PART A: SCIENTIFIC COUNCIL MEETING, 5-19 JUNE 2008

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Missing from picture: Eugene Colbourne, Gary Maillet, Brian Petrie, Ross Hendry, Temur Tairov, Ellen Kenchington, Rudolphe Devillers, Susanna Fuller, Marty King, Johanne Fischer

Ilya Skryabin, Alexander Vaskov and Manfred Stein (STACPUB Chair)

Don Power (SC Chair) and Anthony Thompson (SC Coordinator)

REPORT OF SCIENTIFIC COUNCIL MEETING

5-19 JUNE 2008

Chair: Don Power Rapporteur: Anthony Thompson

I. PLENARY SESSIONS

The Scientific Council met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 5-19 June 2008, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Norway, Russian Federation, 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 to discuss the provisional agenda and plan of work.

The opening session of the Council was called to order at 1315 hours on 5 June 2008. The Council was informed that a supplementary request was received from the Fisheries Commission from deliberations at an Intersessional meeting held from April 30-May 7, 2008, pertaining to Fisheries Commission commitments related to UNGA Resolution 61/105 on Vulnerable Marine Ecosystems. The Chair noted that although this request was less than the 60-day advance notice required in its Rules of Procedure (Rule 4.1 and 4.3), much of the basis to respond to the request had already been provided by the Scientific Council Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) which met a week prior to this Scientific Council meeting. The Council agreed to revise the provisional agenda to include the supplemental request. The provisional agenda was **adopted** and the Scientific Council Coordinator, Anthony Thompson was appointed the rapporteur.

The Council was informed that authorization had been received by the Executive Secretary for proxy votes from Cuba and Iceland.

Applications for Observer status were made by WWF-Canada and the Ecology Action Centre (EAC). Marty King and Susan Fudge from WWF-Canada were welcomed to the meeting. Susanna Fuller from EAC was also welcomed.

The opening session was adjourned at 1600 hours on 5 June 2008. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda. The Council considered and **adopted** the STACFEN report on 11 June 2008 and the STACREC report on 18 June 2008.

The concluding session was called to order at 1000 hours on 19 June 2008.

The Council considered and **adopted** the remaining reports of STACPUB, STACFIS and the Scientific Council Report of this meeting of 5-19 June 2008.

The meeting was adjourned at 1420 hours on 19 June 2008.

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 at Appendix V.

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 2007

The Council noted recommendations made in 2007 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 the Scientific Council Meeting, 7-21 June 2007

VII. Management Advice and Responses to Special Requests

1. Fisheries Commission (Appendix V, Annex 1)

d) Special Requests for Management Advice

ii) Evaluation of Recovery Plans

Scientific Council has noted in the past that there are several stocks, currently under moratorium, for which bycatch is preventing or severely limiting biomass growth. These stocks, such as Div. 3NO cod, Div. 3LNO American plaice and Div. 3M cod, are at low levels, despite a ban on directed fishing for about twelve years. Bycatches also continue on other stocks that have very low biomass levels. Scientific Council **recommended** that *rebuilding or recovery plans for these stocks be considered, which should incorporate specific measures to reduce bycatch.*

STATUS: The Div. 3NO cod conservation and rebuilding strategy was adopted by Fisheries Commission in September 2007 and published in the 2008 CEM. Contracting Parties were requested to keep bycatch level to a minimum, but no additional specific bycatch reduction measures were considered. No other new rebuilding plans were adopted in 2008.

Scientific Council also strongly **recommended** that *Fisheries Commission take steps to ensure that any bycatches taken during existing directed fisheries are true and unavoidable bycatches.*

STATUS: Fisheries Commission amended the bycatch requirements regulation by adding “3LN Redfish” to the species with bycatch restrictions. No further specific bycatch measures were adopted in 2007 for implementation in 2008.

v) Information on Seamounts

Scientific Council **recommended** that *any research survey in the closed areas should be reviewed first by Scientific Council before proceeding. Priority should be given to develop surveys that undertake bathymetric data collection, multi-beam surveys, taxonomic studies, and gear-mounted camera systems for habitat mapping.*

STATUS: Some new scientific surveys have taken place since June 2007 but none have sought the approval of Scientific Council.

Scientific Council also **recommended** that *the boundaries of the seamount areas be modified to include any peaks close to the current boundaries, and that General Council discuss with WECAFC the issue of seamounts which straddle or are adjacent to the southern boundary of the NAFO Convention Area.*

STATUS: No action.

XII. Other Matters

4. Classification Criteria for NAFO Stocks

Scientific Council **recommended** that *the stock classification is included in the summary sheets and that clarification be added to the classification table to record if the stock has references points.*

STATUS: This recommendation was not implemented by Scientific Council at the October-November meeting of Scientific Council and is pending further deliberations. This issue will be further discussion at this June 2008 meeting (Item X.3).

5. Other Business

a) VMS data

Scientific Council **recommended** that *position be reported at shorter intervals than the current 2 hours, and the NAF fields for speed (code SP) and course (code CO) be added to the POS reports transmitted to the Secretariat.*

STATUS: The Secretariat developed an SCR document (SCR Doc. 08/30) that supported the reduction to a one hour reporting time and the inclusion of speed. This will be submitted to STACTIC in July 2008, along with the original Scientific Council request, for consideration.

From the Scientific Council Annual Meeting, 24-28 September 2007

V. Special Requests from the Fisheries Commission

Therefore, in order to provide complete and timely advice, Scientific Council **recommended** that *for the Annual Meeting the Fisheries Commission submits, whenever possible, its questions for Scientific Council well in advance of the meeting.* Scientific Council asks that the Secretariat includes this recommendation in the circulation of the Annual Meeting agenda.

STATUS: This was included in the Annual Meeting agenda that was circulated this year.

4. Special Request from the Fisheries Commission on Ecosystem Proposals

Regarding the protection of corals, Scientific Council was asked to identify any historical fishing activity in the proposed zone over the last five years;

Scientific Council **recommended** that *appropriate observer and VMS data be made available.*

STATUS: Observer data is presently being digitized in the NAFO Secretariat. VMS data is available in the NAFO Secretariat and can be provided to Scientific Concil in summary form upon specific requests from the Scientific Council Chair.

III. FISHERIES ENVIRONMENT

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

STACFEN made no formal recommendations during this 2008 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:

STACPUB **recommended** that *to widen the scope of JNAFS in order to cover the fields of benthic ecology and the Ecosystem Approach, it was agreed to create two new Associate Editor positions and to identify potential candidates to join the Editorial Board.*

V. RESEARCH COORDINATION

The Council **adopted** the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chair, Ricardo Alpoim. 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:

STACREC **recommended** that *the Secretariat discuss the following with Contracting Parties: i) dropping the numeric codes for species and using the appropriate alpha codes provided by FAO ASFIS species list; and ii) the harmonization of electronic data submissions.*

STACREC **recommended** that *the Secretariat maintain a list of information sources and this list be made more accessible on the web site. In addition STACREC encourages Contracting Parties to continue reporting research activities in the NRA, including those conducted by commercial vessels.*

STACREC reiterates the importance of maintaining a database of data used in stock assessments and **recommended** that *when there is a change in Designated Expert the Secretariat and Chair of Scientific Council contact the past Designated Expert to ensure that the stock assessment data is submitted to the Secretariat so this data continues to be available to STACFIS and Scientific Council.*

VI. FISHERIES SCIENCE

The Council **adopted** the Report of the Standing Committee on Fisheries Science (STACFIS) as presented by the Chair, Michael Kingsley. 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 Scientific Council as endoresed by the Council, is as follows: *all Contracting Parties take measures to improve the accuracy of their catch estimates and present them as far in advance of future June meetings as possible.*

VII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. Fisheries Commission

(Appendix V, Annex 1)

The Scientific Council noted that updated scientific advice on northern shrimp (Northern shrimp in Div. 3M and Div. 3LNO) for 2008 and advice for 2009 was delivered to the Fisheries Commission at an Intersessional FC meeting held April 30-May 7, 2008. Updated advice for 2009 will be provided at the Annual meeting in 2008 through an Interim Monitoring Report and further requests from Fisheries Commission will be considered during Scientific Council Meeting on 22-30 October 2008.

Requests Received from September 2007 Annual Meeting

a) Request for Advice on TACs and Other Management Measures for the Year 2009

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 2007 agreed to consider certain stocks in 2008. This section presents reports for which the Scientific Council provided scientific advice for 2009 during this meeting.

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

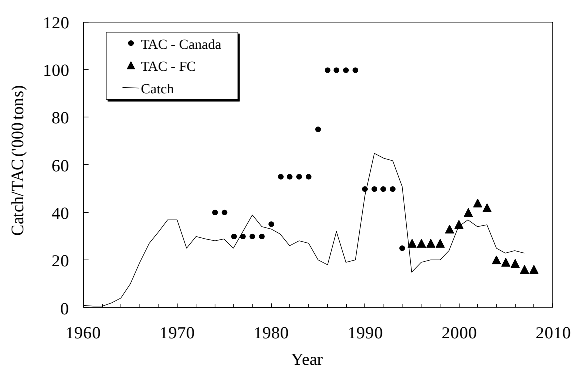
Background: The Greenland halibut stock in Subarea 2 and Div. 3KLMNO is considered to be part of a biological stock complex, which includes Subareas 0 and 1.

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 t 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 t, the highest since 1994. The estimated catch for 2002 was 34 000 t. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 t to 38 500 t. A fifteen year rebuilding plan has been implemented by Fisheries Commission for this stock. The catches in 2004-2007 have exceeded the rebuilding plan TACs by 27%, 22%, 27%, and 42% respectively, despite reductions in fishing effort.

	Catch ('000 t)		TAC('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2005	23	18[1]	nr	19
2006	24	17[1]	nr	18.5
2007	23	15[1]	nr	16
2008			nr	16

[1] Provisonal

nr No recommendation – Evaluation of Rebuilding Plan

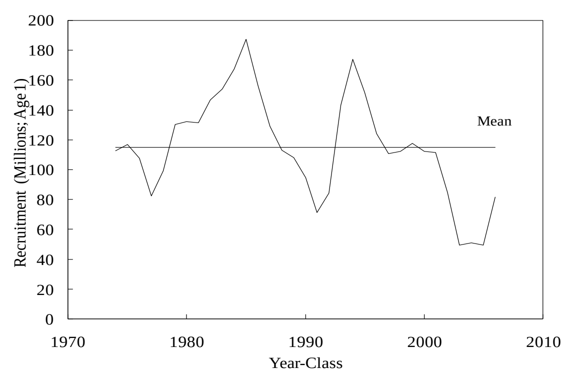


Data: CPUE data throughout the stock area were available from fisheries conducted by Canada, EU-Spain and EU-Portugal. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2+3KLMNO (1978-2007), EU in Div. 3M (1988-2007) and EU-Spain in Div. 3NO (1995-2007). Commercial catch-at-age data were available from 1975-2007.

Assessment: An analytical assessment using Extended Survivors Analysis (XSA) tuned to the Canadian spring (Div. 3LNO; 1996-2007), and autumn (Div. 2J, 3K; 1996-2007) and the EU (Div. 3M; 1995-2007) surveys was used to estimate the 5+ exploitable biomass, level of exploitation and recruitment to the stock. Natural mortality was assumed to be 0.2 for all ages.

Fishing Mortality: High catches in 1991-94 resulted in F_{5-10} exceeding 0.50. F_{5-10} then dropped to about 0.25 in 1995 with the substantial reduction in catch. F_{5-10} increased since then with some decline after 2003 and has remained high in spite of the Fisheries Commission rebuilding plan.

Recruitment: The 2003-2006 year-classes are estimated to be well below average. As such, the immediate recruitment to the exploitable biomass is expected to be poor.



Biomass: The exploitable biomass (age 5+) was reduced to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. However, increasingly higher catches and fishing mortality since then accompanied by poorer recruitment has caused a subsequent decline. The current (2004-2008) estimates of exploitable biomass are amongst the lowest in the series.

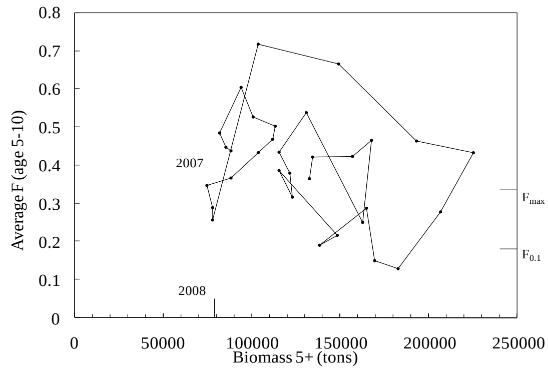
During recent assessments of this stock, the exploitable biomass has been underestimated and fishing mortality overestimated. However, the weaker strength of the 2003-2005 year-classes has not shown appreciable retrospective bias.

State of the Stock: The exploitable biomass has been declining in recent years and the current estimates (2004-2008) are amongst the lowest in the series. Recent recruitment has been far below average, and fishing mortality, although decreasing, remains high.

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

For this stock F_{max} is estimated to be 0.34 and $F_{0.1}$ is 0.18 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 exceeds the F_{max} level. Scientific Council also noted that the average fishing mortality has been below $F_{0.1}$ only twice.



Projections and Evaluation of the Management Strategy:

Four projections were considered. The assumed catches for 2009-2012 correspond to (i) fishing mortality of $F_{0.1}$, (ii) current fishing mortality (F_{2007}), (iii) fixed 16 000 t catches, or (iv) fixed 22 750 t catches. All projections assume that the catch for 2008 corresponds to status quo fishing mortality (24 150 t).

Projection results (deterministic projection results tabulated below, see figures for stochastic projection results) under either the current fishing mortality, fixed catch of 16 000 t or fixed catch of 22 750 t are pessimistic, because the majority of the year-classes which recruit to the exploitable biomass are estimated to be well below average.

F0.1

Year	5+ Biomass (t)	Yield (t)	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	10471	0.180
2010	71477	10652	0.180
2011	80184	10389	0.180
2012	90180	10755	0.180
2013	100757		

Fcurrent

Year	5+ Biomass (t)	Yield	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	21252	0.432
2010	58341	16573	0.432
2011	58946	14251	0.432
2012	63078	14169	0.432
2013	68182		

16,000 t

Year	5+ Biomass (t)	Yield	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	16000	0.298
2010	64737	16000	0.343
2011	66507	16000	0.406
2012	68977	16000	0.439
2013	72132		

22,750 t			
Year	**5+ Biomass (t)**	**Yield**	**Fbar (5-10)**
2008	79050	24154	0.432
2009	67937	22750	0.475
2010	56517	22750	0.734
2011	49533	22750	1.394
2012	42699	22750	2.798
2013	35401		

Growth rates of the exploitable (5+) and 10+ biomass over the projection period (2013 relative to 2008), and since the beginning of the rebuilding plan (2013 relative to 2003) indicate that out of the scenarios considered, exploitable biomass increases only if fishing mortality is reduced to $F_{0.1}$.

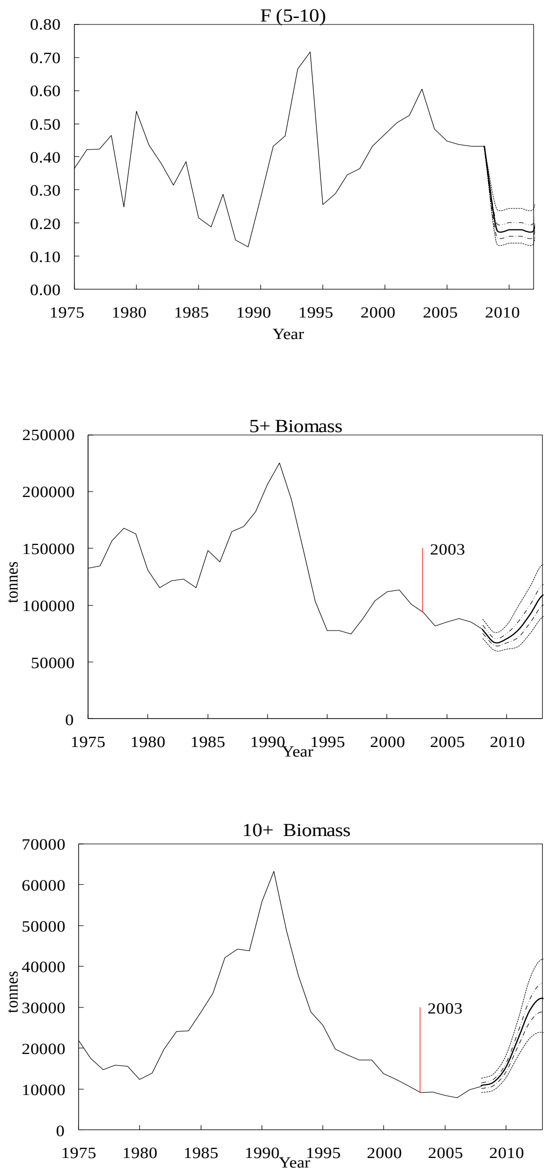
Exploitable Biomass	F0.1	F2007	16 000t	22 750t
[B(2013)-B(2008)] / B(2008)	27%	-14%	-9%	-55%
[B(2013)-B(2003)] / B(2003)	7%	-27%	-23%	-62%

10+ Biomass	F0.1	F2007	16 000t	22 750t
[B(2013)-B(2008)] / B(2008)	199%	4%	38%	-92%
[B(2013)-B(2003)] / B(2003)	253%	23%	63%	-91%

The level of the projected biomass in 2013 in relation to the rebuilding plan target (140 000 t) indicates that the biomass remains below this target under each scenario, but is most optimistic under $F_{0.1}$. Note that if catches are maintained at the current TAC level (16 000 t), the biomass in 2013 is projected to be 52% of the target level with only six years remaining in the rebuilding plan.

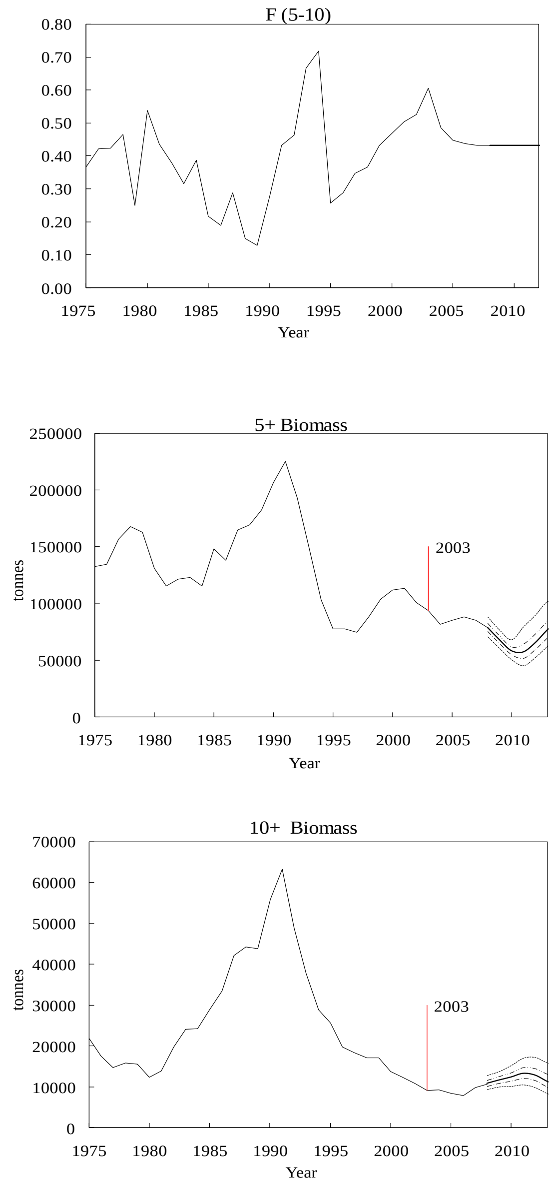
Scenario	Projected Biomass Relative to 140 000t
F0.1	0.72
F2007	0.49
16,000 t	0.52
22,750 t	0.25

$F_{0.1}$



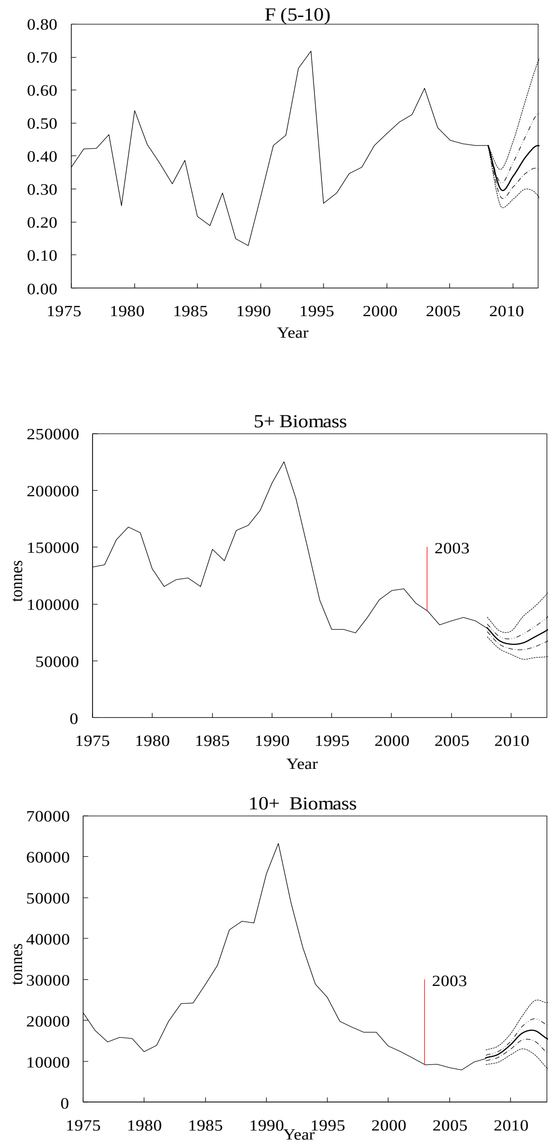
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2009-2013 assuming an F_{sq} catch (24 150 t) in 2008, and a fishing mortality of ***$F_{0.1}$*** thereafter. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

F_{2007}



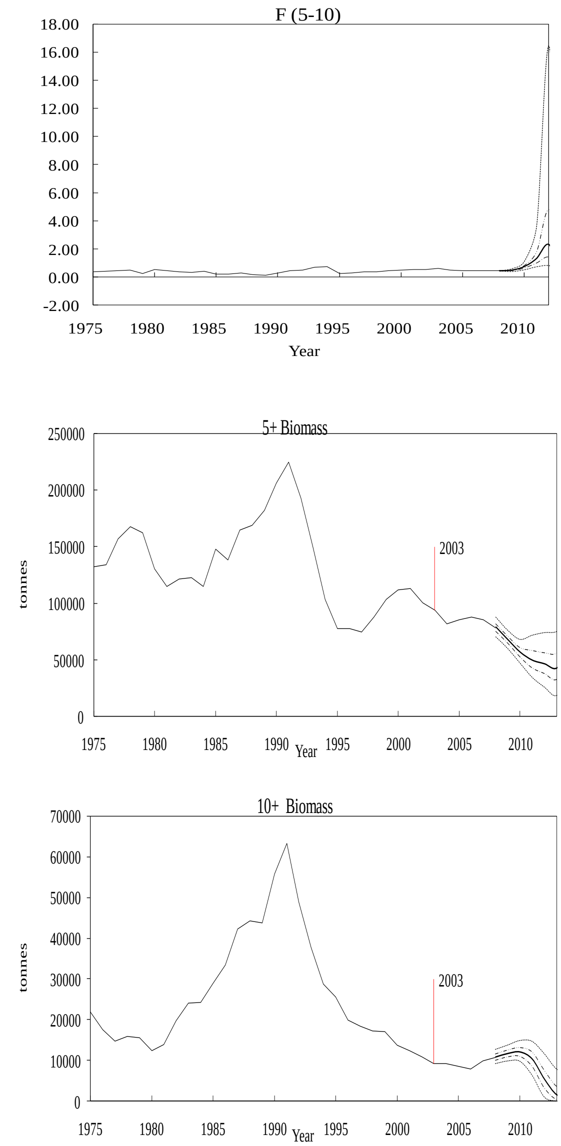
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2009-2013 assuming an F_{sq} catch (24 150 t) in 2008, and a fishing mortality of ***F_{2007}*** thereafter. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

16 000 t



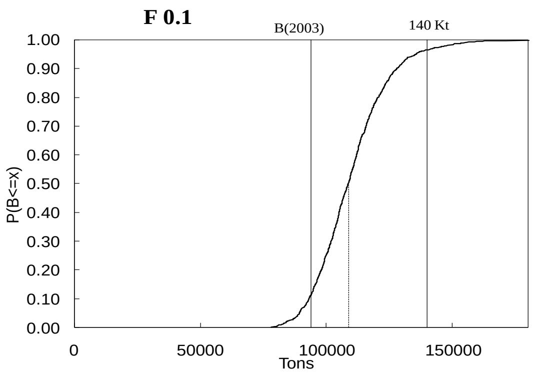
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2009-2013 assuming an F_{sq} catch (24 150 t) in 2008, and fixed catches of 16 000 t thereafter. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

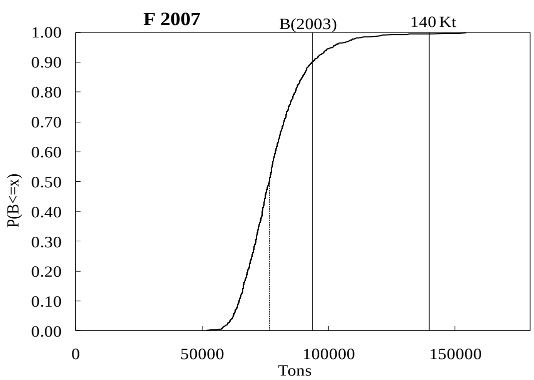
22 750 t



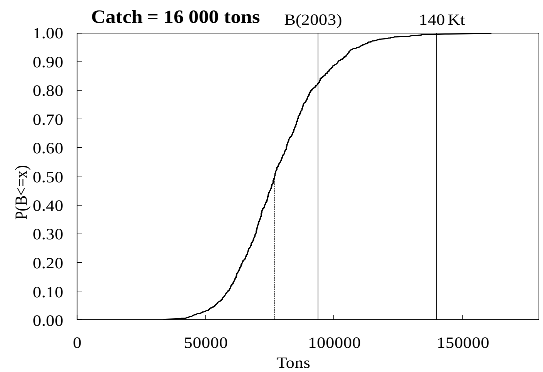
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2009-2013 assuming an F_{sq} catch (24 150 t) in 2008, and fixed catches of 22 750 t thereafter. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

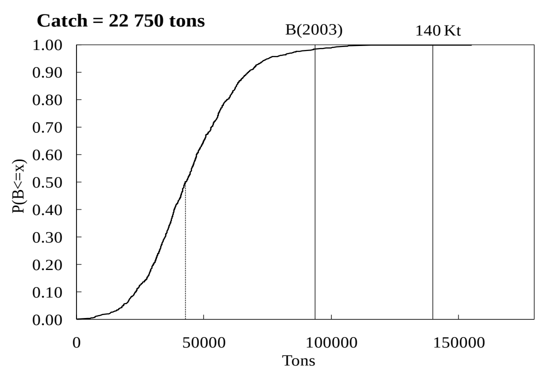
The risk of the projected exploitable biomass in 2013 being below a reference level is given in the figures below. The solid vertical lines highlight the level of the exploitable biomass in 2003 estimated in the present assessment (93 800 t), when the rebuilding plan was implemented, and also 140 000 t, the target identified in the rebuilding plan. For example, under the $F_{0.1}$ scenario, there is a high probability (approximately 0.90) that the 2013 biomass will exceed the 2003 exploitable biomass, but a low probability (<0.05) that the rebuilding target will be attained by 2013.





Probability profile of exploitable biomass in 2013. Vertical lines indicate the biomass levels in 2003 (year in which Fisheries Commission rebuilding plan developed) and the rebuilding plan target of 140 000 t. The dashed vertical lines indicate the median exploitable biomass in 2013.





Probability profile of exploitable biomass in 2013. Vertical lines indicate the biomass levels in 2003 (year in which Fisheries Commission rebuilding plan developed) and the rebuilding plan target of 140 000 t. The dashed vertical lines indicate the median exploitable biomass in 2013.

Recommendation: To provide a consistent increase of the 5+ exploitable biomass, Scientific Council recommended that fishing mortality should be reduced to a level not higher than $F_{0.1}$.

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. In recent years, the proportion of older individuals in the catch has decreased.

Scientific Council noted that the prospects of rebuilding this stock have, to date, been hampered by catches that have exceeded the Rebuilding Plan TACs.

Scientific Council expressed concern that most of the year-classes which will recruit to the exploitable biomass in coming years are presently estimated to be well below average.

Scientific Council reviewed the issue of using CPUE indices in the assessment and confirmed its view that CPUE indices for this stock should not be interpreted to reflect stock size, and they were therefore not used in the current population model.

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.

The next assessment will be in 2009.

Sources of Information: SCR Doc. 08/1, 7, 18, 20, 25, 31, 32, 34, 46, 47, 48; SCS Doc. 08/5, 6, 7, 12, 13; FC Doc. 03/13.

b) Request for Advice on TACs and Other Management Measures for the Years 2009 and 2010

The Scientific Council at its meeting of September 2007 reviewed the assessment schedule and agreed to consider certain stocks on a multi-year rotational basis. This section presents those stocks for which the Scientific Council provided scientific advice for the years 2009 and 2010. The next assessment of these stocks will be in 2010.

Thorny Skate (Amblyraja radiata) in Div. 3LNOPs

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.

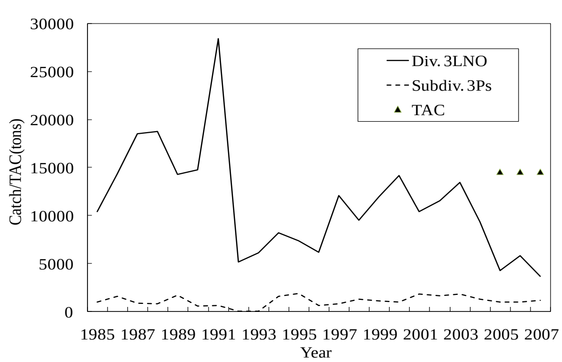
Fishery and Catches: Commercial catches of skates comprise a mixture of skate species. However, thorny skate represents about 95% of the skates taken in the catches. Thus, the skate fishery on the Grand Banks can be considered as directed for thorny skate.

The main participants in this fishery are Canada, EU-Spain, EU-Portugal and Russia. 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 peaked at about 31 500 t in 1991, averaged 22 300 t from 1985 to 1991, and averaged 8 600 t from 1992-1995. Catch levels as estimated by STACFIS for divisions 3LNO averaged 9 050 t during the period 2000-2007.

Thorny skate came under quota regulation in 2004, with a Total Allowable Catch (TAC) of 13 500 t for 2005-2007 in Div. 3LNO, and Canada set a TAC of 1 050 t for Subdivision 3Ps.

	Div. 3LNOPs Catch ('000 t)		TAC('000 t)[1]	
Year	STACFIS[2]	21A	Recc.	Agreed
2005	5.1	4.4	11[3]	14.55
2006	7.0	6.7[2]	11[3]	14.55
2007	4.7	6.5[2]	11	14.55
2008			11	14.55

[1] TAC includes NAFO Div. 3LNO plus Canada Sundiv. 3Ps
[2] Provisional
[3] Includes NAFO Div. 3LNO only



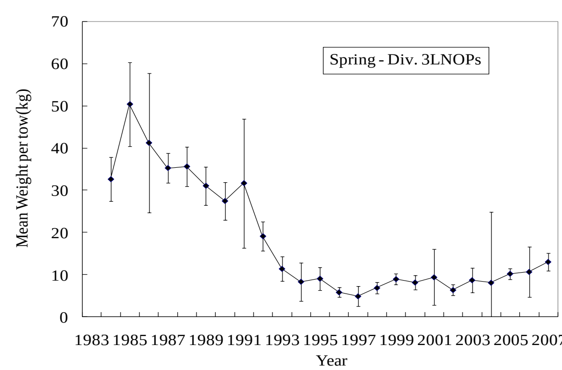
Data: Length frequencies were available for EU-Spain (1985-1991 and 1997-2007), EU-Portugal (2002-2004;2006-2007), Canada (1994-2006) and Russia (1998-2007).

Indices of biomass from the Canadian spring survey in Div. 3L, 3N, 3O and Subdivision 3Ps employed a Yankee 41 trawl from 1972-1982, an Engel trawl 1984 to 1995 and a Campelen 1800 trawl thereafter. Maximum depth surveyed in the spring was 366 m before 1991 and ~750 m thereafter. Autumn survey biomass indices in NAFO Division 3LNO from 1990-1994 were conducted with an Engel trawl, and from 1995-2007 with a Campelen 1800 trawl.

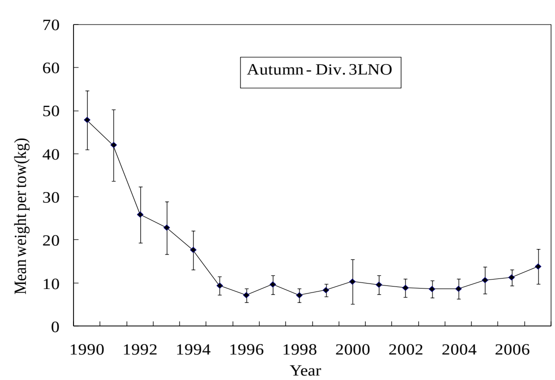
Spanish survey biomass indices in the NRA Div. 3NO were available for 1997-2007. Spanish survey biomass estimates in the NRA Div. 3L were available for 2003-2004 and 2006-2007.

Assessment: No analytical assessment was accepted.

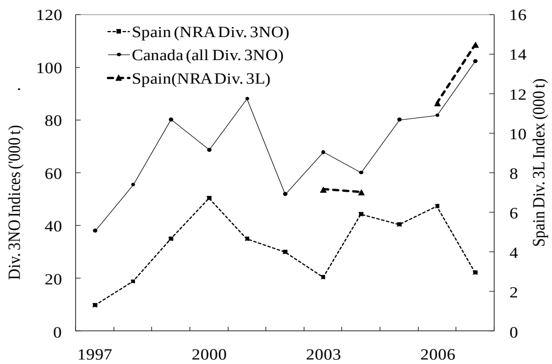
Biomass. The Canadian spring survey biomass indices fluctuated without trend prior to the mid-1980s then declined rapidly until the early-1990s. The biomass has been stable during the 1996 to 2004 period. During recent years the biomass appears to be increasing.



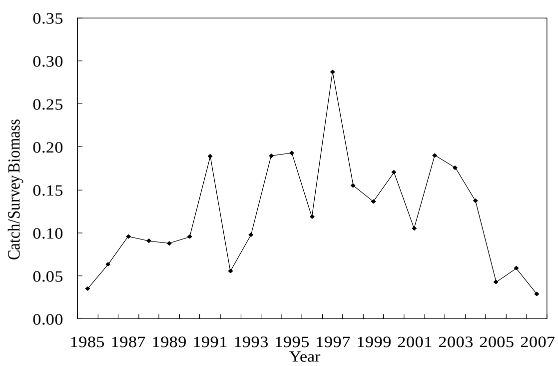
The pattern from the Canadian autumn survey, for comparable periods, was similar.



The biomass trajectory from the Spanish surveys was similar to that of the Canadian surveys. However, the Spanish 3NO survey decreased during 2007.



Fishing Mortality. The catch/survey biomass index increased from ~7% in the mid-1980s to an average of ~15% in the late 1990s. During recent years, the index has declined from 19% in 2002 to an average of ~4% in 2005-2007.



Recruitment. Not available.

State of the Stock: The current state of the stock is unclear compared to the historic (pre-1980s) period. The biomass has been relatively stable from 1996 to 2004 but at much lower levels than in the mid-1980s. During 1995-2004, average catch was about 11 900 t. Recent catches from 2005-2007 averaged 5 580 t during a period when the biomass indices increased slightly.

Recommendation: To promote recovery of thorny skate, Scientific Council recommended that catches in 2009 and 2010 should not exceed 6 000 t (the average catch during the past three years) in NAFO Divisions 3LNOPs.

Reference Points: Not determined.

Special Comments: 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.

Ratios of staged young of the year to mature female skates, as a measure of recruits per spawner, have declined from 2.5 in 1996 to 0.5 in 1999. This ratio has varied without pattern at this low level since that decline.

The next assessment will be in 2010.

Sources of Information: SCR Doc. 08/9, 21, 43; SCS. Doc. 08/5, 6, 7

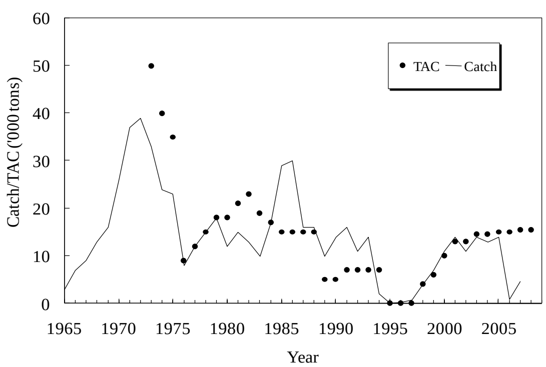
Yellowtail flounder (Limanda ferruginea) in Div. 3LNO

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 increased from 4 400 t in 1998 to 13 900 t in 2005. TACs were exceeded each year from 1985 to 1993, and 1998-2001, but not since 2002. In 2006 and 2007 catches were much lower than the TACs.

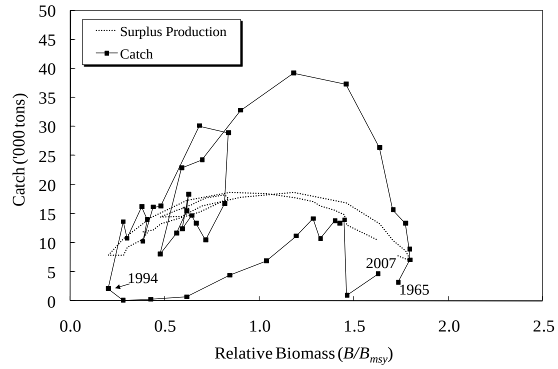
	Catch ('000 t)		TAC('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2005	13.9	13.9	15.0	15.0
2006	0.9	0.6[1]	15.0	15.0
2007	4.4	4.6[1]	15.5	15.5
2008			15.5	15.5

[1] Provisonal

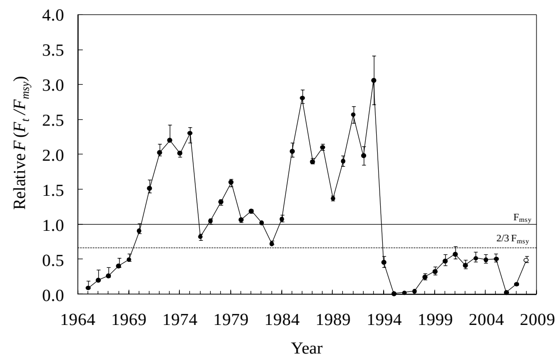


Data: CPUE from Canadian trawlers were available from 1965 to 2005, and 2007. Length frequency data from the Canadian fishery (2007) and from bycatches of Spanish (2007), Portuguese and Russian (2006 and 2007) trawlers were available. Abundance and biomass indices were available from: annual Canadian spring (1971-1982; 1984-2007) and autumn (1990-2007) bottom trawl surveys; annual USSR/Russian spring surveys (1972-1991); and Spanish surveys in the NAFO Regulatory Area of Div. 3NO (1995-2007).

Assessment: An analytical assessment using a stock production model was accepted to estimate stock status in 2008. Since the moratorium (1994-1997), the catches have been low enough each year to allow the stock to grow.

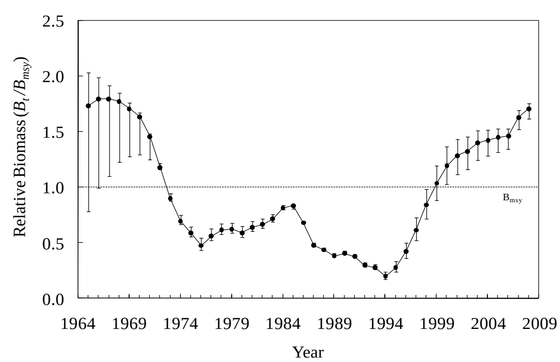


Fishing Mortality: F has been below F_{msy} since 1994 In 2007, F is about 15% of F_{msy}, and is projected to be about 49% of F_{msy} in 2008 with an assumed catch of 15 500 t (TAC).



Recruitment: Based on a comparison of small fish (<22 cm) in research surveys, recent recruitment appears to be about average.

Biomass: Biomass estimates in all 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 70% above B_{msy} in 2008.



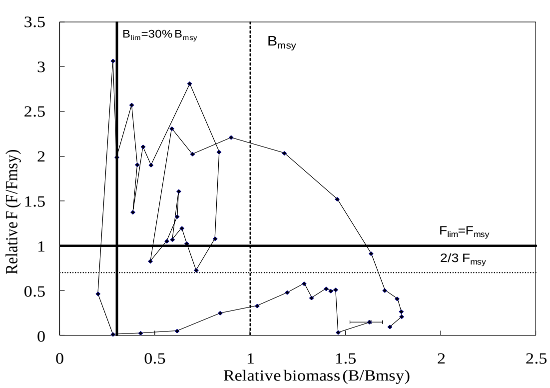
State of Stock: Stock size has steadily increased since 1994 and is currently estimated to be 1.7 times B_{msy}, well above the level of the mid-1980s.

Catch Projections in 2009-2010: Catch projections (in '000 t) at various levels of *F* are shown below.

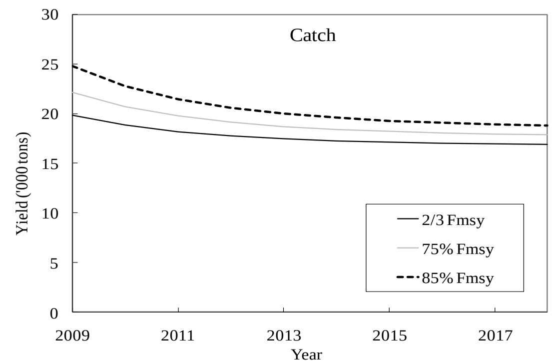
Projected *F*	Catch 2009	Catch 2010
F_{2008} (catch=15 500t)	15.0	14.7
2/3 F_{msy}	19.9	18.8
75% F_{msy}	22.1	20.7
85% F_{msy}	24.8	22.8
F_{msy}	28.7	25.7

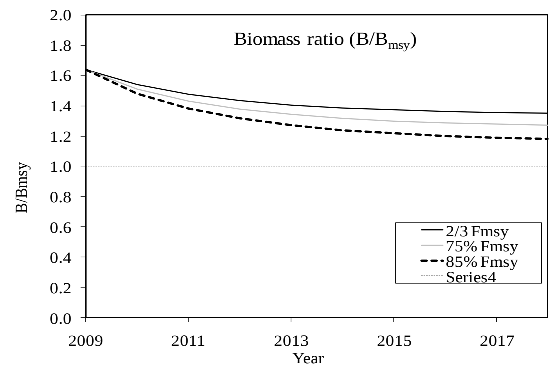
Recommendation: Scientific Council noted that this stock is well above B_{msy}, and recommended any TAC option up to 85% F_{msy} for 2009 and 2010.

Reference Points: 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 recommended that B_{lim} *be set at 30%* B_{msy}, *following the recommendation of the Limit Reference Point Study Group. 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 0.26. Projections were made to estimate catch for each year from 2009 to 2018 at a range of fishing mortalities. Although yields are projected to decline at the levels of *F* examined (2/3 F_{msy}, 0.75 F_{msy} and 0.85 F_{msy}), at the end of the projection period, biomass is still projected to be above B_{msy}.





Special Comment: Scientific Council noted that the yellowtail flounder fishery takes cod and American plaice as bycatch. Hence, in establishing the TAC for yellowtail flounder, the impacts on Div. 3NO cod and Div. 3LNO American plaice of any increase in yellowtail flounder TAC should be considered.

Because of the uncertainty in the estimation of F_{msy}, Scientific Council does not consider it prudent to fish above 85% F_{msy}.

The next Scientific Council assessment of this stock will be in 2010.

Sources of Information: SCR Doc. 08/8, 44, 45; SCS Doc. 07/ 6, 8, 9; 08/5, 6, 8.

c) Request for Advice on TACs and other Management Measures for the Years 2009, 2010 and 2011

The Scientific Council at its meeting of September 2007 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 2009, 2010 and 2011 except where noted. The next assessment of these stocks will be in 2011.

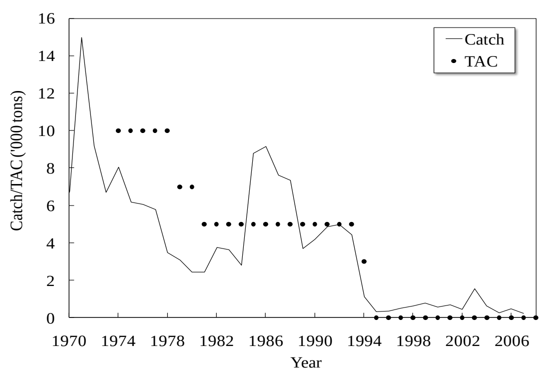
Witch flounder (Glyptocephalus cynoglossus) in Div. 3NO

Background: The stock mainly occurs in Div. 3O along the southwestern slopes of the Grand Bank but appear to move onto the shallow banks seasonally. 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 t including unreported catches. Catch for 2003 was estimated to be between 844 and 2 239 t. Catches in the most recent two years were 481 t and 222 t respectively.

	Catch ('000 t)		TAC('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2005	0.3	0.3	ndf	ndf
2006	0.5	0.2[1]	ndf	ndf
2007	0.2	0.2[1]	ndf	ndf
2008			ndf	ndf

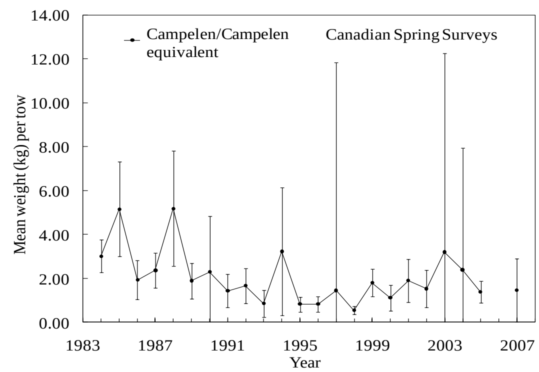
[1] Provisonal
ndf No directed fishing



Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring surveys during 1984-2007 and autumn surveys during 1990-2007. Biomass data is available from the Spanish Div. 3NO spring surveys during 1995-2001 in Pedreira units and 2001-2007 in Campelen units.

Assessment: No analytical assessment was possible with current data.

Biomass: Survey mean weights (kg) per tow in the Canadian spring series indicate no clear trend since 1990 and the stock remains at a low level compared with the 1980s.



Recruitment: Recruitment (fish less than 20cm) has been poor since 2002.

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

Recommendation: No directed fishing on witch flounder in 2009, 2010 and 2011 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 2011.

Sources of Information: SCR Doc. 08/39; SCS Doc. 08/5, 6, 7, 12.

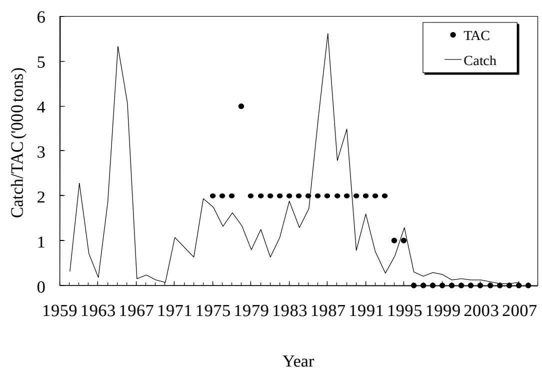
American plaice (Hippoglossoides platessoides) in Div. 3M

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 t)		TAC('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2005	0.05	0.1	ndf	ndf
2006	0.05	0.1	ndf	ndf
2007	0.1	0.1[1]	ndf	ndf
2008			ndf	ndf

[1] Provisonal
ndf No directed fishing

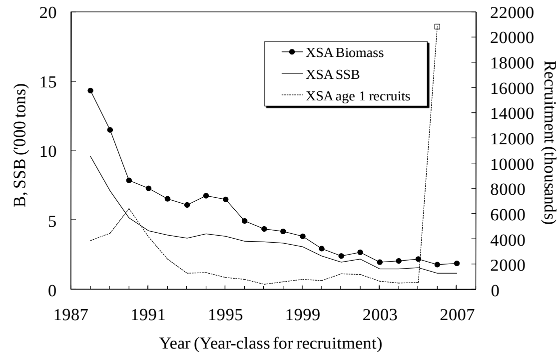


Data: Length compositions were available from the 1988 to 2007 fisheries. Abundance and biomass from surveys were available from USSR/Russia (1972-2002), EU (1988-2007) and Canada (1978-1986). Age-length keys were available from EU surveys (1988-2007).

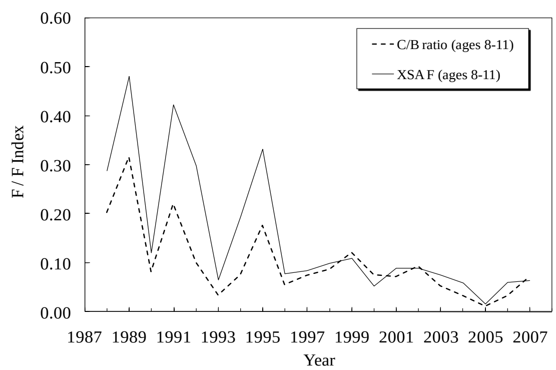
Assessment: An analytical assessment (XSA) was presented.

Recruitment: 1991 to 2005 year classes are estimated to be weak. The strength of the 2006 year class (age 1 in 2007) should be considered preliminary.

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 from the 1991 to 2005 year classes.



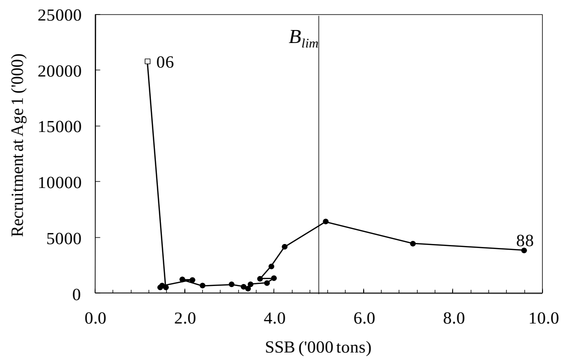
Fishing Mortality: Both the ratio of catch to EU survey biomass (*F*-index) and XSA fishing mortality declined from the mid-1980s to the mid-1990s and then fluctuated between 0.05 and 0.1 from 1996 to 2007 with the exception of 2005. Recent *F* is at a very low level.



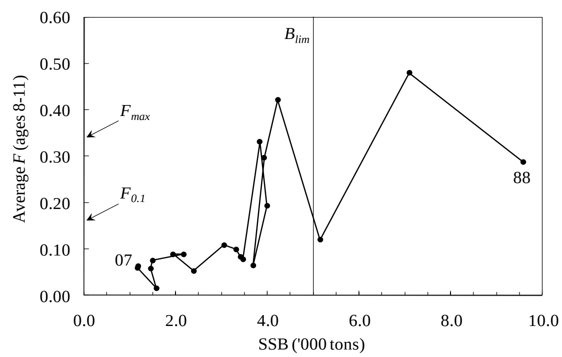
State of the Stock: The stock biomass and the SSB are at very low levels and there is no sign of recovery.

Recommendation: Scientific Council recommended that there should be no directed fishery on American plaice in Div. 3M in 2009, 2010 and 2011. Bycatch should be kept at the lowest possible level.

Reference Points: Based on the 18 years data available from the XSA to examine a stock/recruitment relationship, a proxy for B_{lim} will be 5 000 t of SSB.



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



The yield-per-recruit analysis gave $F_{0.1}$ = 0.162 and F_{max} = 0.346.

Special Comments: The apparent good recruitment of the 2006 year class remains to be confirmed in the next years. Because the value estimated by the XSA for the age 1 in 2007 is determined by one point from the EU-survey, the strength of the 2006 year class should be considered preliminary.

The next Scientific Council full assessment of this stock will be in 2011.

Sources of Information: SCR Doc. 08/34, 40; SCS Doc. 07/6, 9, 08/5, 6.

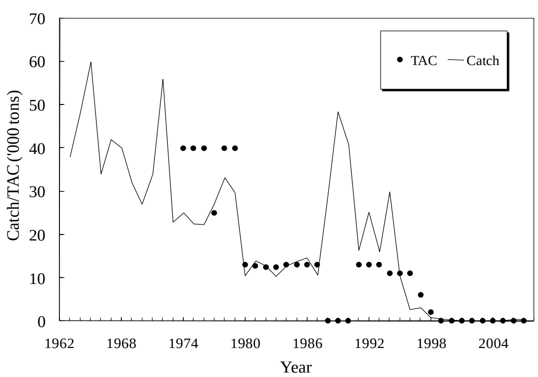
Cod (Gadus morhua) in Div. 3M

Background: The cod stock in 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 1992-1994. Bycatch was estimated to be low in the shrimp fishery since 1993. Catches since 1996 were very small compared with previous years. The directed fishery was closed in 1999. Yearly bycatches between 2000 and 2005 were below 60 t, rising to 339 and 345 t in 2006 and 2007, respectively.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2005	0.0	0.0	ndf	ndf
2006	0.3	0.1	ndf	ndf
2007	0.3	0.1[1]	ndf	ndf
2008			ndf	ndf

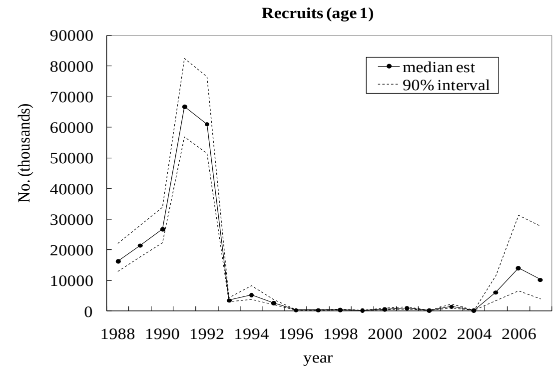
[1] Provisional.
ndf No directed fishing.



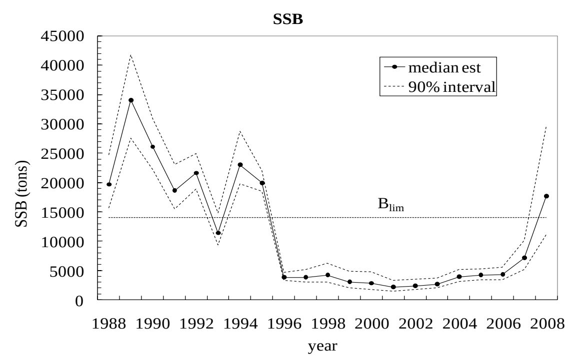
Data: Length and age compositions of the 2002-2005 bycatch were not available. Length distributions were available for 2006 and 2007, although sampling levels were low. Abundance at age indices were available from the EU bottom trawl survey since 1988, covering the whole distribution area of the stock. Survey age-length keys were applied to the bycatch.

Assessment: An analytical assessment based on an age-structured model was accepted to estimate the state of the stock.

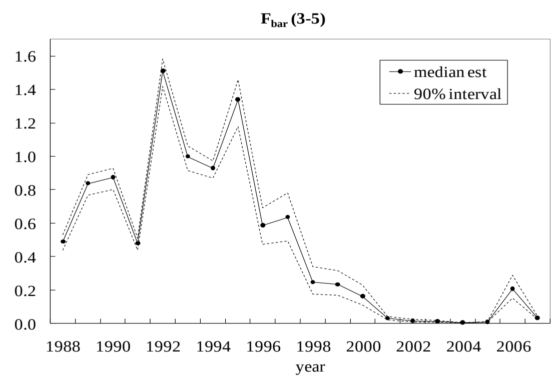
Recruitment: After recruitment failures during 1996-2004, values are higher in 2005-2007, although still below the levels of the late 1980's and early 1990's.



Biomass: Spawning biomass has increased in recent years, with the increase in 2008 largely due to the recruitments in 2005 and 2006. However, the composition of 2007 and 2008 spawning biomass is unusual, as population numbers are still much lower than before 1995. This is explained by the fact that fish are now heavier at age than they were then and are maturing at younger ages.



Fishing mortality: Very low since 2001.



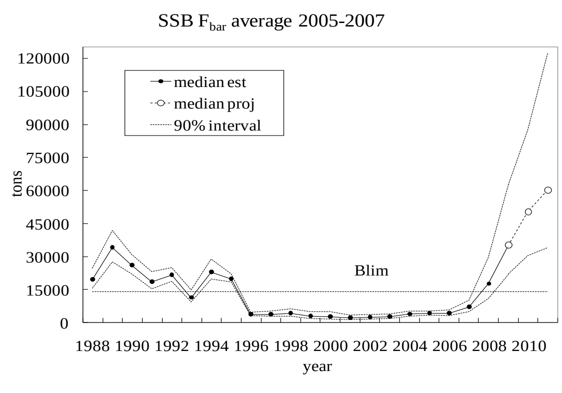
State of the Stock: Despite the significant spawning biomass increase, stock numbers are still much lower than before 1995. As a result of changes noted in weight and maturity, it is unclear whether the meaning of spawning biomass as an indicator of stock status is the same as in the earlier period. Whereas recruitment has been better during 2005-2007, it is below levels in the earlier period. Hence, the state of the stock, although improved, is still poor.

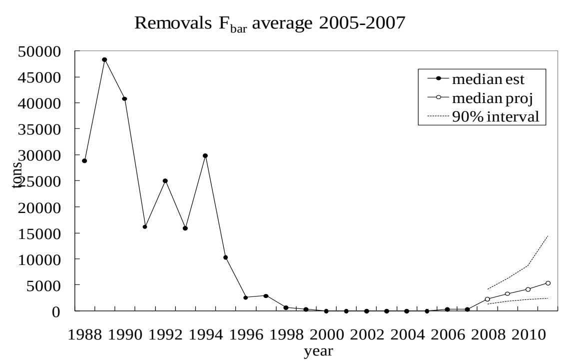
Reference Points: A spawning biomass of 14 000 t has been identified as B_{lim} for this stock. There is 20% probability that spawning biomass is below B_{lim} in 2008.

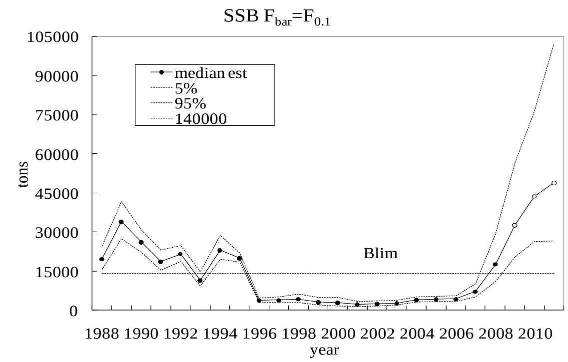
Stock Projections: Stochastic projections were performed for 2009-2011 under two fishing mortality scenarios: (1) average F_{bar} during 2005-2007 (median=0.08); (2) F_{bar} corresponding to $F_{0.1}$ (median=0.17).

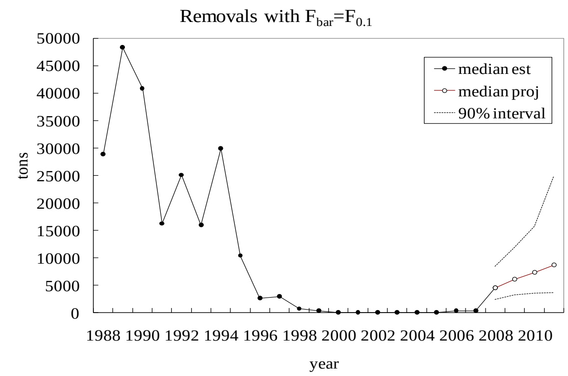
Under both scenarios, SSB has a high probability of growing to levels at least as high as before 1995. However, the weights and maturities at age used in the projections were drawn from those in the last three years (much improved from those in the earlier period). If these conditions do not persist, projection results will be overly optimistic.

Projected values for 2009-2011 are heavily reliant on the relatively abundant three most recent cohorts rather than on healthy population abundances across all ages.









Recommendation: In order to allow spawning biomass to grow above B_{lim} with a high probability in the near future, Scientific Council recommended that no directed fishery for cod in Div. 3M in 2009. Bycatch of cod on the Flemish Cap should be kept at a low level.

Special Comments: As a redfish fishery has developed in recent years in depths shallower than 350 m, and as cod is a bycatch species in that fishery, it may be expected that fishing mortality levels will increase during the next few years and may cause stock decline.

This assessment estimates that current spawner biomass has an increased probability of being above B_{lim}. Since the current status and also short term development of this stock is dependent on recent year classes, Scientific Council has scheduled this stock for a full assessment in 2009.

Sources of Information: SCR Doc. 08/26, 34; SCS Doc. 08/5, 6, 7.

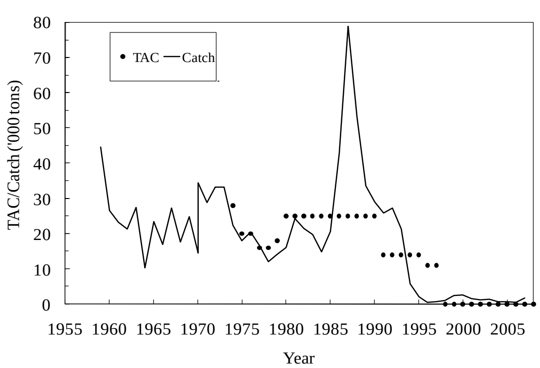
Redfish (Sebastes mentella and S. fasciatus) in Div. 3LN

Background: There are two species of redfish, *Sebastes mentella* and *Sebastes fasciatus*, which occur in Div. 3LN and are managed together. These are very similar in appearance and are reported collectively as redfish in statistics. Most studies the Council has reviewed in the past have suggested a closer connection between Div. 3LN and Div. 3O, for both species of redfish. However, differences observed in population dynamics between Div. 3O and Div. 3LN suggests that it would be prudent to keep Div. 3LN as a separate management unit.

Fishery and Catches: The average reported catch from Div. 3LN from 1959 to 1985 was about 22 000 t ranging between 10 000 t and 45 000 t. Catches increased sharply from about 21 000 t in 1985, peaked at an historical high of 79 000 t in 1987 then declined steadily to about 450 t in 1996. Catch increased from 900 t in 1998, the first year under a moratorium on directed fishing, to 3 100 t in 2000. Catches declined from 2001 until 2006, with an historic low of 496 t, but recorded over a three time fold increase in 2007 with a catch estimate of 1 660 t. Since 1998 catches were taken as bycatch primarily in Greenland halibut fisheries by EU-Portugal, EU-Spain and Russia.

	Catch ('000 t)		TAC('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2005	0.7	0.7	ndf	0
2006	0.2	0.5	ndf	0
2007	1.7	0.2[1]	ndf	0
2008			ndf	ndf

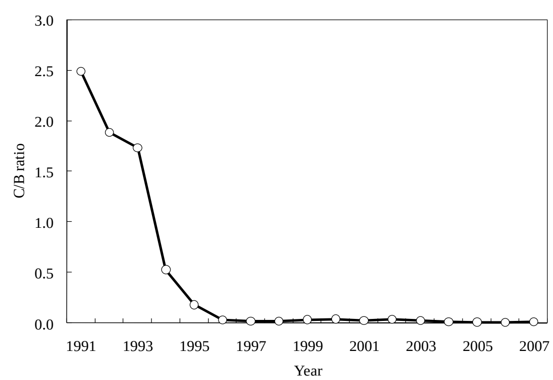
[1] Provisonal
ndf No directed fishing



Data: Catches from 1959-2007, a 1959-94 CPUE series from STATLANT data (as derived in the 1997 assessment), and most of the stratified-random bottom trawl surveys conducted by Canada and Russia in various years and seasons in Div. 3L and Div. 3N, from 1978 onwards.

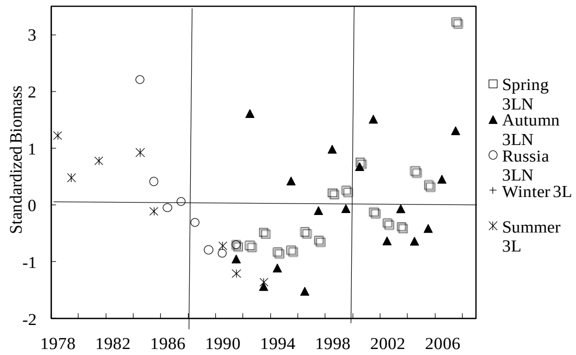
Assessment: The above CPUE and surveys data were incorporated in a non-equilibrium surplus production model (ASPIC), in order to assess the status of the stock. Due to poor diagnostic fit of the model and to the low correlations between model and input data, the ASPIC model was not accepted as a quantitative basis for the 2008 assessment of this stock. Bottom trawl surveys conducted by Canada and Russia from 1978 to 2007 are the basis for the assessment of stock status.

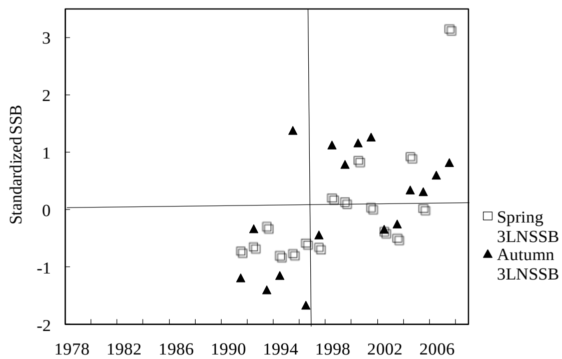
Fishing Mortality: Ratios of catch to Canadian spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy of fishing mortality. Catch/biomass ratio declined continuously from 1991 to 1996, with a drop between 1993 and 1994. From 1996 onwards the proxy of fishing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



Recruitment: There was a relatively good pulse of recruitment observed in the Canadian autumn survey conducted in 1991-1992 in Div.3LN. There has been no sign of good year-classes since then.

Biomass: Biomass indices for redfish, derived either from commercial or survey catch rates, typically show large inter-annual variability, too drastic to be only explained by changes in stock size from one year to the next. In order to smooth the wide inter annual variability of the indices, makes the survey series comparable and facilitate the detection of trends within stock dynamics, the available survey biomass series and the female SSB survey series were standardized to zero mean and unit standard deviation.





From the mid 1980s to the beginning of the 1990s standardized bottom trawl survey data from Canada in Div. 3L and Russia in Div. 3LN suggests that stock size suffered a substantial reduction. Redfish survey biomass in Div. 3LN remained below the average level until 1998 and increase to above average level afterwards. A decline is observed in 2002-2004, followed by a consistent increase of the remaining biomass indices over the most recent years. The survey indices available for 2007 are in line with this upward trend. The 1991-2007 standardized female SSB series showed patterns similar to correspondent total survey biomasses series over the years, with most observations below average before 1998 and most above average afterwards.

State of the Stock: The available Div. 3LN survey indices indicate an increase in stock in recent years broadly to level seen in the first half of the 1980s. However the considerable inter-annual variability of the survey indices makes the measurement of the magnitude of the stock increase difficult to quantify. In addition stock length structure has been improving from small to medium size fish, confirming the survival of recent year-classes regardless of their low sizes and the lack of good recruitment for more than a decade.

Recommendation: Taking into account the biomass indices of the stock and the very low recent values of the catch/biomass ratio (a proxy for fishing mortality), there is sufficient evidence to allow a small amount of directed fishing on this stock. Given that this species is relatively long-lived and slow growing, Scientific Council recommended that a precautionary adaptive management approach be adopted to determine how resilient the stock is to a slight increase in exploitation, and that this be monitored closely. Noting the increase in allowable bycatch from 5% to 10% in 2008, as well as the 2007 catch estimate of 1 700 t, Scientific Council recommended that the total catch of Div. 3LN redfish in 2009 not exceed 3 500 t. This total catch should include any directed catches and all bycatches of Div. 3LN redfish taken in other fisheries. Before making a recommendation for 2010, Scientific Council will review this in 2009, when the catch in 2008 is known.

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

Special Comments: Bycatch of species under moratorium in the redfish fishery should be kept to the lowest possible level.

The next assessment will be in 2010.

Sources of Information: SCR Doc. 08/21, 33; SCS Doc. 07/5, 6, 7.

d) Monitoring of stocks for which Multi-year Advice was provided in 2007

(i) Finfish

The Scientific Council in 2007 provided 2-year advice (for 2008 and 2009) for four stocks (American plaice in Div. 3LNO, Redfish in Div. 3M, White hake in Div. 3NOPs, Capelin in Div. 3NO). As well 3-year advice (for 2008, 2009 and 2010) was provided for four stocks (Redfish in Div. 3LN, Redfish in Div. 3O, Cod in Div. 3NO and Witch flounder in Div. 2J+3KL). The Scientific Council reviewed the status of seven of these stocks (interim monitor) at this June 2008 meeting, and found no significant change in the status for any of these stocks to alter the multi-year advice. For Redfish in Div. 3LN a full assessment was conducted and advice was provided separately (see SC report Section VII.1.c).

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

It was noted that while a full assessment of Northern shortfin squid was requested by the Fisheries Commission, the expertise needed to complete this task was not available during this meeting. An interim monitoring report was completed and found no significant change in the status of this stock and therefore Scientific Council advises that the TAC for 2009 be set between 19 000 and 34 000 t.

e) Special Requests for Management Advice

i) The Precautionary Approach

The Fisheries Commission requested:

4. Noting the Precautionary Approach Framework as endorsed by Fisheries Commission, the Fisheries Commission requests that the Scientific Council provide the following information for the 2008 Annual Meeting of the Fisheries Commission for all stocks under its responsibility requiring advice for 2009:

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

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

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

5. The following elements should be taken into account by the Scientific Council when considering the Precautionary Approach Framework:

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

b) Where reference points are proposed by the Scientific Council as indicators of biological risk, they should be accompanied by a description of the nature of the risk associated with crossing the reference point such as recruitment overfishing, impaired recruitment, etc.

c) When a buffer reference point is proposed in the absence of a risk evaluation in order to maintain a low probability that a stock, measured to be at the buffer reference point, may actually be at or beyond the limit reference point, the Scientific Council should explain the assumptions made about the uncertainty with which the stock is measured.

d) Wherever possible, short and medium term consequences should be identified for various exploitation rates (including no fishing) in terms of yield, stability in yield from year to year, and the risk or probability of maintaining *the stock within, or moving it to, the Safe Zone. Whenever possible, this information should be cast in terms of risk assessments relating fishing mortality rates to the trends in biomass (or spawning biomass), the risks of stock collapse and recruitment overfishing, as well as the risks of growth overfishing, and the consequences in terms of both short and long term yields.*

e) When providing risk estimates, it is very important that the time horizon be clearly spelled out. By way of consequence, risks should be expressed in timeframes of 5, 10 and 15 years (or more), or in terms of other appropriate year ranges depending on stock specific dynamics. Furthermore, in order to provide the Fisheries Commission with the information necessary to consider the balance between risks and yield levels, each harvesting strategy or risk scenario should include, for the selected year ranges, the risks and yields associated with various harvesting options in relation to Blim, and Flim and target F reference points selected by managers. (Item 4-5)

The Chair noted that the reference points indicated in the Fisheries Commission request, and the analyses of risks and associated projections, were being applied to individual stock assessments where possible.

ii) Evaluation of Recovery Plans

The Fisheries Commission requested: *Many of the stocks in the NAFO Regulatory Area are well below any reasonable level of B_{lim} or B_{buf}. For these stocks, the most important task for the Scientific Council is to inform on how to rebuild the stocks. In this context and building on previous work of the Scientific Council in this area, the Scientific Council is requested to evaluate various scenarios corresponding to recovery plans with timeframes of 5 to 10 years, or longer as appropriate. This evaluation should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, including information on the consequences and risks of no action at all.*

a) information on the research and monitoring required to more fully evaluate and refine the reference points described in paragraphs 1 and 3 of Annex II of the Agreement; these research requirements should be set out in the order of priority considered appropriate by the Scientific Council;

b) any other aspect of Article 6 and Annex II of the Agreement which the Scientific Council considers useful for implementation of the Agreement's provisions regarding the precautionary approach to capture fisheries; and

c) propose criteria and harvest strategies for new and developing fisheries so as to ensure they are maintained within the Safe Zone.(Item 6)

This request for advice is addressed for Greenland halibut in Subarea 2 and Div3KLMNO under agenda item X.3 "Report of the SC Study Group on Evaluation of Management Strategies for Greenland Halibut" and also under agenda item VII.1.a in the Scientific Council summary sheet for "Greenland Halibut in Subarea 2 and Divisions 3KLMNO".

iii) Review pelagic redfish distribution and stock-affinities

The Fisheries Commission requested: *Regarding pelagic S. mentella redfish in NAFO Subareas 1-3, the Scientific Council is requested to review the most recent information available on the distribution and abundance of this resource, as well as any new information on the affinity of this stock to the pelagic redfish resource found in the ICES Sub-area XII, parts of SA Va and XIV and to the shelf stocks of redfish found in ICES Sub-areas V, VI and XIV, and NAFO Subareas 1-3.* (Item 7)

Scientific Council notes that no new information was analysed on the spatial distribution and stock affinities of pelagic redfish since this request was last reviewed by Scientific Council in June 2006 (*NAFO Sci. Coun. Rep*., 2006, p. 22-24). The lack of understanding of the biology and stock affinities leads to difficulties in the stock assessment and uncertainties associated with the catch advice. Because of this, ICES has noted that a review of the most recent information on stock identification of redfish will be carried out by an expert group early 2009. Scientific Council noted the importance of improving our understanding of the stock structure and biology of *S. mentella.*

iv) Provide certain information on porbeagle shark (Lamna nasus)

Fisheries Commission requested Scientific Council to provide advice on: *With respect to porbeagle shark (Lamna nasus) in the NAFO Convention Area, the Fisheries Commission with the concurrence of the Coastal State requests Scientific Council, at a meeting in advance of the 2008 Annual Meeting, to provide the following:*

a) Information on historical and current catches and bycatches of the species in the NAFO Convention Area and NRA, summarized by NAFO Subarea and fishery;

b) Information on the abundance and distribution of the species in the Convention Area and the NRA;

c) Identification and delineation of any fishery areas or exclusion zones which might reduce the incidental bycatch of this species in NAFO regulated fisheries. (Item 8)

The Scientific Council responded:

The porbeagle shark (*Lamna nasus*) is a large cold-temperate pelagic shark species of the family Lamnidae that occurs in the north Atlantic Ocean and in the southern Atlantic and Pacific Oceans. There are distinct eastern and western stocks in the north Atlantic. The range of the north-western stock extends from Newfoundland to New Jersey and possibly to North Carolina. The eastern stock extends from the western Barents Sea to Morocco and the Mediterranean in the east Atlantic. Porbeagle around Iceland are of unknown stock affiliation.

According to ICCAT (2005) porbeagle are caught mostly as bycatch in the pelagic longline fisheries, but can also be caught in pelagic and bottom trawls, gillnets and handlines. Catches of porbeagle are reported to NAFO (STATLANT 21) and to ICCAT.

The abundance of porbeagle in the northwest Atlantic has declined substantially since the fishery began in 1961. In 2004, the population was designated as Endangered by Canada's COSEWIC, and in 2007 the species was proposed for listing under Appendix 2 of CITES but not accepted.

ToR 8a: Information on historical and current catches and bycatches of the species in the NAFO Convention Area and NRA, summarized by NAFO Subarea and fishery. Porbeagle landings in the Convention area since 1961 have been as high as 9 000 t, but have averaged less than 500 t annually since the introduction of restrictive Canadian catch quotas in 2001. Most of the Canadian catch has been by pelagic longline. Relatively few of the foreign vessels monitored by the Canadian Observer Program have caught porbeagle, but those that have done so, have occasionally fished outside of the EEZ in the NAFO Regulated Area (NRA). Catches in the NRA were reported differently to NAFO and ICCAT, and have generally been small and sporadic (average of <10 t annually). However, longline catches in the NRA in 2005 and 2006 were 221 t and 230 t, respectively. On-board scientific observers estimate that the catches of porbeagle in trawls are very low to zero. The current Canadian recovery plan for porbeagle places strict and monitored catch quotas of 185 t on Canadian vessels at levels that are less than the MSY catch of 250 t. There is no restriction on catches in the NRA.

ToR 8b: Information on the abundance and distribution of the species in the Convention Area and the NRA. Porbeagle are a cold-water temperate shark species, with well defined temperature limits. The distribution of porbeagle within the Canadian EEZ is well summarized by the distribution of the Canadian catch, which lies mainly on the continental shelf and slope. The distribution of mature females varies seasonally, but is concentrated off southern Newfoundland and in the Gulf of St. Lawrence in the late summer and fall. The distribution of porbeagle in other EEZs and in the NRA is not well known. Observed vessels have caught porbeagle in NAFO subareas 3 and 4 of the NRA, but for the most part, vessels fishing the NRA do not report the fishing location for porbeagle. Recent tagging of porbeagle with archival satellite popup tags has indicated that a certain proportion of porbeagle tagged on the continental shelf later swim into the NRA (S. Campana, unpublished). However, the extent or duration of time spent in the NRA is unknown.

A forward-projecting age- and sex-structured population dynamics model was used to model the abundance and biomass of the population, and formed the basis for the last peer-reviewed stock assessment of porbeagle in 2005 (Gibson and Campana, 2005). Within the model, the population was projected forward from an equilibrium starting abundance and age distribution by adding recruitment and removing catches. A key assumption in the model was that the porbeagle population was at an unfished equilibrium at the beginning of 1961, when the directed commercial fisheries for porbeagle began. Model parameter estimates were obtained by fitting the model to the available length, catch, CPUE and tagging data using maximum likelihood. A population viability analysis was then used to project population recovery under various scenarios. Full model details, plus the stock assessment, are available in Gibson and Campana (2005).

Model variants placed the 2005 abundance at about 22% its size in 1961, and female spawner abundance at about 14% of its 1961 level (Fig. 1). Estimates of the population size in 2005 from the three models were similar, ranging from 188 000 to 195 000 fish. The estimated number of mature females ranged from 9 000 to 13 000 fish. The exploitable mid-year biomass in 2005 was estimated at just over 4 500t. The models with the lowest assumed productivity produced the highest estimates of the exploitable biomass.

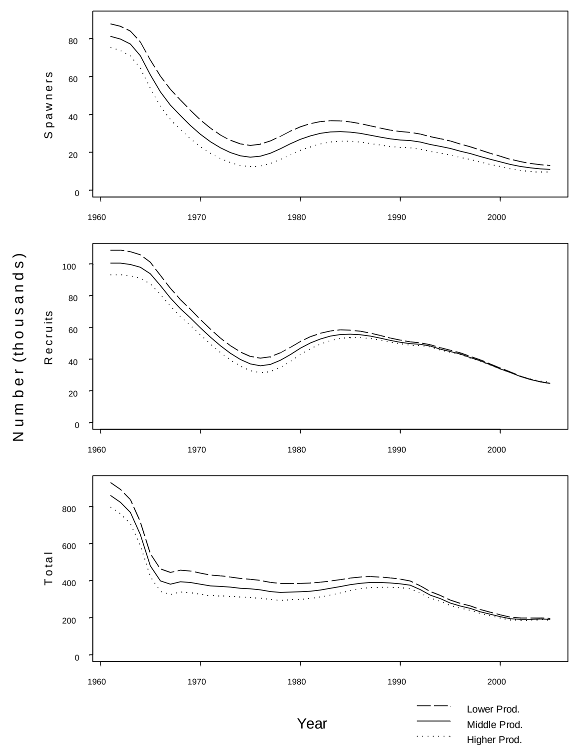


Fig. 1. Female spawner abundance, recruitment at age 1, and total population number from each of the porbeagle population models. All models show similar trajectories.

All models indicate that the population can recover if levels of fishing mortality are kept below about a 4% exploitation rate, corresponding to a total catch of 185 t. Although recovery rates vary among models, time scales are on the order of decades. In the absence of fishing mortality, the three models place recovery to SSN_{msy} sometime between 2030 and 2060. An exploitation rate of 4% of the exploitable biomass is predicted to delay recovery to SSN_{msy} into the 22nd century (or later) by all models except the one with the highest productivity (a delay of 28 years relative to the scenario with no fishing mortality) (Fig. 2). At an exploitation rate of 8% of the vulnerable biomass, the population will not recover to SSN_{msy}.

Based on the middle productivity model, median recovery times under the stochastic Population Viability Analysis (PVA) model were slightly longer than under the deterministic model (Fig. 2). At an exploitation rate of 2%, time to recovery to SSN_{msy} varied by about 3 decades and 90% of simulated populations recovered to SSN_{msy} by about 2075. At a fishing mortality rate of 4%, about 30% of the populations did not recover to SSN_{msy} within 100 years. None of the simulated populations recovered to SSN_{msy} at an exploitation rate of 7% of the vulnerable biomass (graph not shown).

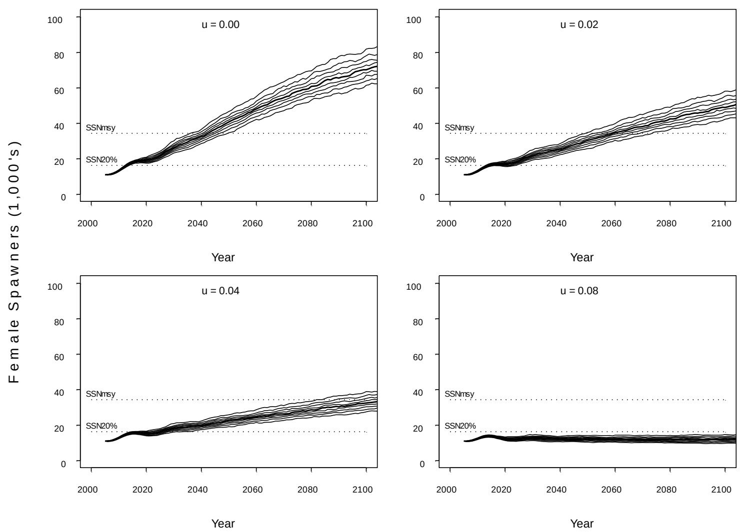


Fig. 2. Predicted stochastic recovery trajectories from the Population Viability Analysis under four different exploitation scenarios. The quantiles of the population size in each year from low (bottom line = 0.1) to high (top line = 0.9). This encompasses the uncertainty of the estimated population size in each year.

ToR 8c: Identification and delineation of any fishery areas or exclusion zones which might reduce the incidental bycatch of this species in NAFO regulated fisheries. Although most of the porbeagle population resides in Atlantic Canadian waters, some porbeagle is caught in international waters especially in recent years. It is the only large shark for which a directed commercial fishery exists in Canadian coastal waters. Sensitive areas for porbeagle are those associated with mating around the southern Grand Bank off southern Newfoundland, with most of this area lying within the Canadian EEZ. If catches in the NRA are >100 t, then total porbeagle catches in the northwest Atlantic (including the Canadian catch) would put the porbeagle exploitation rate at unsustainable levels. This is relevant since a new longline fishery has recently started in subareas 3, 4 and 6. Population projections indicate that the population would crash at catch levels exceeding about 300 t.

The fisheries most likely to catch porbeagle are pelagic and bottom longlines and gillnets. There are records in STATLANT 21 of catches of porbeagle in otter trawls from the 1960s and 1970s, but scientific observer data strongly suggests that trawls seldom catch porbeagle.

Scientific Council considers that there is no current threat to porbeagle from trawler bycatch in NAFO regulated fisheries. However, increases in porbeagle catch by longlines in the NRA is of considerable concern.

Additional comment

ICCAT monitors porbeagle as a bycatch to the longline fishery, and will undertake a stock assessment no later than 2009 (ICCAT 2007 Resolution 07-06). This assessment could possibly lead to management measures. There are currently no management restrictions by any agency on porbeagle catches in international waters of the North Atlantic.

Gibson, A.J.F. and S.E. Campana. 2005. Status and recovery potential of porbeagle shark in the Northwest Atlantic. CSAS Res. Doc. 2005/53. 79 p.

ICCAT. 2005. Report of the 2004 Inter-sessional Meeting of the ICCAT Subcommittee on Bycatches: shark stock assessment. Col. Vol. Sci. Pap. ICCAT, 58(3): 799-890.

v) Cod bycatch reduction measures

Fisheries Commission requested: *Noting the FC Rebuilding Plan for 3NO cod adopted in September 2007, Fisheries Commission requests Scientific Council to advise, before September 2010, on a range of possible management measures to ensure bycatch of cod is kept at the lowest possible level.* (Item 9)

Scientific Council responded:

The spatial distribution of Div. 3NO cod in Canadian spring and autumn research vessel surveys was examined to determine if areas of concentration were consistent enough to allow for spatial avoidance of cod bycatch. The distribution of cod in 15 surveys from 2000 to 2007 was examined, as were previous publications of cod distribution in Div. 3NO. Cod are generally widespread throughout Div. 3NO, although in low abundance. There were no consistent areas of high concentration. This lack of a consistent spatial distribution indicates that there is little opportunity to avoid bycatch of Div. 3NO cod by restricting fishing to certain areas, at least in the period of the year covered by the spring and autumn surveys.

Based on STACFIS estimates, since 2000, Canadian fisheries have accounted for on average 32% of the total Div. 3NO cod bycatch, with the percentage ranging from 16-64%. On average 92% of the bycatch taken by Canada is taken by Canada NL. Examination of landings data from Canada NL shows a clear temporal trend with most bycatch of Div. 3NO cod being taken in the second half of the year, particularly in months 9 and 10. The most important fishery is for yellowtail flounder which has taken from 61-87% of the bycatch taken by Canada NL over the 2000-2007 period, except in 2006 when that fishery only operated for three months at a much reduced level.

Percent bycatch of Div. 3NO cod in the Canada NL yellowtail flounder fishery was highest in months 8-10 in almost every year (Fig. 3). Bycatch percentage was also high in July, a month when yellowtail fishing is generally limited because of a closure for spawning. Catch of yellowtail flounder on the other hand is generally distributed throughout the year with peaks in months 4-5 and 8-10 (Fig. 3). From 2000-2005 (years when the Canada NL yellowtail flounder fishery operated on a normal basis), catch in the first six months of the year made up on average 46% of the total yearly catch.

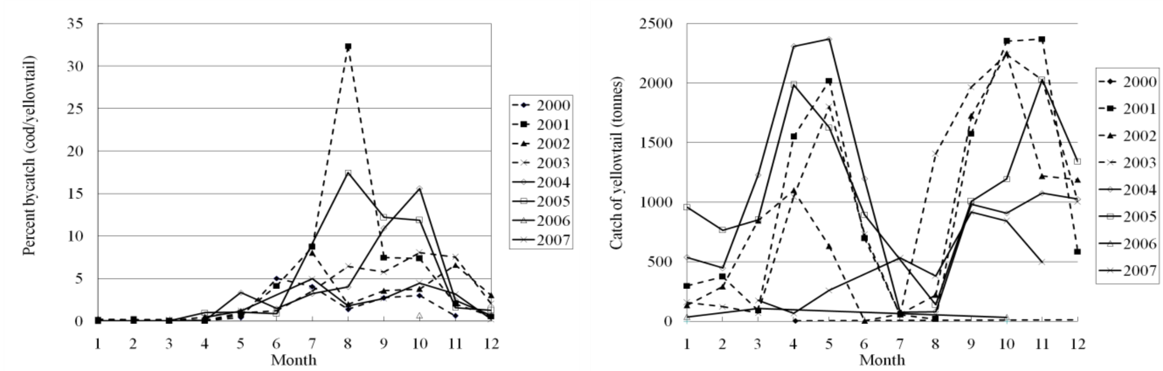


Fig. 3. Percent bycatch of Div. 3NO cod in the Canada NL yellowtail flounder fishery by month and year (left) and catch of yellowtail flounder by month and year (right) in that same fishery.

A series of scenarios were developed to examine the impact on bycatch of redistributing the yellowtail catch from months with the highest cod bycatch in fishery for yellowtail flounder conducted by Canada NL (Table 1). In each scenario the total catch of yellowtail flounder was the same (12 500 t), the average catch during 2003-2005 and the expected yellowtail flounder catch by Canada NL with a quota of 15 000 t. Assuming average monthly bycatch rates, a fishery spread over the year in the pattern usually observed would take 400 t of cod bycatch. If the same amount of yellowtail flounder was caught but fishing did not occur in months 6-11, bycatch could be reduced by 85% in this fishery. If months 7-11 were avoided bycatch could be potentially be reduced by 76% and if directed fishing for yellowtail flounder avoided months 7-10, bycatch could potentially be reduced by 66%. It should be kept in mind that the Canada NL fishery operates only on a limited basis in July (month 7) so that this scenario (no fishing month 7-10) would result in a closure of three months compared to the current fishing practice. If the catch of yellowtail flounder in months 7-11 was decreased by 50% and that amount of catch equally distributed across the other months, the bycatch of cod in the Canada NL yellowtail flounder fishery could be expected to decline by 38%. There appears to be substantial potential to decrease bycatch of Div. 3NO cod in the Canada NL fishery for yellowtail flounder by avoiding fishing in months when cod bycatch is highest (months 6-11).

Table 1. Catch of yellowtail flounder and cod (tonnes) based on the mean percentage bycatch of cod each month in the yellowtail fishery, taking a yellowtail catch of 12,500 t over 12months with normal catch pattern, 6, 7 or 8 months or 12 months with catch reduced in months 7-11 by 50%.

		Fish in all months		Fish in 6 months		Fish in 7 months		Fish in 8 months		Reduce 7-11 by 50%	
Month	percent bycatch	catch ytail	catch cod	catch ytail	catch cod	catch ytail	catch cod	catch ytail	catch cod	catch ytail	catch cod
1	0.08	425	0	2083	2	1786	1	1563	1	786	1
2	0.08	418	0	2083	2	1786	1	1563	1	779	1
3	0.03	669	0	2083	1	1786	1	1563	1	1030	0
4	0.30	1674	5	2083	6	1786	5	1563	5	2035	6
5	1.26	1743	22	2083	26	1786	23	1563	20	2104	27
6	2.54	711	18	0	0	1786	45	1563	40	1072	27
7	5.42	67	4	0	0	0	0	0	0	33	2
8	9.34	382	36	0	0	0	0	0	0	191	18
9	6.46	1562	101	0	0	0	0	0	0	781	50
10	7.73	1935	150	0	0	0	0	0	0	967	75
11	3.42	1827	63	0	0	0	0	1563	53	914	31
12	1.27	1100	14	2083	26	1786	23	1563	20	1461	19
	sum	12513	412	12500	63	12500	99	12500	140	12153	256
bycatch reduction (%)					85		76		66		38

Scientific Council noted that these analyses apply only to the directed yellowtail flounder fishery conducted by Canada NL. Fisheries conducted by other Contracting Parties in Div. 3NO could also be examined for the potential for temporal avoidance of cod bycatch. Scientific Council also noted that there may be other measures, such as gear modification, that could be effective at avoiding cod bycatch. The Scientific Council Coordinator will discuss technical measures regarding gear modifications relative to bycatch reduction of cod in Div. 3NO with the Chair of the ICES WGFTFB. If necessary, the Chair of Scientific Council will draft a suitable term of reference to be presented to ICES for inclusion in the WGFTFB agenda at their next meeting.

vi) Protection of vulnerable marine ecosystems

Fisheries Commission, recognizing the initiatives on vulnerable marine ecosystems (VMEs), requests Scientific Council to:

a) Develop initial methodologies for the identification of VME and assessment of individual fishing activities, drawing on relevant international information and objective standards and guidelines as may be developed, as deemed appropriate for this work;

b) Assess, at least on a preliminary basis, using the best available scientific information and assessment methodology, whether individual bottom fishing activities would have significant adverse impacts on identified vulnerable marine ecosystems, with a view to reporting these findings to the Fisheries Commission and ensuring that additional conservation and management measures, where required, are recommended, through a Working Group of Fishery Managers and Scientists on Ecosystem Management, to the Fisheries Commission at its September 2008 meeting;

c) Develop appropriate scientific methods for the longer term monitoring of the health of VME.

Fisheries Commission further requests the Scientific Council to *provide supplementary advice with respect to commitments related to UNGA Resolution 61/105 by:*

For the NAFO Regulatory Area and using existing information:

1. Identifying vulnerable species and habitat-forming species that are documented/considered sensitive and likely vulnerable to deep-sea fisheries.

2. Identifying areas (mega-habitats) which are topographical, hydro-physical or geological features (including fragile geologic structures) known to support vulnerable species, communities, or habitats.

3. This identification process should draw on relevant international information as may have been developed and as deemed appropriate for this work.

4. Mapping locations of vulnerable marine ecosystems, if any, as well bottom substrate features contained therein.

Additionally, the following VME Data Collection Protocol is referred to Scientific Council for review and advice.

Vulnerable Marine Ecosystem (VME) Data Collection Protocol

Observers on fishing vessels in the NAFO Regulatory Area who are deployed pursuant to Chapter III, Article 24 shall:

i. Monitor any set for evidence of VME and the presence of vulnerable marine species.

ii. For VME generally, record Species Code, Trip#, Set#, Vessel Name, Gear Type, Latitude/Longitude, Depth, Date and Name of Observer on datasheets, if possible,

- *Live animals should be measured and released, dead animals measured and sexed*
- *Samples may be collected and frozen (eg: gonads from dead specimens), when requested by Scientific Council or the scientific authority in a Contracting Party*

iii. For deep-sea coral species, also collect as many samples as practicable for use in confirmation of species identification, genetic and geochemistry composition:

- *Collect a small (~5 cm) piece of each coral species and freeze in plastic bag, with a pre-printed waterproof label indicating Species Code, Trip#, Set#, Vessel Name, Gear Type, Latitude/Longitude, Depth, Date and Name of Observer.*
- *For species with large skeletons (Primnoa, Paragorgia, Paramuricea, Bathypathes), collect as large a piece of the coral as possible, label with total weight and sub-sample weight, and freeze.*

iv. Samples should be provided to the scientific authority in a Contracting Party at the end of the fishing trip.

Observer and masters should refer to the NAFO Coral Species Identification Guide and other material provided by Scientific Council.

Completion of this work is requested by September 2008 to facilitate a meeting of the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems.

The information presented here in response to the Fisheries Commission requests is based on the Report of the NAFO Scientific Council Working Group on Ecosystem Approach to Fisheries Management (WGEAFM) (NAFO SCS Doc. 08/10) and 2008 Report of the joint ICES/NAFO Working Group on Deep-water Ecology (WGDEC).

a) Identification of VME and assessment of fishing activity

VMEs are mostly subcomponents of larger ecosystems that can be associated with a precise geographical location. Although VMEs have a spatially explicit context (i.e. cover areas), the ecosystem attribute is not confined to just benthic habitat as they may also support communities of other vulnerable species, including fish. The most sensitive and vulnerable VMEs are ones that are both easily disturbed and are very slow to recover or have very limited recovery potential. Some of these ecosystem components may be physically or functionally fragile.

The vulnerabilities of populations, communities and habitats must be assessed relative to specific threats. Some features, particularly ones that are physically fragile or inherently rare may be vulnerable to most forms of disturbance, but the vulnerability of some populations, communities and habitats may vary greatly depending on the type of fishing gear used or the kind of disturbance experienced (FAO, 2008).

Significant adverse impacts are defined by the FAO as those that compromise ecosystem integrity (i.e. ecosystem structure or function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types. Impacts should be evaluated individually, in combination and cumulatively.

When determining the scale and significance of an impact, the following six factors should be considered:

i. the intensity or severity of the impact at the specific site being affected;

ii. the spatial extent of the impact relative to the availability of the habitat type affected;

iii. the sensitivity/vulnerability of the ecosystem to the impact;

iv. the ability of an ecosystem to recover from harm, and the rate of such recovery;

v. the extent to which ecosystem functions may be altered by the impact; and

vi. the timing and duration of the impact relative to the period in which a species needs the habitat during one or more life-history stages.

Temporary impacts are those that are limited in duration and that allow the particular ecosystem to recover over an acceptable time frame. Such time frames should be decided on a case-bycase basis and should be on the order of 5-20 years, taking into account the specific features of the populations and ecosystems. In determining whether an impact is temporary, both the duration and the frequency with which an impact is repeated should be considered. If the interval between the expected disturbance of a habitat is shorter than the recovery time, the impact should be considered more than temporary. [In circumstances of limited information, States and RFMOs should be precautionary in their determinations regarding the nature and duration of impacts.] (FAO, 2008)

Initial methodologies for the identification of VMEs are based on the criteria documented in the draft FAO Guidelines for the Management of Deep-sea Fisheries (FAO, 2008). These criteria are not restrictive; FAO guidelines state that they can be expanded and/or adapted for their application in specific cases. Five criteria are cited:-

i. Uniqueness or rarity - an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by other similar areas. These include:

- habitats that contain endemic species;
- habitats of rare, threatened or endangered species that occur only in discrete areas; or
- nurseries or discrete feeding, breeding, or spawning areas.

ii. Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species.

iii. Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities.

iv. Life-history traits of component species that make recovery difficult - ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics:

- slow growth rates;
- late age of maturity;
- low or unpredictable recruitment; or
- long-lived.

v. Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems. Further, such ecosystems often have high diversity, which is dependent on the structuring organisms.

Regarding uniqueness or rarity (criterion i), this was understood to include fish species for which there is currently a NAFO moratorium on fishing. However, it was recognized that widely distributed species under moratorium, such as cod, redfish, American plaice etc, are not associated with clearly defined habitats, so these species were not used to support the identification of candidate VMEs. Vulnerable species were identified on the basis of inclusion in the conservation list of Canada's Species at Risk Act (SARA). This list is extensive, and given the limited time available to WGEAFM the fish species identified should not be regarded as comprehensive. Although SARA refer to species within the Canadian EEZ, given that many of the listed species straddle into the NRA, Scientific Council took the view that these listings provide an indication as to whether these species may be vulnerable in the NRA.

Regarding life history characteristics (criterion iv), this was expanded to include fish species found in dense aggregations associated with seamounts and known to be vulnerable to rapid depletion e.g. alfonsino species.

Available information to identify VMEs is only available down to the maximum perceived depth of bottom trawling (2000 m). Below 2000 m it is envisaged that VMEs will be identified and protected under and according to a new fishing area protocol.

Information relevant to the FAO criteria was collated for corals and sponges and other benthic invertebrates known to occur in the NAFO Convention Area (down to the species level where possible). Information on other benthic invertebrates was very sparse. For selection, species/genera had to fulfill at least one of the FAO criteria. This information was then filtered to identify the most vulnerable biota (again using the FAO criteria). Available distribution data for these vulnerable corals, sponge were then examined and areas were identified where there were higher concentrations and/or an overlap between species. A similar procedure was carried out for fish species, except only four criteria (i, ii, iv and v) were considered relevant.

Regarding assessment of fishing activities, the spatial pattern of trawl fishing effort within the NRA from 2003-2007 was determined using commercial fishing vessel positions in the VMS database held at the NAFO Secretariat. A vessel was taken to be trawling if the calculated speed was between 2-4 knots (Fig. 4).

References

FAO 2008. FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas, draft for the August 2008 meeting. *FAO* TC:DSF2/2008/2

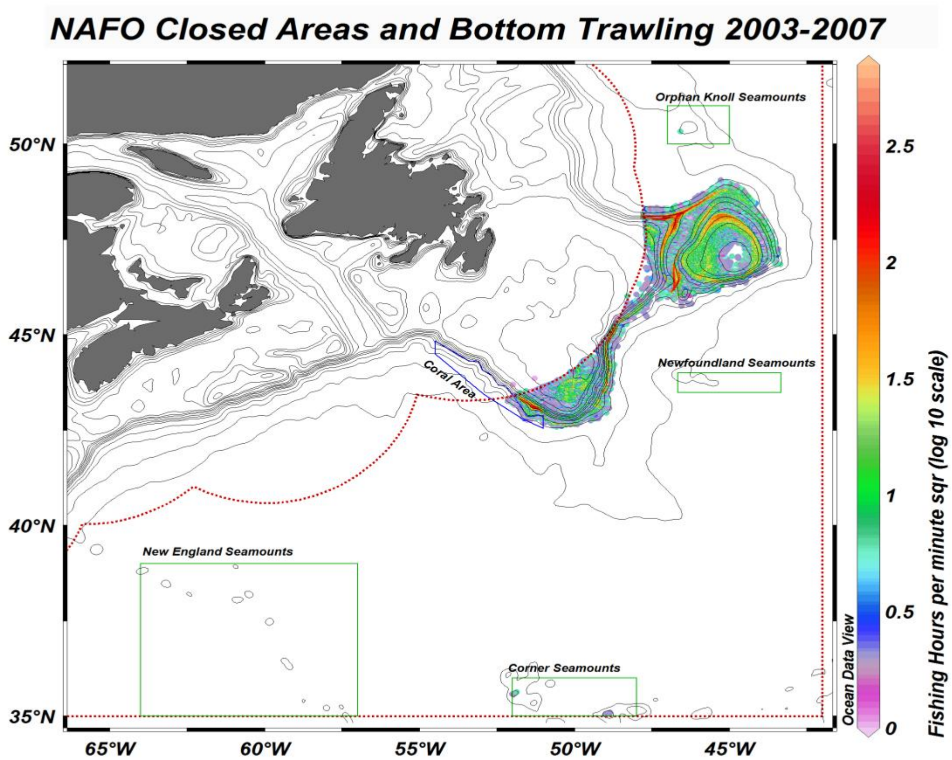


Fig. 4. Map of trawl fishing effort in 2003-2007 based on VMS data and current closures to bottom fishing in the NRA. Plotted are fishing hours aggregated to an area of a minute latitude by minute longitude then transformed to a $\log_{10}$ scale (1=10 hours, 2=100 hours, etc)

b) Adverse impacts of bottom fishing

This issue can only be assessed on a preliminary basis, paying attention to the most obvious effects of fishing activities. However, in the last years, the studies of fishery impacts to the benthos and the ecosystem in NAFO area have increased and they will be very useful to understand the fishery effects on the ecosystem. However, most of them are in small areas and shallow waters and the effects of fishing activities in deep waters may be very different. The Scientific Council's response is largely based on information collated and presented in the 2008 Report of the ICES/NAFO Working Group on Deep-water Ecology (WGDEC).

There are three main categories of demersal fisheries in the NRA: longline, trawl and gillnet fisheries. These fisheries can impact on VMEs in different ways. Direct physical impacts of bottom trawl gears on benthic VMEs are the most damaging/destructive and are well documented in other Atlantic areas e.g. on cold-water corals to the west of Ireland and to the northwest of Scotland. The structural characteristics and long-lived nature of some deep-water corals make them especially vulnerable to damage by the mechanical impacts of bottom fishing activities. Longlines may also impact on the benthic habitats (particularly on hard and soft corals) by means of anchoring and loss of rope and snagging and breaking of corals. Lost fishing gears, particularly gillnets and traps, can result in 'ghost fishing', whereby fish and crustaceans continue to be caught for many months and, in deep-water fisheries where there are lower rates of biofouling and tidal scouring, for several years.

Trawl fishing on alfonsino aggregations on seamounts is a concern because aggregations can be rapidly depleted (in a single fishing season) and the trawl gear used can occasionally impact on seamount benthic habitats. Five of the Corner Rise Seamounts have been explored using an ROV and areas of pristine coral as well as evidence of large-scale trawling damage were found on the summits of Kukenthal Peak and Yukutat Seamount (Waller *et al.*, 2007), both of which are within the NAFO closed area covering the Corner Rise Seamount complex.

References

Waller, R., L. Watling, P. Auster, and T. Shank. 2007. Anthropogenic impacts on the Corner Rise seamounts, North-west Atlantic Ocean. *J. Mar. Biol. Ass. UK*, 87: 1075-1076.

c) Methods for monitoring the health of VMEs

Once VMEs are identified, non-destructive/non-invasive monitoring methods (multi-beam surveys, camera surveys, ROV activities) can be used to monitor health and recovery (where appropriate). Key indicator species can be identified and subsequently surveyed and evaluated periodically for recruitment, abundance, spatial distribution, etc.

Additional Request received from Fisheries Commission Intersessional Meeting, 30 April-7 May 2008

1. Species sensitive and vulnerable to deep-sea fisheries

Scientific Council was of the view that a formal definition of 'vulnerable' and 'sensitive' would be useful as a precursor to responding to this request. The following definition is taken from the ICES Report of the Working Group of the Ecosystem Effects of Fishing Activities (WGECO):

"*Sensitivity is the degree to which a component responds to a pressure, and is a function of its resistance to a pressure (i.e. how much of the pressure it can withstand) and its inherent resilience (i.e. its recovery potential). Vulnerability is the probability or likelihood that a component will be exposed to a pressure to which it is sensitive"*

Vulnerable species and habitat-forming species that are documented/considered sensitive and likely vulnerable to deep-sea fisheries were identified using the methodology and criteria described in the response to Request 10a. Detailed species information for corals, sponges and other benthic taxa is not presented here, but can be found in WGEAFM Report. However, the information presented in the report and the list of fish species described below should not be regarded as definitive and there may be refinements at a later date when WGEAFM has further time and data available.

Corals: The following groups of corals are considered indicators and key components of VMEs: Antipatharians (Black Corals), Gorgonians (Sea Fans), Cerianthid anemone fields, *Lophelia* and other reef-building corals and sea pen fields. Corals can form structural habitats that contribute to vertical relief and increase the availability of microhabitats. Increasing complexity provides feeding opportunities for aggregating species, a hiding place from predators, a nursery area for juveniles, fish spawning aggregation sites and attachment substrate for fish egg cases and sedentary invertebrates, all of which have been reported for deep water coral habitats. In general, deep-water coral habitats represent biodiversity hotspots for invertebrates, and commonly support a large abundance of fish. Aggregations of sea pens may provide important structure in low-relief sand and mud habitats where there is little physical habitat complexity. Also, sea pens may provide habitat and refuge for small planktonic and benthic invertebrates, which in turn may be preyed upon by fishes. They also may alter water current flow, thereby retaining nutrients and entraining plankton near the sediment.

Sponges: In the Northwest Atlantic, there are more than 300 species of sponges, ranging in form from thin and encrusting, to branching to mound forming. Species belonging to all three sponge classes Calcarea, Demospongiae and Hexactinellida are found in the NAFO Convention Area. Sponges, particularly those of large size, are known to be habitat forming structures, often with numerous other species living within and around their body structures. The extent to which an individual sponge can act as a host for other species is dependent on sponge surface characteristics, size of ostia, and the size of the sponge itself. One study in the north Atlantic found over 200 species within 11 sponges. As is found in many other habitats, species richness increases with habitat area for a broad variety of species.

Sponges are widespread throughout all depths and bottom types in the Northwest Atlantic, however there are particular species and species groups that are vulnerable to fishing impacts. These sponges can be categorized by three main types: Hexactinellid patches, found to date on the Scotian Shelf in soft sediment areas as well as scattered specimens in areas where deep-sea corals are also found, *Geodia* spp. found along the shelf edge, in gravel or hard bottom areas and *Thenea* sp. generally found in soft bottom and growing on spicule mats.

Other benthic taxa: A number of other benthic taxa meet the FAO criteria for vulnerable species. These include but are not limited to stalked crinoids and tunicates, xenophyophores, file shells, deep-water urchins, sea stars, sea cucumbers and other echinoderms. Megafaunal invertebrates form structures if they aggregate in high numbers, especially in areas of low relief. For example, high-density “forests” of crinoids provide refuge and substrata for a wide variety of small fishes and invertebrates. Similarly, high-density aggregations of brittle stars and brachiopods in boulder-cobble areas and fields of sea urchins in sand and mud habitat also provide space and structure for other organisms. In addition, some organisms such as bryozoans, hydroids, ascidians, barnacles, etc., can provide habitat complexity in diverse environments. This biogenic turf can be used by fish as a refuge from predation, especially for juvenile life stages.

Fish species: These were identified using the methodology described in 10a. Some of these species are associated with seamounts while, for the other listed species, information from trawl surveys showed overlapping distributions and/or concentrations in particular areas. Widely distributed fish species under moratorium, such as cod, redfish, and American plaice were not considered. The fish species included and the reasons for including them are given below (Table 2).

Table 2. Some fish species considered to be sensitive and likely vulnerable to deep-sea fisheries and the reasons for identification. Note (i) life history characteristics refers to one or more of the life history traits listed under criterion iv of the FAO Guidelines (see Request 10a above), (ii) alfonsinos are included because fisheries mostly target dense aggregations on seamounts which can be rapidly depleted and (iii) capelin are included because the SE Shoal is the only known offshore spawning area for the Div. 3NO capelin stock.

Species	**Seamount species**	**Life hist. character.**	**SARA listing**	**NAFO Moratorium**	**Other (see caption)**
Alfonsinos (*Beryx spendens* & *B. decadactylus*)	x				x
Orange roughy (*Hoplostethus atlanticus*)	x	x			
Silver roughy (*Hoplostethus mediterraneus*)	x	x			
Wreckfish (*Polyprion americanus*)	x	x			
Cardinal fish (*Epigonus telescopus*)	x	x			
Capelin (*Mallotus villosus*)				x	x
Black dogfish (*Centroscyllium fabricii*)		x			
Deep-water catshark (*Apristurus profundorum*)		x			
Portuguese dogfish (*Centroscymnus coelolepis*)		x			
Atlantic wolffish (*Anarhichas lupus*)			x		
Northern wolffish (*Anarhichas denticulatus*)			x		
Spotted wolffish (*Anarhichas minor*)			x		
Smooth skate (*Malacoraja senta*)			x		
Spinytail skate (*Bathyraja spinicauda*)		x			

2 and 3. Identifying areas known to support vulnerable species, communities, or habitats

The following mega-habitats in the NRA are known to support vulnerable species, communities, or habitats. For some habitats little is known about the vulnerable species and communities they support. Notwithstanding they are included here in a habitat context:-

Submarine canyon ecosystems can support diverse biological communities, including sensitive structure-forming cold-water corals and deep-water fishes. Fifteen canyons occur along the continental shelf edge in the NRA (Fig. 5), with the highest density along the eastern edge of the southern Grand Bank (Fig. 5). Eleven are named: Jukes, Whitbourne, Denys, Cameron, Jackman, Guy, Hoyles, Kettle, Clifford Smith, Lilly, and Carson Canyons (listed from west to east). Here, the 200m isobath was used to delineate the upper limit of the canyons while the lower limit varied generally was determined by the 2000m isobath. The Carson and Lilly Canyons extend into the Canadian EEZ. The ecology of the canyons in the NRA is not well documented, however, extensive research on other canyons in the region (e.g., The Gully) suggests that these features support vulnerable species and communities.

Seamount ecosystems are sensitive to anthropogenic disturbance because the fishes and invertebrates they include are mostly slow growing, long-lived, late to mature, and have low natural mortality. Deep-water fishes aggregate on seamounts and filter-feeding invertebrates – including corals and sponges – are often found attached to the hard substrates associated with these features. Seamount species also display a relatively high degree of endemism. These characteristics indicate that seamounts are vulnerable to fishing pressure. Several distinct seamount chains can be found in the NRA along with a few more isolated knolls, which are smaller, more rounded seamounts. The majority of these features are located in deep water well beyond the continental slope, with the prominent groupings including the New England Seamounts, the Corner Rise Seamounts, and the Newfoundland Seamounts. Other seamounts and knolls in the NRA include: the Fogo Seamounts, Orphan Knoll and Beothuk Knoll. Information on the ecology and species associated with the seamounts and knolls of the NRA is quite limited but research and exploratory fishing activities have been carried out on a subset of these features. Periodic Soviet Union/Russian research and commercial activities has been carried out on the Corner Rise Seamounts since the mid 1970s. The total fish removals between 1976 and 1995 exceeded 19,000t, most of which alfonsino spp.. Several other fishes were taken in commercial quantities (see Request 4 below: candidate VME 8). Catches of deep-water fish species in Spanish experimental trawl surveys in 2004 on several of the New England and Corner Rise Seamounts mainly comprised of alfonsino species. The western portion of the Corner Rise is an area of high fish species diversity and abundance compared to other parts of the Corner Rise Seamounts, based on Spanish trawl catches between 2005 and 2007. The most abundant species encountered were alfonsino, black scabbardfish, and wreckfish. Corals have been documented on the New England and Corner Rise Seamounts but information on detailed distribution is lacking.

Southeast Shoal is the shallowest (<55m) area on the southeastern Grand Banks (Fig. 5). It supports two possibly relict bivalve populations, including the wedge clam (*Mesodesma deauratum*). On the Grand Banks, the Southeast Shoal is the only known offshore area for the spawning of 3NO capelin, a population that is at a low level and under moratorium. The area is important habitat for several other species under moratorium or at risk, including cod, American plaice, and striped wolffish. Characteristics, such as capelin spawning beds, flatfish (yellowtail flounder and American plaice) nurseries, and occurrence of long-lived bivalve populations, are a consequence of the physical characteristics and related habitat. It is an area of high productivity and biodiversity, and is an important feeding area for several marine mammals, including humpback whales, as well as for various seabirds. It has been identified by Canada as part of an Ecologically and Biologically Significant Area (EBSA) on the southern Grand Bank.

Cold seeps, carbonate mounds and hydrothermal vents: the deep-sea in the NRA has not been extensively mapped and information on them is sparse. There is evidence of seeps and carbonate mounds in the northeastern area of the Orphan Basin and on the Orphan Knoll, however these areas have not been mapped and little is known about the composition of the benthic communities they may support. One mound on the Orphan Knoll, the Einarsson submarine mound, is 1.5 - 2 km wide and around 100 - 200 m in height.

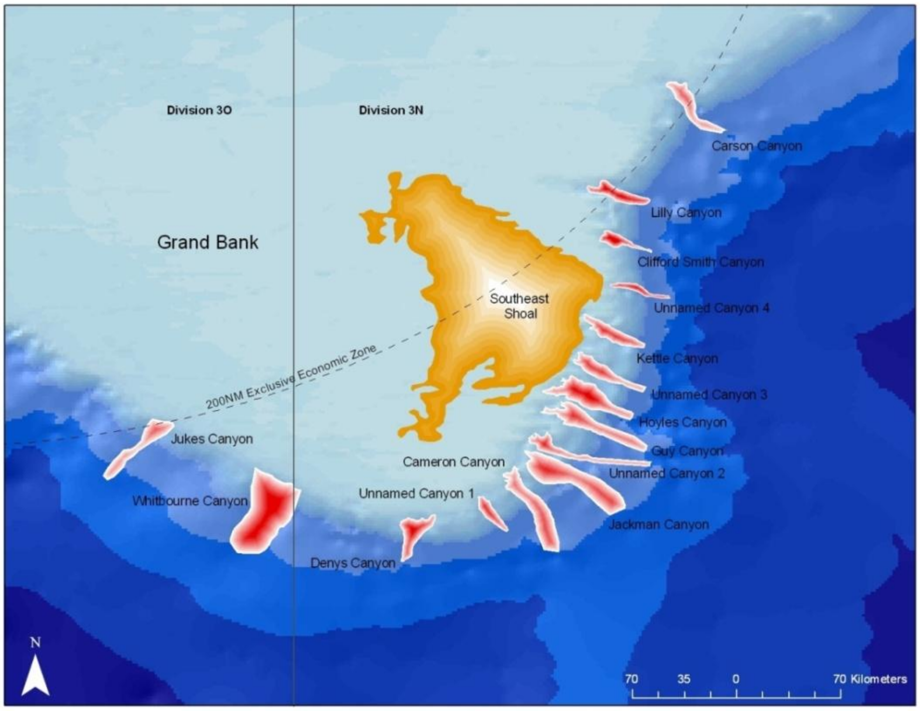


Fig. 5. Distinct topographical features on the southern Grand Bank.

4. Locations of VMEs and bottom substrate features

Candidate VMEs in the NRA were identified using the method and criteria described under Request 10a. The primary data used were spatial distribution data for identified corals, sponges, other benthic taxa and fish species, from Canadian trawl surveys (1995-2007), Spanish/EU trawl surveys (2005-2007), Maritimes fisheries Observer data (1977-2001), Russian observer data (2000-2008), Spanish/EU trawl surveys (Duran *et al*., 2005; Murillo *et al*., 2008) and Russian exploratory fishing activity since the 1970s (Vinnechenko, 1997). Trawl survey data are available down to a depth of 1500m and observer data from commercial bottom trawling are available down to 2000m.

Candidate VME areas at depths were mapped giving the greatest weighting to the distribution vulnerable corals and sponges, as these were considered to be more vulnerable to fishing, particularly to bottom trawling, than vulnerable fish species, and taking into account geological/topographical features known or considered likely to support concentrations of vulnerable biotic and abiotic features. The candidate VME areas are listed below and mapped in Fig. 6 and 7. Some areas extend into the Canadian EEZ for the sake of representing ecologically coherent units.

VME boundaries should be regarded as preliminary, as they are based only on the relatively broad-scale distribution information currently available. In all cases high resolution habitat mapping is required to identify these boundaries with greater certainty. Due to the lack of high resolution mapping data no attempt was made to define biological buffer areas which may be required around VMEs to insulate them from the effects of fishing on peripheral margins and transition zones.

<u>1. Flemish Cap East</u>

Rationale: Large sponge catches >1000 kg / tow
Suggested depth: 500-1500 m
Comments: Between Flemish Cap east and west, area generally unknown but slope steepness and topography suggest area where VME likely to occur.
Vulnerable fish species: black dogfish, smooth skate.

2. Northern Flemish Cap

Rationale: Area of high bycatch of corals: pennatulacea, alcyonacea and antipatharia
Suggested depth: 500-1000 m
Vulnerable fish species: northern wolffish

3. Sackville Spur

Rationale: High density of sponges in area, several catches > 1000 kg / tow
Suggested depth: 1000-1500 m
Vulnerable fish species: none identified

4. Southern Flemish Pass to Eastern Canyons

Rationale: Large catches of sponge > 1000 kg / tow large gorgonians
Suggested depth: 500-1500 m
Comments: Identified as a Canadian Ecologically and Biologically Significant Area (EBSA).
Vulnerable Fish Species: striped wolffish, spinytail skate, northern wolffish, black dogfish, deep-water catshark.

5. Beothuk Knoll

Rationale: Large gorgonian corals, large sponge catches > 1000 kg
Suggested depth: 500-3000 m
Vulnerable fish species: northern wolffish, spinytail skate, deepwater catshark, black dogfish.

6. Southeast Shoal and adjacent shelf slope and canyons

Rationale: Unique spawning grounds on SE Shoal for capelin, marine mammal feeding grounds, long-lived and relict bivalve populations in sandy shoal habitat. Identified as an EBSA. Deep-water canyons- presence of corals.
Suggested depth: down to 1500m
Comments: May be appropriate to divide into two separate VMEs: SE Shoal and slope/canyons.
Vulnerable fish species: SE Shoal: spawning capelin; Canyons: northern wolffish, Atlantic and spotted wolffish, black dogfish.

7. Division 3O Coral Closure Area

Rationale: Existing coral closed areas, based on coral concentrations, high bycatch of pennatula and solitary scleractinians
Suggested depth: 200-1500 m
Comments: ICES/NAFO WG on Deep-water Ecology (WGDEC, 2008) recommendation that the depth of the closure be decreased to 200m. Boundaries reflect that recommendation.
Vulnerable fish species: white hake, black dogfish, smooth skate, deep-water catshark.

8. Seamounts and other knolls (New England Seamounts, Corner Rise Seamounts, Fogo Seamounts, Newfoundland Seamounts and Orphan Knoll)

Rationale: Topographical features constituting mega-habitats and host or are likely to host VME habitats including corals, sponges and a range of vulnerable fish species, some of which are considered to be endemic. Carbonate mounds are found on and around Orphan Knoll but little information is available on associated benthic fauna.
Suggested depth: All and adjacent seafloor within existing closed areas.
Comments: All except the Fogo seamounts are currently protected by existing NAFO closed areas
Vulnerable fish species: alfonsino spp., orange roughy and silver roughy, wreckfish and cardinal fish.

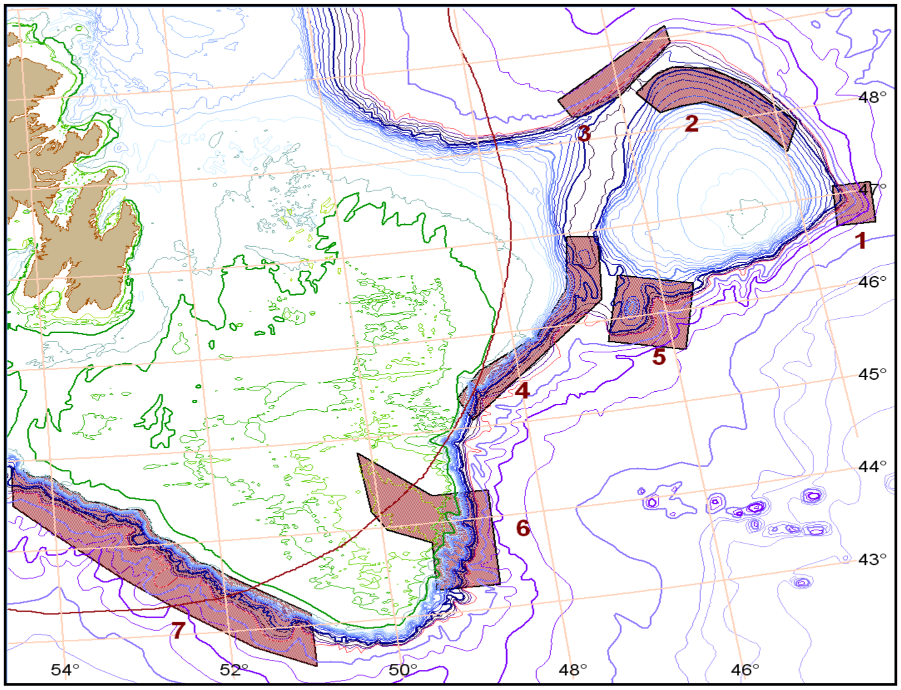


Fig. 6. Candidate VME areas proximal to the Grand Banks and Flemish Cap (VME numbers correspond to the VMEs 1-7 above and the 100, 500, 1000, 2000, 3000, and 4000m depth contours are depicted as thick lines). The already closed seamounts are VME 8 and are not shown on this map.

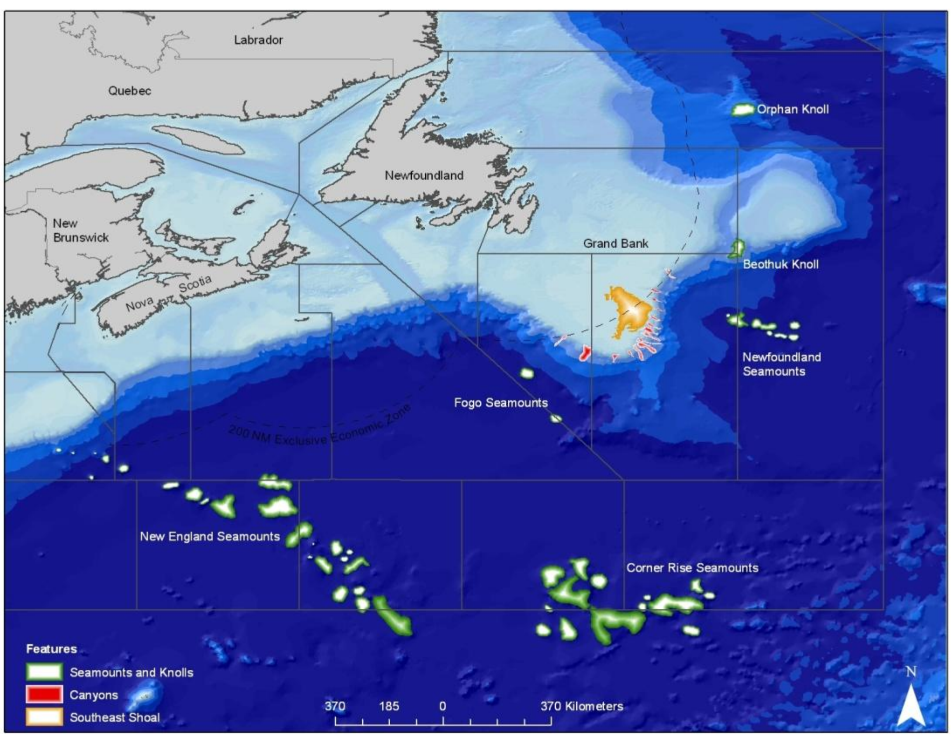


Fig. 7. Map of topographical features in the NRA that are known or likely to support or contain VMEs (see VME 8 in list above).

References

Duran Muñoz, P., M. Mandado, A. Gago, C. Gomez, and G. Fernandez. 2005. Brief results of a trawl experimental survey at NW Atlantic. *NAFO SCR Doc.* No. 05/32.

Murillo, F.J., P. Duran Muñoz, M. Sacau, D. Gonzalez-Troncoso and A. Serrano. 2008. Preliminary data on cold-water corals and large sponges bycatch from Spanish / EU bottom trawl groundfish surveys in NAFO Regulatory Area (Divs. 3LMNO) and Canadian EEZ (Div. 3L) 2005-2007 period. *NAFO SCR Doc.* No. 08/10.

Vinnechenko, V. I. 1997. Russian investigations and deep water fishery on the Corner Rising seamount in Subarea 6. NAFO Scientific Council Studies, 30: 41-49.

VME Data Collection Protocol

Scientific Council observed that it was difficult to review the VME Data Collection Protocol since the purpose of the collection protocol was not stated. The importance of data collection is stressed throughout UNGA Resolution 61/105 and relates to data on catches, bycatch and discards, and on other components of the ecosystem. The DSF guidelines (FAO TC:DSF2/2008/2) have elaborated on the types of data to be collected in Annex 1. There are also data collection requirements for the exploratory fishing protocol and for reporting under the encounter protocol. The collection protocol provided in the request seems to have united all of these separate data collection requirements. Further, the transport of antipatherians (black corals) and scleractinians (stony corals) across international boundaries is regulated under Appendix II of CITES.

Further more specific comments are:

- Explanation of why these samples are required on the instructions sheet.
- Clarification in the quantities and species (phyla, classes, orders, etc.) to be collected or photographed, and specifically if this includes fish species.
- Concerns over training and workload of observers.
- The collection of shooting and hauling positions, as well as depth range.
- Clearer identification of the names of contact institutes or persons who will collect the samples from the port.
- The concern that NAFO Scientific Council does not have a coral key (although discussions have commenced on the production of a NAFO coral key), a sponge key, or indeed any other invertebrate keys.
- This needs to be supported by a list of VME indicator species and possible additional lists of vulnerable marine species.
- Quality control of the quality of observer data may be needed to ensure that the data are reliable.
- Further elaboration of the protocol may be needed in future to ensure that data collected by different Contracting Parties are, and remain, consistent and are standardized to allow further analysis of the data collected.

The following simplified collection protocol may be sufficient:

i) For VME generally Trip#, Set#, Vessel Name, Gear Type, shooting and hauling latitude and longitude, Depth, Date and Name of Observer on datasheets,

ii) Record evidence of VME by reporting VME indicator species and the presence of other vulnerable marine species using the scientific name or species code. When possible, animals should be measured, and photographs taken when appropriate.

Scientific Council **recommended** that *the collection protocol be reviewed and re-drafted, possibly at the Fisheries Commission ad hoc Working Group of Managers and Scientists on VME to take in to account the above issues.*

2. Coastal States

a) Request by Canada for Advice

The Scientific Council noted that the requests for advice on northern shrimp (Northern shrimp in Div. 3M and Div. 3LNO (Item 1)) will be considered during Scientific Council Meeting on 22-30 October 2008).

i) TAC for Greenland halibut in Subarea 2 and Div. 3K, and in Div. 3LMNO

Canada requested the Scientific Council to *advise on appropriate TAC levels for 2009, based on biomass distribution, for Greenland halibut in these areas separately: SA 2+ Division 3K and Divisions 3LMNO.* (Item 3)

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. On average, over 80% of the biomass occurred in SA2 + Div. 3K and 20% in Div. 3LMNO and future quotas based upon biomass distribution could be allocated accordingly.

ii) Status of Greenland halibut in relation to the Rebuilding Plan and Strategy

Canada requested the Scientific Council to *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.* (Item 3)

The Scientific Council responded :

The Rebuilding Plan initially specified TACs for the years 2004 to 2007 and were set as 20 000, 19 000, 18 500, 16 000 t (FC Doc. No. 03/13). Catches for these years exceeded the TACs by 27%, 22%, 27% and 42%.

During the 2007 Scientific Council meeting, a simulation was conducted assuming catches equaled the TACs for 2004 to 2007 (*NAFO Sci. Coun. Rep*., 2007, p. 13). The Scientific Council concluded that if the Rebuilding Plan had been effectively implemented, the exploitable biomass would have recovered (27% increase) from the very low level estimated in 2004 and that fishing mortality would have been significantly reduced.

In addition, noting the lack of improvement in the exploitable biomass and the below average estimates of recruitment expected to recruit to the biomass, the Council in 2007 recommended (*NAFO Sci. Coun. Rep*., 2007, p. 13) that *fishing mortality should be reduced to a level not higher than* $F_{0.1}$, *or alternatively, catches over the next four years should be reduced by 15% annually from the 2007 TAC (16 000 t).*

The Rebuilding Plan TAC for 2008 was subsequently set as 16 000 t.

Despite reductions in fishing mortality, the cumulative effect of exceeding Rebuilding Plan TACs has seriously hampered stock recovery. Projections conducted in the current assessment (tabulated below) indicate that the exploitable biomass in 2013 will remain far below the Rebuilding Plan target of 140 000 t. These projections are pessimistic as current biomass is relatively low and several successive year-classes which are about to recruit to the exploitable biomass are estimated to be well below average.

Scenario	Projected Biomass Relative to 140 000t
F0.1	0.72
F2007	0.49
16,000 t	0.52
22,750 t	0.25

Further, unless fishing mortality is reduced to $F_{0.1}$, the exploitable biomass at the end of the projection period (2013) will remain lower than that when the Rebuilding Plan was implemented.

Exploitable Biomass	F0.1	F2007	16 000t	22 750t
[B(2013)-B(2008)] / B(2008)	27%	-14%	-9%	-55%
[B(2013)-B(2003)] / B(2003)	7%	-27%	-23%	-62%

Refer also to agenda item X.3.

b) Request by Denmark (Greenland) for Advice

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: *provide advice on the scientific basis for the management of Roundnose grenadier in Subarea 0+1 for 2009-2011.*

The Scientific Council responded as follows:

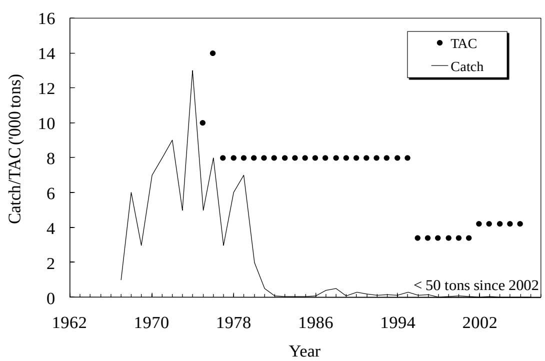
*i) Roundnose Grenadier (***Coryphaenoides rupestris***) in Subareas 0 and 1*

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

Fishery and Catches: Recommended TACs were at 8 000 t in the period 1977-1995. The advice since 1996 has been that the catches should be restricted to bycatches in fisheries targeting other species. There has been no directed fishery for this stock since 1978. An unknown proportion of the reported catches are roughhead grenadier (*Macrourus beglax*).

	Catch ('000 t)		TAC('000 t)	
Year	STACFIS	21A	Recc.	Agreed[2]
2005	0.01[1]	0.01	ndf	4.2
2006	0.05[1]	0.02	ndf	4.2
2007	0.01[1]	0.03	ndf	No TAC
2008			ndf	No TAC

[1] Provisonal
[2] Set by Greenland for Subarea 1
ndf No directed fishing, catches restricted to bycatch in other fisheries

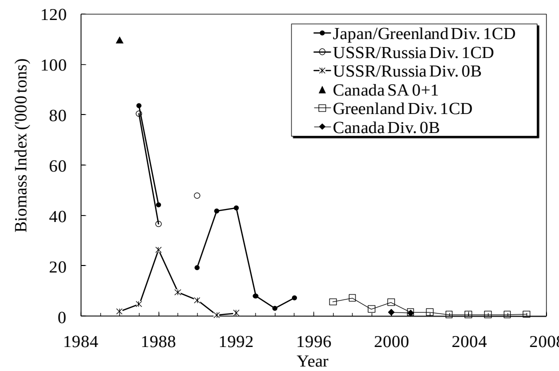


Data: Biomass estimates of roundnose grenadier from surveys in Div. 0B during the period 1986-1992, from Div. 1CD during the period 1987-1995, from Div. 1CD in 1997-2007 and Div. 0B in 2000-2001 were available.

Assessment: No analytical assessment could be performed.

Fishing Mortality: Exploitation level not known.

Biomass: There are no recent estimates of biomass of roundnose grenadier for the entire stock area. In 2007 the biomass of roundnose grenadier was estimated at 838 t for Div. 1CD, close to the lowest ever observed (600 t). Surveys in Div 0B in 2000 and 2001 also showed a very low biomass; 1 700 and 1 300 t, respectively.



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

Reference points: No reference points available.

Recommendation: There should be no directed fishing for roundnose grenadier in Subareas 0 and 1 in 2009-2011. Catches should be restricted to bycatches in fisheries targeting other species.

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

The next Scientific Council assessment of this stock will be in 2011.

Sources of Information: SCR Doc. 08/17; SCS Doc. 08/8, 11.

ii) Demersal Redfish and other finfish in Subarea 1

Advice for redfish (*Sebastes* spp.) and other finfish, (American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*A. minor*) and thorny skate (*Amblyraja radiata*)) in Subarea 1 was in 2005 given for 2006-2007. Denmark, on behalf of Greenland, requests the Scientific Council to: *provide advice on the scientific basis for the management of Redfish (Sebastes spp.) and other finfish in Subarea 0+1 for 2009-2011.* (Item 2)

The Scientific Council responded as follows:

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

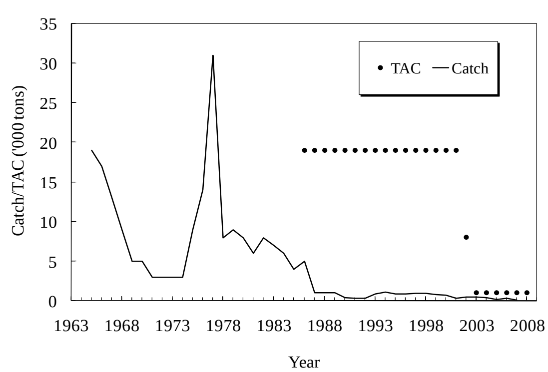
Background: There are two species of commercial importance in Subarea 1, golden redfish (*Sebastes marinus*) and deep-sea redfish (*Sebastes mentella*). Relationships to other North Atlantic redfish stocks are unclear.

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

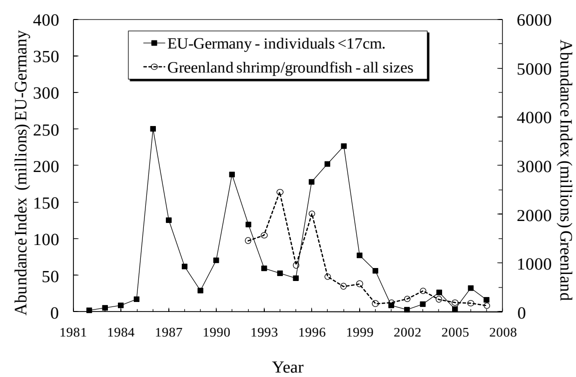
	Catch[1]	TAC ('000 t)	
Year	('000 t)	Recommended	Agreed
2005	<0.5	ndf	1
2006	<0.5	ndf	1
2007	<0.5	ndf	1
2008			1

[1] Provisional.

ndf No directed fishing, Discarded bycatch should be at the lowest possible level.



Data: No data on CPUE from any commercial fishery were available. Assessments of recent stock abundance, biomass and length structure for these stocks were based on annual bottom trawl surveys conducted by EU-Germany and Greenland. Both the abundance and biomass index estimated from the Greenland bottom trawl survey showed the lowest values seen since 1992.

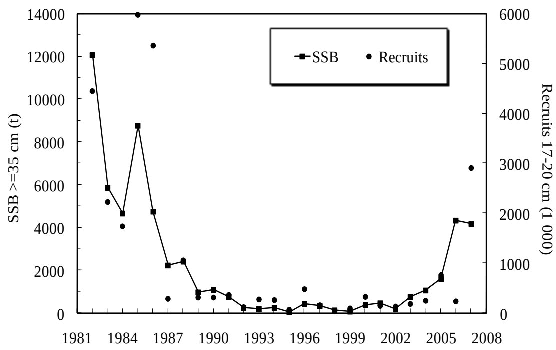


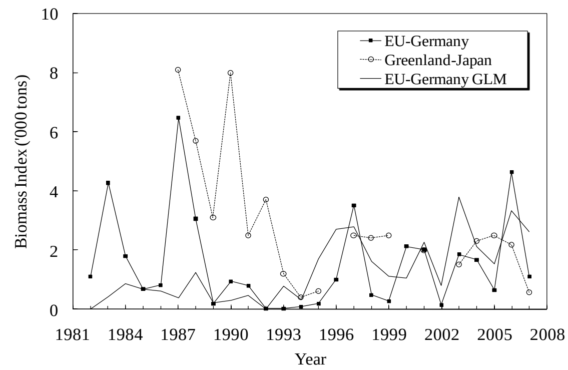
Spawning stock biomass and recruitment indices for both redfish stocks were derived from EU-German survey data.

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

Recruitment: Recruitment index has been low since 1986. However, the recruitment index in 2007 was the highest since the mid 1980s.

SSB: SSB index has been low since 1989, although showing some signs of recovery since 2002.



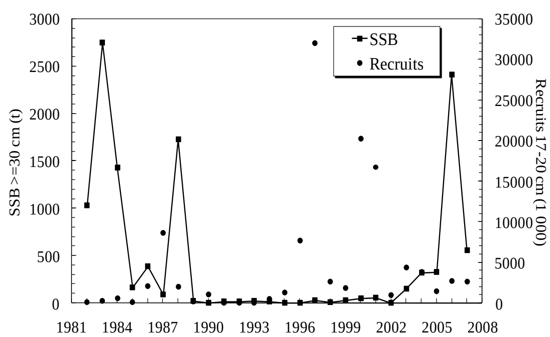


State of the Golden Redfish Stock: The stock of golden redfish in Subarea 1 remains severely depleted, although some signs of rebuilding are observed.

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

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

SSB: SSB index has been below average since 1989.



Biomass: Total stock biomass indices have been variable through time, with no clear trend. The stock is mainly composed of immature fish.

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

Recommendation for Golden and Deep-sea Redfish Stocks: No directed fishery should occur on demersal redfish in Subarea 1 in 2009, 2010 and 2011. Bycatches in the shrimp trawl fishery should be kept at the lowest possible level.

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

Special Comments: The next Scientific Council assessment of this stock will be in 2011.

Sources of Information: SCR Doc. 08/16, 17, 28, 37; SCS Doc. 08/11.

Other Finfish in Subarea 1

Background: The resources of other finfish in Subarea are mainly American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolffishes (*Anarhichas lupus* and *A. minor*) and thorny skate (*Amblyraja radiata*).

Fishery Development and Catches: Wolffishes have been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. American plaice and thorny skate are mainly taken as bycatch offshore in trawl fisheries directed to shrimp. No data on catches of American plaice and Thorny skate were available for SA1. Both wolffish species are combined in the catch statistics, since no species specific data are available. The catch figures do not include trawl-fishery discards.

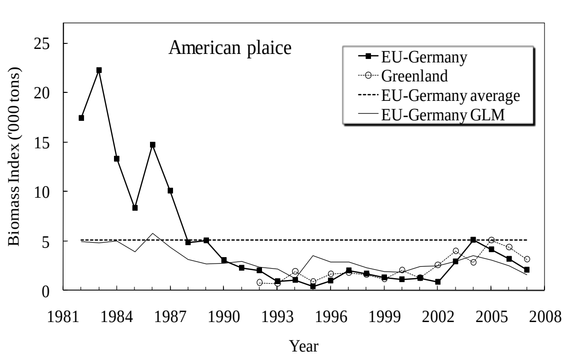
Catches of wolffish in SA1:

	Catch[1]	TAC ('000 t)	
Year	('000 t)	Recommended	Agreed
2005	0.3	ndf	1
2006	0.7	ndf	1
2007	0.6	ndf	1
2008			1

[1] Provisional.
ndf No directed fishing.

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

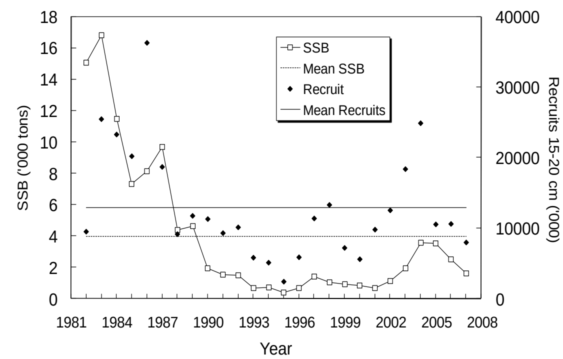
Assessment of American plaice: No analytical assessment was possible.



Biomass indices: Biomass indices for American plaice decreased in the 1980s and have remained at a low level since then.

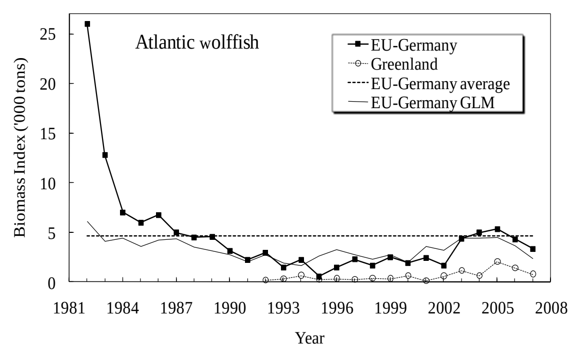
Recruitment: Indices have been low since 1987 but were above average in 2003 and 2004.

SSB: After an increase in 2003 and 2004, SSB has decreased to pre-2003 levels, and is still considered to be at low level compared to the early and mid-1980s.



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

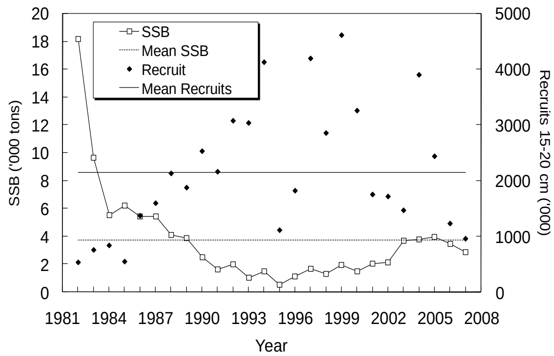
Assessment of Atlantic wolffish: No analytical assessment was possible.

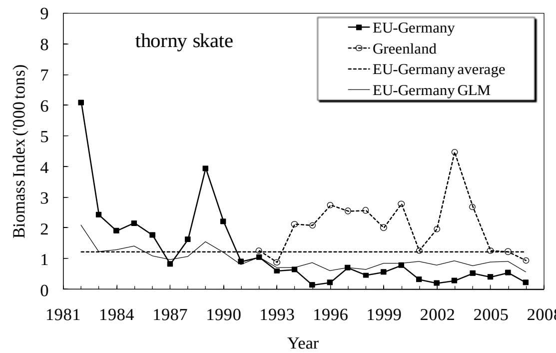


Biomass indices: The modeled biomass indices for Atlantic wolffish have been low since the beginning of the 1980s, although slightly increasing in 2005.

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

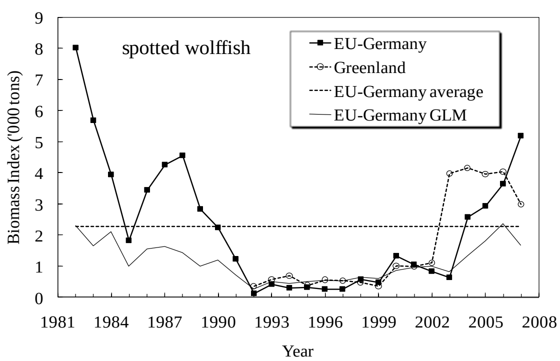
SSB: Since 1982, the SSB index decreased drastically and remained severely depleted since the early 1990s. SSB increased in 2003 but has remained stable since then.





State of the Atlantic wolffish stock: The stock remains depleted despite a steady increase in recruitment since the early 1980s. The stock is dominated by small individuals.

Assessment of Spotted wolffish: No analytical assessment was possible.



Biomass indices: Biomass indices for spotted wolffish have increased between 2002 and 2006 to a level above average for the series. The stock shows no signs of dominating year-classes.

State of the Spotted wolffish stock: Improvements are observed and the stock is at or above average level.

Assessment of Thorny skate: No analytical assessment was possible.

Biomass indices: Thorny skate biomass indices are less clear, but after a decrease in 1980s, indices have remained at a low level. The stock is dominated by small individuals below 25 cm.

State of the Thorny skate stock: The stock of Thorny skate remains severely depleted.

Recommendation for the stocks of American plaice, Atlantic wolffish, and thorny skate: No directed fishery in Subarea 1 for American plaice, Atlantic wolffish and thorny skate should occur in 2009, 2010 and 2011. Bycatches of these species in the shrimp fisheries should be kept at the lowest possible level.

Recommendation for Spotted wolffish: The Scientific Council is unable to advice on the catch level for spotted wolffish.

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

Special Comments: The next Scientific Council assessment of these stocks will be in 2011.

Sources of Information: SCR Doc. 08/16, 28, 41; SCS Doc. 08/11.

iii) Greenland Halibut in Div. 1A Inshore

Advice for Greenland halibut in Subarea 1A inshore was in 2006 given for 2007-2008. Denmark, on behalf of Greenland, requests the Scientific Council to: *provide advice on the scientific basis for the management of Greenland halibut in Subarea 1A inshore for 2009-2010* (Item 4).

The Scientific Council responded as follows:

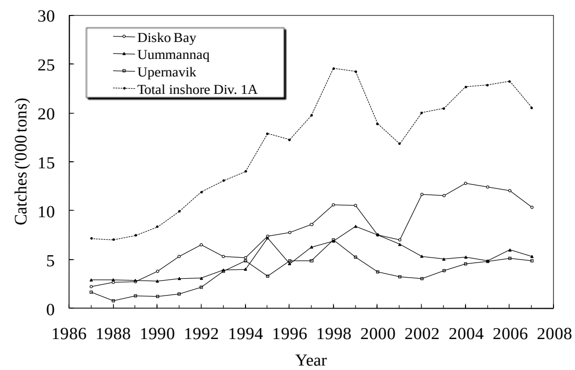
*Greenland Halibut (***Reinhardtius hippoglossoides***) in Division 1A inshore*

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 implications for the recruitment to the inshore stocks.

Fishery and Catches: The fishery is conducted with longlines and gillnets. Total landings in all areas have increased gradually since the late 1980s until 1998 when the landings were almost 25 000 t. Landings then declined to 16 900 t in 2001 but increased again during 2002-2005 reaching 23 000 t. Since then landings have decreased overall to 20 000 t in 2007. In Disko Bay landings have been increasing since 2001 reaching 12 900 t in 2004. Since then landings have decreased continuously specially the last year where they were 10 400 t. In Uummannaq landings decreased from 1999-2003 but increased slightly until 2004 reaching 5 000 t and have remained at that level since then. In Upernavik landings have remained at around 5 000 t since 2004.

		Catch ('000 t)	TAC ('000 t)	
Area	Year	STACFIS	Recc.	Agreed
Disko Bay	2005	12.5	ni[2]	
	2006	12.1	ni[2]	
	2007	10.4	ni[2]	
	2008		ni[2]	12.5
Uummannaq	2005	4.9	5.0	
	2006	6.0	5.0	
	2007	5.3	5.0	
	2008		5.0	5.0
Upernavik	2005	4.8	na[1]	
	2006	5.1	na[1]	
	2007	4.9	na[1]	
	2008		na[1]	5.0

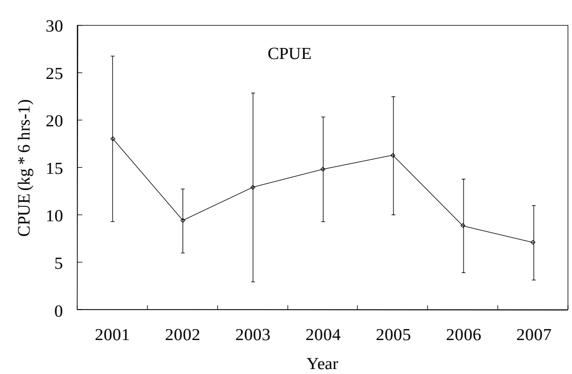
[1] No advice
[2] No increase in effort



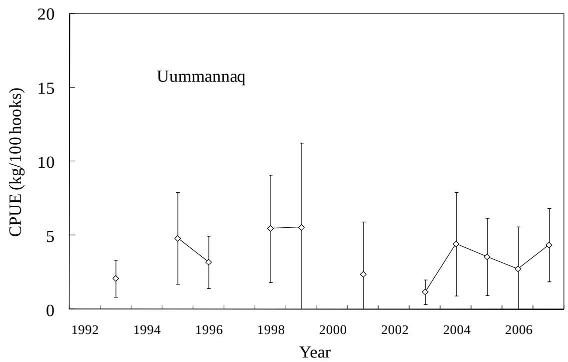
Data: Length frequencies from the commercial fisheries were available for all three areas. Catch rate and length frequency data were available from the longline survey in Uummannaq and the gillnet survey in Disko Bay. A biomass estimate and recruitment index for age 1 was available from the trawl survey in Disko Bay. Catch-at-age data were available from Disko Bay and Uummannaq from 1988 to 2007.

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 2006 catches have been at a record high level but have decreased especially over the last year. Mean length in commercial catch shows a decrease over the last six years. The gillnet survey (2001-2007) shows decreasing catch rates over the last two years. Trawl survey biomass has been declining since 2004 but is still above the level in the 1990s.

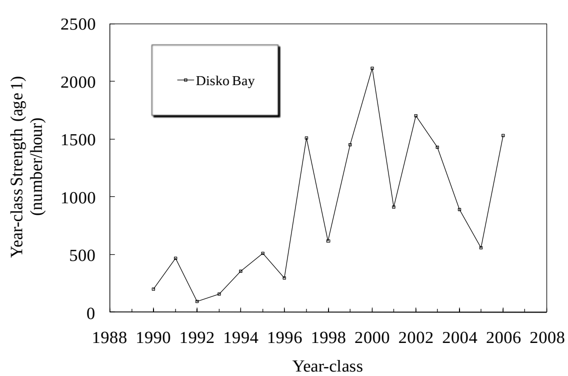


Uummannaq. Longline-survey abundance indices and landings have remained stable over the last three years. Mean lengths from the surveys are relatively stable over the entire period, while mean lengths from the fishery have decreased slightly over the last years.



Upernavik. Surveys have not been conducted since 2000, and samplings from the commercial fishery were not carried out during 2002 to 2004, but length-frequency sampling from the winter fishery in 2005 and 2006 indicate that mean lengths have been stable during recent years.

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 and younger age groups compared to the early 1990s and the fishery has thus become more dependent on incoming year-classes.

Disko Bay: Landings have been declining since 2004, especially between 2006 and 2007. Mean length in the landings have been gradually declining since 2001. CPUE (kg) in the gill net survey has been declining since 2005 and NPUE (number) has been declining since 2004. The decline in mean length in the commercial fishery is hence unlikely to be caused by incoming new young year-classes to the fishery. These trends are a cause of concern. Trawl survey biomass has been declining since 2004 but is still above the level in the 1990s. Recruitment has varied since the good 1997 year-class, but has been above the level in early and mid 1990s. The recruitment of the 2006 year-class was the third largest in the time series.

Uummannaq. Landings have remained stable since 2002. Mean lengths from the commercial fishery have been relatively stable until 2007. Abundance indices in the longline survey indicate an increase until 1999, from 2001 to 2003 abundance indices decreased and in the same period landings declined, since 2004 abundance indices have remained stable. Both survey indices and mean lengths in the commercial fishery indicate a stable stock in the Uummannaq area.

Upernavik. Landings and 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 is likely to be a sign of a high exploitation. Further, recruitment indices from the gillnet survey is decreasing. Scientific Council expresses concern about the high exploitation level. Scientific Council therefore recommended that catches should be significantly reduced to 8 800 t for 2009-2010, which is a 25% reduction of the mean catches of 2005-2007, in an attempt to restore the growth potential of the stock**.**

Uummannaq: Based on the last three years stable CPUE indices and catches, Scientific Council considers the last advice on a catch level to be appropriate for 2009-2010. Scientific Council therefore recommended that TAC for 2009-2010 should be 5000 t.

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

Reference Points: not determined.

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

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

The next Scientific Council assessment of this stock will be in 2010.

Sources of Information: SCR Doc. 08/28, 38; SCS Doc. 08/11.

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

The Scientific Council noted that the requests for advice on northern shrimp (Northern shrimp in Div. 3M and Div. 3LNO (Item 1)) will be undertaken during Scientific Council Meeting on 22-30 October 2008)

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 2009, and to specifically:

a) advise on appropriate TAC levels for 2009, separately, for Greenland halibut in the offshore area of Divisions 0A+1AB and Divisions 0B+1C-F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.

The Scientific Council response is as follows:

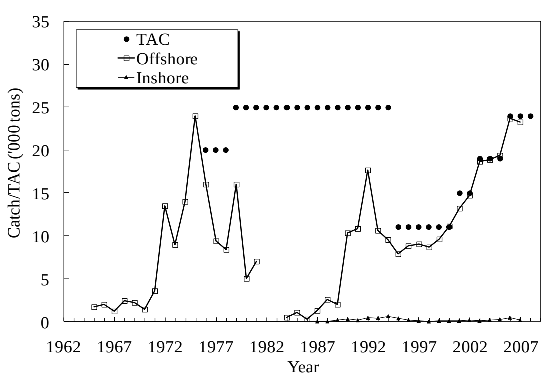
Greenland Halibut (Reinhardtius hippoglossoides) in SA 0 + Div. 1A Offshore and Div. 1B-1F

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 t in 1989 to 18 000 t in 1992 and have remained at about 10 000 t annually until 2000. Since then catches have increased gradually to 19 000 t in 2003 primarily due to increased effort in Div. 0A and in Div. 1A. Catches stayed at that level in 2004-2005. Catches increased in 2006 to 24 000 t due to increased effort in Div. 0A and 1A and stayed at level in 2007.

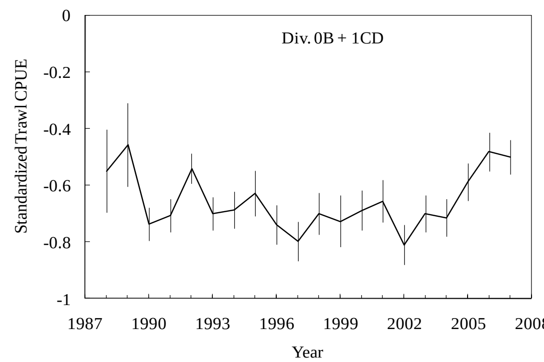
	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2005	20	14[1]	19[2]	19
2006	24	16[1]	24[2]	24
2007	23	16[1]	24[2]	24
2008			24[2]	24

[1] Provisional
[2] Including 4 000 t allocated specifically to Div. 0A and 1A in 2002, 8 000 t from 2003 to 2005 and 13 000 t from 2006 to 2008.



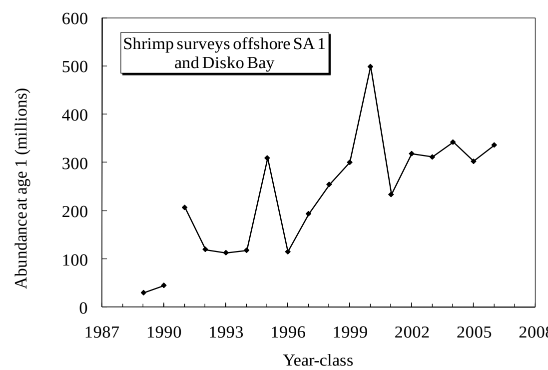
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Standardized catch rates were available from Div. 0A, 0B and Div. 1CD. Biomass estimates from deep sea surveys in 2007 were available from Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2007.

Assessment: No analytical assessment could be performed. The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002, increased again until 2006 but decreased slightly in 2007 to the second highest seen since 1989. Standardized catch rates in Div. 0A decreased slightly between 2006 and 2007 and is about average for the time series. Standardized catch rates in Div. 0B have decreased slightly since 2005 but is still above the level seen during 1999-2004. Standardized catch rates in Div. 1CD have increased in recent years. Unstandardized catch rates decreased slightly in Div. 1A.

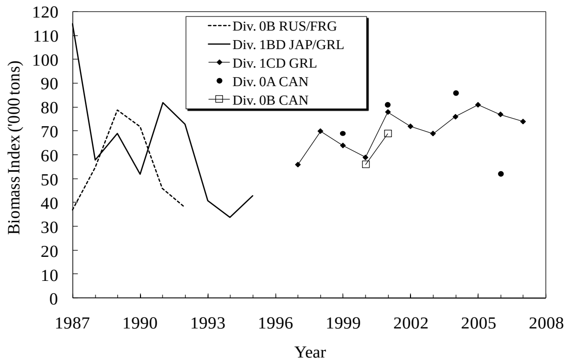


Fishing Mortality: Level not known.

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 2002-2006 year-classes were well above average.



Biomass: The biomass in Div. 1CD in 2007 was estimated at 74 000 t, which is above average for the eleven years time series. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has decreased gradually since 2004 but the 2007 estimate is still above average for time series. (1991-2007). The biomass in Div. 0A decreased to 52 000 t in 2006. However, the survey coverage was incomplete in 2006. No survey in Div. 0A in 2007.



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 relatively stable since 2001 and at the level observed in the late 1980s and 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 2009 should not exceed 11 000 t.

Considering the relative stability in biomass indices and CPUE rates, for Greenland halibut in Div. 0A and 1AB Scientific Council advises that TAC in Div. 0A and Div. 1A off shore + Div. 1B for 2009 should not exceed 13 000 t.

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

Special Comments: The next Scientific Council assessment of this stock will be in 2009.

Sources of Information: SCR Doc. 08/17, 28, 35 SCS Doc. 08/6, 8, 11, 12, 15.

3. Scientific Advice from Council on its own Accord

a) Oceanic (pelagic) redfish

Pelagic Redfish (*Sebastes mentella*) in NAFO Subareas 1-3 and adjacent ICES areas V, VI and XIV, is not assessed by the NAFO Scientific Council. ICES receives a request from NEAFC each year to undertake an assessment and it is in the ICES North-Western Working Group (NWWG) that the assessment is made. NWWG met during 21-29 April 2008 (ICES CM 2008/ACOM:03) to assess the status of pelagic Redfish and ICES (ICES Advice 2008, Book 2, p. 94) gave the following advice for 2009:

"*The new landing and logbook data available for this stock do not change the perception of the stock. The advice for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: ICES advises that a management plan be developed and implemented which takes into account the uncertainties in science and the properties of the fisheries. ICES suggests that catches of* S. mentella *are set at 20 000 t as a starting point for the adaptive part of the management plan.*"

The ICES advice for the 2008 fishery (ICES Advice 2007, Book 2, p. 12) was:

"*ICES advises that a management plan be developed and implemented which takes into account the uncertainties in science and the properties of the fisheries. ICES suggests that catches of* S. mentella *are set at 20 000 t as a starting point for the adaptive part of the management plan.*"

NEAFC will discuss the ICES advice for 2009, which is the same as the 2008 advice, at its annual meeting in 10-14 November 2008 and set the annual TAC. A portion of the TAC is transferred to NAFO. In 2007, ICES advised for 2008 the establishment of a management plan with an initial precautionary annual catch of 20 000 t. ICES notes that there is considerable uncertainty in the stock structure as well as in the data available for assessing the status of this stock. Despite that the survey data indicates that the stock size is low compared to the early 1990s, stock size has not shown any clear trends since 1999. For 2008, NEAFC has set a rolled over TAC of 46 000 t, "of which 2 875 tonnes will be allocated to NAFO, and 123 tonnes will be available to co-operating non contracting parties". As the NEAFC contracting parties did not reach a unanimous decision, the total TAC in force for 2008 is about 74 000 t, and this is considerably higher than the ICES advice (Table 3).

Table 3. Catch, advice and TAC for Pelagic Redfish in NAFO Subareas 1-3 and adjacent ICES areas V, VI and XIV.

	Catch	ICES advice	NEAFC TAC	NAFO TAC (by agreement)
2007	64 000 t	0	46 000 (73 000[2]) t	2 875 t
2008		20 000 t[1]	46 000 (74 000[2]) t	2 875 t
2009		20 000 t[1]		

[1] Assuming implementation of a management plan.
[2] Sum of all quotas in force

NAFO Scientific Council reviewed the 2008 ICES advice to NEAFC for 2009 (see first italicized paragraph above) and, given the difficulties with the assessment of this stock (or stocks), supported the conclusions and advice. However, Scientific Council notes that the ICES advice to NEAFC is cast within a two-stage sequential process: (a) develop a management plan and (b) then set an annual TAC of 20 000 t as a starting point when implementing the plan. However, there is no assurance that such a management plan will be developed prior to 2009. Therefore, the Scientific Council advises Fisheries Commission that it would be prudent for NEAFC to implement a total TAC of 20 000 t in 2009 for pelagic redfish in NAFO Subareas 1-3 (and adjacent ICES areas V, VI and XIV), irrespective of any progress made in developing and implementing a management plan for this resource.

NAFO Scientific Council reviewed the recommendation made by the ICES Arctic Fisheries and North-Western Working Groups to discuss the possibility of establishing a joint ICES/NAFO redfish assessment working group. Scientific Council noted the importance of improving the collaboration between NAFO and ICES redfish expertise but was uncertain that a joint ICES/NAFO redfish assessment working group was the best way forward and that other ways to improve the collaboration should first be investigated.

b) Monitoring of Stocks assessed in 2007

Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3

The Scientific Council reviewed the status of this stock (interim monitor) at this June 2008 meeting. Based on overall indices for the current year, Scientific Council found no significant change in the status of this stock. The next full assessment of this stock is planned to be in 2010.

VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

1. Scientific Council Meeting and Special Session, September–October 2008

The Council reconfirmed that the Annual Meeting will be held on 22-26 September 2008 at the Maritime Station, in Vigo, Spain. The Symposium, co-sponsored by NAFO, ICES and NAMMCO "The Role of Marine Mammals in the Ecosystem in the 21st Century" will be held on 29 September – 1 October 2008 at the Alderney Landing, Dartmouth, NS, Canada.

2. Scientific Council Meeting, October 2008

Scientific Council decided to change the dates for the 2008 NIPAG meeting that were agreed in 2006 and hold the meeting a week earlier (*NAFO Sci. Coun. Rep.*, 2007, p. 218). This was because of the tight deadline for informing ICES ACFM of the NIPAG advice for shrimp stocks. The dates and venue of the next SC/NIPAG meeting will be Wednesday 22 – Thursday 30 October 2008 at the ICES HQ, Copenhagen, Denmark.

3. Scientific Council Meeting, June 2009

Scientific Council agreed that its June meeting will be held on 4-18 June 2009 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada.

4. Scientific Council Meeting and Special Session, September/November 2009

Scientific Council noted that the Annual Meeting will be held 21-25 September 2009. The Special Session of Scientific Council will be the symposium entitled "Rebuilding Depleted Fish Stocks – Biology, Ecology, Social Science and Management" to be held on 3-6 November 2009 in Warnemünde, Rostock, Germany. (see Agenda Item IX.2 for further information)

5. Scientific Council Meeting, October-November 2009

The dates and venue of the Scientific Council meeting in conjunction with the NIPAG meeting will be decided at the October 2008 SC/NIPAG Meeting. Provisional dates and venue are 21-29 October 2009 at the NAFO Secretariat, Dartmouth, NS, Canada (*NAFO Sci. Coun. Rep.*, 2007, p.218). However, the reason for moving the meeting one week forward was due to an ACFM requirement. With the dissolution of the ACFM it may now be possible to move the meeting dates back to better accommodate NAFO survey analyses requirements.

6. NAFO/ICES Joint Groups

a) WGHARP, August 2008

A request submitted to WGHARP in 2006 regarding Fisheries Commission request item 10 of 2005 (FC Doc. 05/14) was withdrawn from the WGHARP TOR as it had been answered by Scientific Council in June 2007 (*NAFO. Sci. Coun. Rep*., 2007, p. 73)

b) NIPAG, October/November 2008

see item 2 above.

c) WGDEC, 2009

The next meeting will be held in Copenhagen, Denmark in 2009.

d) NIPAG, October/November 2009

The dates and venue will be decided at the October 2008 meeting.

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Progress Report on Special Session in 2008: The Role of Marine Mammals in the Ecosystem in the 21st Century

The Symposium on the Role of Marine Mammals in the Ecosystem, co-sponsored by NAFO, ICES and NAMMCO will be held 29 September – 1 October, 2008 in Dartmouth, Canada. The symposium will be co-convened by G. Stenson (Canada) and T. Haug (Norway). A scientific steering committee, consisting of the co-convenors, M Hammill (Canada), P. Hammond (UK) and A. Thompson (NAFO), has identified four (4) theme sessions and keynote speakers:

1. Biological and environmental factors affecting life history traits – M. Hindell (Australia)
2. Foraging strategies and energetic considerations - D. Costa (USA)
3. Theoretical considerations on apex predators and multispecies models – A. Trites (Canada)
4. Marine mammal-fisheries interactions - J. Harwood (UK)

A total of 54 abstracts were submitted to the steering committee for consideration. Of these 53 (34 oral, 19 poster) were accepted for presentation at the symposium. The global nature of the questions being addressed by the symposium is illustrated by the wide range of countries represented. Authors will come from 11 countries including, Australia, Canada, Faroe Islands, Iceland, Japan, Norway, Russia, Spain, Sweden, UK and USA.

Information regarding the symposium is on the NAFO, ICES and NAMMCO websites and will be updated soon with the list of presentations. The deadline for participants to register is September 1, 2008. The NAFO Secretariat will provide the customary support before, during and after the symposium. Manuscripts from the symposium will be published in the on-line open-access Journal of Northwest Atlantic Fishery Science.

2. Special Session in 2009

Scientific Council reviewed the suggestions for workshops made earlier (October/November 2007 Report, Item V.7.c, p. 220) and felt that these could be deferred until 2010.

Upon invitation from ICES, Scientific Council agreed to become a co-sponsor of the ICES/PICES/UNCOVER symposium on “Rebuilding Depleted Stocks – Biology, Ecology, Social Science and Management Strategies” to be held on 3 – 6 November 2009 in Warnemünde, Rostock, Germany, and proposed Dr F. Serchuk as the NAFO representative on the Symposium Steering committee. Dr Serchuk accepted this offer. Dr P. Shelton was also proposed to be the Co-convenor that represents NAFO, and subject to approval from ICES, has accepted this position. Scientific Council further proposed that funding be made available to support Dr. Serchuk and one keynote speaker. The Scientific Council Coordinator will forward this request to STACFAD for approval at the Annual Meeting.

3. Topics for Future Special Sessions

Scientific Council was supportive of the work undertaken at and subsequent to the meeting of the NAFO SC Study Group on Evaluation of Management Strategies for Greenland Halibut in Vigo during February 2008 and welcomed suggestions that a follow-up special session may be appropriate for 2010. Many participants of the Vigo meeting noted that further work needs to be undertaken to further develop the programming tools and the application of the FLR software prior to any future meetings. Additional suggestions were as follows: (1) a meeting on assessment methods to develop a standard suite of programs and to provide a manual that will improve consistency in the application of methods and also serve to assist incoming Designated Experts; and (2) development of a workshop to help facilitate the transfer of techniques developed by the Working Group on Reproductive Potential, in particular, on completion of its ToR 3 (see Agenda Item X.1 for further information on ToR 3) as well as those noted from the October 2007 Scientific Council meeting (new assessment methods including FLR, the Ecosystem Approach, and that consideration also be given to advances in the application of limit reference points to stocks where no analytical model exists.

X. MEETING REPORTS

1. Working Group on Reproductive Potential

Progress of the NAFO Working Group on Reproductive Potential was provided by E.A. Trippel (Chair). 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 21 members representing 8 countries (Canada, Denmark, Iceland, Norway, Russia, Spain, United Kingdom, and USA) (SCS Doc. 08/20).

The 7th Meeting of the NAFO WG on Reproductive Potential was held at IPIMAR in Lisbon, Portugal, 4-6 October, 2007. There were 17 WG participants spanning 8 countries: Tara Marshall (UK), Richard Nash (Norway), