When the WG decides that this method should be the main basis for the advice it must be fully documented including data and diagnostics.

Specific Issues

Section 4.1.3: Why is it possible to convert Swedish landings of boiled shrimps but not Norwegian/Danish? Problems with statistics? There seem still to be problems in getting reliable discard data. The conversion of Danish fishing days to Norw/Sweed hours could be better explained.

Section 4.3.1: The report states that sampling could be improved - it would be useful when such comments are made to also discuss how improvements could be made. No length data are available in 2003 and 2004 for the major fishing nation. The estimation of the SSB seems to be problematic and it is difficult to evaluate the method used but it seems sensible to standardise this for all stocks in the NA.

Section 4.4.2.3: Shrimp predator biomass doubled from 2004 to 2005 - there is a need to discuss the implications of this in relation to management implications

Stock on Fladen Ground and Farn Deep

No comments

Barents Sea Stock

The WG investigates possible approaches given the poor recent data and concludes that predictions cannot be given because survey time series have been discontinued. The assessment is then based on various CPUE trends.

Specific comments:

Section 6.1: This sentence is not easy to understand: *However, the regulation by smallest allowable shrimp size is not considered to be an efficient management tool in the Russian Economic Zone (REZ) due to the high predation of shrimp.*

Section 6.2.3: Discards: In the REZ a TAC regulation is in place. Does the GLM used for standardization of CPUE take into account double/triple gears? There does not seem to be an overview of actual sampling intensity in the report.

Annex 3: WGPAND Report 2005: WG Paper

SERIAL NO. N5189 **NAFO SCR DOC. 05/84**

SCIENTIFIC COUNCIL MEETING - OCTOBER/NOVEMBER 2005

Deriving Quantitative Biological Advice for the Shrimp Fishery in Skagerrak and Norwegian Deep (ICES Divisions IVa east and IIIa)

by

C. Hvingel

Institute of Marine Research
Box 6404, N-9294 Tromsø, Norway

Abstract

A previously used method for assessing the shrimp resource in Skagerrak and Norwegian Deep was investigated. The biomass dynamic model used to describe stock variability lack feedback mechanisms and may in some instances be unstable. Available data series of stock size, recruitment, predation and catch used for fitting the model were found not to be informative.

A model based on these data cannot estimate management parameters such as Maximum Sustainable Yield and fishing mortality and thus its predictive capability is low.

The data did, however, indicate a long period of stable stock size in a stable environment of catch and predation. This information is used to estimate the relative location of the stock on a logistic stock-production curve. The risk that the stock had been overexploited (catches above *MSY* and stock below the optimal biomass level, B_{MSY}) or below the stock biomass limit reference point, B_{lim}, was by use of Bayesian inference quantified to be low, less than 9% for the period 1990-2005.

The stock may likely sustain larger catches than the current level of around 13 000 tons given that the environmental settings remain stable. However, increases in the exploitation level should be carefully planned and designed to provide more information to help estimate the productive capability of the stock. Management should be ready to respond to new information e.g. by reducing catches. This approach could be founded in a multi-annual adaptive management plan.

Introduction

The stock has previously been assessed by Virtual Population Analysis (VPA) (Megrey, 1989) by applying standard ICES software packets to the age distributions of the catches. Ageing was done by modal analyses of their estimated length distributions. Commercial catch rates or abundance indices from the Norwegian survey (Hvingel, 2005a) was used for tuning. However, this method performed poorly and was therefore replaced by a biomass dynamic model in 2001 (Anon., 2004a).

This model relied on data from the survey. The survey series was, however, discontinued after 2002 (Hvingel, 2005a) and the model was therefore not updated in 2003 and 2004 and stock projections were not made. Furthermore, the assessment working group did not seem satisfied with the model (Anon., 2004): "the Working Group has taken notice of the problems and criticism of the simple SPP model used" and provides in the report a 4-bulletpiont list of disadvantages. However, the criticism is imprecise and leaves some confusion in where exactly the shoe pinches.

The purpose of this paper is to investigate the suitability of the biomass dynamic model hitherto used in this assessment and to derive quantitative statements of stock status in the context of the Precautionary Approach.

Investigating the Assessment Model Currently Used

The model currently used is a process equation describing the hypotheses of how the stock varies, and a data link function giving the hypotheses of how the data relate to the process equation:

$$\text{Process:} \quad B_{t+1} = \alpha B_t - C_t + \beta R_t - \delta D_t \qquad \text{(eq. 1)}$$
$$\text{Data link:} \quad U_t = qB_t + \varepsilon_t$$

where the subscript t indexes year, B is shrimp biomass, C is catch, R is observed recruitment, D is observed biomass of predators, and U is an observed index of shrimp biomass from the Norwegian survey (Hvingel, 2005a). α, β, δ and q are model parameters to be estimated along with initial biomass B_0, and ϵ_t, an error term Normally, independently and identically distributed with mean 0 and variance σ_ε^2. A similar model has been used for assessing shrimp in offshore Icelandic waters (Stefánsson *et al*., 1994)

Model behaviour and its predictive properties may not be optimal for the assessment for several reasons. In the model predation rate, δ, is independent of prey biomass, while stock biomass, B, has no limits. With no feedback based on biomass, the model risks being unstable: for example, if the biomass went below some critical threshold, unremitting predation could quickly drive it to extinction, or if it went above a critical upper limit, predation and catch could become insignificant and the stock run off to infinity. Stochastic behaviour is not included, but if it was, it would likely make the model even more unstable (Hvingel, 2005b).

However, a bigger problem for the assessment might be the level of information regarding stock dynamics contained in the data series. The variability of the two explicit components of mortality, catch and predation, have been low in the time series (Fig. 1A and 1C) - and without trend. The CVs (standard error/mean) of the annual values are 10% for the catches and 20% for the index of predator biomass, which is at or even lower than the within-year variation typically estimated for such data.

The recruitment series (Fig. 1D) supposedly being a main determinant of future stock size do have periods with trend as do the survey biomass indices (Fig. 1B), and some correlation between these two variables is noticeable. Part of this is likely a year-effect of the survey, but neither this correlation (Fig. 2A) nor the one between recruitment and the stock in the following year (Fig. 2.B) is significant ($P > 0.17$). However, a correlation between the recruitment and survey biomass two years later (Fig. 2C) was ($P < 0.01$).

As expected the catches could not be found to correlate with either the biomass of recruits or the 2+ group (Fig. 3A and 3B). The Biomass of predators did not correlate with recruitment (Fig. 4A and 4B), but showed a positive correlation with the biomass of the 2+ group in the same year ($P < 0.05$) (Fig. 4C). Again some year effect of the survey might be to blame. With a one year lag (Fig.4D) the correlation is still positive but not significant ($P = 0.12$).

Finally the variables were analysed together using a General Linear Model (GLM) of the form:

$$B_t = u + B_{t-1} + C_{t-1} + R_{t-1} + D_{t-1} + e \qquad \text{(eq. 2)}$$

where B is the index of biomass of age group 2+, u is the intercept, C is the landings (C_{t-1} is 0.25*landings in year t-1 + 0.75*landings in year t because the survey is conducted in the autumn), R is recruitment (biomass index of age 0 and 1), D is the index of predator biomass taken as a sum of the estimated survey biomass of 20 different fish species, e is an error term and t indexes year. Input data series were based on Anon., 2004. Neither the individual main effects or their interactions nor the model were significant:

The GLM Procedure. Dependent variable: B_t

Source	DF	SS	MS	F Value	Pr > F
Model	4	0.61293030	0.15323257	1.17	0.3698
Error	13	1.70678162	0.13129089		
Corrected Total	17	2.31971192			

Source	DF	Type III SS	Mean Square	F Value	Pr > F
B_{t-1}	1	0.00066142	0.00066142	0.01	0.9445
C_{t-1}	1	0.18905529	0.18905529	1.44	0.2516
D_{t-1}	1	0.10855779	0.10855779	0.83	0.3797
R_{t-1}	1	0.03947770	0.03947770	0.30	0.5927

Parameter	Estimate	SE	t Value	Pr > |t|
Intercept	-.7528493398	0.91479585	-0.82	0.4254
B_{t-1}	0.0226627544	0.31929325	0.07	0.9445
C_{t-1}	0.0000828340	0.00006903	1.20	0.2516
D_{t-1}	0.5387551394	0.59248620	0.91	0.3797
R_{t-1}	0.1286604984	0.23463166	0.55	0.5927

In conclusion: the hypothesis of how the stock varies as represented by the assessment model (eq. 1) lacks biological realism and might in some instances be unstable. The perturbation history of the stock is badly suited for extracting information on how the fishery and predation affect the stock. Neither of the explanatory variables used in the model correlate with the stock biomass in the following year. Thus the model cannot be used to make predictions.

For extracting information on exploitation level (fishing mortality) the model relies on the ability to estimate absolute biomass. As there is no information on absolute consumption by predators the stock size can be scaled only by the catch series. As this series has low variability and no correlation with stock size absolute stock biomass cannot be estimated.

An alternative model

The stock has since the mid 1980s experienced a relatively stable environment of predation and exploitation (Fig. 1A and 1C) and have itself remained relatively stable (Fig. 1B). This indicates that the stock can sustain the current level of exploitation. With such information in the data it is with a few assumptions still possible to quantify the risks of the stock being overexploited (catches above *MSY* and stock below B_{MSY} (biomass that gives *MSY*)) or outside safe limits (=below B_{lim}, a limit reference point for stock biomass).

Assume that the production curve of the stock is dome shaped, e.g. population growth follows a logistic curve and the biomass series therefore can be described by:

$$\text{Process:} \quad B_{t+1} = B_t + rB_t(1 - \frac{B_t}{K}) - C_t \qquad \text{(eq. 3)}$$

$$\text{Data links:} \quad U_t = qB_t$$

where r is intrinsic rate of growth (per year), K is carrying capacity; otherwise notation as before. The logistic model deviates from model used previously (eq. 1) in also including a function of density-dependent population growth - and thus adds some biological realism and stability to the model. Predation, although an important source of mortality for shrimp (Hvingel, 2005b and references therein), was not included as an explicit variable because the predation indices do not vary much (see previous section).

As the uncertainty of absolute stock size is huge biomass is dealt with on a relative scale to cancel out the uncertainty in q (Hvingel and Kingsley, 2005). Relative biomass $P_t = B_t / B_{MSY}$, this implies that $K = 2$ and $P_{MSY} = 1$. Observation and process error was implemented simultaneously using a state space framework:

$$\text{Process:} \quad P_{t+1} = \left(P_t - \frac{C_t}{B_{MSY}} + rP_t\left(1 - \frac{P_t}{2}\right)\right) \cdot \exp(\nu_t) \qquad \text{(eq. 4)}$$

$$\text{Data links:} \quad U_t = qB_t \exp(\beta_t)$$

The 'process errors', v, and observation errors, β, are normally, independently and identically distributed with mean 0 and variance σ_v^2 and σ_β^2. Bayesian inference was used to estimate probability distributions of model parameters following the approach of Hvingel and Kingsley (2005). Similar models have been applied to the shrimp fisheries off West Greenland (Hvingel and Kingsley, 2005; Hvingel, 2004; Anon., 2004b).

Low-information or reference priors were given to *MSY*, q, K, P_1 and σ_v as there was little or no information on what their probability distributions might look like. *MSY* was given a generously wide uniform prior between 0 and 150 000 tons. The catchability q were given a distribution uniform on a log scale as a reference prior (Hvingel and Kingsley, 2005). A similar distribution was used for K between 1 and 665 000 tons (The upper limit corresponds to about 11g or about 5-10 shrimp per m^2 over the survey area of 57 300 km^2 which by shrimp experts is considered to be high). The prior for the stock size in the first year, P_1, was uniform 0 to 2. The prior distributions for the error terms associated with the biomass indices were assigned inverse gamma distributions (the gamma distribution, G(r,μ), is defined by: $\mu^r x^{r-1} e^{-\mu x}/\Gamma(r); x>0$). Estimates of the variance of survey biomass estimates 1984-2002 was not available. CVs of the 2004-2005 survey values were 30% (Hvingel, 2005a) but are probably over-estimated due to the fixed station design. Observation error was therefore given an inverse gamma distribution with a mode at 0.2, comparable to the CVs found in the Greenlandic shrimp survey (Wieland *et al*., 2004).

Results

As expected absolute scale of stock biomass and production (Fig. 5) could not be determined with any precision. However, the model is quite certain that the stock has been larger than B_{msy} (P = 1) and indeed above the limit reference of P = 0.3 (The limit reference point for stock size, B_{lim}, for a logistic production curve is 30% B_{msy} (Shelton, 2004)) (Fig. 6). The uncertainty of the relative stock size are big for all years but increases after 2002 as these values are model predictions due to missing survey data (Fig. 6).

The risk of the stock being below B_{msy} is between 1.5 and 8.2% and and even smaller, 0.1-2.2% for being below B_{lim} for the period 1990-2005. The risk of the fishing mortality being above F_{lim} was not estimated due to the inability to estimate the full distribution of *MSY*, however, an index of harvest rate (landings/estimated median biomass) (Fig. 7) has shown a declining trend since the late 1980s. The risk table is as follows:

Year	p(B<Bmsy)	p(B<Blim)	p(F>Flim)	p(C>MSY)
1990	8.2%	0.2%		1.6%
1991	5.4%	0.1%	Declining trend (1991–2003) ↓	2.4%
1992	4.1%	0.1%		2.5%
1993	3.7%	0.1%		1.7%
1994	3.4%	0.1%		2.4%
1995	3.0%	0.1%		3.2%
1996	2.4%	0.1%		4.6%
1997	2.0%	0.1%		4.8%
1998	2.2%	0.1%		2.0%
1999	2.1%	0.1%		1.3%
2000	2.2%	0.1%		1.4%
2001	1.7%	0.1%		1.7%
2002	1.5%	0.1%		2.3%
2003	6.4%	1.0%		2.2%
2004	5.1%	1.2%		2.2%
2005	7.7%	2.2%		1.6%

Estimated series of median stock size relative to the reference points are shown in Fig. 9.

As the productive potential of the stock remains unknown an evaluation of different future catch options could not be made.

Discussion

The choice of upper limits of the priors for *K* and *MSY* has a small influence on the calculated risk values. If they are increased the risk values tend to increase slightly, and decline if they are reduced. However, the truncation was chosen so that higher values would be unlikely and the calculated risks may in this respect therefore be considered to be conservative.

Berenboim *et al.* (1980) estimated a catchability of 0.173 by calibrating trawl catches to the results of a photo survey. If this is chosen as basis for an informative prior by giving *q* a lognormal distribution with a median of 0.173 and a variance of 0.3 (Fig. 8) the estimated posterior distribution of *K* would be tighter; however *MSY* can still not be determined as the data have not "explored" that region of the production curved yet. With this prior the risks calculated in the first model run (see text table above) remain largely unchanged.

The stock may likely sustain larger catches than the current level of around 13 000 tons given that the environmental settings remain stable. However, increases in the exploitation level should be carefully planned and designed to provide more information on stock dynamics and to help estimate the productive capability of the stock. It should be kept in mind that an increased exploitation could affect catch rates negatively and might also lead to lower mean size of shrimp in the catch. Management should be ready to respond to new information e.g. by reducing catches. This approach could be founded in a multi-annual adaptive management plan.

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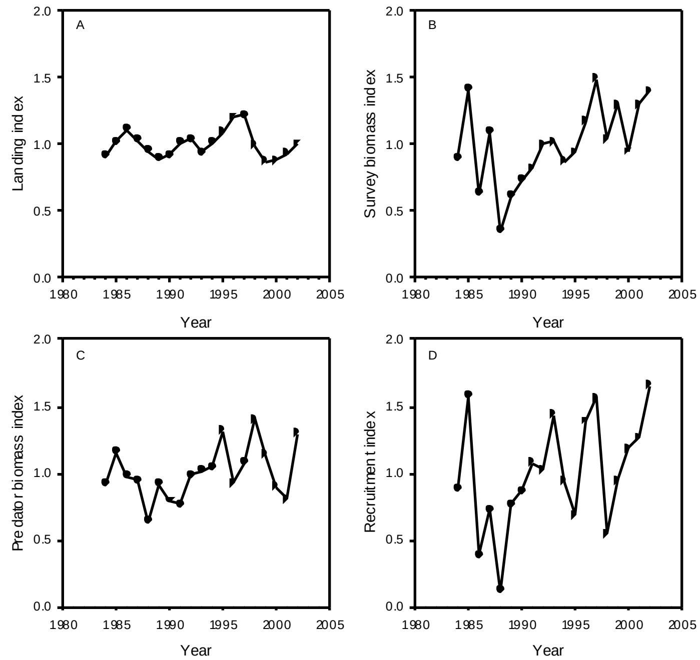

Fig. 1. Time series of landings (**A**), biomass index of age 2+ (**B**), biomass index of predators (**C**) and recruitment biomass index (age 0 and 1) (**D**) available for the biomass dynamic model used in the assessment of the shrimp stock in Skagerrak and Norwegian Deep. All scaled to their mean (mean=1).

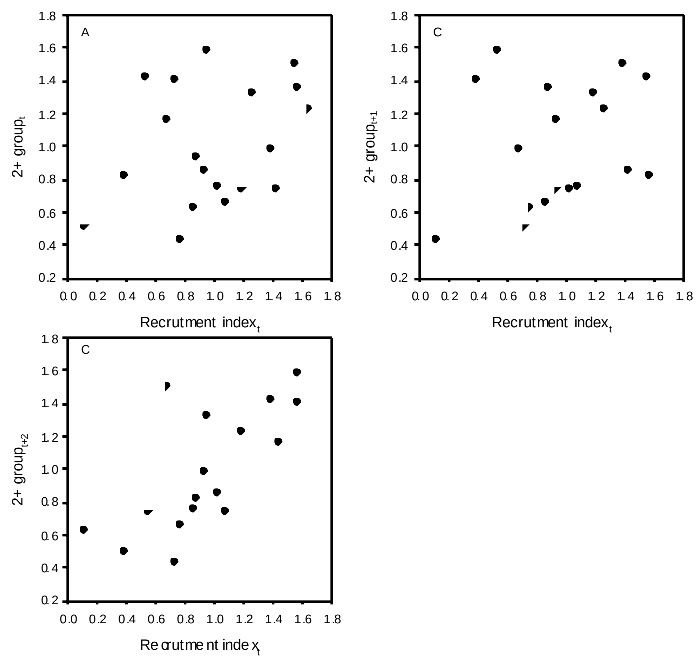

Fig. 2. Index of recruitment (biomass of age 0 and 1 from the survey) *vs.* the 2+ group survey index 0, 1 and 2 years later. The variables were scaled to their means (mean =1).

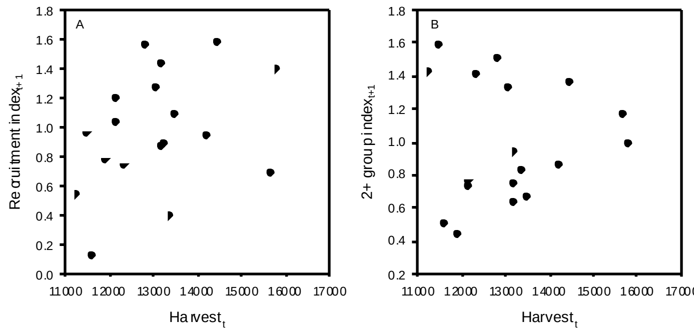

Fig. 3. Harvest (0.25*landing in year t+0.75*landings in t+1) *vs.* survey biomass of recruits (age 0 and 1s) and 2+ group scaled to their means (mean = 1).

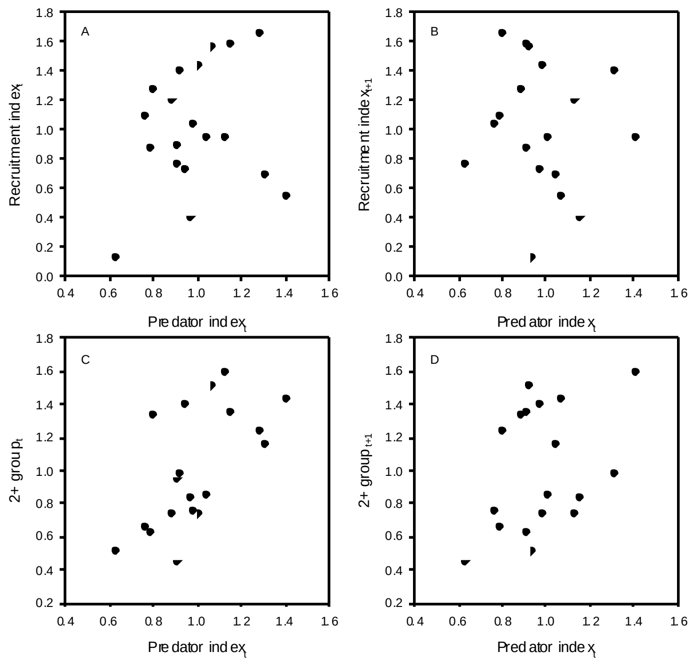

Fig. 4. Predator biomass indices from the Norwegian survey (mean = 1) *vs.* the survey recruitment and 2+ group indices in the same and following year (mean = 1).

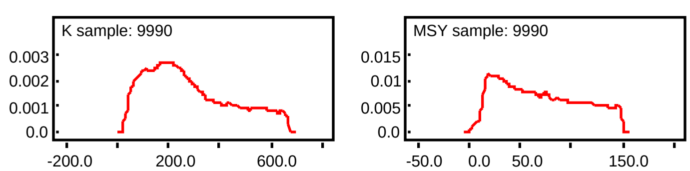

Fig. 5. Posterior probability density distributions of the carrying capacity, *K*, and maximum sustainable yield, *MSY*, derived by Monte-Carlo-Markov-Chain (MCMC) sampling methods using the model (eq. 4). The scale of the X-axis is Ktons.

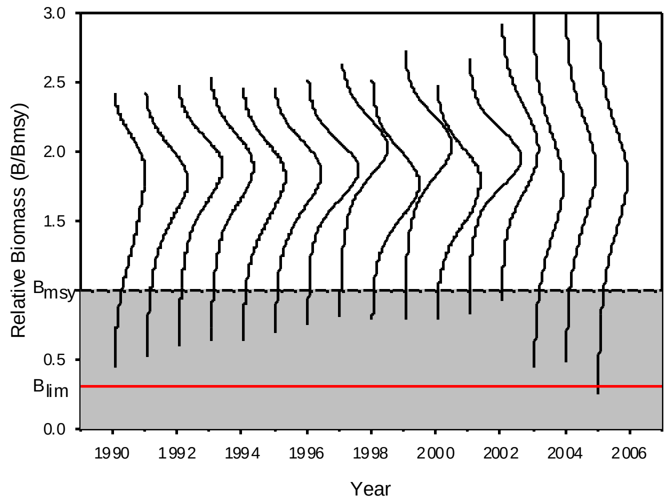

Fig. 6. Posterior probability density distributions of stock biomass (relative to B_{msy}) 1990-2006 derived by applying Bayesian inference and MCMC sampling techniques to a logistic model of shrimp stock dynamics. The 2003-2006 values are predicted due to the lack of standardized survey data after 2002. Red line is a limit reference point.

