PART A

Scientific Council Meeting, 1-15 June 2006

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Participants at Scientific Council Meeting, 1-15 June 2006 (Front to back – Left to right):

Back: Stanislav Lisovsky, Brian Petrie, Carmen Fernandez, Hilario Murua, Ole Jorgensen, Dorothy Auby, Dave Kulka, Tony Thompson, Eugene Colbourne, Sergiy Rebyk, Ricardo Alpoim

Middle: Bjarne Lyberth, Manfred Stein, Dawn Maddock Parsons, Margaret Treble, Johanne Fischer, Brian Healey, Sergey Golovanov, Phillip Reid, Steve Walsh, Antonio Avila de Melo, David Cross

Front: Fernando González-Costas, Antonio Vázquez, Don Power, Jean-Claude Mahe, Diana Gonzalez Tronsco, Gary Maillet, Konstantin Gorchinsky, Bill Brodie, Franco Zampogna

Not in Picture: Barb Marshall, Joanne Morgan, Evan Edinger, William Perrie, Ed Trippel, Mark Simpson, Susana Junquera, Leonid Kokovkin, Lisa Hendrickson, Fred Serchuk

Scientific Council Chairs, Executive Secretary and Scientific Council Coordinator, 1-15 June 2006:

Left to Right: Anthony Thompson (SC Coordinator), Antonio Vázquez (Chair Scientific Council), Don Power (Chair STACFIS), Konstantin Gorchinsky (Chair STACREC), Eugene Colboune (Chair STACFEN), Johanne Fischer (Executive Secretary) and Manfred Stein (Chair STACPUB)

STACFIS in session during 1-15 June 2006 Meeting.

REPORT OF SCIENTIFIC COUNCIL MEETING

1-15 JUNE 2006

Chair: Antonio Vázquez Rapporteur: Anthony Thompson

I. PLENARY SESSIONS

The Scientific Council met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 1-15 June 2006, 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, Portugal and Spain), Russian Federation, Ukraine and United States of America. The Executive Secretary, Johanne Fischer, and the Scientific Council Coordinator, Anthony Thompson, 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 1315 hours on 1 June 2006.

The Chair welcomed the representatives, advisors and experts to this session of the Scientific Council, held in Dartmouth, Nova Scotia. The Chair thanked Dr. Rikhter, Russia, for his continued support and participation in NAFO matters and asked that his colleagues convey this message to him. The Chair also welcomed the new NAFO Scientific Council Coordinator, Anthony Thompson, who 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 France (in respect of St. Pierre et Miquelon), Iceland, Japan and Norway to record their abstentions during any voting procedures. Bulgaria, Cuba and Republic of Korea did not convey their wishes to the Secretariat.

Having reviewed the work plan, the Agenda (Part D, Agenda I, this volume) was **adopted.**

An application for observer status was made by WWF Canada – Atlantic Region for Andrea Carew. Having no objections, Andrea Carew was invited as observer to the meeting.

The opening session was adjourned at 1545 hours on 1 June 2006.

The Council through 1-15 June 2006 addressed various outstanding agenda items as needed.

The concluding session was called to order at 1000 hours on 16 June 2006.

The Council considered and **adopted** the STACFEN, STACPUB, STACREC and STACFIS Reports and Scientific Council Report of this meeting of 1-15 June 2006, noting changes as discussed during the reviews would be made by the Chair and the Secretariat.

The meeting was adjourned at 1345 hours on 15 June 2006.

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 2005

The Council noted recommendations made in 2005 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, 2-16 June 2005

1. 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* (*NAFO Sci. Coun. Rep.*, 2005, p. 47).

   This was reported to Scientific Council in September 2005 (*NAFO Sci. Coun. Rep*., 2005: 198-199).

2. Scientific Council recommendation to 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* (*NAFO Sci. Coun. Rep.*, 2005, p. 50).

   This was reported to the Fisheries Commission by the Scientific Council Chair and is noted in their report (Fisheries Commission Report, September 2005, Item 15b).

From Scientific Council Meeting, 19-23 September 2005

3. In order to enhance Scientific Council's ability to produce catch estimates in advance of the June Meeting, Scientific Council **recommended** that *the deadline for submission of STATLANT 21A data be set at 1 May in each year starting in 2006* (*NAFO Sci. Coun. Rep.*, 2005, p. 201).

   This was implemented. This issue was considered again by STACREC under Item 3a.

4. Council discussed the most appropriate format of this [The Fahay Monograph] book and decided that a two-volume hard cover version was the best. Scientific Council **recommended** 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.* (*NAFO Sci. Coun. Rep.*, 2005, p. 202)

   This was discussed in STACPUB under Item 3f.

5. In June 2005, 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* (*NAFO Sci. Coun. Rep.*, 2005, p. 202).

   This was discussed in STACPUB under Item 5a,b.

6. Noting that data for provisional letters are submitted pursuant to Conservation and Enforcement Measures, Scientific Council **recommended** that *Fisheries Commission revise the Conservation and Enforcement Measures to require submission of data by country for the monthly letters on provisional catch statistics* (*NAFO Sci. Coun. Rep.*, 2005, p. 203).

   This issue has been forwarded to STACTIC/Fisheries Commission to be addressed.

7. Many people are still not clear about the reporting of catch under charter or quota transfer arrangement. Therefore, Scientific Council **recommended** 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 **recommended** that *the spreadsheet of catch statistics be updated to expedite access to these data by Designated Experts* (*NAFO Sci. Coun. Rep.*, 2005, p. 203).

   An explanation of the NAFO reporting requirements of catch statistics under charter and quota transfer arrangements was provided at this meeting by the Secretariat. The Excel spreadsheet had been updated during the past year.

8. Scientific Council reiterates its recommendation from the September 2004 meeting that Contracting Parties provide all available data on bycatch and discards of Greenland halibut in Subarea 2 and Divisions 3KLMNO shrimp fishery for consideration in future assessments. Scientific Council further **recommended** that *data collected on species taken as bycatch in or discarded from the shrimp fishery in Subarea 2 and Divisions 3KLMNO be made available for consideration in future assessments* (*NAFO Sci. Coun. Rep.*, 2005, p. 203).

   Data on bycatch of adult and juvenile Greenland halibut were available even though they were not yet included in the assessment.

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 2006 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. *accept the format changes and the single citation for the Journal as proposed by the Secretariat.*

2. *adopt the Creative Commons license for the Journal and Studies as proposed by the Secretariat.*

3. *adopt the Author/Owner consent form for the Journal and Studies as proposed by the Secretariat.*

4. *the distribution of both the free reprints and the reprints at cost be discontinued for manuscripts submitted after 15 June 2006.*

V. RESEARCH COORDINATION

The Council **adopted** the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chair, Konstantin Gorchinsky. The full report of STACREC is at Appendix III.

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

1. *the deadline of 1 May for the acquisition of STATLANT 21A data be maintained but that the deadline for STATLANT 21B be changed to 31 August*.

2. *approval be sought from the Fisheries Commission for the Secretariat to make catch and effort data (days at sea) from VMS available to Scientific Council.*

3. *Designated Experts be reminded by the Secretariat following each June Scientific Council meeting to fill in the assessment data spreadsheets.*

4. *the new mesh gauge OMEGA be adopted as the standard for scientific purposes.*

VI. FISHERIES SCIENCE

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

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

A **recommendation** made by STACFIS for the work of the Scientific Council as endorsed by the Council, is as follows: *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 on 25 October - 2 November 2006)

   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 2005 agreed to consider certain stocks in 2007. This section presents reports for which the Scientific Council provided scientific advice for 2007 during this meeting.

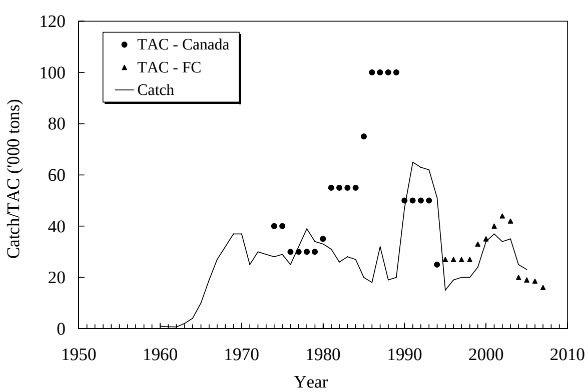
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 2 and Divisions 3KLMNO

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 catches in 2004 and 2005 were 25 500 and 23 000 tons, which exceed the rebuilding plan TACs by 27% and 22%, respectively.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	32-38.5[2]	27[1]	36	42
2004	25	16[1]	16	20
2005	23	18[1]	nr	19
2006	-	-	nr	18.5

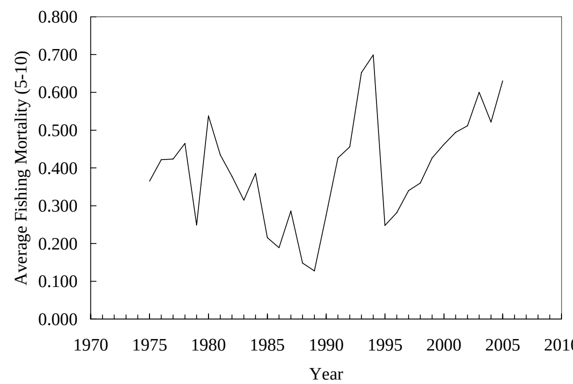
[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
nr No recommendation



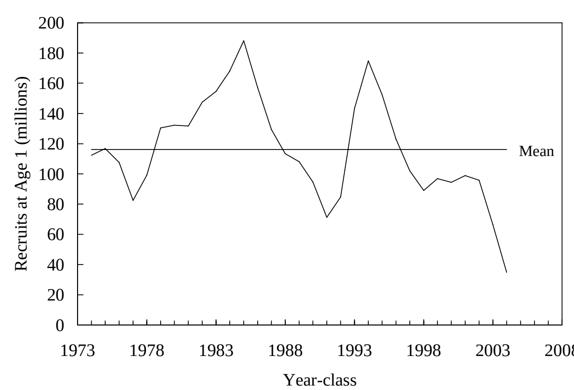
Data: CPUE data throughout the stock area were available from Canadian and EU-Portugal fisheries. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2J+3KLMNO (1978-2005), EU in Div. 3M (1988-2005) and EU-Spain in Div. 3NO (1995-2005). Commercial catch-at-age data were available from 1975-2005.

Assessment: An analytical assessment using Extended Survivors Analysis (XSA) tuned to the Canadian spring (Div. 3LNO; 1996-2005), and autumn (Div. 2J, 3K; 1996-2005) and the EU (Div. 3M; 1995-2005) surveys was used to estimate the 5+ exploitable biomass, level of exploitation and recruitment to the stock. Natural mortality was assumed to be 0.20 for all ages.

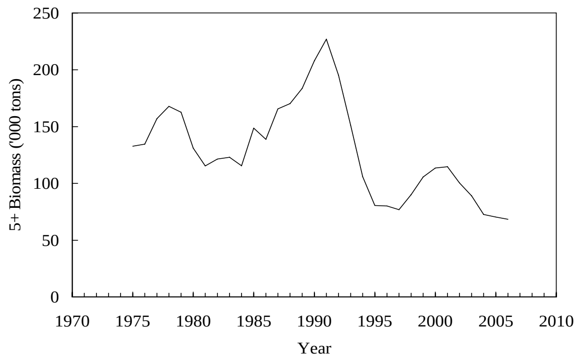
Fishing Mortality: High catches in 1991-94 resulted in $F_{5\text{-}10}$ exceeding 0.50. $F_{5\text{-}10}$ then dropped to about 0.20 in 1995 with the substantial reduction in catch. $F_{5\text{-}10}$ increased since then and has remained high in spite of the Fisheries Commission rebuilding plan.



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. Based upon 2005 survey results, the 2004 year-class is estimated to be very weak.



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. Estimated exploitable biomass has been decreasing since 2001; the 2006 estimate is the lowest in the series.

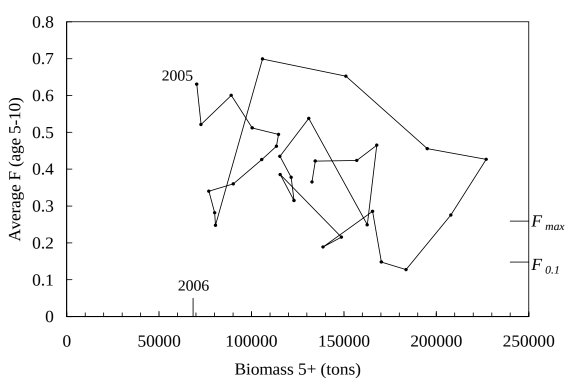


State of the Stock: The exploitable biomass has been declining in recent years and is presently estimated to be at its lowest observed level. Recent recruitment has been below average, and fishing mortality has increased substantially in recent years, and is currently estimated very high.

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

For this stock F_{max} is computed to be 0.26 and $F_{0.1}$ is 0.15 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 indicates that the current average fishing mortality is more than twice F_{max}. Scientific Council also noted that the average fishing mortality has been below F_{max} for only six years of the time series, and been below $F_{0.1}$ only once.



Evaluation of the Management Strategy 2006-2008: Scientific Council noted that the 2004 and 2005 catches of 25 500 and 23 000 tons exceeded the rebuilding plan TAC by 27% and 22% respectively.

Projections were conducted assuming that the catches in 2006 to 2007 do not exceed the rebuilding plan TAC (18 500 and 16 000 tons, respectively) and with catches in excess of 20%. Catches in 2008 were assumed equal to the 2007 removals. Projection results (see figures below) indicate that for both scenarios fishing mortality is projected to remain relatively high, and projected biomass remains below the exploitable biomass in 2003 when the FC rebuilding plan was implemented. Scientific Council noted that in all of these projection scenarios, the 2009 exploitable biomass remains well below the target level of biomass specified in the FC rebuilding plan.

Scientific Council noted that if the remaining rebuilding plan TACs are exceeded, the prospects for rebuilding would be further diminished.

Deterministic projections were also carried using different values of fishing mortality for 2007 and 2008: $F_{current}$, $F_{0.1}$ and F_{Max}. Results are summarized in table below:

Fcurrent

Year	5+ Biomass	Yield	F
2006	68413	24184	0.631
2007	65000	23141	0.631
2008	57417	21696	0.631
2009	45021		

F_0.1

Year	5+ Biomass	Yield	F
2006	68413	22200	0.557
2007	67540	7621	0.148
2008	80233	10592	0.148
2009	84931		

F_Max

Year	5+ Biomass	Yield	F
2006	68413	22200	0.557
2007	67540	12429	0.259
2008	74056	15520	0.259
2009	71716		

Scientific Council noted that given these results fishing mortality should be reduced to a level not higher than $F_{0.1}$ in order to provide a consistent increase of the 5+ exploitable biomass.

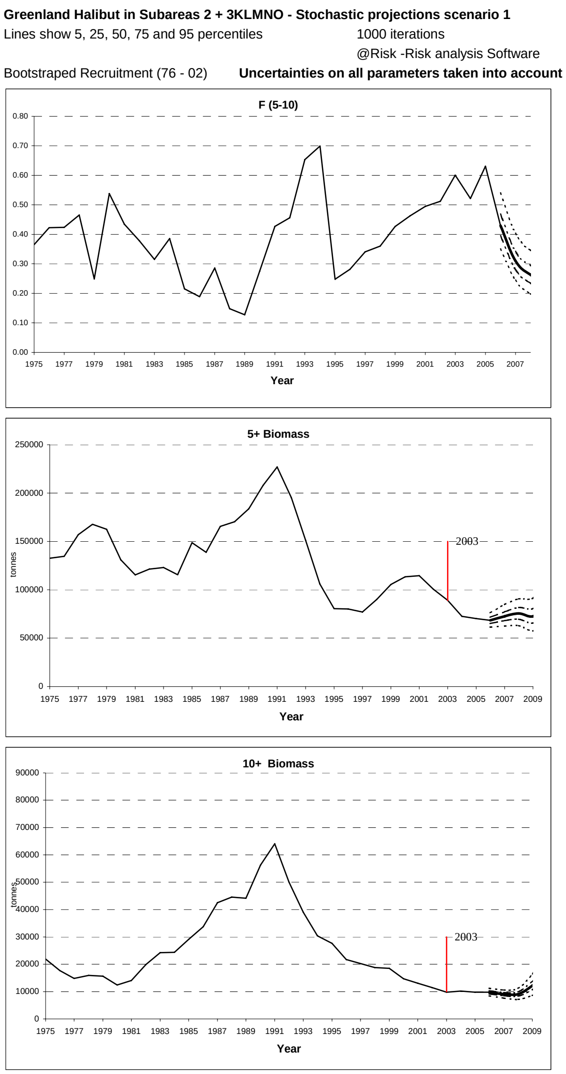
Special Comments: The Council reiterates its concern that the catches taken from this stock consist mainly of young, immature fish of ages several years less than that at which sexual maturity is achieved.

The 5+ biomass around 2000 and 2001 was over-estimated, but in recent years has been underestimated. Fishing mortality in recent years has been over-estimated. Despite this all recent assessments have shown a decreasing trend in 5+ biomass and an increase in recent fishing mortality.

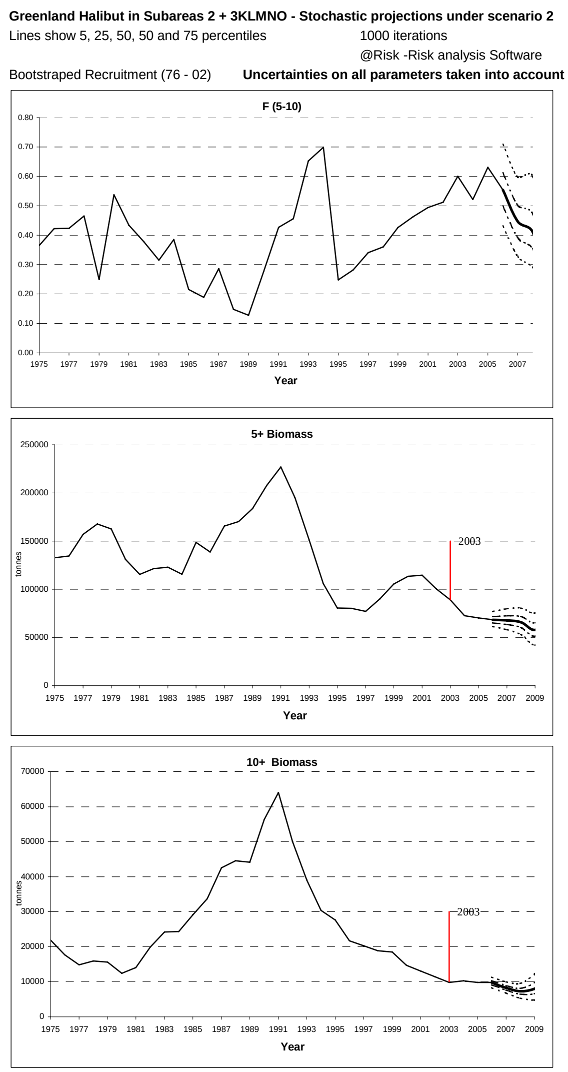
During previous assessments, Scientific Council has noted that fishing effort should be distributed in a similar fashion to biomass distribution in order to ensure sustainability of all spawning components.

Scientific Council strongly **recommends** that *Fisheries Commission take steps to ensure that any bycatches of other species during the Greenland halibut fishery are true and unavoidable bycatches.*

Sources of Information: SCR Doc. 06/12, 16, 34, 42, 51, 49; SCS Doc. 06/6, 7, 9, 11.



A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2006-2009, under the Fisheries Commission rebuilding plan and assuming a catch of 16 000 tons in 2008. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.



A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2006-2009, with catches in excesss of 20% of the Fisheries Commission rebuilding plan for 2006 and 2007 and of 19 200 tons for 2008. 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 2007 and 2008**

The Scientific Council at its meeting of September 2005 reviewed the assessment schedule and agreed to consider certain stock on a multi-year rotational basis. This section presents those stocks for which the Scientific Council provided scientific advice for the years 2006 and 2007. The next assessment of these stocks will be in 2008.

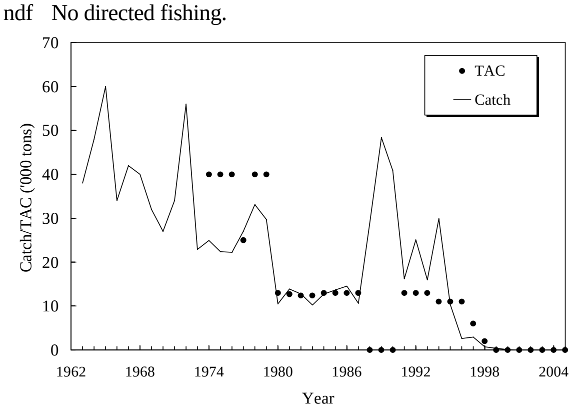
Cod (Gadus morhua) in Division 3M

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

Fishery and Catches: Catches exceeded the TAC from 1988 to 1994, but were below the TAC from 1995 to 1998. Catches taken by vessels from non-Contracting Parties have been important in some years. Large numbers of small fish were caught by the trawl fishery in the past, particularly during the 1992-1994 period. Bycatches were estimated to be low in the shrimp fishery since 1993. The fisheries since 1996 were very small compared with previous years. The fishery was closed in 1999. The catches were 19 tons in 2005.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	0.0	0.0[1]	ndf	ndf
2004	0.0	0.0[1]	ndf	ndf
2005	0.0	0.0[1]	ndf	ndf
2006			ndf	ndf

[1] Provisional.
ndf No directed fishing.

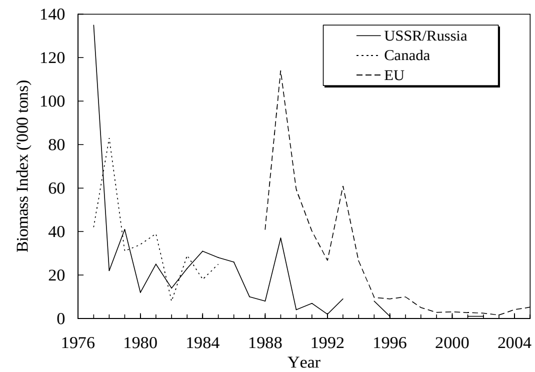


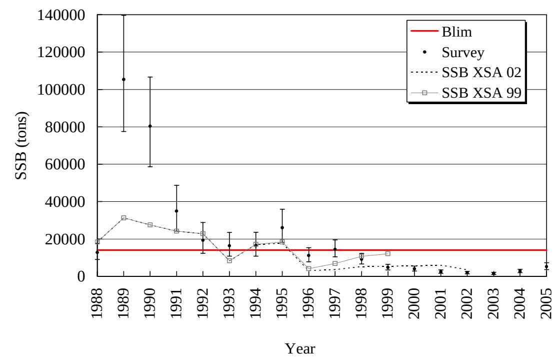
Data: Length and age composition of the 2002 to 2005 bycatches were not available. Data were available from the EU bottom-trawl and the Russian trawl surveys, both covering the whole distribution area of the stock.

Assessment: Analytical assessment was not attempted because of the current very low catch level.

Recruitment: The 1992 and subsequent year-classes have been weak. Abundance at age 1 in 2005 survey was the highest observed since 1993.

Biomass: Estimates of the current spawning stock biomass, based on survey results, indicate that its level is well below B_{lim}.





State of the Stock: The stock remains at a very low level. Although the abundance at age 1 in 2005 was the highest observed since 1993, it was well below in comparison to the pre-1993 level and, therefore, it is not expected that the stock will recover in the foreseeable future.

Recommendation: No directed fishery for cod in Div. 3M in years 2007 and 2008. Also, bycatch of cod in fisheries directed to other species on Flemish Cap should be kept at the lowest possible level.

Reference Points: A SSB of 14 000 tons has been identified as a preliminary B_{lim} for this stock.

Special Comments: The next Scientific Council assessment of this stock will be in 2008.

Sources of Information: SCR Doc. 03/38, 05/29, 06/16, 32; SCS Doc. 06/6.

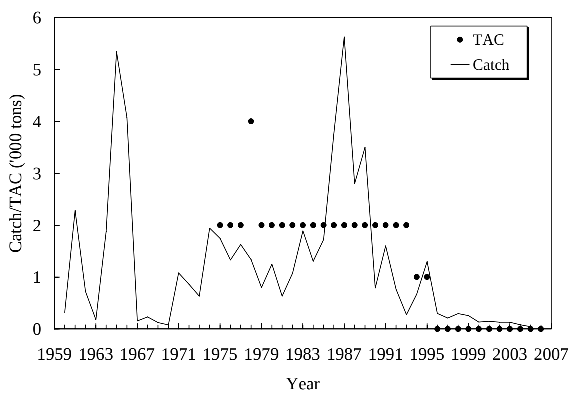
American Plaice (Hippoglossoides platessoides) in Division 3M

Background: The stock occurs mainly at depths shallower than 600 m on Flemish Cap.

Fishery and Catches: Catches are taken mainly by otter trawl, primarily in a bycatch fishery of the Contracting Parties since 1992.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	0.1	0.1[1]	ndf	ndf
2004	0.1	0.1[1]	ndf	ndf
2005	0.05	0.1[1]	ndf	ndf
2006			ndf	ndf

[1] Provisional.
ndf No directed fishing.

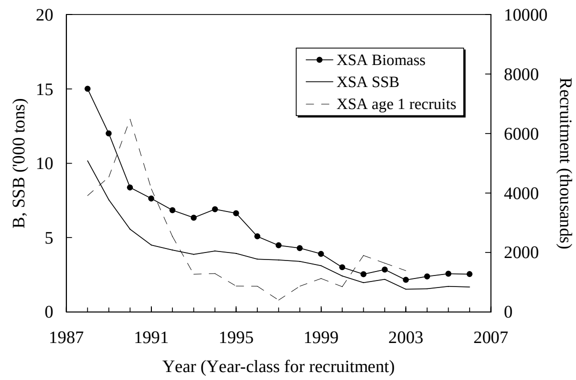


Data: Length compositions were available from the 1988 to 2005 fisheries. Abundance and biomass from surveys were available from USSR/Russia (1972-2002), EU (1988-2005) and Canada (1978-1986). Age-length keys were available from EU surveys (1988-2005).

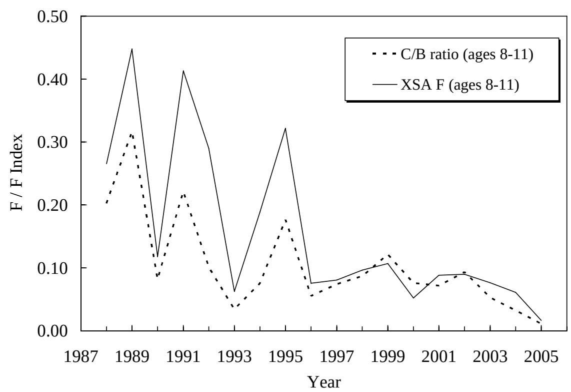
Assessment: An analytical assessment (XSA) was presented.

Recruitment: Only weak year-classes have been observed since 1991.

Biomass: Stock biomass and the SSB are at very low levels and there is no sign of recovery due to the consistent year-to-year recruitment failure since the beginning of the 1990s.



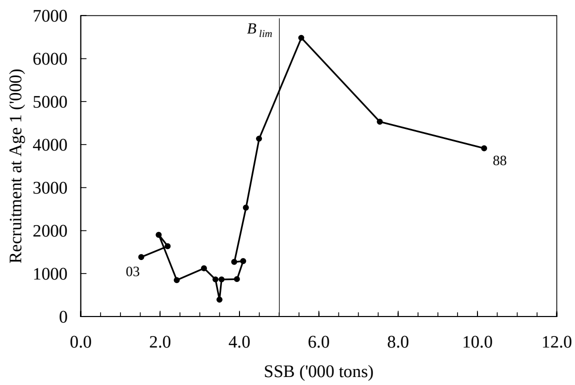
Fishing Mortality: The ratio of catch to EU survey biomass (*F*-index) and XSA fishing mortality declined from the mid-1980s to the mid-1990s, fluctuated between 0.05 and 0.1 from 1996 till 2002. Since then, the *F*-index has decreased and in 2005 was at a very low level.



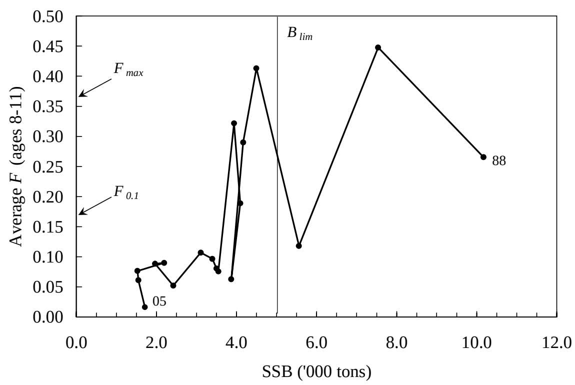
State of the Stock: The stock biomass and the SSB are at very low levels and there is no sign of recovery.

Recommendation: There should be no directed fishery on American plaice in Div. 3M in 2007 and 2008. Bycatch should be kept at the lowest possible level.

Reference Points: Based on the 16 points available from the XSA to examine a stock/recruitment relationship, a proxy for B_{lim} will be 5 000 tons of SSB.



XSA current estimates of fishing mortality are quite low, despite this spawning stock biomass remains at a very poor level.



The yield-per-recruit analysis gave $F_{0.1}$ = 0.165 and F_{max} = 0.365.

Special Comments: Since 1991 recruitment (age 3) has been very poor as shown by EU survey indices. Although there was a marginal improvement in the index for both the 2001 and 2002 year-classes they are still considered to be poor in relation to the pre-1991 estimates of recruitment.

The next Scientific Council assessment of this stock will be in 2008.

Sources of Information: SCR Doc. 05/29, 06/16, 38; SCS Doc. 06/7, 9.

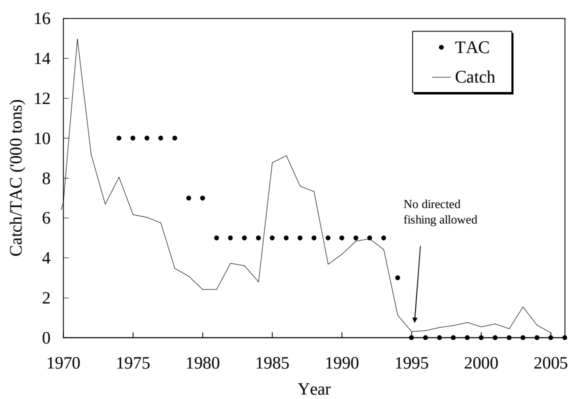
Witch Flounder (Glyptocephalus cynoglossus) in Divisions 3N and 3O

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

Fishery and Catches: Catches exceeded the TAC by large margins during the mid-1980s. The catches from 1995-2002 ranged between 300-800 tons including unreported catches. Catch for 2003 was estimated to be between 844 and 2 239 tons. Catches in the most recent two years were 630 and 260 tons respectively.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	0.8-2.2[2]	0.5[1]	ndf	ndf
2004	0.6	0.6[1]	ndf	ndf
2005	0.3	0.3[1]	ndf	ndf
2006			ndf	ndf

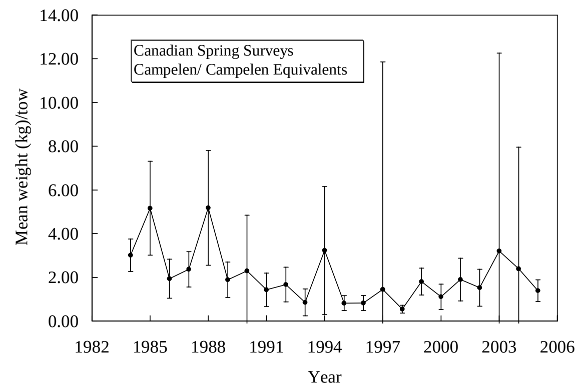
[1] Provisional.
[2] In 2003, STACFIS could not precisely determine catches.
ndf No directed fishing.



Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring surveys during 1984-2005 and autumn surveys during 1990-2005.

Assessment: No analytical assessment was possible with current data.

Biomass: Survey mean weights (kg) per tow in the Canadian spring series trended downwards from the mid-1980s until 1998, which has the lowest observed value. Some increase in the index has occurred since then. Although the index in Div. 3NO appeared higher in 2003 than in previous years, it was driven by one large set. The index then decreased in 2004 and 2005.



Recruitment: No information.

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

Recommendation: No directed fishing on witch flounder in the years 2007 and 2008 in Div. 3N and 3O to allow for stock rebuilding. Bycatches in fisheries targeting other species should be kept at the lowest possible level.

Reference Points: Not determined.

Special Comments: The next Scientific Council assessment of this stock will be in 2008.

Sources of Information: SCR Doc. 06/37; SCS Doc. 06/6, 7, 9.

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

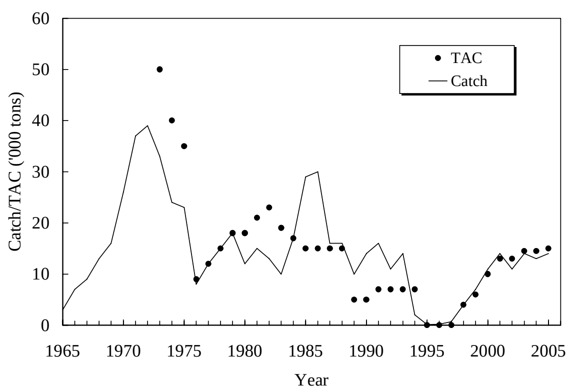
Background: The stock is mainly concentrated on the southern Grand Bank and is recruited from the Southeast Shoal area nursery ground, where the juvenile and adult components overlap in their distribution.

Fishery and Catches: There was a moratorium on directed fishing from 1994 to 1997, and small catches were taken as bycatch in other fisheries. The fishery was re-opened in 1998 and catches have increased from 4 400 tons in 1998 to 13 900 tons in 2005. TACs were exceeded each year from 1985 to 1993, and 1998-2001, but not since 2002.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	13.5-14.1[2]	13[1]	14.5	14.5
2004	13.4	13.4[1]	14.5	14.5
2005	13.9	13.9[1]	15.0	15.0
2006			15.0	15.0

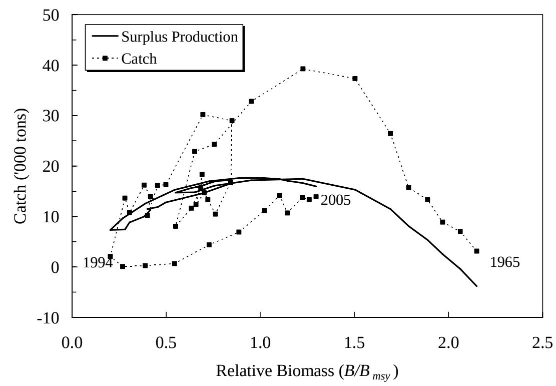
[1] Provisional.

[2] STACFIS could not precisely estimate catches.

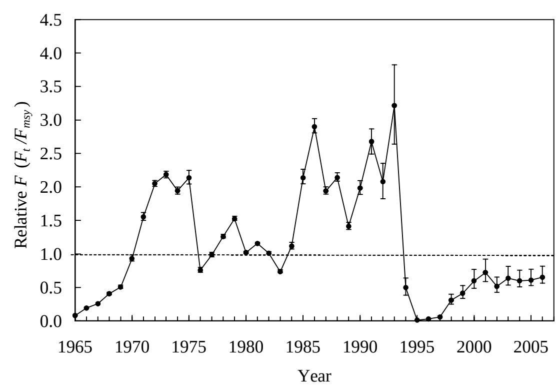


Data: CPUE from Canadian trawlers were available from 1965 to 2005. For 2004 and 2005, length frequency data from the Canadian fishery and from bycatches of Spanish, Portuguese and Russian trawlers were available. Abundance and biomass indices were available from: annual Canadian spring (1971-82; 1984-2005) and autumn (1990-2005) bottom trawl surveys; annual USSR/Russian spring surveys (1972-91); and Spanish surveys in the NAFO Regulatory Area of Div. 3NO (1995-2005).

Assessment: An analytical assessment using a stock production model was presented to estimate stock status in 2006. Since the moratorium (1994-97), the catches have been low enough each year to allow the stock to grow.

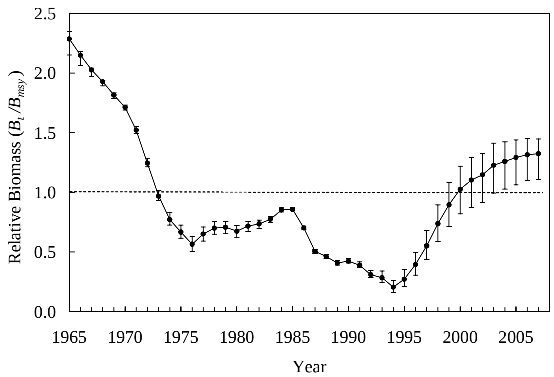


Fishing Mortality: Has been below F_{msy} since 1994 and is projected to be about 65% of F_{msy} in 2006 with an assumed catch of 15 000 tons (TAC).



Recruitment: The cohort model for relative year-class strength was not updated in 2006 due to uncertainty in modelling the age data. No conclusions on recruitment could be drawn from a length-based analysis.

Biomass: Biomass estimates in the Spanish and both Canadian surveys have been relatively high since 2000. Relative biomass from the production model has been increasing since 1994, is estimated to be above the level of B_{msy} after 1999, and is about 30% above B_{msy} in 2006.



State of Stock: Stock size has steadily increased since 1994 and now has begun to level off. It is estimated to be at a level well above that of the mid-1980s.

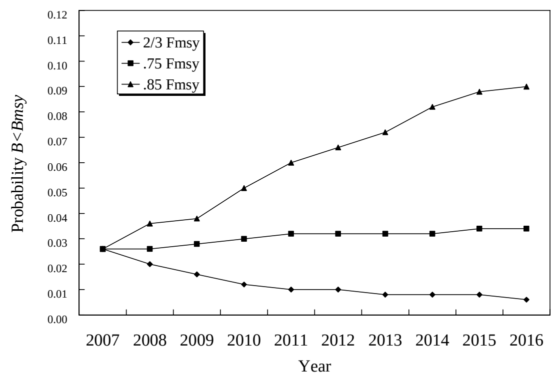
Catch Projections in 2007-08: Catch projections (in '000 tons) at various levels of *F* are shown below.

Projected F	Catch 2007	Catch 2008
F_{2006} (catch=15 000t)	15.1	15.2
2/3 F_{msy}	15.5	15.6
75% F_{msy}	17.3	17.1
85% F_{msy}	19.4	18.9
F_{msy}	22.5	21.3

Recommendation: Total catches should not exceed 15 500 tons in 2007 and 2008. This corresponds to catch projections based on *F* = 2/3 F_{msy} and an assumed catch of 15 000 tons (= TAC) in the year 2006. Scientific Council noted that catches exceeded TACs in 1998-2001, but were lower than the TACs since 2002. Scientific Council again notes that the advice applies to all removals (directed plus bycatch).

Reference Points: 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 Limit Reference Point Study Group in April 2004. Currently the biomass is estimated to be above B_{lim} and F below F_{lim}, so the stock is in the safe zone as defined in the NAFO Precautionary Approach Framework.

Medium Term Considerations: F_{msy} was estimated to be 0.22. Projections were made to estimate catch for each year from 2007 to 2016 at a range of fishing mortalities. The results at 2/3F_{msy} suggest that the projected catch would remain constant at 15 600 tons to the year 2016. At 0.75 F_{msy} and 0.85 F_{msy}, catch and biomass are projected to decrease slightly over the 10 years. At 2/3 F_{msy}, the estimated probability of biomass falling below B_{msy} decreases over the 10 years. At 0.75 F_{msy}, the probability of biomass falling below B_{msy} remains stable, and at *F* = 0.85 F_{msy}, the probability increases. The probabilities were low under all projected levels of fishing mortality. It was not possible at this time to quantify the risk of stock size being below B_{lim} (30% B_{msy}), but these probabilities are likely to be very low under all 3 projected levels of *F*.



Special Comment: Age-based reference points are not available for this stock at this time. Scientific Council noted that considerable progress has been made on ageing of yellowtail in recent years and recommends that priority be given to restore the Council's ability to do age-structured analyses on this stock.

The next Scientific Council assessment of this stock will be in 2008.

Sources of Information: SCR Doc. 06/13, 23, 29, 40, 41, 48; SCS Doc. 05/ 5, 6, 8; SCS Doc. 06/7, 9.

Thorny Skate (Amblyraja radiata) in Divisions 3L, 3N and 3O and Subdivison 3Ps

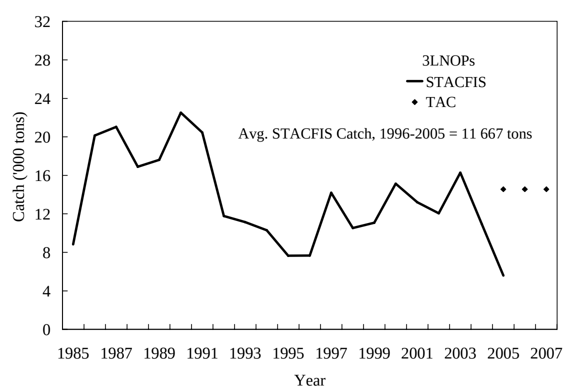
Background: Thorny skate in Div. 3LNO was previously treated as an assessment unit within NAFO. However, distribution dynamics and studies on biological characteristics suggest a single stock within Div. 3LNOPs. This report treats thorny skate within Div. 3LNOPs as the stock unit.

Fishery and Catches: Commercial catches of skates comprise a mixture of skate species. However, thorny skate represents about 95% of the skates taken in the catches. Thus, the skate fishery on the Grand Banks can be considered as directed for thorny skate.

The main participants in this fishery are EU-Spain, Canada, Russia and EU-Portugal. There are substantial uncertainties in the catch levels prior to 1996. Nominal catches increased in the mid-1980s with the commencement of a directed fishery for thorny skate. Catches in 3LNOPs peaked at about 36 000 tons in 1991, averaged 25 000 tons from 1985 to 1991, and were reduced to 9 600 tons from 1992 to 1995. Catch levels as estimated by STACFIS on Div. 3LNOPs have averaged 11 700 tons since 1996. This species has been regulated by quota in Div. 3LNO since 2005 (13 500 tons 2005-2007), and separately within Canadian waters in Subdiv. 3Ps (1 050 tons in 2005).

	3LNOPs Catch ('000 tons)		TAC ('000 tons)[1]	
Year	STACFIS	STAT. 21A	Rec.	Agreed
2003	16.3	14.3[2]		
2004	10.9	11.8[2]		
2005	5.6	3.6[2]	11[3]	14.55
2006			11[3]	14.55

[1] TAC includes NAFO (3LNO) plus Canada (3Ps)
[2] Provisional
[3] Refers to 3LNO only.



Data: Length frequencies were available for EU-Spain (1985-1991 and 1997-2005), EU-Portugal (2002-2004), Canada (1994-2005) and Russia (1998-2005).

Indices of biomass from the Canadian spring survey in Div. 3L, 3N, 3O and Subdiv. 3Ps employed a Yankee 41 trawl from 1972-1982, an Engel trawl 1984 to the autumn of 1995 and a Campelen 1800 trawl thereafter. The latter two survey series have been standardized to Campelen equivalents. Maximum depth surveyed in the spring was 366 m before 1991 and ~750 m thereafter.

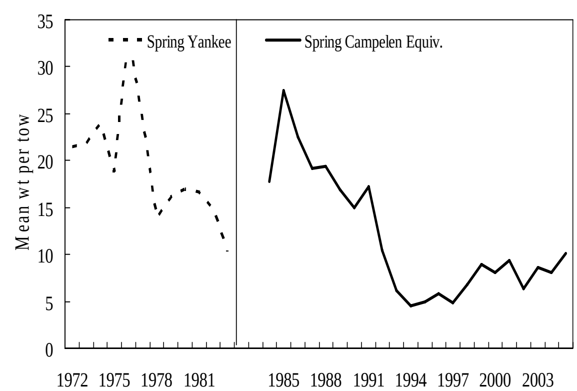
Spanish survey biomass indices in Div. 3NO were available for 1997-2005 in Campelen equivalents.

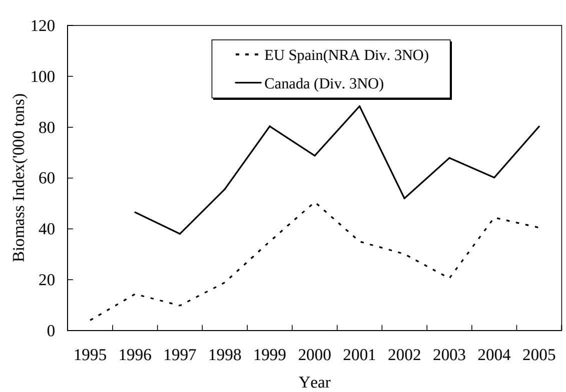
Assessment: An analytical assessment was presented but was not accepted.

Recruitment: Not available.

Biomass: The Canadian spring Yankee survey biomass index fluctuated without trend prior to 1983. The Campelen equivalent biomass index declined rapidly from 1985 until the early-1990s and has been stable or has increased slightly since. The pattern from the Canadian autumn survey, for comparable periods, was similar.

The biomass trajectory from the Spanish survey was very similar to that of the Canadian spring survey. However, the Spanish survey was conducted in the NRA portion of Div. 3NO while the Canadian survey covered the entire extent of Div. 3NO.





Fishing Mortality. Relative *F* increased from ~7% in the mid-1980s to an average of ~15% in the late 1990s then declined from ~13% in 2000-2003 to 4% in 2005, the lowest level in the time series.

State of the Stock: The stock is presently near its lowest level over the standardized time series (since 1984). The current state of the stock is unclear compared to the historic (pre-1980s) period. The biomass has been relatively stable from 1996 to 2005 but at a lower level than in the mid-1980s During 1996-2005, average catch as estimated by STACFIS was about 11 700 tons.

Recommendation: Scientific Council recommended that thorny skate be managed as a unit within Div. 3LNO and Subdiv. 3Ps.
Scientific Council recommended that for Div. 3LNOPs, catches not exceed 11 000 tons in 2007 and 2008.
Reference Points: Not determined.

Special Comments: While the biomass has remained relatively constant since the mid-1990s, the spatial dynamics have not. The density of skate increased up to 2002 within the area on the southwest Grand Bank where >80% of the biomass has concentrated in recent years. Extent of the high density concentrations of thorny skate have increased from ~4% of the total area of the Grand Banks in 1992-1995 to 15% after 2004-2005. However, area without skate, mainly in Div. 3L has also continued to increase from 8% to 22% during that same period.

The life history characteristics of thorny skate result in low intrinsic rates of increase and are thought to lead to low resilience to fishing mortality.

The next Scientific Council assessment will be in 2008.

Sources of Information: SCR Doc. 06/14, 44; SCS Doc. 06/7, 9

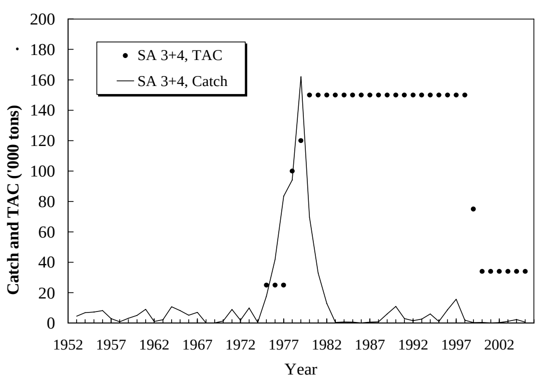
Northern Shortfin Squid (Illex illecebrosus) in Subareas 3 and 4

Background: Northern shortfin squid is an annual species (1-year life cycle) that is considered to comprise a unit stock throughout its range in the Northwest Atlantic Ocean, from Newfoundland to Florida, including Subareas 3-6.

Fishery and Catches: Catches in Subareas 3+4 increased during the late-1970s, averaging 80 600 tons during 1976-1981, and reached a peak of 162 100 tons in 1979. Thereafter, catches in Subareas 3+4 declined sharply to 100 tons in 1986 and then increased to 11 000 tons in 1990. During 1991-1995, catches in Subareas 3+4 ranged between about 1 000 tons and 6 000 tons, then increased to 15 600 tons in 1997; the highest level since 1981. Catches declined from 1 00 tons in 1998 to 60 tons in 2001, then subsequently increased to 2 300 tons in 2004. In 2005, catches were 600 tons. A TAC for Subareas 3+4 was first established in 1975 at 25 000 tons, but was increased in 1978, 1979 and 1980. The Subareas 3+4 TAC remained at 150 000 tons during 1980-1998 and was set at 75 000 tons for 1999 and 34 000 tons for 2000-2005.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	1.1	1.1[1]	19-34	34
2004	2.3	2.3[1]	19-34	34
2005	0.6	0.6[1]	19-34	34
2006			19-34	34

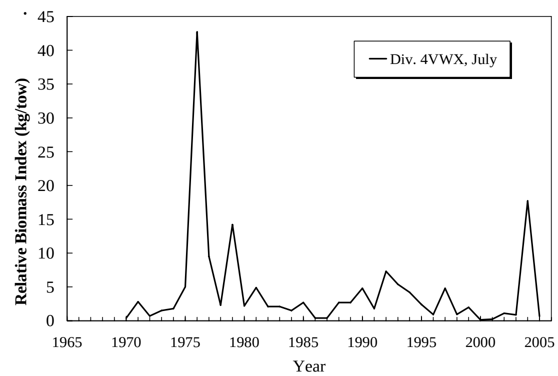
[1] Provisional.



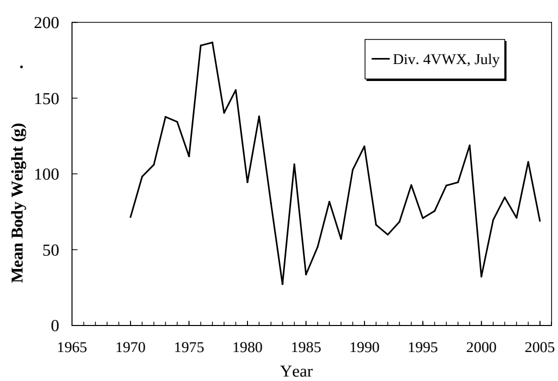
Data: Relative biomass and abundance indices were available from annual Canadian bottom trawl research surveys conducted in Subarea 4 in July on the Scotian Shelf (Div. 4VWX, 1970-2005) and in September in the southern Gulf of St. Lawrence (Div. 4T, 1971-2005). The July survey indices are assumed to reflect relative biomass at the beginning of the fishing season.

Assessment: Absolute biomass, fishing mortality rates and recruitment estimates for northern shortfin squid in SA 3+4 were not available.

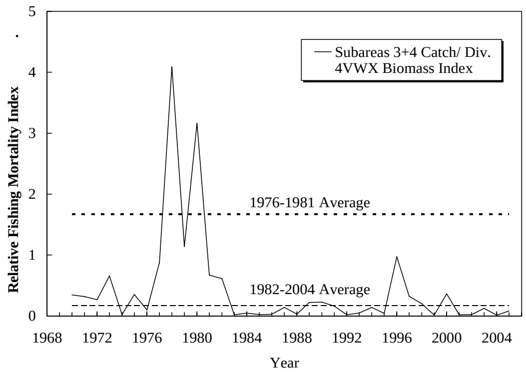
Biomass: Research survey biomass indices from Div. 4VWX reached peak levels during the late-1970s, indicating that this was a period of high squid productivity. Since 1982, survey biomass indices have been markedly lower. During 1998-2003 and in 2005, biomass indices were below the 1982-2004 average for the low productivity period.



Body Size: Annual mean body weights of squid from the Div. 4VWX survey declined markedly during 1982-1983, following a period of much higher mean weights during 1976-1981. Squid size increased gradually thereafter, and in 1999, reached the largest size since 1981. Mean body weight was the lowest on record in 2000, then increased slightly in 2001 and was near the 1982-2004 low productivity period average during most years thereafter.



Relative Fishing Mortality Indices: Relative fishing mortality indices were highest during 1978-1980 and averaged 1.67 during the period of highest catch (1976-1981). During 1982-2004, the indices were much lower and averaged 0.17. The 2005 index was well below the 1982-2004 average for the low productivity period.



State of the Stock: Based on the below average biomass index and mean size of squid in the Div. 4VWX survey during 2005, the northern shortfin squid resource in Subareas 3+4 remained in a state of low productivity in 2005.

Recommendation: Based on available information, including an analysis of the upper range of yields that might be expected under the present low productivity regime (19 000-34 000 tons), the Council advises that the TAC for 2007 and 2008 be set between 19 000 and 34 000 tons.

The advised TAC range is applicable only during periods of low productivity. During periods of high productivity, higher catches and TAC levels are appropriate.

Reference Points: *Northern shortfin squid* is an annual, semelparous species. Recruitment is strongly influenced by environmental conditions, and as a result, the Subareas 3+4 stock component has experienced low and high productivity states. Since the onset of the 1982 low productivity period, the magnitude of the Div. 4VWX biomass index has not consistently reflected the magnitude of the fishery removals during each respective year. Given this inconsistent response and the lack of a stock-recruitment relationship, limit reference points or proxies thereof are not currently estimable for the Subareas 3+4 stock component.

Special Comments: It is important to note that northern shortfin squid in Subareas 3-6 (and further south to Florida) are considered to comprise a unit stock and that the current assessment only applies to the northern stock component.

The 2006 assessment advice applies to the period 2007-2008. The next assessment of this stock will occur in 2008.

Sources of Information: SCR Doc. 98/59, 75, 06/45, 46.

c) **Special Requests for Management Advice**

i) **The Precautionary Approach** (Item 4-5)

The Chair noted that the reference points indicated in the Fisheries Commission request were being applied to the individual stock assessments as analysis permits.

ii) **Evaluation of Recovery Plans** (Item 6)

The Fisheries Commission's recovery plan for Greenland halibut in Subarea 2 and Division 3KLMNO was evaluated and conclusions are presented in the Greenland halibut section.

iii) **Pelagic *Sebastes mentella* (Redfish) in Subareas 1-3 and Adjacent ICES Area** (Item 7)

Regarding pelagic redfish *S. mentella* 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 Scientific Council notes that the following information is presented in the Spring 2006 ICES ACFM Report on the Pelagic Redfish Stocks in the Irminger Sea and Adjacent Areas (ICES CM2006/ACFM:26):

STOCK AFFINITY

"A working document was presented to ICES, which argues that concentrations of pelagic and demersal *S. mentella* are ecological groups of a biologically single population of *S. mentella* in the Irminger Sea and adjacent waters. Two studies on geographic variation in otolith shapes and otolith microchemistry (Stransky *et al.*, 2005a, b) have been published recently, showing high individual variation within areas and low separation between areas across the entire North Atlantic. Recent underwater tagging experiments (Sigurdsson *et al.*, 2006) showed that *S. mentella* tagged in the pelagic fisheries areas southwest off Iceland were recaptured in shelf areas in Division Va."

"The ICES working group on the assessment of *S. mentella* did not have sufficient expertise to thoroughly review the scientific content of these documents, nor to integrate these findings with previous information. Drawing firm conclusions on the stock identity of *S. mentella* in the Irminger Sea would require a broad critical synthesis of all existing information, including identifying shortcomings in the existing information, and drawing on experience with stock identity problems in general."

"In the absence of firm conclusions on the stock identity, ICES [will] continue to provide advice for the pelagic *S. mentella* unit in the Irminger Sea and adjacent waters separately from the demersal *S. mentella*."

STATUS OF STOCK

State of the Stock

"In the absence of reference points and an analytical assessment, the state of the stock cannot be fully evaluated. Even though the stock status is uncertain, trends in survey indices, the decline in CPUE in 2004 and 2005, and the rapid decrease in catches from 2004 suggest that the stock is in a state of rapid depletion."

Single-stock exploitation boundaries

"Even though the stock status is uncertain, trends in survey indices, CPUE data, and the development of the fishery suggest that the stock is in a state of rapid depletion. **Therefore, ICES recommends that no fishing takes place. The stock should continue to be monitored, and the fishery should not be reopened unless there are clear indications of recovery.**"

Management considerations

"NEAFC Contracting Parties have agreed that a maximum of 80% of the catches of pelagic redfish can be taken prior to 1 July 2006. It is expected that if a substantial reduction in TAC is implemented a greater share of the catches will therefore be taken prior to 1 July, i.e. in the northeastern area where fishery is conducted in the first half of the year."

"ICES has in the last two years advised that catches should not exceed 41 000 tons, i.e. the catches exerted in the period 1989-1992. After that period, quota and catches have always been far above that level. CPUE dropped steeply in 2004, and declined further in 2005, in particular in the NE part of the area. CPUE data are considered less reliable than survey indices, because CPUE may remain stable in spite of a decline of the stock, in particular with fish that tend to aggregate, as *S. mentella* does. In recent years, hydographic conditions may have favoured such aggregation. In this situation, a sharp decline in CPUE most likely signals that the resource is being exhausted. Catches in 2005 were markedly lower than in previous years. There is no international agreement on quotas in this fishery, but autonomous quotas have been in effect, and none of the major fleets have taken their quota in 2005. The acoustic survey estimate in 2005 was at the same low level as in 1999 and 2001, but much lower than in the early 1990s. Also, the acoustic survey covers only the upper part of the water column. The survey as well as the catches in 2005 indicates a substantial decrease in the abundance of fish larger than 40 cm. The trawl surveys only cover a short time span and show no trend, but are inconsistent from year to year."

"These observations taken together raise serious concern that the stock is more depleted than previously assumed. *Sebastes mentella* is a typical deep-sea species with late maturation and slow growth, and is hence considered to be vulnerable to overexploitation, taking long to recover if depleted. All this, together with the unclear stock situation leads ICES to conclude that fishery on this stock cannot be recommended until there are clear indications of recovery."

"ICES notes that monitoring of the stock is essential in order to keep track of biomass changes as they occur. Similarly, it is important to gather the information needed to evaluate the productivity of the stock. This includes information on recruitment, nursery areas, stock identification, and biomass estimation."

"A comparison of the number of vessels fishing the resource and reporting to NEAFC by VMS with those visible on satellite images indicates that the unreported effort might be a significant amount. During the observation days in June 2002, 2003, and 2004 (in the main fishing season), the effort could be more than 15 33% higher than reported to NEAFC, and thus the unreported catch could be in that order of magnitude. No information is available for 2005."

"The stock structure of redfish *S. mentella* in Subareas V, VI, XII, and XIV, and in the NAFO Convention Area has been evaluated by an ICES study group in 2004. The outcome is not conclusive and supports different hypotheses (from a one-stock- to different multi-stock-hypotheses). Consequently, and solely for practical reasons, the perception of stock structure in this report is unchanged from the 2003 report. Additional information on stock structure has been available since 2004. Drawing conclusions from this information would require a comprehensive evaluation that integrates these results with those from other disciplines. It is suggested that this is done by a panel of selected experts on stock identity."

"Commercial CPUE series were previously used to determine stock size. However, the fishery targets pelagic aggregating fish and fishing technology is improving at an increasing rate. Therefore, stable or increasing CPUEs are not considered to reflect the stock status reliably, but decreasing CPUE likely indicates a decreasing stock. Overall CPUEs declined between 1994 and 1997 and have since fluctuated without a clear trend. However, all nations reported a substantial decline in CPUE in 2004 and 2005."

References

Sigurdsson, T., V. Thorsteinsson, and L. Gústafsson. 2006. In situ tagging of deep-sea redfish: application of an underwater, fish-tagging system. *ICES J. Mar. Sci.*, **63**: 523-531.

Stransky, C., S. Gudmundsdottir, T. Sigurdsson, S. Lemvig, K. Nedreaas, and F. Saborido-Rey. 2005a. Age determination and growth of Atlantic redfish (*Sebastes marinus* and *S. mentella*): bias and precision of age readers and otolith preparation methods. *ICES J. Mar. Sci.*, **62**: 655-670.

Stransky, C., G. Kanisch, A. Krüger, and S. Purkl. 2005b. Radiometric age validation of golden redfish (*Sebastes marinus*) and deep-sea redfish (*S. mentella*) in the Northeast Atlantic. *Fish. Res.*, **74**: 186-197.

iv) **Spiny Dogfish (*Squalus acanthias*) and Black Dogfish (*Centroscyllium fabricii*) in the NRA** (SCR Doc. 06/20, 44) (Item 8)

The Scientific Council was requested to review all available information from both research vessel surveys and commercial catches on the stock structure, relative biomass, geographic distribution, life history, and size/age/sex composition of spiny dogfish (*Squalus acanthias*) and black dogfish (*Centroscyllium fabricii*) occurring within the NAFO Regulatory Area and update the information on the latter species previously provided by the Scientific Council in 2001. For both species, the Council is requested to provide historical and recent information on catches and bycatches, and to identify those fisheries in which either of the two species were taken as bycatch.

Spiny dogfish

Spiny dogfish is a temperate shelf species and on the Grand Banks is at the northern fringe of a much wider distribution in the northwest Atlantic (Fig. 1). It was previously thought to form a unit stock in NAFO Subareas 2-6 although tagging studies suggest that the population structure and movements are complex. Spiny dogfish are observed on St. Pierre Bank during all months, also moving inshore around Newfoundland in the summer months. Thus, at least some portion of the population does not migrate south in the winter. Only 6% of the Canadian distribution (area occupied) of spiny dogfish occurs in Div. 3LNOPs. On average, 10% of the distribution and <0.5% of the abundance of spiny dogfish in 3LNOPs occurs in the NRA (Fig. 2). Thus, spiny dogfish occurring in the NRA constitute only a tiny fraction of the northwest Atlantic population. Only fish >58 cm are observed on the Grand Banks indicating that early life history including pupping does not occur there (Fig. 3).

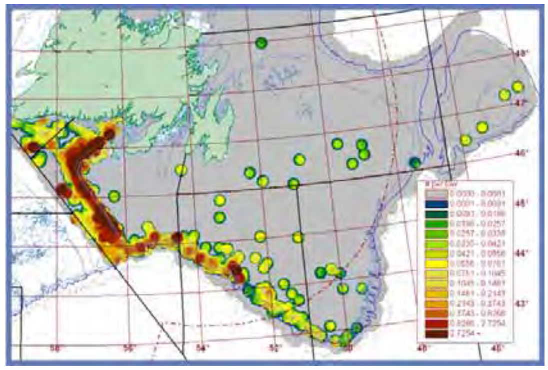


Fig. 1. Distribution of spiny dogfish on the Grand Banks, kg per tow 1971-2005 Canadian spring trawl survey

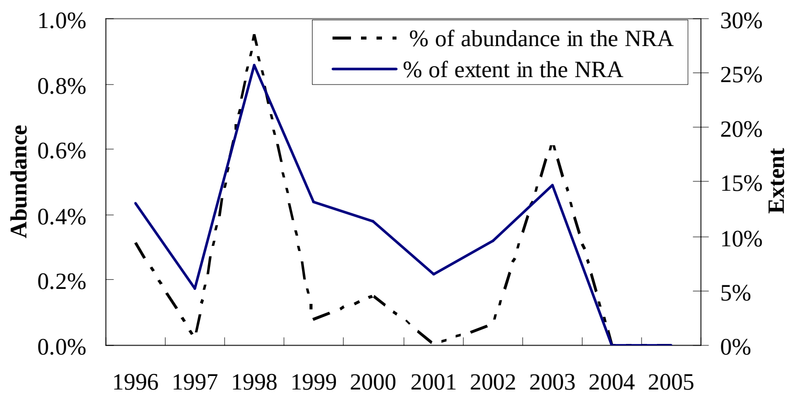


Fig. 2. Proportion of extent (area occupied) of distribution and abundance of spiny dogfish in Div. 3LNOPs that occurs in the NRA.

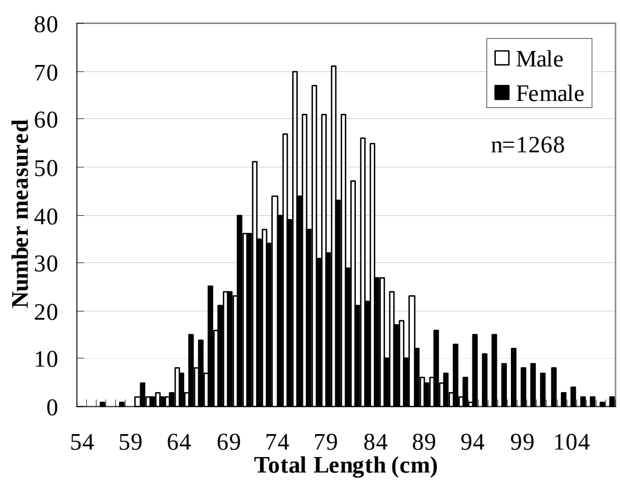


Fig. 3. Frequency distribution of spiny dogfish on the Grand Banks from Canadian trawl surveys, 1974-2002.

The Canadian survey index of abundance for spiny dogfish on the Grand Banks is highly variable, without trend. Given their highly aggregated, restricted distribution and migratory behaviour, it is unlikely that the survey indices reflect trends in population size. However, over the past ten years, the area occupied by spiny dogfish on the Grand Banks has diminished. They have not been recorded by Canadian surveys in the NRA since 2003. Catches of spiny dogfish in the Spanish Div. 3NO and 3M surveys in the NRA were small and sporadic, at depths <500 m.

Small amounts of spiny dogfish were reported in Div. 3LMNO, averaging 7 tons annually from this area in 2000-2005 (Table 1)

TABLE 1. Reported catches of dogfish in Div. 3LMNO.

Spiny Dogfish					
Year	**3L**	**3M**	**3N**	**3O**	**Total**
2000					0
2001	1				1
2002					0
2003	6	3	22		31
2004	5	2	1		8
2005					0
Dogfish ns					
Year	**3L**	**3M**	**3N**	**3O**	**Total**
2000	107	133	152	10	402
2001	194	114	357	11	676
2002	152	91	188	43	474
2003	248	89	256	19	612
2004	145	43	157	20	365
2005	3	0	6		9

Canadian fishery observer data was used to estimate levels of bycatch in Canadian fisheries. On average, 14 tons of spiny dogfish was taken annually as bycatch in Canadian St Pierre Bank (Div. 3Ps) fisheries from 1998-2005 primarily in the cod gillnet fishery, mixed halibut/monkfish/white hake gillnet and longline fisheries, the redfish trawl fishery as well as in crab pots and scallop dredges.

Black dogfish

Black dogfish is a bathydemersal species distributed along the entire length of Canadian and NRA slope waters mainly at depths >700 m and also in the Laurentian Channel at depths of 350-600 m (Fig. 4). Information on stock structure is conjectural but all evidence suggests that black dogfish in Canadian waters form a single stock and is different from those off Greenland.

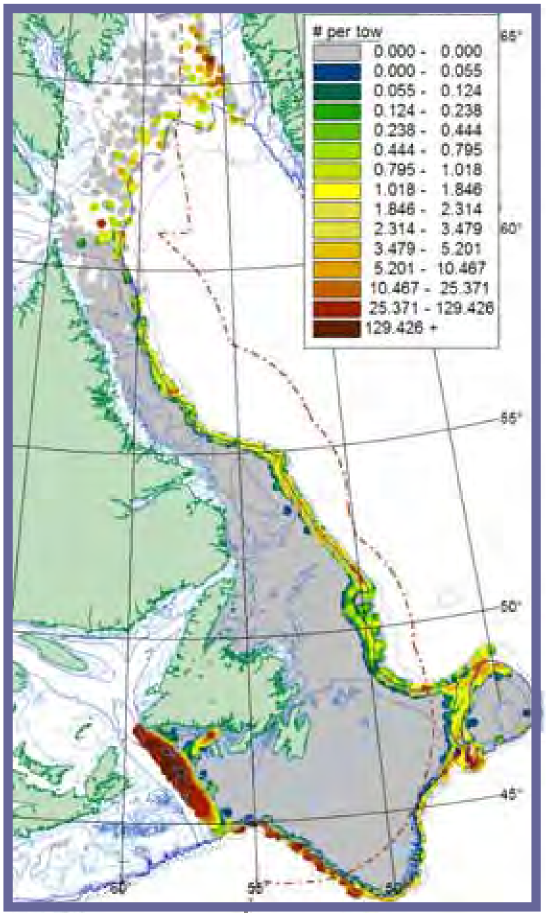


Fig. 4. Distribution of black dogfish in Canadian and NRA waters, kg per tow, from the 1971-2005 Canadian spring trawl surveys.

Black dogfish have a highly structured distribution with separation of life stages by area and depth (Fig. 5). Large mature (presumably pregnant) females are concentrated along the periphery (<400 m) of the Laurentian Channel. Newly born (17-30 cm) young concentrate in the deeper mid-channel and older juveniles are found within the deepest part of the channel at 500-600 m. Young of the year are largely absent from areas outside the Channel, except off Greenland. Some older juveniles but primarily adults (>60 cm) occupy the slope waters off Canada at depths >800 m, including within the NRA and around the Flemish Cap. Most fish in the Div. 3NO Spanish survey were between 40 and 75 cm (Fig. 6). This spatially different size structure indicates that black dogfish reproduction (pupping) occurs only in the Laurentian Channel while presumably larger juveniles and non-reproductive adults occupy slope waters.

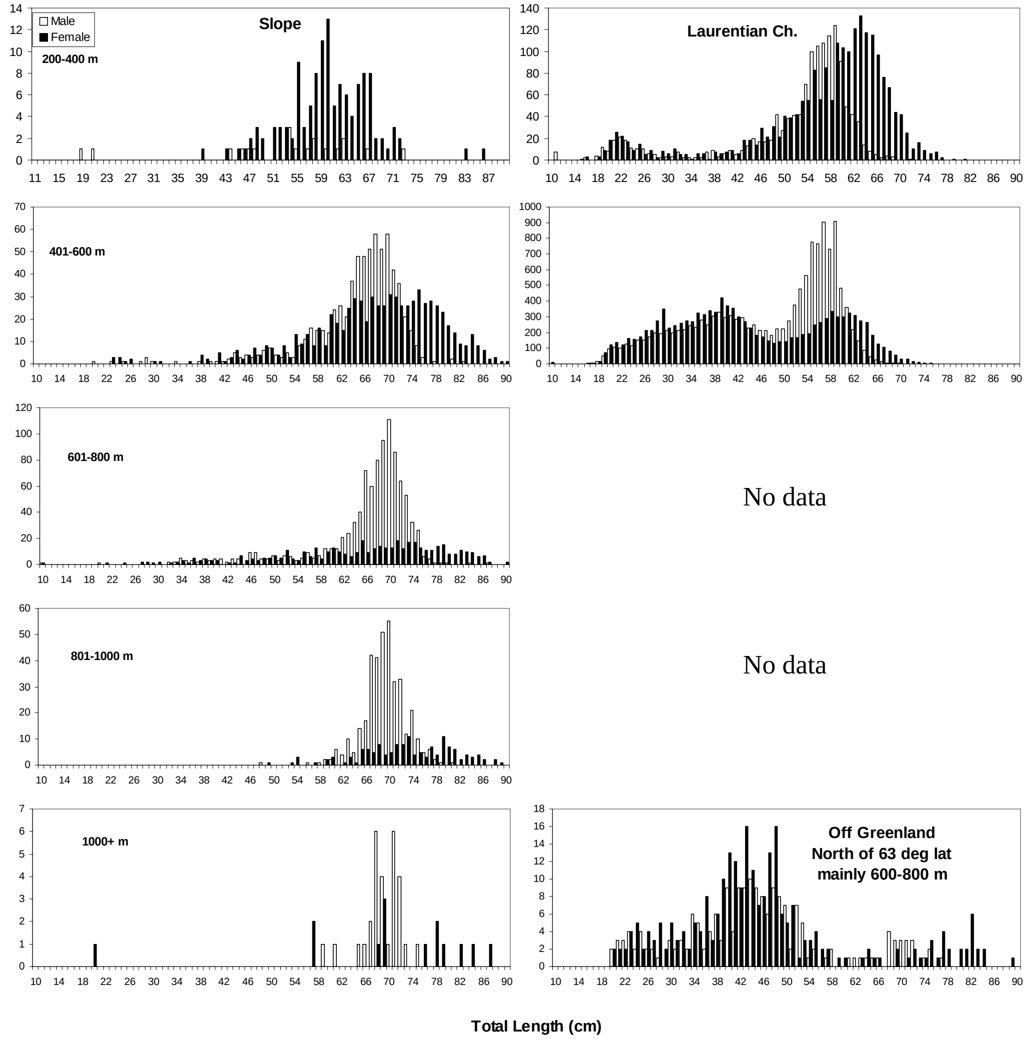


Fig. 5. Size of black dogfish by depth and location (Laurentian Channel, Slope waters south of Lat 63° and slope off Greenland).

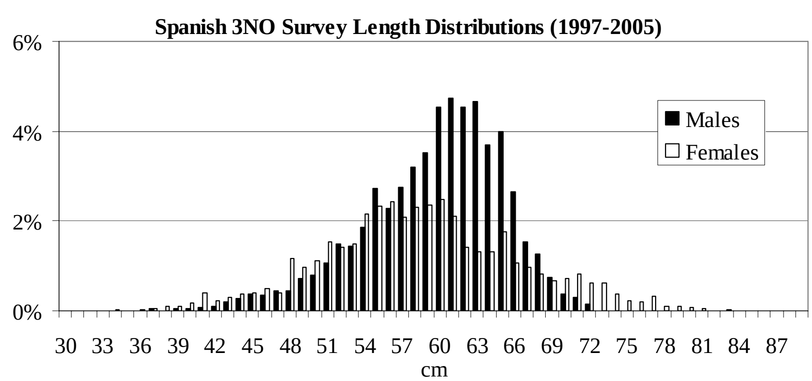


Fig. 6. Spanish 3NO survey length frequencies of black dogfish in the NRA.

On average, 41% of the extent of the area occupied by black dogfish on the Grand Banks (Div. 3LNOPs) occurred within the NRA (15% of the Canadian distribution, Fig. 7). However, only 1.5% of the total Canadian abundance occurs within in the NRA because young of the year and juveniles are about 10 times more densely concentrated in the Laurentian Channel compared to adults in slope waters of the NRA.

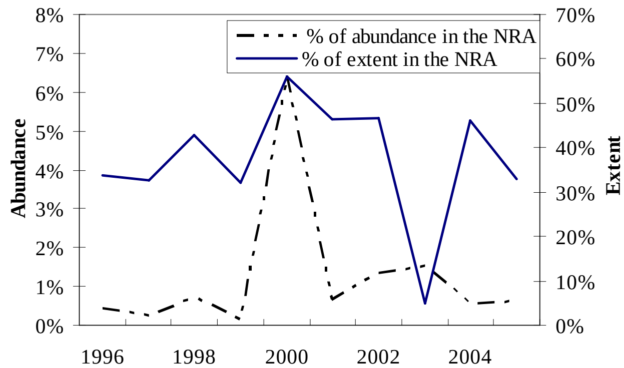


Fig. 7. Proportion of extent of distribution and abundance of black dogfish in Div. 3LNOPs that occurs in the NRA.

In the Laurentian Channel, the spring index of abundance fluctuated at a relatively low level during the 1970s-early 1980s then increased and stabilized from 1990 to 1995 (Fig. 8a). Since that time, the index has declined, perhaps reaching stability in recent years. This index comprises primarily juveniles and mature females. The 1995-2005 index for the slope fluctuated without trend. The Spanish survey index for Div. 3NO indicated an increase in abundance between 2002 and 2005.

Black dogfish are not reported in the NAFO statistics. However, an average of 423 tons of "dogfish (ns)" was reported annually between 2000 and 2005. This unspecified dogfish category may comprise up to 5 species but black dogfish is the most common shark in the NRA and are most abundant along the slope at the depths that Greenland halibut are fished. Thus, "dogfish (ns)" likely comprise mainly black dogfish.

Bycatch in Canadian waters (based on fishery observer bycatch records) averaged 68 tons annually between 1996 and 2005 and was observed in a wide range of fisheries primarily: with Greenland halibut (gillnet, longline, trawl), crab pots, shrimp, monkfish/white hake mixed fishery (gillnet, longline), redfish (trawl) and witch (trawl). Bycatch in the NRA was primarily associated with the Greenland halibut and redfish trawl fisheries. In 2005 Spanish catches in Div. 3LMNO were 47 tons. Sizes of fish captured in the Russian and EU-Spanish Greenland halibut trawl fisheries were similar, primarily ranging from 45-75 cm (older juveniles and adults) (Fig. 8b and c).

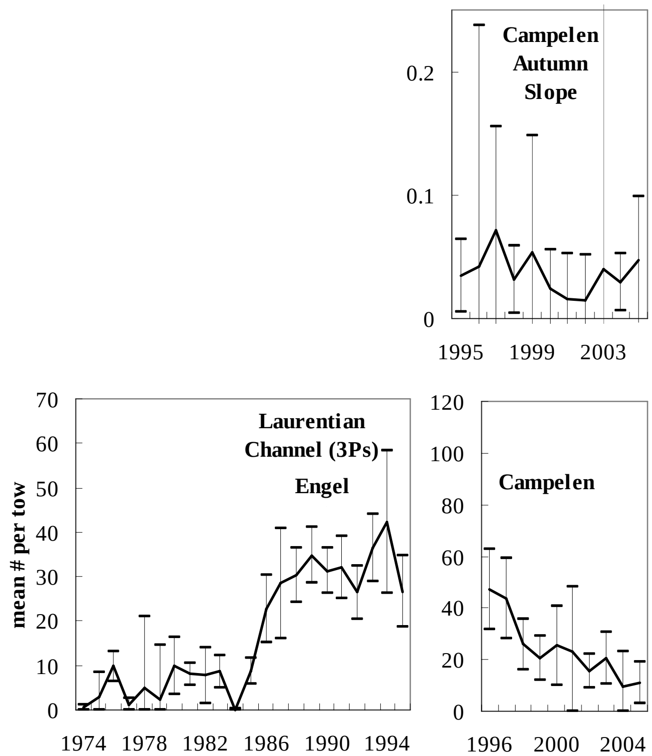


Fig. 8a. Black dogfish abundance indices: upper panel – Canadian autumn survey from slope waters; lower panels – Canadian spring survey in Subdiv. 3Ps.

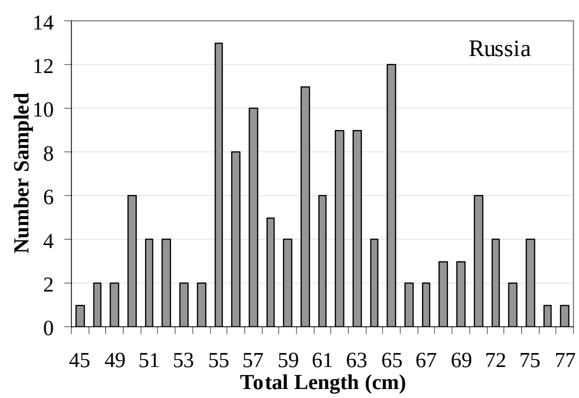


Fig. 8b. Length frequency of commercial bycatches of black dogfish in the Russian Greenland halibut fisheries in the NRA.

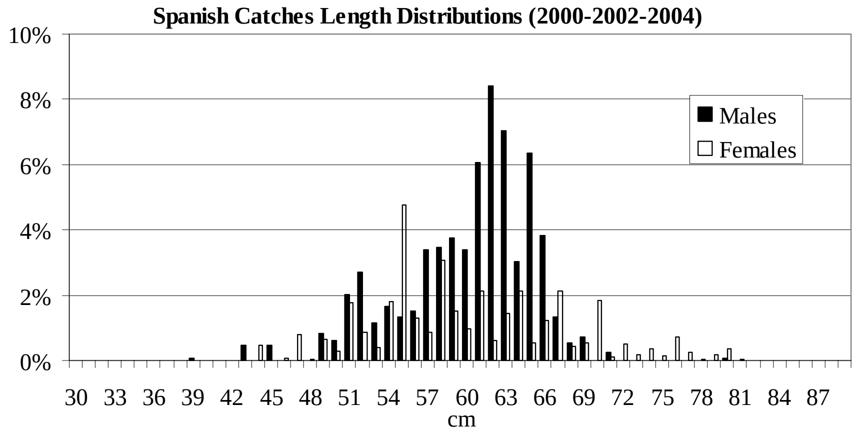


Fig. 8c. Length frequency of commercial bycatches of black dogfish in the Spanish Greenland halibut fisheries in the NRA.

Other Species

Four other species of small sharks have been recorded in the NRA, but none are abundant: the smooth dogfish (*Mustelus canis*) a warm temperate vagrant, Portuguese Shark (*Centroscymnus coelolepis*) the deepsea cat shark (*Apristurus profundorum*) and great lantern shark (*Etmopterus princes),* are all bathydemersal species.

v) **Deep-water Habitats**

In order to assist the Fisheries Commission in prioritizing the areas of ecological and biological significance and determining appropriate management measures to conserve vulnerable deep water habitats and sensitive areas, the following request was submitted to the Scientific Council:

I. *Regarding the conservation of vulnerable deep-water habitats, the NAFO Scientific Council is requested to:*

   a) D*evelop criteria for determining areas of marine ecological and biological significance, in particular areas associated with seamounts, hydrothermal vents, and cold-water corals in the NRA.*

   b) *Provide information on the distribution of cold-water corals, hydrothermal vents, and seamounts in the NAFO Regulatory area. To the extent that information allows, differentiate among*

      i) *Areas where there is information on which to evaluate the occurrence of corals;*

      ii) *Areas where concentrations of corals (soft/hard) are known to occur; and*

      iii) *Areas where concentrations of corals are unlikely to occur.*

   c) *Recognizing the unique character and relatively easy identification of seamounts, develop a data collection protocol for any survey, exploratory, or commercial fishing activity on seamounts in the NRA, to enhance scientific council's knowledge of these areas.*

II. *With view to assisting the Scientific Council's work, the Secretariat will be asked to provide information to Scientific Council on historic and recent fishing effort in areas identified in a), b) and c) in a summary fashion, based on VMS and observer data. This information should then be evaluated by Scientific Council to determine levels of fishing activity in these areas, and its potential impact on these areas.*

Scientific Council invited Dr Evan Edinger, Memorial University of Newfoundland, Canada, to give a presentation on corals and deep-water habitats. He presented recent studies that he undertook with his co-worker, Vonda Wareham, and provided the Council with the following summary of his presentation on "Coral distributions and conservation strategies in the Newfoundland and Labrador region":

"Deep-sea corals in Newfoundland and Labrador waters are broadly distributed along the continental slope. At least 23 species of corals are present, including skeletal gorgonians (8 spp.), antipatharians (2+ spp.), sea pens (7-10 spp.), scleractinian cup corals (4+ spp.), and alcyonacean soft corals (3-4 species). Most coral species are found only on continental slopes at depths greater than 150 m, except for the alcyonacean soft coral *Gersemia rubiformis*, which occurs at shelf depths. Cold water and lack of hard substrates probably limit most other corals from shelf depths. Major concentrations of all types of corals occur in the Davis Strait – Northern Labrador area, southeastern Labrador slope, the edge of the Northeast Newfoundland shelf, and the southwestern Grand Banks continental slope. Additional concentrations of soft corals, sea pens, and cup corals occur on the north side of the Flemish Cap, but the Flemish Cap data is derived exclusively from fisheries observer data and may be effort-biased. Areas where information on coral distributions are lacking include the south side of the Flemish Cap, the margins of the Orphan Basin, and waters deeper than 1400 m throughout the region."

"Criteria for determining deep-water Ecologically and Biologically Significant Areas (EBSA's) should follow established criteria for definition of terrestrial or shallow marine biodiversity hotspots: diversity, endemism, congruence, representativity, uniqueness (or rarity), resilience (inverse of sensitivity) and endangerment."

"Patterns of coral bycatch in commercial fisheries may be useful as a measure of endangerment. Greatest frequency of coral bycatch in commercial fisheries observer data occurred in the Greenland Halibut fishery, but the highest percentage of sets with corals occurred in the Atlantic Halibut, Redfish, and Greenland Halibut fisheries, in that order. Within the Greenland Halibut fishery, the highest frequency of coral observations came from the otter trawl gear sector, but the highest percentage of corals recorded was in the longline gear sector. The high percentage of sets with coral bycatch in longline sectors (Atlantic Halibut, Greenland Halibut) likely reflect high coral bycatch in very rocky untrawlable areas fished using longline gear. Knowledge of coral distributions, and rate of coral removal in commercial fisheries, particularly surrounding the Flemish Cap, would both be improved by coral collections by EU fisheries surveys and EU fisheries observers aboard commercial vessels."

"The authors will provide coral identification keys and collection protocols to the NAFO scientific council to ensure that data collected in Canadian and EU surveys or observer programs are comparable."

Scientific Council thanked Dr Edinger for an interesting presentation. During the discussion, it was noted that most of the presented information came from observers on Canadian vessels. Previous relevant studies undertaken by Scientific Council include the Russian Investigations and Deep Water Fishery on the Corner Rising Seamount in Subarea 6 (*NAFO Sci. Coun. Studies*, 30: 41-49) and the Spanish experimental trawl survey in Subareas 4 and 6 (NAFO SCR Doc. 05/32). This has also been addressed by Fisheries Commission in connection with EAF Interim Measures (Fisheries Commission Report September 2005, Annex 4, NAFO FC Doc. 05/15) which outlines the background for this requested agenda item.

Scientific Council noted that their current expertise is principally focussed on stock assessment of fin-fish, squid and shrimp, environment influence, and extends to seals through a joint NAFO/ICES WG. SC was undecided as to the best way to answer questions relating to the safeguarding of sensitive habitats, but strongly felt that these questions should first be addressed by a competent scientific body. Scientific Council noted that either Contracting Parties could select appropriate Advisors/Experts to attend Scientific Council meetings, or that WG formed some arrangement jointly with other organisations like ICES that have more appropriate expertise.

Scientific Council **recommended** that

- *criteria are developed for identifying sensitive areas,*
- *the collection of biological information important for safeguarding habitats from CP fishing surveys be incorporated as a standard routine in the surveys in the area, and further studies on bycatch be undertaken,*

- *fishing in sensitive areas, for example on and around sea mounts, be monitored, possibly by the provision of summary information based on VMS, and*
- *Contracting Parties identify the expertise necessary to allow Scientific Council to address issues relating to safeguarding habitats.*

vi) **Seals** (item 10)

The Chair said that this question had been referred to the Harp and Hooded Seals WG. They are meeting in June 2006 and would provide an answer to Scientific Council for consideration by the Council at the September 2006 meeting.

The NAFO Secretariat has received a request from the General Secretary, NAMMCO, to explore the possibility that NAMMCO assumes a formal joint role in the ICES-NAFO Harp and Hooded Seals Working Group. Scientific Council noted that requests for scientific advice relating to harp and hooded seals could already be made to the Working Group through ICES or NAFO Secretariats, where most of the countries belonging NAMMCO are also involved. As such, Scientific Council **recommended** that *the proposal made by NAMMCO to formally join the ICES-NAFO Harp and Hooded Seals Working Group be rejected.*

vii) **Scientific Observer Program** (Item 11)

The usefulness of observers involved in the NAFO Observer Programme to collect biological sampling data on board was considered. Scientific Council stressed the importance of the national Scientific Observer Programmes and believed that, in the interests of collecting the highest scientific quality data, these should continue to be operated and managed by the Contracting Parties' fisheries research centres. Scientific Council expressed concern that generalization of scientific sampling by the NAFO Observer Program could result in a worsening for national programs. Scientific Council **recommended** that *scientific sampling by the NAFO Observer Programme should manage to cover sampling catches of those Contracting Parties that did not have their own programmes, and that the electronic recording forms designed by the Secretariat be adopted for use by the NAFO Observer Programme for that purpose.*

viii) **Mesh Size Reductions for Div. 3O Redfish Fishery** (Item 12)

Taking into account that a reduction of mesh size in different type of trawls is an important element of harmonization of mesh size within and outside of 200-mile limit of the Canadian Zone in the target redfish fishery in Div. 3O, the Fisheries Commission the Scientific Council was requested to: *evaluate possible biological consequences of a reduction of mesh size to 90- 100 mm, such as:*

- *Impact on other stocks in the vicinity of redfish*
- *Merits of a minimum fish size*
- *Effect on size composition of redfish catches*
- *Catch efficiency of different size groups*

and provide an advice on the appropriateness of mesh size reduction.

Redfish are fished with either a mid-water trawl or a bottom trawl. Current regulations for Atlantic Canadian waters (inside the EEZ) are 90 mm mesh size and a minimum landing size of 22 cm for bottom trawls. The minimum mesh size in the NRA is 130 mm and there is no minimum landing size.

Russian investigations showed that 90% of redfish caught escaped from the mid-water trawl in 130 mm mesh size cod-ends during fishing and/or haul back. During haul back, these escaping fish were assumed to die due to the hydrostatic change and other injuries. The proportion of escapement from a 90 mm mesh cod-end in a mid-water trawl is around 30% (SCR Doc. 06/17).

Russia has presented results of redfish selectivity studies using cod-end mesh sizes of 88 mm, 100 mm 118 mm and 132 mm in mid-water trawls. The mid-water trawl bycatch in cod-ends with mesh sizes ranging from 100-132 mm is less than 1% (SCR Doc. 06/17). No information was presented on the bycatch when using bottom trawls but it is expected that both the size and species selectivity would be reduced with a decrease in mesh size, i.e. more smaller fish and more species would be caught with a reduction in cod-end mesh size.

Yield per recruit analysis was presented in 2006 based on selectivity data from Russian mid-water experiments as functions of a fishing mortality plotted for different mesh sizes (88 mm, 100 mm 118 mm and 132 mm). It indicated that yield per recruit would increase with larger mesh sizes, but only when fishing mortality was above recommended levels. For redfish, which is a slow-growing long-lived species, optimal exploitation rates are probably below 0.2, and then maximum Y/R estimates would occur for mesh sizes 88-100 mm at a low fishing mortality (SCR Doc. 06/17). Scientific Council noted some concerns about the analysis of the effect of selectivity on fishing mortality at age and the estimates for different mesh sizes that produced unrealistic estimates for larger mesh sizes. Scientific Council is requesting a more detailed analysis.

In response to Fisheries Commission,
Scientific Council can only comment on the results of the effect of mesh size reduction for a mid-water trawl fishery because all of the data and analyses were based on experimental cod-end selectivity experiments for mid-water trawls.

1) *Impact on other stocks in the vicinity of redfish:* the bycatch in a mid-water trawl fishery with a reduced cod-end mesh size is expected to have minimal effect on bycatch of other stocks.

2) *Merits of a minimum fish size:* None can be envisioned since using a small mesh such as 90 mm in a mid-water trawl fishery will decrease size selectivity by catching more small fish in the area. The minimum fish size must be set to match the selectivity properties of the mesh size used, to reduce the discarding of dead fish.

3) *Effect on size composition of redfish catches:* From the Russian analysis, the differences in the size composition of redfish in catches in mid-water trawls with mesh sizes of 88 mm, 100 mm 118 mm and 132 mm were less than expected based on the selectivity results provided.

4) *Catch efficiency of different size groups:* Selectivity experiments show that the proportion of smaller fish retained increases as mesh size decreases.

5) *Provide an advice on the appropriateness of mesh size reduction*: Scientific Council reiterates STACFIS (*NAFO Sci. Coun. Rep*., 1995, p. 120-121) view on the appropriateness of a mesh size reduction stated for a redfish fishery in Div. 3LN. Trawls with mesh over 90 mm may not result in significant long-term gains in yield if assumptions of high escapement mortality during the haul back for this species are correct. The size composition in the catches of a cod-end mesh size below the regulated minimum mesh size of 130 mm would include substantial numbers of small fish, which for females, would be several years younger than the age of maturity. This generates the concern that exploiting individuals of a fish stock many years before they have reached sexual maturity puts a stock at risk even at low levels of fishing mortality.

Nevertheless, if assumptions of high escapement mortality during the haul back in mid-water trawl fisheries for redfish using a regulated minimum 130 mm cod-end mesh size are correct then substantial numbers of small fish will also suffer mortality and have the same effect on SSB. A mid-water trawl fishery for redfish in Division 3O, using cod-end mesh size reduced to 90-100 mm, i.e., below the regulated 130 mm size, should need to be closely monitored to determine if additional management measures are required. Scientific Council does not support reducing minimum mesh size in bottom trawl fisheries.

Scientific Council shares the concern of the Fisheries Commission on the necessity of harmonizing mesh size regulations within and outside of the 200-mile limit of the Canadian Zone in the target redfish fishery in Div. 3O and recommends the continuation of more studies in this field. It is suggested that investigations be made into possible gear improvements that allow for escapement of small live fish at depth and yet retain all fish during haul back e.g. lastridge ropes, etc.

d) **Monitoring of Stocks for which Multi-year Advice was Provided in 2005**

The Scientific Council in 2005 provided 2-year advice (for 2006 and 2007) for 8 stocks (Cod in Div. 3NO, American plaice in Div. 3LNO, Witch flounder in Div. 2J + 3KL, Redfish in Div. 3M, Redfish in Div. LN, Redfish in Div. 3O, Capelin in Div. 3NO and White hake in Div. 3NOPs). The Scientific Council reviewed the status of these eight stocks (interim monitor) at this meeting in June 2006, and found no significant change in the status for any of these stocks. The next Scientific Council assessment of these stocks will be in 2007.

2. **Coastal States**

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

Canada requested the Scientific Council to:

1) *to advise on appropriate TAC levels for 2007, based on biomass distribution, for Greenland halibut in these areas separately: SA 2+Division 3K and Divisions 3LMNO.*

2) *provide information on the status of Greenland halibut in SA 2+ Div. 3KLMNO in relation to the Greenland Halibut Rebuilding Plan and Strategy, including commentary on progress in relation to the targets described in the Strategy. In particular Scientific Council is requested to advise:*

I. *whether the 5+ biomass projected for Jan 1 2008 in its 2006 assessment is larger or smaller than this value from Scientific Council's 2005 assessment.*

II. *whether the 5+ biomass projected for Jan 1 2008 in its 2006 assessment is larger or smaller than the 5+ biomass estimated for 1 Jan. 2003 in its 2006 assessment.*

III. *the probabilities that the 5+ biomass target of 140 000 tons will be achieved by the years 2010, 2015, and 2020. SC should assume that the Rebuilding Plan TACs will be followed in 2006 and 2007, and that various fishing mortality strategies, at least but not restricted to the following, are to be examined for 2008-2019:* $F_{01.}$, F_{max}, *and* F_{2005}.

The Council's response to point 1 was:

This request was made by Fisheries Commission to Scientific Council last year and no further data has been received to modify the reply given then (*NAFO Sci. Coun. Rep*., 2005, p. 31). This was that "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."

The Council's response to point 2 was:

Stochastic projections were carried using input data from the XSA summarised Table 2 and a recruitment bootstrapped in the 1975-2002 time series.

Attention is to be drawn on the fact that, as discussed by Patterson *et al*. (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. Scientific Council further cautions that long-term projections are completely determined by the recruitment assumptions applied, and that long-term projections should be regarded as an exercise in scenario modelling.

1) The distributions of the 5+ biomass estimates projected for 1 Jan 2008 in the 2006 assessment (following option 1) and the one projected in the 2005 assessment were compared and Fig. 9 shows that there is no significant differences in the estimates.

2) Figure 10 shows the cumulative distributions of the 5+ biomass estimates projected for 1 Jan 2008 following options 1 and 2. In either option, there is a very high probability that the 5+ biomass projected is smaller than the 5+ biomass estimated for 1 Jan 2003.

3) Long-term stochastic projections were conducted assuming that the catches in 2006 and 2007 follow the Rebuilding Plan TACs and assuming a fishing mortality strategy from 2008 onwards to be $F_{0.1}$, F_{max} and F_{2005}. Results are given in Figs. 11a-c and summarized in Table 2 for the different fishing values. Scientific Council noted that (i) the probability to achieve the 5+ biomass target of 140 000 tons by 2010 is very low in all the options analysed, (ii) the 5 + target biomass will be achieved with high probability in the scenario $F_{0.1}$ by 2015 whereas the probability will be low for the rest of scenarios, and (iii) for 2020, the 5 + target biomass will be achieved with high probability in the scenario $F_{0.1}$, with medium probability in the scenario F_{max} and with low probability in the *F* current scenario. Nevertheless, in view of low historic values of 10+ biomass, the recent low recruitment observed at these levels, and the recruitment assumption made in the projections it should be pointed out that the results may be overoptimistic. Scientific Council reiterates that these results are contingent on the recruitment assumption applied.

Table 2. Summary of stochastic projection results for different options of fishing mortalities.

	75-02 bootstrapped recruitment		
Rebuilding plan in 2006 & 2007	p(5+B >=140kt) in year		
F in years 2008-2019	2010	2015	2020
$F_{0.1}$	<5%	>95%	>95%
F_{max}	<5%	35%	64%
F_{2005}	<5%	<5%	<5%

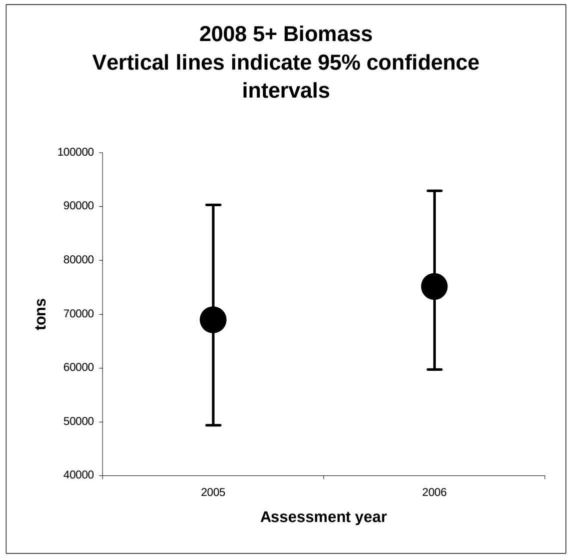
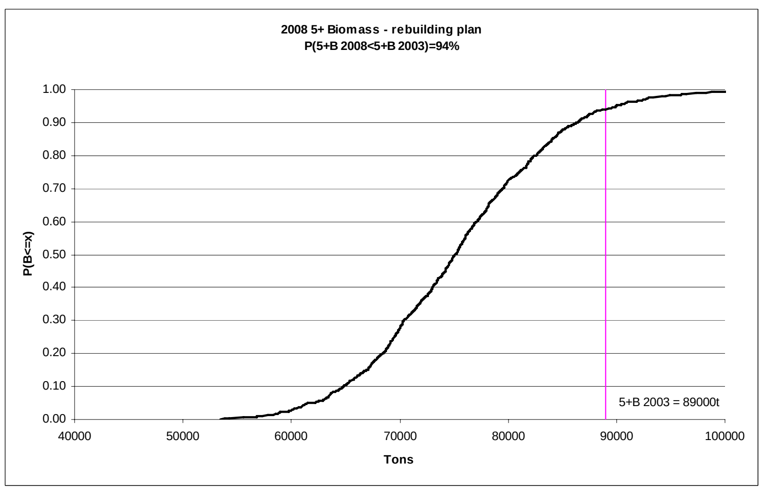


Fig. 9. 1- 5+ Biomass at 1st January 2008 – comparison of estimates from Assessment 2006 and 2005.



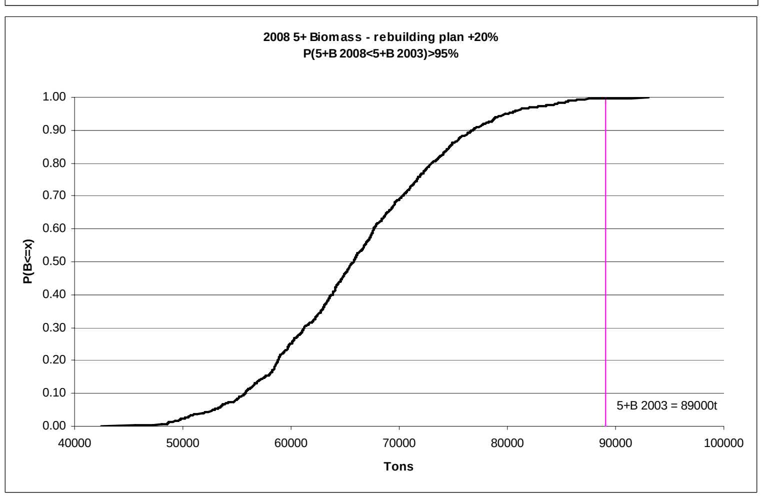


Fig. 10. 2- 5+ Biomass at 1st January 2008 – comparison of estimates with 5+Biomass at 1st January 2003

Greenland Halibut in Subareas 2 + 3KLMNO - Stochastic projections under current management plan
F0.1 from 2008 on **1975-2002 bootstrapped Recruitment**
1000 iterations
Uncertainties on all parameters taken into account @Risk -Risk analysis Software
Lines show 5, 25, 50, 75 and 95 percentiles

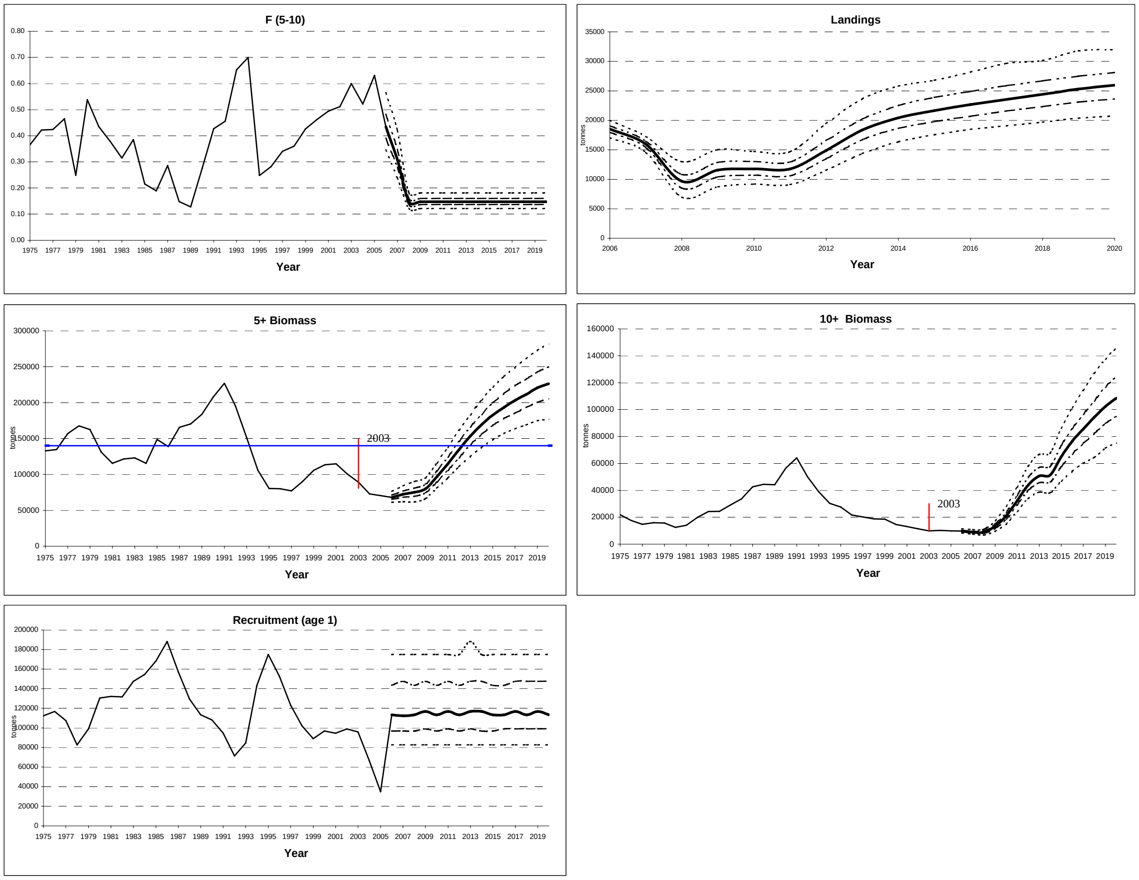


Fig. 11a. Greenland halibut in SA 2+ 3KLMNO: Stochastic projections.

Greenland Halibut in Subareas 2 + 3KLMNO - Stochastic projections under current management plan
Fmax from 2008 on **1975-2002 bootstrapped Recruitment**

1000 iterations

Uncertainties on all parameters taken into account @Risk -Risk analysis Software

Lines show 5, 25, 50, 75 and 95 percentiles

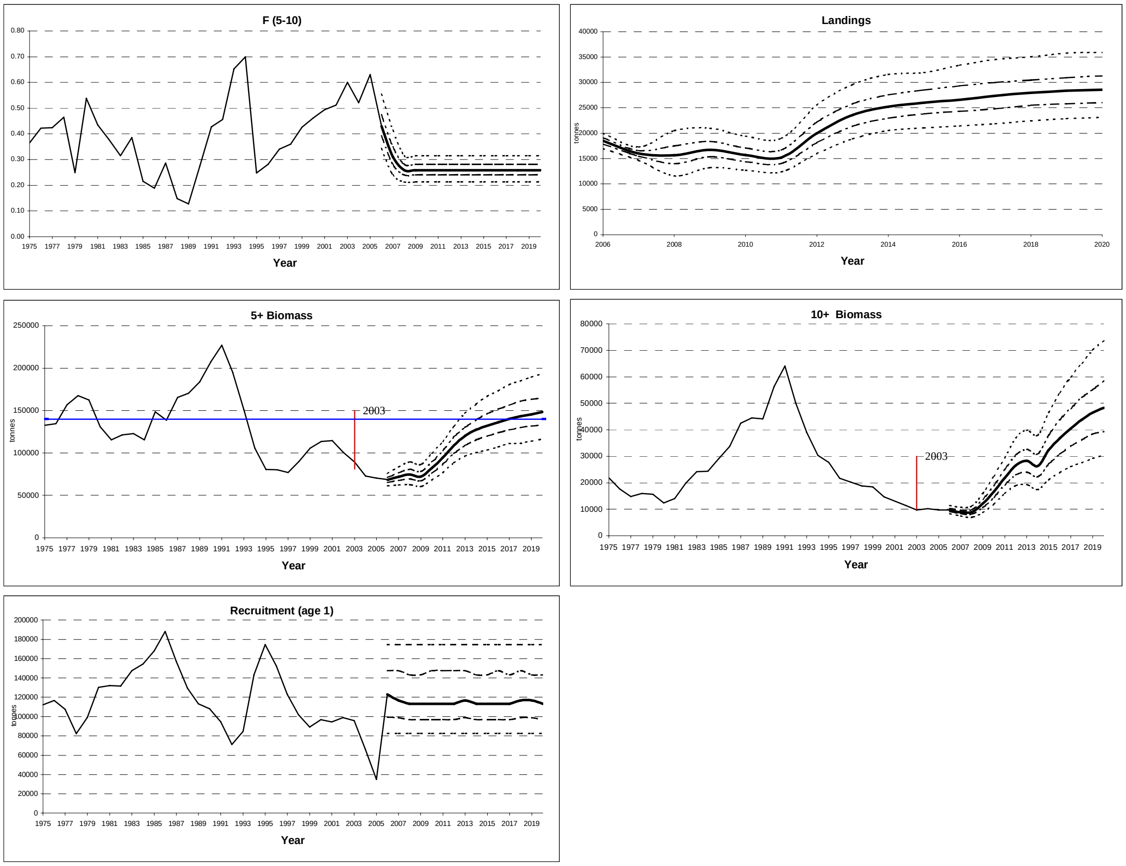


Fig. 11b. Greenland halibut in SA 2+ 3KLMNO: Stochastic projections.

Greenland Halibut in Subareas 2 + 3KLMNO - Stochastic projections under current management plan

F2005 from 2008 on **1975-2002 bootstrapped Recruitment**

1000 iterations

Uncertainties on all parameters taken into account @Risk -Risk analysis Software

Lines show 5, 25, 50, 75 and 95 percentiles

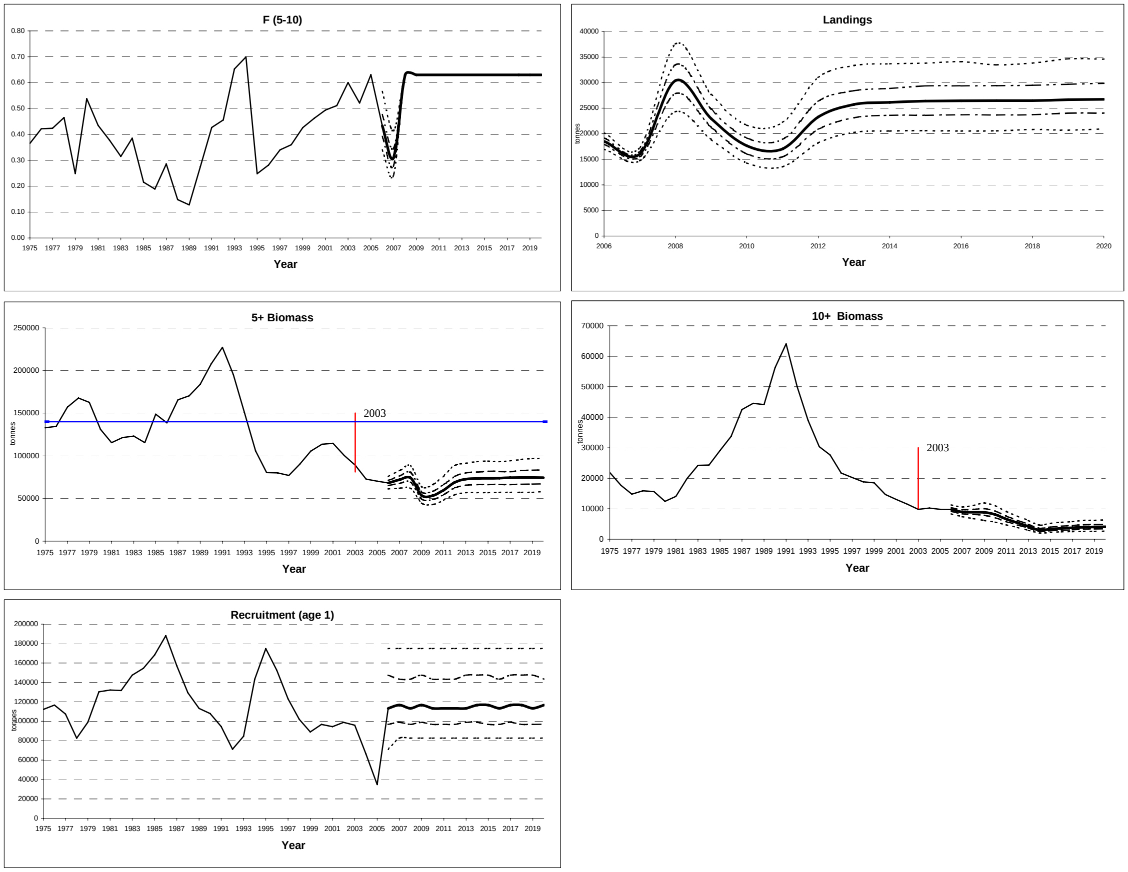


Fig. 11c. Greenland halibut in SA 2+ 3KLMNO: Stochastic projections.

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

i) **Roundnose Grenadier in Subareas 0 and 1** (monitor) (Item 1)

In the Scientific Council Report of 2005, scientific advice on the management of roundnose grenadier in Subareas 0+1 was given as 3-year advice (for 2006, 2007 and 2008). Denmark, on behalf of Greenland, requests the Scientific Council to: Continue to monitor the status of roundnose grenadier in Subarea 0+1 annually and should significant change in stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate.

At its June 2005 Meeting, Scientfic Council provided 3-year advice for 2006, 2007 and 2008 for roundnose grenadier in Subareas 0+1. The Scientific Council reviewed the status of this stock at this June 2006 meeting and found no significant changes in the status. Therefore, Scientific Council has not provided updated/revised advice for 2007. The next Scientific Council assessment of this stock will be in 2008.

ii) **Demersal Redfish and Other Finfish in Subarea 1** (monitor) (Item 2)

Advice for redfish (*Sebastes* spp.) and other finfish in Subarea 1 was in 2005 given for 2006 and 2007. Denmark, on behalf of Greenland, requests the Scientific Council to: *Continue to monitor the status of redfish (*Sebastes *spp.) and other finfish in Subarea 0+1 annually and, should significant changes in stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate.*

At its June 2005 Meeting, Scientific Council provided 2-year advice for 2006 and 2007 for demersal redfish and other finfish (American plaice, Atlantic wolfish, spotted wolfish and thorny skate) in Subarea 1. The Scientific Council reviewed the status of these stocks at this June 2006 meeting and found no significant changes in the status. Therefore, Scientific Council has not provided updated/revised advice for 2007.

Furthermore Denmark, on behalf of Greenland, requests the Scientific Council to: *Consider if a 3-year advice for redfish (*Sebastes *spp.) and other finfish in Subarea 1 would be appropriate.*

The Scientific Council responded as follows:

Redfish

There has been no directed fishery offshore for redfish (golden redfish (*Sebastes marinus*) and deep sea redfish (*Sebastes mentella*)) in Subarea 1 since the mid-1980s. The survey biomass has been at a low level for more than two decades and the biomass and abundance is at present among the lowest observed. Further, the stock(s) are comprised almost entirely of fish <17 cm. Redfishes are slow growing species and Scientific Council does not expect any major change in the status of the stock(s) in the near future.

Given that there is no directed fishery and that the biomass is at a very low level Scientific Council does not see any disadvantage in changing its advice from a biannual to a triennial basis. Should any significant change be observed (i.e. from survey results) in stock status, the Scientific Council will evaluate this change and provide appropriate advice to the coastal state in intervening years.

The Scientific Council **advises** a schedule for providing triennial (every three years) advice for redfish in Subarea 1 initiated in 2005 for the advice in 2006-2008.

Other finfish

Fisheries for other finfish such as, Greenland cod (*Gadus ogac*), American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*), thorny skate

(*Amblyraja radiata*), lumpsucker (*Cyclopterus lumpus*) and Atlantic halibut (*Hippoglossus hippoglossus*) have been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. These species are also taken as bycatch in offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut.

Biomass estimates for the species American plaice, Spotted and Atlantic wolfish and thorny skate from the offshore areas have all been at a very low level in the last decade and the stocks mainly consist of small fish. The species are slow growing and Scientific Council does not expect any major change in the status of the stocks in the near future.

Given that the biomass is at a very low level and that the stocks mainly are comprised of small fish Scientific Council does not see any disadvantage in changing its advice from a biannual to a triennial basis. Should any significant change be observed (i.e. from survey) in the status of any of the stocks, the Scientific Council will evaluate this change and provide appropriate advice to the coastal state in intervening years.

The Scientific Council advises a schedule for providing triennial (every three years) advice for other finfish in Subarea 1 initiated in 2005 for the advice in 2006-2008.

The triennial advice for redfish and other finfish in Subarea 1 will be in accordance with Scientific Council attempt to improve the Council working procedures.

iii) **Greenland Halibut in Div. 1A Inshor**e (Item 3)

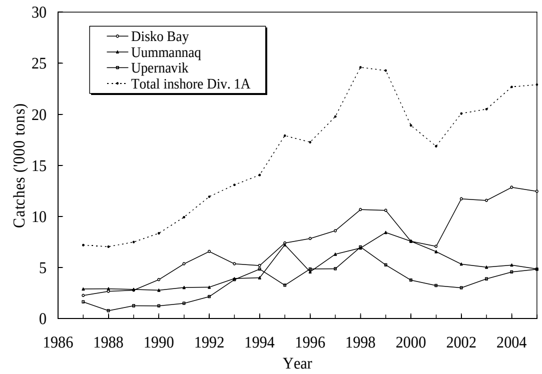
Greenland Halibut (Reinhardtius hippoglossoides) in Division 1A inshore

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, and remained there in 2005. In Uummannaq landings decreased from 1999-2003 but increased slightly in 2004 compared to 2003, and remained around 5 000 tons in 2005. Landings have increased by around 23% in Upernavik 2005 compared to 2003. In Disko Bay landings have been increasing since 2001 reaching 12 900 tons 2004 and 12 500 tons in 2005.

Area	Year	Catch ('000 tons) STACFIS	Advice ('000 tons) TAC
Disko Bay	2003	11.7	7.9
	2004	12.9	na
	2005	12.5	ni
	2006		ni
Uummannaq	2003	5.0	6.0
	2004	5.2	na
	2005	4.9	5.0
	2006		5.0
Upernavik	2003	3.9	2.4
	2004	4.6	na
	2005	4.8	na
	2006		na

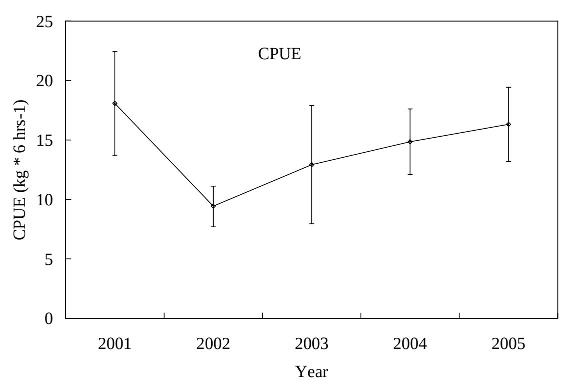
na No advice.
ni No increase in effort.



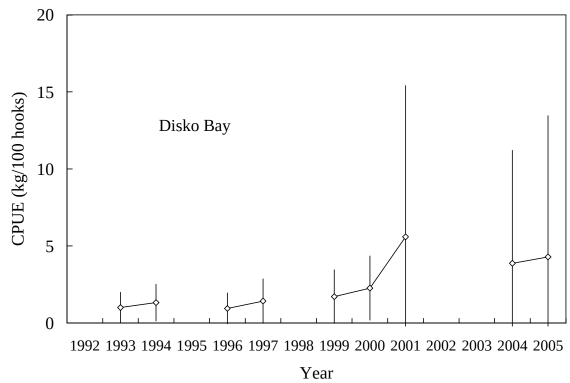
Data: Data on length frequency from commercial sampling were available for all three areas, and individual weight data were available for Upernavik. Catch rate and length frequency data were available from the longline survey in Uummannaq and a longline and gillnet survey in Disko Bay. A biomass estimate 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 2005.

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

Disko Bay: From 2002 through to 2005 catches have been at a record high level. Mean length in commercial catch shows a decrease over the last five years. The gillnet survey (2001-2005) shows stable catch rates over the last five years. Shrimp surveys done in 1991-2005 indicate that biomass of Greenland halibut in Disko Bay have increased since 1991.

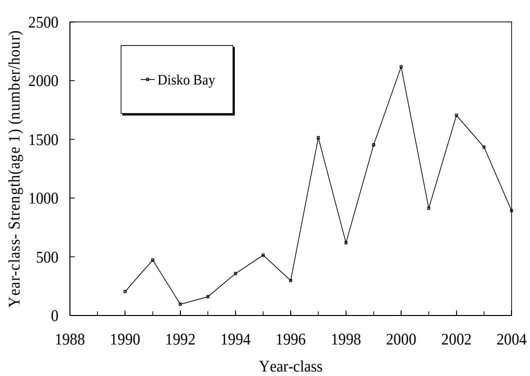


Uummannaq. Catches have been steadily decreasing since 1999. In the same period the CPUE in the longline survey also decreased indicating that in recent years, catch levels of 6 200 tons (average catches 2000-2003) had been too high. Longline-survey abundance indices and landings decreased significantly from 1999 to 2003, in 2004 both survey index and landings increased, and in 2005 both decreased slightly. Mean lengths from the surveys are relatively stable over the entire period, while mean lengths from the fishery have decreased over the last year.



Upernavik. Surveys have not been conducted in Upernavik since 2000, samplings from the commercial fishery have not been carried out during 2002 to 2004, however length frequency sampling from the winter fishery in 2005 and 2006 indicate that mean lengths have been stable during recent years. Sampling of individual weights in 2002-2006 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 fishery has thus become more dependent on incoming year-classes.

Disko Bay: CPUE index of abundance has been increasing in recent years; shrimp survey biomass suggests that recruitment has been above average in recent years. But both surveys primarily measure the pre-recruits to the fishable stock. Length distributions in the summer and winter fishery have been decreasing.

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, and both decreased slightly in 2005.

Upernavik. Mean lengths in the winter fishery have been stable. But otherwise there is not enough 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: The decrease in mean lengths from the fishery, could be a sign of high recruitment, or a response to high exploitation or a combination of both. 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 2007-2008.

Uummannaq: Based on the last two years stable CPUE indices and catches, Scientific Council considers last years advice on a catch level of 5 000 tons to be appropriate for 2007-2008.

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, a management objective aiming towards optimal stock productivity not appropriate for this stock, instead a management objective seeking a requested stock composition should be implemented. Also exploitation of the spawning stock and bycatches in the shrimp fishery should be taken into account when managing the fishery in the fjords.

Sources of Information: SCR Doc. 06/28, 35; SCS Doc. 06/13.

Also Denmark, on behalf of Greenland, requests the Scientific Council to: c*onsider if 2-year advice for inshore areas would be appropriate.*

The Council responded as follows:

The assessment of Greenland halibut inshore in Div. 1A is hampered by poor input data. The catch data (catch figures and catches broken down by gear) from the commercial fishery are imprecise, there is no information on effort in the fishery (logbooks) and the information on length distribution, especially from Upernavik, is scattered, and cover only a small fraction of the fishery. Further, the variance in the CPUE series from the scientific longline surveys is very high and the time series of the CPUE index from the gill net survey in Disko Bay is short. Scientific Council is hence only able to evaluate long-term trends in the development of the stock status in the three areas.

The Scientific Council **advises** a schedule for providing biannual (every two years) advice for Greenland halibut inshore in Div. 1A initiated in 2006 for the advice in 2007-2008. Should any significant change be observed in the status of the stock in any of the three areas (Upernavik, Uummannaq or Disko Bay), the Scientific Council will evaluate this change and provide appropriate advice to the coastal state in intervening years.

Biannual advice for Greenland halibut will be in accordance with Scientific Council attempt to improve the Council working procedures.

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

Canada requested the Scientific Council, 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 2007, and to specifically:

a) advise on appropriate TAC levels for 2007, separately, for Greenland halibut in the offshore area of Divisions OA+l AB and Divisions OB+l C-F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.

b) 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.

The Scientific Council response is as follows:

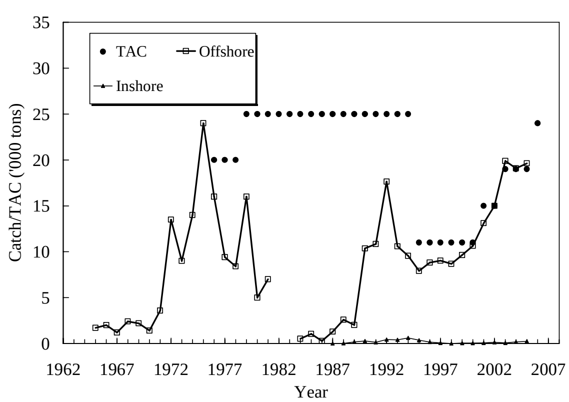
Greenland Halibut (Reinhardtius hippoglossoides) in Subarea 0 + Division 1A Offshore and Divisions 1B-1F

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 slightly in 2004 but was back at 20 000 ton in 2005.

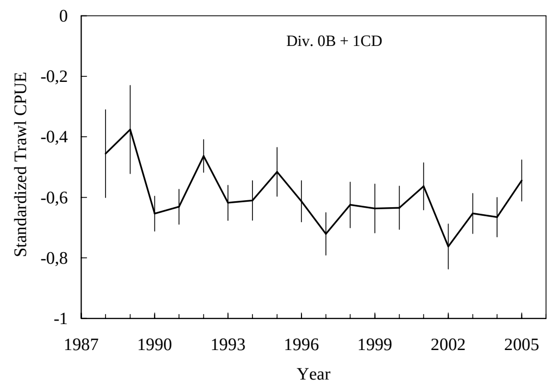
	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2003	20	15[1]	19[2]	19
2004	19	8[1]	19[2]	19
2005	20	8[1]	19[2]	19
2006			24[2]	

[1] Provisonal.
[2] Including 8 000 tons allocated specifically to Div. 0A and 1A in 2003 to 2005 and 13 000 tons in 2006.



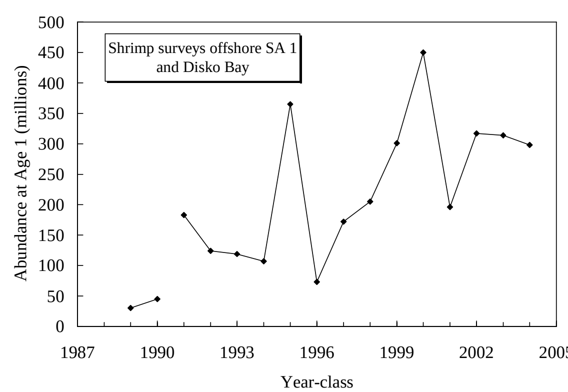
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized catch rates were available from Div. 1AB and 1CD. Standardized catch rates were available from Div. 0B and Div. 1CD. Biomass estimates from deep sea surveys in 2005 were available from Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2005.

Assessment: No analytical assessment could be performed. Combined standardized catch rates for SA Div. 0B + Div. 1CD and Div. 1CD have been stable during 1990-2005. Standardized catch rates for Div. 0B have shown an increase since 2002. Unstandardized catch rates in Div. 1A and Div. 1CD increased slightly between 2004 and 2005.

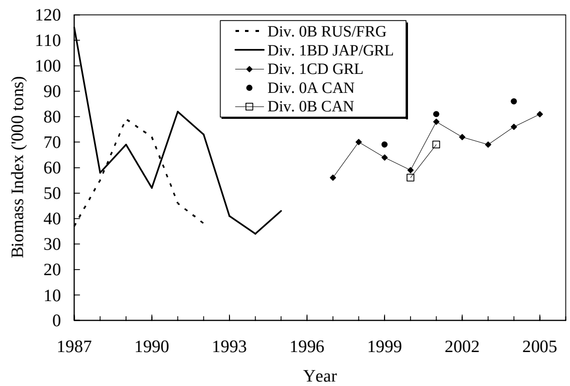


Fishing Mortality: Level not known.

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 2002-2004 year-classes were well above average. The recruitment of the 2004 year-class in the offshore nursery area (Div. 1A (to 70°N) - Div. 1B) was around average.



Biomass: The biomass in Div. 1CD in 2005 was estimated at 81 000 tons, the highest in the nine years time series. The biomass in the shrimp survey was estimated at 23 600 tons, which was almost exclusively found in Div. 1AB. The estimate is a decline compared to 2004 but still the second highest in the time series (1991-2005).



State of the Stock: Length compositions in the catches have 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 2007 should not exceed 11 000 tons.

Except for an update of the unstandardized catch rates in Div. 1A and the Greenland shrimp survey there was no new information in 2005 from Div. 0A and Div. 1A off shore + Div. 1B. Scientific Council advises that TAC in Div. 0A and Div. 1A offshore + Div. 1B for 2007 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. 06/5, 15, 27, 28, 39; SCS Doc. 06/7, 11, 13, 17.

VIII. FUTURE SCIENTIFIC COUNCIL MEETINGS 2006 AND 2007

1. Scientific Council Meeting, September 2006, Dartmouth, NS, Canada

The Council reconfirmed that the Annual Meeting will be held 18-22 September 2006 in Dartmouth, NS, Canada. The Scientific Council Special Session "Environmental and Marine Resources Histories in the Northwest Atlantic – What Influences Living Marine Resource?" will be held 13-15 September at the same venue.

2. Joint Scientific Council/ICES WGPAND Meeting, October/November 2006 (assessment of shrimp stocks) Copenhagen, Denmark

Following discussions in November 2005, the Scientific Council reconfirmed the dates of 25 October – 2 November 2006 for this meeting to be held jointly with the ICES *Pandalus* Assessment Working Group (WGPAND) at the ICES Headquarters, Copenhagen, Denmark.

3. Scientific Council Meeting, June 2007

Scientific Council agreed to the dates of 7-21 June 2007 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada. Scientific Council also agreed that, as a norm, the June meetings should start on the Thursday falling between 31 May and 6 June.

4. Scientific Council Meeting and Special Session, September 2007

Scientific Council noted that the Annual Meeting will be held 24-28 September 2007. Due to overlapping dates with ICES Annual Science Conference the Symposium will be held the week following the Annual Meeting during 1-3 October 2007.

5. Scientific Council Meeting, November 2007 (assessment of shrimp stocks)

The dates and venue of the Scientific Council meeting will be decided at the October-November 2006 Meeting. Provisional dates were previously set for 24 October – 1 November 2007 (*NAFO Sci. Coun. Rep*., 2005, p. 224).

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Progress Report on Special Session in 2006: Environmental and Ecosystem Histories in the Northwest Atlantic - What Influences Living Marine Resources?

An update was presented on Scientific Council's 2006 Symposium:

The Symposium is scheduled for 13-15 September 2006, immediately preceding the NAFO Annual Meeting, in Dartmouth, NS. Co-convenors are Bill Brodie (Canada), Jason Link (USA), Helle Siegstad (Denmark/Greenland), and Manfred Stein (EU-Germany). The theme sessions are:

- Large-scale climatic forcing on the physical oceanography of the Northwest Atlantic seas
- 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 cause, including fishery effects
- Inter-comparisons between marine ecosystems (e.g., between those in the NW Atlantic, and between NW Atlantic and other areas).
- Economic, social impacts of ecosystem changes in NW Atlantic.

Initial deadline for submission of titles was 30 April 2006 and to date, about 30 titles have been received covering a wide range of topics. Several more are expected prior to the deadline for submission of abstracts, which is 30 June. To reflect this, the deadline for submission of titles with abstracts should be changed to 30 June on the NAFO website. Shortly after 30 June, the convenors will decide on acceptability of submissions, draft a Symposium program, and continue with arrangements for the meeting. Dr. Ken Frank, of the Bedford Institute of Oceanography in Dartmouth, has agreed to attend as an invited speaker, and other invited speakers are under consideration.

Noting that there were no major problems thus far in organizing the Symposium, Scientific Council was pleased with the progress to date.

2. **Progress Report on Special Session in 2007: Reproductive Potential**

At the June 2005 Scientific Council Meeting a proposal was accepted to hold a NAFO led Symposium in 2007 entitled "*Reproductive and Recruitment Processes in Exploited Marine Fish Stocks*". The objective of the symposium is to provide a scientific forum in which investigators could present study findings on reproduction, early life history and recruitment in exploited finfish and invertebrate stocks. The continued low population sizes and low recruitment of many fish stocks necessitates a broad examination of several key biological processes underlying potential stock recovery. Commonly, sessions on reproduction and larval life history stages are segregated at scientific symposia. This symposium will attempt to join these components in a cohesive fashion and thereby facilitate our understanding of factors influencing recruitment in marine ecosystems. The forum is intended to provide opportunities for dialogue among those in these areas of biological study that can be used to foster future research relevant to the symposium's theme.

The following advances have been made for the meeting. Both PICES and ICES, with the assistance of the NAFO Executive Secretary, have been tentatively invited to co-sponsor the symposium to be held 1-3 October 2007 (venue to be confirmed). Within this framework, it is proposed there be three Co-convenors and a Scientific Steering Committee. One Co-convenor would be from NAFO (Ed Trippel), one from PICES and one from ICES; their selection would rest in part with each organization.

Dr. Alex Bychkov (Executive Secretary, PICES) has accepted the invitation and has made travel funds available for their yet to be selected Co-convenor. Their selection awaits the approval of the NAFO Scientific Council for having the 2007 Symposium sponsored by three science organizations. Dr. Gerd Hubold (Executive Secretary, ICES) has expressed a positive interest in co-sponsoring the symposium though a final decision will have to wait until September after discussion by the Consultative Committee at the ICES Annual Science Conference. It is anticipated that with a positive reply at this time that we could begin to advertise the symposium under the banner of the three organizations including the selected venue.

Scientific Steering Committee to date includes Joanne Morgan (Canada), Fritz Köster (Denmark), Hilario Murua (EU-Spain), and Anthony Thompson (NAFO Secretariat). A number of other individuals will be selected in consultation with the selected Co-convenors and NAFO Scientific Council.

Theme Sessions that are tentatively being proposed include:

These will be appraised and modified as needed by the Co-Convenors, Steering Committee and NAFO Scientific Council.

1. Population Size, Maturation and Recruitment Variation in Marine Fish Stocks
2. Demographic and Condition Effects on Fecundity and Spawning Success
3. Spawning Activity and Larval Distribution
4. Early Life History Fitness – Environmental and Parental Effects
5. Stock Compensatory and Depensatory Mechanisms to Exploitation
6. Fisheries Management Strategies that Incorporate Spawning, Reproduction and Recruitment

It is anticipated that administrative support for the Symposium will be provided by the NAFO Secretariat, as is customary for NAFO led symposia. Oral and poster sessions will be planned, within a single session so as to achieve the goal of integrating the various study areas and provide continuity in discussion items arising from the audience. Members of the NAFO Working Group on Reproductive Potential will provide further input into the design of the Symposium at their 6th Meeting to be held in Klauster, Iceland, 18-21 August 2006.

Presentations will encompass a number of species, stocks and ocean ecosystems including field and laboratory studies and analysis of existing data sets. Theoretical reviews and synthesis of concepts will be welcomed. Manuscripts are to be submitted at the Symposium and will undergo scientific peer review. The Co-Convenors along with Anthony Thompson (technical assistance) will take on the editorial responsibilities of the proceedings. NAFO will take the lead and the resulting peer-reviewed manuscripts will be published in the *Journal of Northwest Atlantic Fishery Science*.

NAFO Scientific Council approved the approach of having PICES and ICES as co-convenors and **recommended** that *each of the organizations provide financial contributions towards the Symposium. It is anticipated that the Symposium will have a broad appeal and be well attended.*

3. Topics for Future Special Sessions

There were no new topics discussed at this meeting.

4. Further Discussion

There was an extensive general discussion around NAFO symposium issues. These are not going to affect the above symposium to be held on 1-3 October 2007, but should be considered when organising future symposia.

(a) Location and timing. The 'September' Symposium is traditionally held at the same venue as the annual meeting and either immediately before or after it. Other symposia could be held separate from the annual meeting.

(b) Subject matter. The reason for NAFO supporting a Symposium in close proximity to the annual meeting is for cross-fertilisation of ideas between Symposium and meeting participants. It is therefore important to ensure that the symposium subject matter be of relevance to the annual meeting and its participants.

(c) Logistic support. The Secretariat provides extensive support for the 'September' Symposium through the provision of Secretariat personnel.

(d) Financial support. NAFO directly provides funds for the 'September' Symposium to cover venue costs, travel costs for keynote speakers and a limited budget for the reception. Additionally, the Secretariat provides personnel whose costs are covered by the NAFO recurrent salary budget. Venue costs for annual meeting/symposia held outside Dartmouth are kindly supported by the host.

(e) Additional financial support for the Symposium. Additional funds could be raised by having a Symposium registration fee, say in the $200 to $500 range. This would generate, say $15 000 to $40 000, that could be used to cover some of the symposium costs. SC has debated this issue in the past and no consensus was achieved.

(f) 'September' Symposium. It was generally felt that the 'September' Symposium should have a carefully chosen subject matter and be supported from NAFO funds.

(g) Other symposia. It was felt that NAFO symposia held separately from the annual meeting should consider the introduction of a registration fee. It is not known how much Secretariat support would be provided for such symposia.

X. REPORTS OF WORKING GROUPS

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

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, EU-Spain, EU-United Kingdom, and USA).

The 5th Meeting of the NAFO Working Group on Reproductive Potential was held at Fisheries and Oceans Canada, Institut Maurice Lamontagne Mont-Joli, Québec, October 20-23, 2005. A total of 10 of the Working Group members were in attendance: Yvan Lambert (Canada), Joanne Morgan (Canada), Rick Rideout (Canada), Ed Trippel (Canada), Loretta O'Brien (USA), Hilario Murua (EU-Spain), Jonna Tomkiewicz (Denmark), Peter Wright (UK), Tara Marshall (UK), and Nathalia Yaragina (Russia). Local arrangements were kindly provided by Yvan Lambert and 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. Some of the data comprehensive ICES stocks will be completed with the assistance of the UNCOVER program funded by the European Commission. The resulting inventory of data is to be made available on both NAFO and ICES websites. It is anticipated that data collection phase will be completed by late 2006. Once completed, information in tables will be analysed in 2007 and a manuscript prepared in 2008 on the degree to which these data are used in standard stock assessments.

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 multiyear 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.

The objectives of these two ToRs are to (i) identify patterns of variation in fecundity between different stocks of the same species, (ii) find environmental and biological factors that explain these patterns of variation and (iii) assign data poor stocks to environmental data groups and apply fecundity models of rich stocks of the same environmental data group to predict fecundity. A presentation on the approach and preliminary findings on Atlantic cod fecundity was given at the 2005 ICES Annual Science Conference in Aberdeen, Scotland. At the WG meeting in Mont Joli further questions were addressed including are all fecundity data on cod included, is the formulation of explanatory variables complete, is discriminant analysis the best approach, and is it possible to apply the same approach to other species? Some additional cod fecundity data are being accumulated and additional variables such as parameters of the von Bertalanffy growth curve and size at 50% maturity are being used to help predict size-specific fecundity. It is expected that the analysis will be completed by October 2006 and a manuscript a year later. Additional species being considered include the small pelagics anchovy and sprat.

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)

Alternative indices of reproductive potential will be estimated that include: SSB estimated using knife-edge or constant maturity ogive, SSB with year- or cohort-specific maturity ogives, female-only spawner biomass and total egg production. The stocks to be examined include six cod stocks (Northeast Arctic, Icelandic, Baltic, Georges Bank, Northern Gulf of St. Lawrence and Div. 3NO) and two other stocks (Div. 3LNO American plaice and Northern hake). B_{lim} will be estimated for each index using a standard approach. Short-term projections will be conducted to determine whether there are differences among alternative indices in rate of rebuilding (if the stock is below B_{lim}) or increase (if the stock is within safe biological limits). The purpose is to show that different estimates of reproductive potential will produce different perceptions of the status of a stock and its ability to rebuild/grow. Once this work is completed examination will be made of how the alternative indices affect the slope at the origin of stock-recruit curves. By October 2006, short-term (t year) projections will be run using either a deterministic or stochastic approach at F=0 and a range of F values. Manuscript is to be prepared for 2007.

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)

A review has been made of inter-annual variation in spawning times and possible causes, in particular effects of changes in age or size structure of stocks. Evidence from studies has shown that protracted spawning may be adaptive if selection on birth date is non-random.

A second manuscript is planned to document age/size related differences in spawning times for 10 groundfish stocks. Duration of spawning times in relation to stock demography will be estimated. An analysis will be undertaken to assess whether this temporal variable is related to recruitment variation. Relevance will also be explored on seasonal spawning closures and fixed closures over time. This work is being led by Peter Wright with data compilation being carried out and literature review completed.

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. This latter work is being led by Chris Chambers and a post-doctoral student. Preliminary findings were presented at 2005 Annual Meeting of the American Fisheries Society.

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 variable of interest. The frequency and sampling intensity needed when sampling maturity, with Baltic cod being used as a case study, will be reviewed with the intention of producing a manuscript: "Sampling intensity and frequency needed for estimating reproductive potential". In Mont Joli, the feasibility of holding a workshop led by Jonna Tomkiewicz on histological techniques for use in maturity identification was considered. The workshop would take place in 2007 or 2008. The workshop approach may extend beyond histology. The fecundity sampling approach has been previously completed by Hilario Murua and co-authors and will be further evaluated by the project Reproduction and Stock Evaluation for Recovery (RASER).

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 to ToRs 2, 3 and 4.

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

Life history models will be used to estimate the intrinsic rate of increase (r) and net reproductive rate (Ro) which will act as metrics to determine how environment influences stock reproductive potential (SRP). A total of 8 cod stocks will be compared (Northern Gulf of St. Lawrence, Northeast Arctic, Georges Bank, Gulf of Maine, Baltic, Icelandic, Flemish Cap, and Irish Sea). A literature review will be made for established relationships affecting reproduction, i.e., growth rate changes as temperature increases/decreases. Assimilate environmental time series, e.g., temperature, salinity, oxygen, age diversity that likely influence reproduction for each stock. Conduct simulations/scenario modeling and report preliminary findings at 6th Working Group Meeting in Iceland and complete manuscript in 2007.

Future WG Activities

The format for publication of results for the second set of ToRs will likely include both peer and nonpeer reviewed outlets and has yet to be determined for each specific ToR. Based on timing of completion, some manuscripts may be presented at the 2007 NAFO-led symposium on Reproductive and Recruitment Processes in Exploited Marine Fish Stocks.

The 6th Meeting of the NAFO Working Group on Reproductive Potential will be held in Klauster and Reykjavik, Iceland, during 17-21 August 2006. Dr. Gudrun Marteinsdottir (Iceland) has kindly agreed to help coordinate local arrangements with the support of the Marine Research Institute.

A Workshop was identified in ToR 6 which will be further discussed at the the 6th Working Group Meeting.

Upon presentation by the Chair, NAFO Scientific Council was pleased with the progress of the Working Group and its leading contributions to this area of fishery science. NAFO Scientific Council **recommended** that *the Working Group consider holding a Workshop in conjunction with NAFO stock assessment personnel detailing advanced methods related to ToR 4 on biological reference points.*

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

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

No reports had been received from the Scientific Council EU member from Latvia who sits on ACFM (*NAFO Sci. Coun. Rep.*, 1995, p. 48). Scientific Council approved that their EU member from Estonia will now be the Scientific Council representative on ACFM and will report back to Scientific Council on important issues.

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

No new issues were raised that will affect the regular the work plan for the September Meeting.

3. **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 be the same.

4. **Review of Frequency of Assessments**

Some changes have already been made for complete assessments to be undertaken every two or three years. It was felt that four years was too long a time period between assessments e.g. for redfish. Interim monitoring on an annual time period would continue to be undertaken in the years without complete assessments. Scientific Council asked Designated Experts to review their current assessment frequencies and to review this at the September 2006 Meeting.

5. **Other**

No items were raised.

XII. OTHER MATTERS

1. **Proposal of a Study Group on Deep-water Habitats in the NAFO Area**

This item was considered unnecessary after agenda item VII.1.(c).v.: Deep-water habitats.

2. **Report of CWP Intersessional Meeting, Madrid, Spain**

This item has been reported in STACREC under agenda item V.3(b).

3. **Report from the FIRMS Steering Committee (FSC) Meeting of February 2006**

This item has been presented in the STACREC committee under agenda item V.5(a).

It was agreed to attempt a classification of NAFO stocks according to the FIRMS Stock Criteria during the next September meeting. The current FIRMS classification is:

1. Stock abundance status		**2. Exploitation rate status**	
A	Virgin or high abundance	**A**	No or low fishing mortality
B	Intermediate abundance	**B**	Moderate fishing mortality
C	Low abundance	**C**	High fishing mortality
D	Depleted	**D**	Uncertain/Not assessed
E	Uncertain/Not assessed		

(after *FIRMS Steering Committee Meeting: Third Session. Final Report.* FIRMS FSC3/2006 Report: Annex 3.)

4. **Meeting Highlights for NAFO Website**

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

5. **NAFO Reform** (SCS Doc. 06/21)

The "Working Group on the Reform of NAFO" has referred the following issues to Scientific Council:

- *Are the provisions on the Scientific Council currently found in the Convention still adequate and are there any overlaps with the proposed functions of the new Commission?*
- *Review the proposal by Ukraine (Annex 15).*
- *Are the species listed in Annex 1 to the Convention still relevant in terms of the fishery resources currently found in the NAFO Convention Area (Canada proposed to delete Atlantic mackerel, Atlantic butterfish, and river herring from the current list)? Do any species need to be deleted or added to this list in the view of the Scientific Council?*
- *Are the duties of Contracting Parties regarding the collection and exchange of scientific, technical and statistical data pertaining to the Convention Area covered satisfactorily in the relevant paragraph of the Chairperson's Working Paper?*

The Scientific Council Chair explained that the NAFO Convention Reform process started in 2005 when General Council formed a Reform Working Group and invited its Chair to draft a proposal for a modified *NAFO Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries* (known as the *Chair's Working Paper* or *Chair's WP*) for discussion at the Montreal NAFO Reform meeting in April 2006. The *Chair's WP* is now in a second revision and was made available at the Scientific Council meeting in electronic form. The Chair asked participants to discuss those sections of the *Chair's WP* that are relevant to Scientific Council, principally *Article VII – the Scientific Council* which defines the Scientific Council and its role.

The Chair noted that the *Rules of Procedure for the Scientific Council* section in the *NAFO Rules of Procedure & Financial Regulations* (p. 23-30) could be modified by Scientific Council without the need for Fisheries Commission approval, but that discussion on this was not the purpose of this agenda item.

Scientific Council discussed the wider implications of the NAFO Reform process particularly as it related to the modern approach to fisheries management. The importance of the Ecosystem Approach to Fisheries (EAF) was outlined and it was noted that this term was not included in the *Chair's WP*, as no satisfactory single definition existed. However, the functional aspects of EAF were included as nine items listed in *Article III – Basic Principals*. It was noted that three recent ICES Documents (*ICES C.M. Doc*., No. 2005/MCAP:03, *ICES C.M. Doc*., No. 2006/MCAP:03 and *ICES Coop. Res. Rep*., No. 267) were relevant to the NAFO Reform process, especially with regard to implementing the EAF in a managerial and scientific context. It was observed that Fisheries Commission was already addressing new types of questions to Scientific Council, such as the importance of corals, sea mounts, and the role of marine mammals in the ecosystem. These new questions form an extension of the current Scientific Council remit above and beyond the assessment of the fishery resource. It was noted that the scientific competence required to implement certain aspects of the EAF was not currently completely available within Scientific Council. It was suggested that Scientific Council consider working alongside or jointly with ICES, or other experienced scientific organisations, that could provide additional expertise to complement that available within the NAFO Scientific Council.

It was noted that the wording used in the *Chair's WP* should be consistent with, and was often taken from, other recently drafted or re-drafted conventions, for example CCSBT, SIOFA, CCAMLR, IATTC, NEAFC and UN Fish Stock Agreement.

It was also noted that there were items that were currently part of the *NAFO Convention*, that may be better placed in the *Rules of Procedure*.

Scientific Council nominated an *ad hoc* Working Group to review the *Chair's WP*. The working group comprised Manfred Stein (EU-Germany, Chair), Leonid Kokovkin (Russian Federation), Fred Serchuk (USA) and Bill Brodie (Canada).

The *ad hoc* Working Group produced a revised version of the *Chair's WP* (see NAFO SCS Doc. 06/21) based on the request from the "Working Group on the Reform of NAFO" as described in the four bullet points above.

There was a detailed and thorough discussion of many of the revisions made by the *ad hoc* Working Group and suggestions made by Scientific Council were incorporated. It was noted that, whereas most participants wanted the move the last sentence of Article VII.2 "*The Chairperson and Vice-Chairperson shall be from different Contracting Parties"* to the *Rules of Procedure*, there was one Contracting Party that objected to this. Russia agreed to drop this item from the text of the Convention to the Rules of Procedure only if the current text will not be changed.

Scientific Council notes the following:

1. All of the species listed in Annex 1 to the Convention still occur in the NAFO Convention Area.
2. There are several species currently regulated under the Convention - or for which advice or scientific information has been provided by the Scientific Council - that are not included on the list in Annex 1. These species include:

   White hake…………………………………. *Urophycis tenuis*
   Thorny skate……………………………….. *Amblyraja radiata*
   Deepwater redfish…………………………. *Sebastes mentella*
   Acadian redfish……………………………. *Sebastes fasciatus*
   Greenland cod……………………………… *Gadus ogac*
   Atlantic wolffish…………………………….*Anarhichas lupus*
   Spotted wolffish…………………………… *Anarhichas minor*
   Lumpsucker…………………………………*Cyclopterus lumpus*
   Roughhead grenadier………………………. *Macrourus berglax*
   Roundnose grenadier………………………. *Coryphaenoides rupestris*
   Spiny dogfish……………………………….*Squalus acanthias*
   Black dogfish………………………………. *Centroscyllium fabricii*

3. Scientific Council noted that the boundary definition of Division 3M does not include the south-western deeper part of the Flemish Cap. Certain deep-water species living on the south-western corner of the Flemish Cap are currently recorded under Division 3L. An exception has been made for shrimp by recording catches from the rectangular portion of 3L as 3M (see CEM 2006, Annex 12, Fig. 1, p. 1-8). Scientific Council **recommended** that *boundaries of Divisions 3M and 3L be re-defined so that 3M includes that small rectangle currently in 3L.*
4. The Scientific Council Chair will formally send NAFO SCS Doc. 06/21 to the Chair of the Reform Working Group and ask that the revisions contained in this document be considered for inclusion in to the new Convention.

6. **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, STACPUB and 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 Secretariat.

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 to the General Council and Fisheries Commission.

XV. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 15 June 2006, the Council considered the Draft Report of this meeting, and **adopted** the report with the understanding that the Chair and the Secretariat will incorporate later the text insertions related to plenary sessions of 1-15 June 2006 and other modifications as discussed at plenary.

XVI. ADJOURNMENT

The Chair thanked the participants for their hard work and cooperation, noting particularly the efforts of the Designated Experts and the Standing Committee Chairs. The Chair thanked the Secretariat for their valuable support. There being no other business the meeting was adjourned at 13:15 on 15 June 2006.

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 2 and 8 June 2006, 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 (France, Germany, Portugal, Spain and United Kingdom), Russian Federation and Ukraine.

1. Opening

The Chair opened the meeting by welcoming participants to this June Meeting of STACFEN. The Chair welcomed Dr. Philip C. Reid, Director, Sir Alister Hardy Foundation for Ocean Science, Plymouth, UK 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. 06/01, 02, 10, 11, 18, 19, 22, 23, 24, 25, 26 and 29; SCS Doc. 06/07, 10, 11, 13 and 17.

Gary L. Maillet (Canada) was appointed rapporteur.

2. Invited Speaker

The Chair introduced this year's invited speaker Dr. Philip C. Reid (Sir Alister Hardy Foundation for Ocean Science, Plymouth, UK, *http://www.sahfos.org*). The Committee was informed that his research focused on large scale and long term trends in plankton abundance of the North Atlantic that may be linked to global climate change. The work which is mainly based on data from the Continuous Plankton Recorder (CPR) surveys, included studies of the relationship of changes in plankton abundance and distribution to oceanographic and meteorological variability at a range of temporal and spatial scales. Recent results have identified a step-wise change in the ecosystems of the North east Atlantic from the mid-1980s that is reflected in all trophic levels and the physical and chemical characteristics of the sea. The work also suggests that the 'regime shift' is closely correlated with changes observed in Northern Hemisphere temperatures. His presentation consisted of an overview of CPR program followed by a review of recent changes in plankton abundance and distribution, possible relationships between plankton abundance and changes in marine species and finally links to global warming. The following is an abstract of his presentation entitled "*Climate impacts on North Atlantic ecosystems: the relevance of plankton monitoring to NAFO*" and the subsequent discussion.

Plankton are sensitive indicators of environmental change, integrating signals from a wide range of biological and hydrometeorological signals. These organisms also play a key role in climate change, through the transfer of excess CO_2 from the atmosphere to the deep ocean via the 'Biological Pump', in cloud formation *via* Dimethylsulfide (DMS) production, and in altering the reflectivity of sea water as a component of suspended particulate matter. At the base of the food chain, plankton also modulate the carrying capacity of all regional seas as the primary source of nutrition for living marine resources and effects on fish recruitment. It is known that certain plankton groups are more likely to be deposited as detritus in the deep ocean than others so that changing composition of the plankton may effect the efficiency of the biological pump. Many planktonic groups, including the larval stages of shellfish, have calcareous body parts. Their existence is threatened by the increasing acidity of the ocean caused by higher levels of CO_2 and may provide a further feedback to the biological pump that could reduce the ability of the oceans to take up CO_2 from the atmosphere. Given their key role in the biosphere and to be able to assess changes in space and time extensive basin scale synoptic plankton surveys are needed. The Continuous Plankton Recorder survey is one of a very few such surveys in the world. Some examples will be shown of the application of CPR results: as indicators of environmental change, in the production of regional assessments, in HAB research, to help interpret crashes in fish stocks e.g. cod and salmon, use in new approaches to fish stock assessment, in defining distribution changes e.g. the spread of arctic/boreal species in the Northwest Atlantic, use of DNA analysis to interpret meroplankton variability and trophic mismatch/phenology, Relevance to climate change will be shown through the strong links that have been demonstrated between the plankton and Northern Hemisphere temperatures, the North Atlantic Oscillation (NAO) and sea-surface temperatures. The Colour index of the CPR survey has shown a substantial increase in season length and intensity and implies increases in chlorophyll and primary production in a wide belt across the North Atlantic and especially in shelf seas. Parallel increases in the benthos imply that sedimentation from the plankton has also increased in the last decade. There have also been marked associated changes in fish stocks. These events that occurred after the mid-1980s have been termed a regime shift and appear to be linked to changing patterns of circulation and hydrography. Superimposed on the changes associated with the regime shift has been a northerly movement of warmer water plankton on the eastern side of the Atlantic and a southerly movement of plankton characteristic of fresher and until recently colder water in the western Atlantic. The rate of change has been substantial, a movement of 1000 km in only forty years in the eastern Atlantic. The pronounced changes seen in the North Sea have occurred with a rise in temperature of ~0.5°C. According to the IPCC global surface temperatures are expected to increase by a further 1.4 to 5.8°C by 2100. It is likely that changes in temperature at this scale and rate are likely to have a pronounced effect on the plankton, ecosystems, the biological pump and the circulation of the oceans on a global scale. The scale of the changes seen over the last six decades and their relevance to understanding the carbon budget of the oceans emphasises the importance of maintaining existing and establishing, as a matter of urgency, new long term and wide scale monitoring programmes elsewhere in the world under the flag of the Global Ocean Observing System (GOOS).

The presentation stimulated a wide variety of comments and questions from the committee and further discussions on the relevance of plankton monitoring and the need for continued support and developments for expansion of the CPR within NAFO. The issue of the feasibility of experiments to seed parts of the ocean with micro-nutrients to stimulate the biological pump to manipulate carbon dioxide levels was raised. The experiments that have been conducted to date have not demonstrated that enhanced productivity results in the deposition to the benthic habitat. The point was further elaborated that more directed measurements of ocean productivity along with following the deposition of this organic material to the benthos similar to the Hawaii Ocean (e.g. HOTS) and the Bermuda Atlantic Time Series (BATS), and Station Papa weather station monitoring programs needs to be further developed in other oceanic regions in order to gain some insights into the potential feedback mechanisms. The potential for feedback mechanisms and other modifications to the ecosystem from seeding experiments can be difficult to predict the outcome.

The role of top-down control of predators and the relative influence of environmental changes on their prey sources was addressed. It was recognized that the removal of large fish and invertebrate populations from commercial fishing activities has clearly resulted in top-down impacts. It was also suggested that top-down impacts at the lower trophic levels (phytoplankton and zooplankton) may be less important in the western North Atlantic due to the mismatch in timing between phytoplankton and zooplankton populations. A question regarding the invasion of the diatom (Neodenticula semilia) into the western North Atlantic from Pacific waters was raised and the dependence on open "ice-free" waters. The available evidence suggested that an extensive ice-free area was observed in 1998 and 1999 in the arctic region which correlated with the observation of the Pacific diatom invading the western north Atlantic. Additional evidence suggested increased inflow of Pacific waters into the Atlantic during this period allowed the opportunistic colonization of this particular diatom.

Some general issues were discussed including the lack of basic plankton information in many deep water oceanic areas and the general problem of finding suitable expertise and resources to enumerate and identify large numbers of plankton samples. This will likely continue to result in reduction of information regarding plankton dynamics in many areas. Oceanographic studies in Davis Strait were identified by NAFO member countries which are the interface between major water masses (Pacific, North Atlantic, Greenland waters). The possibility of collaborations with interested members regarding the potential impacts of climate change and associated biological impacts was briefly raised. The observation of dramatic changes in the timing of plankton documented in the eastern North Atlantic with comparisons to recent results in the western North Atlantic was briefly discussed. Although ocean warming, the main causative factor identified in the eastern Atlantic studies, and has been documented over much of the NE and NW Atlantic, does not appear to have resulted in significant changes in the timing of plankton on the Grand Banks based on CPR data of dominant taxa. The issue about selection of plankton species to evaluate changes in dynamics was briefly addressed. The use of multivariate analyses using a wide variety of taxa from the CPR database was suggested as an appropriate method for evaluating the influence of environmental changes.

3. **Marine Environmental Data Service (MEDS) Report for 2005** (SCR Doc. 06/19)

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. Provision of a meaningful report to the Scientific Council requires the submission to MEDS of a completed oceanographic inventory form for data collected in 2005, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2005. The data of highest priority are those from the standard sections and stations, as described in NAFO SCR Doc., No. 1, Serial N1432, 9 p. STACFEN members were encouraged to remind its national representatives to send data and information to the designated data center in order to get significant return for NAFO member countries. It was indicated that the data collected by the Spanish EU survey on Flemish Cap during 2005 and in West Greenland waters during the Danish spring survey was submitted to MEDS for archival.

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 (GTS) 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 2005 and information on several recent activities.

i) **Hydrographic data collected in 2005**

Data from 4 203 oceanographic stations collected in the NAFO area sent in delayed mode to MEDS in 2005 have been archived, of which 1 639 were CTD profiles, 1 298 were BTs and 1 266 were bottles. Roughly twice as many (7 569) were sent in 2004. A total of 74 136 stations were received through the GTSPP (Global Temperature and Salinity Profile Programme) and have been archived, of which 1 730 were BTs and 72 406 were TESAC messages. This represents an increase over the previous years 65 566 profiles.

ii) **Historical hydrographic data holdings**

Data from 15 295 oceanographic stations collected prior to 2005 were obtained and processed during 2005, of which 1 367 consisted of vertical CTD profiles, 6 905 were towed CTD profiles, 1 753 were BTs and 5 270 were bottle data. This is compared to 9 399 stations collected prior to and processed during 2004.

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 31 878 stations in the Northwest Atlantic being received during 2005, a large increase from the 1 191 stations received during 2004.

iv) **Drift buoy data**

MEDS drifting buoy archive contains over 42 million records for the world's oceans, from 1978 to 2005 and is currently growing at a rate of one million messages per month. A total of 98 drift-buoy tracks within NAFO waters were received by MEDS during 2005 representing 176 748 buoy messages and approximately 315 buoy months of data. This is an increase of 33 buoys and 92 000 messages from 2004.

v) **Wave data**

During 2005, 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 11 wave buoy stations were operational in the NAFO area during 2005 which is 3 more than in 2004.

vi) **Tide and water level data**

During 2005, 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 archived observed heights with up to a 3-minute sampling interval, hourly heights and monthly instantaneous extremes collected around Canada. Approximately 370 000 new readings were updated every month from the network with the increase in sampling interval. The historical tides and water level data archives presently hold over 30 million records with the earliest dating back before 1900. A total of 27 stations were processed during 2005, one less than the previous year.

vii) **Current meter data**

A total of 45 current meter instruments were recovered in the NAFO area during 2005 and an additional 64 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 at *(http://www.mar.dfo-mpo.gc.ca/science/ocean/database/data_query.html).*

viii) **Recent activities**

MEDS reported on two other initiatives during 2005:

a) Argo is an international program to deploy profiling floats on a 3 by 3 degree grid in the oceans of the world. Each profiling float samples and reports both temperature and salinity from 2000m to the surface every 10 days. Some of the newer floats now also report oxygen. Data are distributed on the Global Telecommunications System (GTS) within 24 hours of collection and made available on two Global servers located in France and the US. MEDS role is to carry out the processing of the data received from Canadian floats, to distribute the data on the GTS and the global servers within 24 hours 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 at *(http://argo.jcommops.org).* During 2005, Canada deployed a total of 31 floats of which 13 were in the North Atlantic.

b) The Canadian DFO's Atlantic Zone Monitoring Program (AZMP) activities include regular sampling for 7 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 from 1999 to the present are currently available on the web site. Climate indices have also been added to show long term trends of physical variables. Water level data for 9 gauges ranging from 1895 to present are also available. Recent updates to the web site during 2005/2006 included addition of Rimouski as a seventh (7^{th}) fixed station, a new interface for browsing chemical and physical data at all seven fixed stations and T-S diagrams for bottle and CTD data were added for browsing.

4. **Review of the Physical, Biological and Chemical Environment in the NAFO Convention Area During 2005**

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 2005 was presented (SCR Doc. 06/24). After 4 consecutive years of below normal values, the NAO index based on December to February data was above normal (~4.1 mb) in 2005. A positive NAO index usually implies stronger winds from the northwest, cooler air temperatures and enhanced heat loss from the ocean during winter over the Labrador Sea and partly over the Labrador and Newfoundland Shelf. However, except for January, the observed air temperatures were warmer than normal over the Labrador Sea;

furthermore, the NCEP winter wind anomalies were generally towards the north in the Labrador Sea, opposite to our expectations for a positive NAO anomaly. Annual average air temperatures were above normal by 0.7 to 2.2°C over the Labrador Sea and Shelf, the Newfoundland Shelf, the Gulf of St. Lawrence and the Scotian Shelf; Gulf of Maine air temperatures were about 0.4°C below normal. The Newfoundland-Labrador ice coverage was the 5th lowest in 43 years and its duration was generally less than average. The Gulf of St. Lawrence ice coverage in 2005 was also less than normal ranking 15th of 43 years; the ice season was the 6th shortest in 43 years. Both the ice coverage, 13th least in 44 years, and its duration, 17th shortest in 44 years, on the Scotian Shelf were below normal. Only 11 icebergs reached the Grand Banks in 2005, considerably less than the 262 in 2004, and the lowest since 1985, when more accurate counts became available. It was also the 7th lowest count in 126 years. The analysis of satellite data indicates a north-south gradient of sea surface temperatures similar to the air temperature distribution. In 2005, there were positive annual SST anomalies from ocean Station Bravo in the Labrador Sea to the central Scotian Shelf of 0.6 to 1.3°C, with the exception of the St. Lawrence Estuary which had an anomaly of nearly 0°C. The western Scotian Shelf, Lurcher Shoals, Bay of Fundy and Georges Bank were colder than normal with annual SST anomalies of ~0°C to -0.9°C.

A review of meteorological and sea ice conditions around Greenland during 2005 was presented (SCR Doc. 06/01 and 02). The North Atlantic marine climate is largely controlled by the so-called North Atlantic Oscillation (NAO), which is driven by the pressure difference between the Azores High and the Iceland Low pressure cells. The winter (December-March) sea level pressure (SLP) difference between Ponta Delgada, Azores and Reykjavik, Iceland during winter 2004/2005 was slightly negative similar to the previous year. The Icelandic Low during this period was deflected northward centred in the middle of Nordic Seas and the Azores High was also deflected north of its usual position. As a result the centre of westerly winds was shifted towards the north and was weaker than normal over the North Atlantic from Portugal to Cape Farewell. Air temperatures were warmer than normal around Greenland during most of 2005 with values at Nuuk of 1.6°C above normal. In fact air temperatures during 2005 were above normal for almost the entire North Atlantic region with anomalies of >2°C west of Greenland and >3°C over the Davis Strait region. 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).

Satellite derived ice charts for all months of 2005 indicate that winter sea ice conditions were light during 2005 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 end-February off Maniitsoq/Sukkertoppen, a month earlier than during 2004. Multi-year sea ice 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 3-10 tenth. There was also a tongue of newly formed ice in the Cape Farewell region. Sea ice formed again in Baffin Bay in the first decade of November when 3-10 tenth 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 decade of November.

An analysis of air-sea heat fluxes and sea-surface temperature conditions in the Labrador Sea was presented (SCR Doc. 06/10). On an annual average, the Labrador Sea loses heat to the overlying atmosphere. The greatest heat losses normally occur in January and February. The NCEP reanalysis sea-air heat flux anomalies for the central Labrador Sea for 2005 show values of 20-30 W/m^2 less than normal for both 2004 and 2005, but the 2005 map features an area of reduced heat flux south of Greenland. Changes in annual mean sea-air heat flux from 2004 to 2005 indicate that this feature is part of a notable reduction in annual mean heat loss in the northern Labrador Sea. A time series of annual mean sea-air heat flux anomaly in the west-central Labrador Sea indicate a normal value is 66 W/m^2 with annual mean heat losses at this location have been less than normal for the past eight years. The 2005 annual mean of 44 W/m^2 was slightly greater than the 39 W/m^2 value for 2004 but was still the third lowest since 1987.

Monthly averages sea surface temperature (SST) data for the Labrador Sea extracted from the global HadISST1 data set produced by the UK Met Office Hadley Centre indicate that both 2004 and 2005 were above normal by more than 1°C. SST values in the west-central Labrador Sea were virtually identical for

2004 and 2005. Conditions were slightly cooler in the northern Labrador Sea, but warmer to the south and east. Annual SST anomalies show warmer than normal conditions since the mid-1990s. The 2004 annual mean was a record high for post-1960 conditions. The 2005 value was virtually identical to the 2004 value. In general, 2005 was a very mild year in the Labrador Sea, similar to 2004. Annual mean 2005 patterns in sea surface temperature and sea-air heat flux both reflected mild conditions in 2005, with some differences in spatial structure compared to 2004.

In 2005 monitoring of sea-surface temperature (SST) at locations in the Labrador, Gulf Stream and the North Atlantic Currents were completed (SCS Doc. 06/07). For this purpose the mean monthly SST deviation from the long-term mean values at 13 locations in NAFO Div. 2J, 3KLMN, 4VWX and adjacent open-sea area were used, as well as anomalies based on localized indices of three water mass boundaries: the boundary of the cold Shelf Water mass, the boundary of the Slope Water mass and the northern boundary of the Gulf Stream front in the area between 55°W and 70°W. In 2005, similar to 2004, the positive SST anomalies continued on the shelf of the Northwestern Atlantic Ocean and adjacent open sea areas. In the Labrador current from 55ºN to 49ºN, positive anomalies of SST were observed during 10-11 months with maximum anomalies occurring during spring and summer when they were 2-3°C above normal. In the North Atlantic Current to the north of the Flemish Cap, SST values were in 0.3-2.6ºC below normal in January-April, while from May the warming began and continued to the end of the year. During 2005 on the eastern slope and shelf of the Grand Bank the positive SST anomalies also prevailed exceeding the values in 2004. On the eastern Scotian Shelf SSTs were close to normal in winter to spring but exceeded the normal value by 0.9-1.3ºC in summer to autumn. Analysis of hydrological front fluctuations in 2005 demonstrated that in the areas of New England and Nova Scotia cold water mass boundary was still southwards of its mean long-term position, similar to two previous years, indicating the increased advection of cold water to the Scotian Shelf.

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 and within several Fjords off the west coast of Greenland during an oceanographic survey in the summer of 2005. The survey was carried out according to the agreement between the Greenland Institute of Natural Resources and Danish Meteorological Institute during the period June 20-29, onboard the Danish naval ship "*TULUGAQ*"**.** During the period July 5-27, 2005 the Greenland Institute of Natural Resources also carried out trawl surveys from Sisimiut to the Disko Bay area and further North onboard "R/V *PAAMIUT*". During these surveys CTD measurements were carried out on national oceanographic standard stations (SCR Doc. 06/01; SCS Doc. 06/13). During October and November 2005 the Institut für Seefischerei in Hamburg, Federal Republic of Germany conducted oceanographic observations at NAFO standard oceanographic sections Cape Desolation and Fylla Bank aboard the FRV "*Walther Herwig III*". During the German groundfish autumn survey oceanographic measurements were also performed at 89 fishing stations off West Greenland using a CTD-Rosette system (SCR Doc. 06/02; SCS Doc. 06/17).

The results of the 2005 Danish summer survey to the standard sections along the west coast of Greenland were presented together with CTD data obtained during their trawl surveys (SCR Doc. 06/01**)**. The cold and low salinity conditions observed close to the coast off Southwest Greenland reflect the inflow of Polar Water carried to the area by the East Greenland Current. Water of Atlantic origin ($T>3^oC$; $S>34.5$) is found at the surface at the three outermost stations on the Cape Farewell and Cape Desolation sections. In the Baffin Bay the very low surface salinities, generally below 33, is caused by melting of sea-ice during summer and fresh water runoff from land. The salinities around 34 reflect the core of the West Greenland Current, which is slightly modified by Atlantic Water. The warm surface waters in and around the Disko Bay is caused by solar heating of the 20-30 m thin low-saline surface layer. The results from standard sections show that at intermediate depths pure Irminger Water ($T \sim 4.5^oC$; $S > 34.95$) was traced north to the Cape Desolation section. Modified Irminger Water ($T > 3.5^oC$; $34.95 > S > 34.88$) was observed all the way north to Fylla Bank section. The northward extension of modified Irminger Water indicates medium to high inflow of water of Atlantic origin to the West Greenland area. The average salinity and temperature at 400-600 m depth west of Fylla Bank, which is where the core of the Irminger Water is normally found indicates that the inflow of Irminger Water was higher than normal in 2005. The temperature of this layer is 4.58°C which is 0.43°C higher than normal and the average salinity of 34.90 is 0.09 higher than normal.

This is the 6th highest value for salinity and 9th highest for temperature out of 49 years of measurements. In general temperatures have been warm and stable since the mid-1990s in all layers. Likewise, the mean salinity in the 400-600 m layer has increased in the early 2000s indicating increased strength of the Irminger Current. Surface salinity values were in general higher than normal and the multi-year-ice "Storis" was absent at West Greenland and only in small concentration on the Southeast coast in the Irminger Basin. In the surface layer (0-100 m) weak gradients between the cold, low-saline Polar Water and the warm, high-saline water of Atlantic origin were 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 2005 this core was hardly recognizable, which is a sign of a reduced inflow of Polar Water in 2005. Measurements west of Fylla Bank indicate reduced inflow of Polar Water and above normal inflow of Atlantic Water. The surface temperature (0-50 m) was the fifth highest observed, more than 1°C above average and the surface salinity was the second highest, more than 0.6 above average. At intermediate depths at 50-150 m and 150-400 m temperatures were respectively the second highest and highest observed about 1.9°C and 1.3°C above average conditions. The salinities were the highest observed about 0.5 and 0.3 above average conditions. From the Aasiaat section up to the Upernavik section, a very cold subsurface layer is found with temperatures below -1°C (below 0°C at Aasiaat) with cores at depth at about 75 m. This layer is most likely formed during winter by convection. Brine rejection increases the low surface (0-50 m) salinities, so it can overcome the strong surface gradients which are created during summer by melting of sea-ice and run-off of fresh water from land. Below the cold subsurface layer, a relative warm (>1°C) water mass is found with a core around 400-500 m. This water is the extension of the Irminger Water component of the West Greenland Current.

Results of the 2005 German autumn survey to the standard sections along the west coast of Greenland were presented in SCR Doc. 06/02. Measurements made along the Fylla Bank section during 2005, which crosses the core of the West Greenland Current, show temperature and salinity values of 5.8°C and 34.986 at about 235 m depth. Maximum temperature and salinity values of 6.41°C and 34.920 were found at 118 m depth. The surface layers were dominated by low saline (~33.5) water with temperatures in the range of 2°C to 3°C. Along the Cape Desolation section temperature and salinity values of 6.0°C and 34.024 were recorded at 232 m depth during early November 2005. At depths near 3000 m *in situ* temperature and salinity values of 1.74°C and 34.889 were recorded. Based on autumn measurements (September-November) at station 4 of the Fylla Bank Section, the temperature anomaly time series reveals a warming trend which is persistent since 1993. 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. Subsurface warming during 2005 was in the range of the warm 1960s temperatures, but was less than during autumn 2003 when temperatures were 2.44°C above normal.

Subareas 1 and 2. Hydrographic conditions in the Labrador Sea (SCR Doc. 06/10) 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.

The 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 16th annual AR7W survey took place in late May and early June 2005. Between 1990 and 2005 the upper layers of the Labrador Sea have become warmer and saltier. Changes in temperature and salinity averaged over the upper 150 m during this period amount to about 1°C and 0.1, respectively. The upper 2 000 m of the water column in the west-central Labrador Sea have become steadily warmer over the past six years. By this measure, conditions in 2005 were the warmest in the 16 years of annual AR7W surveys. Salinity has shown a more complex behaviour during this time period. For the past four years, salinity has been higher than during the previous decade, with conditions in 2005 slightly fresher than in 2004. Density changes during the past few years have been relatively small, with changes linked to temperature and salinity nearly in balance. The 2005 survey encountered warm and saline waters in the offshore branch of the West Greenland Current, with maximum salinities greater than 34.95. The 2005 observations suggest that vertical mixing in the west-central Labrador Sea during the winter of 2004-2005 was confined to the upper 700 m and restricted to potential density anomalies of less than approximately 27.72 kg/m^3.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador Region during 2005 was presented (SCS Doc. 06/11). 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 2005 with three physical and biological oceanographic offshore surveys carried out along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Hamilton Bank on the southern Labrador Shelf. The first was conducted on the CCGS Teleost from April 30 to May 9, the second from July 16 to August 3 and the last from November 26 to December 14. 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 main objectives are 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 2005 referenced to their long-term (1971-2000) means were presented in SCR Doc. 06/11. At Station 27 off St. John’s, the depth-averaged annual water temperature decreased slightly from the record high of 2004 to just over 0.5°C above normal, the 7th highest on record. Annual surface temperatures at Station 27 were identical to 2004, 1°C above normal, the highest in the 60 year record. Bottom temperatures were also above normal by 0.8°C, the 3rd highest in the 60-year record. Annual surface temperatures on Hamilton Bank were 1°C above normal, the 4th highest on record, on the Flemish Cap they were 2°C above normal, the 3rd highest and on St. Pierre Bank they were 1.7°C above normal, the highest in 56 years. Upper-layer salinities at Station 27 were above normal for the 4th consecutive year. The area of the cold-immediate-layer (CIL) water mass on the eastern Newfoundland Shelf during 2005 was below normal for the 11th consecutive year and the 5th lowest since 1948. The near-bottom thermal habitat on the Newfoundland and Labrador Shelf continued to warm in 2005, with bottom temperatures reaching a record of 2°C above average on Hamilton Bank off southern Labrador during the autumn. Bottom temperatures on St. Pierre Bank were above normal during the spring of 2005, the highest since 2000 and the 6th highest in 36 years. The area of bottom habitat on the Grand Banks covered by sub-zero water has decreased from >50% during the first half of the 1990s to near 15% during the past 2 years. In general, water temperatures on the Newfoundland and Labrador Shelf decreased slightly from the record high values of 2004, but remained well above their long-term means, continuing the warm trend experienced since the mid- to-late 1990s. Newfoundland and Labrador Shelf water salinities, which were lower than normal throughout most of the 1990s, increased to the highest observed in over a decade during 2002 and have remained above normal at shallow depths during 2003-2005.

Biological oceanographic observations from a fixed coastal station and oceanographic sections in Subareas 2 and 3 during 2005 were presented and referenced to previous information from earlier periods when data were available (SCS Doc. 06/11; SCR Doc. 06/18). Overall, the seasonality of chemical and biological variables at Station 27 and along the major AZMP sections in 2005 was similar to previous years (1999-2004). 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. There were a few notable trends in the observations from Station 27 and the oceanographic transects. At Station 27, the integrated seasonally-adjusted chlorophyll inventory along with many zooplankton species (*C. finmarchicus, C. glacialis, C. hyperboreus*, *Metridia* spp., *Oithona* spp., euphausiids and larvaceans) were at their lowest levels since the start of AZMP. Few of these trends were statistically significant, largely as a result of the considerable sampling variability. Also, the deep (0-150 m) inventories of nitrate and silicate remained low relative to that observed in 2000. However, the trends observed at Station 27 were in marked contrast with those observed along the oceanographic transects. With the exception of the decline in the seasonally-adjusted deep (50-150 m) silicate inventory along the Flemish Cap transect, none of the standard oceanographic variables (integrated chlorophyll, surface and deep nitrate and silicate inventories) showed significant trends during the period 2000-2005. Values in 2005 were generally near the overall mean since the inception of AZMP. In addition, most of the seven major copepod taxa along the Flemish Cap, Bonvasita Bay and Seal Island transects were either at or near their maximum seasonally-adjusted means, in contrast to the patterns at Station 27. Zooplankton abundance along the Southeast Grand Banks showed few clear trends, and none were statistically significant. Discrepancies between the patterns of seasonally-adjusted means for oceanographic variables and major zooplankton taxa between Station 27 and the oceanographic transects is in marked contrast with the relatively large decorrelation scales found in temperature and salinity. Aliasing of sampling and the onset of the spring phytoplankton bloom are likely to prevent an estimation of the annual mean phytoplankton standing stock from the oceanographic surveys. Estimates of annual mean phytoplankton standing stock or surface nutrient inventories along oceanographic transects based on GLM analysis are highly influenced by the magnitude of the spring phytoplankton bloom observed during our surveys. However, attempts to derive average annual values were strongly influenced by the stage of the spring phytoplankton bloom, as determined from the relative abundance of nutrients and phytoplankton. In some years (e.g., 2003), phytoplankton standing stock was low during the spring oceanographic surveys whereas the surface nitrate inventory was high, while the opposite was true in 2000. The most notable advance in 2005 was in our ability to provide quantitative analysis of inter-annual differences in the abundance of dominant zooplankton taxa at Station 27 and along the key oceanographic transects. The analytical approach is somewhat simplistic and does not take into consideration of major shifts in the spatial distribution of species. However, the approach has revealed significant inter-annual variations in the abundance of zooplankton on the Shelf. Data from Station 27 revealed that only 12 taxa were sufficiently abundant and frequent to allow appropriate inter-annual comparison in abundance patterns, which included copepods, gastropods, larvaceans and euphausiids. In contrast, only 7 to 8 species of copepods were sufficiently abundant and frequent on the shelf to allow effective and reliable inter-comparison throughout the AZMP implementation period. Other groups, such as bivalves, gastropods, euphausiids and larvaceans were highly patchy in their distribution, making statistical inter-comparisons unfeasible at this time.

Subarea 4. A description of environmental information collected on Scotian Shelf and in the Eastern Gulf of Maine and adjacent offshore areas during 2005 was presented (SCR Doc. 06/25). A review of physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine and adjacent offshore areas during 2005 has shown the temperature conditions were generally from 0 to 1°C below normal. This contrasts with 2004 when cooler conditions prevailed. St. Andrews sea surface temperature was 0.07°C below normal making 2004 the 49th coldest in 85 years. At Prince 5, 0-90 m, monthly mean temperatures were generally below normal by about 0.3 to 0.4°C. Salinities were 0.42 (0 m) and 0.17 (90 m) below normal. Halifax sea surface temperature was 1.0°C below normal, making 2005 the 8th coldest in 80 years. At Halifax Station 2, 0-140 m temperature anomalies were generally within 1°C of normal; salinity was slightly below normal values. Sydney Bight and Misaine Bank had typical temperature anomalies of 0.5 and 0°C; Emerald Basin, Lurcher Shoals, Georges Basin and eastern Georges Bank profiles featured typical anomalies of –0.5°C at most depths. Standard sections in April and October on the Scotian Shelf support the overall conclusion of near normal temperatures in the upper 100m. The temperatures from the July groundfish survey increased substantially from the record cold values in 2004. The overall anomaly for the combined areas of 4Vn,s, 4W and 4X was -0.07°C. The overall stratification was slightly above normal for the Scotian Shelf region in 2005.

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. 06/10). A total of 1996 CTD (conductivity, temperature, depth) profiles were made on NEFSC cruises during 2005. These data were processed and made available via an anonymous FTP site. Data access and reports of the oceanographic conditions indicated by these observations are available at *ftp://ftp.nefsc.noaa.gov/pub/hydro/cruise_rpts/2005/.* Similar reports have been issued each year since 1991. Preliminary results indicate that relatively low surface salinities persisted throughout 2005. The surface temperatures were cool during the 2005 winter, but exhibited positive anomalies during the summer and into the fall. The very warm summer surface temperatures in the summer of 2005 likely resulted from the concentrating of seasonal heating in the near surface layer since the corresponding bottom temperature anomalies were comparably negative. During 2005, zooplankton community distribution and abundance were monitored using 673 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 transects across the Gulf of Maine from Cape Sable, NS to Boston and twelve transects across the mid-Atlantic Bight from New York to the Gulf Stream during the same time period.

Highlights of environmental conditions in the NAFO Convention Area for 2005

1. The North Atlantic Oscillation (NAO) (Dec.-Feb.) index was above normal during the winter of 2005 however arctic outflow during the winter to the Northwest Atlantic was weaker than normal.

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

3. Sea-ice coverage during 2005 remained below normal for the 11^{th} consecutive year on the Newfoundland and Labrador Shelf. In West Greenland Waters, the Gulf of St. Lawrence and on the Scotian Shelf sea-ice was also lighter than normal.

4. Mean sea surface temperatures during 2005 were warmer than normal from the Labrador Sea (>1°C) to the Scotian Shelf.

5. Shelf water salinities which increased to the highest observed in over a decade during 2002 remained above normal in most areas in 2005, reducing the overall stratification of the water column throughout the waters of eastern Canada, although there was considerable local variability.

6. The waters over much of the Labrador Sea have become steadily warmer and more saline over the past five years and in 2005 the upper water column was the warmest in the past 16 years, while sea surface temperatures were similar to 2004 which was the warmest in the past 45 years.

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

8. The warm ocean conditions observed during 2003 to 2005 off West Greenland coincided with an increase in the production of haddock and cod.

9. Ocean temperatures on the Newfoundland and Labrador Shelf remained well above normal in 2005, continuing the warm trend experienced since the mid- to late 1990s. The 2005 values however decreased slightly over the record highs of 2004.

10. Annual mean nutrient inventories have remained at or near the long-term mean (1993-2005) in the upper layer in 2005 on the Newfoundland and Labrador Shelf compared to earlier years, while deep inventories remained lower than the long-term mean in 2005, following a pattern that started in the late 1990s.

11. Annual mean chlorophyll a inventories, a proxy of phytoplankton biomass, declined slightly below the long-term mean (1993-2005) in 2005.

12. The abundance of many dominant zooplankton at Station 27 (Div. 3L) in 2005 reached their lowest levels encountered since routine collections began in the late 1990s. In contrast, the abundance of many copepod species were generally at their highest levels on the northeast Newfoundland Shelf along oceanographic transects above 48ºN in 2005.

13. CPR estimates of the abundance of small copepods *Oithona* spp. and *Paracalanus* / *Pseudocalanus* spp. and *Oithona* spp. indicate steadily decreasing abundance in NAFO Div. 3L and Subdiv. 3Ps throughout the 1990s and recent years. The abundance for *C. finmarchicus*, *C. glacialis*, and 'Copepod nauplii' showed the opposite trend, with increasing levels during the late 1990s and recent years in Subdiv. 3Ps.

14. Further south, on the Scotian Shelf, ocean temperatures increased over 2004 values to above normal conditions over central and eastern areas but remained below normal over western areas.

15. In the region from the Gulf of Maine to the Mid-Atlantic Bight surface salinities were relatively low throughout 2005. The surface temperatures were cool during the 2005 winter, but exhibited positive anomalies during the summer and into the autumn while the corresponding bottom temperature anomalies were comparably negative.

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 2006 Meeting:

a) *Distribution of 0-group cod off West Greenland during the Walther Herwig III autumn 2005 in relation to a warming ocean environment. M. Stein.* The survey was primarily a stratified random bottom trawl survey, conducted from October 13th to November 25th aiming at cod in depth strata of 0-200 m and 200-400 m off East and West Greenland. Results show that numbers of 0-group cod specimens in the bottom trawl used during the cruises since 1982 were most abundant in 1984 and 1985, as well as during 2003-2005. It was emphasized that these findings are not representative for the abundance of 0-group cod in these waters, since the net is primarily designed to catch adult cod however, with the used of a 10 mm mesh size cod end liner, we were able to sample 0-group cod qualitatively. Despite this, it was argued that these data may be taken as an index for recruitment to the Greenland cod stock. It was questioned whether the 0-group cod found as far north as Danas Bank on November 9, 2005 off West Greenland may have come from East Greenland spawning sites, or whether they originate from spawning sites off West Greenland. No clear answer could be found during the presentation of the data. It is hoped, however, that otoliths taken from 0-group cod might clarify this question. Results from qualitative stomach analysis indicated that cod eats fish, shrimps and benthic species like sea cucumbers. Cod of 27 cm length was found in the stomachs of 70-80 cm cod, as well as 0-group cod was found in stomachs of cod of smaller size. Abundance and biomass data from cod indicate that the 2005 situation for the cod stocks off Greenland are at similar levels as during 1986. Information from the website of the Federal Research Centre for Fisheries in Hamburg, Germany (*http://www.bfa-fisch.de*) was presented which deals with "*Recovery Potential of Greenland Cod – A Sustainable use of the 2003 year-class*". This article emphasizes that results from the 2005 German bottom trawl survey in Greenland waters indicate that the positive trend for the Greenland cod stock is continuing. Compared to the historical scenario, this trend however can only be seen as minor recovery based on the 2003 year-class which clearly dominates the other age groups. Additionally, warming of water masses as observed since the mid-1990s in the area and no directed fishery on cod seem to play a role. Medium-term development of catches and spawning stock biomass under the assumption of different harvesting strategies: no fishery, maximum yield, and a sustainable fishery are presented in this article. The proposed precautionary harvesting strategy ($F_{0.1}$) is in accordance with the common fishery policy of the EU which follows the Johannesburg Declaration on Sustainable Use of Stocks. A major problem of the realisation of a sustainable cod fishery off Greenland, as emphasized in the article, is the potential conflict with the Greenlandic shrimp fishery. This is due to (a) by-catches of young cod in the shrimp fishery and (b) due to the potential feeding pressure of cod on shrimps.

b) *Moored measurements of bottom pressure and currents for calibrating and interpreting DST data on the Grand Bank. Guoqi Han, Stephen J. Walsh, Charlie Fitzpatrick and Wade Bailey. SCR Doc. 06/22*. As an integrated part of a renewed data storage tagging (DST) program for the yellowtail flounder on the Grand Bank, an oceanographic mooring was deployed from November 2003 to November 2004. Harmonic analysis was carried out on bottom pressure gauge, DST pressure, and current meter data from the mooring. The observational results provide further validation of Han's (2000) tidal model in the study region. The present study indicates that moored DST sensors are capable of accurately capturing the semi-diurnal and diurnal tidal response in spite of their low accuracy. Both the Conductivity-Temperature-Depth (CTD) and DST data indicate substantial change in the bottom temperature, most strikingly, in response to the migration of the cold intermediate layer.

c) *The Distribution and Abundance of Yellowtail Flounder (Limanda ferruginea) in Relation to Bottom Temperatures in NAFO Divisions 3LNO based on Multi-Species Surveys from 1990-2005. E. B. Colbourne and S. J. Walsh. SCR Doc. 06/23.* An analysis of near-bottom temperatures in NAFO Div. 3LNO during spring and fall surveys was presented in relation to the spatial distributions and abundance of yellowtail flounder for the years 1990 to 2005. The thermal habitat in the Div. 3LNO region has shifted from mainly cold sub-zero °C conditions of the early 1990s, to a relatively warm environment from 1998 to 2000 with approximately 60% of the bottom covered by water >2°C by the autumn of 1999 in water depths <100 m. Since the record-warm year of 1999 temperatures began to decrease reaching the lowest value since 1994 in the spring of 2003. During 2004 and 2005 however bottom temperatures recovered to warmer than normal values, similar to the late 1990s. The shift in the thermal habitat from the cold sub-zero °C conditions of the first half of the 1990s to a relatively warm environment during the latter half of the 1990s and early 2000s resulted in an increase in bottom temperatures to >0°C values over almost 100% of the traditional bottom habitat of yellowtail flounder on the Grand Bank. Coincident with these changes there has been a significant increase in the number of yellowtail flounder per tow in survey sets in Div. 3NO and larger catches have become more widespread in the southern areas of Div. 3L. It appears that the most significant distributions of yellowtail are found south of the 0°C isotherm in warmer water and within the 100-m isobath on the Grand Banks. A strong association was found between bottom temperatures and mean catches rates in water depth <100 m on the southern Grand Bank with catch rates increasing with temperature. The results are discussed in terms of an improved thermal environment and other factors, possibly resulting in an associated increase in catchability and distribution.

d) *Progress toward modeling tagging data to investigate spatial and temporal changes in habitat utilization of yellowtail flounder on the Grand Bank. Stephen J. Walsh, M. Joanne Morgan, Guoqi. Han, and Joe Craig. (SCR Doc. 06/29).* Recent data storage tagging (DST) data have indicated that adult yellowtail flounder over the Grand Bank of Newfoundland undergo distinct off-bottom vertical migrations. A preliminary examination of the potential relationship between the tide and off-bottom migration over the Grand Bank suggest the off-bottom excursion of yellow tail flounder during the nighttime be associated with high tides (Walsh and Morgan, 2004). This vertical migration behavior was further confirmed from new tagging observations, when examined in conjunction with tidal height variation based on Han's (2000) model (Fig. 24). A possible explanation is the fish's response to the change in the hydrostatic pressure as a result of tidal rise and fall. In fact, this mechanism was discussed in juvenile plaice (e.g. Hunter *et al*., 2004). The analysis presented here for Peterson disc tags show yellowtail movements are generally southward from their release site. The electronic data storage tag measurement data for depth and temperature for yellowtail flounder during their period at liberty showed substantial vertical activity in all 15 DST fish. There were three basic patterns in the depth data: 1) periods of very limited vertical movements, 2) periods of relatively frequent vertical movements and 3) periods of no detectable vertical movements. Most of the vertical movements occurred at night. Night-time movements often lasted for several hours with occasional descents back to the bottom. Coincidental with some of these vertical movements was a change in recorded temperatures and it was evident that yellowtail were crossing the thermocline during the summer. These results are similar to the Walsh and Morgan (2004) analysis on yellowtail behavior from 29 DSTs. Seasonal examination of the number of observations and time off bottom showed that, July, August, and September were the most active months. Off bottom vertical movements of yellowtail flounder are mainly diurnal and possibly timed to high tide. There is some indication that vertical movements may be linked with southwest-northwest current direction. Similar findings in yellowtail flounder making extensive vertical movements have also been reported on Georges Bank (Cadrin and Westwood, 2004). Passive drift in mid-water currents are thought to be the reason for yellowtail flounder in that area making extensive vertical migrations to move among fishing grounds or stock areas.

e) *Exploring Relationships between Bottom Temperatures and Spatial and Temporal Patterns in the Canadian Fishery for Yellowtail Flounder on the Grand Bank. Stephen J. Walsh and William B. Brodie. (SCR Doc. 06/26).* Temperature data from data storage tags on yellowtail flounder and an oceanographic mooring site in NAFO Division 3N were analyzed for the period, June 2003 to November 2004 for seasonal trends. Seasonal trends in the Canadian fishery for yellowtail flounder were also examined for the same time period. An overlay of temperatures and catch rates (CPUE) suggests a temperature trend in catch rates. Several patterns emerge in the analysis of the Canadian fleet fishery for yellowtail flounder on the Grand Bank. There appears to be a seasonal trend in depths fished by the Canadian fleet in the 2003-2004 fishery, with shallower depths being fished during the winter months when compared to the rest of the year. Catch rates are highest at these shallower depths and the fishery is mainly concentrated on or adjacent to the Southeast Shoal. There is a general temperature trend for higher yellowtail flounder fishery catches to be taken in warm rather than cold sub-Arctic waters as was evident in annual spring and fall survey catches (Colbourne and Walsh, 2006). There is also an apparent temperature trend in fishery catch rates with both signals moving in the same direction in the Mooring data and to some extent in the Fish data. Colbourne and Walsh (2006) analysis of 1990-2005 spring and fall survey catch rates also found a similar signal and suggested a temperature dependent catchability as one possible conclusion. There are three spatial patterns in the fishery. A similar spring and fall pattern of wide spread effort and catches across Div. 3NO; a summer pattern, from June to September, with the southern range of fishing protracted because of the plaice by-catch issue and more effort is seen further north; and a December to April pattern where most of the effort and catches are restricted to the area of the Southeast Shoal. The western side of the Southeast Shoal area appears to be an area providing good catches at all times of the year and possibly the only area during the winter months. The significance of the winter fishery pattern is unclear but Canadian fishing skippers have mentioned that this is the only area where any high catches are found on the bank. This paper represents the first approach in exploring patterns in temporal and spatial shifts in the fishery and catch rates with independent measures of temperature with some encouraging results. It is noteworthy that many non-environmental factors can influence fishing patterns and catch rates including market demands, fuel costs, plaice by-catch, fish size, and experience of the fishing skippers. In addition, most of the 15 DST fish were caught in the Southeast Shoal area whose data like that of the mooring may represent only what part of the population is experiencing. Also the DST fish data is contaminated with off-bottom depths and temperatures associated with vertical movements which need to be removed and the averages re-calculated to see if the signals of temperature and catch rates are more or less aligned. Further investigations will continue.

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 includes 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. The 2005 status summary that covered most of the NAFO Convention Area based on contributions received for Subareas 0-1, West Greenland (M. Stein and M. Ribergaard), Subareas 2 and 3 (E. Colbourne and R. Hendry), Subareas 4 and 5 (B. Petrie) and Subareas 5 and 6 (D. Mountain) will be updated and posted on the NAFO website (*http://www.nafo.int/science/frames/ecosystem.html*) shortly after this STACFEN Meeting.

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 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 the 2005 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. No progress was made at the 2006 meeting but continued efforts are encouraged to pursue correlative studies between marine species and trends in the environment. Statistical modeling studies remain ongoing with invertebrate populations and are used as "indicators" in those specific assessments. The implications to fully implement ecosystem based management into stock assessments will most likely necessitate the need to increase the level of environment information required and therefore committee members were encouraged to submit ideas for integration of environmental information into this process.

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

STACFEN made no formal recommendations during this 2006 meeting but the committee was again encouraged to provide ideas for additional environmental indices for future use and any additional species that could be evaluated in relation to the environment.

9. **National Representatives**

The Committee was not informed of any changes in the national representative responsible for hydrographic data submissions. 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 brought forward or discussed by the Committee.

11. **Acknowledgements**

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

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

Chair: M. Stein Rapporteur: Margaret A. Treble

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 2 and 12 June 2006, 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 (France, Germany, Portugal and Spain), Ukraine, Russian Federation and United States of America. The Executive Secretary and Scientific Council Coordinator were in attendance as were other members of the Secretariat's publication staff.

1. Opening

The Chair opened the meeting at 9:05 by welcoming the participants. The Committee was informed of a "Pre-STACPUB" meeting held on 31 May 2006 at the NAFO Secretariat (SCS Doc. 06/18). The agenda as presented in the Provisional Agenda was extended by sub-topics under items 7) and 9) and was adopted. Margaret A. Treble (Canada) was appointed rapporteur.

2. Review of Recommendations in 2005

a) Recommendations in June

i) 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.*

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

ii) 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.*

This item is discussed below under item 5. b) Journal Copyright.

iii) 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, and if any of them have strong concerns this decision will be revisited by June 2006 Meeting.*

This item is discussed below under item 5. a) Review of the format of Journal of Northwest Atlantic Fishery Science.

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

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

v) 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.*

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

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

This item is discussed below under item 4. b) Presentation of New Structure of Public NAFO Website.

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

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

3. **Review of Publications**

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

STACPUB was informed that:

Volume 36. Eight independent papers have been published to date on the website e-Journal and one paper has been rejected. 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 editorial process of papers presented (17 papers) at the September 2004 Symposium on "*The Ecosystem of the Flemish Cap*" was extended. Nine papers have been published to day on the website e-Journal. The editorial process is currently underway for 8 papers. The suggested time-frame for completion of this Journal issue is mid-2006 but this deadline will not be achieved.

b) **NAFO Scientific Council Studies**

STACPUB was informed that there were no items outstanding.

c) **NAFO Statistical Bulletin**

STACPUB was informed that:

Catch 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 becomes available. No Statistical Bulletin has been published since the publication and circulation of Vol. 49 containing 1999 data in January 2002. The Secretariat does not intend to publish the Statistical Bulletin again in a paper hardcopy format but will consider publication in CD format.

d) **NAFO Scientific Council Reports**

STACPUB was informed that:

The *NAFO Scientific Council Reports* (Redbook) 2005 Volume (359 pages) has been published and contains reports of the June, September and November 2005 Scientific Council Meetings. This book will be distributed to participants of the June 2006 Scientific Council Meeting.

The Website publication of Reports of all Scientific Council Meetings held in 2005 was issued in January 2006. It differs from the print version mentioned in the above paragraph in that it contains navigation tools to quickly locate the meeting reports.

e) **Index and Lists of Titles**

STACPUB was informed that:

The provisional index and list of titles for 97 research documents and 20 summary documents presented at the Scientific Council Meetings during 2005 were compiled and presented in SCS Doc. 06/4 (excel format – only on the LAN) for the June 2006 Meeting.

f) **Book by M. P. Fahay**

Update on the book on "Early Stages of Fishes in the Western North Atlantic Ocean (Davis Strait, Southern Greenland and Flemish Cap to Cape Hatteras)" by Michael P. Fahay. The final proofs for Volume 1 have been sent to the author for approval and Volume 2 is now being formatted at the Secretariat.

g) **Others**

STACPUB was informed that:

At its meetings since 1980, STACPUB has nominated a total of 824 research documents. This includes 17 documents from the Symposium on "*The Ecosystem of the Flemish Cap*" in September 2004. Since 1980, a total of 741 papers have been published in the Journal (426) and Studies (315).

In addition, 5 papers from outside the STACPUB nomination process were submitted for Journal consideration since June 2005.

4. **NAFO Website**

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

Since the Journal Vol. 34 went on line in October 2004, 4 volumes with 66 papers have been placed on the website. In addition pdf's are available going back to Vol. 20. The number of total visits has increased from approximately 3 000 visits to over 7 000. The average number of pages viewed per visit to the NAFO website is 4-5, above the internet average of 2-3 pages per visit. 15-20% of visitors go to the first page and 33% of those will go on to view other articles. 10% of visitors will print the pdf version of the paper. Papers place on the start page are more accessible and during a review of the website they got six times the number of visits compared to a Journal paper listed elsewhere. NAFO Secretariat staff encouraged STACPUB members to provide feedback and comments on how to improve the Journal website.

b) **Presentation of New Structure of Public NAFO Website**

The Committee was very impressed with the recent advances made on the NAFO website, which is now fully operational. The Chair expressed his thanks to the Secretariat for a very good job.

5. **Journal of Northwest Atlantic Fishery Science**

a) **Review of the Format of Journal of Northwest Atlantic Fishery Science**

The Secretariat proposed that the front page of the Journal and Studies change slightly so that it will be identical whether it is viewed online or in print. The citation will be included on the new front page along with a digital object identifier (doi) so it can be tracked on-line. This will eliminate the long paths used when files are placed on a web server and will not change even if the server changes. There would also be a clear statement as to who the copyright owner is and that people have the right to copy the paper. The date of publication will appear in the top corner and may not be the same as the date the volume is bound (i.e. papers from one or more years may be bound together in a single volume). The front page of the Journal volume will provide the years covered by the articles it contains.

An objective might be to publish a miscellaneous volume once a year and this would provide regular Journal output that STACPUB would like to have.

There is value in keeping both pdf and html versions of the articles on the website. The html versions are growing in popularity as they download faster if the article has many graphics and it allows for dynamic linking with the doi number which is not possible with a pdf.

STACPUB **recommended** *to accept the format changes and the single citation for the Journal as proposed by the Secretariat.*

b) **Journal Copyright**

The Secretariat proposed that a new "copyright", the Creative Commons Deed, be placed on the inside front page of the Journal and Studies volumes. This is not a copyright but rather a right to copy. Users would have the freedom to copy the work and distribute in any way providing that it doesn't discredit the authors or provide financial gain.

STACPUB **recommended** *to adopt the Creative Commons license for the Journal and Studies as proposed by the NAFO Secretariat.*

The Secretariat proposed that STACPUB consider a new Author Agreement so that authors will be made aware that under certain conditions articles published in the journal can be copied. This Agreement has been prepared with the assistance of a lawyer.

STACPUB **recommended** *to adopt the Author/Owner consent form for the Journal and Studies as proposed by the NAFO Secretariat.*

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

a) **Invitational Papers**

STACPUB discussed the possibility of publishing a special issue on papers concerning Hooded Seals that would contain approximately 10 papers. The Committee noted that NAFO has a policy that workshop papers be published in the Studies. STACPUB agreed that the papers be made available as SCR documents on the NAFO website and could be published later as a special issue of the Studies.

b) **New Initiatives for Publications**

i) While the Journal does not specifically restrict publication of social science and economic articles these areas of research are not included in the Journal description found on the web page. STACPUB agreed that social science and economics be added to the list of topics covered by the Journal and that appropriate editorial board capacity be installed.

ii) The Secretariat noted that reprints could be made by authors from the pdf version of the articles.

STACPUB **recommended** *that the distribution of both the free reprints and the reprints at cost be discontinued for manuscripts submitted after June 15, 2006.*

7. **Editorial Matters Regarding Scientific Publications**

a) **Review of Editorial Board**

i) The Chair of STACPUB suggested that committee members consider the appointment of a General Editor who would oversee the production of the Journal and Studies Volumes, report to STACPUB and consult with the Chair. STACPUB appointed Anthony Thompson as General Editor for the Journal.

ii) The Chair suggested that it would be useful to have the Associate Editors present at STACPUB meetings and that the Scientific Council Chair could approach the Executive Secretary to raise this issue with STACFAD for funds to facilitate this.

iii) STACPUB nominated Dave Kulka (Canada) to fill a vacancy on the Editorial Board (Vertebrate Fisheries Biology).

b) **Progress Report of Publications of Vol. 36, Journal issue of Miscellaneous Papers**

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

c) **Progress Report of Publications of Vol. 37, Symposium "*The Ecosystem of the Flemish Cap*"**

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

d) **Progress Report of Publications of book by Michael P. Fahay on "*Early Stages of Fishes in the Western North Atlantic Ocean North of 35°N and West of 40°W*".**

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

8. **Papers for Possible Publication**

STACPUB Chair reminded the Committee to review the research documents submitted to the June 2006 meeting.

9. **Other Matters**

a) **Science Citation Index (SCI)**

The SCI issue will be re-visited during the June 2007 Meeting of STACPUB.

b) **Closing**

The Chair thanked the participants for their valuable contributions, the rapporteur for taking the minutes and the Secretariat for their support. The meeting was adjourned at 12:00 pm.

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

Chair: Konstantin Gorchinsky Rapporteur: Joanne Morgan

The Committee met at Alderney Landing, at 2 Ochterloney Street, Dartmouth, Nova Scotia, during 5-13 June 2006 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 (France, Germany, Portugal, and Spain), the Russian Federation, Ukraine and the United States of America. The Executive Secretary and Scientific Coordinator were in attendance.

1. **Opening**

   a) **Appointment of Rapporteur**

   The chair opened the meeting at 0900 on 5 June 2006. He welcomed all the participants, and thanked the Secretariat for hosting the meeting. Joanne Morgan was appointed as rapporteur. The Chair pointed out some minor adjustments to the agenda, which was then adopted.

2. **Review of Previous Recommendations**

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*.

This item was considered under agenda item 3.

STACREC **recommended** that *NAF be submitted to Scientific Council for consideration*.

This item was considered under agenda item 3.

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*.

This item was considered under agenda item 4.

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.*

This item was considered under agenda item 5.

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

The Executive Secretary informed STACREC that STACFAD had approved money for this project in the 2006 budget. However because of overall NAFO budgetary problems this project has not been started. The Secretariat intends to pursue this project in future as resources permit.

3. Fishery Statistics

a) Progress report on Secretariat activities in 2005/2006

Acquisition of STATLANT 21A and 21B reports for recent years.

The Scientific Council Coordinator described the status of STATLANT data for this year. There were some difficulties with Contracting Parties in meeting submission dates and some data were submitted only as 21B (Tables 1 and 2). However, over all there were no major new difficulties.

The issue of determining when data are no longer 'provisional' was discussed. In the past, data were considered to be provisional until the Statistical Bulletin for that year was published. Statistical bulletins will no longer be published in paper form. So we need a new way to decide if data are provisional. Data are continually updated on the web site. The data could be placed on different parts of the site 'final' vs 'provisional'. The Secretariat can monitor when a given year is 'complete' with all submissions and when all inconsistencies are addressed, placing the data in the 'final' section of the web site when this process is complete. National statistical reporting agencies could be asked when the data are final as part of this process. Including the date of submission and what countries have submitted on the site in association would be helpful to users in determining how much data is available in any provisional data set. The ‘Statistical Bulletin’ could also be published when the data are final on CD ROM with an official publication date.

The EU (EUROSTAT) noted that, while every effort would be made to respect the revised deadline of 1 May for the submission of the STATLANT 21A data, the nature of EU fisheries in the NW Atlantic (distant-water vessels with lengthy absences from port) created difficulties for the national statistical services in the timely collection of the data. It was also pointed out that the deadline for the submission of the STATLANT 21B data could be relaxed from 30 June because little use is made of the data between the Scientific Council June and September meetings. Such a change would result in a more realistic deadline for the statistical services. STACREC noted the difficulty of some contracting parties in meeting the deadline for submission of STATLANT data but recognized that the acquisition of 21A data in advance of the June meeting is very important to the work of the Scientific Council and **recommended** that *the deadline of 1 May for the acquisition of STATLANT 21A data be maintained but that the deadline for STATLANT 21B be changed to 31 August.*

TABLE 1. Dates of receipt of STATLANT 21A and 21B reports for 2003-2005 at the Secretariat up to 14 June 2006.

Country/ Component	STATLANT 21A (15 May deadline)[1] 2003	2004	2005	STATLANT 21B (30 June deadline) 2003	2004	2005
BGR*	No fishing	No fishing	No fishing	No fishing	No fishing	No fishing
CAN-CA	-	-	-	-	-	-
CAN-M	13 May 04	11 May 05	-	28 Feb 05 (partial)	-	-
CAN-N	20 May 04	2 Jun 05	03 May 06	18 Feb 05	-	03 May 06
CAN-Q	22 Mar 04	22 Dec 04	20 Dec 05	-	-	-
CUB	-	-	-	-	-	-
E/EST**	17 Mar 04	13 May 05	28 Apr 06	17 Mar 04	-	-
E/DNK	13 May 04	06 May 05	09 May 06	01 Aug 05	06 May 05	09 May 06
E/FRA-M	-	-	-	-	-	-
E/DEU	11 May 04	13 May 05	03 May 06	15 Jun 04	04 Jul 05	-
E/NLD	No fishing	No fishing	No fishing	No fishing	No fishing	-
E/LVA**	25 May 04	13 May 05	24 Apr 06	29 Jun 04	13 May 05	24 Apr 06
E/LTU**	18 May 04	09 May 05	30 May 06	-	-	-
E/POL**	01 Sep 04	16 Feb 05	15 May 06	01 Sep 04	01 Mar 05	31 May 06
E/PRT	22 Jun 04	07 Jun 05	12 May 06	19 Aug 04	19 Aug 05	-
E/ESP	01 Jun 04	31 May 05	-	01 Jun 04	01 Jun 05	30 May 06
E/GBR	26 May 04	17 May 05	-	30 Jun 04	No fishing	-
FRO	03 Sep 04	06 Sep 05	-	21 Sep 04	06 Sep 05	-
GRL	07 Jun 04	01 Sep 05	-	01 Sep 05	01 Sep 05	-
ISL	14 May 04	16 May 05	15 May 06	14 May 04	15 Jun 05	29 May 06
JPN	27 May 04	13 May 05	08 May 06	27 May 04	27 Jun 05	-
KOR	-	-	-	-	-	-
NOR	20 May 04	3 Jun 05	11 May 06	09 Aug 05	04 Jul 05	
RUS	26 May 04	06 Jun 05	16 May 06	23 Jul 04	05 Jul 05	14 Jun 06
USA	-	-	-	-	-	-
FRA-SP	20 Feb 04	12 May 05	29 May 06	28 Apr 04	-	-
UKR	14 Sep 04	17 May 05	-	14 Sep 04	27 May 05	-

[1] Deadline for submission of 21A reports was revised to 1 May in 2005.
- Data not received
* 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 2002-2005. **Note**: **Bulgaria** has not reported in recent years and **USA** data from 1994-present are not available.

STATLANT 21A 2001	2002	2003	2004	2005	STATLANT 21B 2000	2001	2002	2003	2004	2005
CUB	CUB	CAN-CA	CAN-CA	CAN-CA	GRL	CUB	CUB	CAN-CA	CAN-CA	CAN-N
USA	USA	CUB	CUB	CAN-M	USA	GRL	E/DEU	CAN-M (partial)	CAN-M	E/DNK
		E/FRA-M	E/FRA-M	CUB		LTU	LTU	CAN-Q	CAN-N	ISL
		KOR	KOR	E/FRA-M		USA	USA	CUB	CAN-Q	E/ESP
		USA	USA	E/ESP				E/FRA-M	CUB	LVA
				FRO				LTU	E/FRA-M	E/POL
				GRL					E/EST	
				KOR				KOR	E/EST	
				USA				USA	E/LTU	
				UKR					KOR	
									FRA-SP	
									USA	

b) **Report of the Intersessional Coordinating Working Party on Fishery Statistics (CWP), Madrid, Spain, 15-16 February 2006**

The CWP briefly met intersessionally for 2 days in February in Madrid, Spain, and the Executive Secretary provided STACREC with an overview of the meeting. Among other items participants discussed issues related to vessels and ports, specifically the North Atlantic Format (NAF) and its use for scientific purposes. In this context the Executive Secretary asked the Scientific Council to review the NAF as annexed to the NAFO Conservation and Enforcement Measures and to see if the messages included could be amended by others that may be significant for scientific assessment purposes or if the information incorporated in the NAF so far would be sufficient. Also, FAO announced during the meeting that the update by FAO/CWP of the 2003 publication "Fishery Data Quality Indicators: Review of progress and possible approaches to addressing data quality and cost effectiveness" was almost concluded and will be accessible on the FAO website (in June not yet available). The report of the meeting is available at the CWP website. The next meeting of the CWP will take place in Rome, Italy, in conjunction with the COFI meeting late February/early March 2007 (no definite date yet). It is anticipated that the Chair of STACREC (Vice-Chair of Scientific Council) will attend this next meeting of the CWP.

c) **Various Matters** (FISHSTAT Plus, NAFO-FAO statistical data discrepancies)

FISHSTAT Plus

David Cross (EUROSTAT) described difficulties with installing FISHSTAT Plus software on the NAFO computer system. He has been responsible for the updating of this file for NAFO for the last few years because of these technical difficulties. David Cross informed the committee that he will continue to update the data for the next few years, even after his retirement, until these difficulties are overcome.

NAFO-FAO statistical data discrepancies

It has become clear that there are discrepancies between the fisheries statistics databases for NAFO and FAO. These discrepancies arise from a variety of reasons. FAO, NAFO and EUROSTAT have agreed to a study in the summer 2006 to determine the extent of the problem and to investigate methods of eliminating the existing discrepancies and of preventing the recurrence of the problem in the future. The Executive Secretary will report back to the committee on the progress of these discussions and on discussions of this issue at CWP.

VMS data

At its meeting of 26 October to 3 November 2005, Scientific Council recommended that *approval be sought from the Fisheries Commission to obtain catch information from VMS to be used in assessments.* To further consider this recommendation, STACREC reviewed the data that is collected by the Secretariat via VMS. These data can be used to calculate catch within the NRA and effort in terms of days at sea. Given the potential value of these VMS data to Scientific Council in assessing the status of stocks, STACREC **recommended** that *the Secretariat make catch and effort data (days at sea) from VMS available to Scientific Council.*

4. **Research Activities**

a) **Biological Sampling**

i) **Report on activities in 2005/2006**

STACREC reviewed the list of Biological Sampling Data for 2005 (SCS Doc. 06/08) 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 2006 Meeting.

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

Canada-Newfoundland (SCS Doc. 06/11): 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+3KL, 3NO, 3Ps), yellowtail flounder (Div. 3LNO), redfish (Div. 3LN, Div. 3O, Unit 2), northern prawn (Div. 0AB, Div. 2GHJ, Div. 3KLMNO), Iceland scallop (Div. 2HJ, Div. 3LN, Subdiv. 3Ps, Div. 4R), sea scallop (Div 3L, Subdiv. 3Ps), snow crab (Div. 2J+3KLNO, Subdiv. 3Ps, Div. 4R), squid (SA 2+3), thorny skate (Div 3LNOP), white hake (Div. 3NOP), lobster (SA 2+3+4), and capelin (SA 2 + Div. 3KL), was included.

EU-Portugal (SCS Doc. 06/6): Data on catch rates and length composition were obtained from trawl catches for Greenland halibut (Div. 3LM). Data on length composition of the catch were obtained for redfish (Div. 3M) and roughhead grenadier (Div. 3LM).

EU-Spain (SCS Doc. 06/9): All effort and catch information in this Report are based on information from NAFO observers on board. All length, age and biological information presented is based on sampling carried out by IEO observers: in 2005, more than 680 samples were taken, with more the 110 000 individuals of different species examined.

A total of 10 Spanish pelagic trawlers operated in NAFO Subarea 1 and 2 (Div. 1F and 2J) during 2005. Catches in Div. 1F and 2J were 1005 tons of pelagic redfish (*Sebastes mentella*).

The Spanish fishery in NAFO Div. 3LMNO is mainly directed to 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 catch, length and age composition of the trawl catches were obtained for Greenland halibut and roughhead grenadier. Data on length composition of the trawl catches were obtained for cod, yellowtail flounder, witch flounder, American plaice, skates and redfish.

A total of 3 Spanish trawlers operated in NAFO Subarea 6, Div. 6G and 6H, in 2005. The most important species in the catches, in order of importance, were *Beryx* spp., *Polyprion americanus* and *Aphanopus carbo*.

Denmark/Greenland (SCS Doc. 06/13): Length frequency and catch-at-age data were available from the inshore fishery for Greenland halibut in Div 1A. Further, CPUE data were available from the trawl fishery for Greenland halibut in Div. 1A and 1D.

EU-Germany (SCS Doc. 06/17): Subarea 1 - In 2005, demersal fishing was conducted with low effort in Division 1D inside the Greenland EEZ from September until November. The fishery was directed towards Greenland halibut (*Reinhardtius hippoglossoides*). By end of the year, reported landings amounted to 549 tons of Greenland halibut. There was negligible by-catch of roundnose grenadiers (4 tons), wolffish and skates reported (less than 1 ton). Information on effort, landings, and non-standardised Greenland halibut CPUE by month and year, as well as the annual trend were presented.

While the demersal fishery for Greenland halibut is a normal activity, the pelagic fishery for pelagic redfish (*Sebastes mentella*) occurred for the first time off Southwest Greenland in 1999 and increased substantially in 2000 due to a change in distribution patterns of the stock in westerly direction as derived from a biennial international hydro-acoustic surveys conducted in June/July 2001-2005 by Iceland, Russia and Germany. Catches declined to a record low of 794 tons in 2005 obtained with 1535 h effort. CPUE also reached a record low in 2005. Information on effort, landings, and non-standardised pelagic redfish CPUE by area, year and quarter were presented.

Subarea 2 - In 2005, German trawlers conducted a pelagic fishery for pelagic redfish (*Sebastes mentella*) in NAFO Regulatory Area of Div. 2J. The fishery was conducted in Div. 2J during the 3rd quarter only at depths above 500 m and targeted almost exclusively mature redfish with almost no discard and no by-catch of other species. In 2005, landings amounted to 232 tons in 2005. Information on effort, landings, and non-standardised pelagic redfish CPUE by year and quarter were presented.

Russia (SCS Doc. 06/7): In 2005 Russian fishing vessels operated in Subareas 1, 2 and 3. The fishery was mainly directed on Greenland halibut in Div. 1ABCD and 3LMN, deep-water redfish in Div. 1F, 2J, 3M, 3O and skates in Div. 3N. Data on catch, sex, maturity, age, individual weight and length composition were obtained from bottom trawl catches for Greenland halibut (Div. 1D, Div. 3LMN) and redfish (Div. 1F, 2J). Data on catch, sex, maturity and length composition from bottom trawl catches were available for redfish (Div. 3LMNO). Data on catch and length composition were presented for cod (Div. 3LMNO), roughhead grenadier (Div. 3LMN), American plaice (Div. 3LNO), threebeard rockling (Div. 3LMN), thorny skate (Div. 3LMNO), witch flounder (Div. 3LMNO), yellowtail flounder (Div. 3LNO), American plaice (Div. 3M), white hake (Div. 3NO), black dogfish (Div. 3LMNO), northern wolfish (Div. 3LMNO), blue hake (Div. 3LMNO) and common grenadier (Div. 3LMNO).

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

Designated Experts were invited by the Chair to report any problems with data availability. No problems were reported. Designated Experts were reminded to provide available data from commercial fisheries to the Secretariat.

b) **Biological surveys**

i) Review of survey activities in 2005 (by National Representatives and Designated Experts)

Canada (SCS Doc. 06/11): Research survey activities carried out by Canada (N) were summarized, and stock-specific details were provided in various research documents associated with the stock assessments. The major multispecies surveys carried out by Canada in 2005 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2J3KLMNO. The spring survey was conducted from mid April to late June, and consisted of 290 tows, with the Campelen 1800 trawl, by the research vessel *Wilfred Templeman*. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to January, and consisted of 653 tows with the Campelen 1800 trawl. Three research vessels were used: *Teleost*, *Wilfred Templeman*, and *Alfred Needler*. This survey continued a time series begun in 1977. Additional surveys during 2005, directed at various species using a variety of designs and fishing gears, are described in detail in SCS Div. 06/11 and in other documents. Oceanographic surveys were discussed in detail in STACFEN.

EU-Spain (SCS Doc. 06/9): Subarea 3 - The Spanish bottom trawl survey in NAFO Regulatory area Div. 3NO was conducted in June 2005 on board R/V *Vizconde de Eza* using Campelen gear with a stratified design. A total of 122 hauls were carried out up to a depth of 1 450 m, two of which were nulls. The results of the Spanish 3NO bottom trawl survey for all the period studied (1995-2005), including biomass indices with their errors and length distributions, as well as the calculated biomass based on conversion of length frequencies are presented in SCR Doc. 06/12, SCR Doc. 06/13 and SCR Doc. 06/14 for Greenland halibut and American plaice, Atlantic cod and yellowtail flounder, Thorny skate, white hake, and roughhead grenadier. Feeding studies on the main species continued to be conducted and SCR Doc. 06/31 presents the results of these studies for the period 2002-2005.

EU-Spain and Portugal: The EU bottom trawl survey in Flemish Cap (Div. 3M) was carried out on board R/V *Vizconde de Eza* using the usual survey gear (Lofoten) from July 1st to August 21st 2005. The area surveyed was Flemish Cap Bank to depths up to 800 fathoms (1 400 m) following the same procedure as in previous years. The number of hauls was 180 and four of them were nulls. 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. 06/16. For shrimp some errors were found in the catches recorded in the EU survey last year and, therefore, they were corrected and presented in the previous SCR Document. The roughhead grenadier of Flemish Cap survey were presented in SCR Doc. 06/07. Oceanography and feeding studies on the main species continued to be performed, and samples for histological assessment of sexual maturity of cod, redfish, Greenland halibut and Roughhead grenadier were also taken.

Denmark/Greenland: The West Greenland standard oceanographic stations were surveyed in 2005 as in previous years. Further, a number of oceanographic stations were taken in the fjord system south of Sisimiut (SCR Doc. 06/01).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2005. In July-August 212 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 (SCR Doc. 06/28).

A Greenland deep sea trawl survey series for Greenland halibut was initiated in 1997. The survey is a continuing of the joint Japanese/Greenland survey carried out in the period 1987-95. In 1997-2005 the survey covered Div. 1C and 1D between the 3 nautical mile line and the 200 nautical mile line or the midline against Canada at depths between 400 and 1 500 m. In 2005 61 valid hauls were made (SCR Doc. 06/27).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2005 the longline survey was conducted in Uummannaq and Disko Bay (SCR Doc. 06/35).

Since 2001 a gillnet survey has been conducted in the Disko Bay area. In 2005 a total of 47 gillnet settings were made along 4 transect. Each gillnet was composed of four panels with different mesh size (46, 55, 60 and 70 mm stretch meshes) (SCR Doc. 06/35).

EU-Germany (SCS Doc. 06/17; SCR Doc. 06/43): 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. 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 (*Amblyraja radiata*) are documented.

During June/July 2005, Germany participated in the international hydro-acoustic pelagic trawl survey together with Icelandic and Russian vessels. The survey is designed to cover the entire distribution of pelagic redfish in NAFO and ICES Divisions down to 1 000 m depth. The redfish abundance in NAFO Div. 1F was slightly increased in 2005 compared to the period prior to 2003 (survey in 2003 was not recommended to be used for assessment purposes).

USA (SCS Doc. 06/10): The USA Research Report provided an updated summary on the status of 28 finfish and shellfish stocks in US waters of the NAFO Convention Area. Summaries of environmental research are also provided including projects involved with hydrographic work, plankton studies, benthic investigations, and shellfish habitat requirements. Projects studying biological aspects of several important commercial and recreational species including summer flounder, tomcod, goosefish and weakfish are also highlighted in the Report. Information about other biological studies on food web dynamics, age and growth and by-catch are presented as well in the document. Finally, brief reviews are included on five areas of population dynamics research in 2005: (1) Atlantic salmon research; (2) the cooperative research commercial ‘study fleet’ program; (3) stock assessment methods development; (4) biological studies focused on sea scallops; and (5) ecosystem modeling work. Details on USA tagging programs for Atlantic cod, yellowtail flounder, scup, and haddock are provided in SCS Doc. 06/5. Further information on these programs is available at the following websites:

Atlantic cod:	*http://codresearch.org/Index.htm*
Yellowtail Flounder:	*http://www.cooperative-tagging.org/*
Scup:	*http://www.nefsc.noaa.gov/read/popdy/scup-tagging/*
Haddock:	*http://www.gmamapping.org/haddockmapping/viewer.htm*

ii) **Surveys planned for 2006 and early-2007**

An inventory of biological surveys planned for 2006 and early 2007, 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 2006 Meeting.

c) **Stock Assessment Spreadsheets – Update**

Only 9 of 26 stocks have had the spreadsheets of assessment data filled in. This is still considered to be an important source of information for Scientific Council. STACREC reiterates the importance of maintaining a database of data used in stock assessments and **recommended** that *Designated Experts be reminded by the Secretariat following each June Scientific Council meeting to fill in the assessment data spreadsheets.*

d) **Greenland Halibut Ageing Workshop**

In 2004 the NAFO Standing Committee on Fisheries Science recommended at Scientific Council 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.* This workshop was postponed to 2006 and expanded to include participants from all labs working on age determination for this species, including labs from outside the NAFO convention area. The workshop was held in St. John's, Newfoundland and Labrador, February 21-24, 2006. Prior to the workshop there was an exchange of otoliths and scales collected during the 2005 EU survey in SA3. The labs participating in the exchange were from the NAFO area; Canada, Greenland, Spain, Portugal and Russia. During the workshop each lab presented information on ageing methods using scales, otolith whole and otolith section. It was found that no two labs were using the same method. Research related to methods and age validation was also presented.

Observations have been made in recent years that suggest Greenland halibut are longer lived and slower growing than previously thought. The otolith cross-section methods presented during the workshop indicated older ages at a given length. For the Alaskan stock it was suggested that the age reading methods diverge at approx. 60 cm or age 7 yr. For the stock in NAFO SA0 deviations in the bias plot of whole versus section ages began at about age 15 (approx. 50 cm). For the Northeast Atlantic stock off the Norwegian coast ages derived from a revised whole otolith method began to deviate beginning at ages 4-5 (approx. 40 cm). Dark "featureless" translucent margins on large otoliths indicate an accumulation of compacted small annual zones. Greenland halibut have a larger size at maturity (40 cm for males and 60 cm for females) which is typical of many long-lived species. It became clear during the workshop that the recommendation from 2004 could not be met. Bias between age readers could not be solved by simply agreeing to common interpretation practices.

The workshop concluded that:

- Current ageing methods underage old fish but it is not known to what extent or at what size/age the under ageing begins.
- Validation methods that have been applied; bomb radiocarbon dating and tagging and oxytetracycline marking for Greenland halibut, have been carried out for NAFO Div. 0B and 2G that indicate longevity of this species goes beyond that indicated by present techniques.
- Biological methods that indicate longevity have been applied for the Barents Sea, analysis of otolith morphometry and length measures, and show much greater age expectancy and this affects the fishable portion of the stock.

- Precision and bias are still problematic due to a lack of standard application of methods and criteria.
- The current scale method under-estimated the current otolith methods at the oldest ages.
- Systematic studies of new methods and comparisons there of are needed to determine a reliable method for production ageing.

STACREC commended the convenors of the workshop on a very comprehensive and successful meeting. STACREC noted that the recommendation that led to the workshop was not fully addressed, that is there is still no agreed method for ageing Greenland halibut, although some new methods are under development.

There appears to be under ageing of older ages but this seems to be a larger problem for ages older than the ages that make up the bulk of the assessment. It is not yet known why this occurs as the problem begins to occur at approximately age 8, younger than the estimated age at maturity.

e) **Selectivity Studies**

Russia (SCR Doc. 0/17): On Minimal Codend Mesh Size in Mid-water Redfish Fishery in Div. 3O of NAFO Regulatory Area. SCR Doc. 06/17): Russia presented data on species composition of redfish catches and by-catch of the other species as well as the estimates of the efficiency of changing mesh size in trawl codends when fishing by midwater trawls in Div. 3O of NAFO Regulatory Area. The data show that here primarily redfish species *S. fasciatus* (85%) are caught and the by-catch of each fish species doesn't exceed 0.35%.

When changing mesh size from 132 to 118, 100 and 89 mm the catch is composed of fish aged 14, 10 and 8 years old, respectively.

Long-term profit calculations having been made before (SCR Doc. 05/18) corroborate the efficiency of redfish fishing by midwater trawls with 90-100 mm mesh size in Div. 3O. The fishery of redfish by the trawls with smaller mesh size will allow us to reduce fish escape and, as a consequence, traumatic death of fish having escaped in lifting fishing gear to the vessel board as a result of abrupt change of hydrostatic pressure (SCR Doc. 95/25).

STACREC notes the importance of problem connected with optimal mesh size in redfish fishery in Div. 3O and proposes to continue the discussion in NAFO Scientific Council meeting in September with the use of additional data on by-catch of other species and new calculations of the estimates of yield per recruit by trawls with different mesh size, as well as spawner per recruit if possible.

f) **Introduction of OMEGA Gauge**

Stephen Walsh (Canada) gave a presentation entitled "A new mesh gauge". The Executive Secretary letter GFS-06/86 referring to official letter from ICES General Secretary to use the OMEGA gauge as NAFO standard measurement device was available.

The mesh sizes in the NAFO regulations are recommended by scientists, based on selectivity experiments in which the meshes are measured by a different instrument, the ICES gauge. This operates by stretching the mesh with a controlled force. It has been shown that the measurements with the ICES gauge are lower than when using the wedge gauge for fishery inspectors. Over the last decade these methods have been questioned. Both gauges are regarded as no longer suitable for mesh measurement of modern netting. Using different gauges has adverse effects on the selectivity of fishing gears as the mesh sizes in commercial use are smaller than those recommended by the scientists.

Standardization of mesh measurement methodology required the development of an objective mesh gauge. After extensive testing the OMEGA gauge, which stands for Objective MEsh GAuge", has been accepted by ICES as the 'new' standard mesh gauge for scientific research in mesh selection. This gauge delivers precise mesh measurements independent of human influence. The Protocol specifies the mesh dimension to be measured on mesh types commonly found in use. Detailed instructions are given on how to prepare, calibrate and operate the gauge, the number of meshes to be measured and how to select those meshes.

Guidance is given on whether to accept or reject readings.

In 2006, the OMEGA gauge will also be considered by EUROCORD, European Committee of Netting Manufacturers, and The Directorate-General for Fisheries and Maritime Affairs of the European Commission as a replacement for the standard wedge gauge used in the EU netting industry and by EU fisheries inspectors.

Recognizing the importance of using the identical measurement device on both sides of the North Atlantic Ocean, STACREC **recommended** that *the new mesh gauge OMEGA be adopted as the standard for scientific purposes.*

5. FAO Cooperation

a) Report of the Fisheries Resources Monitoring System (FIRMS) Steering Committee (FSC) Meeting, Madrid, Spain 13-15 February 2006

The FIRMS Steering Committee meeting was hosted by ICCAT and chaired by Hans Lassen (ICES). A new chair (Victor Restrepo, ICCAT) and vice chair (Johanne Fischer, NAFO) were elected. The following Secretariats were represented at the meeting: ICCAT, ICES, CCAMLR, NEAFC, NAFO, EUROSTAT, and FAO. The meeting reviewed the current FIRMS membership and the contributions of the new members. Much time was dedicated to a discussion of the FIRMS website (launched in May 2006) and a number of related technical issues that still needed to be solved. Many of these had been discussed already by the meeting of the FIRMS Technical Working Group in December 2005 (with Barb Marshall representing the NAFO Secretariat).

An issue of particular interest concerned the organization of the information contributed by members on the website and the development of appropriate search terms that will allow access to the information. In this context, the FIRMS Steering Committee proposed stock status descriptors that will function as search terms for the FIRMS users. These descriptors are submitted for discussion and approval to the scientific bodies of the member organizations. The proposal foresees that two different and independent sets of descriptors be used, one for stock abundance (biomass) and the other for the fishery exploitation rate. The goal is to have common descriptors that can be used for search purposes on all contributions independently from the specific terminology used by different partners. 1) Stock abundance status descriptors: a) Virgin or high abundance; b) intermediate abundance; c) low abundance; d) depleted. 2) Exploitation rate status: no or low fishing mortality; b) moderate fishing mortality; c) high fishing mortality; d) uncertain/not assessed. STACREC discussed this issue at length and suggested that STACFIS decide how each stock should be categorized and that this be attempted on a trial basis at the current June 2006 meeting. Concern was raised about the specific categories in this proposal, including the lack of an 'uncertain' category for stock abundance. The Executive Secretary agreed to address this to the next FIRMS Steering Committee meeting.

The next FIRMS Steering Committee meeting will be held in Rome the week before COFI and in connection with the CWP meeting end of February/early March.

b) Participation at ICES/FAO WG on Fishing Technology and Fish Behaviour – Steve Walsh

A sub-group of the **ICES-FAO Working Group on Fishing Technology and Fish Behaviour Group (WGFTFB)** worked by correspondence through 2005/2006 and at the Working Group meeting in Turkey on updating the *1971 FAO Technical Report 222 on Gear Classification* that is used worldwide today including NAFO. Steve Walsh (Canada) represented NAFO at the WG meeting. The 13 member group representing 12 countries produced a draft form of new gear descriptions and gear classification codes, which have been modified to include gear designs that have evolved since the publication of original document e.g. twin and multiple trawls. Some gear codes have been removed to reflect changing legislation e.g. poison and dynamite. The group concluded that it needs to continue work for a further year and outlined a timetable for the production of a draft that will be presented to the ICES-FAO WGFTFB during its meeting in 2007 for approval. It was decided to publish the new gear classification document as a joint FAO-ICES publication. Work will continue intersessionally on the report as well as continued efforts to identify gear parameters that could be used to provide better estimates of commercial CPUE estimates. The WG is also intending to broaden the participation and attract fisheries managers and fisheries statistics personnel. STACREC supported the continuation of Steve Walsh (Canada) as NAFO representative on this WG.

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

SCR Doc. 06/03 V. A. Rikhter. Possible Approach to the Analysis of Stock-recruitment Relationship by the Example of Some Fish Species in NAFO Area: Role of the Latter in These Species Abundance Dynamics and Fishery Management.

The attempt was made to reveal the indications o f the stock-recruitment relationship effect, differences in its manifestation pattern and to evaluate, at least at the qualitative level, the extent of its impact on recruitment abundance formation in 12 unit stocks of fish in NAFO area. Classification of the spawning biomass by favourable, high and low level and estimation of respective mean ratios became the methodical basis of this approach application. The indications of SRR effect were found in all stocks considered. The results obtained, allow to distinguish 2 fish groups distinctly different in this relationship extent and manifestation pattern. For each group the recommendations on fishery management and, accordingly, optimal range of spawning biomasses was proposed on the basis of qualitative assessment of the limiting reference point level.

STACREC noted that much of the data used in this study were quite old and it would be interesting to see the same work with more recent assessment results.

SCR Doc. 06/08 A. Vaskov. Maturity of Golden Redfish *Sebastes marinus* on the Flemish Cap.

The results from study of sexual maturation, annual cycle of gonad development, sex ratio and reproduction of golden redfish *Sebastes marinus* from the Flemish Cap Bank (Div. 3M) in 1971-2005. Females in catches significantly prevailed over males. The total sex ratio in the period of research was close to 1. Mature males found for the first time have the length of 19 cm and females of 23 cm. Males (over 50%) basically mature when they are as long as 34 cm, half of females having the length of 35 cm. Males completely mature with the length of 46 cm, females of 48 cm. The peak of larva hatching was in May. Mass coupling takes place in October when most of mature males are at Maturity Stages V and VI.

STACREC noted that all data were combined for 1971 to 2005 and there may have been some changes in maturation over that time period. Maybe it would be possible to separate the data into time periods. However, sample size is quite low and this may not be possible.

SCR Doc. 06/09 A. Ferreira *et al*. Results of the Atlantic Cod (*Gadus morhua*) Otolith Exchange Between Canada and Portugal

An exchange of 101 otoliths of *Gadus morhua* obtained by the Portuguese commercial fleet was conducted between Portugal and Canada in 2004 to verify if the ageing criteria are being applied equally by all readers. A combination of statistical methods and graphical analysis was used to evaluate differences in terms of bias and precision. In general there wasn't detection of bias between age readers and the precision index's calculated indicate a high level of precision. The coefficient of variation presented values under 5%, the average percent error presented values rounding the 3% and the correlation coefficient values above the 0.9. The lowest percent agreement was register for the Portuguese and Canadian 4 age readers (66%) while the highest value was obtained by Canadian 2 *vs.* Canadian 1 and Canadian 1 *vs.* Canadian 4 readers (82% for both comparisons), however with the tolerance level of ±1 year the percent agreement between age readers was above 90% in all cases. The results of the exchange indicate that in general the ageing criteria are being applied equally by all readers.

STACREC noted that the percent agreement between readers is perhaps not as high as for some other stocks for which exchanges have been made.

SCR Doc. 06/16 D. González Troncoso *et al*. Results from Bottom Trawl Survey on Flemish Cap of July-August 2005

A stratified random bottom trawl survey on Flemish Cap was carried out from July 1st to August 21st 2005. The area surveyed was extended up to depths of 800 fathoms (1 400 meters) following the same procedures as in previous years and increasing the number of hauls planned (195). The survey was carried out by the *R/V Vizconde de Eza* with the usual survey gear (Lofoten). A total of 176 valid hauls were made by the vessel *R/V Vizconde de Eza,* 117 up to 730 meters depth and 59 up to 1 400 meters. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, Greenland halibut and Shrimp are presented. The general indexes for this year are estimated taken into account the traditional swept area (strata 1-19, up to depths of 730 m) and the total area surveyed (strata 1-34, up to depths of 1 400 m).

STACREC noted that the contour map of Greenland halibut must be based on an extrapolation as it shows fish distributed in areas where there were no survey sets. The survey timing in 2005 was somewhat later than other years but most of the main strata were covered during the regular timing. It was also noted that the 2005 abundance at age 1 for Greenland halibut is the lowest in the time series.

SCR Doc. 06/21 M. Koen-Alonso *et al*. An Update on the Canadian Re-aging Effort for Building Age-length Keys for Yellowtail Flounder on the Grand Bank

A long term goal in the assessment of yellowtail flounder (*Limanda ferruginea*) is to supplement the current stock-production model with an age-structured model. Before this goal can be achieved, and given the inaccuracies in the old whole-otolith ageing method, a significant part of the historical otolith archive will have to be re-aged. Therefore, a first step is to determine how many otoliths actually need to be re-aged in order to produce age-length keys from sub-samples of the complete collection with a minimum loss of information. A preliminary analysis carried out using 1998 survey otolith data indicated that sub-sampling sizes around 60% of the total sample size can produce adequate age-length matrices (Dwyer *et al.* 2004). However, this result relied on data from a single year, and hence, potential differences between years could not be evaluated. To address this issue, we repeated these analyses for a different year. The year 1991 was selected because it provides good contrast with 1998, mainly due to the differences between years in the survey trawls employed (Engels trawl in 1991 and Campelen trawl in 1998), and the trends of the yellowtail flounder stock (decreasing in 1991and increasing in 1998). Despite these differences, the results for 1991 were highly consistent with the findings already obtained for 1998. The spring and fall age-length matrices differed significantly (2D Kolmogorov-Smirnov test *p*-value=0.0017), and sub-sampling sizes of 60% allow building sub-sampled age-length matrices (SSALMs) that are similar enough to the full data age-length matrices (FDALMs) to be considered adequate for building age-length keys from survey otoliths with a minimum loss of information.

STACREC noted that the age length plot indicates that there are some very old small fish and that this should be investigated.

SCR Doc. 06/31 C. González *et al*. Feeding Habits of Fish Species Distributed on the Grand Bank (NAFO, Divisions 3NO, 2002-2005)

24 917 stomach contents corresponding to 17 fish species of the Grand Bank in the period 2002-2005 were analyzed. Importance of prey was based in weight percentage. Feeding intensity was high for most species (>75%). Greenland halibut and northern wolffish were the species with the lowest feeding intensity (<45%). This index showed a trend to decrease with the increase of predator size and depth range. Round skate and witch flounder were specialist species with a little niche width, and black dogfish turned up to be the most generalist species in feeding habits.

A high number of prey in stomach contents was common, but most part of stomach contents were compound of between 2 and 8 prey, which supplied >70% of the total weight. Greenland halibut, Arctic and spynitail skates were piscivorous species. Roundnose grenadier, redfish and smooth skate showed pelagic, bathypelagic or epifaunal crustacean feeding habits, and northern wolffish was pelagic invertebrate organism feeder on ctenophores. Roughhead grenadier and yellowtail flounder were benthic predators on different prey species, scyphozoans and crustaceans respectively, and polychaetes were common in the diet of both species. Witch flounder and round skate were polychaete feeders on bottom benthos.

Atlantic and spotted wolffish showed a diet primarily based on benthic and bottom organisms with predominance of different prey in each species. Black dogfish preyed on benthic groups (crustaceans, scyphozoans and fishes), like American plaice (echinoderms, fishes and crustaceans). Thorny skate and Atlantic cod showed similar diets based on fishes and crustaceans. Specific predation and diet overlap observed among some species changed with depth.

STACREC noted that the diet of grenadier is different in this study than for those on Flemish Cap. This could be because of a different prey spectrum. The apparent niche overlap for A. radiata and G. morhua at 1000 – 1199 m may be based on a small sample size of cod at that depth.

SCS Doc. 06/12 Kulka *et al.* Accurate identification of wolffish and hake species harvested in the NAFO Regulatory Area

Accurate reporting of all species harvested in the NAFO Regulatory Area (NRA), including those that are not subject to a directed fishery, is essential to the management of fish stocks and monitoring of overall ecosystem health. Of particular concern in recent years is the apparent misidentification of hake and rockling species (genus *Urophycis* and *Gaidropsarus*) and non-specific identification of wolffish species (genus *Anarhichas*) caught in the NRA. This prompted STACTIC to recommend to the Scientific Council (FC Doc. 05/15) to produce "a *mechanism to assist in the accurate catch reporting of wolfish and hake (Annex 8 – STACTIC WP 05/38)*".

It is proposed that a colour photo handout be developed for masters, inspectors, fishery observers and biological technicians to facilitate the differentiation of hake/rocklings and wolffish species. A proposed draft includes colour photos of the species with diagnostics, distribution maps and three-alpha codes for accurate recording and requires the adoption of new codes for the identification of Northern wolffish, Longfin hake and Threebeard rockling. These are to be designed to be water-resistant and printed in colour back-to-back on letter-size laminated paper or plastic paper.

STACREC noted the importance of improving the identification of these species and made several suggestions for improvement of this handout. STACREC also noted the importance of producing this handout in colour.

7. Other Matters

a) Tagging Activities

Information on tagging activities in the Northwest Atlantic was presented by the Secretariat in SCS 06/5.

b) Research Activities

Margaret Treble informed STACREC that her institute was preparing an annotated bibliography of Greenland halibut publications that should be available in 2006 as a Canadian Technical Report in Fisheries Science.

NAFO survey manual

A sub-group STACREC was formed (Chair: Stephen J. Walsh, Canada) to revise the DOUBLEDAY, W.G. 1981. Manual on groundfish surveys in the Northwest Atlantic. *NAFO Sci. Coun. Studies, No. 2*. The justification is that the 1981 manual does not reflect the current status of surveys in the NAFO area. The emphasis of the new manual would be on surveys in the 21st century. An outline of content will focus on

1. Introduction - a brief historical background of surveys from 1981 onward in Subareas 0 to 3;
2. Survey design and statistical methods. This will include relevant stratification charts;

3. General procedural requirements for vessels and gear to include detailed trawl gear drawings of current bottom survey trawls used in 2006.
4. Standardization of Survey Procedures. This will include fishing operation procedures for each survey
5. Data types that should be collected during standard surveys.
6. Data analysis-basic description of calculation of stratified mean number per tow, swept area abundance, etc.

The sub-group will work by correspondence and present an update at the 2007 June Meeting of STACREC

c) **Other Business**

The Chair thanked the participants for their valuable contributions to the Committee. Special thanks were extended to the rapporteur and to the Executive Secretary, Scientific Council Coordinator and all other 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 2006 STACREC Meeting.

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

Chair: Don Power Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 1-15 June 2006, 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, Portugal, and Spain), Russian Federation, Ukraine and the United States of America. Various scientists, notably the designated stock experts, assisted in the preparation of the report considered by the Committee.

The Chair, Don Power (Canada), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The provisional agenda was **adopted**. During the meeting, the STACFIS agenda item IV.1 Review of Information on Stock Structure, Relative Biomass, Distribution and Life History Characteristics of Spiny Dogfish (*Squalus acanthias*) and Black Dogfish (*Centroscyllium fabricii*) Occurring Within the NRA and item IV.2 Evaluation of the Consequences of a Mesh Size Reduction to 90-100 mm in the Directed Redfish Fishery in Division 3O were addressed by the Scientific Council during it's plenary sessions.

II. GENERAL REVIEW

1. Review of Recommendations in 2005

STACFIS agreed that relevant stock-by-stock recommendations from previous years would be reviewed during the presentation of a stock assessment or the tabling of an interim monitoring report as the case may be. Responses to those recommendations were as follows:

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

STACFIS **recommended** that *the investigations of the bycatch 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.

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.*

STATUS: A CPUE series from Div. 0B was updated and made available for the assessment in 2005. No progress for the other points.

ii) Considering Greenland Halibut (*Reinhardtius hippoglossoides)* in Division 1A Inshore

It was noted that in 2001 an annual gillnet 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 gillnet survey should be continued in order to allow use of the whole time series for Greenland halibut in Disko Bay.*

STATUS: Progress continues but nothing was reported to this meeting. It was noted that the 2005 longline survey was the last and that the calibration studies between the gillnet survey and the longline survey will only involve data from two years of overlap between these surveys.

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

STATUS: No progress.

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

STATUS: No progress.

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

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

STATUS: No progress.

iv) **Considering Other Finfish in Subarea 1**

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

STATUS: No progress.

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

STACFIS **recommended** that *information on the distribution of shrimp and small redfish (<12 cm) in Div. 3M be compiled for review during the June 2006 Meeting of Scientific Council.*

STATUS: not implemented

STACFIS had **recommended** that *an update of the Div. 3M redfish bycatch 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: not implemented in 2005 as regards size distribution of redfish caught in the Div. 3M shrimp fishery.

vi) **Considering Cod (*Gadus morhua*) in Divisions 3N and 3O**

STACFIS **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}.

STATUS: The estimate of SSB in 2005 was 5 500 tons which is 9% of B_{lim}. There is no indication that SSB has increased since then.

STACFIS **recommended** that *a sensitivity analysis be conducted to investigate the impact of excluding the Canadian juvenile survey index from the SPA.*

STATUS: The effect of removing the short juvenile series (1989-1994) was examined. The mean square error was slightly larger for the run excluding the juvenile survey. There was an increase in error on the parameter estimates when the survey was excluded. The exclusion of the Canadian juvenile survey results in a model fit that is slightly worse than when the index is included.

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.*

STATUS: The mean square error was larger for the run including the survey by EU-Spain (0.845) compared to the run including only the Canadian spring, autumn and juvenile indices (0.706). There was an increase in the relative error for estimates of catchability when the indices from the survey from EU-Spain were included. The inclusion of the EU-Spain survey results in a model fit that is worse than when the index is excluded.

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

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.*

STATUS: No progress reported.

STACFIS **recommended** that *investigation be carried out on the sensitivity of the estimation of* F_{msy} *to these parameters.*

STATUS: No progress reported.

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

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.

STATUS: No progress

ix) **Considering Redfish (*Sebastes* spp.) in Divisions 3O**

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.*

STATUS: No studies of size at maturity were presented.

x) **Considering White Hake (*Urophycis tenuis*) in Divisions 3N, 3O and Subdivision 3Ps**

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 hake comprise a single breeding population.*

STATUS: Tissue samples from these areas are presently being analyzed. First results are expected in 2007.

STACFIS **recommended** that *the collection of information on commercial catches of white hake be continued; and now include sampling for age and sex.*

STATUS: Length data is being collected by various countries. This is now part of the standard sampling protocol.

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.*

STATUS: Collection of otoliths from Canadian surveys is now standard protocol. Limited samples of otoliths have been prepared and read.

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

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

STATUS: Some progress. Bycatch estimates were available for some countries. No information available on discarding.

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.*

STATUS: A workshop was held in St. John's, Newfoundland and Labrador, 21-24 February 2006. The results of the workshop can be found in the Report of STACREC (Appendix III.4.d). There appears to be under ageing of older ages but this seems to be a larger problem for ages older than the ages that make up the bulk of the assessment. There was no consensus reached on a method for ageing Greenland halibut, although some new methods are under development.

2. General Review of Catches and Fishing Activity

As in previous years STACFIS conducted a general review of catches in the NAFO Subareas 0-4 in 2005. In order to derive estimates of catches for the various stocks, estimates from various sources were considered along with reported catches available to June 1, 2006 as compiled from STATLANT 21 reports. Differences in the estimation of the catches were resolved for all stocks with minimum difficulty.

STACFIS agreed to continue documenting the tabulation of preliminary catch data from STATLANT 21 reports and the best estimate of catches as agreed by STACFIS. A series of these tabulations from 1997-2005 will be found in the introductory catch table within the report for each stock. A stock by stock summary for 2005 is as follows:

	CATCHES (‘000 tons)	
STOCKS	**STATLANT 21A[1]**	**STACFIS**
Stocks off Greenland and in Davis Strait		
Greenland halibut in Subarea 0 and 1 offshore and Div. 1B-1F	8	20
Greenland halibut in Div. 1A inshore	22.9	
Roundnose grenadier in Subareas 0 and 1	0.00	0.02
Demersal Redfish in Subarea 1	0.5	
Other finfish in Subarea 1	10.3	
Stocks on the Flemish Cap		
Cod in Div. 3M	0.0	0.0
Redfish in Div. 3M	6.6	3.1
American plaice in Div. 3M	0.1	0.05
Stocks on the Grand Banks		
Cod in Div. 3N and 3O	0.6	0.7
Redfish in Div. 3L and 3N	0.7	0.7
American plaice in Div. 3L, 3N and 3O	2.3	4.1
Yellowtail flounder in Div. 3L, 3N and 3O	13.9	13.9
Witch flounder in Div. 3N and 3O	0.3	0.3
Capelin in Div. 3N and 3O	0.0	

STOCKS	CATCHES ('000 tons) STATLANT 21A[1]	STACFIS
Redfish in Div. 3O	6.9	11.3
Thorny skate in Div. 3LNOPs	4.0	5.6
White hake in Div. 3NOPs	2.4	2.4
Widely Distributed Stocks		
Roughhead grenadier in Subareas 2 and 3	0.6	1.5
Witch flounder in Div. 2J+3KL	0.2	0.2
Greenland halibut in Subarea 2 and Div. 3KLMNO	17.9	23.0
Short-finned squid in Subareas 3 and 4	0.6	0.6

[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 Fylla 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 Fylla 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 five years and in 2005 were the warmest and saltiest in the past 16 years of surveys. Sea surface temperatures over much of the Labrador Sea during both 2004 and 2005 were among the warmest on record, more than 1°C above normal. The northward extension of Irminger Water as far north as Fylla Bank indicates high inflow of water of Atlantic origin to the West Greenland area during 2005. The time series of mid-June temperatures on top of Fylla Bank was about 1°C above average, the 5th highest on record, while the salinity was the 2nd highest on record. 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 continuing the warmer than normal trend since 1993.

1. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 0 and Division 1A Offshore and Divisions 1B-1F** (SCR Doc. 97/21, 05/39, 06/5, 15, 27, 28, 39; SCS Doc. 05/09, 06/7, 11, 13, 17)

a) **Introduction**

The annual catches in Subarea 0 and Div. 1A offshore and Div. 1B-1F were below 2 600 tons from 1984 to 1988. From 1989 to 1990 catches increased from 2 200 tons to 10 500 tons, remained at that level in 1991 and then increased to 18 100 tons in 1992. 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, decreased slightly in 2004, but was back at 20 000 tons in 2005 (Fig. 1.1).

In Subarea 0 catches peaked in 1992 at 12 400 tons, declined to 4 300 tons in 1994 and stayed at that level until 1999, to increase to 5 400 tons 2000. 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 declined to 9 400 tons in 2004 and increased again to 10 100 tons in 2005. 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 declined to 3 740 tons in 2004 but was back at the 2003 level in 2005 (4 300 tons).

Catches in Div. 1A offshore and Div. 1B-1F fluctuated between 900 and 2 400 tons during the period 1987-91. After then catches have fluctuated between 3 900 and 5 900 tons until 2001. 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 and 2005 (9 700 tons). Prior to 2001 catches offshore in Div. 1A and in Div. 1B 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 but was back at the 2003 level in 2005 (4 000 tons).

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	11	11	11	11	15[1]	15[1]	19[2]	19[2]	19[2]	24[3]
TAC	11	11	11	11	15[1]	15[1]	19[2]	19[2]	19[2]	24[3]
SA 0	4	4	5	5	8	8	10	9	10	
SA1 exl. Div. 1A inshore	5	5	5	5	6	7	10	10	10	
Total STATLANT 21A	9	9	17[4]	8[5]	13[5]	15[5]	15[5,6]	8[5]	8[5]	
Total STACFIS	9	9	10	11	13	15	20	19	20	

[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 a TAC of 13 000 tons allocated specifically to Div. 0A and 1AB
[4] Including 7 603 tons reported by error from Subarea 1.
[5] Provisional.
[6] Including 1 366 tons reported by error from Subarea 0.

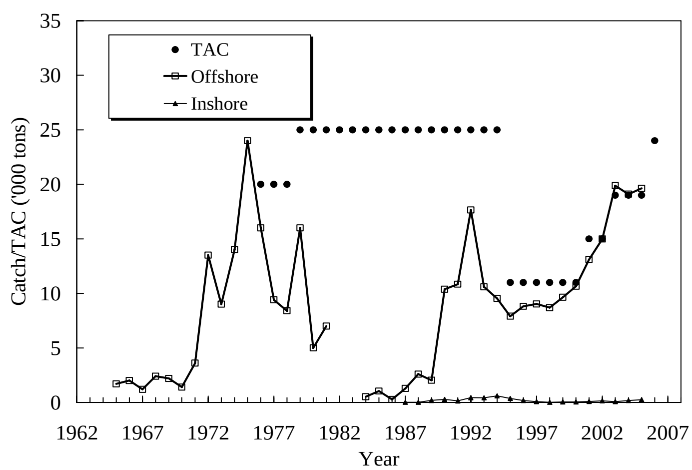


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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. Since 1998 the fishery in Div. 0B has been executed almost exclusively by Canadian vessels. In 2005, 631 tons were taken by longlines, 1 618 tons by gillnet and 3 553 tons by trawlers.
Besides Canadian trawlers, a number of different countries participated in the trawler fishery in Div. 0A from 2001 to 2003 through charter arrangements with Canada. Since then all catches were taken by Canadian vessels. In 2005, trawlers caught 3 149 tons and 1 118 tons were taken by gillnetters. 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 (southern Baffin Island in Div. 0B) 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 in Cumberland Sound amounted to 244 tons in 2003 but declined to 63 tons in 2004 and further to 9 tons in 2005.

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, Faroe Islands and EU (mainly Germany). These countries, except Japan, were also engaged in the fishery in the area in 2005. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 tons in 2004 and there was no gillnet fishery in the area in 2005. An offshore longline fishery in Div. 1CD took place during 1994-2002 and 237 tons were taken in 2005 by longlines. Inshore catches in Div. 1B-Div. 1F amounted to 250 tons, which were mainly taken by gillnets.

Throughout 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 from about 100 tons in 2000 to about 4 200 tons in 2004 with a decline to 4 000 tons in 2005. All catches were taken by trawlers primarily from Greenland, Russia and Faroe Islands. 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 gillnet fishery Div. 0A. The length distributions in the trawl fishery were almost identical in Div. 0A and 0B with modes at 48-50 cm and resembled the length frequency seen in previous years. The bulk of the catches in the gillnet fishery in Div. 0A were between 50 and 70 cm with a mode around 54-56 cm.
Information on length distribution of catches was available from trawlers from Russia (SCS Doc. 06/07) and Norway fishing in Div. 1D.

The length distribution in Div. 1D showed clear modes at 48 and 50 cm in the Russian and, Norwegian, respectively. The mode in the trawl fishery in Div. 1D has been at 47-51 cm in the last decade. The length distribution in the small longline fishery in Div.1D was dominated by fish between 50 and 80 cm.

Age distributions were available from the Russian trawl fishery in Div. 1D. Age 6-7 dominated the trawl catches in Div. 1D as seen in previous years (SCS Doc. 06/7) while ages 7-8 dominated the Norwegian catches in Div. 1D.

Unstandardized catch rates in Div. 1A from Greenland twin trawlers, which have been taking the majority of the catches, have been increasing in the last 3 years and was 1.11 tons per hour in 2005. The Russian catch rates (Div. 1AB, small and large trawlers combined (SCR Doc. 06/15)) were stable between 2004 and 2005, but the Faroese catch decreased from 0.87 ton/hr in 2004 to 0.55 ton/hr in 2005. This is, however, still above the level in 2001-2003 (SCR Doc. 06/39).

Unstandardized catch rates from Div. 1CD showed all minor increases between 2004 and 2005 (SCR Doc. 06/39). The EU-German research report (SCS Doc. 06/17) was first available after the assessment was completed. The EU-German CPUE data also showed and increase in CPUE between 2004 and 2005. The EU-German data for 2005 were not included in standardized CPUE series (see below), but the catches only comprised less than 3% of the total catches.

The standardized CPUE series from trawlers in Div. 0B was updated based on log book data from Canadian authorities. The index decreased gradually from 1995 to 2002, but has been increasing since then and is now at the same level as in the early 1990s (Fig. 1.2).

Standardized catch rate series, based on logbook data from the Greenland authorities and data from the EU German trawl fishery for 1996-2004 (SCS Doc. 05/9), were available for the offshore trawl fishery in Div. 1CD for the period 1988-2005.
The standardized catch rates in Div. 1CD declined gradually from 1989-1996 but has been more or less stable since then with a slight increasing trend. The index also increased slightly between 2004 and 2005 (Fig. 1.2).

The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but has increased again since then, and is in 2005 at the level seen in 1990-2001 (Fig. 1.2).

Due to the frequency of fleet changes in the fishery in both SA0 and SA1 and change in fishing grounds in Div. 1A, both the unstandardized and the standardized indices of CPUE should, however, be interpreted with caution.

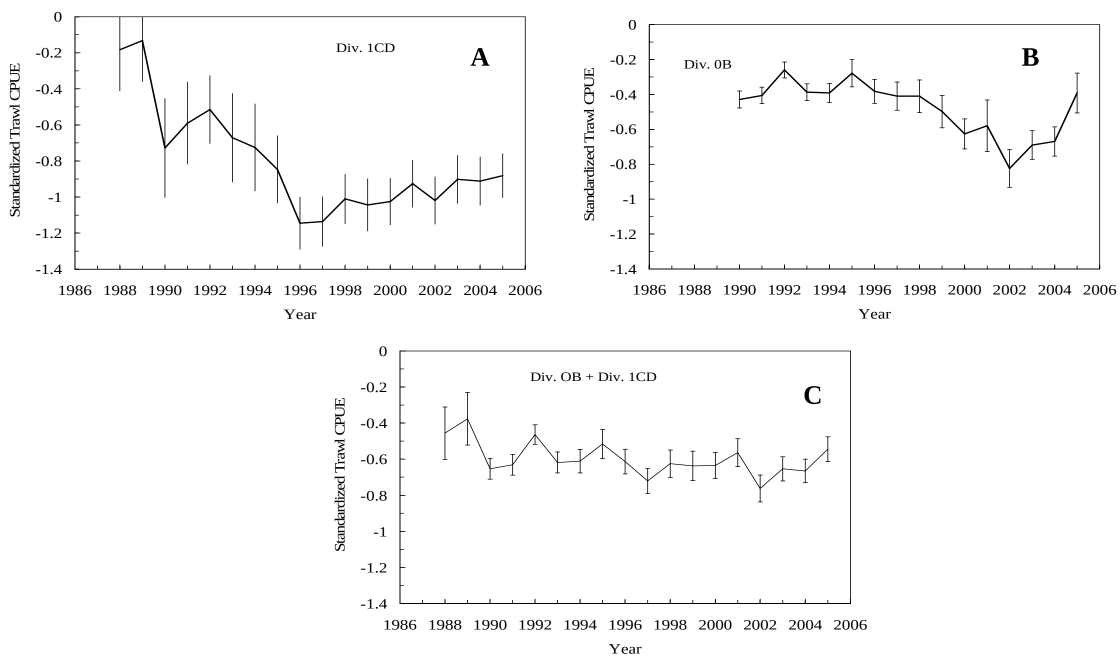


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): **A**: Standardized trawler CPUE from Div. 0B with ± S.E. **B**: Standardized trawler CPUE from Div. 1CD with ± S.E. **C**: Combined standardized trawler CPUE from Div. 0B and Div. 1CD.

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 81 000 tons in 2005 which is a gradual increase from 69 000 tons in 2003 and the highest for the time series (Fig. 1.3) (SCR Doc. 06/27).

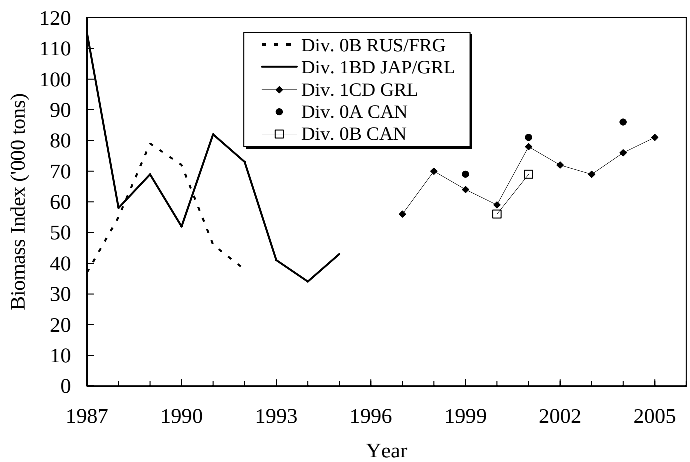


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from bottom trawl surveys.

Greenland shrimp survey. Since 1988 annual surveys have been conducted with a shrimp trawl off West Greenland between 59°N and 72°30'N from the 3-mile boundary to the 600 m depth contour line. The 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. The biomass decreased in 2005 to 23 600 tons (the second highest in the time series). The 2004 estimate included a relatively high proportion of age 3+ fish not seen in 2005. The survey gear was changed in 2005, but the 2005 figures are adjusted for that. The preliminary conversion factors are given in SCR 06/28. (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 the 2001 survey. The number of one-year-olds declined in 2002 but increased in 2003 to 317 million and stayed at that level in 2004 (314 million) and 2005 (298 million), which is well above the average level (Fig. 1.4).

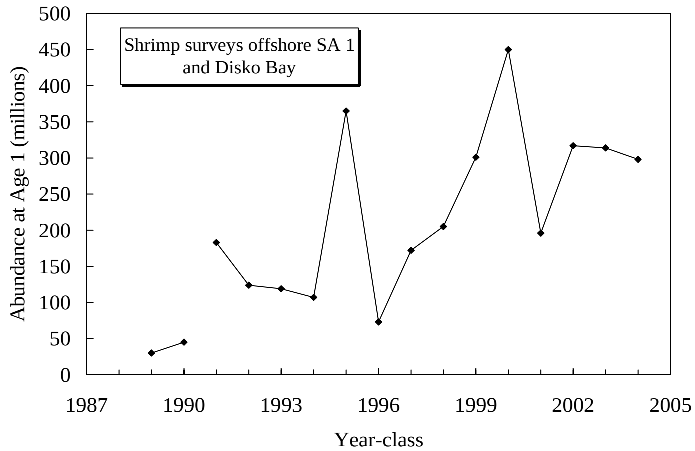


Fig. 1.4. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (The 1989 and 1990 year-classes are poorly estimated as age 1).

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1B-1AS declined between 2003 and 2004 but increased again in 2005 and the 2004 year-class as age one was about 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. 06/28).

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. 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 had not been previously surveyed. The trawlable biomass was estimated to 46 000 tons and 54 000 tons, respectively, in the two areas. These surveys in Baffin Bay have not been repeated in 2005.
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 2005 was the second highest observed in the time series.

The length distribution in the trawl fishery in Div. 0A has been stable during 2002-2005, with a mode around 48 cm.

The mode in the trawl fishery in Div. 1A has varied between the different fleets in recent years but was around 50 cm in 2004. There was no length frequency information available from Div. 1AB in 2005.

Unstandardized trawl CPUE from Div.1A showed a gradual increase from 2003 to 2005 for the fleet that takes the majority of the catches. Another fleet showed stability between 2004 and 2005, while the third fleet showed a decrease, but the level is still above the level in 2001-2003.

Divisions 0B + 1C-1F

The bottom trawl survey biomass index in Div. 1CD increased between 2003 and 2005 where the estimate was 81 000 tons which is the highest for the time series. Although the survey series from 1987-95 is not directly comparable with the series from 1997-2005, 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. The modes in the length distributions from the two fleets, from which data were available in 2005, were at 48 cm and 50 cm, respectively.

A standardized CPUE series from Div. 0B showed an increase between 2002 and 2005 and is now at the level seen in the 1990s. A standardized CPUE series from Div. 1CD has been increasing slightly since 1996. The combined standardized trawl CPUE index from SA 0B and Div. 1CD has been stable during 1990-2005.

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 the poor 1996 year-class and the 2000 year-class was the largest in the time series. The 2001 year-class was relatively poor, but the following year-classes including the 2004 year-class are 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 did not show 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 declined between 2003 and 2004 but increased again in 2005 and the 2004 year-class around 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 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 bycatch 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 2006.*

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

2. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Division 1A Inshore** (SCR Doc. 06/28, 35; SCS Doc. 06/13)

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 to 16 900 tons in 2001 but increased again the following years reaching 22 900 tons in 2005 (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:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC[1]					7.9	7.9	7.9	na	ni	ni
Disko Bay[2]	8.6	10.7	10.6	7.6	7.1	11.7	11.6	12.9	12.5	
Recommended TAC[1]					6.0	6.0	6.0	na	5.0	5.0
Uummannaq	6.3	6.9	8.4	7.6	6.6	5.4	5.0	5.2	4.9	
Recommended TAC[1]					4.3	4.3	4.3	na	na	na
Upernavik	4.9	7.0	5.3	3.8	3.2	3.0	3.9	4.6	4.8	
Unknown[3]	-	-	-	-	2.2				0.8	
STATLANT 21A	20.8	19.7	24.3	21.1[4]	16.7[4,5]	17.6[4]	20.6[4]			
STACFIS	19.8	24.6	24.3	21.0	16.9	20.1	20.5	22.7	22.9	

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

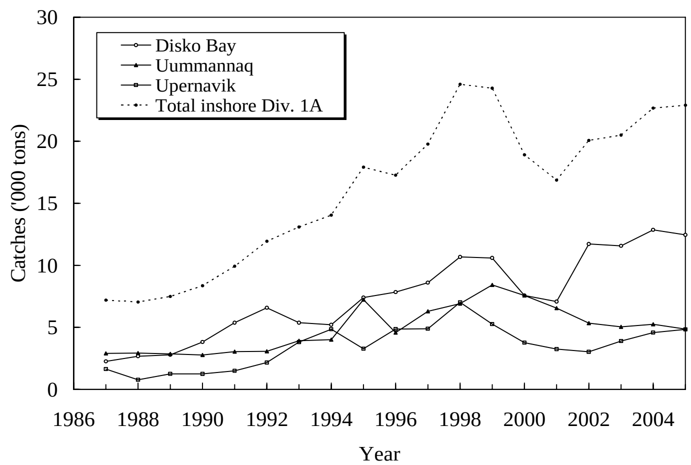


Fig. 2.1. Greenland halibut in Div. 1A inshore: landings by area.

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 restriction on gillnets has been in force since 2000, although dispensation is presently given to a fishery at Ilulissat in Disko Bay, and a fishery in the outer parts of the fjords in Uummannaq and Upernavik in 2002. In 2003 the areas of dispensation for gillnets were increased, and authority to lay down local rules have been given Uummannaq and Upernavik municipalities. 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 registered 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 7 000 tons in 2001, after that landings have increased every year until 2004 where landings reached a record high of about 12 900 tons, the landings decreased slightly to 12 500 tons in 2005.

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 have remained stable reaching about 4 900 tons in 2005.

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 reaching about 4 800 tons in 2005.

b) **Input Data**

i) **Commercial fishery data**

Landings data available at the time of the assessment were preliminary. Length distributions were available from longlines and gillnets 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 2006 in Disko Bay indicated that the fisheries take place on smaller sub-components of the stock, as size distribution differs between summer and winter, especially in Disko Bay.

In Disko Bay, mean length in the summer fishery have fluctuated between 1993 and 2001 with a slightly increasing trend, but have thereafter been decreasing from 63 cm in 2001 to 57 cm in 2005. 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 about 80cm in 2001 to 64 cm in 2006, and is now below the average level for the period of study. In Uummannaq mean length in the winter fishery have been stable throughout the period at about 66 cm. Mean size in landings from the summer fishery decreased in the early period from 1993 to 1997, but have thereafter remained stable at about 64 cm until 2005 where it dropped to 62 cm, mean size in landings from winter fishery have been relatively stable around 66 cm until 2004 but have decreased in 2005 and 2006 to 63 cm.

In Upernavik, the mean length has varied but an overall decreasing trend was observed until 1999, especially in the winter fishery. 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 and 2006 winter fishery show that mean length remains stable compared to 1999-2001.

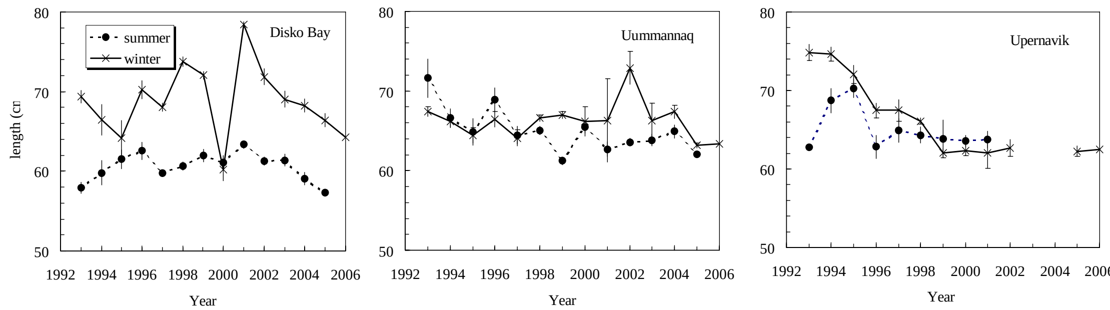


Fig. 2.2 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik with 95% CI**.**

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 75% fish being 10 years and younger.

In 2006, logbooks became 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, in 2004 and 2005 CPUE has stabilized at a level below the CPUE of 2001. Standardised CPUE for Uummannaq has been decreasing from 1999 to 2003, followed by an increase in 2004. The 2005 CPUE is unchanged compared to the previous year (Fig. 2.3). However none of the changes in standardised CPUE were significant.

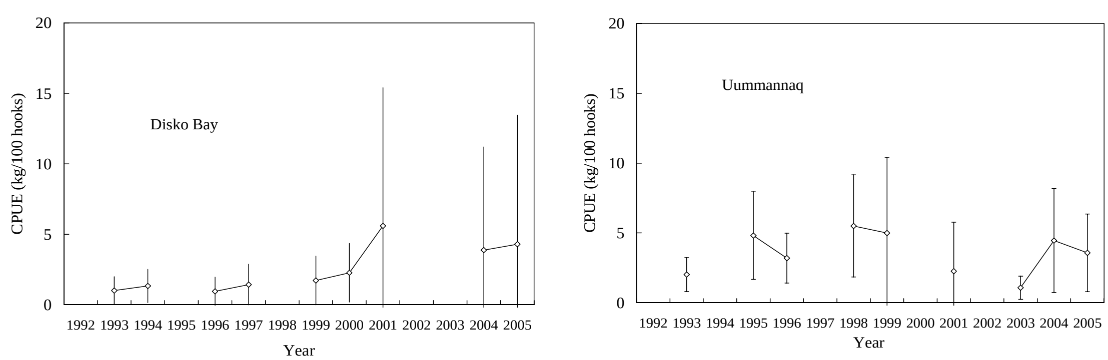


Fig. 2.3. Greenland halibut in Div. 1A inshore: standardised CPUE from longline surveys in Disko Bay and Uummannaq 1993-2005, re-transformed values given as kg/100 hooks.

Since 2001 gillnet surveys have been carried out in Disko Bay. Both CPUE (kg) and NPUE (number) from the gillnet surveys have decreased from 2001 to 2002, but increased again during 2002-2005, NPUE has decreased a little in 2005 compared to 2004, though not significantly (Fig. 2.4).

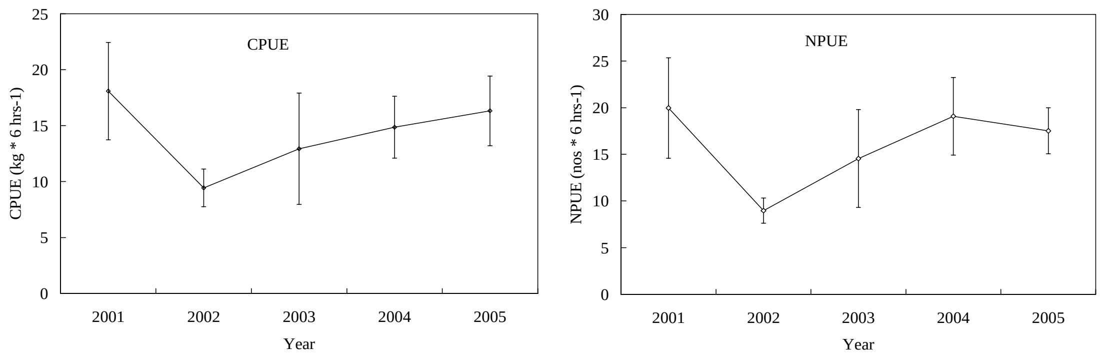


Fig. 2.4. Greenland halibut in Div. 1A inshore: CPUE and NPUE from gillnet survey Disko Bay 2001-2004

Since 1988 annual shrimp trawl surveys have been conducted 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.

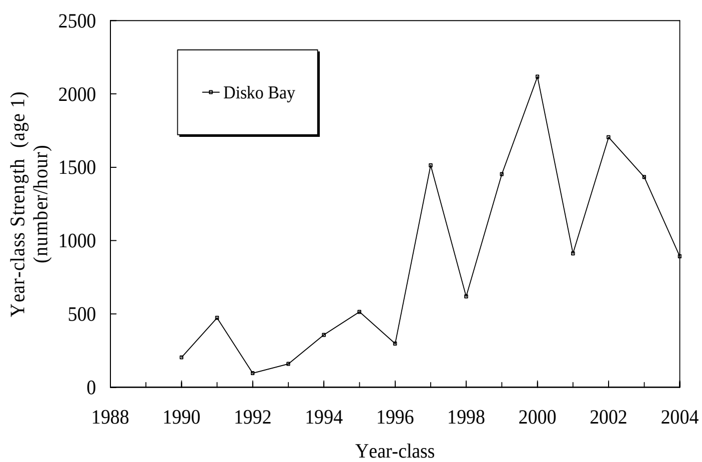


Fig. 2.5 Greenland halibut in Disko Bay: recruitment at age 1 from Greenland shrimp trawl survey.

Biomass indices of Greenland halibut in Disko Bay have increased since 1991. The majority of catches in the survey comprises of juveniles at age 1, except for 2004 where catches contained an unusually high number of 2-3 year olds (Fig. 2.6).

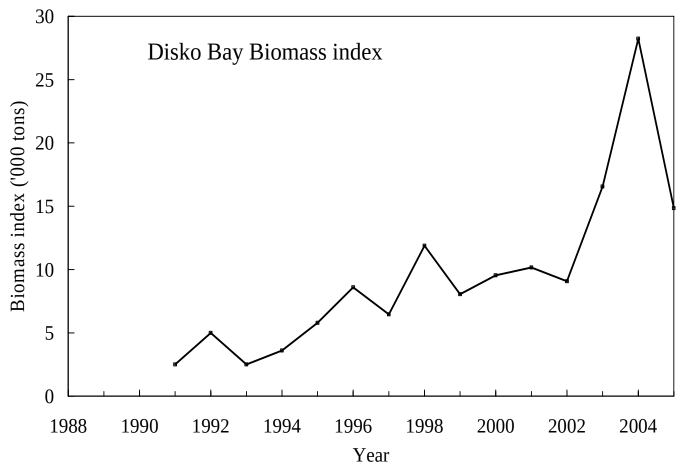


Fig. 2.6 Greenland halibut in Disko Bay: biomass indices from Greenland shrimp trawl survey.

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. The gillnet survey (2001-2005) shows stable catch rates over the last years. Mean length in commercial catches shows a decrease over the last four years. Biomass index was high in 2004, declined in 2005 but was above average in 2005. Recruitment indices from Disko Bay suggest high 1997 and onward year-classes, which might benefit the fishery in future years.

An explorative analytical assessment (Separable VPA, XSA and SURBA) was attempted for the Disko Bay Stock, but no reliable results could be achieved.

Uummannaq. Abundance indices indicate an increase until 1999, from 2001 to 2003 abundance indices decreased and in the same period landings declined, in 2004 both abundance index and landings increased slightly, to a level maintained in 2005. Mean lengths from fishery have been relatively stable over up until 2004, but has decreased during the last year.

Upernavik. Since no surveys and sampling from landings has been conducted in Upernavik from 2002 until winter 2005 and 2006, it is difficult to evaluate the Greenland halibut stocks in that area, however, mean length are unchanged compared to 1999-2001.

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. Some gillnet effort shifted 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 through 2005 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 gillnet 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 gillnet surveys, in relation to previous year's longline surveys, should be continued in order to allow use of the whole time series for Greenland halibut in Disko Bay.*

STACFIS **recommended** that *investigations of bycatch 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. 06/27; SCS Doc. 06/13)

Interim Monitoring Report

a) **Introduction**

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is taken as bycatch in the Greenland halibut fishery. A total catch of 23 tons was estimated for 2005 compared to 12 tons for 2004.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	3.4	3.4	3.4	3.4	3.4	4.2	4.2	4.2	4.2	4.2
STATLANT 21A	0.15[2]	0.03[3]	0.04	0.1[1]	0.06[1]	0.03[1]	0.05[1]	0.01[1]	0.00[1]	
STACFIS	0.15[2]	0.03[3]	0.04	0.1	0.06	0.03	0.05	0.01	0.02	

[1] Provisional.
[2-3] Includes roughhead grenadier from Div. 1A misreported as roundnose grenadier: 30[2] tons, 28[3] tons.
ndf No directed fishing.

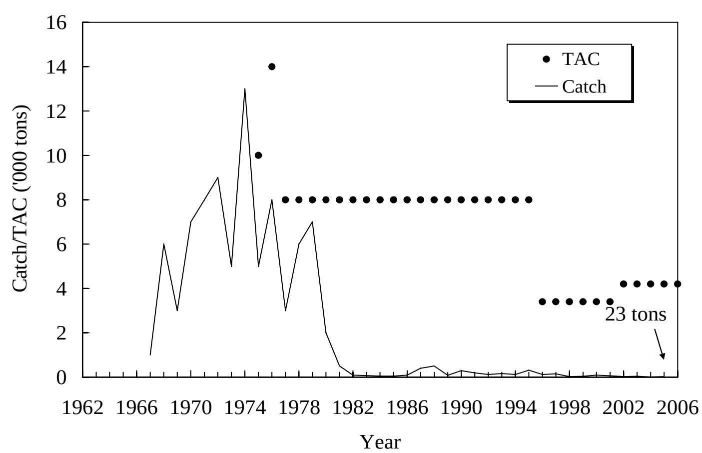


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs.

b) **Data Overview**

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 re-stratified and the biomass indices recalculated in 1997). Russia has in the period 1986-1992 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 1997-2005 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.

In the Greenland survey in 2005 the biomass in Div. 1CD was estimated at 733 tons, the second lowest in the time series, and hence the biomass has remained at the very low level observed since 1993. Most of the biomass was found at depths >1 000 m in Div. 1D. The fish were generally small, between 3 and 8 cm preanal fin length. The Canadian surveys in Div. 0B in 2000 and 2001 also showed very low biomasses, 1 660 and 1 256 tons, respectively.

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 catches have 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 resent years.

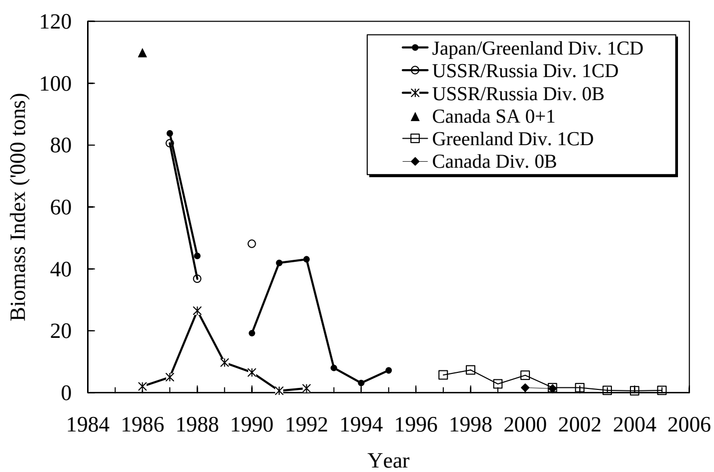


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland and Greenland surveys in Div. 0B and Div. 1CD.

c) **Conclusion**
Recent survey data indicate that the stock biomass is on a very low level and the 2005 survey did not indicate a change.

4. **Demersal Redfish (*Sebastes* spp.) in Subarea 1** (SCR Doc. 06/27, 28, 43, SCS Doc. 06/13)

Interim Monitoring Report

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.

Reported catches of golden redfish and redfish (unspecified) in Subarea 1 have been less than 1 000 tons since 1987. Redfish is mainly taken as bycatch by the offshore shrimp trawlers; reported bycatches in both

2004 and 2005 were 500 tons, however, this must be considered an underestimate. Smaller vessels take a minor amount inshore mainly golden redfish.

Recent catches ('000 tons) are as follows:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	19	19	19	19	19	19	8	1	1	1
Catch	1	0.9	0.8	0.6[1]	0.3[1,2]	0.5[1,2]	0.5[1,2]	0.5[2]	0.5[2]	

[1] Provisional.
[2] Estimated.
ndf No directed fishery.

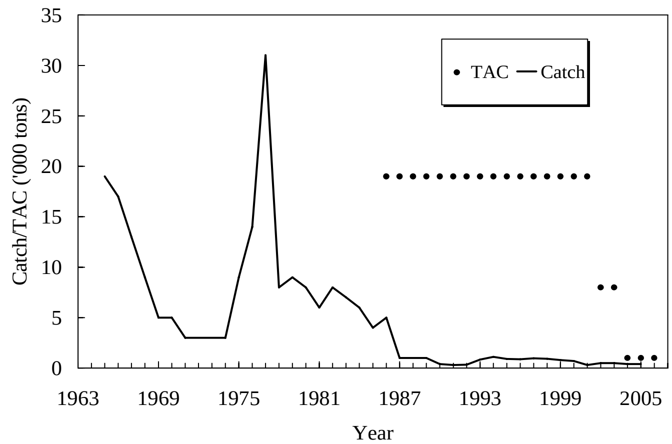


Fig. 4.1. Redfish in Subarea 1: catches and recommended TAC.

b) **Data Overview**

The Greenland fish and shrimp survey, the Greenland deep-sea survey and the EU-Germany survey were conducted during 2005. The survey estimates did not alter the perception of the status by STACFIS (Fig. 4.2, 4.3, 4.4)

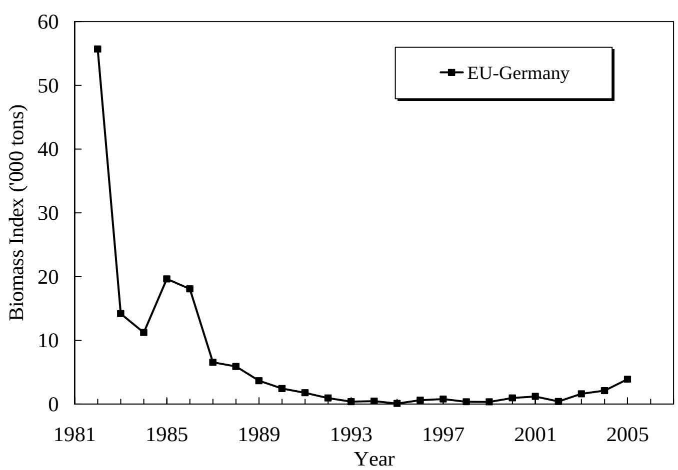


Fig. 4.2. Golden redfish in Subarea 1: survey biomass index

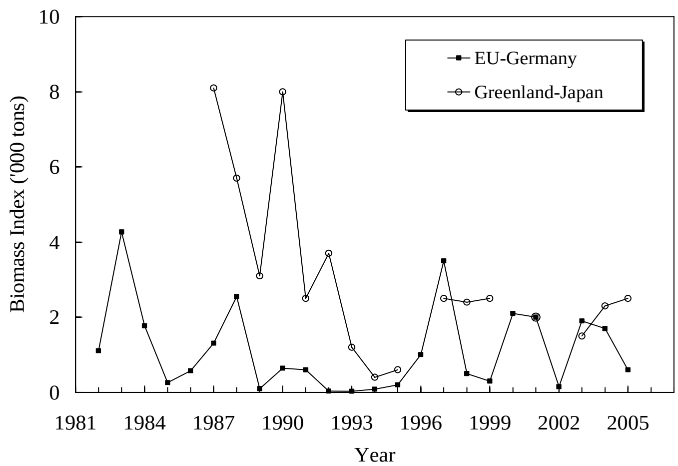


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass index

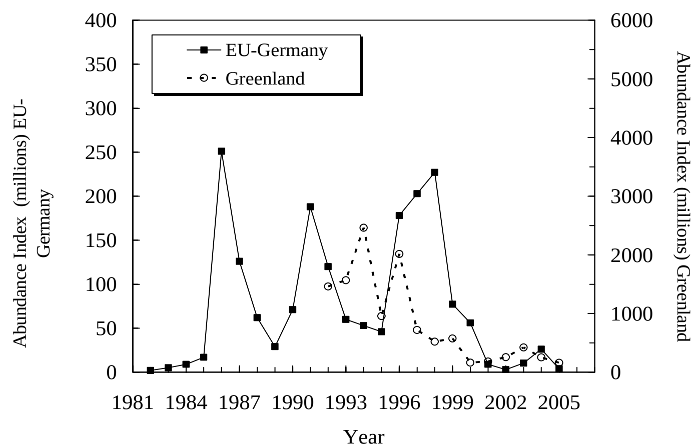


Fig. 4.4. Juvenile redfish (<17 cm) (deep-sea redfish and golden redfish combined) in Subarea 1: survey abundance indices. The Greenland survey data include the entire length range, but very few fish >16 cm.

c) **Conclusion**

Survey estimates from 2005 showed that the status of both stocks still is very poor.

5. **Other Finfish in Subarea 1** (SCR Doc. 06/28, 43; SCS Doc. 06/13)

Interim Monitoring Report

a) **Introduction**

The resources of other finfish in Subarea 1 are mainly Greenland cod (*Gadus ogac*); American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*A. minor*) and thorny skate (*Amblyraja radiata*) (Fig. 5.1); lumpsucker (*Cyclopterus lumpus*); Atlantic halibut (*Hippoglossus hippoglossus*) and sharks.

Nominal reported catches (tons) are as follows:

Species[3]	1997	1998	1999	2000	2001[1]	2002[1]	2003[1]	2004[1]	2005[1]
Greenland cod	1 729	1 717	1899	931	1152	939	1288	963	1080
Wolffishes	68	30	33	59	75	118	393	334	300
Atlantic halibut	22	22	45	9	1	1	0	43[2]	nd
Lumpsucker	1 158	2 143	3058	1211	3216	5795	8832	8199	8960
Sharks	nd	nd	nd	nd	nd	nd	nd	3	nd
Non-specified finfish	1 269	588	nd	769	589	584	475	663	nd
Sum	4 246	4 500	5035	2979	5033	7437	10988	10162	10340

nd No data
[1] Estimated.
[2] Including catches from the Spanish experimental fishery.
[3] The recommended TAC for American plaice, wolffishes and thorny skate has been ndf from 1986 onwards. There has been no TAC set for these stocks.

b) Data Overview

The Greenland fish and shrimp survey, the Greenland deep-sea survey and the EU-Germany survey were conducted during 2005. The survey estimates did not alter the perception of the status by STACFIS (Fig. 5.1).

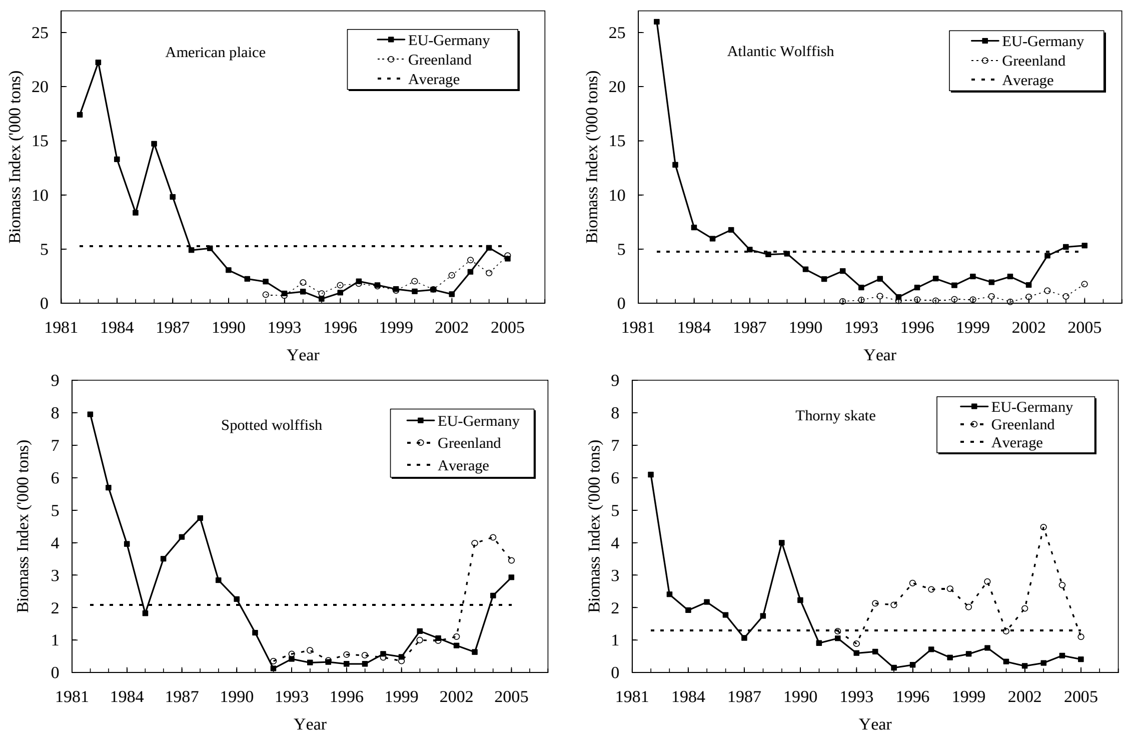


Fig. 5.1. Finfish in Subarea 1: survey biomass indices of various finfish species (The average is derived from the EU-Germany survey 1982-2005).

The stocks of American plaice, Atlantic and spotted wolfish indicate recovery potential due to increased recruitment as well as the observed slight increases in biomass for the whole length range in the recent 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, and even low amounts of fish taken and discarded by the shrimp fishery might be sufficient to delay the recovery potential of these stocks. The continued failures of the recruits to rebuild the spawning stocks indicate high mortality rates in excess of the sustainable level. The prospect of stock recovery would be enhanced by minimizing the bycatch of finfish in Subarea 1 to the lowest possible level.

c) **Conclusion**

The survey estimates from 2005 did not alter the perception of the status of the American plaice, Atlantic and spotted wolfish and thorny skate stocks. Although minor improvements have been seen in the stock status of some of the species in recent years, these stocks remain at a very low level.

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°-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.

During the summer of 2005, surface temperatures directly over the Cap were 2°C above normal, the 3rd highest on record. Near bottom temperatures over the Cap during both 2004 and 2005 were >4°C, which was above normal by near 1°C over the shallow areas of the Cap, the 3rd highest on record. Salinities over most of the upper water column during the summer of 2005 were generally saltier-than-normal while in the deeper water (>100-m depth) salinities were about normal. During 2005 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. Finally, during the summer of 2005, it appears that the circulation pattern around the 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 slight strengthening of the gyre circulation.

6. Cod (*Gadus morhua*) in Division 3M (SCR Doc. 03/38, 05/29, 06/16, 32; SCS Doc. 06/6)

a) **Introduction**

i) **Description of the fishery**

The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod has also been taken as bycatch in the directed redfish fishery by Portuguese trawlers. Small amounts of cod were taken as bycatch in the shrimp fishery by Canada and Norway. The bycatch of cod in the past Russian pelagic fishery for redfish was also low. The fishery has been under moratorium since 1999.

ii) **Nominal catches**

From 1963 to 1979, the mean reported catch was 32 000 tons, showing high variations between years. Reported catches declined after 1980, when a TAC of 13 000 tons was established, but Scientific Council regularly expressed its concern about the reliability of some catches reported in the period since 1963, particularly those since 1980. Alternative estimates of the annual total catch since 1988 were made available in 1995 (Fig. 6.1), including non-reported catches and catches from non-Contracting Parties.

In 1999 the fishery was closed and catches were estimated in that year as 353 tons, most of them taken by non-Contracting Parties based on Canadian Surveillance reports. Those fleets were not observed since 2000, and the current reduced catches are mainly obtained as bycatch of the redfish fishery. The catches in 2005 were 19 tons.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	6	2	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	1.5	0.5	0.0	0.0[1]	0.1[1]	0.0[1]	0.0[1]	0.0[1]	0.0[1]	
STACFIS	2.9	0.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	

[1] Provisional.
ndf No directed fishery.

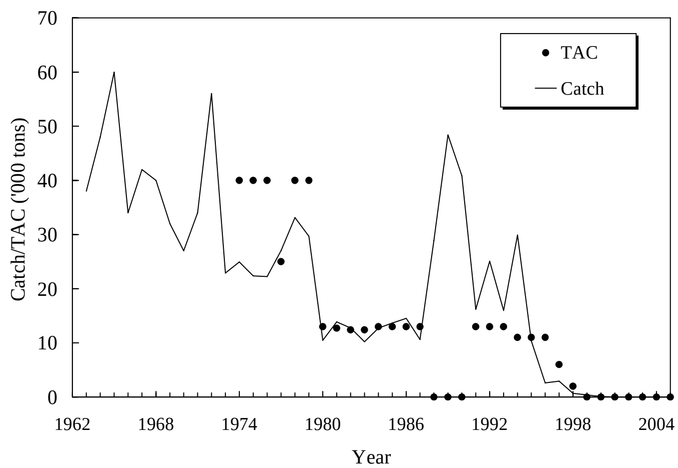


Fig. 6.1. Cod in Div. 3M: catches and TACs, catch figures include estimates of misreported catches since 1988.

b) Input Data

i) Commercial fishery data

Length and age compositions from the 2002 to 2005 commercial catches were not available. That information is available for the 1973 to 2001 period.

ii) Research survey data

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

Biomass and abundance estimates were also available from bottom trawl surveys conducted by USSR/Russia from 1977 to 1996, with the exception of 1994, and in 2001 and 2002 (Fig. 6.2), and with a concurrent acoustic survey from 1985 to 1993. The estimates of bottom trawlable biomass in the most recent period, showed a maximum level of 37 000 tons in 1989; a minimum 2 500 tons in 1992, and a decline from 8 300 tons in 1995 to 700 tons in 1996. The estimates in 2001 and 2002 were 800 and 700 tons, respectively.

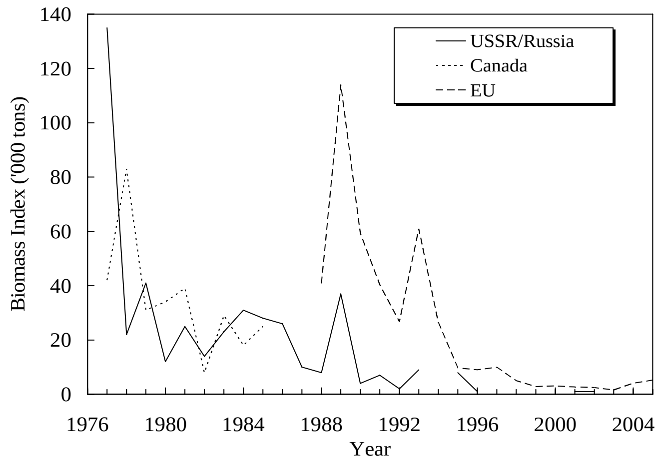


Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

A stratified-random bottom trawl survey was conducted by Canada in 1996, as part of an overall survey of Div. 2GHJ and 3KLMNO. Trawlable biomass was estimated at 9 300 tons. Biomass estimates for cod, American plaice and redfish in the Canadian survey and the EU survey in 1996 were similar.

Stratified-random bottom trawl surveys were conducted by the EU from 1988 to 2005. From 2003 onwards the survey was carried out with the new R/V *Vizconde de Eza* and, therefore, in order to make the series comparable parallel fishing trials were performed in 2003 and 2004 with the former vessel, R/V *Cornide de Saavedra*, and the new one (Casas and González Troncoso, 2005). The converted EU survey indices also showed a decline in trawlable biomass from a peak of 114 000 tons in 1989 to 27 000 tons in 1992, an increase to 61 000 tons in 1993, a decrease to around 10 000 tons in the 1995 to 1997 period, and continuously decreased to the lowest observed level of 1 600 tons in 2003. The converted biomass increased slightly in 2004 and 2005 at around 5 000 tons but is still low in comparison to historic levels. The peak stock biomass in 1989 indicated by both EU and Russian surveys were produced by the relatively abundant 1985 and 1986 year-classes. The biomass level observed in the period 1998-2005 by the EU survey is 17 times below the observed mean in the 1988-1993 period.

The EU-Flemish cap survey indicates poor recruitment of the 1992 to 1994 year-classes. Recruitment indices for the 1995 and subsequent year-classes were even lower at all observed ages. The abundance at age 1 in the 2005 survey has been the highest observed since 1993, however that level is still very low in comparison to pre-1993 levels.

c) **Estimation of Parameters**

Last sequential population analysis (XSA) was carried out for ages 1 to 8+ and years 1973 to 2001. Catch-at-age data were not available for the period 2002 to 2005, and it impedes further analyses using XSA. Catch-at-age data for most recent years had become imprecise because of the low catch, scarce sampling, and the use of the EU survey age-length keys.

The indices of abundance from the 2005 EU survey were scaled to population estimates of SSB based on the method accepted in the last assessment. This method allows to judge the current level of SSB in relation to the 14 000 tons accepted as a preliminary B_{lim} for this stock. This transformation in the scale of the figures, from survey indices to absolute SSB values, involves catchability-at-age parameters. These parameters were calculated based on previous XSA analysis using 1973 to 1999 data, because at that time catch-at-age numbers were available and, consequently, XSA provided reliable catchability estimates. This method will be useful as a criterion to reopen the fishery, because it provides the SSB estimate and the probability for such value being above or below B_{lim}.

d) **Assessment Results**

Estimates of the current spawning stock biomass indicate that its level is well below B_{lim} (Fig. 6.3). Although the abundance at age 1 in the EU survey in 2005 was the highest observed since 1993, it was well below in comparison to the pre-1993 level. The stock continues to be collapsed and it is not expected to recover in the short or medium term.

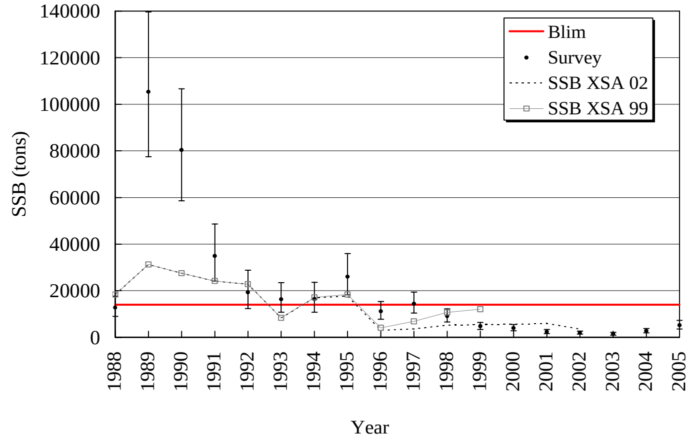


Fig. 6.3. Cod in Div. 3M: SSB values and confidence intervals for years 1988 to 2005 estimated with the stochastic survey-based method. The grey line and broken line represent the SSB values estimated from XSA in 1999 and 2002. The red thick line is the B_{lim} level at 14 000 tons. Catches and TACs, catch figures include estimates of misreported catches since 1988.

e) **Reference Points**

A preliminary B_{lim} for this stock is estimated at 14 000 tons.

7. **Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3M** (SCR Doc. 06/4, 8, 16; SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

a) **Introduction**

There are three species of redfish that are commercially fished on Flemish Cap; deep-sea redfish (*Sebastes mentella*) with a maximum abundance at depths greater than 300 m, golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*) preferring shallower waters of less than 400 m. The term "beaked redfish" is used for *S. mentella* and *S. fasciatus* combined. STACFIS evaluates the status of the Div. 3M beaked redfish stock, regarded as a management unit composed of populations of two very similar species, representing on average 78% of the redfish EU survey biomass.

The redfish fishery in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, declining continuously since then until 1998-1999, when a minimum catch around 1 000 tons was recorded mostly as bycatch 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 2004-2005 beaked redfish catch returned to the 3 000 tons level, with EU-Portugal consolidating its major role in the present fishery (Fig. 7.1).

In July 2005 EU survey showed an important increase in bottom survey biomass of all redfish species on Flemish Cap. As regards golden redfish this increase justified a directed fishery pursued by Portugal and Russia from September to mid-November, when the Div. 3M redfish fishery was closed due to TAC overshooting. Based on Russian commercial sampling data of the redfish catch by species from the autumn of 2005, STACFIS estimated that the overall golden redfish catch should be at 3 500 tons.

From Canadian observer data, the redfish bycatch on the 2005 3M shrimp fishery was reduced to 80 tons, reflecting a 75% reduction of the shrimp catch from 2004 to 2005. No length sampling of this bycatch is however available.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	20	20	10	3-5	3-5	3-5	3-5	3-5	3-5	3-5
TAC	26	20	13	5	5	5	5	5	5	5
STATLANT 21A	0.4	1	0.8	3.81	3.21	3.01	2.01	3.11	6.6[1]	
STACFIS Catch[2]	1.3	1	1.1	3.7	3. 2	2.9	1.9	2.9	3.1	
Bycatch[3]	0.16	0.19	0.1	0.1	0.74	0.77	1	0.47	0.1	
Total catch[4]	1.5	1.2	1.2	3.8	3.9	3.8	2.9	3.4	3.2	

1 Provisional.
2 Estimated beaked redfish catch.
3 In shrimp fishery (D. Kulka and J. Firth Dept. Fisheries and Oceans Canada, pers. comm.).
4 Total STACFIS + bycatch.

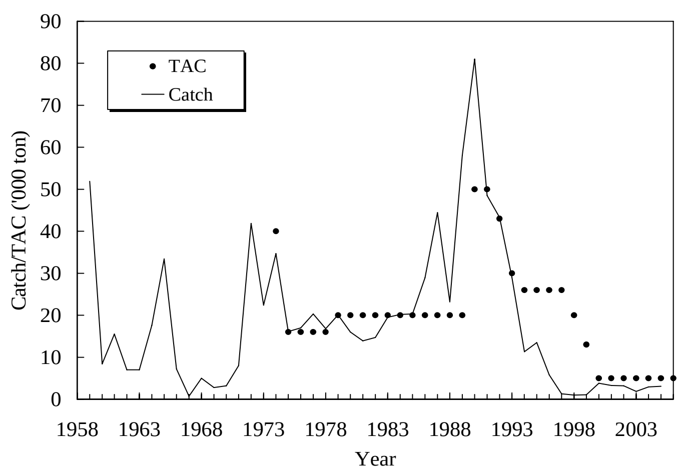


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

b) **Data Overview**

Research surveys

In June 2003 a new Spanish research vessel, the *RV Vizconde de Eza* (VE) replaced the *RV Cornide de Saavedra* (CS) 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 time series the original survey indices 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 from 2003 onwards (Fig. 7.2).

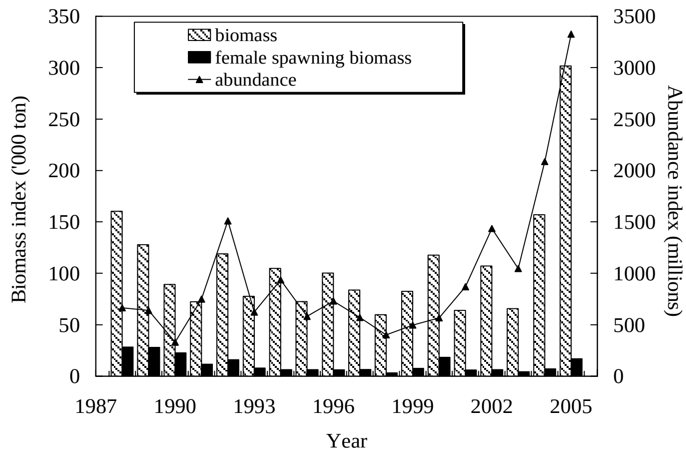


Fig. 7.2. Beaked redfish in Div. 3M: survey biomass, female spawning biomass and abundance from EU surveys (1988-2005).

c) **Conclusions**

In 2005, survey biomass and abundance continue to increase, supported by the survival and growth of the above average 1998 and 2000 year-classes. Survey exploitable biomass and female spawning biomass record important and consistent increases as well that confirms the full assessment of this stock carried out in 2005.

d) **Current and Future Studies**

STACFIS **recommended** that *an update of the Div. 3M redfish bycatch 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 their size distribution.*

8. **American Plaice (*Hippoglossoides platessoides*) in Division 3M** (SCR Doc. 05/29, 06/16, 38; SCS Doc. 06/7, 9)

a) **Introduction**

On the Flemish Cap the stock of American plaice mainly occurs at depths shallower than 600 m. Catches of Contracting Parties, in the recent years, are mainly bycatches in trawl fisheries directed to other species in this Division.

Nominal catches increased during the mid-1960s, reaching a peak of about 5 341 tons in 1965, followed by a sharp decline to values less than 1 100 tons until 1973. Since 1974, when catches of this stock became regulated, catches ranged from 600 tons (1981) to 5 600 tons (1987). After that catches declined to 275 tons in 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. Catch for 2005 was estimated to be 45 tons.

From 1979 to 1993 a TAC of 2 000 tons was in effect for this stock. A reduction to 1 000 tons was agreed for 1994 and 1995 and a moratorium was agreed to thereafter (Fig. 8.1).

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.1	0.2	0.2	0.3[1]	0.2[1]	0.2[1]	0.1[1]	0.1[1]	0.1[1]	
STACFIS	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.05	

[1] Provisional.
ndf No directed fishing.

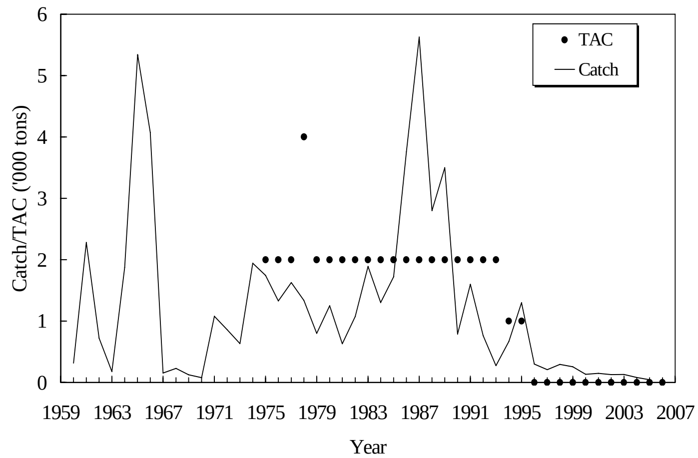


Fig. 8.1. American plaice in Div. 3M: STACFIS catches and agreed TACs.

b) **Input Data**

i) **Commercial fishery data**

EU-Portugal, EU-Spain and Russia provided length composition data for the 2004 and 2005 trawl catches. EU-Portugal and EU-Spain length compositions were used to estimate the length and age compositions for the 2004 total catch. EU-Spain length composition was used to estimate the length and age compositions for the 2005 total catch. The 1991 year-class (age 14 in 2005) was the most abundant one.

ii) **Research survey data**

The series of research surveys conducted by the EU since 1988 was continued in July 2005. 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, the original mean catch per tow, biomass and abundance at length distributions for American plaice 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. The methodology for convertion of the previous series from 1988-2002 was accepted by STACFIS in 2005 (SCR Doc. 05/29). The results of the calibration show that the new RV *Vizconde de Eza* is 33% more efficient than the former RV *Cornide de Saavedra* in catching American plaice.

The USSR/Russian survey series that began in 1972 was concluded in 1993. From 1972 to 1982 the survey series was post-stratified because surveys were conducted using fixed-station design. Since 1983 USSR/Russia adopted the stratified random survey method. A new Russian survey was carried out in 2001 and 2002. Canada conducted research vessel surveys from 1978 to 1985, and a single survey was conducted in 1996 with a different vessel and gear.

A continuous decreasing trend in abundance and biomass indices was observed from the beginning of the EU survey series. The 2000 abundance and biomass were the lowest of the series and remained at very low levels in 2005. Although the USSR/Russian survey series shows higher variability, it also showed a decreasing trend during the 1986-93 period. Abundance and biomass from the Russian survey in 2001 were the lowest of the series. Canadian survey biomass and abundance between 1978 and 1985 were around 6 700 tons and 10 million fish. Both indices from the Canadian survey in 1996 were at the same level of the ones from the EU survey (Fig. 8.2 and 8.3).

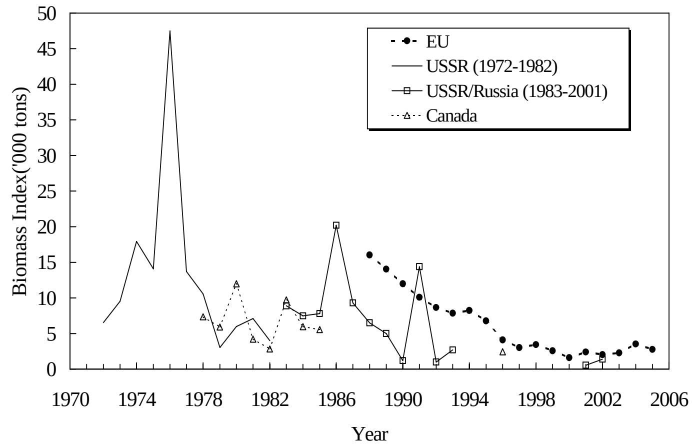


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys.

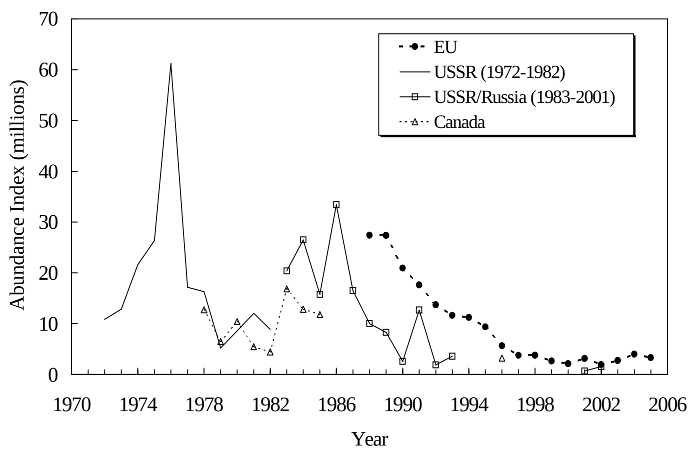


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys.

Ages 9 and older were dominant in the 2005 EU survey. Since 1991 recruitment (age 3) has been very poor as shown by EU survey indices. Although there was a marginal improvement in the index for both the 2001 and 2002 year-classes they are still considered to be poor in relation to the pre-1991 estimates of recruitment.

In the EU surveys an index of spawning stock biomass (50% of age 5 and 100% of age 6 plus) has been declining since 1988. A minimum was recorded in 2000.

c) **Estimation of Parameters**

A fishing mortality index is given by the ratio of catch to EU survey biomass ratio for ages fully recruited to the fishery (ages 8-11).

A partial recruitment vector for American plaice in Div. 3M was revised assuming flat topped partial recruitment and adjusting a relative mean index-at-age to a general logistic curve. This index was derived by determining the ratio between the 1989-2005 age composition of the catch and American plaice EU survey abundance. Both data sets were standardized to numbers-per-thousand prior to analysis.

An XSA for the most recent period of 1988-2005 was run, using the EU survey data for tuning. Natural mortality (*M*) was set at 0.2. This XSA was accepted by STACFIS noting that the fishing mortality (*F)* in the most recent years is very low (Fig. 8.4). If the average *F* continues to be much lower than *M*, STACFIS considers that the utility of this method must be re-evaluated.

d) **Assessment Results**

The fishing mortality index (Catch/EU Survey Biomass for ages 8-11) and XSA fishing mortality show similar patterns over a comparable time period. Both declined from the mid-1980s to the mid-1990s, then fluctuated between 0.05 and 0.1 from 1996 until 2002 (Fig. 8.4). Since then both decreased and in 2005 are at a very low level.

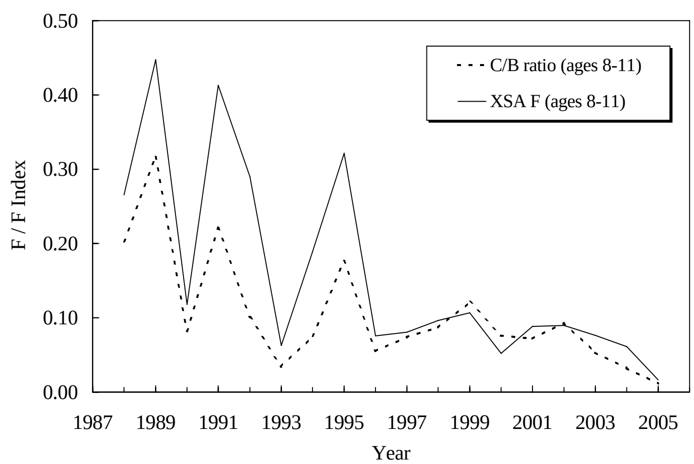


Fig. 8.4. American plaice in Div. 3M: fishing mortality index (catch/biomass) from EU survey (ages 8-11) and XSA estimated fishing mortality (ages 8-11).

EU survey data and XSA both indicate no sign of recruitment since 1991 with only weak year-classes expected to recruit to the SSB for at least the next five years. Stock biomass and the SSB are at a very low level and there is no sign of recovery, due to consistent year-to-year recruitment failure since the beginning of the 1990s (Fig. 8.5).

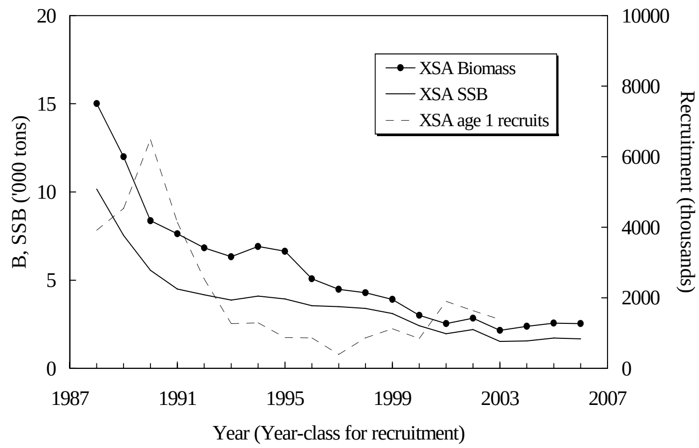


Fig. 8.5. American plaice in Div. 3M: biomass, spawning stock biomass (SSB) and corresponding recruitment from XSA

e) **Reference Points**

Based on the 16 points available from the XSA to examine a stock/recruitment relationship, a proxy for B_{lim} will be 5 000 tons of SSB (Fig. 8.6). XSA current estimates of fishing mortality are quite low, despite this spawning stock biomass remains at a very poor level (Fig. 8.7).

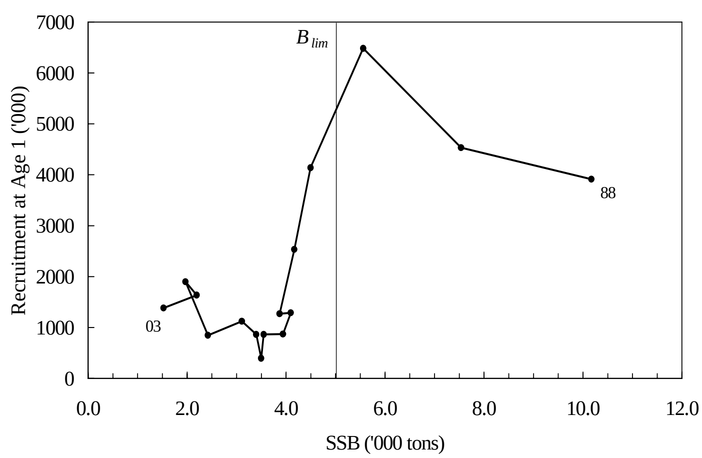


Fig. 8.6. American plaice in Div. 3M: SSB-Recruitment scatter plot.

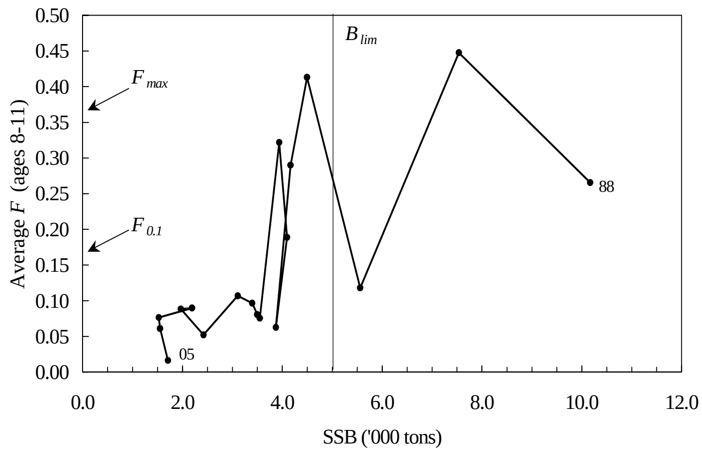


Fig. 8.7. American plaice in Div. 3M: stock trajectory within the NAFO PA framework.

The following set of parameters was used for the yield-per-recruit analysis: M = 0.2; exploitation pattern described above; a knife edge maturity of 50% at age 5 and 100% at age 6 plus; and an average mean weights-at-age in the catch and in the stock for the period 1988-2005. This analysis gave a $F_{0.1}$ = 0.165 and a F_{max} = 0.365.

f) **Research Recommendations**

Average *F* in recent years has been very low relative to *M*. Therefore STACFIS **recommended** that *the utility of the XSA must be re-evaluated and the use of alternative methods (for e.g. survey based models, stock production models) be attempted in the next assessment of Div. 3M American plaice.*

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°-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 area of bottom habitat on the Grand Banks covered by <0°C water has decreased from near 50% during the first half of the 1990s to near 15% during 2004 and 2005.

On the Grand Bank 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 8th consecutive year in 2005. 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°-3.5°C and generally >3.5°C along the southwest slopes of the Grand Bank in Div. 3O. Time series of the spatially average bottom temperatures for Divs. 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 over 2004 to about 2°C.

9. Cod (*Gadus morhua*) in NAFO Divisions 3N and 3O (SCR Doc. 06/09, 13, 36; SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

a) Introduction

The cod stock in Div. 3NO has been under moratorium to directed fishing both inside and outside the Regulatory Area since February 1994. Catches increased steadily from the implementation of the moratorium to 2003 (Fig. 9.1). The total catch of cod for 2005 in Div. 3NO from all fisheries was estimated to be 700 tons.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	nf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.4	0.5	0.5	0.5[1]	0.9[1]	1.2[1]	1.6[1]	0.8[1]	0.6[1]	
STACFIS	0.4	0.5	0.9	1.1	1.3	2.2	4.3-5.5[2]	0.9	0.7	

[1] Provisional.
[2] STACFIS could not precisely estimate the catch. Figures are the range of estimates.
nf No fishing.
ndf No directed fishery and bycatches of cod in fisheries targeting other species should be kept at the lowest possible level.

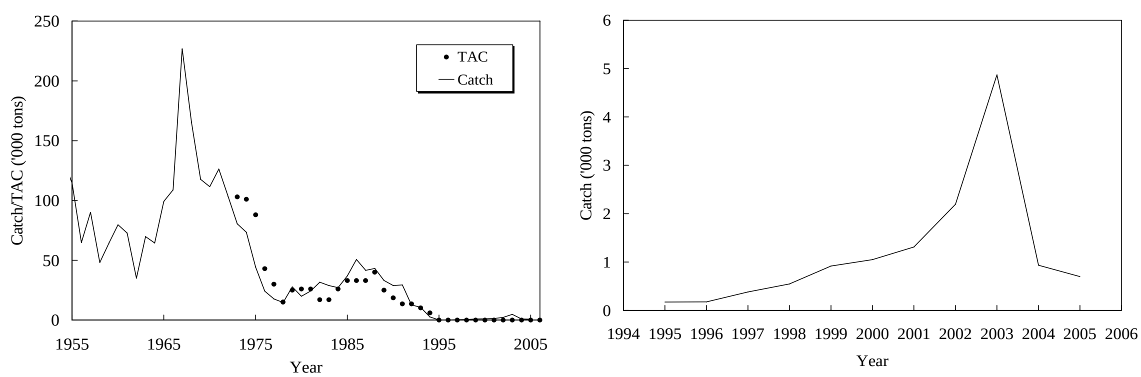


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) Data Overview

Canadian stratified-random bottom trawl surveys. 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 2005 survey estimate is higher than 2004 but still at a very low level (Fig. 9.2).

Canadian autumn surveys. 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 2005 survey estimate is higher than 2004 but is still at a very low level (Fig. 9.2)

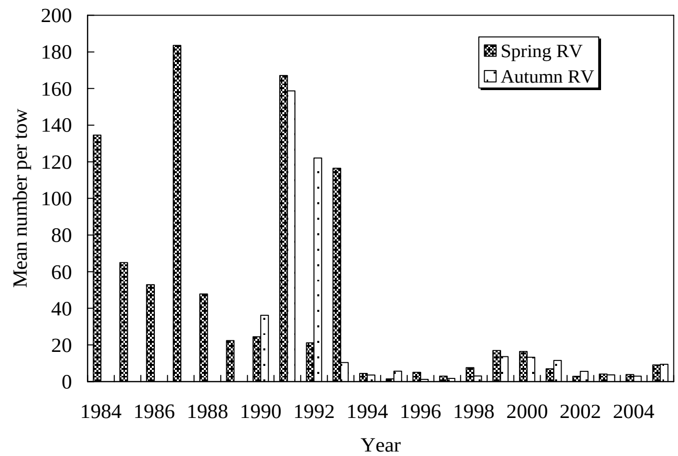


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian spring and autumn research surveys.

Survey by EU-Spain. Surveys have been conducted annually from 1995 to 2005 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. The survey series has been revised since the 2005 assessment (NAFO SCR Doc. 06/13). The highest point in the time series was 2001. There appears to be no overall trend in the series (Fig. 9.3).

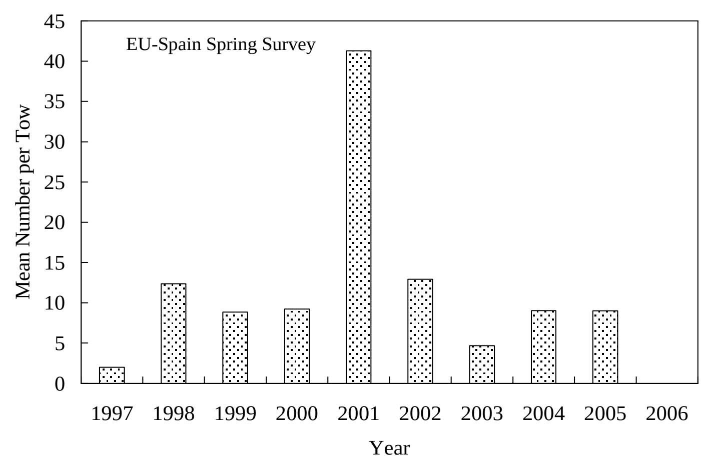


Fig. 9.3. Cod in Div. 3NO: mean number per tow from EU-Spain spring surveys.

Exploration of SPA

In 2005 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.* The effect of removing the short juvenile series was examined. The mean square error was slightly larger for the run excluding the juvenile survey. There was an increase in error on the parameter estimates when the survey was excluded. The exclusion of the Canadian juvenile survey results in a model fit that is slightly worse than when the index is included.

In addition to the survey indices currently used to tune the SPA, there is available a survey conducted by EU-Spain in the regulatory area of 3NO. 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.* The mean square error was larger for the run including the survey by EU-Spain (0.845) compared to the run including only the Canadian spring, autumn and juvenile indices (0.706). There was an increase in the relative error for estimates of catchability when the indices from the survey from EU-Spain were included. The inclusion of the EU-Spain survey results in a model fit that is worse than when the index is excluded.

The inclusion of survey series in SPAs as tuning indices needs to be examined not only based on model fit but also on the quality of the survey.

c) **Conclusion**

In 2005 the assessment concluded that the total biomass and spawning biomass were estimated to be at extremely low levels. Based on overall indices for the current year, there is nothing to indicate a change in the status of this stock.

10. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N (SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

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 fasciatu*s). 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 1959-1985 reported catch from Div. 3LN was about 22 000 tons, ranging between 10 000 tons and 45 000 tons. Catches increased sharply to a 1987 high of 79 000 tons and fall steadily afterwards to 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. Catches declined gradually in 2001-2003 and stabilized in 2004-2005 at 650 tons level (Fig. 10.1).

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	14	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	11	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT	0.6	0.9	1.8	1.5	0.9	1.0	1.3	0.7	0.7[1]	
STACFIS	0.6	0.9	2.3	2.6	1.4	1.2	1.3	0.6	0.7	

ndf No directed fishing.
[1] Provisional.

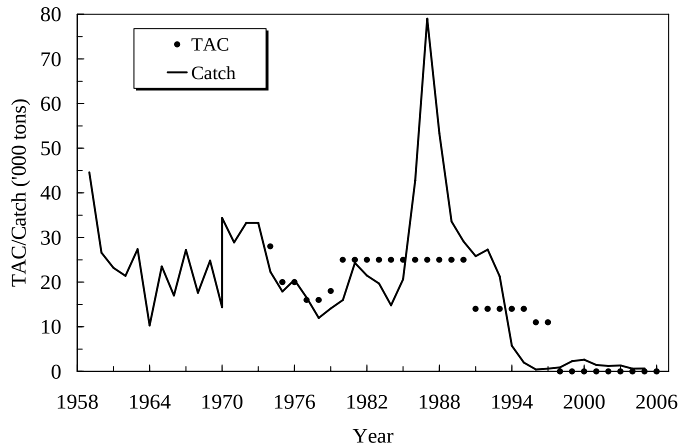


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

b) **Data Overview**

Research surveys

Since 1991 spring and autumn Canadian series of annual stratified-random surveys covered both Div. 3L and Div. 3N on an annual basis, with strata down to 732 m (400 fathoms) depth regularly sampled. 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. Campelen data and Engel data converted into Campelen units were used as survey indices.

For each spring and autumn series the annual proportion of female spawning biomass was calculated and applied to the swept area survey biomass to give an estimate of the 1991-2005 survey female SSB in Div. 3LN (Fig. 10.2).

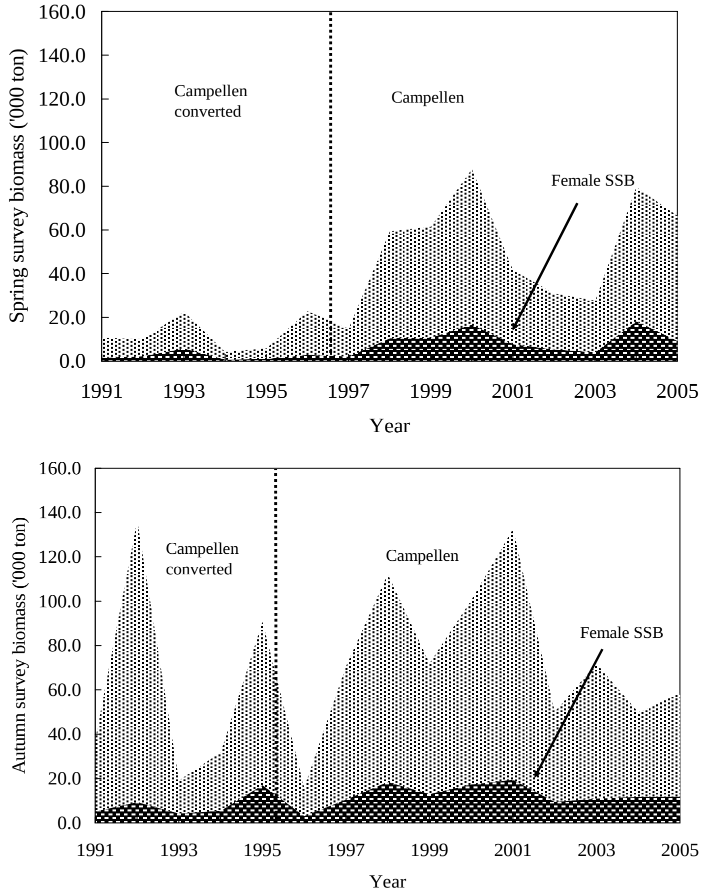


Fig. 10.2. Redfish in Div. 3LN: survey biomass and female spawning biomass, 1991-2005 (darker portion = female SSB/female spawners).

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.

c) **Conclusions**

The assemblage of Div. 3L and 3N survey indices, in order to give a picture of the relative size of this redfish management unit as a whole, suggests that stock was higher in the mid-2000s than in the early 1990s in terms of, biomass and female spawning biomass. 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.

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.

d) **Current and Future Studies**

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

11. **American plaice (*Hippoglossoides platessoides*) in NAFO Divisions 3L, 3N and 3O** (SCR Doc. 06/12, 05/34; SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

a) **Introduction**

This fishery was under moratorium since 1995. Total catch in 2005 was 4 110 tons, mainly taken in the Regulatory Area and as bycatch 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:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	nf	nf	nf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	1.4	1.6	2.4	2.6[1]	3.0[1]	3.1[1]	3.8[1]	2.9[1]	2.3[1]	
STACFIS	1.4	1.6	2.6	5.2	5.7	4.9	6.9-10.6[2]	6.2	4.1	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
nf No fishing.
ndf No directed fishing.

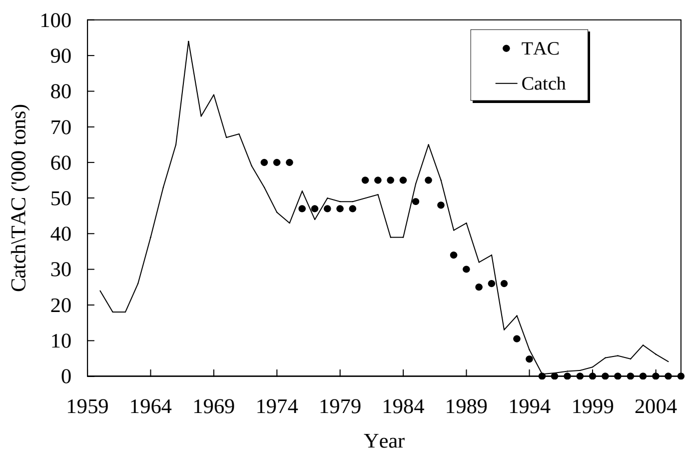


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs

b) **Data Overview**

Canadian stratified-random bottom trawl surveys. Data from **spring surveys** in Div. 3L, 3N and 3O were available from 1985 to 2005. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 2005, the depth range has been extended to at least 731 m in each survey.

In the spring survey 2005 the biomass (mean weight per tow) estimates for Div. 3LNO as well as the abundance (mean number per tow) both increased from the 2004 values. Biomass in Div. 3LNO combined has increased somewhat since 1996 but the 2005 value is only 30% of that of the mid-1980s. The mean number per tow in 2005 was 40%. Over the last 3 years the mean weight and mean number per tow have averaged 24% and 27%, respectively of the mid-1980s average (Fig. 11.2). Biomass continues to be distributed more to the south compared to historically, with less than 40% of the biomass distributed north of 45°N in 2005, compared to more than 80% during the mid-1980s.

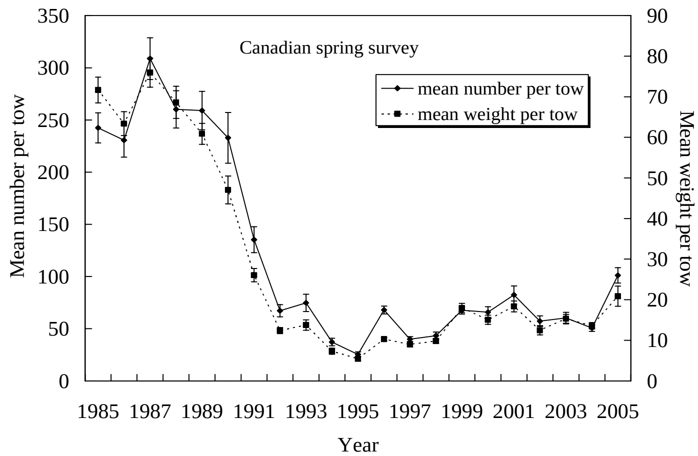


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys.

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 2003-2005 being 33% of the level of 1990. The mean number per tow in the autumn survey has shown a similar trend with the 2003-2005 average being 39% of the value in 1990 (Fig. 11.3). Survey coverage in Div. 3L in autumn 2004 was incomplete and therefore results may not be comparable (SCR Doc. 05/34).

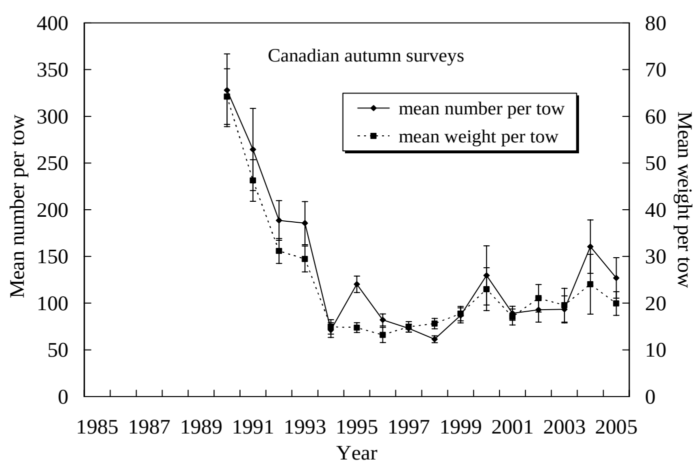


Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys. Note that due to incomplete survey coverage indices in 2004 may not be comparable.

Survey by EU-Spain. Surveys have been conducted annually from 1995 to 2005 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. The survey series has been revised since the 2005 assessment (SCR Doc. 06/12). The biomass value was highest in 2000 and abundance index in 2004 from this survey. Since 2000 there has been little trend in either biomass or abundance (Fig. 11.4).

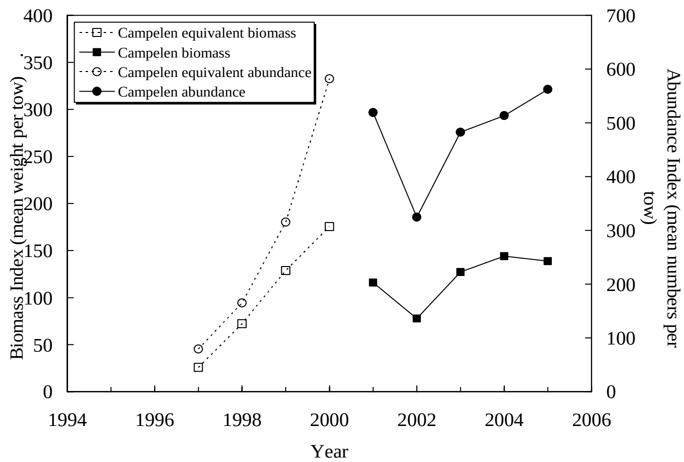


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from the survey by EU-Spain

c) **Conclusion**

In 2005 the assessment concluded that SSB declined to the lowest observed levels in 1994 and 1995 and remains very low at just over 23 000 tons. Considering the stock is under moratorium, average *F* is high. Based on overall indices for the current year, there is nothing to indicate a change in the status of this stock.

12. **Yellowtail Flounder (*Limanda ferruginea*) in Divisions 3L, 3N and 3O** (SCR Doc. 06/13, 21, 22, 26, 29, 40, 41; SCS Doc. 05/5, 6, 8, 06/7, 9)

a) **Introduction**

Since the fishery re-opened in 1998, catches have increased from 4 400 tons to 14 100 tons in 2001 (Fig. 12.1). Catches in 2005 were about 13 900 tons, similar to the level in 2004.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	4.0	6.0	10.0	13.0	13.0	14.5	14.5	15.0	15.0
TAC	ndf	4.0	6.0	10.0	13.0	13.0	14.5	14.5	15.0	15.0
STATLANT 21A	0.7	4.4	7.0	10.6[1]	12.8[1]	10.4[1]	13.0[1]	13.4[1]	13.9[1]	
STACFIS	0.8	4.0	7.0	11.0	14.1	10.8	13.5-14.1[2]	13.4	13.9	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishing.

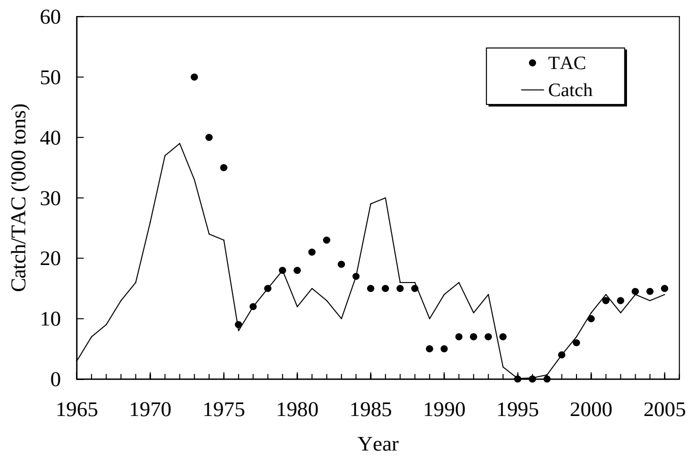


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data** (SCR Doc. 06/26, 40; SCS Doc. 05/5, 6, 8, 06/7, 9)

Catch and effort data from the Canadian commercial fishery in 2004-05, were included in a multiplicative model to analyze the CPUE series from 1965 to 2005. The index showed a steady decline from 1965 to 1976 and then rose to a relatively stable level from 1980-85 before declining to its lowest level during the 1991-93 time period. STACFIS again noted that the 1998-2005 CPUE values are not directly comparable to CPUE indices from previous years because of changes in the 1998-2005 fishing patterns. The 1998-2005 catch rates are related to the Canadian fleet's fishing pattern, which because of the 5% bycatch rule, resulted in concentrating effort mainly in areas where yellowtail flounder was abundant and catches of American plaice and cod were expected to be low. In 2001, bycatch rates of American plaice increased, and remained at this level in 2002-05. Excluder grates have been used by the Canadian fleet in recent years in an attempt to control bycatch levels, particularly cod. In 2005, the main bycatch in the Canadian fishery was American plaice, cod and thorny skate. Catches of juvenile yellowtail flounder were reduced by the use of large mesh sizes (145-159 mm) in the codend. Mean size of yellowtail flounder in the Canadian fishery was 37 cm in 2004-2005, and has shown little variation during recent years.

There was sampling of yellowtail flounder from bycatches by EU-Portugal, EU-Spain and Russia in the Regulatory Area of Div. 3N in 2004, and EU-Spain and Russia in the Regulatory Area of Div. 3NO in 2005. The minimum codend mesh size in the Canadian fleet is 145 mm while EU-Spain uses a minimum of 130 mm mesh size. In 2004, the mode in the Spanish yellowtail bycatch was 38-39 cm. However, in the 2005 Spanish fisheries the mode of 36-37 cm was similar to that seen in the 2004-2005 Canadian fishery. In 2004 and 2005 skate fisheries of EU-Portugal and Russia, where a minimum codend mesh size of 280 mm is used, the mode of the yellowtail bycatch was 38-39 cm in the 2004 Portuguese and Russian fisheries, while the mode of 32-33 cm in the 2005 Russian fishery showed a shift to smaller fish. This shift in 2005 size composition in the 280 mm mesh codend Russian fishery was not evident in the 145 mm mesh codend Canadian fishery.

ii) **Research survey data**

Canadian stratified-random spring surveys (SCR Doc. 06/41). In 2005, most of the trawlable biomass of this stock continued to be found in Div. 3N. The index of trawlable biomass in 2005 increased from the 2004 value by 14%, and was the highest in the 22-year series (Fig. 12.2) similar to the 2003 value.

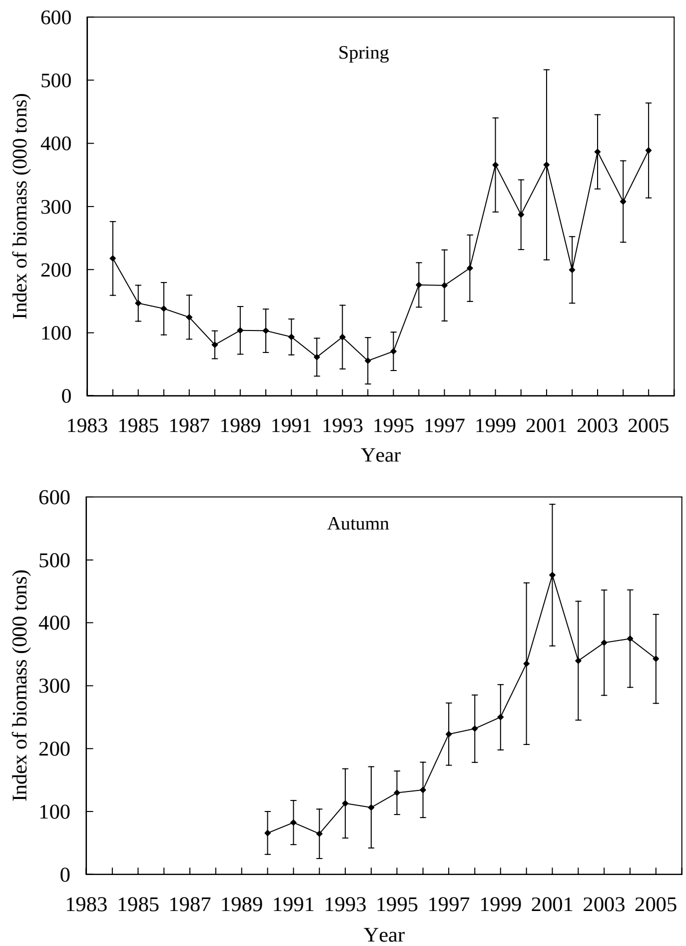


Fig. 12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx 95% confidence intervals, from Canadian spring and autumn surveys.

Canadian stratified-random autumn surveys (SCR Doc. 06/41). Most of the biomass from the autumn survey in 2005 was also found in Div. 3N. The index of trawlable biomass for Div. 3LNO increased steadily from the early 1990s (Fig. 12.2). Following a decline in 2002 from the peak value in 2001, biomass in 2002-2005 has remained relatively stable.

Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO (SCR Doc. 06/13). Beginning in 1995, Spain has conducted stratified-random surveys for groundfish in the NAFO Regulatory Area (NRA) of Div. 3NO. These surveys cover a depth range of approximately 45 to 1 464 m. In 2001, extensive comparative fishing between the old vessel, C/V *Playa de Menduiña* and old *Pedreira* trawl with the new vessel, C/V *Vizconde de Eza*, using a Campelen 1800 shrimp trawl as the new survey trawl was carried out. In 2003, all data were converted to Campelen equivalents.

The biomass of yellowtail flounder increased sharply up to 1999, and has been relatively stable from 2000-2005 (Fig. 12.3). The 1995-2002 results are in general agreement with the Canadian spring series for all of Div. 3LNO. Most (89%) of the biomass comes from strata 360 and 376 similar to other years. Length frequencies in the 2004 and 2005 Spanish survey showed a peak around 32-34 cm. As in the Canadian spring surveys, this survey shows the same progression of the peak in the length frequencies from 1998 to 2005. There is no evidence of recruitment pulse in recent years similar to the Canadian spring survey results.

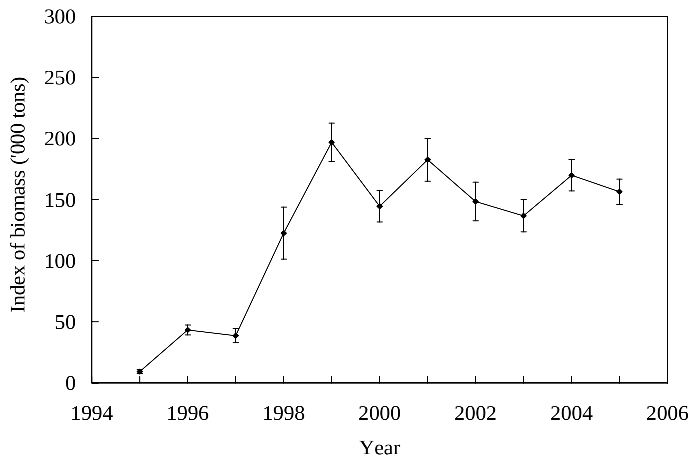


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the Spanish spring surveys in the Regulatory Area of Div. 3NO. Data are in Campelen equivalents. Error bars are ±1 S.D.

Stock distribution (SCR Doc. 06/23, 29, 41). In all surveys, yellowtail flounder were most abundant in strata on the Southeast Shoal and immediately to the west in Div. 3N, most of which straddle the Canadian 200-mile limit. Yellowtail flounder appear to be more abundant in the Regulatory Area of Div. 3N in the 1999-2005 surveys than in previous years, and the northward distribution of the stock has again extended in Div. 3L, similar to mid-1980s when overall stock size was also relatively large. The vast majority of the stock was still found to be shallower than 93 m in both seasons. There is an apparent relationship between 1990-2005 spring and autumn Canadian survey catch rates and bottom temperatures which also coincided with the increase in stock size and the expansion northward from the Southeast Shoal area.

The analysis of yellowtail flounder movements on the Grand Bank using traditional Peterson disc tags and electronic archival data storage tags (DST) showed yellowtail are generally recaptured southward from their release site. All DST returned showed frequent off bottom movements which mainly occurred at night and during all months. Night-time movements often lasted for several hours with occasional descents back to the bottom. The data suggests that July, August and September were the most active months. The effect of this off bottom movement on availability of yellowtail flounder to survey gears is unknown. Further analysis of tagging data will continue.

iii) **Biological studies** (SCR Doc. 06/48)

Validation studies have shown that the current method used for ageing older yellowtail flounder is not accurate, and that re-ageing of some of the historical collection of research and commercial otoliths using thin-sectioned otoliths will be required. A study using re-aged otoliths from spring and autumn Canadian surveys of 1991 was carried out to determine minimum sample size needed for re-ageing. The analysis indicated that sample sizes of about 60% of the archived otoliths would be required for re-ageing, excluding fish less than 25 cm, which the study showed did not need to be re-aged. The results are similar to an earlier analysis of the 1998 survey data. The analysis also indicated that spring and autumn samples should not be combined. Re-aged samples from two years of the fishery data will also be examined in the same manner to determine sub-sampling ratios and whether the quarterly samples can be combined. STACFIS noted that this work is essential in order to enable development of an age-based model for the Div. 3LNO yellowtail flounder stock.

Maturity at size was estimated for each sex separately, using Canadian spring research vessel data from 1984-2005. L_{50} declined in males, by about 7 cm from around 30 cm in the mid-1980s to 23 cm in 1999 (Fig. 12.4). From 2001-2004 there has been a decrease in the L_{50} for males averaging 25 cm. Female L_{50} has been fairly stable until the last 3 years which have all been estimated at less than 32 cm, almost 1.5 cm below the long term average. In general for males, years prior to 1992 were significantly different from 2005. After this there are also years that are significantly different from the final year but there is no pattern. For females, all years are significantly different from 2005.

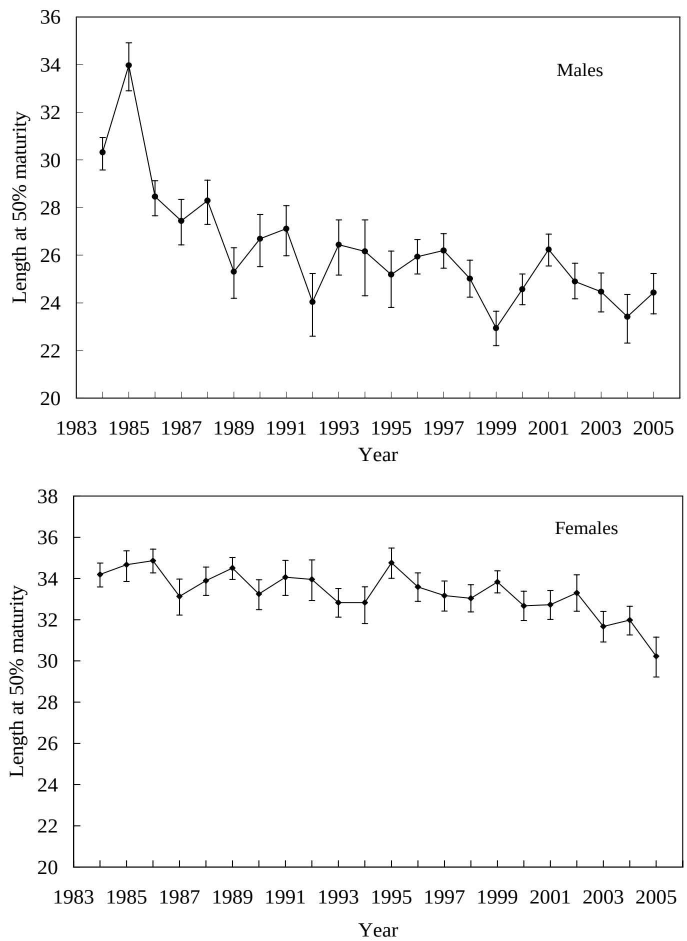


Fig. 12.4. Yellowtail flounder in Div. 3LNO: length at 50% maturity.

A length-based female SSB index was derived from the 1984-2005 Canadian spring survey data, annual maturity ogives and annual mean weights-at-length. Female SSB declined from 1984 to 1992 (Fig. 12.5), but since 1995 it has increased substantially. There was a large increase in the index in 1999 consistent with the large increase in the overall survey abundance index for that year. Estimates for 1999-2001, and 2003-2005 were fairly similar and much higher than previous years. In general, the female SSB index mirrors the trend in the total survey biomass index

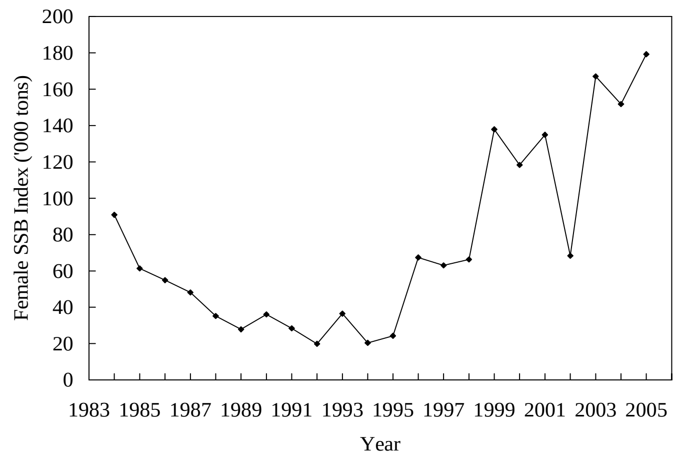


Fig. 12.5. Yellowtail flounder in Div. 3LNO: female spawning stock biomass index estimated from 1984 to 2005 annual spring surveys.

The cohort model for relative year-class strength was not updated in 2005 due to uncertainty in the age data. Analyses of length composition data indicated a correlation in the total number of juveniles (<22 cm) in the Canadian spring and autumn surveys from 1990-2003 which breaks down when 2004-2005 estimates were added. High catches of juveniles in the autumn of 2004 and 2005 were not evident in the spring series (Fig. 12.6). STACFIS noted that it is unable to draw any conclusions on recruitment in this stock in recent years with this dichotomy in the indices.

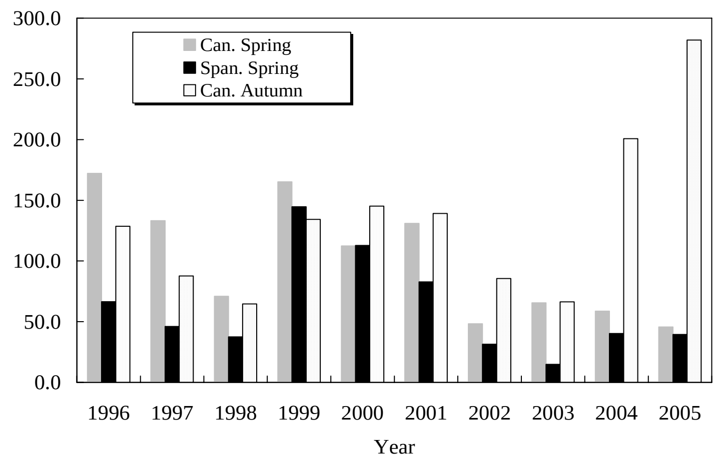


Fig. 12.6. Yellowtail flounder in Div. 3LNO: Juvenile length index estimated from 1996 to 2005 annual spring and autumn surveys by Canada (Can.) and annual spring surveys by EU-Spain (Span.).

c) **Estimation of Parameters** (SCR Doc. 06/48)

A non-equilibrium surplus production model (ASPIC) was used to assess the status of the resource as in previous assessments in 2002 and 2004. This model includes the catch data (1965-2005), Russian spring surveys (1972-91), Canadian spring surveys (1971-82), Canadian spring (1984-2005) and autumn (1990-2005) surveys and the Spanish spring (1995-2005) surveys. All surveys were given equal weight in the analysis. The standard model uses catches from 1965-2005 conditioned on the index of biomass from the 1984-2005 Canadian spring surveys. Catch projections assumed that the TAC of 15 000 tons will be taken in the 2006 fishery. Because of differences in catchability among the various indices, relative indices of biomass and fishing mortality rate were used instead of absolute values. As this stock was assessed with a production model, fishing mortality refers to catch/biomass ratio.

An alternate formulation of a surplus production model was presented with the Russian time series omitted due to poor model fit and a strong residual pattern in the data. Only the Russian and an earlier Canadian spring survey series covered the period 1971-1984 when the biomass trajectory indicates a steep decline. Omission of the Russian series could remove some valuable information about the stock trajectory for that earlier time period. STACFIS also noted that the independent analysis of the Canadian fishery CPUE series also showed that the CPUE declined drastically in the late 1960s to mid-1970s which was indicated by the standard model but not by the model formulation without the Russian series. Therefore STACFIS accepted the same standard formulation used in 2002 and 2004 assessments, updated with current data.

d) **Assessment Results**

The surplus production model results are consistent with the assessment in 2004, and indicate that stock size increased rapidly after the moratorium in the mid-1990s and has now begun to level off. Bias-corrected estimates from the model suggests that a maximum sustainable yield (MSY) of 17 460 tons can be produced by total stock biomass of 78 930 tons (B_{msy}) at a fishing mortality rate of 0.222 (F_{msy}). The analysis showed that relative population size (B_t/B_{msy}) was below 1.0 from 1973 to 1999. Biomass (B_t) has been estimated to be above B_{msy} since then, and the ratio is estimated to be 1.32 at the beginning of 2007 (Fig. 12.7).

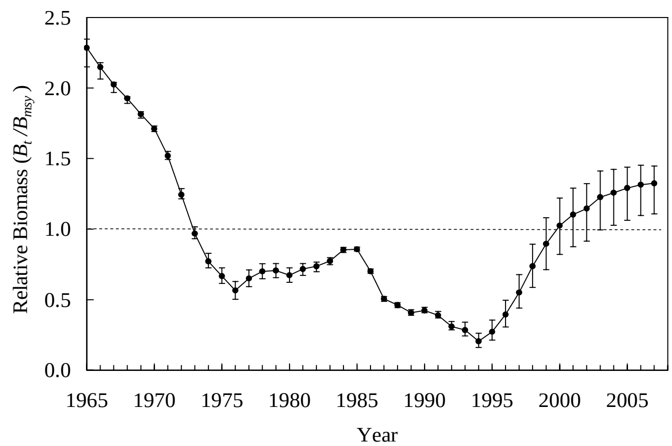


Fig. 12.7. Yellowtail flounder in Div. 3LNO: bias corrected relative biomass trends with approximate 80% confidence intervals.

Relative fishing mortality rate (F_t/F_{msy}) was above 1.0, in particular from the mid-1980s to early 1990s when the catches exceeded or doubled the recommended TACs (Fig. 12.8). After 1993, F_t has remained below F_{msy}. In 2006, F is projected to be 65% of F_{msy} if the TAC of 15 000 tons is caught.

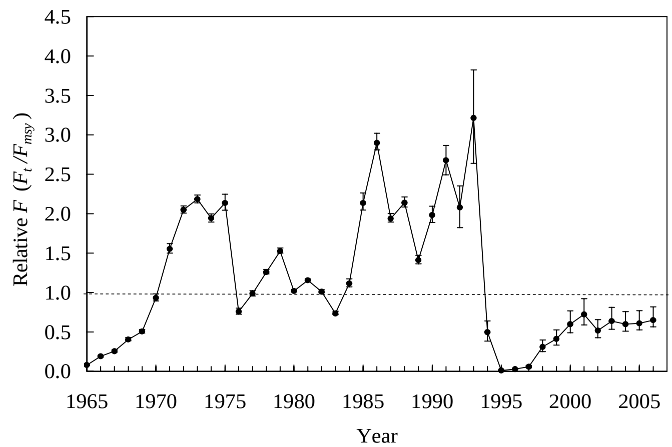


Fig. 12.8. Yellowtail flounder in Div. 3LNO: bias corrected relative fishing mortality trends with approximate 80% confidence intervals.

Since 1994, when the moratorium (1994-97) was put in place, the estimated catch has been below surplus production levels (Fig. 12.9).

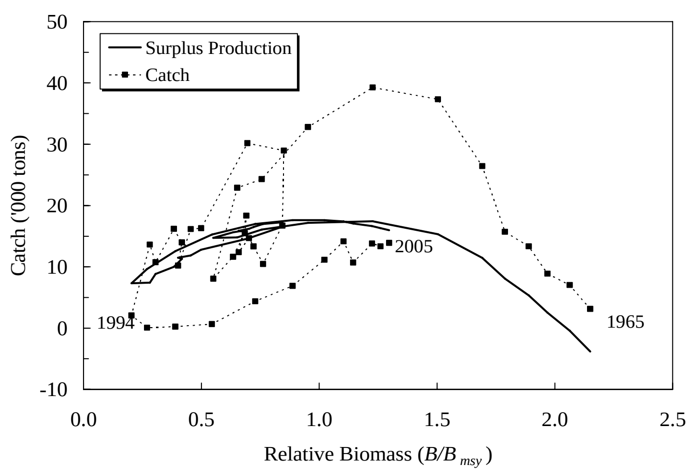


Fig. 12.9. Yellowtail flounder in Div. 3LNO: catch trajectory.

The model was bootstrapped to derive estimates of catch projections for 2007 and 2008 assuming a range of *F* multipliers. Percentiles of fishing mortality, catch and biomass for a series of *F* multipliers were estimated (Table 12.1). STACFIS noted that all analyses assumed that the catch in 2006 would equal the TAC of 15 000 tons. However, the TACs have not been taken in 2004 (92%) and 2005 (97%). Catch projections (in tons) at various levels of *F* are shown below.

Projected *F*	Catch in 2007	Catch in 2008
F_{2006}	15 101	15 177
2/3 F_{msy}	15 524	15 553
75% F_{msy}	17 339	17 135
85% F_{msy}	19 396	18 859
F_{msy}	22 469	21 308

TABLE 12.1. Management options for 2007-2008. F multipliers are applied to F_{2006}. The F multiplier is estimated by dividing F/F_{msy} (0.65 for 2006) into the $\%F_{msy}$.

	F multiplier	2007 F percentiles 5	25	50	75	95
Status quo	1.00	0.128	0.137	0.142	0.147	0.162
2/3 Fmsy	1.03	0.132	0.141	0.146	0.152	0.167
75% Fmsy	1.16	0.149	0.159	0.164	0.171	0.188
85% Fmsy	1.31	0.168	0.180	0.1856	0.193	0.212
Fmsy	1.54	0.197	0.211	0.218	0.227	0.249

F multiplier	2008 F percentiles 5	25	50	75	95
1.00	0.128	0.137	0.142	0.147	0.162
1.03	0.132	0.141	0.146	0.152	0.167
1.16	0.149	0.159	0.164	0.171	0.188
1.31	0.168	0.180	0.186	0.193	0.212
1.54	0.197	0.211	0.218	0.227	0.249

	F multiplier	2007 Catch percentiles 5	25	50	75	95
Status quo	1.00	14.935	15.018	15.101	15.189	15.330
2/3 Fmsy	1.03	15.355	15.440	15.524	15.614	15.755
75% Fmsy	1.16	17.156	17.247	17.339	17.432	17.569
85% Fmsy	1.31	19.203	19.297	19.396	19.494	19.628
Fmsy	1.54	22.255	22.366	22.469	22.565	22.704

F multiplier	2008 Catch percentiles 5	25	50	75	95
1.00	14.891	15.031	15.177	15.339	15.590
1.03	15.265	15.407	15.553	15.716	15.962
1.16	16.842	16.988	17.135	17.290	17.515
1.31	18.573	18.715	18.859	19.005	19.215
1.54	21.040	21.185	21.308	21.414	21.704

	F multiplier	2008 Biomass/Bmsy percentiles 5	25	50	75	95
Status quo	1.00	1.091	1.263	1.347	1.413	1.467
2/3 Fmsy	1.03	1.087	1.259	1.342	1.408	1.462
75% Fmsy	1.16	1.068	1.239	1.322	1.387	1.440
85% Fmsy	1.31	1.046	1.216	1.298	1.363	1.415
Fmsy	1.54	1.014	1.182	1.263	1.326	1.378

F multiplier	2009 Biomass/Bmsy percentiles 5	25	50	75	95
1.00	1.109	1.276	1.354	1.416	1.463
1.03	1.101	1.267	1.345	1.407	1.455
1.16	1.065	1.230	1.308	1.371	1.419
1.31	1.024	1.189	1.267	1.329	1.378
1.54	0.965	1.128	1.207	1.267	1.317

Management option table for 2007 and 2008.

The percentiles of catch in 2007-8 and biomass ratio are based on F in 2007-8 calculated as the product of the F multiplier and F in 2006. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 000 tons in 2006.

Medium-term projections were carried out by extending the ASPIC bootstrap projections forward to the year 2016 under an assumption of constant fishing mortality at 2/3 F_{msy}, 0.75 F_{msy} and 0.85 F_{msy} (Fig. 12.10). The projections are conditional on the estimated values of r, the intrinsic rate of population growth and K, the carrying capacity. STACFIS noted that all analyses assumed that the catch in 2006 would equal the TAC of 15 000 tons. However, the TACs have not been taken in 2004 (92%) and 2005 (93%). At 2/3 F_{msy}, catch and stock size continue to increase slightly (Table 12.2), and the probability that biomass in 2007 is below B_{msy} is about 3%, declining to 2% in 2010 and remaining stable at that level. Catch and biomass both decrease slightly in the projections at 0.75 and 0.85 F_{msy} (Tables 12.3 and 12.4). At 0.75 F_{msy}, the probability of biomass being below B_{msy} is stable around 3% throughout the projection years. At 0.85 F_{msy}, the probability that biomass is below B_{msy} increases from 3% in 2005 to above 7% from 2011 onward (Fig. 12.11). Also, at 0.85 F_{msy}, the 95th percentile of the bootstrapped F is close to F_{msy}.

TABLE 12.2. Medium-term projections for yellowtail flounder. The 5, 25, 50, 75 and 95th percentiles of fishing mortality, biomass, yield and biomass/B_{msy}, are shown, for projected F of 2/3 F_{msy}. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 000 tons (TAC) in 2006.

F	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132	0.132
25	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141
50	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146	0.146
75	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152
95	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167
Fmsy	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
2/3Fmsy	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145

B	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	93.73	94.92	96.01	96.85	97.49	97.99	98.37	98.66	98.91	99.15
25	102.44	103.10	103.22	103.47	103.60	103.77	103.83	103.81	103.91	104.01
50	106.11	106.13	106.22	106.27	106.37	106.43	106.46	106.49	106.48	106.48
75	109.46	109.41	109.29	109.26	109.33	109.28	109.24	109.28	109.26	109.27
95	115.84	117.18	117.29	117.47	117.56	118.13	118.66	118.89	119.04	119.15

Y	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	15.36	15.26	15.20	15.16	15.13	15.11	15.10	15.09	15.08	15.08
25	15.44	15.41	15.38	15.37	15.36	15.35	15.34	15.34	15.33	15.33
50	15.52	15.55	15.57	15.59	15.60	15.61	15.62	15.63	15.63	15.63
75	15.61	15.72	15.79	15.85	15.90	15.93	15.96	15.98	15.99	16.01
95	15.75	15.96	16.12	16.26	16.37	16.46	16.53	16.59	16.64	16.67

Br	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	1.08	1.09	1.10	1.11	1.11	1.12	1.12	1.12	1.13	1.13
25	1.25	1.26	1.27	1.27	1.28	1.28	1.28	1.28	1.28	1.29
50	1.34	1.34	1.34	1.35	1.35	1.35	1.35	1.35	1.35	1.35
75	1.41	1.41	1.41	1.41	1.40	1.40	1.40	1.40	1.40	1.40
95	1.47	1.46	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.44

TABLE 12.3. Medium-term projections for yellowtail flounder. The 5, 25, 50, 75 and 95th percentiles of fishing mortality, biomass, yield, and biomass/B_{msy}, are shown, for projected F of 0.75 F_{msy}. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 000 tons (TAC) in 2006.

F	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149	0.149
25	0.159	0.159	0.159	0.159	0.159	0.159	0.159	0.159	0.159	0.159
50	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164
75	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171
95	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
Fmsy	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
75%Fmsy	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167	0.167

B	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	93.73	93.17	92.91	92.60	92.43	92.32	92.14	91.98	91.85	91.74
25	102.44	101.45	100.40	99.67	99.14	98.76	98.48	98.29	98.13	98.03
50	106.11	104.44	103.33	102.47	101.90	101.45	101.14	100.89	100.71	100.59
75	109.46	107.73	106.35	105.44	104.86	104.35	103.94	103.62	103.35	103.19
95	115.84	117.18	117.29	115.77	114.57	114.04	113.64	113.40	113.12	112.96

Y	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	17.16	16.84	16.63	16.48	16.37	16.30	16.24	16.20	16.16	16.14
25	17.25	16.99	16.80	16.67	16.57	16.50	16.45	16.41	16.38	16.35
50	17.34	17.14	16.98	16.87	16.79	16.73	16.68	16.64	16.62	16.60
75	17.43	17.29	17.19	17.10	17.04	16.99	16.95	16.92	16.90	16.89
95	17.57	17.51	17.47	17.44	17.41	17.39	17.38	17.37	17.37	17.36

Br	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	1.08	1.07	1.07	1.06	1.05	1.05	1.04	1.04	1.04	1.04
25	1.25	1.24	1.23	1.22	1.22	1.22	1.21	1.21	1.21	1.20
50	1.34	1.32	1.31	1.30	1.29	1.29	1.28	1.28	1.28	1.28
75	1.41	1.39	1.37	1.36	1.35	1.34	1.34	1.33	1.33	1.33
95	1.47	1.44	1.42	1.41	1.40	1.39	1.38	1.38	1.38	1.38

TABLE 12.4. Medium-term projections for yellowtail flounder. The 5, 25, 50, 75 and 95th percentiles of fishing mortality, biomass, yield and biomass/B_{msy}, are shown, for projected F of 0.85 F_{msy}. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 000 tons (TAC) in 2006.

F	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168	0.168
25	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180	0.180
50	0.186	0.186	0.186	0.186	0.186	0.186	0.186	0.186	0.186	0.186
75	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193
95	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212	0.212
Fmsy	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
85%Fmsy	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189

B	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	93.73	91.19	89.43	87.87	86.81	85.76	84.92	84.23	83.71	83.21
25	102.44	99.50	97.26	95.58	94.38	93.48	92.81	92.25	91.77	91.43
50	106.11	102.55	100.05	98.20	96.89	95.91	95.19	94.65	94.25	93.92
75	109.46	105.81	103.17	101.16	99.75	98.71	97.93	97.31	96.85	96.54
95	115.84	117.18	117.29	113.83	111.24	109.66	108.48	107.12	105.91	105.10

Y	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	19.20	18.57	18.14	17.84	17.61	17.45	17.31	17.19	17.11	17.03
25	19.30	18.72	18.31	18.01	17.78	17.61	17.48	17.39	17.32	17.26
50	19.40	18.86	18.46	18.17	17.95	17.78	17.65	17.56	17.48	17.43
75	19.49	19.01	18.63	18.36	18.13	17.97	17.84	17.74	17.67	17.62
95	19.63	19.21	18.91	18.69	18.51	18.36	18.25	18.16	18.09	18.04

Br	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
5	1.08	1.05	1.02	1.00	0.99	0.97	0.96	0.95	0.94	0.94
25	1.25	1.22	1.19	1.17	1.15	1.14	1.14	1.13	1.12	1.11
50	1.34	1.30	1.27	1.24	1.23	1.21	1.21	1.20	1.19	1.19
75	1.41	1.36	1.33	1.30	1.29	1.28	1.27	1.26	1.25	1.25
95	1.47	1.42	1.38	1.35	1.33	1.32	1.31	1.31	1.30	1.30

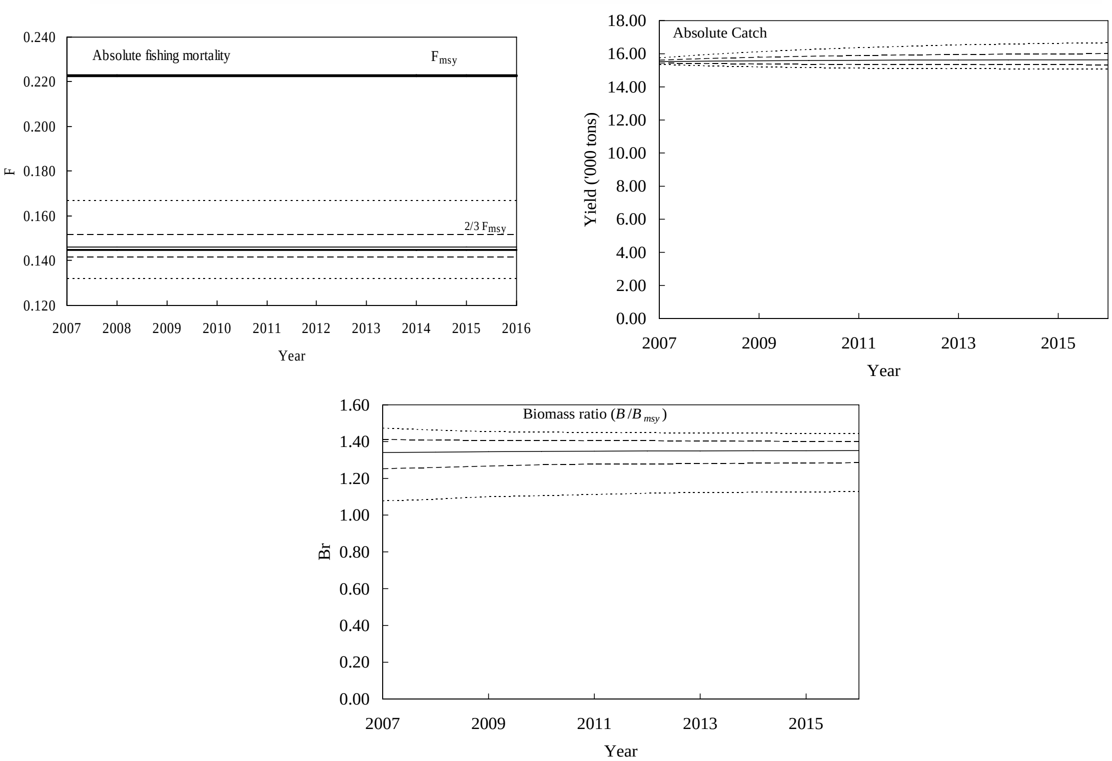


Fig. 12.10. Yellowtail flounder in Div. 3LNO: medium-term projections at a constant fishing mortality of 2/3 F_{msy}. The figures show the 5th, 25th, 50th, 75th and 95th percentiles of fishing mortality, catch, and biomass/B_{msy}. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 000 tons (TAC) in 2006.

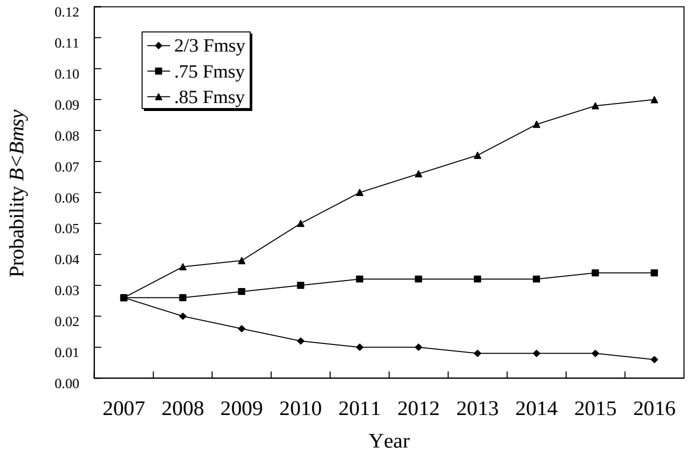


Fig. 12.11. Yellowtail flounder in Div. 3LNO: The probability of biomass being less than B_{msy} for medium term projections at fishing mortalities of 2/3 F_{msy}, 75% F_{msy} and 85% F_{msy}. The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 000 tons in 2006.

e) **Reference Points**

Precautionary approach. The stock production model outputs in the current assessment are similar to those reported in the 2004 assessment. The results indicate that the stock is presently above B_{msy} and below F_{msy}. The data were input into the precautionary framework (Fig. 12.12). At the NAFO SC Study Group meeting in Lorient in 2004 (SCS Doc. 04/12), it was recommended that 30% B_{msy} be considered as a limit reference point (B_{lim}) for stocks where a production model is used. This reference point is indicated, along with F_{lim} (F_{msy}), in Fig. 12.13. Also indicated are B_{msy} and 2/3 F_{msy}. The current assessment results indicate that the stock was below B_{lim} from 1993 to 1995, then increased rapidly during and after the moratorium, exceeding B_{msy} from 2000 onward. At present, the risk of the stock being below B_{lim} = 30% B_{msy} has not been expressed. However, the estimated probability of the current (beginning of 2007) stock size being below B_{msy} is so small (less than 3%), that the probability of being below B_{lim} is negligible.

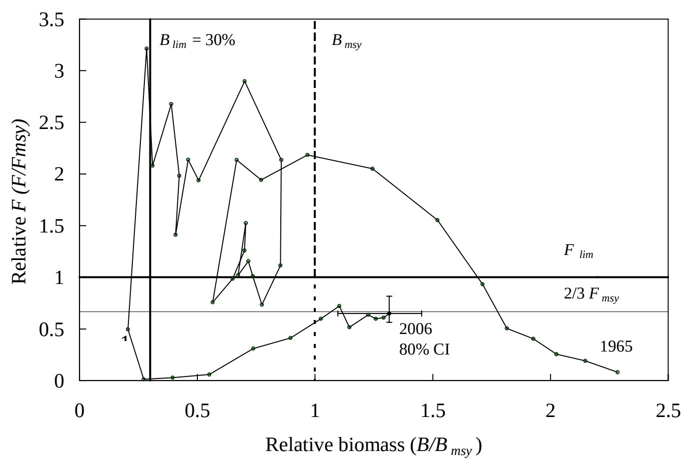


Fig. 12.12. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in the surplus production analysis, under a precautionary approach framework.

f) **Research Recommendations**

STACFIS noted that the cohort model for relative year-class strength was not updated in 2006 due to uncertainty in the modeling the age data and **recommended** that *further exploration of the cohort model continue and results will be presented in 2007.*

STACFIS noted that alternate formulations of the surplus production model (ASPIC) using various combination of the indices can change with the addition of new data from fishery catches and survey time series, accordingly, STACFIS **recommended** that *further exploration of the ASPIC surplus production model, including sensitivity analysis on various input indices, be presented in 2007.*

STACFIS noted that at present, the risk of the stock being below B_{lim} = 30% B_{msy} has not been explored. However, the estimated probability of the current (beginning of 2007) stock size being below B_{msy} is so small (less than 3%), that the probability of being below B_{lim} is negligible. STACFIS **recommended** *that in future assessments of Div. 3LNO yellowtail founder, the risk of the stock being below B_{lim} = 30% B_{msy} be expressed.*

13. **Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 3N and 3O** (SCR Doc. 06/37; SCS Doc. 06/6, 7, 9)

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 bycatch 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:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.5	0.6	0.9	0.7[1]	0.5[1]	0.7[1]	0.9[1]	0.6[1]	0.3[1]	
STACFIS	0.5	0.6	0.8	0.5	0.7	0.4	0.85-2.24[2]	0.6	0.3	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishery.

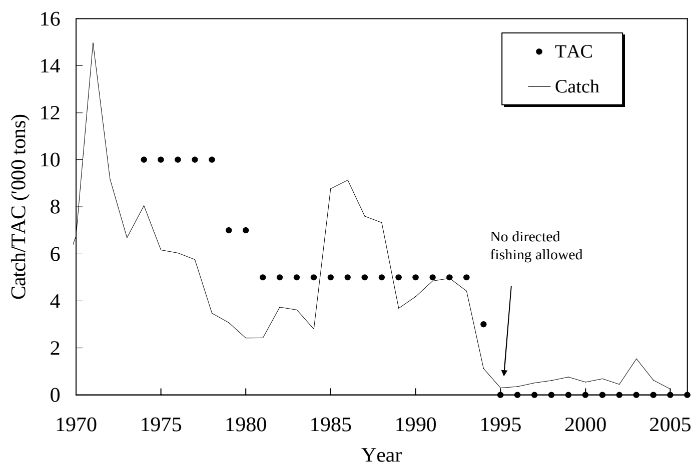


Fig. 13.1. Witch flounder in Div. 3N and 3O: catches and TAC.

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 bycatch 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 and 2005 catches were estimated to be around 630 tons and 260 tons, respectively.

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 then increased to 0.75 kg per tow in 2005. 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, but mean weight per tow has increased in 2005 to 1.25 kg per tow, although with wide confidence intervals. 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 increased slightly in 2003 (6 kg per tow) and then decreased to 2 kg per tow in 2005. Although the combined index in Div. 3NO spring surveys (Fig. 13.2) appeared higher in 2003 than in recent years, it was driven by one large set. The mean weight per tow estimate in 2004 was 3.2 kg per tow with wide confidence limits. In 2005 the index decreased to 1.4 kg per tow.

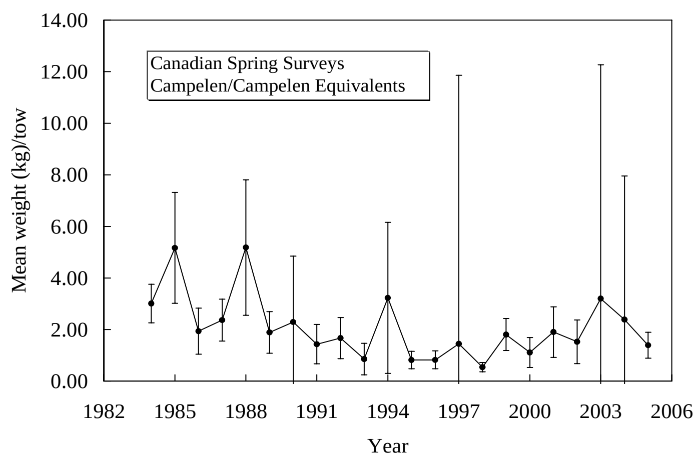


Fig. 13.2. Witch flounder in Div. 3NO: mean weights (kg) per tow from Canadian spring surveys (95% confidence limits are given. Note that the full range of confidence limit is not displayed where it extends below zero).

Length Frequency data: The frequencies taken in the Canadian surveys ranged from 8-65 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, or 2003-2005 surveys. Sampling of witch bycatch from the EU-Spain Greenland halibut fishery in 3NO did not show the smaller sizes (range was 18-60 cm) that may indicate recruitment, but modal length at 38 cm was comparable to the Canadian surveys.

c) **Assessment Results**

In response to a research recommendation in the 2004 assessment of this stock, exploratory investigations using ASPIC to model the catch and biomass indices for this stock were attempted. Results of these investigations indicated poor model fit, and are not appropriate to describe the dynamics of this stock.

Based on the most recent survey data, STACFIS considers that the overall stock remains at a low level and the 2005 value is within the lowest quartile of estimates in the series.

d) **Future Studies**

STACFIS **recommended** that *work should continue in developing precautionary reference points, including* B_{lim}*, for this stock.*

14. Capelin (*Mallotus villosus*) in Divisions 3N and 3O (SCR Doc. 06/6)

Interim Monitoring Report

a) **Introduction**

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 fishing was closed in 1979-1986 and then reopened in 1987-1992. Annual catches in this period did not exceed 25 000 tons. In subsequent years due to abrupt decline of the stock size, the target fishery for capelin was banned. Highest historical catches were taken by Russia (former USSR), Norway, Iceland and Japan. TAC of capelin was set for the first time in 1974 and in 1977-1978 it reached 200 000 tons, then TAC was reduced to 30 000 tons in 1990-1992. Considering that the catch did not exceed TAC in the whole regulation period, the decline of stock size observed since early 1990s could hardly be caused by overexploitation of the stock. A similar idea about capelin stock in NAFO Subarea 2 and Div. 3KL was expressed by J. Carscadden (DFO, 2000). Because of dramatic decline of the capelin stock size since 1993, the ban on target fishery for capelin was imposed as a regulation measure.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	na	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.
na No advice possible.

b) **Data Overview**

i) **Research survey data**

Acoustic surveys of capelin stock in Div. 3NO were conducted by the USSR/Russia in 1975-1994 and Canada in 1981-1992. Now, it is difficult to compare the results of these surveys since some Russian assessments were merged for Div. 3LNO. In recent years, STACFIS several times has advised to conduct investigations of capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this advice was not followed. The average catch per km^2 in 2004, 2005 years was 0.42 and 0.06 thousand accordingly and the average since 1996 has been 0.35 thousand tons (Fig. 14.1).

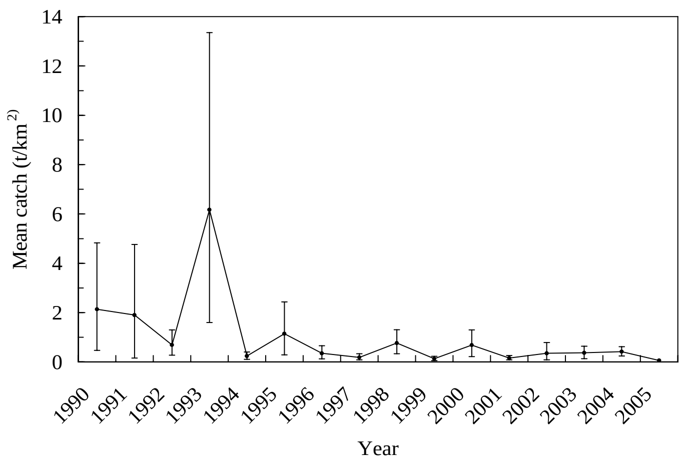


Fig. 14.1. Capelin (*Mallotus villosus*) in Div. 3N and 3O: average catch (t/km^2) according to the data of Canadian spring surveys in Div. 3NO.

c) **Research Recommendation**

STACFIS reiterates its **recommendation** that *initial investigations to evaluate the status of capelin in Div. 3NO utilizing trawl acoustic surveys to allow comparison with the historical time series.*

d) **Conclusion**

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

15. **Redfish *(Sebastes mentella* and *Sebastes fasciatus*) in Division 3O** (SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

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. Total catch of redfish in 3O was estimated to be 11 300 tons in 2005.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC[1]	10	10	10	10	10	10	10	10	20	20
TAC	10	10	10	10	10	10	10	10	20	20
STATLANT 21A	5	13.3	12.6	12.8[2]	22[2]	19.4[2]	21.5[2]	6.4[2]	6.9[2]	
STACFIS	5	14	12.6	10	20.3	17.2	17.2	3.8	11.3	

[1] 1997-2004 only applied within Canadian fishery jurisdiction.
[2] Provisional.

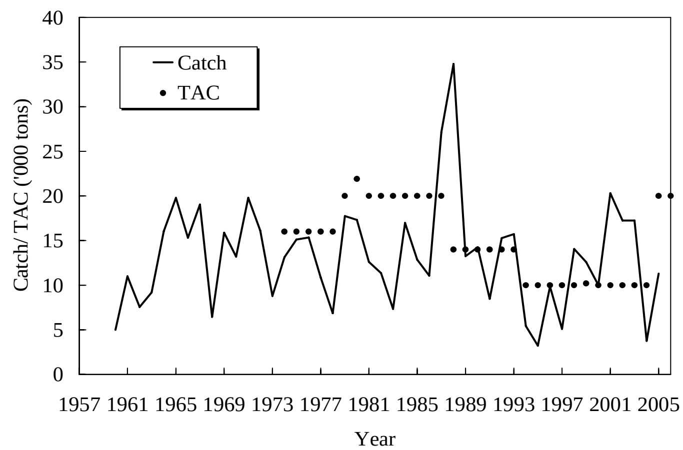


Fig. 15.1. Redfish in Div. 3O: catches and TACs.

b) **Data Overview**

Surveys

Canadian spring and autumn surveys were conducted in Div. 3O during 2005. The 2005 survey mean weight (kg) per tow estimates declined from the previous year in the spring survey and increased in the autumn survey, but they did not alter the perception of the stock status by STACFIS (Fig. 15.2).

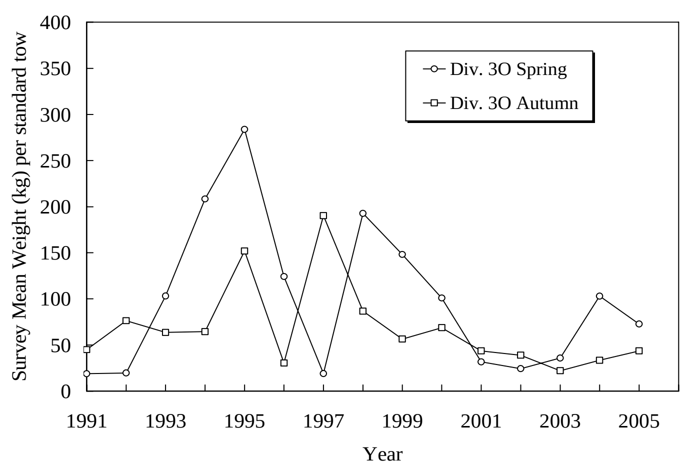


Fig. 15.2. Redfish in Div. 3O: Mean weight (kg) per tow from Canadian surveys in Div. 3O (Campelen/Campelen equivalents).

c) **Conclusion**

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

d) **Research Recommendation**

STACFIS noted estimates of size at maturity from various recent studies were 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, 3O and 3Ps** (SCR Doc. 02/118, 04/58, 06/44, 14; SCS Doc. 86/13, 87/13, 88/14, 89/16, 90/13, 91/16, 92/13, 03/57, 04/3, 5, 9, 12, 24, 06/7, 9)

a) **Introduction**

Stock Structure

Thorny skate on the Grand Banks were first assessed in Canada by Atkinson (1995) for the stock unit 3LNOPs. Subsequent Canadian assessments in 1996, 1998, and 2003 also provided advice for 3LNOPs. This area, which includes Subdiv. 3Ps was chosen as the stock unit based largely on work by Templeman (1982, 1984a, 1984b, 1987a and 1987b) who showed that a number of characteristics of thorny skate in Div. 3L, 3N, 3O and Subdiv. 3Ps were very similar but that these characteristics were different in adjacent areas. These studies were reexamined by STACFIS in the context of stock structure of thorny skate and the findings are as follows.

Templeman indicated that size at sexual maturity and observed maximum length of thorny skate is consistent within Div. 3L, 3N, 3O and Subdiv. 3Ps (L_{50} about 70 cm) but is smaller (L_{50} about 47 cm) for skates off Iceland to the Northeast Newfoundland Shelf and in the Gulf of St. Lawrence (Div. 4RST). He found that secondary sexual characteristics: volume of the largest egg in the ovaries, egg capsule morphometrics (albumen volume, etc.) weight of the shell gland and ratio of clasper length to total length are very similar among the Divisions of 3LNOPs but significantly smaller in Div. 2J+3K, areas north and in Div. 4RST. Progression toward a smoother, less thorny dorsal surface occurred at smaller sizes of skates in Div. 2J+3K and 4RS compared to 3LNOPs and numbers of rows of alar spines, median dorsal spines and slope of the length-weight relationship were similar in 3LNOPs but significantly lower in Div. 2J+3K, areas north and in Div. 4RST. An examination of 2003-2004 length-weight data also shows that the relationship is almost identical in Div. 3LNO compared to Subdiv. 3Ps.

STACFIS also reviewed information on distribution from SCR Doc. 04/58 and 03/57. Survey indices in Div. 3O and Subdiv. 3Ps show similar trajectories. It was also noted that the major concentration of thorny skate straddles the Div. 3O/Subdiv. 3Ps line and that this pattern was consistent among stages of skates and across years and seasons. Those papers further noted that recruitment was greatest in Div. 3L in the early 1980s but has now shifted to Subdiv. 3Ps. Finally, Templeman's tagging results indicated that about 12 recaptures out of 102 had crossed the Div. 3PO line, in both directions indicating a degree of mixing between areas. Thus, distribution dynamics presented in those papers and the earlier studies on biological characteristics suggest a single stock within 3LNOPs. This report treats thorny skate within 3LNOPs as the stock unit. Presently, Subdiv. 3Ps is managed as a unit by Canada and Div. 3LNO is managed by NAFO.

Catch History

Commercial catches of skates comprise a mixture of skate species. However, thorny skate dominates, comprising about 95% of the skate species 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.

Prior to the mid-1980s, this species was commonly taken as a bycatch in other fisheries. Skate continue to be taken as a bycatch, mainly in the Greenland halibut fishery and the Canadian mixed fishery for thorny skate, white hake and monkfish in Div. 3NOPs in the Canadian zone.

Nominal catches increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this new fishery were EU-Spain, Canada, Russia and EU-Portugal. Canada fished for thorny skate in the western part of Div. 3O and in Subdiv. 3Ps while the remainder of the countries fished primarily in Div. 3N and to a lesser extent in Div. 3O in the NRA.

Catches in Div. 3LNOPs peaked at about 36 000 tons in 1991 (STATLANT 21A). From 1985 to 1991, catches averaged 25 000 tons but were lower during 1992-1995 (9 600 tons). There are substantial uncertainties in the catch levels prior to 1996. Catch levels after 1995 as estimated by STACFIS, including discards averaged about 11 700 tons (Fig. 16.1). There is a TAC of 13 500 tons for thorny skate within Div. 3LNO for 2005-07 and 1 050 tons in Subdiv. 3Ps (Canada).

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Div. 3LNO										
Recommended TAC									11	11
TAC									13.5[1]	13.5[1]
STATLANT 21A[2]	12.1	9.5	11.9	18.3	14.9	11.8	14.3	11.5	3.3	
STACFIS (incl. discards)	12.7	9.0	9.8	14.1	11.2	10.6	14.3	9.7	4.7	
Subdiv. 3Ps										
TAC[3]									1.05	1.05
STATLANT 21A[2]	0.8	1.3	1.1	1.0	1.8	1.7	1.8	1.1	0.7	
STACFIS (incl. discards)	1.5	1.5	1.3	1.1	2.0	1.6	2.0	1.2	0.9	
3LNOPs										
STATLANT 21A[2]	12.9	10.8	13.1	19.2	16.7	13.4	16.0	12.9	4.0	
STACFIS (incl. discards)	14.2	10.5	11.1	15.1	13.2	12.1	16.3	10.9	5.6	

1 TAC for 3LNO is for 2005-2007.
2 STATLANT 21A are provisional for 2000-2005.
3 TAC in Subdiv. 3Ps set by Canada

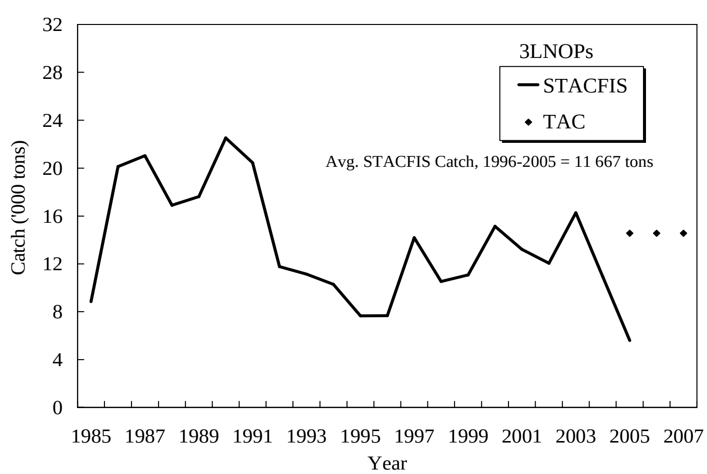


Fig. 16.1. Thorny skate in Div. 3LNO and Subdiv. 3Ps: catches, 1985-2005 and TAC for Div. 3LNO plus Subdiv. 3Ps. The STACFIS estimates include discards.

b) **Input Data**

i) **Commercial fishery data**

Thorny skate are currently not aged in either commercial or survey catches.

Length frequencies were available for EU-Spain (1985-1991 and 1997-2005), EU-Portugal (2002-2004), Canada (1994-2005) and Russia (1998-2005) (Table 1). Maturity ogives used to estimate proportion of mature fish were derived from SCR Doc. 02/118.

TABLE 1. Information on the sizes and proportion of percent mature fish in the various skate fisheries.

Country	NAFO Div.	Year	Size Range (cm)	Percent Mature	Codend Mesh Size
Canada	3O	1995-2005	18-107		305
Portugal	3NO	2002	18-61	1	
	3O	2003	22-57	4	280
	3NO	2004	20-51	1	280
Spain	3NO	1997	13-91	34	
		1999	28-91	42	
		2000	25-91	46	220
		2001	25-91	49	220
		2002	30-96	53	280
		2004	28-95	69	280
		2005	23-90	65	280
Russia	3NO	2000	20-72	4	
		2001	27-90	50	280
		2002	30-102		280
		2003	24-96	62	280
		2004	15-96	69	280
	3N	2005	27-87	77	280

Size of thorny skate in the Canadian commercial catches varied considerably among gear types. Over all years examined, gillnet and longline fisheries caught a similar size range of skates, 50-100 cm TL; averaging 74 cm in a single mode. Trawls captured a wider range of skates, 28-98 cm with approximately 25% less than 55 cm. There was, in Subdiv. 3Ps, a smaller mode at 59 cm not observed in Div. 3O. Annual commercial length frequencies indicates that, where data were available, average length of commercial skates was similar over all years for each of the gear types. On average, Canadian trawls caught larger skates (approximately 25% were smaller than 55 cm consisting of immature fish) than in the 1996-2005 Spanish trawl fishery. Skate sizes in those years in EU-Spain commercial catches were between 30-85 cm TL (mode at 50 cm), and consisted of approximately 55% immature skates. Skate sizes in the 1985-1991 EU-Spain fishery, which included discards, comprised about 20% by number of 12-30 cm fish, corresponding to young of the year (YOY). Skate sizes in Russian catches ranged from 25-92 cm TL, with the majority between 32-60 cm (similar to EU-Spain skate sizes) and EU-Portugal sizes were 18-61 cm.

No standardized commercial CPUE exists for thorny skate.

ii) **Research survey data**

Canadian spring surveys. Stratified-random research surveys have been conducted in spring 1974-2005 by Canada in Div. 3L, 3N, and Subdiv. 3Ps in Div. 3O using the Yankee 41 trawl from 1972-1983, the Engel bottom trawl from 1984 to 1995 and employing the Campelen 1800 shrimp trawl since. Maximum depth surveyed was 366 m before 1991 and about 750 m since.

An index from 1972-1983 (Yankee 41 otter trawl series) fluctuated without trend (Fig. 16.2a).

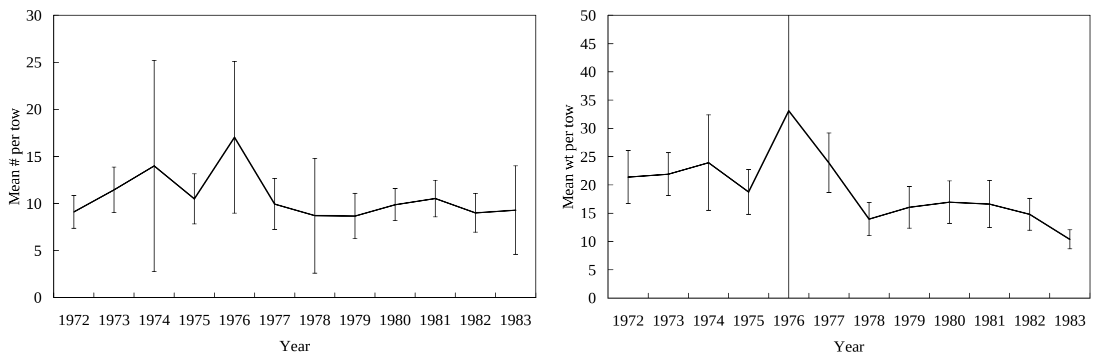


Fig. 16.2a. Thorny skate in Div. 3LNOPs: estimates of Yankee 41 otter trawl mean number and mean weight (kg) per tow from Canadian spring surveys.

In 2005, STACFIS recommended adoption of the results of a multiplicative model for conversion of thorny skate Engel trawl data (1984 to 1995) to derive a standardized time series for thorny skate (SCR Doc. 05/49). Standardized mean number and weight per tow are presented in Fig. 16.2b for 3LNOPs. The indices of thorny skate declined rapidly from the mid-1980s until the early 1990s. Since 1996, the indices have increased slightly and over the past 5 years have been stable at about 40% of the level observed in the mid-1980s (Fig. 16.2b).

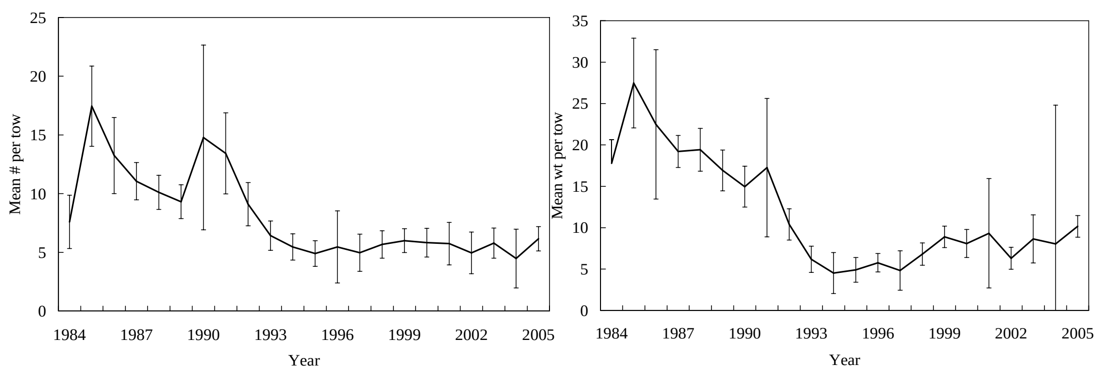


Fig. 16.2b. Thorny skate in Div. 3LNOPs: estimates of Campelen equivalent mean number and mean weight (kg) per tow from Canadian spring surveys.

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 about 1 450 m.

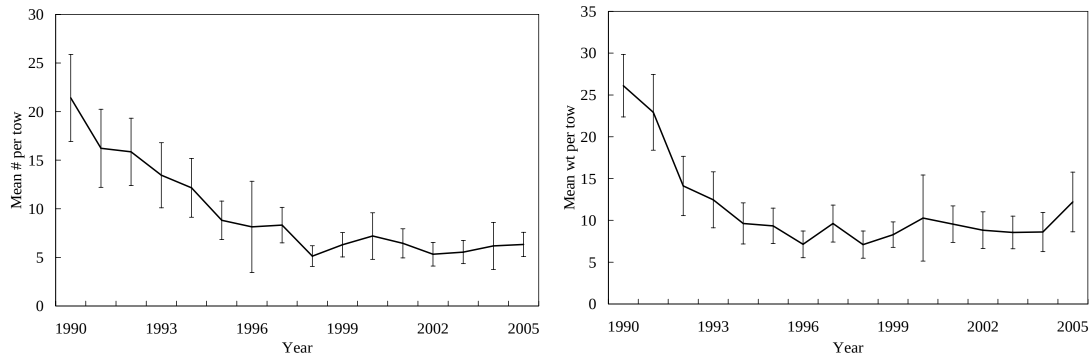


Fig. 16.2c Thorny skate in Div. 3LNO: estimates of Campelen equivalent mean number and mean weight (kg) per tow from Canadian autumn surveys.

Autumn indices, similar to the spring estimates, declined rapidly during the early 1990s. The autumn indices are 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 (about 750 m) and are more deeply distributed during the winter/spring.

Different stages of thorny skate by sex underwent similar changes in abundance over time. The indices for each stage was stable during the 1970s to early 1980s then declined rapidly in 1990-1995. All three stages have been stable at a low level since the mid-1990s. During the period of decline in the stock (late 1980s to mid-1990s) the proportion of mature fish in the population declined while the immature component increased. This trend has reversed after the mid-1990s. While proportion of abundance was changing, proportion of biomass of each stage remained relatively stable over the entire period.

Previous studies (*NAFO Sci. Coun. Rep*., 2003) indicated that on average 26.4% and 22.5% of the survey biomass of thorny skate was found in the NRA in autumn and spring, respectively, mainly in Div. 3N.

Spanish surveys. Spanish survey biomass indices in Div. 3NO were available for the period 1997-2005. The Spanish survey was conducted in the NRA portion of Div. 3NO while the Canadian survey covered the entire extent of Div. 3NO. The biomass trajectory from the Spanish survey was very similar to that of the Canadian spring survey (Fig. 16.3).

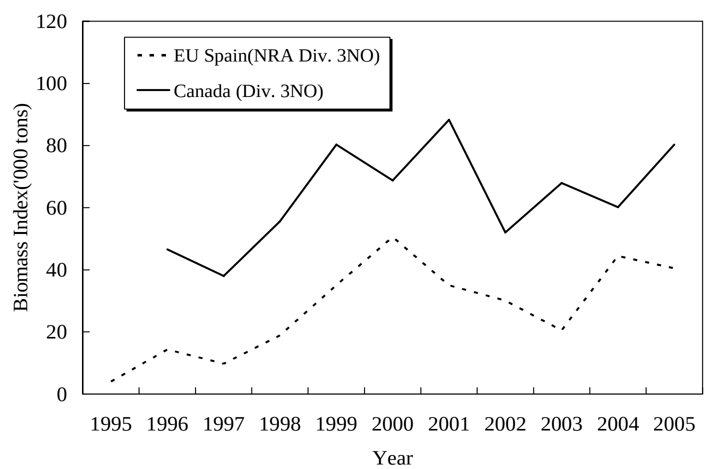


Fig. 16.3. Thorny skate in Div. 3NO: estimates of biomass from Spanish surveys compared to Canadian spring surveys.

iii) **Biological studies**

The ratio of male to female thorny skate has been relatively consistent, with some fluctuations over time for YOY, juvenile and mature adults. The YOY averaged close to 1:1 males to females. Ratio of immature males to females was about 0.75 and SSB averaged 1.5. There are proportionately fewer immature males in the sampled population than mature males and YOY males which potentially suggests changes in the catchability due to differential migration in and out of the sampled area.

Variation in number of recruit per spawner was relatively low and in most years was between 0.5 and 2.0. Values were highest during the period of the decline of the stock. This is due to the greater decline in adult females compared to the YOY. Average over the entire period was 1.4.

In recent years, thorny skate have a length at 50% maturity of about 50 cm, low fecundity and long reproductive cycles. These characteristics result in low intrinsic rates of increase and may result in low resilience to fishing mortality. Investigations relating to these life history characteristics are under way.

A mode of about 12-24 cm fish corresponding to YOY was used as an estimate of recruitment in each year. Maturity ogives and length weight relationships were applied to the female length frequencies to produce estimates of relative SSB. Lowest three years of the female SSB in the series was 14 900 tons, highest three years was 74 400 tons and the last three years was 28 500 tons.

SSB were compared to the estimates of YOY (Fig. 16.4). Lines on Fig. 16.4 relate to the average level of relative YOY and relative SSB in the series.

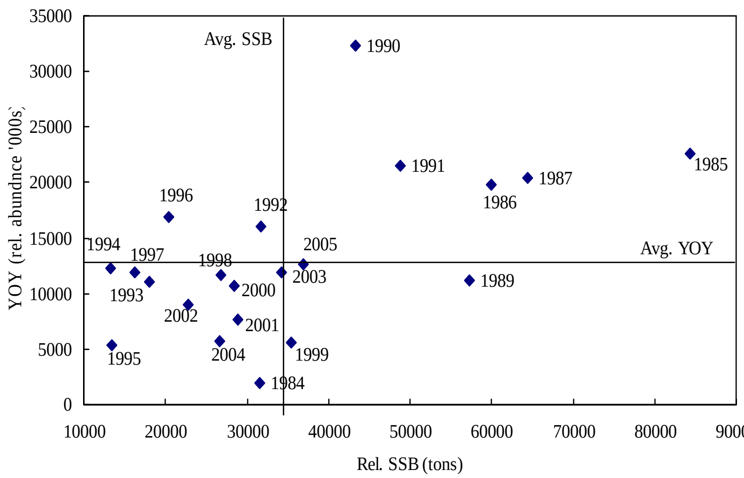


Fig. 16.4. Thorny skate in Div. 3NO: relationship between relative female spawning stock biomass and relative young of the year (YOY) abundance. Lines illustrate average relative YOY and average relative SSB.

c) **Estimation of Stock Parameters**

i) **Non-Equilibrium Surplus Production Model (ASPIC)**

A non-equilibrium surplus production model (ASPIC) was used to assess the status of the resource. The model utilized catches from 1984-2005 conditioned on the index of biomass from the 1984-2005 Canadian spring surveys converted into Campelen units and tuned with the Canadian Engel spring series from 1984-1995. Six different runs of the model were conducted representing different time periods. Although not all model diagnostics were presented, parameter estimates from the different models suggested a wide range of values. In particular, quite different results were obtained with the same model formulation but without the 2005 estimates. STACFIS did not accept any of the results as indicative of the stock dynamics.

ii) **Relative exploitation**

An Exploitation Index (estimated catch including discards/spring survey biomass index) was used to examine relative changes in the impact of fishing mortality (Fig. 16.5). Relative *F* increased from approximately 7% in the mid-1980s to an average of about 15% in the late 1990s then declined from about 13% in 2000-2003 to 4% in 2005, the lowest level in the time series. Relative *F* was consistently lower in Subdiv. 3Ps where catches have remained comparatively small. The recent (7 year) level of relative *F* of 0.11 has resulted in a stable biomass index.

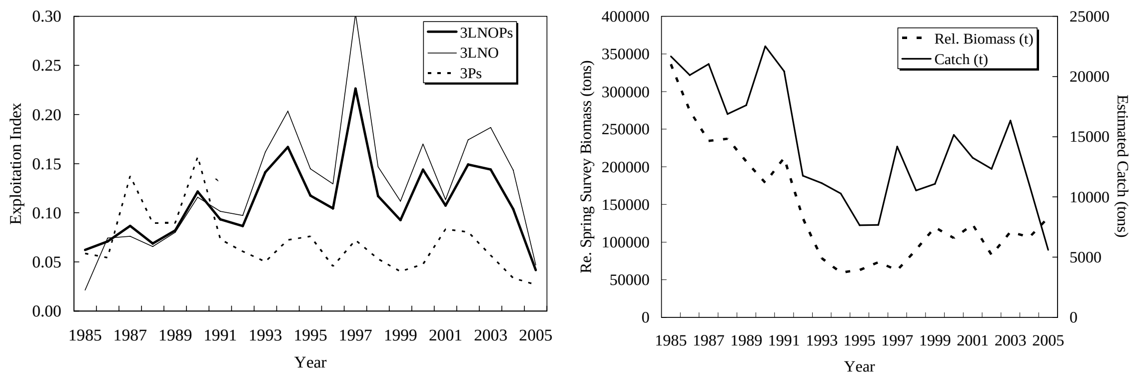


Fig. 16.5. Thorny skate in Div. 3NO: temporal changes in the exploitation index (estimated catch including discards/spring survey biomass) for NAFO Div. 3LNOPs.

d) **Assessment Results**

Distribution: Information on changes in the distribution of thorny skate can be found in the *NAFO Sci. Coun. Rep.*, 2003, p. 174-179. Updated analyses show that while the biomass index has remained relatively constant since the mid-1990s, the density of skate has continued to increase within the area on the southwest Grand Bank where >80% of the biomass index has concentrated in recent years. Based on Canadian spring surveys, extent of the high density concentrations of thorny skate have increased from about 4% of the total area of the Grand Banks in 1992-1995 to 15% after 2004-2005. However, the area without skate, mainly in Div. 3L has also continued to increase from 8% to 22% during that same period.

Biomass: The Canadian spring Yankee survey biomass index fluctuated without trend prior to 1983. The Campelen equivalent biomass index declined rapidly from 1985 until the early 1990s and has been stable or has increased slightly since. The pattern from the Canadian autumn survey, for comparable periods, was similar.

The biomass trajectory from the EU-Spain survey was very similar to that of the Canadian spring survey in Div. 3NO. However, the EU-Spain survey was conducted in the NRA portion of Div. 3NO while the Canadian survey covered the entire extent of Div. 3LNOPs.

Fishing Mortality: Relative *F* increased from about 7% in the mid-1980s to an average of about 15% in the late 1990s then declined from about 13% in 2000-2003 to 4% in 2005, the lowest level in the time series.

Recruitment: Not available.

State of the Stock: The stock is presently near its lowest level over the standardized time series (since 1984). The current state of the stock is unclear compared to the historic (pre-1980s) period. The biomass has been relatively stable from 1996 to 2005 but at a lower level than in the mid-1980s During 1996-2005, average catch as estimated by STACFIS was about 11 700 tons.

e) **Reference Points**

Non-equilibrium production modeling and work on the relationship between SSB and recruits that was done, is considered at this time to be uninformative in the formulation of reference points. There are no reference points established at this time.

f) Research **Recommendations**

STACFIS **recommended** that *further work be conducted for estimation of reference points.*

STACFIS **recommended** that *further testing and sensitivity analysis be conducted on surplus production modeling employing ASPIC 3.8 in addition to ASPIC 5.1.*

STACFIS noted sampling of commercial fisheries was available for a number of years and accordingly **recommended** that *an annual series of commercial catch at length be constructed if sufficient sampling exists.*

g) **References**

ATKINSON, D. B. MS 1995. Skates in NAFO Divisions 3LNO and Subdivision 3Ps: A preliminary examination. *DFO Res. Doc.*, No. 95/26.

TEMPLEMAN, W. 1982. Development, occurrence, and characteristics of egg capsules of thorny skate, *Raja radiata*, in the Northwest Atlantic. *J. Northw. Atl. Fish. Sci.*, **3**(1): 47-56.

TEMPLEMAN, W. 1984a. Migrations of thorny skate, *Raja radiata*, tagged in the Newfoundland area. *J. Northw. Atl. Fish. Sci.*, **5**(1): 55-64.

TEMPLEMAN, W. 1984b. Variations in numbers of median dorsal thorns and rows of teeth in thorny skate (*Raja radiata*) of the Northwest Atlantic. *J. Northw. Atl. Fish. Sci.*, **5**(2): 171-180.

TEMPLEMAN, W. 1987a. Length-weight relationships, morphometric characteristics and thorniness of thorny skate (*Raja radiata*) from the Northwest Atlantic. *J. Northw. Atl. Fish. Sci.*, **7**: 89-98.

TEMPLEMAN, W. 1987b. Differences in sexual maturity and related characteristics between populations of thorny skate (*Raja radiata*) in the Northwest Atlantic. *J. Northw. Atl. Fish. Sci.*, **7**(2): 155-168.

17. **White hake (*Urophycis tenuis*) in Divisions 3N, 3O, and Subdiv. 3Ps** (SCR Doc. 06/14, 33; SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

a) **Introduction**

From 1970-2005, catches in Div. 3NO have averaged aproximately 2 000 tons, exceeding 5 000 tons in only three years during that period. Catches peaked in 1985 at approximately 8 100 tons then declined from 1988 to 1994 averaging 2 090 tons during that period (Fig. 17.1). 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 6 718 tons in 2002 and 4 823 tons in 2003. years and in 2004-2005, average catch was 1 067 tons.

Catches of white hake in Subdiv. 3Ps were greatest in 1985-93, averaging 1 115 tons then decreased to an average of 436 tons in 1994-99. Subsequently, catches increased to an average of 1 000 tons in 2000-2005.

Canada commenced a directed fishery for white hake in 1988 in Div. 3NO and Subdiv. 3Ps. All Canadian landings prior to 1988 were as bycatch in various groundfish fisheries. EU-Spain and EU-Portugal commenced a directed fishery in 2002 in Div. 3NO in the NRA but there was no directed fishery by EU-Spain in 2004 or by EU-Spain, EU-Portugal or Russia in 2005.

Recent nominal catches and TACs ('000 tons) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006-7
Div. 3NO:										
Recommended TAC									[1]	[2]
TAC									8.5	8.5
STATLANT 21A	0.4	0.3	0.4	0.6	0.6[3]	5.3[3]	6.2[3]	0.7[3]	0.9[3]	
STACFIS	0.6	0.2	0.4	0.6	0.6	6.7	4.8	1.3	0.9	
Subdiv. 3Ps:										
STATLANT 21A	0.3	0.6	0.6	1.1	0.9[3]	0.9[3]	1.1[3]	1.1[3]	1.5[3]	

[1] Scientific Council in 2004 advised catches in the directed fishery be limited to 5 800 tons (average of estimated catch for 2002-2003).
[2] SC could not recommend a specific TAC but advised current TAC (8 500 tons) not sustainable.
[3] Provisional.

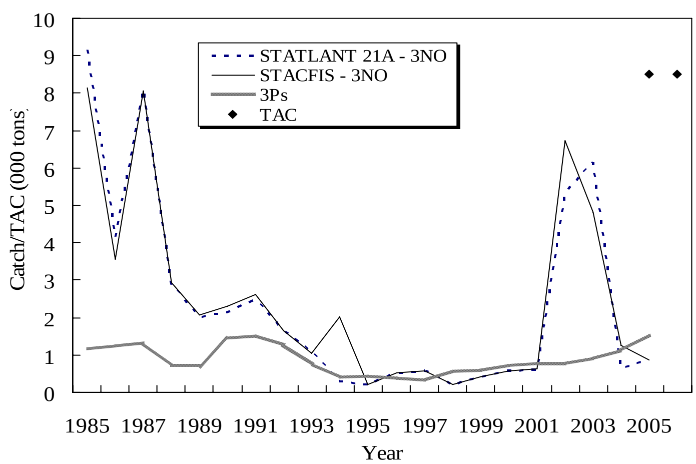


Fig. 17.1. White hake in NAFO Div. 3NO and Subdiv. 3Ps: total catches and TACs.

b) **Data Overview**

Research surveys

The results of the 2005 **Canadian spring stratified-random bottom trawl survey** did not alter the perception of stock status by STACFIS.

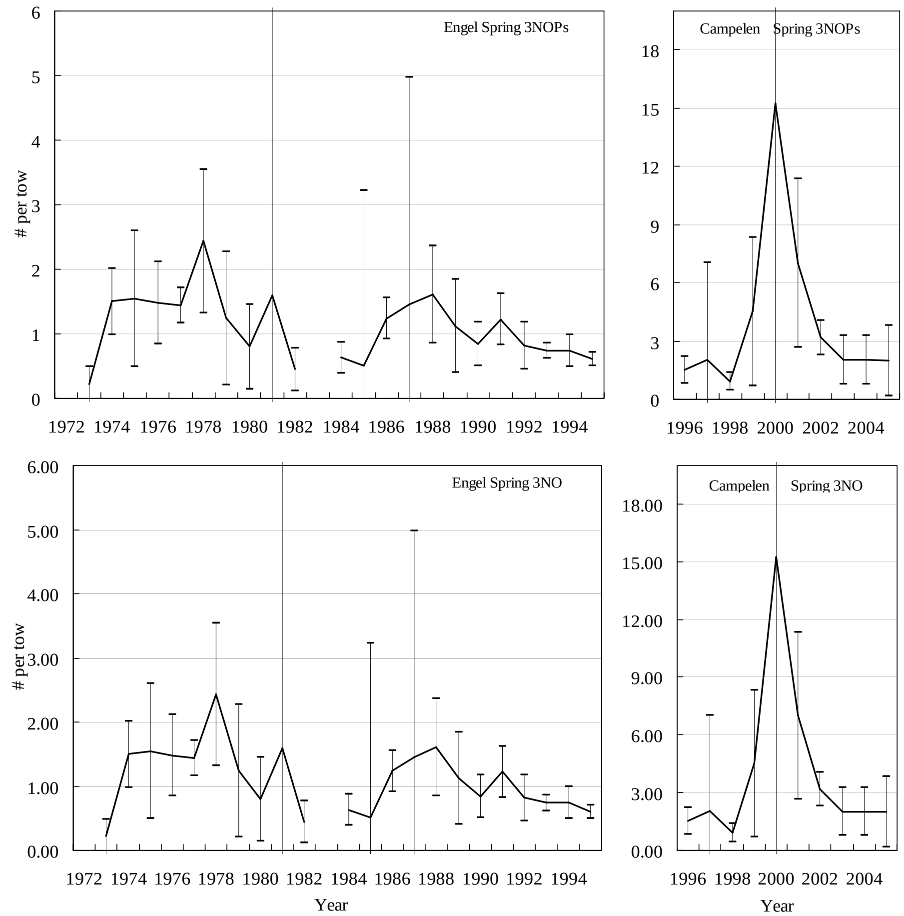


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: biomass and abundance indices from Canadian spring and autumn surveys, 1972-2005. The Engel and Campelen time series are not standardized.

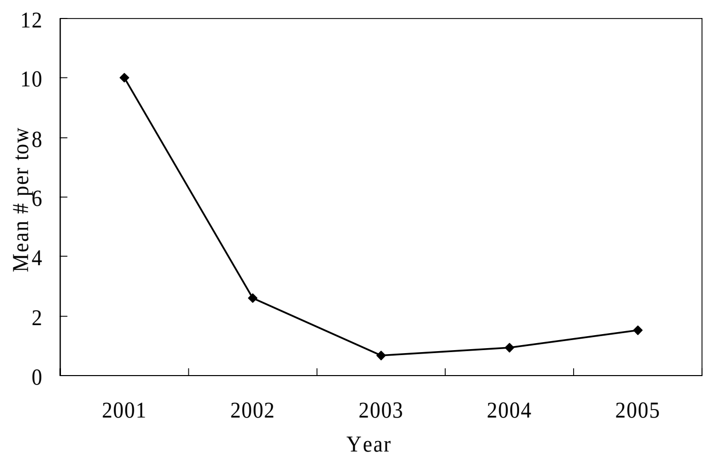


Fig. 17.2b. White hake in the NRA of Div. 3NO: biomass indices from Spanish Campelen spring surveys in 2001-2005.

Recruit per spawner (number of recruits surviving one year after spawning) varied between 0.4 and 35 fish for each adult female in 1997-2004 (Fig. 17.3). Two high values have been observed in this short time series: 13.5 fish in 1998 and 35 in 1999. Since 1999, recruitment has averaged 0.8 recruits per spawner, a level which would not sustain the population.

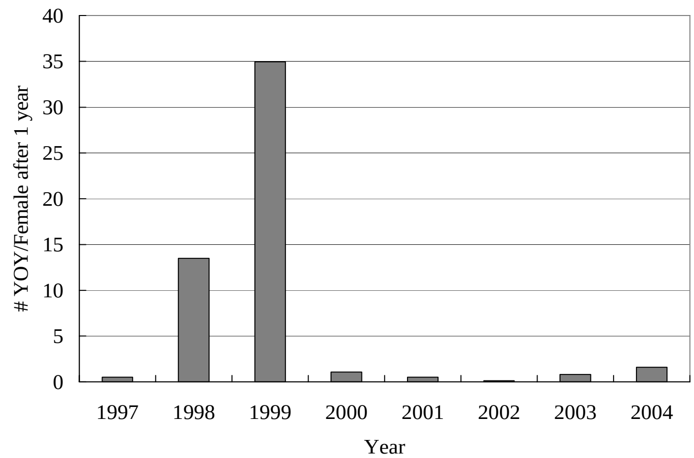


Fig. 17.3. White hake in Div. 3NO and Subdiv. 3Ps: recruit per spawner from Canadian Campelen spring surveys in 1997-2003.

c) **Conclusions**

There is nothing to indicate a change in the status of the stock from the previous year. However, 1998 and particularly 1999 were the dominant year-classes in the Div. 3NO catches in 2002-2003. The 1999 year-class is now 2.5% of its size in 2000. It appears that the stock has returned to a level of abundance similar to what was observed in 1992-1998. Catches during that period averaged approximately 900 tons.

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 -1°-2°C and salinities of 32-33.5. 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°-4°C and salinities in the range of 34-34.75. On average bottom temperatures remain <0°C over most of the northern Grand Banks but increase to 1°-4°C in southern regions and along the slopes of the banks below 200 m. North of the Grand Bank, in Div. 3K, bottom temperatures are generally warmer (1°-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°-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°-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 2005 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 2005 remained below the long-term mean along all sections from Labrador to Southern Newfoundland. In some areas the CIL was below normal for the 11th consecutive year and off eastern Newfoundland it was the 5th lowest (warmest) since 1948. Further south, on the Scotian Shelf ocean temperatures increased over 2004 values to above normal conditions over central and eastern areas but remained below normal over western areas. Sydney Bight and Misaine Bank had typical temperature anomalies of 0.5 and 0°C; Emerald Basin, Lurcher Shoals, Georges Basin and eastern Georges Bank had anomalies of -0.5°C at most depths. The temperatures from the July groundfish survey increased substantially from the record cold values in 2004. The overall anomaly for the combined areas of 4Vns, 4W and 4X was -0.07°C. 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 to 2005, however there were considerable local variability. The overall stratification, which may have important implication for marine production, was slightly above normal during 2005 from Newfoundland to the Scotian Shelf region.

18. Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3 (SCR Doc. 06/7, 14, 16; SCS Doc. 06/6, 7, 9)

Interim Monitoring Report

a) Introduction

It has been recognised that a substantial part of the recent grenadier catches in Subarea 3, previously reported as roundnose grenadier correspond to roughhead grenadier. The misreporting has not yet been resolved in the official statistics before 1996, but the species are reported correctly since 1997. 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). A total catch of 1 456 tons was estimated for 2005 (Fig. 18.1).

Recent catches ('000 tons) are as follows:

	1997	1998	1999	2000	2001	2002	2003	2004	2005
STATLANT 21A	4.7	7.2	7.2	8.9[1]	2.0[1]	1.7[1]	1.8[1]	1.7[1]	0.6[1]
STACFIS	4.7	7.4	7.2	4.8	3.1	3.7	4.2-3.8[2]	3.2	1.5

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.

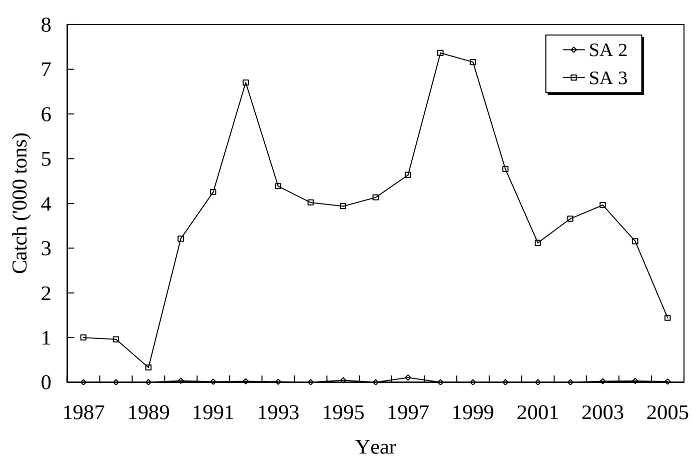


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

b) **Data Overview**

Surveys

Mean weight per tow from the Canadian autumn survey Div 2J+3K, Spanish 3NO survey and EU bottom trawl on Flemish Cap (up to 750 m) survey series with ±2 SE are presented in Fig. 18.2. The survey estimates did not alter the perception of the stock status by STACFIS.

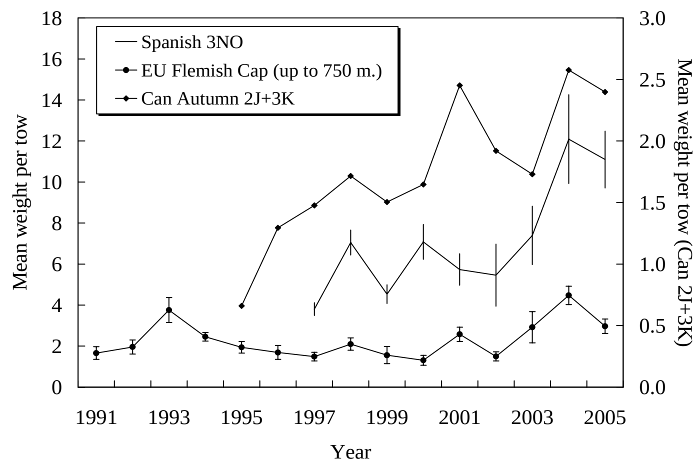


Fig. 18.2. Roughhead grenadier in Subareas 2+3: mean weight per tow from the Canadian autumn (Div. 2J+3K) survey, Spanish 3NO survey and EU Flemish Cap survey.

Although all biomass indices decreased in 2005, the catch/biomass (C/B) indices from the Canadian autumn survey and the Spanish Div. 3NO survey in the period 1995-2005 has not changed the decreasing trend, as noted in last years assessment.

c) **Conclusion**

Based on overall indices for the current year, there is nothing to indicate a change in the status of the stock.

19. **Witch Flounder (*Glyptocephalus cynoglossus*) in Divisions 2J, 3K and 3L** (SCS Doc. 06/6, 7, 9)

In**terim Monitoring Report**

a) **Introduction**

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 2004 catches were estimated to be between 300 and 800 tons, and in 2005 catch was estimated at about 160 tons.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.9	0.4	0.4	0.5[1]	0.6[1]	0.7[1]	0.5[1]	0.3[1]	0.2[1]	
STACFIS	0.8	1.1	0.3	0.7	0.8	0.4	0.7	0.8	0.2	

[1] Provisional.
ndf no directed fishing.

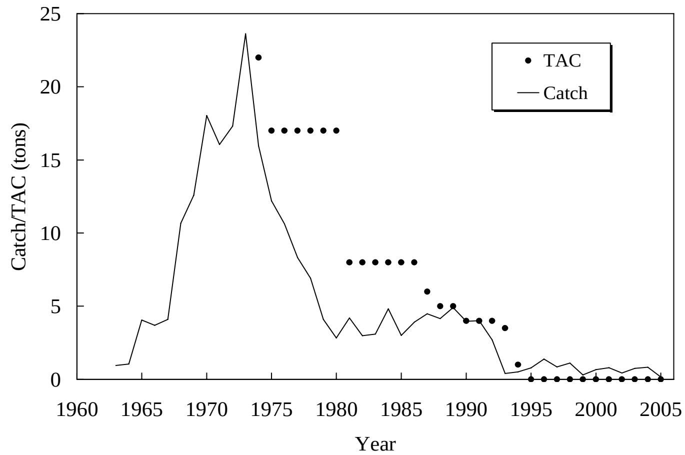


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) **Data Overview**

i) **Surveys**

Canadian surveys were conducted in Divs. 2J+3KL during autumn 2005. The survey estimates show very slight improvement over 2004 values, but did not alter the perception of the stock status by STACFIS (Fig. 19.2). Survey coverage in Div. 3L in autumn 2004 was incomplete (SCR Doc. 05/34) and therefore results may not be comparable.

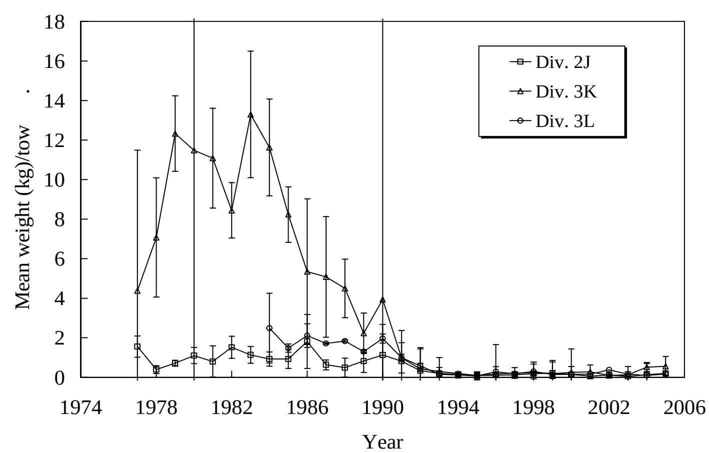


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow from Canadian autumn surveys (95% confidence limits are given. Note that the full range of confidence limits is not displayed where they extend below zero). Note that due to incomplete survey coverage, indices in 2004 may not be comparable.

c) **Conclusion**

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

20. **Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Divisions 3KLMNO** (SCR Doc. 06/12, 16, 34, 42, 47, 49, 50, 51; SCS Doc. 06/6, 7, 9, 11)

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.

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. In 2003 the Fisheries Commission implemented a fifteen year rebuilding plan for this stock (FC Doc. 03/13), and 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. During the first two years of the rebuilding plan, estimated catches for 2004 and 2005 are 25 500 tons and 23 250 tons, respectively. These catches exceed the rebuilding plan TACs by 27% and 22%, respectively.

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 Division 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 Divisions 3LM and to a lesser degree in Divisions 3NO.

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC	nr	nr	30	30	40	40	36	16	nr*	nr*
TAC	27	27	33	35	40	44	42	20[3]	19[3]	18.5[3]
STATLANT 21A	20	20	23	32[1]	29[1]	29[1]	27[1]	16[1]	18[1]	
STACFIS	20	20	24	34	38	34	32-38[2]	25	23	

nr no recommendation.
* evaluation of rebuilding plan.
[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
[3] Fisheries Commission rebuilding plan (FC Doc. 03/13).

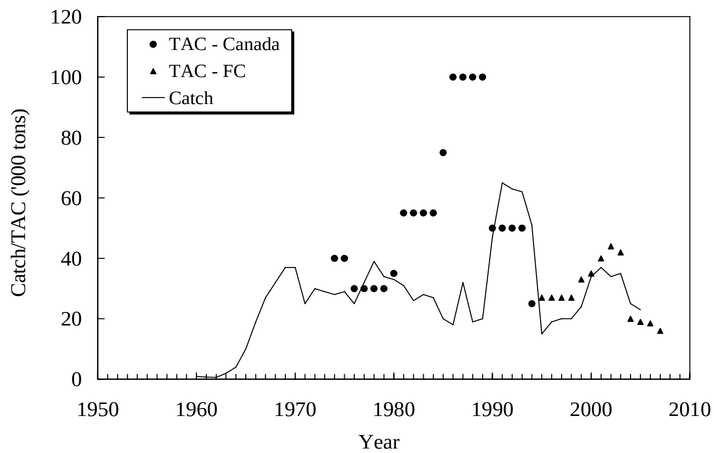


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) **Input Data**

i) **Commercial fishery data**

Catch and effort. Analyses of otter trawl catch rates (Fig. 20.2) from Canadian vessels operating inside of the Canadian 200 mile limit, 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 in 2002 and remained stable to 2005 at the low levels of the mid-1990s (SCR Doc. 06/47). The 2005 estimate is based upon a lower proportion of the effort in this fleet and is considered preliminary.

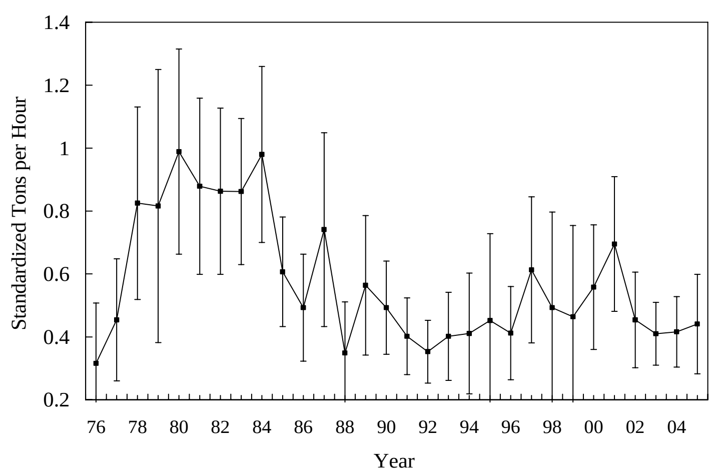


Fig. 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) based on hours fished from the Canadian fishery in Div. 2HJ+3KL.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN from 1988-2005 (Fig. 20.3) declined sharply from 1988 to 1991, and remained around this low level until 1994 (SCS Doc. 06/6). 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 has remained stable since that time, with the exception of 2004. The 2004 CPUE is estimated to be amongst the lowest in the time series.

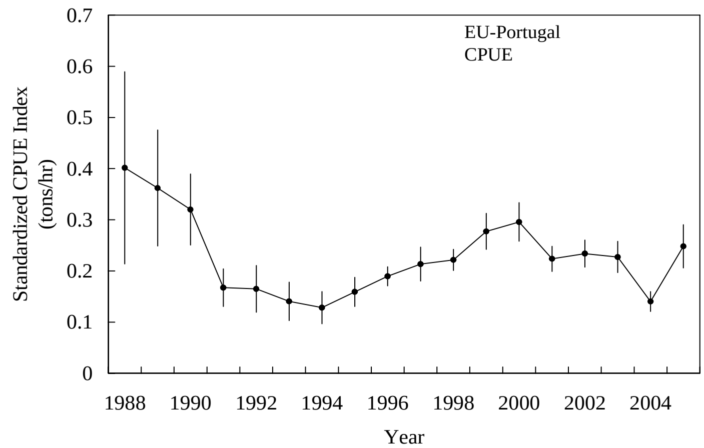


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) from the EU-Portugal trawlers with scientific observers in Div. 3LMN.

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, 05/62, and 06/47. Length samples for the 2005 fishery were provided by EU-Spain (SCS Doc. 06/9), EU-Portugal (SCS Doc. 06/6), Russia (SCS Doc. 06/7) and Canada (SCR Doc. 06/47). Aging information was provided by EU-Spain (SCS Doc. 06/9), Russia (SCS Doc. 06/7), and Canada (SCR Doc. 06/47). Due to aging inconsistencies (SCR Doc. 05/43, 06/49), a Canadian age-length key was used to calculate catch-at-age for all catches in 2005 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. 06/47).

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.

Canadian stratified-random autumn surveys in Div. 2J and 3K (SCR Doc. 06/34)

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. The index increased substantially due to the abundant 1993-1995 year-classes, but this increase was not sustained, and the index decreased by almost 60% over 1999-2002. The index has increased in each of the past three years. Mean numbers per tow were stable through the 1980s, but increased substantially in the mid-1990s, again due to the presence of the 1993-1995 year-classes. After this, abundance declined to the late 1990s and had been relatively stable until declining substantially in 2005. The age-composition of the 2005 survey showed few recruits and increased numbers of older individuals. In 2005 mean numbers declined and mean weight per tow increased (SCR Doc. 06/34).

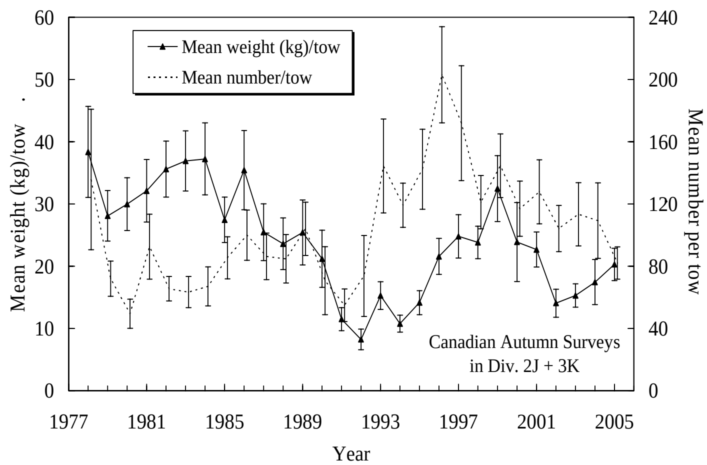


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

Mean weight-per-tow in Div. 2J and 3K combined of fish greater than 30 cm (minimum size limit in commercial fishery) decreased to a low in 1992; and remained at this level until 1995 after which it increased steadily until 1999 when it approached levels of the late 1980s (Fig. 20.5). The index has declined from 1999 to 2002, and has increased considerably over 2003 to 2005. The recent increase in the >30 cm index is unusual in that no increase in recruitment has been observed in the recent past. 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. 06/34).

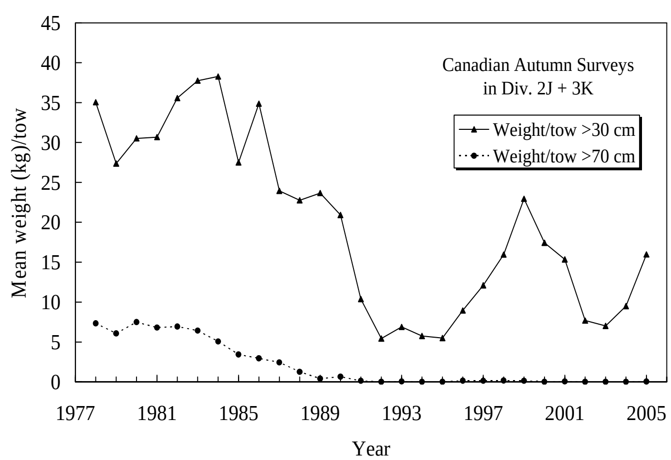


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass indices (mean weight (kg) per tow) for fish >30 cm and >70 cm from Canadian autumn surveys in Div. 2J and 3K.

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 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. 06/34)

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. The index declined from 1998-2002 and has been more or less stable since (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 or 2005.

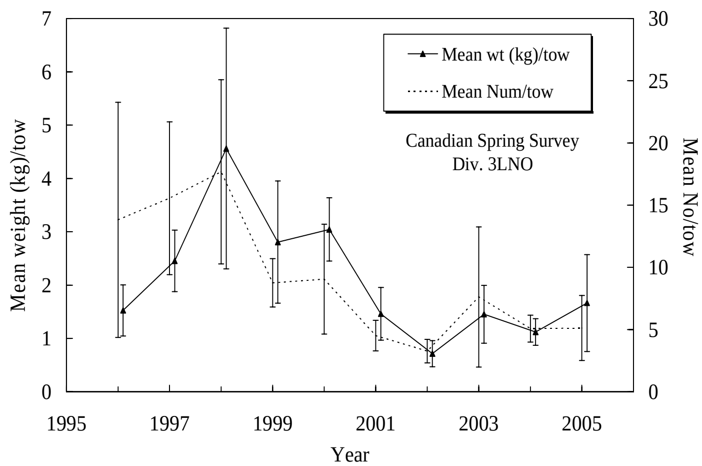


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

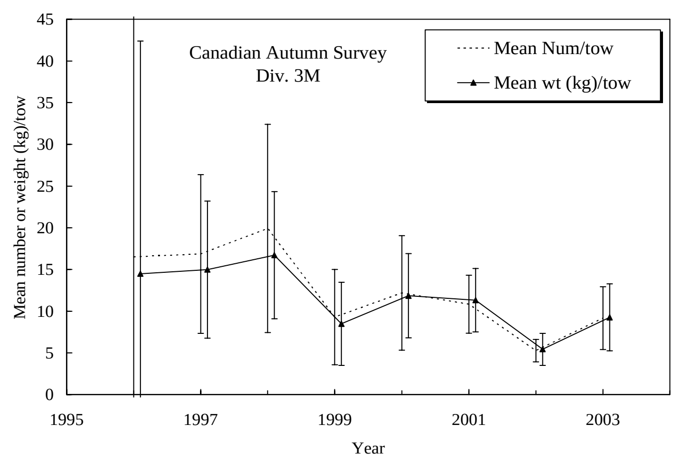


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 3M.

EU stratified-random surveys in Div. 3M (SCR Doc. 06/16)

Surveys conducted by the EU in Div. 3M during summer indicate that the Greenland halibut biomass index (mean weight (kg) per tow) on Flemish Cap in depths to 730 m, increased in the 1988 to 1998 period (Fig. 20.8) to a maximum value in 1998. The biomass index declined consistently over 1998-2003. However, in 2004 and 2005 the index was stable at a level consistent with that measured in 2002.

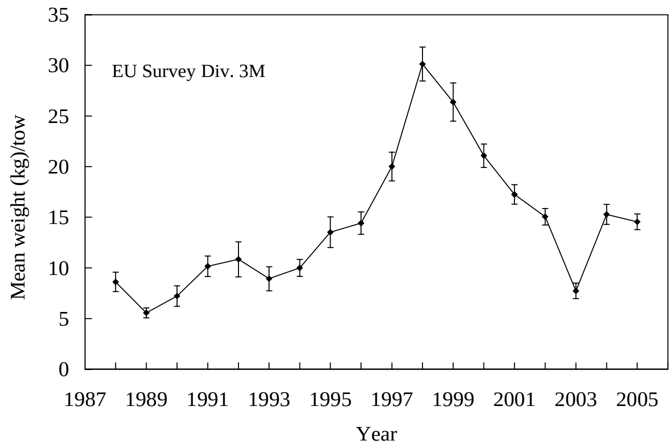


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (mean catch per tow ± 1 S.E.) from EU summer surveys in Div. 3M.

EU-Spain stratified-random surveys in Div. 3NO Regulatory Area (SCR Doc. 06/12)

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 there has been a general decline from 1999 to 2005 (Fig. 20.9).

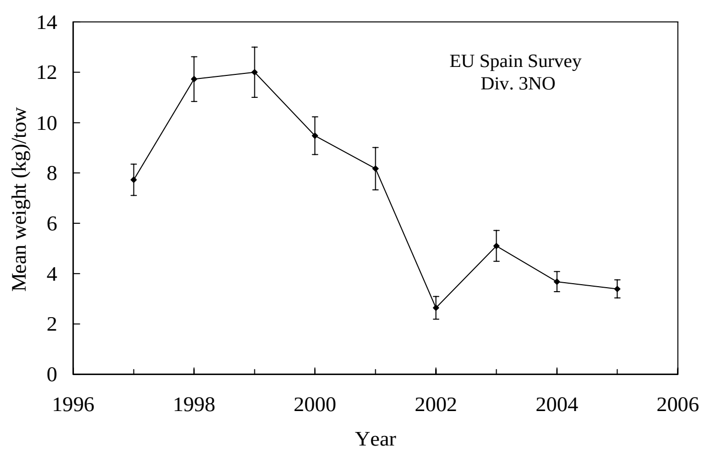


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in Div. 3NO.

Survey evaluation and consistency

Ideally, age dis-aggregated survey indices should measure cohorts consistently at several ages. Measures of the age over age cohort-consistency in the survey series that are used to calibrate the virtual population analysis (VPA) were updated (Fig. 20.10; SCR Doc. 05/37, 06/50). The correlations between successive age groups within each survey are reasonably good up until ages 6 to 7; at ages 7 to 8, all of the survey series had poor correlations. Potential explanations of such poor correlations could include: immigration or emigration to/from the survey area, ageing problems, catchability issues or even a combination of these factors. Nonetheless, due to the fact that the extended survivors analysis (see **Estimation of Parameters**) uses within cohort information to produce estimates of survivors, VPA analyses for this stock are still considered appropriate.

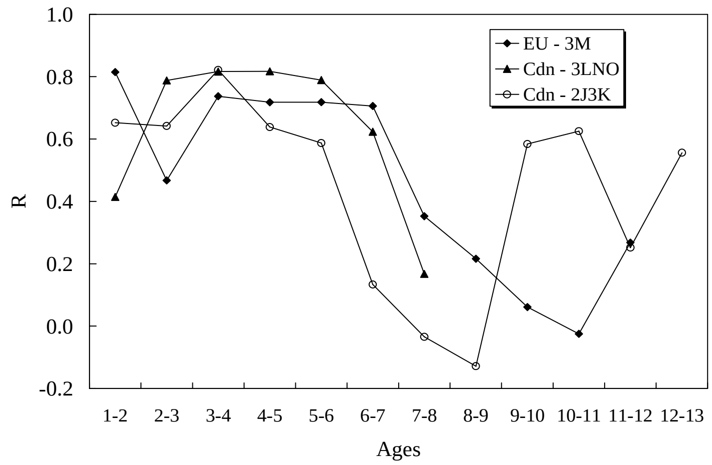


Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: Correlation coefficients between successive age groups from each survey series included in the VPA analysis.

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. The lack of consistency in the survey results from age 7 to age 8 within all surveys remains a cause of concern.

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. 06/42). Four independent data series were used: EU 3M (1991-2005), Canadian Autumn 2J+3K (1996-2005), Canadian Autumn 3L (1996-2005; 2004 excluded – see SCR Doc. 05/34), and Canadian Spring 3LNO (1996-2005). All Canadian data were from surveys using the Campelen 1800 shrimp trawl.

In the current assessment survey estimates for ages 1-4 were used in this analysis as they are considered pre-recruits to the fishery. Due to concerns in the comparibility of the recruitment results from the Canadian Campelen converted time-series, the converted data were excluded from analysis (see SCR Doc. 06/42). This permits estimation of the relative strength of year-classes from 1990-2004.

Model results (Fig. 20.11) indicate that the 1993-95 year-classes were estimated to be well above average despite wide confidence intervals. Of the most recent cohorts; the 1999-2002 cohorts are estimated to be of about average strength; based upon the available information, the 2003 and 2004 cohorts are estimated to be below average.

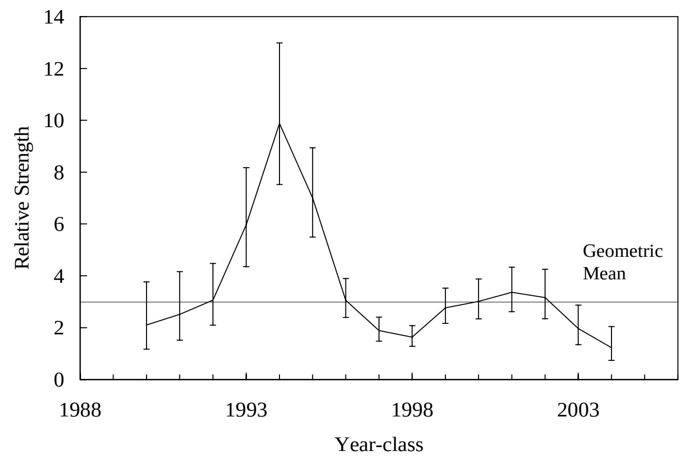


Fig. 20.11. Greenland halibut in Subarea 2 + Div. 3KLMNO: Recruitment index from four research vessel survey series.

c) **Estimation of Parameters** (SCR Doc. 06/51)

At the June 2005 meeting STACFIS reviewed several alternate XSA (SCR Doc. 05/63; Shepherd 1999; Darby and Flatman, 1994) formulations. In addition to the XSA analyses, several formulations of the ADAPTive framework (Gavaris, 1988) were explored. STACFIS concluded that XSA was the most appropriate model to be used in this assessment.

Considering the age-determination concerns for this species (SCR Doc. 06/49), STACFIS reviewed a sensitivity analysis on the impact of reducing the plus-group age in the catch-at-age matrix (SCR Doc. 06/51). Results indicated that differences were minimal and that the resulting advice would remain unchanged. Subsequently, survey data and catch information were used to estimate numbers at age using the 2005 agreed XSA formuation. Model diagnostics indicated that the model structure and assumptions were reasonable, so the XSA formulation was not altered. The XSA model specifications are given below:

Catch data from 1975 to 2005, ages 1 to 14+

Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1995	2005	1	12
Canadian autumn survey (Div. 2J3K) 1996	2005	1	13	
Canadian spring survey (Div. 3LNO)	1996	2005	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. 20.12): 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 to 2006 estimates are the lowest in the series. Estimates of 2006 survivors from the XSA are used to compute 2006 biomass by assuming the 2006 stock weights are equal to the 2003-2005 average. The 2006 5+ biomass is estimated to be about 69 000 tons.

Fishing Mortality (Fig. 20.13): High catches in 1991-94 resulted in F_{5-10} exceeding 0.50. F_{5-10} then declined to about 0.20 in 1995 with the substantial reduction in catch. F_{5-10} increased since then and has remained high in spite of the Fisheries Commission rebuilding plan. The 2003 and 2005 estimates are substantially higher, F_{5-10} in 2005 is estimated to be 0.63.

Recruitment (Fig. 20.14): 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. 05/63). The estimated abundance of the 2003 and 2004 year-classes are the lowest two values in the time series, and the 2004 value is more than 50% smaller than the 2003 year-class estimate. Although the estimated abundance of the 2004 year-class is based only on the 2005 survey data; results from all three survey series confirm the low abundance of this cohort.

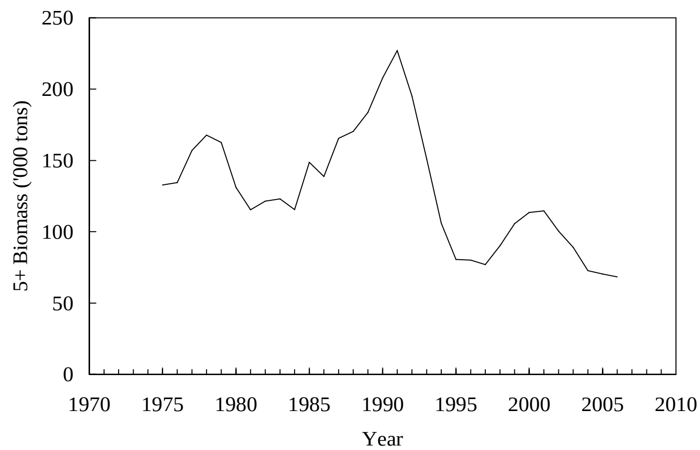


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated 5+ biomass from XSA analysis.

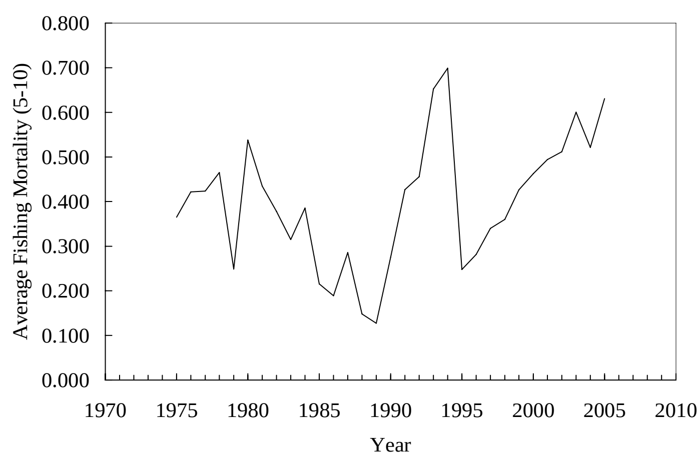


Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: Estimated fishing mortality (5-10) from XSA analysis.

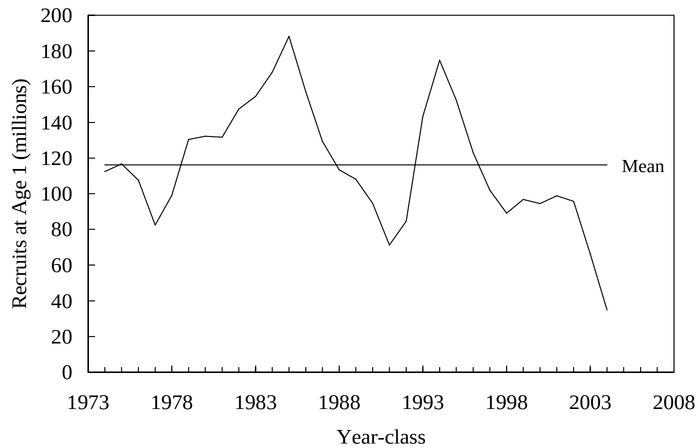


Fig. 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA analysis.

e) **Retrospective Analysis**

A retrospective analysis of the XSA was conducted. Fig. 20.15-20.17 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 1993-1995 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. In addition, the current assessment estimates that the 1998 and 1999 year-classes are more abundant than in previous assessments. However these year-classes along with the 2000-2003 year classes are estimated to be below the long term average. These year-classes are about to enter the exploitable biomass.

The 5+ biomass around 2000 and 2001 was over-estimated, but in recent years has been underestimated (Fig. 20.16). Fishing mortality in recent years has been over-estimated (Fig. 20.17). Despite this all recent assessments have shown a decreasing trend in 5+ biomass and an increase in recent fishing mortality.

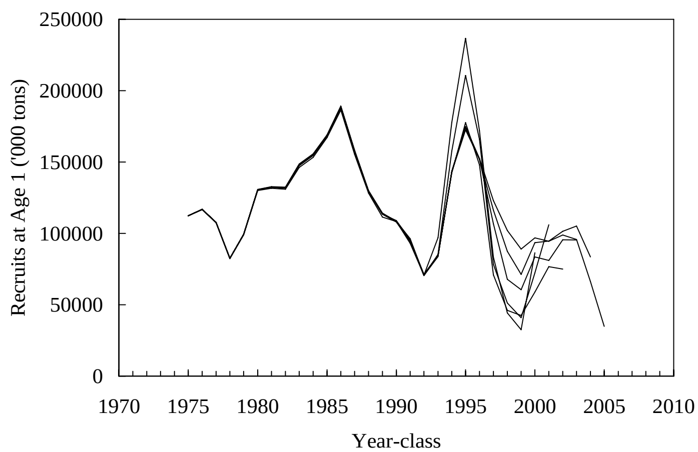


Fig. 20.15. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

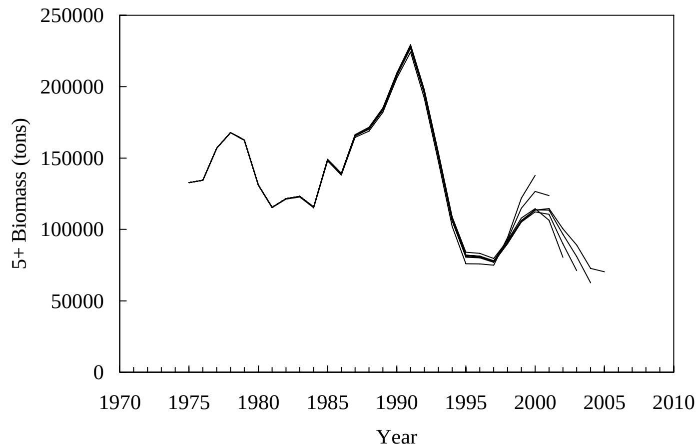


Fig. 20.16. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; 5+ biomass.

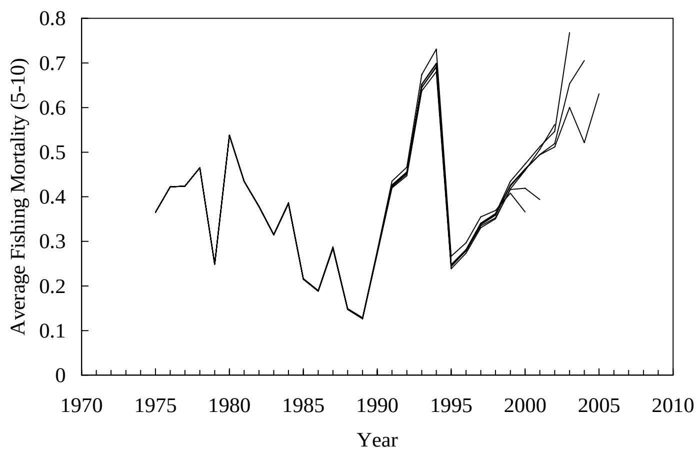


Fig. 20.17. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

f) 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) Yield per recruit reference points

For this stock F_{Max} is computed to be 0.26 and $F_{0.1}$ is 0.15 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. 20.18) indicates that the current average fishing mortality is more than twice F_{Max}. STACFIS also noted that the average fishing mortality has been below F_{Max} for only six years of the time series, and been below $F_{0.1}$ only once.

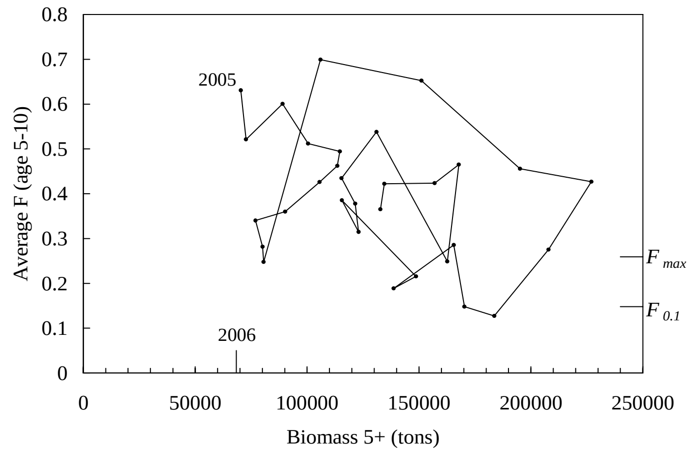


Fig. 20.18. Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory with relation to yield per recruit reference points. The 2006 estimate of biomass (68 500 tons) is indicated on the biomass axis.

g) **Projections** (SCR Doc. 06/51)

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 2003 to 2005, and with natural mortality fixed at 0.2.

Attention is to be drawn on the fact that, as discussed by Patterson *et al*. (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 rebuilding plan TACs for 2004 and 2005 were exceeded by 27% and 22%, respectively. As such, two catch scenarios were projected in the short term (to 2009). Projections were conducted assuming catches in 2006-2008 will be 18 500, 16 000, and 16 000 tons, respectively. A second set of projections were conducted in which the rebuilding plan TACs will be exceeded by 20%. In each projection, the projected catch level for 2008 is assumed to equal the 2007 removals, the final year in which the TAC is explicitly specified in the FC rebuilding plan.

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 2006 and corresponding CVs are computed from the XSA output. Recruitment was bootstrapped from the 1975-2002 age 1 numbers from the XSA; more recent recruitment levels were not included as these estimates are less certain. STACFIS noted that assumed recruitment levels have almost no impact on the short term projections. Scaled selection pattern and corresponding CVs are derived from the 2003 to 2005 average from the XSA. Weights at age in the stock and in the catch and corresponding CVs are computed from the 2003-2005 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 for $F_{0.1}$, F_{Max} and F_{2005} are also presented (Table 20.2). In the $F_{0.1}$ and F_{Max} projections, the catch in 2006 is assumed to be equal to a 20% over-run of the rebuilding plan TAC.

Deterministic projections were conducted assuming a future recruitment value fixed at the 1996-2002 geometric mean of the age 1 XSA estimates.

Deterministic Projection Results

Results indicate that the exploitable biomass remains stable at the 2006 level if the rebuilding plan TACs are adhered to, but biomass declines continue if the TACs are over-run (Table 20.2; Fig. 20.19). Under each TAC scenario the projected biomass for 2009 remains below the level when the Fisheries Commission (FC) rebuilding plan was implemented. Projected average fishing mortality (Table 20.2; Fig. 20.20) indicates a reduction in average *F* from 2006 to 2008 for each TAC scenario, although average fishing mortality in 2008 remains above F_{Max}.

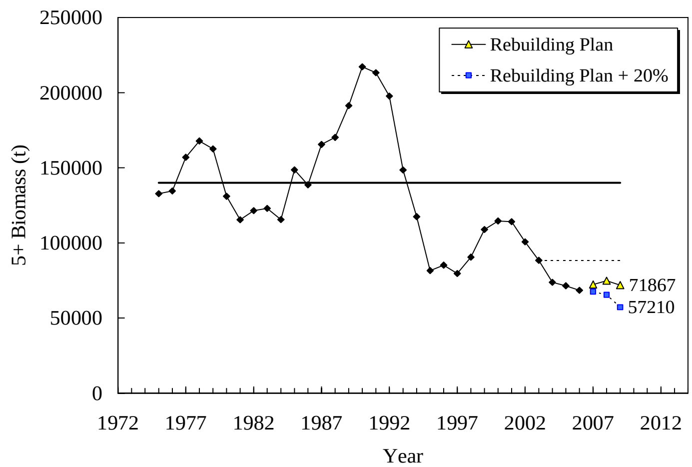


Fig. 20.19. Greenland halibut in Subarea 2 + Div. 3KLMNO: deterministic projection of 5+ biomass to 2009 under FC rebuilding plan and under catches in excess (20%) of rebuilding plan. The solid horizontal line represents the rebuilding plan target biomass of 140 000 tons; the dashed horizontal line is the level of the exploitable biomass in 2003, when the FC rebuilding plan was implemented.

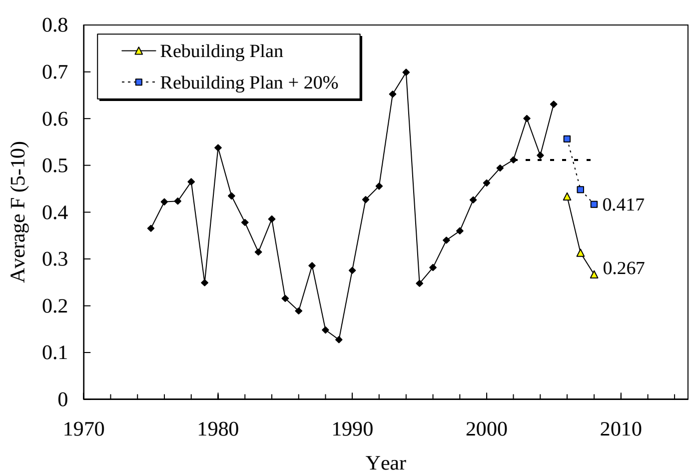


Fig. 20.20. Greenland halibut in Subarea 2 + Div. 3KLMNO: deterministic projection of average fishing mortality to 2008 (triangles) under FC rebuilding plan and under catches in excess (20%) of rebuilding plan. The horizontal dashed line indicates the level of fishing mortality when the rebuilding plan was implemented.

At $F_{0.1}$, F_{Max} and F_{2005} levels, the projections (Table 20.2) indicate that the 5+ biomass will decrease under current levels of fishing mortality, remain stable at a low level under F_{Max}, and would increase by 24% at $F_{0.1}$.

Stochastic Projection Results

The results of the stochastic projections (average fishing mortality, 5+ biomass and 10+ biomass) conducted under the two same catch scenarios as for the deterministic projections are plotted in Fig. 20.21 and 20.22, and projection results are in Table 20.3. 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 remain relatively stable at a low level from 2006 to 2009. Further, the stochastic projections indicate that there is a low probability (less than 10%) of the 5+ biomass reaching the 2003 level (89 000 tons) by 2009. The exploitable 10+ biomass is expected to increase slightly by 25% in 2009 (Table 20.2). Fishing mortality declines to a value slightly below 0.3.

Assuming catches 20% in excess of the TACs set under the rebuilding plan, both the 5+ and 10+ biomass decrease from 2006 to 2009 and the fishing mortality, although declining, remains relatively high at around 0.4.

Results from both scenarios indicate that fishing mortality is projected to remain relatively high, and projected biomass remains below the exploitable biomass in 2003 when the FC rebuilding plan was implemented.

STACFIS noted that in all of these projection scenarios, the 2009 exploitable biomass remains well below the target level of biomass specified in the FC rebuilding plan.

TABLE 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: Inputs for projections.

Greenland Halibut in Subareas 2 + 3KLMNO - Input data for stochastic projections.

Name	Value	Uncertainty		Name	Value	Uncertainty
		(CV)				(CV)
Population at age in 2006				Selection pattern		(2003-2005)
N1	Bootstrap (1975-2002)			sH1	0.000	0.00
N2	28548	0.32		sH2	0.000	0.00
N3	44456	0.24		sH3	0.000	0.00
N4	52583	0.20		sH4	0.033	0.43
N5	43964	0.16		sH5	0.170	0.50
N6	32586	0.14		sH6	0.599	0.32
N7	19952	0.13		sH7	1.836	0.09
N8	3570	0.16		sH8	1.664	0.10
N9	1656	0.20		sH9	1.044	0.07
N10	1244	0.20		sH10	0.687	0.17
N11	959	0.19		sH11	0.715	0.33
N12	604	0.19		sH12	0.754	0.25
N13	223	0.20		sH13	0.751	0.29
N14	260	0.21		sH14	0.751	0.29
Weight in the catch		(2003-2005)		Weight in the stock		(2003-2005)
WH1	0.000	0.00		WS1	0.000	0.00
WH2	0.000	0.00		WS2	0.000	0.00
WH3	0.207	0.10		WS3	0.000	0.00
WH4	0.266	0.01		WS4	0.000	0.00
WH5	0.387	0.03		WS5	0.387	0.03
WH6	0.554	0.03		WS6	0.554	0.03
WH7	0.826	0.02		WS7	0.826	0.02
WH8	1.214	0.00		WS8	1.214	0.00
WH9	1.657	0.04		WS9	1.657	0.04
WH10	2.163	0.03		WS10	2.163	0.03
WH11	2.712	0.04		WS11	2.712	0.04
WH12	3.469	0.03		WS12	3.469	0.03
WH13	4.341	0.00		WS13	4.341	0.00
WH14	5.444	0.03		WS14	5.444	0.03
TAC	Scenario 1	Scenario 2	CV			
2006	18500	22000	0.05			
2007	16000	19200	0.05			
2008	16000	19200	0.05			

TABLE 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: Results of Deterministic projections under various catch levels and fishing mortality options.

	Rebuilding Plan			Re-building TACs*1.2		
Year	5+ Biomass	Yield	F	5+ Biomass	Yield	F
2006	68413	18500	0.434	68413	22200	0.557
2007	72281	16000	0.313	67540	19200	0.448
2008	74839	16000	0.267	65365	19200	0.417
2009	71867			57210		

	$F_{current}$			$F_{0.1}$ *			F_{Max} *		
Year	5+ Biomass	Yield	F	5+ Biomass	Yield	F	5+ Biomass	Yield	F
2006	68413	24184	0.631	68413	22200	0.557	68413	22200	0.557
2007	65000	23141	0.631	67540	7621	0.148	67540	12429	0.259
2008	57417	21696	0.631	80233	10592	0.148	74056	15520	0.259
2009	45021			84931			71716		

*Note that the assumed removals in 2006 for the $F_{0.1}$ and F_{Max} scenarios add a 20% over-run on the rebuilding plan TAC.

TABLE 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: Results of **Stochastic** Projections assuming the catches follow the rebuilding plan TACs and with catches 20% in excess.

Stochastic (median values)	2006	2007	2008	2009
Catch (t)	18500	16000	16000	
F (5-10)	0.43	0.31	0.26	
5+B (t)	68391	72724	75485	72688
10+B (t)	9713	9080	9069	12189

Catch (t)	22211	19202	19202	
F (5-10)	0.55	0.45	0.41	
5+B (t)	68348	67823	65827	57965
10+B (t)	9722	8262	7274	7972

Greenland Halibut in Subareas 2 + 3KLMNO - Stochastic projections scenario 1

Lines show 5, 25, 50, 75 and 95 percentiles 1000 iterations

@Risk -Risk analysis Software

Bootstraped Recruitment (76 - 02) **Uncertainties on all parameters taken into account**

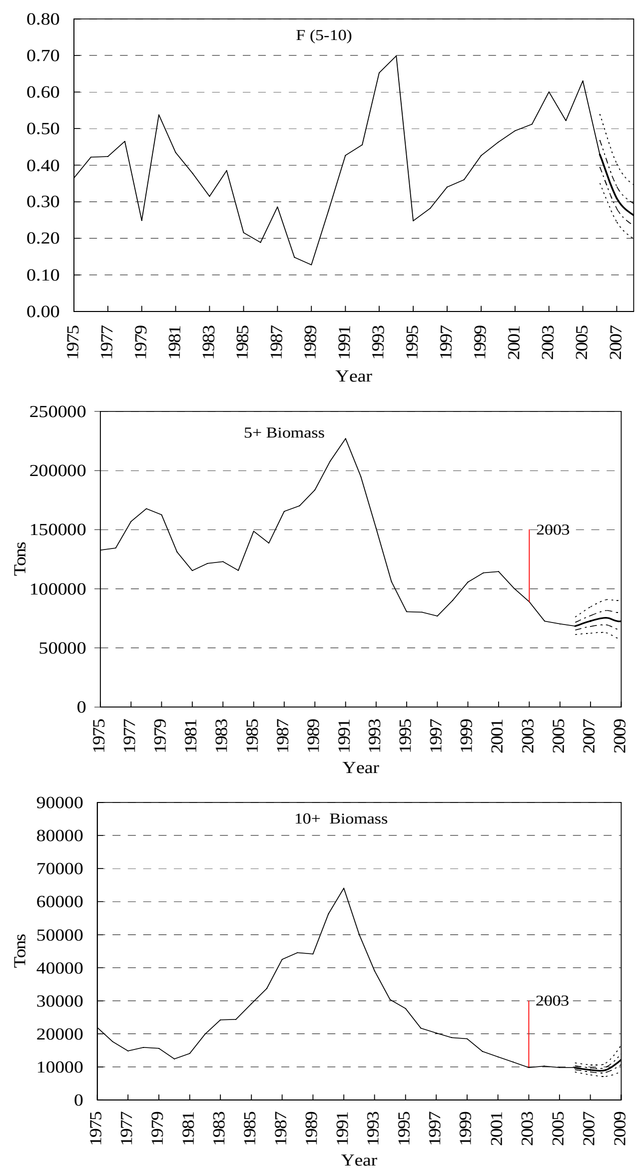


Fig. 20.21. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2005-2007 under Fisheries Commission rebuilding plan. The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

Greenland Halibut in Subareas 2 + 3KLMNO - Stochastic projections under scenario 2

Lines show 5, 25, 50, 50 and 75 percentiles 1000 iterations

@Risk -Risk analysis Software

Bootstraped Recruitment (76 - 02) **Uncertainties on all parameters taken into account**

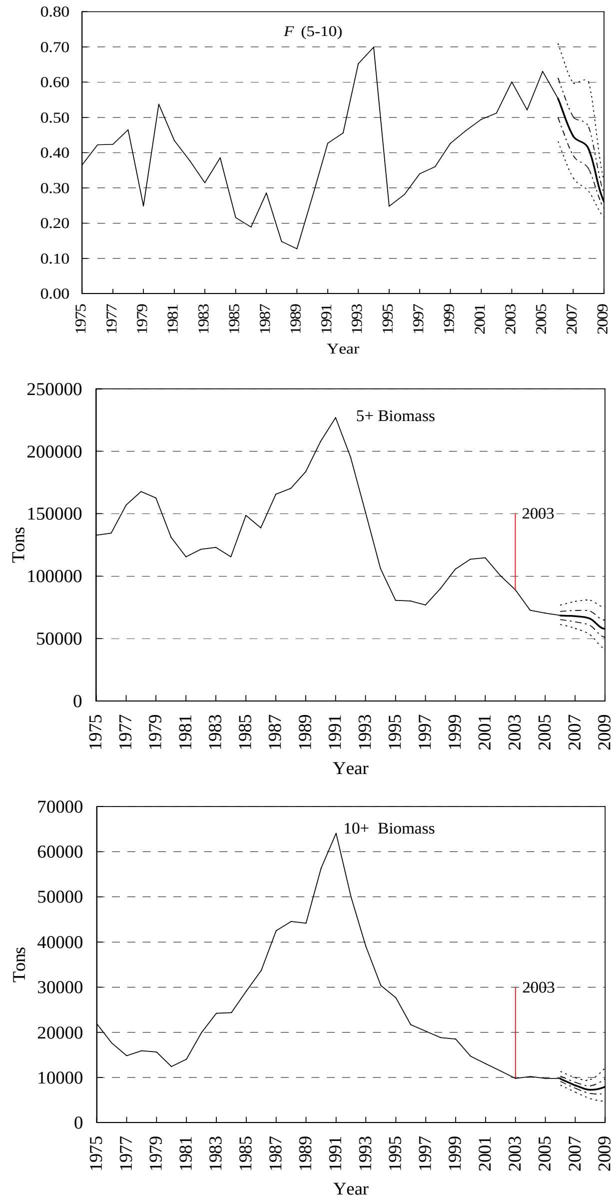


Fig. 20.22. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2005-2007 under catches 20% in excess of Fisheries Commission rebuilding plan. The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

REFERENCES

Darby, C. D., and S. Flatman. 1994. Virtual Population Analysis: Version 3.1 (Windows/Dos) user guide. *Info. Tech. Ser., MAFF Direct. Fish. Res*., Lowestoft, (1): 85 p.

Patterson, K. R., R. M. Cook, C. D. Darby, S. Gavaris, B. Mesnil, A. E. Punt, V. R. Restrepo, D. W. Skagen, G. Stefansson, and M. Smith. 2000. Validating three methods for making probability statements in fisheries forecasts. *ICES C.M. Doc*., No. V:06

NAFO 1993. STACFIS Report.*NAFO Sci. Coun. Rep*. p.43-130

NAFO 2004. STACFIS Report. *NAFO Sci. Coun. Rep*. p.85-173

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.

h) **Research Recommendation**

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

STACFIS **recommended** that *research continue on age determination for Greenland halibut in Subarea 2 and Div. 3KLMNO to improve accuracy and precision.*

21. **Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3 and 4** (SCR Doc. 98/59, 75, 06/45, 46)

a) **Introduction**

i) **Description of the fisheries**

Fisheries for northern shortfin squid consist of a Canadian inshore jig fishery in Subarea 3 and an international bottom trawl fishery for silver hake, squid and argentine in Subarea 4. A USA bottom trawl fishery occurs in Subareas 5+6. Historically, international bottom trawl and mid-water fleets participated in directed squid fisheries in Subareas 3, 4 and 5+6.

In Subareas 3+4, a TAC of 150 000 tons was in place during 1980-1998. It was set at 75 000 tons for 1999 and at 34 000 tons since then. Occasionally, very low catches from Subarea 2 occur; these have been included with Subarea 3 for convenience. Subareas 3+4 catches declined sharply from 162 100 tons in 1979 to 100 tons in 1986, then subsequently increased to 11 000 tons in 1990. During 1991-1995, catches in Subareas 3+4 ranged between about 1 000 tons and 6 000 tons, and in 1997, increased to 15 600 tons; the highest level since 1981. After 1997, catches ranged between 100 tons in 2001 and 2 300 tons in 2004 and totaled 600 tons in 2005 (SCR Doc. 06/46).

Since this annual species is considered to constitute a single stock throughout Subareas 2 to 6 (SCR Doc. 98/59), trends in Subareas 3+4 must be considered in relation to those in Subareas 5+6. Subarea 5+6 catches ranged between 2 000 tons and 24 900 tons during 1970-1997. During 1998-2003, catches in Subareas 5+6 declined from 23 600 tons to 6 400 tons. Catches increased sharply in 2004 to the highest catch on record (26 100 tons), but then declined by more than 50% (12 000 tons) in 2005 (Fig. 21.1).

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

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Recommended TAC SA 3+4	150	150	75	34	34	34	34	34	34	34
STATLANT 21A SA 3+4	15.6	1.9	0.3	0.4	<0.1	0.2	1.1[1]	2.3[1]	0.6[1]	
STATLANT 21A SA 5+6	13.6	23.6	7.4	9.0	4.0	2.7	6.4[1]	26.1[1]	12.0[1]	
STACFIS SA 3+4	15.6	1.9	0.3	0.4	<0.1	0.2	1.1	2.3	0.6	
STACFIS SA 5+6	13.6	23.6	7.4	9.0	4.0	2.8	6.4	26.1	12.0	
STACFIS Total SA 3-6	29.2	25.5	7.7	9.4	4.1	3.0	7.5	28.4	12.6	

[1] Provisional.

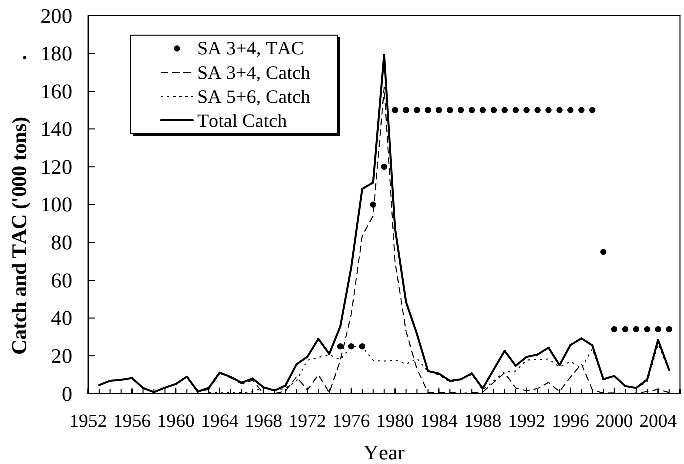


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs in relation to catches from Subareas 5+6 and the total stock.

b) **Input Data**

i) **Commercial fishery data**

Nominal catches were available for Subareas 3+4, during 1953-2005, and for Subareas 5+6 during 1963-2005. Catches from Subareas 5+6, prior to 1976, may not be accurate because distant-water fleets did not report all squid catch by species. The accuracy of the Subareas 3+4 catches prior to the mid-1970s is unknown. During 1987-2005, Subarea 4 catches include catches obtained by the Canadian Observer Program Database during a period of 100% fishery coverage plus catches from the Canadian Zonal Interchange Format Database.

ii) **Research survey data**

Fishery-independent indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were available from stratified, random bottom trawl surveys conducted by Canada on the Scotian Shelf (Div. 4VWX) during July of 1970-2005 and in the southern Gulf of St. Lawrence (Div. 4T) during September of 1971-2005. Different vessels were used to conduct the Div. 4VWX survey during the periods of 1970-1981 (CCGS *A. T. Cameron*), 1982 (*Lady Hammond*), 1983-2003 and in 2005 (*Alfred Needler*), and 2004 (*Teleost*). However, there are no conversion coefficients available with which to standardize squid catch rates prior to 2004. The 2004 index was adjusted to account for a significant vessel catchability effect between the CCGS Teleost and the CCGS *Alfred Needler*. The Div. 4VWX surveys occurs before or at the start of the fisheries and the indices are assumed to represent relative biomass and abundance levels at the start of the fishing season. Indices were also available for bottom trawl surveys conducted by the USA in Subareas 5+6 during September-October of 1967-2005. Surveys in Div. 4T and Subareas 5+6 occur at or near the end of the fisheries and the indices are assumed to represent relative abundance and biomass levels at the end of the fishing season. Survey biomass indices for Div. 4VWX and Subareas 5+6 during 1970-1997 (Fig. 21.2) were positively correlated and the indices were also positively correlated with the total catches from Subareas 3-6 during the same time period (SCR Doc. 98/59).

Abundance and biomass indices for Subarea 3 were also derived using catches in all strata from the Canadian surveys conducted in Div. 3LNOP during April-June and in Div. 3KLNO during September-December of 1995-2005. Indices were also derived from the EU survey of the Flemish Cap (Div. 3M) conducted during July of 1988-2005. Indices from the spring survey in Div. 3LNOP are similar to the trends in the Div. 4VWX indices, but indices from the autumn survey in Div. 3KLNO and the July survey in Div. 3M are not. Because *Illex* are distributed in few strata during the Div. 3LNOP and Div. 3KLNO surveys, it is likely that the precision of the indices will be improved if they are derived using catches from a subset of 56 strata sampled in Div. 3LNO during spring and 51 strata sampled in Div. 3LNO during autumn (SCR Doc. 06/45). However, it is unknown whether the distribution patterns from these two surveys reflect *Illex* abundance or the timing of the surveys in relation to the species' annual migrations through the survey areas. Although lower in magnitude, the Div. 4T indices appear to track the trends in the July survey in Div. 4VWX (Fig. 21.2).

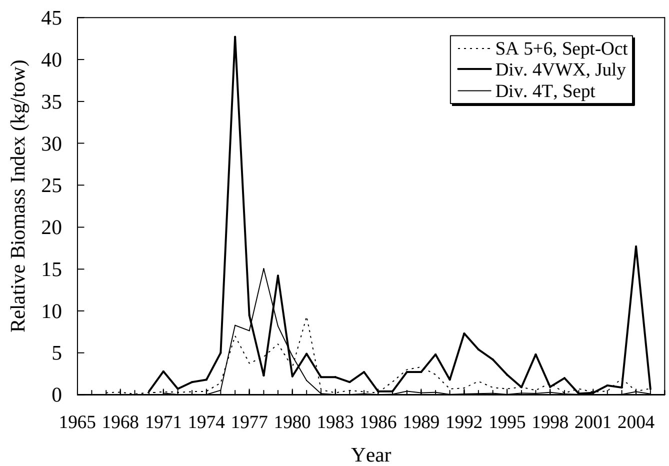


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices in Div. 4VWX during July, in Div. 4T during September, and in Subareas 5+6 during September-October.

iii) **Biological studies**

Annual mean body weights of squid from the July survey in Div. 4VWX declined sharply during 1982-1983, following a period of much higher mean weights during 1976-1981 (Fig. 21.3). Mean body weight increased gradually thereafter, and in 1999 (119 g), reached the highest value since 1981. Mean body weight declined sharply to a record low in 2000 (32 g), then increased slightly in 2001 and ranged between 69 g (in 2005) and 85 g (in 2002) during most years thereafter. Similar trends were evident in Subareas 5+6, with higher mean body weights during 1976-1981 than thereafter, but with a record low occurring in 2005 (67 g). During most years since 2001, squid from both surveys were of a size similar to the 1982-2004 average (77 g) and ranged between 67 g and 85 g.

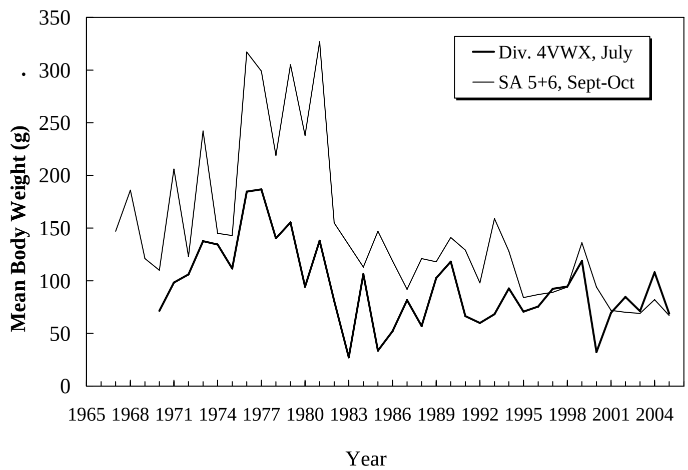


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weight of squid in the Div. 4VWX surveys during July and in the Subareas 5+6 surveys during September-October.

iv) **Relative fishing mortality indices**

Relative fishing mortality indices (Subareas 3+4 nominal catch/Div. 4VWX July survey biomass index) in Subareas 3+4 were highest during 1978-1980, within the 1976-1981 period of highest catch (Fig. 21.4), and were much lower during 1982-2004. During 2005, the fishing mortality index (0.08) was well below the 1982-2004 average (0.17).

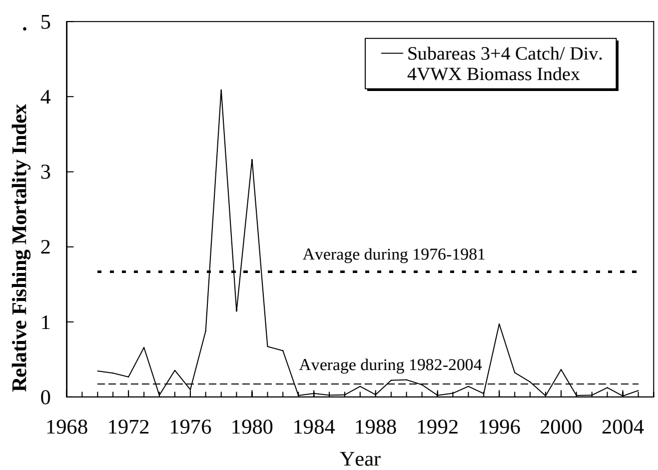


Fig. 21.4. Northern shortfin squid in Subareas 3+4: relative fishing mortality indices.

c) **Assessment Results**

Trends in fishery and research vessel survey data indicate that a period of high productivity occurred in Subareas 3+4 during 1976-1981, followed by a period of much lower productivity during 1982-2004. The high productivity period was associated with a larger mean body size than the more recent low productivity period.

Since 2000, catches in Subarea 4 have been at some of the lowest levels on record (≤45 tons) because there was no directed fishery other than a single Korean vessel which caught 13 tons of squid in an experimental jig fishery during 2005. Squid catches in Subareas 3+4 reached the highest level since 1981 in 1997 (15 600 tons), then subsequently declined to less than 100 tons in 2001; the second lowest level since

1953. Catches increased between 2002 (300 tons) and 2004 (2 300 tons), then declined to 559 tons in 2005; a level well below the 1982-2004 average (3 400 tons).

During 1998-2003, the relative biomass index from the Div. 4VWX survey was below the 1982-2004 average for the low productivity period (3.0 kg/tow). The high relative biomass index in 2004 (17.7 kg/tow) was followed by a large decline (0.7 kg/tow) in 2005. Since reaching a record low in 2000 (32 g), mean body weights have been near the 1982-2004 average (77 g) during most years thereafter. During 2005, mean body weight was below this average. The combination of a below average biomass index and body size of squid caught in the July Div. 4VWX survey suggest that the Subareas 3+4 stock component remained in a state of low productivity during 2005.

d) **Reference Points**

Illex illecebrosus is an annual, semelparous species. Recruitment is strongly influenced by environmental conditions, and as a result, the Subareas 3+4 stock component has experienced low and high productivity states (SCR Doc. 98/75). Since the onset of the 1982 low productivity period, the magnitude of the Div. 4VWX biomass index has not consistently reflected the magnitude of the fishery removals during each respective year. Given the inconsistent response of the annual relative biomass indices to fishery removals and the lack of a stock-recruitment relationship, limit reference points or proxies thereof are not currently estimable for the Subareas 3+4 stock component.

e) **Research Recommendation**

For northern shortfin squid in Subareas 3+4, STACFIS **recommended** that *abundance and biomass indices from the Canadian multi-species bottom trawl surveys conducted during spring and autumn in Div. 3LNO, beginning with 1995, be derived using the two subsets of strata listed in SCR Doc. 06/45 in order to improve the precision of the indices.*

IV. OTHER MATTERS

1. **Review of SCR Documents**

SCR Doc. 06/4 A. Vaskov. On Including Golden Redfish (*Sebastes marinus*) into the Calculations to Estimate Redfish Stocks on the Flemish Cap

The paper presents data on distribution and biology of *Sebastes marinus*, *S. mentella* and *S. fasciatus* from fishing catches on the Flemish Cap in 2005. Biological data were collected by the observers being aboard Russian fishing vessels in October-November 2005. Fishing was executed at 200-400 m depths. Fishing gears were bottom trawls with the mesh size of not less than 130 mm.

According to the preliminary data, in 2005, on the Flemish Cap, the catch of redfish species by Russian vessels was equal to 1 016 tons. Golden redfish (*S. marinus*) prevailed (more than 50%) in catch. The results of bathymetric distribution researches showed that, at 200-299 m depths, *S. marinus* made up the bulk of catches. With the increase in fishing depth the portion of beaked redfish species (*S. mentella* and *S. fasciatus*) which amounted to 95.6% at 400-499 m depths rose.

In according to the results from the trawl surveys by EU, mean long-term biomass of *S. marinus* equaled to 20% of the total redfish stock. Increase or decrease in the total stock of redfish species was mainly connected with golden redfish stock growth and reduction.

At present, on the Flemish Cap the overall stock size is estimated and recommendations for their exploitation are developed based on fishing and biological data on two species – *S. mentella* and *S. fasciatus*. To obtain more comprehensive and correct data on redfish stock, golden redfish *S. marinus* should be included into the calculations.

With regards the possible inclusion of Flemish Cap golden redfish (Sebastes marinus) in the assessment of 3M redfish, regarded at present as a management unit composed of populations of two very similar redfish species (*Sebastes mentella* and *Sebastes fasciatus*), STACFIS decided to defer this matter to the June 2007 meeting as there was insufficient time remaining in this meeting to thoroughly discuss the best way to assess redfish populations in Div. 3M.

2. **STACFIS Working Procedures**

During the assessment of Greenland halibut in SA2 and Divisions 3KLMNO, STACFIS noted that the relative strength of cohorts were not consistent across all age groups. Specifically, the correlation of survey indices at ages 7 and 8 for a given cohort was poor in all surveys considered.

STACFIS agreed that for all stocks, survey indices should be subject to quality validation, prior to inclusion into any population model and, accordingly, STACFIS **recommended** that *candidate indices for inclusion in population models should be subject to analyses of their ability to indicate trends in population size and that, suggestions for appropriate analyses be presented and evaluated at the June 2007 Meeting.*

During its deliberations on several stocks, a concern was raised with regard to the practice of including tuning indices into age-structured population models in cases where the index is derived from only a partial coverage of the stock area. The committee agreed that it was not best practice to simply allow the model goodness-of-fit statistics to determine whether such indices are informative within the model formulation. If possible, a-priori arguments should be provided to justify inclusion of indices which survey only part of the stock area and that an evaluation of the potential of partial indices to track population trends should be conducted.

3. **Acknowledgements**

The Chair thanked the participants for their valuable contributions. He particularly acknowledged the hard work and dedication of the Designated Experts and recognized their contribution to the entire meeting. Special thanks were extended to the Secretariat for their excellent support to the meeting. The meeting was adjourned noting that the report will be reviewed and that minor editorial changes will be made by the Chair.