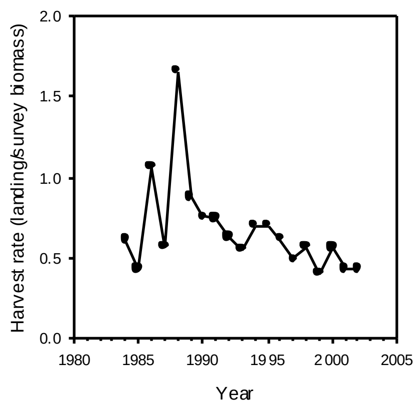

Fig. 7. An index of harvest rate (survey biomass$_t$/0.25*landing$_t$+0.75*landing$_{t+1}$ t indexes year).

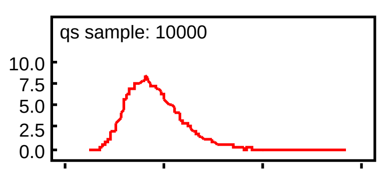

Fig. 8. Alternative informative prior for the catchability, *q* (scaling survey biomass to real biomass), based on Berenboim *et al.* (1980).

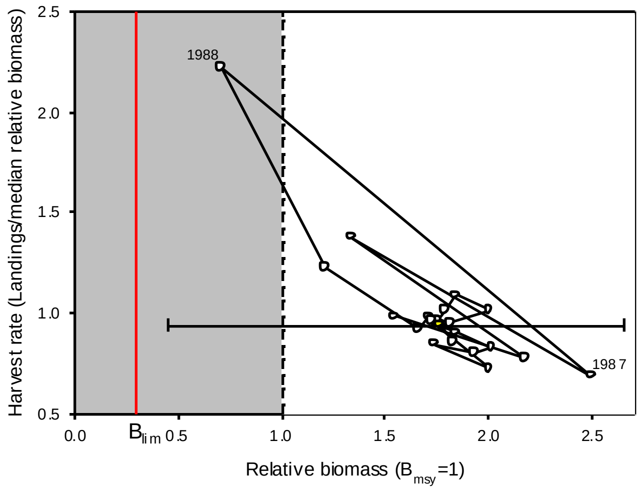

Fig. 9. Shrimp in Skagerrak and Norwegian Deep: Stock dynamics 1984 to 2005 in a fishing mortality/biomass continuum. Points are the median values of estimated biomass and harvest rate. Red line is limit reference point. Error bars for the 2005-value (yellow point) are 95% conf. interval.

PART D

Miscellaneous

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AGENDA I

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2. Adoption of Agenda
3. Attendance of Observers
4. Plan of Work
5. Report of Proxy Votes (by Executive Secretary)

II. Review of Scientific Council Recommendations in 2004 (see Appendix III)

III. Fisheries Environment (STACFEN Chair: Eugene Colbourne)

1. Opening
   a) Introduction and Administrative Matters
   b) Appointment of Rapporteur

2. Invited Speaker (Mariano Koen-Alonso, Northwest Atlantic Fisheries Centre, St. John's NL, "Multispecies Bioenergetic-allometric Models and Ecosystem-based Management: a Synoptic (personal and probably biased) View of the Lessons Learned and the Road Ahead")
3. Marine Environmental Data Service (MEDS) Report for 2004
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3. Review of Publications
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      - Redfish (Div. 3LN; Div. 3M; Div. 3O)
      - American plaice (Div. 3LNO; Div. 3M (monitor))
      - Witch flounder (Div. 2J and 3KL; Div. 3NO (monitor))
      - Yellowtail flounder (Div. 3LNO (monitor))
      - Northern shortfin squid in Subareas 3 and 4 (monitor)
      - Greenland halibut (Subareas 2 and 3)
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   e) Assessment of other stocks
      - Roughhead grenadier in Subareas 2 and 3

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ANNEX 1. FISHERIES COMMISSION'S REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2006 OF CERTAIN STOCKS IN SUBAREAS 2, 3 AND 4

1. The Fisheries Commission with the concurrence of the Coastal State as regards the stocks below which occur within its jurisdiction, requests that the Scientific Council, at a meeting in advance of the 2005 Annual Meeting, provide advice on the scientific basis for the management of the following fish and invertebrate stocks or groups of stocks in 2006:

   Shrimp (Div. 3M, 3LNO)
   Greenland halibut (Subarea 2 and Div. 3KLMNO)

2. The Fisheries Commission with the concurrence of the Coastal State as regards shrimp in Div. 3LNO requests Scientific Council, at its meeting of November, 2004 in review of the most recent data to provide advice concerning the scope for an adjustment to the TAC for 2005 from the currently advised level of 13,000 t.

3. The Fisheries Commission with the concurrence of the Coastal State as regards the stocks below which occur within its jurisdiction, requests that the Scientific Council, at a meeting in advance of the 2005 Annual Meeting, provide advice on the scientific basis for the management of the following fish stocks on an alternating year basis:

   Cod (Div. 3NO; Div. 3M)
   Redfish (Div. 3M; Div. 3LN; Div. 3O)
   Yellowtail flounder (Div. 3LNO)
   American plaice (Div. 3LNO; Div. 3M)
   Witch flounder (Div. 2J3KL; Div. 3NO)
   Skates (Div. 3LNO)
   Capelin (Div. 3NO)
   Northern Shortfin Squid (Subareas 3 and 4)

   - In 2004, advice was provided for 2005 and 2006 for cod in 3M, American plaice in 3M, yellowtail flounder in 3LNO, witch flounder in 3NO and northern shortfin squid in SA 3&4. These stocks will next be assessed in 2006.

   - In 2005, advice will be provided for 2006 and 2007 for cod in 3NO, American plaice in 3LNO, witch flounder in 2J3KL, redfish in 3M, redfish in 3LN, redfish in 3O and capelin in 3NO. These stocks will next be assessed in 2007. For redfish in Div. 3O the Scientific Council is requested to also provide its advice in the context of the 3-year management plan.

   The Fisheries Commission requests the Scientific Council to continue to monitor the status of all these stocks annually and, should a significant change be observed in stock status (e.g. from surveys) or in by-catches in other fisheries, provide updated advice as appropriate.

4. 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 advice on the scientific basis for the management of white hake in Div. 3NO including recommendations regarding the most appropriate TAC for 2006 and 2007 in the context of the 3-year management plan. This stock will be assessed in alternate years thereafter.

5. 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.

6. The Commission and the Coastal State request the Scientific Council to consider the following in assessing and projecting future stock levels for those stocks listed above:

   a) The preferred tool for the presentation of a synthetic view of the past dynamics of an exploited stock and its future development is a stock assessment model, whether age-based or age-aggregated.

   b) For those stocks subject to analytical-type assessments, the status of the stocks should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. As general reference points, the implications of fishing at $F_{0.1}$ and F_{2004} in 2006 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options.

   c) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. In this case, the level of fishing effort or fishing mortality (F) required to take two-thirds MSY catch in the long term should be calculated.

d) For those resources for which only general biological and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of management requirements for long-term sustainability and the advice provided should be consistent with the precautionary approach.

e) Spawning stock biomass levels considered necessary for maintenance of sustained recruitment should be recommended for each stock. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing reproductive potential of the stock, management options should be offered that specifically respond to such concerns.

f) Information should be provided on stock size, spawning stock sizes, recruitment prospects, fishing mortality, catch rates and TACs implied by these management strategies for the short and the long term in the following format:

I. For stocks for which analytical-type assessments are possible, graphs should be provided of all of the following for the longest time-period possible:
- historical yield and fishing mortality;
- spawning stock biomass and recruitment levels;
- catch options for the year 2006 and subsequent years over a range of fishing mortality rates
- (F) at least from $F_{0.1}$ to F_{max};
- spawning stock biomass corresponding to each catch option;
- yield-per-recruit and spawning stock per recruit values for a range of fishing mortalities.

II. For stocks for which advice is based on general production models, the relevant graph of production as a function of fishing mortality rate or fishing effort should be provided. Age aggregated assessments should also provide graphs of all of the following for the longest time period possible:
- exploitable biomass (both absolute and relative to B_{MSY})
- yield/biomass ratio as a proxy for fishing mortality (both absolute and relative to F_{MSY})
- estimates of recruitment from surveys, if available.

III. Where analytical methods are not attempted, the following graphs should be presented, for one or several surveys, for the longest time-period possible:
- time trends of survey abundance estimates, over:
- an age or size range chosen to represent the spawning population
- an age or size-range chosen to represent the exploited population
- recruitment proxy or index for an age or size-range chosen to represent the recruiting population.
- fishing mortality proxy, such as the ratio of reported commercial catches to a measure of the exploited population.

For age-structured assessments, yield-per-recruit graphs and associated estimates of yield-per-recruit based reference points should be provided. In particular, the three reference points, actual F, $F_{0.1}$ and F_{max} should be shown.

7. 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.

8. The following elements should be taken into account by the Scientific Council when considering the Precautionary Approach Framework:

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

b) Where reference points are proposed by the Scientific Council as indicators of biological risk, they should be accompanied by a description of the nature of the risk associated with crossing the reference point such as recruitment overfishing, impaired recruitment, etc.

c) When a buffer reference point is proposed in the absence of a risk evaluation in order to maintain a low probability that a stock, measured to be at the buffer reference point, may actually be at or beyond the limit reference point, the Scientific Council should explain the assumptions made about the uncertainty with which the stock is measured.

d) Wherever possible, short and medium term consequences should be identified for various exploitation rates (including no fishing) in terms of yield, stability in yield from year to year, and the risk or probability of maintaining the stock within, or moving it to, the Safe Zone. Whenever possible, this information should be cast in terms of risk assessments relating fishing mortality rates to the trends in biomass (or spawning biomass), the risks of stock collapse and recruitment overfishing, as well as the risks of growth overfishing, and the consequences in terms of both short and long term yields.

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

8. Many of the stocks in the NAFO Regulatory Area are well below any reasonable level of B_{lim} or B_{buf}. For these stocks, the most important task for the Scientific Council is to inform on how to rebuild the stocks. In this context and building on previous work of the Scientific Council in this area, the Scientific Council is requested to evaluate various scenarios corresponding to recovery plans with timeframes of 5 to 10 years, or longer as appropriate. This evaluation should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, including information on the consequences and risks of no action at all.

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

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

c) propose criteria and harvest strategies for new and developing fisheries so as to ensure they are maintained within the Safe Zone.

9. 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 the ICES Sub-area XII, parts of SA Va and XIV and to the shelf stocks of redfish found in ICES Sub-areas V, VI and XIV, and NAFO Subareas 1-3.

10. 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.

ANNEX 2. CANADIAN REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2006 OF CERTAIN STOCKS IN SUBAREAS 0 TO 4

1. Canada requests that the Scientific Council, at its meeting in advance of the 2005 Annual Meeting of NAFO, subject to the concurrence of Denmark (on behalf of Greenland), provide advice on the scientific basis for management in 2006 of the following stocks:

   Shrimp (Subareas 0 and 1)
   Greenland halibut (Subareas 0 and 1)

   The Scientific Council has noted previously that there is no biological basis for conducting separate assessments for Greenland halibut throughout Subareas 0-3, but has advised that separate TACs be maintained for different areas of the distribution of Greenland halibut. The Council is asked therefore, 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:

   a) 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 these resources.

   The Council also is asked to advise on appropriate TAC levels separately – for Greenland halibut in SA 2+Division 3K and for Divisions 3LMNO.

   With respect to shrimp, it is recognized that the Council may, at its discretion, delay providing advice until later in the year, taking into account data availability, predictive capability, and the logistics of additional meetings.

2. Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for Shrimp and Greenland halibut in Subareas 0 and 1:

   a) For those stocks subject to analytical-type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. The implications of no fishing as well as fishing at $F_{0.1}$, and F_{2004} in 2006 and subsequent years should be evaluated in relation to precautionary reference points of both fishing mortality and spawning stock biomass. The present stock size and spawning stock size should be described in relation to those observed historically and those to be expected in the longer term under this range of fishing mortalities, and any other options Scientific Council feels worthy of consideration under the NAFO Precautionary Approach Framework.

      Opinions of the Scientific Council should be expressed in regard to stock size, spawning stock sizes, recruitment prospects, catch rates and catches implied by these management strategies for the short and long term. Values of F corresponding to the reference points should be given. Uncertainties in the assessment should be evaluated and presented in the form of risk analyses related to B_{lim} (B_{buf}) and F_{lim} (F_{buf}), as per the NAFO Precautionary Approach Framework.

   b) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. Management options should be within the NAFO Precautionary Approach Framework.

   c) For those resources for which only general biological advice and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of management requirements for long-term sustainability and management options evaluated in the way described above to the extent possible. Management options should be within the NAFO Precautionary Approach Framework.

   d) Presentation of the results should include the following:

      I. For stocks for which analytical-type assessments are possible:
         - A graph of historical yield and fishing mortality for the longest time period possible;
         - A graph of spawning stock biomass and recruitment levels for the longest time period possible. The biomass graph should indicate the stock trajectory compared to B_{lim};
         - Graphs and tables of catch options for the year 2006 and subsequent years over a range of fishing mortality rates (F) at least from F=0 to $F_{0.1}$ including risk analyses;
         - Graphs and tables showing spawning stock biomass corresponding to each catch option including risk analyses;
         - Graphs showing the yield-per-recruit and spawning stock per recruit values for a range of fishing mortalities.

II. For stocks for which advice is based on general production models, the relevant graph of production on fishing mortality rate or fishing effort.

In all cases, the reference points, F=0, actual F, and $F_{0.1}$ should be shown. As well, Scientific Council should provide the limit and precautionary reference points as described in the NAFO Precautionary Approach Framework, indicating areas of uncertainty (when reference points cannot be determined directly, proxies should be provided).

Yours sincerely,
David Bevan
Assistant Deputy Minister
Fisheries and Aquaculture Management
Department of Fisheries and Oceans
Ottawa, Canada

ANNEX 3. DENMARK (GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2006 OF CERTAIN STOCKS IN SUBAREA 0 AND 1

1. In the Scientific Council report of 2002, scientific advice on management of Roundnose grenadier in Subarea 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 Subarea 0+1 for 2006, 2007 and 2008 and to continue to monitor status of Roundnose grenadier in Subarea 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.

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 red fish and other finfish in Subarea 1 for 2006 and 2007 and to continue to monitor the status of redfish and other finish 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.

3. Subject to the concurrence of Canada as regards Subarea 0, the Scientific Council is requested to provide advice on the scientific basis for the management of Greenland halibut in the offshore area of Divisions 0A+1AB and Divisions 0B+1C-F in 2006 and as many years ahead as data allow.

   Further, for Subarea 1A inshore, the Council is asked to provide advice on allocation of TACs distributed in the areas of Illulissat, Uummannaq and Upernavik, respectively.

4. Subject to the concurrence of Canada as regards Subarea 0, Denmark, on behalf of Greenland, requests the Scientific Council of NAFO before December 2005 to provide advice on the scientific basis for management of Northern shrimp (*Pandalus borealis*) in Subarea 0 and 1 in 2006, and as many years ahead as data allow.

   Further, the Council is requested to advise, in co-operation with ICES, on the scientific basis for management of Northern shrimp (*Pandalus borealis*) in the Denmark Strait and adjacent areas east of southern Greenland in 2006, and as many years forward as data allow.

Yours sincerely,
Amalie Jessen
Deputy Minister
Greenland Home Rule
The Department of Fisheries and Hunting

AGENDA II

SCIENTIFIC COUNCIL MEETING, 19-23 SEPTEMBER 2005

I. Opening (Chair: M. Joanne Morgan)

1. Appointment of Rapporteur
2. Adoption of Agenda
3. Attendance of Observers
4. Plan of Work

II. Review of Scientific Council Recommendations from June 2005

III. Fisheries Science (STACFIS Chair: Hilario Murua)

1. Opening
2. Nomination of Designated Experts
3. Other Matters
   a) Review of SCR and SCS Documents (if necessary)
   b) Other Business

IV. Research Coordination (STACREC Chair: Antonio Vázquez)

1. Opening
2. Fisheries Statistics
   a) Progress Reports on Secretariat Activities
      i) Acquisition of STATLANT 21 data
      ii) Publication of statistical information
   b) Revision of the North Atlantic Format (NAF) for position and catch reporting
3. Research Activities
   a) Surveys Planned for 2005 and Early 2006
4. NAFO Observer Program
   a) Digitization of available data
5. Stock Assessment Database
   a) Evaluation of the current procedures
6. Other Matters
   a) Review of SCR and SCS documents
   b) Other Business

V. Special Requests from Fisheries Commission

1. Update on Advice for Northern Shrimp in Div. 3M (Item 1)
2. Update on Advice for Northern Shrimp in Div. 3LNO (Item 1)

VI. Working Group Reports

1. Report of WGHARP

VII. Review of Future Meeting Arrangements

1. Scientific Council Meeting on Shrimp, October/November 2005
2. Scientific Council Meeting, June 2006
3. Annual Meeting, September 2006
4. Scientific Council Meeting on Shrimp, 2006
5. Scientific Council Meeting, June 2007

VIII. Future Special Sessions

1. Progress on Special Session for 2006
2. Topics for Special Session in 2007

IX. Scientific Council Working Procedures and Protocol

1. Timetable and Frequency of Assessments
2. Proposals to Shorten June Meeting

X. The Ecosystem Approach to Fisheries Management

XI. Other Matters

XII. Adoption of Reports

1. Committee Reports STACFIS, STACREC
2. Report of Scientific Council

XIII. Adjournment

AGENDA III

SCIENTIFIC COUNCIL MEETING, 26 OCTOBER-3 NOVEMBER 2005

I. Opening (Chair: Antonio Vázquez)

1. Appointment of rapporteur
2. Adoption of agenda
3. Plan of work

II. Fisheries Science (STACFIS Chair: Don Power)

1. Review of Recommendations in 2004 and in 2005 (to include outcome of Scientific Council Meeting of 19-23 September 2005) (see Appendix 3)
2. Review of Catches
3. General environmental review
4. Stock assessments (Annexes 1, 2, 3 and 4, to include request from 2005 Annual Meeting) from NAFO area
    - Northern shrimp (Div. 3M)
    - Northern Shrimp (Div. 3LNO)
    - Northern shrimp (Subareas 0 and 1)
    - Northern shrimp (in Denmark Strait and off East Greenland)
5. Stock assessments from ICES area
    - Northern shrimp in Skagerrak and Norwegian Deep (ICES Divisions IIIa & IVa East)
    - Northern shrimp in Fladen Ground (ICES Division IVa)
    - Northern Shrimp in Barents Sea and Svalbard area (ICES Sub-areas I & II)
6. Other Business

III. Formulation of Advice (see Annexes 1, 2, 3 and 4)

1. Advice for Northern Shrimp

   Request from Fisheries Commission (to include outcome of Annual Meeting of 19-23 September 2005)
    - Northern shrimp (Div. 3M)
    - Northern shrimp (Div. 3LNO)

2. Requests from Coastal States
    - Northern shrimp (Subareas 0 and 1)
    - Northern shrimp (in Denmark Strait and off East Greenland)

IV. Other Matters

1. Meeting of October/November 2006
2. Meeting of October/November 2007
3. Coordination with ICES Working Groups on Shrimp Stock Assessments
4. Other Business

V. Adoption of Scientific Council and STACFIS Reports

VI. Adjournment

LIST OF RESEARCH AND SUMMARY DOCUMENTS, 2005

RESEARCH DOCUMENTS (SCR)

SCR No.	Ser. No.	Author(s) and Title
05/1[1]	N5072	STEIN, M. North Atlantic subpoplar gyre warming - impacts on Greenland offshore waters? (14 pages)
05/2[1]	N5076	STEIN, M. Climatic conditions around Greenland – 2004. (19 pages)
05/3[1]	N5077	MORGAN, M. J. An illustration of the implications for B_{lim} and stock projections of various indices of reproductive potential for Divisions 3LNO American plaice. (9 pages)
05/4[1]	N5079	VASKOV, A. Reproduction of deepwater redfish *Sebastes mentella* on the Flemish Cap Bank. (10 pages)
05/5[1]	N5080	PETRIE, B., R. G. PETTIPAS and W. M. PETRIE. An overview of meteorological, sea ice and sea-surface temperature conditions off eastern Canada during 2004. (32 pages)
05/6[1]	N5081	PETRIE, B., R. G. PETTIPAS, W. M. PETRIE, and V. SOUKHOVTSEV. Physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine during 2004. (29 pages)
05/7[1]	N5082	HENDRY, R. M. Environmental conditions in the Labrador Sea in 2004. (15 pages)
05/8[1]	N5083	BRODIE, W. A description of the autumn mutlispecies surveys in SA 2 + Divisions 3KLMNO from 1995-2004. (21 pages)
05/9[1]	N5087	MADDOCK PARSONS, D., and W. B. BRODIE. Cooperative surveys of yellowtail flounder in NAFO Divisions 3LNO, 1996-2004. (23 pages)
05/10[1]	N5089	SHELTON, P. A. Does the rebuilding plan for Greenland halibut in Subarea 2 and Divisions 3KLMNO have a scientific basis and is it on track? (8 pages)
05/11[1]	N5090	VASKOV, A. A. On maturation of Acadian redfish (*Sebastes fasciatus*) in Division 3O. (6 pages)
05/12[1]	N5091	MAILLET, G. L., and P. PEPIN. Timing of plankton cycles on the Newfoundland Grand Banks: potential influence of climate change. (12 pages)
05/13[1]	N5092	JØRGENSEN, O. A. Surveys for Greenland halibut in NAFO Divisions 1C-1D, 2004. (26 pages)
05/14[1]	N5093	JØRGENSEN, O. A. Survey for Greenland halibut in the northern part of Baffin Bay, NAFO Division 1A, 2004. (12 pages)
05/15[1]	N5094	GONZALEZ, F., and J. L. DEL RIO. Description of the Spanish pelagic fishery of oceanic redfish (*Sebastes mentella* Travin) in the North Atlantic (2000-2004). (11 pages)
05/16[1]	N5097	CERVINO, S., J. GIL, and R. SANCHEZ. Changes in Flemish Cap cod distribution and its relationship with environmental changes. (12 pages)

[1] Scientific Council Meeting, 2-16 June 2005.

SCR No.	Ser. No.	Author(s) and Title
05/17[1]	N5098	GORCHINSKY, K. V., and S. E. GOLOVANOV. State of capelin stock in the NAFO Divisions 3NO based on data from trawl surveys. (9 pages)
05/18[1]	N5099	LISOVSKY, S. F., Yu A. KONDRATYUK, A. A. PAVLENKO, and A. A. VASKOV. On the minimal trawl codend mesh size in the fishery of redfish species in Division 3O of the NAFO Regulatory Area. (15 pages)
05/19[1]	N5100	RIBERGAARD, M. H., and E. BUCH. Oceanographic investigations off West Greenland, 2004. (20 pages)
05/20[1]	N5101	RATZ, H-J., and C. STRANSKY. Stock abundance indices and length compositions of demersal redfish and other finfish in NAFO Subarea 1 and near bottom water temperature derived from the German bottom trawl survey, 1982-2004. (24 pages)
05/21[1]	N5103	GORCHINSKY, K.V., and G. A. MAKEENKO. Preliminary results from Russian surveys and fishery of white hake, *Urophycis tenius*, in Divisions 3NO in 2000-2004. (8 pages)
05/22[1]	N5106	MAILLET, G. L., P. PEPIN, S. FRASER, and D. LANE. Biological oceanographic conditions in NAFO Subareas 2 and 3 on the Newfoundland and Labrador Shelf during 2004. (17 pages)
05/23[1]	N5107	COLBOURNE, E. B., C. FITZPATRICK, D. SENCIALL, P. STEAD, J. CRAIG, and W. BAILY. An assessment of the physical oceanographic environment on the Newfoundland and Labrador Shelf in NAFO Subareas 2 and 3 during 2004. (31 pages)
05/24[1]	N5108	TOMLINSON, S. Marine Environmental Data Service Report for 2004. (51 pages)
05/25[1]	N5110	GONZÁLEZ TRONCOSO, D., C. GONZÁLEZ and X. PAZ. American plaice and yellowtail flounder indices from the Spanish survey conducted in Divisions 3NO of the NAFO Regulatory Area. (27 pages)
05/26[1]	N5112	GONZÁLEZ TRONCOSO, D., and X. PAZ. Biomass and length distribution for Atlantic cod, thorny skate and white hake from the surveys conducted by Spain in NAFO Divisions 3NO. (29 pages)
05/27[1]	N5113	GONZÁLEZ TRONCOSO, D., E. ROMÁN, and X. PAZ. Results for Greenland halibut of the Spanish survey in NAFO Divisions 3NO: biomass, length distribution and age distribution for the period 1997-2004. (18 pages)
05/28[1]	N5114	GONZÁLEZ TRONCOSO, D., X. PAZ, and F. GONZÁLEZ. Results for the roughhead grenadier from the Spanish surveys conducted in the NAFO Regulatory Area of Divisions 3NO, 1997-2004. (17 pages)
05/29[1]	N5115	GONZÁLEZ TRONCOSO, D., and J. M. CASAS. Calculation of the calibration factors from the comparative experience between the R/V *Cornide de Saavedra* and the R/V *Vizconde de Eza* in Flemish Cap in 2003 and 2004. (8 pages)

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SCR No.	Ser. No.	Author(s) and Title
05/30[1]	N5118	GONZALEZ, C., and X. PAZ. Distribution of American plaice (*Hippoglossoides platessoides*) on the Grand Bank (NAFO Divisions 3NO), 1995-2004. (16 pages)
05/31[1]	N5119	IGASHOV, T. M., S. E. GOLOVANOV, and S. E. LOBODENKO. The relationship between water temperature and distribution of Greenland halibut on the Flemish Cap in 1988-2002. (9 pages)
05/32[1]	N5095	DURAN MUNOZ, P., M. MANDADO, A. GAGO, C. GOMEZ, and G. FERNANDEZ. Brief results of a trawl experimental survey at NW Atlantic. (4 pages)
05/33[1]	N5104	DEL RIO, J. L., C. GONZALEZ, A. GAGO, and F. GONZALEZ. Results of the 2004 Spanish experimental fishing in NAFO Subarea 1. (9 pages)
05/34[1]	N5117	HEALEY, B. P., and K. S. DWYER. A simple examination of Canadian autumn survey trends in NAFO Divisions 3LNO for Greenland halibut and American plaice: the impact of incomplete coverage of this survey in 2004. (28 pages)
05/35[1]	N5121	CASAS, J. M., and D. GONZÁLEZ TRONCOSO. Results from bottom trawl survey on Flemish Cap of July 2004. (35 pages)
05/36[1]	N5122	MURUA, H., F. GONZÁLEZ, and M. CASAS. A review on roughhead grenadier (*Macrourus berglax*) biology and population structure on Flemish Cap (NAFO Division 3M) 1991-2004 based upon EU Flemish Cap bottom survey data. (18 pages)
05/37[1]	N5123	GONZÁLEZ-CASTOS, F., and D. GONZÁLEZ. Quality of tuning series in the assessment of Greenland halibut in Subarea 2 and Divisions 3KLMNO. (17 pages)
05/38[1]	N5124	VÁZQUEZ, A., and S. CERVIÑO. A review of the status of the cod stock in NAFO Division 3M. (7 pages)
05/39[1]	N5125	STORR-PAULSEN, M., and O. A. JØRGENSEN. Biomass and abundance of demersal fish stocks off West Greenland estimated from the Greenland shrimp surveys, 1988-2004. (27 pages)
05/40[1]	N5126	SIEGSTAD, H., H.-J. RÄTZ, and C. STRANSKY. Assessment of demersal redfish in NAFO Subarea 1. (9 pages)
05/41[1]	N5127	SIEGSTAD, H.-J. RÄTZ and C. STRANSKY. Assessment of other finfish in NAFO Subarea 1. (6 pages)
05/42[1]	N5128	KOEN-ALONSO, M. Multispecies bioenergetic-allometric models and ecosystem-based management: a synoptic (personal and probably biased) view of the lessons learned and the road ahead. (3 pages)
05/43[1]	N5129	TREBLE, M. A., S. E. CAMPANA, R. J. WASTLE, C. M. JONES, and J. BOJE. An assessment of age determination methods, with age validation of Greenland halibut from the Northwest Atlantic. (22 pages)
05/44[1]	N5130	TREBLE, M. A., and B. VAN HARDENBERG. Oceanographic data from Baffin Bay collected during surveys conducted in Division 0A in 2004. (6 pages)

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SCR No.	Ser. No.	Author(s) and Title
05/45[1]	N5131	HENDRICKSON, L. C. Interim monitoring report for the assessment of northern shortfin squid (*Illex illecebrosus*) in Subareas 3+4 during 2004. (9 pages)
05/46[1]	N5132	GONZÁLEZ, F., and H. MURUA Roughhead grenadier NAFO Subarea 2 and 3 age disaggregate data (1992-2003). (16 pages)
05/47[1]	N5133	ÁVILA DE MILO, A., R. ALPIOM, and F. SABORIDO-REY. A revised assessment of beaked redfish (*Sebastes mentella* and *Sebastes fasciatus*) in NAFO Division 3M using the original EU survey indices converted to the new RV *Vizconde de Eza* units. (40 pages)
05/48[1]	N5134	WALSH, S. J. Conversion of the Canadian juvenile (Yankee trawl) groundfish survey time series for yellowtail flounder on the Grand Bank, NAFO Divisions 3LNO, into Campelen trawl units. (11 pages)
05/49[1]	N5135	SIMPSON, M. R., and D. W. KULKA Development of Canadian research trawl gear conversion factors for thorny skate on the Grand Banks based on comparative tows. (13 pages)
05/50[1]	N5136	VALENTIN, A., J.-M. SÉVIGNY, D. POWER, J.-P. CHANUT and X. PENIN. Population structure of *Sebastes mentella* and *Sebastes fasciatus* in NAFO Divisions 3LNO based on microsatellite genetic markers and geometric morphometrics data. (14 pages)
05/51[1]	N5137	JØRGENSEN, O. Assessment of the Greenland halibut stock component in NAFO Subarea 0 + Division 1A Offshore + Divisions 1B-1F. (21 pages)
05/52[1]	N5138	ÁVILA DE MELO, A. M., D. POWER, and R. ALPOIM. An assessment of the status of the redfish in NAFO Divisions 3LN. (19 pages)
05/53[1]	N5139	MADDOCK PARSONS, D. Witch flounder population trends in NAFO Divisions 2J, 3K and 3L. (22 pages)
05/54[1]	N5140	GONZÁLEZ COSTAS, F., and H. MURUA. Assessment of roughhead grenadier, *Macrourus berglax*, in NAFO Subareas 2 and 3. (18 pages)
05/55[1]	N5141	WALSH, S. J., M. F. VEITCH, K. S. DWYER, and W. B. BRODIE. 2005 Interim monitoring of yellowtail flounder stock status on the Grand Bank, NAFO Divisions 3LNO. (15 pages)
05/56[1]	N5142	TREBLE, M. Analysis of data from the 2004 trawl surveys in NAFO Division 0A. (24 pages)
05/57[1]	N5143	BOJE, J., and B. LYBERTH. Survey calibration for Greenland halibut in Division 1A inshore. (8 pages)
05/58[1]	N5144	LYBERTH, B., and J. BOJE. An assessment of the Greenland halibut stock component in NAFO Division 1A inshore. (23 pages)
05/59[1]	N5145	POWER, D. An assessment of the status of the redfish in NAFO Division 3O. (19 pages)

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SCR No.	Ser. No.	Author(s) and Title
05/60[1]	N5146	KULKA, D. W., C. M. MIRI, and M.R. SIMPSON. Distribution and aspects of life history of white hake (*Urophycis tenuis,* Mitchill 1815) on the Grand Banks of Newfoundland. (39 pages)
05/61[1]	N5147	DWYER, K. S., M. J. MORGAN, D. MADDOCK PARSONS, W. B. BRODIE, B. P. HEALEY, P. A. SHELTON, and H. MURUA. An assessment of American plaice in NAFO Divisions 3LNO. (79 pages)
05/62[1]	N5148	BRODIE, W. B., and D. POWER. The Canadian fishery for Greenland halibut in SA 2 + Divisions 3KLMNO, with emphasis on 2004. (16 pages)
05/63[1]	N5149	HEALEY, B. P., and J.-C. MAHÉ. An assessment of Greenland halibut in Subarea 2 + Divisions 3KLMNO, with projections under the Fisheries Commission rebuilding plan. (54 pages)
05/64[1]	N5150	DWYER, K. S., and B. P. HEALEY. Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on annual Canadian research vessel survey results during 1978-2004. (57 pages)
05/65[1]	N5151	HEALEY, B. P., and K. S. DWYER. Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO: trends in recruitment based upon research vessel survey data. (16 pages)
05/66[1]	N5153	KULKA, D. W., C. M. MIRI, and M. R. SIMPSON. The status of white hake (*Urophycis tenuis*, Mitchill 1815) in NAFO Divisions 3L, 3N, 3O and Subdivision 3Ps. (55 pages)
05/67[1]	N5154	POWER, D., B. P. HEALEY, E. F. MURPHY, J. BRATTEY, and K. DWYER. An assessment of the cod stock in NAFO Divisions 3NO. (40 pages)
05/68[2]	N5160	ORR, D. C., P. J. VEITCH, and D. J. SULLIVAN. Divisions 3LNO northern shrimp (*Pandalus borealis*) – interim monitoring update. (13 pages)
05/69[2]	N5161	SKÚLADÓTTIR, U. The Icelandic shrimp fishery (*Pandalus borealis* Kr.) at Flemish Cap in 1993-2005. (7 pages)
05/70[2]	N5162	SKÚLADÓTTIR, U. The by-catch in the shrimp fishery of Iceland at Flemish Cap in 1996-2005. (9 pages)
05/71[2]	N5165	SHELTON, P. A. A PA-compliant rebuilding plan for Subarea 2 + Divisions 3KLMNO Greenland halibut based on the 2005 NAFO assessment. (6 pages)
05/72[2]	N5166	SKÚLADÓTTIR, U. A provisional assessment of the international fishery for shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2005. (7 pages)
05/73[3]	N5178	STORR-PAULSEN, M., and K. WIELAND. A Preliminary estimate of cod (*Gadus morhua*) biomass in West Greenland offshore waters (NAFO Subarea 1) in 2005. (7 pages)

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2 Scientific Council Meeting, 19-23 September 2005.
3 Scientific Council Meeting, 26 October-3 November 2005

SCR No.	Ser. No.	Author(s) and Title
05/74[3]	N5179	WIELAND, K., and B. BERGSTRÖM. Results of the Greenland bottom trawl survey for northern shrimp (*Pandalus borealis*) off West Greenland (NAFO Subarea 1 and Division 0A), 1988-2005. (36 pages)
05/75[3]	N5180	WIELAND, K. Conversion of northern shrimp (*Pandalus borealis*) biomass, recruitment and mean size from previous years (1988-2004) to the new standard trawl used in the Greenland bottom trawl survey at West Greenland in 2005. (6 pages)
05/76[3]	N5181	SIEGSTAD, H. The Greenland fishery for northern shrimp (*Pandalus borealis*) in NAFO Divisions 3M and 3L 2003-2005. (3 pages)
05/77[3]	N5182	CASAS, J. M., and J. TERUEL. Northern shrimp (*Pandalus borealis*, Krøyer) in Spanish bottom trawl survey 2004 and 2005 in NAFO Divisions 3LNO. (10 pages)
05/78[3]	N5183	CASAS, J. M., J. L. DEL RIO, J. TERUEL, and A. ALONSO. Northern shrimp (*Pandalus borealis*) on Flemish Cap surveys 2005 (27 pages)
05/79[3]	N5184	CASAS, J. M., and J. L. DEL RIO. The Spanish shrimp fishery on Flemish Cap (Division 3M) and Division 3L in 2004. (4 pages)
05/80[3]	N5185	HVINGEL, C. The Norwegian fishery for northern shrimp (*Pandalus borealis*) in the North Sea and Skagerrak (ICES Divisions IVa east and IIIa), 1970-2004. (7 pages)
05/81[3]	N5186	SUNNANÅ, K. A note on a possible concept for a length based biomass model for assessment of North-east Arctic stock of northern shrimp (*Pandalus borealis*). (15 pages)
05/82[3]	N5187	HVINGEL, C. Results of the Norwegian bottom trawl survey for northern shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deeps (ICES Divisions IIIa and IVa) in 2004-2005. (8 pages)
05/83[3]	N5188	KINGSLEY, M. C. S., and C. HVINGEL. The fishery for northern shrimp (*Pandalus borealis*) off West Greenland, 1970-2005. (19 pages)
05/84[3]	N5189	HVINGEL, C. Deriving quantitative biological advice for the shrimp fishery in Skagerrak and Norwegian Deep (ICES Divisions IVa east and IIIa). (9 pages)
05/85[3]	N5190	KINGSLEY, M. C. S., and C. HVINGEL. A provisional assessment of the shrimp stock off West Greenland, updated 2005. (13 pages)
05/86[3]	N5191	BAKANEV, S., and P. LUBIN. Results of the Russian stratified-random trawl survey for northern shrimp (*Pandalus borealis*) in the Barents Sea and Spitzbergen, 1984-2005. (13 pages)
05/87[3]	N5192	COLBOURNE, E. Oceanographic conditions on the Flemish Cap in NAFO Division 3M during the summer of 2005. (14 pages)
05/88[3]	N5193	ORR, D. C., P. J. VEITCH, and D. J. SULLIVAN. An update of information pertaining to northern shrimp (*Pandalus borealis*, Krøyer) and groundfish in NAFO Divisions 3LNO. (59 pages)

[1] Scientific Council Meeting, 2-16 June 2005.
[3] Scientific Council Meeting, 26 October-3 November 2005

SCR #	Serial #	Author(s) and Title
05/89[3]	N5194	SKÚLADÓTTIR, U., and G. PÉTURSSON. Assessment of the international fishery for shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2005. (21 pages)
05/90[3]	N5195	ASCHAN, M., and S. BAKANEV. The *Pandalus* stock in the Barents Sea and Svalbard area. (13 pages)
05/91[3]	N5196	COLBOURNE, E. B., and D. C. ORR. The distribution and abundance of northern shrimp (*Pandalus borealis*) in relation to bottom temperatures in NAFO Divisions 3LNO based on multi-species surveys from 1995-2005. (24 pages)
05/92[3]	N5197	ROSING, M., and K. WIELAND. Preliminary results from shrimp trawl calibration experiments off West Greenland (2004, 2005) with notes on encountered experiment design/analyses problems. (6 pages)
05/93[3]	N5198	SIEGSTAD, H., and C. HVINGEL. An assessment of the shrimp stock in Denmark Strait/off East Greenland – 2005. (19 pages)
05/94[3]	N5199	SKULADOTTIR, U. Icelandic shrimp fishery (*Pandalus borealis* Kr.) at Flemish Cap in 1993-2004. (23 pages)
05/95[3]	N5201	SKANES, K. R., and G. T. EVANS. Testing OGMAP as a tool for estimating biomass and abundance of northern shrimp. (3 pages)
05/96[3]	N5202	CASAS, J. M. The Spanish NE Arctic shrimp fishery in 2004. (4 pages)
05/97[3]	N5203	JOHANNESEN, E., and M. ASCHAN. How much shrimp does the cod really eat? – five years later. (12 pages)

SUMMARY DOCUMENTS (SCS)

SCS No.	Ser. No.	Author(s) and Title
05/1[1]	N5073	FISHERIES COMMISSION. Fisheries Commission's request for scientific advice on management in 2006 of certain stocks in Subareas 2, 3 and 4. (4 pages)
05/2[1]	N5074	BEVAN, DAVID. Canadian request for scientific advice on management in 2006 of certain stocks in Subareas 0 to 4. (2 pages)
05/3[1]	N5075	JESSEN, AMALIE. Denmark (Greenland) request for scientific advice on management in 2006 on certain stocks in Subarea 0 and 1. (1 page)
05/4[1]	N5084	NAFO SECRETARIAT (Barb Marshall). Provisional index and list of titles of research and summary documents of 2004. (1 page + Excel file)
05/5[1]	N5085	VASKOV, A. A., K. V. GORCHINSKY, T. M. IGASHOV, S. P. MELNIKOV, S. F. LISOVSKY, I. K. SIGAEV, and V. A. RIKHTER. Russian Research Report for 2004. (22 pages)

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1 Scientific Council Meeting, 2-16 June 2005.
3 Scientific Council Meeting, 26 October-3 November 2005

SCS No.	Ser. No.	Author(s) and Title
05/6[1]	N5086	VARGAS, J., R. ALPOIM, E. SANTOS, and A. M. AVILA DE MELO. Portuguese Research Report for 2004. (55 pages)
05/7[1]	N5120	SOSEBEE, K. A. United States Research Report for 2004. (22 pages)
05/8[1]	N5096	GONZÁLEZ, F., J. L. DEL RIO, A. VÁZQUEZ, H. MURUA, E. ROMÁN, M. CASAS, P. DURAN, and G. RAMILO. Spanish Research Report for 2004. (26 pages)
05/9[1]	N5102	RATZ, H.-J., C. STRANSKY, and M. STEIN. German Research Report for 2004. (7 pages)
05/10[1]	N5155	NAFO. Report of Scientific Council Meeting, 2-16 June 2005. (214 pages)
05/11[1]	N5105	NAFO SECRETARIAT (Cindy Kerr). List of Biological Sampling Data for 2004. (1 page + Excel file)
05/12[1]	N5109	OSBORNE, D. R., M. TREBLE, L. DUECK, and S. COSENS. Canadian Research Report for 2004. (33 pages)
05/13[1]	N5111	NAFO SECRETARIAT (Dorothy Auby). Tagging activities for the Northwest Atlantic in 2004 and early 2005. (6 pages)
05/14[1]	N5116	SIEGSTAD, H. Denmark/Greenland Research for 2004. (9 pages)
05/15[1]	N5152	ROMANOV, E. V., S. T. REBIK, and Yu. V. KORZUN. Ukrainian Research Report for 2004. (1 page)
05/16[2]	N5157	NAFO. Available data from the commercial fisheries related to stock assessment (2004) and inventory of biological surveys conducted in the NAFO area in 2004 and biological surveys planned for 2005 and early-2006. (5 pages)
05/17[2]	N5163	ICES/NAFO WG. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. (30 pages)
05/18[2]	N5164	NAFO. Report of Scientific Council Meeting, 19-23 September 2005. (26 pages)
05/19[3]	N5200	NAFO. Report of Scientific Council Meeting, 26 October-3 November 2005. (118 pages)
05/20[3]	N5208	NAFO SECRETARIAT. A compilation of research vessel surveys on a stock-by-stock basis. (25 pages)

[1] Scientific Council Meeting, 2-16 June 2005.
[2] Scientific Council Meeting, 19-23 September 2005.
[3] Scientific Council Meeting, 26 October-3 November 2005

APPENDIX VII. LIST OF REPRESENTATIVES AND ADVISERS/EXPERTS, 2005

Meetings*

CANADA

Representatives:

Brodie, W.(Bill).B.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-3288 – Fax: +709-772-4105 – E-mail: brodieb@dfo-mpo.gc.ca	A	B	C

Advisers/Experts:

Allen, Chris	Senior Advisor, Fisheries Environment & Biodiversity Science Directorate, Dept. of Fisheries & Oceans, 200 Kent Street, 12th Floor, Ottawa, Ontario K1A 0E6 Phone: +613 990 0105 - Fax: +613 954 0807 – E-mail: allenc@dfo-mpo.gc.ca		B	
Colbourne, Eugene B.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-6106 – Fax: +709-772-4105 – E-mail: colbourn@dfo-mpo.gc.ca	A	B	C
Dwyer, Karen S.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-0573 – Fax: +709-772-4188 – E-mail: dwyerk@dfo-mpo.gc.ca	A		
Goodyear, Julian	Science, Oceans & Envir. Br., Dept. of Fish. & Oceans, P.O. Box 5667, St. John's, Nfld. A1C 5X1 Phone: +709-772-2027 – Fax: +709-772-6100 – E-mail: goodyearj@dfo-mpo.gc.ca	A		
Healey, Brian P.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: + 709-772-8674 – Fax: + 709-772-4105 – E-mail: healeybp@dfo-mpo.gc.ca	A		
Koen-Alonso, Mariano	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL, A1C 5X1 Phone: + 709-772-2047 – Fax: + 709-772-4188 – E-mail: koen-alonsom@dfo-mpo.gc.ca	A		
Kulka, David W.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: + 709-772-2064 – Fax: + 709-772-5469 – E-mail: kulkad@dfo-mpo.gc.ca	A		
Maddock Parsons, Dawn	Science Br., DFO Newfoundland & Labrador, P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-2495 – Fax: + 709-772-4188 – E-mail: parsonsda@dfo-mpo.gc.ca	A		
Maillet, Gary	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, Nfld. A1C 5X1 Phone: + 709-772-7675 – Fax: + 709-772-4105 – E-mail: mailletg@dfo-mpo.gc.ca	A		
Miri, Carolyn M.	Science Br., DFO Newfoundland & Labrador Reg., P. O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-0471 – Fax: 709-772-4188 – E-mail: miric@dfo-mpo.gc.ca	A		
Morgan, M. Joanne	Science Br., DFO Newfoundland & Labrador Reg., P. O. Box 5667, St. John's, Nfld. A1C 5X1 Phone: +709-772-2261 – Fax: +709-772-4105 – E-mail: morganj@dfo-mpo.gc.ca	A	B	
Orr, David C.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-4935 – Fax: +709-772-4105 – E-mail: orrd@dfo-mpo.gc.ca		B	C
Power, Don	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-4935 – Fax: +709-772-4105 – E-mail: powerd@dfo-mpo.gc.ca	A		C
Simpson, Mark R.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-4148 – Fax: +709-772-4105 – E-mail: simpsonmr@dfo-mpo.gc.ca	A		
Skanes, Katherine R.	Science Branch, DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-8437 – Fax: +709-772-4105 – E-mail: skanesk@dfo-mpo.gc.ca			C
Stansbury, Don	Science Branch, DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709 772-0559 – Fax: +709-772-4105 – E-mail: stansburyd@dfo-mpo.gc.ca			C
Walsh, Stephen J.	Science Br., DFO Newfoundland & Labrador Reg., P.O. Box 5667, St. John's, NL A1C 5X1 Phone: +709-772-5478 – Fax: +709-772 -4188 – E-mail: walshs@dfo-mpo.gc.ca	A		
Campana, Steven	Dept. of Fisheries & Oceans, BIO, P. O. Box 1006, Dartmouth, N.S. B2Y 4A2 Phone: +902-426-3233 – Fax: +902-426-9710 – E-mail: campanas@mar.dfo-mpo.gc.ca	A		
Greenan, Blair J.W.	Ocean Circulation Section, BIO, P. O. Box 1006, Dartmouth, N.S. B2Y 4A2 Phone: +902-426-9963 – Fax: +902-426-3711 – E-mail: greenanb@mar.dfo-mpo.gc.ca	A		
Koeller, Peter A.	Department of Fisheries and Oceans, BIO, P. O. Box 1006, Dartmouth, N.S. B2Y 4A2 Phone: +902-426-5379 – Fax: +902-426-1862 – E-mail: koellerp@mar.dfo-mpo.gc.ca			C
Sinclair, Mike	Reg. Dir. Sci., Dept. of Fisheries & Oceans, BIO, P.O. 1006, Dartmouth, N.S. B2Y 4A2 Phone: +902-426-3490 – Fax: +902-426-8484 – E-mail: sinclairm@mar.dfo-mpo.gc.ca	A		

Meetings*

- A Scientific Council Meeting, 2-16 June 2005.
- B Scientific Council Annual Meeting, 19-23 September 2005.
- C Scientific Council Meeting, 26 October-3 November 2005.

Meetings*

CANADA (continued)

Advisers/Experts:

		A	B	C
Treble, Margaret A.	Dept. of Fisheries & Oceans, Freshwater Inst., 501 University Cres., Winnipeg, Man. R3T 2N6 Phone: +204-984-0985 – Fax: +204-984-2403 – E-mail: treblem@dfo-mpo.gc.ca	A		
Tomlinson, Scott	Dept. of Fisheries & Oceans, MEDS, 12W0S2, 200 Kent St., Ottawa, Ontario K1A 0E6 Phone: +613-990-0261 – Fax: +613-993-4658 – E-mail: tomlinson@meds-sdmm-dfo-mpo-gc.ca	A		

DENMARK (in respect of Faroe Islands and Greenland)

GREENLAND

Representative:

		A	B	C
Siegstad, Helle	Greenland Institute of Natural Resources, P. O. Box 570, DK-3900, Nuuk Phone: +299 36 1200 - Fax: +299 36 1212 - E-mail: helle@natur.gl			C

Advisers/Experts:

		A	B	C
Bergstrøm, Bo	Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk Phone: +299 36 1203 – Fax: +299 36 1212 – E-mail: bobe@natur.gl			C
Hvingel, Carsten	Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk Phone: +299 36 1206 – Fax: +299 36 1212 – E-mail: hvingel@natur.gl			C
Kingsley, Michael C.S.	Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk, Phone: +299 36 1200 – Fax: +299 39 1212 – E-mail: mcsk@natur.gl			C
Lyberth, Bjarne B.R.	Greenland Institute of Natural Resources, P. O. Box 570, DK-3900, Nuuk Phone: +299 36 1238 - Fax: +299 36 1299 - E-mail: bjly@natur.gl	A		
Jørgensen, Ole A.	Danish Institute for Fisheries Research, Department of Marine Fishieres, Charlottenlund Slot DK-2920 Charlottenlund, Denmark Phone: +45 33 96 3300 - Fax: +45 33 96 3333 - E-mail: olj@dfu.min.dk	A		
Wieland, Kai	Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk Phone: +299 37 1248 – Fax: +299 36 1212 – E-mail: wieland@natur.gl			C

EUROPEAN UNION (EU)

Representative:

		A	B	C
Junquera. Susana	European Commission, General Directorate of Fisheries, Joseph II 99, Brussels, Belgium Phone: +32 2 29 84727 – Fax: +32 2 29 55700 – E-mail: susana.junquera@cec.eu.int	A	B	

Advisers/Experts:

		A	B	C
González Tronsco, Diana	Instituto Español de Oceanografia, Aptdo 1552, E-36280 Vigo (Pontevedra), Spain Phone: +34 986 49 2111 – Fax: +34 986 49 2351 – E-mail: diana.gonzalez@vi.ieo.es	A		
Mahé, Jean-Claude	IFREMER, Station de Lorient, 8, Rue François Toullec, 56100 Lorient, France Phone: +33 2 9787 3818 – Fax: +33 2 9787 3801 – E-mail: jcmahe@ifremer.fr	A		
Stein, Manfred	Institut fur Seefischerei, Palmaille 9, D-22767 Hamburg, Federal Republic of Germany Phone: +49 40 38905 174 – Fax: +49 40 38905 263 – E-mail: manfred.stein@ish.bfa-fisch.de	A	B	

Meetings*

A Scientific Council Meeting, 2-16 June 2005.
B Scientific Council Annual Meeting, 19-23 September 2005.
C Scientific Council Meeting, 26 October-3 November 2005.

Meetings*

EUROPEAN UNION (EU) (continued)

Avila de Melo, Antonio	Inst Instituto Nacional de Investigacao Agrária e das Pescas (INIAP/IPIMAR), Av. de Brasilia, 1449-006 Lisbon, Portugal Phone: +351 21 302 7000 – Fax: +351 21 301 5948 – E-mail: amelo@ipimar.pt	A		
Alpoim, Ricardo	Instituto Nacional de Investigacao Agrária e das Pescas (INIAP/IPIMAR), Av. de Brasilia, 1449-006 Lisbon, Portugal Phone: +351 21 302 7000 – Fax: +351 21 301 5948 – E-mail: ralpoim@ipimar.pt	A	B	
Casas Sanchez, Jose Miguel	Instituto Español de Oceanografía, P.O. Box 1552, Vigo, Spain Phone: +34 986 49 2111 – Fax: +34 986 49 2351 – E-mail: mikel.casas@vi.ieo.es			C
De Cárdenas, Enrique	Secretaria General de Pesca Maritima, Jose Ortega y Gasset, 57, 28006 Madrid, Spain Phone: +34 91 347 6110 – Fax: +34 91 347 6037 – E-mail: edecarde@mapya.es		B	
Gonzalez-Costas, Fernando	Instituto Español de Oceanografia, Aptdo 1552, E-36280 Vigo (Pontevedra), Spain Phone: +34 9 86 49 2111 – Fax: +34 9 86 49 2351 – E-mail: fernando.gonzalez@vi.ieo.es	A	B	
Janusz, Jerzy	Dept. of Biology & Fish Resources Conservation, 1, Kottataja str., 81-332 Gdynia, Poland Phone: +48 58 620 17 28 ext. 214 – Fax: +48 586 20 28 31 – E-mail: jjanusz@mir.gdynia.pl		B	
Kozlovski, Aleksandrs	Latvian Fish Resources Agency, Daugavgmivas 8, LV-1048, Riga, Latvia Phone: +371 7618 712 – E-mail: aleksandrs.kozlovskis@latzra.lv		B	
Le Garrec, Jean-Dominique	Domestic/International Business Development, 5 Forbes Terrace, Pittsburgh, PA 15217, USA Phone: +412 521 4585 – Fax: +412 726 5893 – E-mail: jd-legarrec@verizon.net		B	
Munch-Petersen, Sten	Danish Inst. of Fish. Res. (DIFRES), Charlottenlund Castle, 2920 Charlottenlund, Denmark Phone: +45 33 96 3390 – Fax: +45 33 96 3333 – E-mail: smp@dfu.min.dk			C
Murua, Hilario	AZTI Foundation, Herrera Kaia, Portualde z/g, 20110 Pasaia, Basque Country, Spain Phone: +34 9 43 00 48 00 – Fax: +34 9 43 00 48 01 – E-mail: hmurua@pas.azti.es	A	B	
Vazquez, Antonio	Instituto de Investigaciones Marinas, Eduardo Cabello 6, 36208 Vigo Phone: +34 9 86 23 1930 – Fax: +34 9 86 29 2762 – E-mail: avazquez@iim.csic.es	A	B	C
Saat, Toomas	Estonian Marine Fisheries, 10A Mäealuse Str., 12618 Tallinn, Estonia Phone: + 372 6718 901 – Fax: + 372 6718 900 – E-mail: tsaat@sea.ee	A	B	
Sirp, Silver	Head of Observer Working Group, Estonian Marine Institute, University of Tartu, Tartu, Estonia Phone: +372 5295396 – E-mail: silver.sirp@ut.ee		B	
Statkus, Romas	Taikos 83-69, Klaipeda, Lithuania Phone: + 37 04 639 1122 – Fax: +37 04 639 1104 – E-mail: statrom@gmail.com	A	B	
Vitins, Maris	Daugavgrivas 8, Riga, LV-1048, Latvia Phone: + 371 761 2409 – Fax: 371 761 6946 – E-mail: maris.vitins@latzra.lv	A		
Ulmestrand, Mats	Institute of Marine Research, P. O. Box 4, 45321 Lyseki, Sweden Phone: +46 523 18700 – E-mail: mats.ulmestrand@fiskeriverket.se			C

ICELAND

Representative:

Skúladóttir, Unnur	Marine Research Institute, Skúlagata 4, Pósthólf Box 1390, 121 Reykjavik Phone: +354 552 0240 – Fax: +354 562 3790 – E-mail: unnur@hafro.is		B	C

NORWAY

Representative:

Aschan, Michaela	Institute of Marine Research, P. O. Box 6404, 9294 Tromsø Phone: +47 99 26 1488 – Fax: +47 77 609701 – E-mail: michaela.aschan@imr.no			C

Meetings*

A Scientific Council Meeting, 2-16 June 2005.
B Scientific Council Annual Meeting, 19-23 September 2005.
C Scientific Council Meeting, 26 October-3 November 2005.

NORWAY (continued)

Advisers/Experts:

Name	Address	Meetings*
Søvik, Guldborg	Institute of Marine Research, Sykehusveien 23, PB 6404, N-92494 Tromsø Phone: +47 77 60 9753 – Fax: +47 77 60 9701 – E-mail: guldborg.soevik@imr.no	C
Hvingel, Carsten	Institute of Marine Research, Sykehusveien 23, PB 6404, N-9294 Tromsø Phone: +47 77 55 23 8500 – Fax: +47 77 60 9701 – E-mail: carstenh@imr.no	C
Sunnanå, Knut	Institute of Marine Research, Sykehusveien 23, PB 6404, N-92494 Tromsø Phone: +47 77 60 9735 – Fax: +47 77 60 9701 – E-mail: knut.sunnanaa@imr.no	C

REPUBLIC OF KOREA

Representative:

Name	Address	Meetings*
Choi, Seok-Gwan	Distant Water Fisheries Resources, National Fisheries Research & Development Institute, 408-1, Shirang-ri, Gijang-up, Gijang-gun, Busan, Korea, 619-902 Phone: +82 51 720-2334 – Fax: +82 51 720-2337 – E-mail: sgchoi@nfrdi.re.kr	B

RUSSIAN FEDERATION

Representatives:

Name	Address	Meetings*
Babayan, Vladimir K.	Russian Federal Research Institute of Fisheries & Oceanography (VNIRO), 17, V.Krasnoselskaya Moscow, 107140 Phone: +70 95 264 6983 – Fax: +70 95 264 6983 – E-mail: vbabayan@vniro.ru	A B
Bakanev, Sergey	Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk 183763 Phone: +81 52 47 2464 – Fax: +47 789 10 518 – E-mail: bakanev@pinro.ru	C
Gorchinsky, Konstantin V.	Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich St., Murmansk 183763 Phone: +7 (8152) 47 2532 – Fax: +7 (8152) 47 3331 – E-mail: inter@pinro..ru	A B
Kokovkin, Leonid	Rep. Russian Federation on Fisheries, 47 Oceanview Dr., Bedford, N.S., Canada B4A 4C4 Phone: +902 832-9225 – Fax: +902 832-9608 – E-mail: rusfish@ns.sympatico.ca	A

Advisers/Experts:

Name	Address	Meetings*
Igashov, Taras M.	Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk 183763 Phone: +7 8152 45 0568 –E-mail: taras@pinro.ru	A
Lisovsky, Stanislav	Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk 183763 Phone: +7 (8152) 47 30 50 – Fax: +7 (8152) 47 33 31 – E-mail: lisovsky@pinro.ru	A

UKRAINE

Representatives:

Name	Address	Meetings*
Korzun, Yuriy	Southern Scientific Research Institute of Marine Fisheries & Oceanography (YugNIRO), 2, Sverdlov St., Kerch, 98300, Crimea Phone: + 380 6561 21012 – Fax: +380 6561 61627– E-mail: yugniro@kerch.com.ua	C

Meetings*
- A Scientific Council Meeting, 2-16 June 2005.
- B Scientific Council Annual Meeting, 19-23 September 2005.
- C Scientific Council Meeting, 26 October-3 November 2005.

		Meetings*
	UKRAINE (continued)	
Romanov, Evgeny V.	Head of Division, Network, Southern Scientific Research Institute of Marine Fisheries And Oceanography (YugNIRO), 2, Sverdlov St., Kerch, 98300 Phone: + 380 6561 2 1065 – Fax: +380 6561 2 1572 – E-mail: island@crimea.com	A

UNITED STATES OF AMERICA (USA)

Representative:

Serchuk, Fred M.	National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543 Phone: +508-495-2245 – Fax: +508-495-2258 – E-mail: fred.serchuk@noaa.gov	B

Advisers/Experts:

Hendrickson, Lisa C.	National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543 Phone: +508-495-2285 – Fax: +508-495-2393 – E-mail: lisa.hendrickson@noaa.gov	A

NAFO SECRETARIAT

Johanne Fischer, Executive Secretary
Tissa Amaratunga, Deputy Executive Secretary
Dorothy Auby, Office Secretary
Barbara Marshall, Information Manager
Forbes Keating, Administration Officer & Meeting Coordinator
Stan Goodick, Senior Finance and Staff Administrator
Bev McLoon, Personal Assistant to Executive Secretary
Ricardo Federizon, Fisheries Commission Coordinator
Cindy Kerr, Fisheries Information Manager
Barry Crawford, Senior Publications Manager
Ron Myers, Graphic Art/Printing Technician
Ferne Perry, Senior Publications Manager
Leonie Renwratz, Intern

TECHNICAL SUPPORT

Madis Voogjarv, Agency Reisiekspert, Roosikrantsi 19, 10119 Tallinn, Estonia — B

Meetings*

A Scientific Council Meeting, 2-16 June 2005.
B Scientific Council Annual Meeting, 19-23 September 2005.
C Scientific Council Meeting, 26 October-3 November 2005.

LIST OF RECOMMENDATIONS IN 2005

The following are the specific **recommendations made by the Scientific Council** at its meetings through 2005 besides those made with respect to scientific advice on stocks considered. The recommendations with respect to stock advice appear in the stock-by-stock Summary Sheets presented in this publication. Recommendations listed under the Standing Committees were **endorsed** by the Scientific Council.

All recommendations listed here were **adopted** by the Scientific Council and are presented as they appear in this publication under the relevant sections and pages mentioned.

Scientific Council Meeting, 2-16 June 2005

SCIENTIFIC COUNCIL

NOTE: All 2-15 June 2004 recommendations pertaining to the work of the Scientific council, except those related to stocks under STACFIS, were listed in Part A, Sections III, IV, V and VI. These and other recommendations pertaining to all Constituent Bodies of NAFO are presented below under the relevant section and subject headings.

X. REPORTS OF WORKING GROUPS (see also Section XIV of Scientific Council Report)

2. **Joint NAFO-ICES Working Group on Harp and Hooded Seals** (page 47)

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.*

XIV. SCIENTIFIC COUNCIL RECOMMENDATIONS TO GENERAL COUNCIL AND FISHERIES COMMISSION (page 50)

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.*

FISHERIES ENVIRONMENT (STACFEN)

STACFEN made no formal recommendations during this 2005 meeting.

PUBLICATIONS (STACPUB)

NAFO Website

Web Statistics (with focus on the Journal) (page 69)

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.*

Other Matters

Consider Becoming a Member of the Aquatic Sciences and Fisheries Abstracts (ASFA) (page 71)

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.*

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*" (page 71)

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).*

Instructions for Authors Submitting Papers to the Journal (page 71)

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

RESEARCH COORDINATION (STACREC)

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

Fisheries Statistics

Progress Report on Secretariat Activities in 2004/2005

Acquisition of STATLANT 21A and 21B reports for recent years (page 74)

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.*

Report of the Coordination Working Party on Fishery Statistics (CWP) 21st Session, Copenhagen, 1-4 March 2004 (page 76)

STACREC **recommended** that *NAF be submitted to Scientific Council for consideration.*

Stock assessment database (page 79)

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.*

Other Business

Gear codes: (page 83)

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.*

FISHERIES SCIENCE (STACFIS)

General Review of Catches and Fishing Activity (page 89)

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.*

Greenland Halibut (*Reinhardtius hippoglossoides)* in Subarea 0 and Division 1A Offshore and Divisions 1B-1F (page 97)

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.*

Greenland Halibut (*Reinhardtius hippoglossoides*) in Division 1A Inshore (page 103)

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.*

Demersal Redfish (*Sebastes* spp.) in Subarea 1 (page 110)

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

Other Finfish in Subarea 1 (page 113)

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

Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3M (page 121)

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.*

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

Reference Points (page 128)

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}.

Recommendations (page 130)

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.*

American Plaice (*Hippoglossoides platessoides*) in Divisions 3L, 3N and 3O (page 143)

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.*

STACFIS **recommended** that *investigation be carried on the sensitivity of the estimation of F_{msy} to these parameters.*

Capelin (*Mallotus villosus*) in Divisions 3N and 3O (page 149)

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.*

Redfish *(Sebastes mentella* and *Sebastes fasciatus*) in Division 3O (page 154)

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.*

White hake (*Urophycis tenuis*) in Divisions 3N, 3O and Subdivision 3Ps (page 163)

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.*

Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO (page 188)

*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.*

Scientific Council Annual Meeting, 19-23 September 2005

SCIENTIFIC COUNCIL

IX. SCIENTIFIC COUNCIL WORKING PROCEDURES AND PROTOCOL

Timetable and Frequency of Assessments

Proposals to Shorten June Meeting (page 201)

In order to enhance Scientific Council's ability to produce catch estimates in advance of the June meeting, Scientific Council **recommends** that *the deadline for submission of STATLANT 21A data be set at 1 May in each year starting in 2006*.

XI. OTHER MATTERS

Fahay Monograph (page 202)
Council discussed the most appropriate format of this book and decided that a 2 volume hard cover version was the best. Scientific Council **recommends** that *the Monograph by M. Fahay entitled 'Early Stages of Fishes in the Western North Atlantic Ocean North of 35°N and West of 40°W' be published in 2 volumes and be in hard cover.*

Editorial Board (page 202)

In June 2005 STACPUB **recommends** 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.*

Provision of Monthly Catch Statistics by Secretariat (page 203)

Noting that data for provisional letters are submitted pursuant to Conservation and Enforcement Measures, Scientific Council **recommends** that *Fisheries Commission revise the Conservation and Enforcement Measures to require submission of data by country for the monthly letters on provisional catch statistics.*

Many people are still not clear about the reporting of catch under charter or quota transfer arrangement. Therefore, Scientific Council **recommends** that *the Secretariat provide a clear explanation of the reporting of catch statistics under charter and quota transfer arrangements*. It was noted that the Excel spreadsheet designed by the Secretariat and available on the website was useful and Scientific Council **recommends** that *the spreadsheet of catch statistics be updated to expedite access to these data by Designated Experts.*

Questions from the Fisheries Commission (page 203)

Scientific Council reiterates its recommendation from the September 2004 Meeting that Contracting Parties provide all available data on by-catch and discards of Greenland halibut in Subarea 2 and Divisions 3KLMNO shrimp fishery for consideration in future assessments. Scientific Council further **recommends** that *data collected by Contracting Parties on species taken as by-catch in or discarded from the shrimp fishery be made available for consideration in future assessments.*

RESEARCH COORDINATION

NAFO Observer Program

Digitization of Available Data (page 210)

It was noted that Scientific Council members generally have access to NAFO observer data from their own country, and if NAFO digitizes these observer reports, this would allow sharing with other Scientific Council members. There was no objection to this proposal, and STACREC **recommends** that *the digitization of observer data be carried out and that these data then be made available to Scientific Council.*

Scientific Council Meeting, 26 October-3 November 2005

SCIENTIFIC COUNCIL

Other Business

New Possibilities to Improve Catch Information Available (page 224)

The Scientific Council **recommends** that *approval be sought from the Fisheries Commission to obtain catch information from VMS to be used in assessments.*

Proposal for Shrimp Working Group (page 225)

Scientific Council expressed their best wishes for the group and **recommends** that *the Working Group submits their progress report to the Council regularly.*

FISHERIES SCIENCE (STACFIS)

Research Recommendations (page 235)

STACFIS **recommends** that, for Northern Shrimp in Division 3M

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to Designated Experts by 1 September 2006.*

- *indices of female stock size be presented with error bars where possible.*

- *the relationship between the recruitment index and fishable biomass be investigated further.*

Research Recommendations (page 244)

STACFIS **recommends** that, for Northern Shrimp in Divisions 3LNO

- *Ogmap should be reviewed further to determine whether it is an appropriate method to determine Div. 3LNO shrimp biomass/abundance indices from stratified random surveys.*

- *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to the Designated Expert, in the standardized format, by 1 September 2006.*

Research Recommendations (page 257)

STACFIS **recommends** that, for Northern Shrimp in Subareas 0 and 1

- *sampling of catches by observers - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - should be re-established in Subarea 1.*

- *ways to include the exploration of the effects of future trajectories of the cod stock on assessment predictions should be investigated and presented in 2006.*

- *the impact of other predators on the stock should also be considered for inclusion in the assessment model.*

- *the age-2 abundance index and its link to subsequent fishable biomass should be considered for inclusion in the shrimp assessment model.*

Research Recommendations (page 261)

STACFIS **recommends** that, for Northern Shrimp in Denmark Strait and off East Greenland

- *a survey be conducted, to provide fishery independent data of the stock throughout its range*

- *as a minimum requirement: sampling of catches by observers is required - essential for assessing age, size, sex composition, fecundity and frequency of spawning of the stock - and be re-established in the Greenland EEZ and improved in the Icelandic EEZ.*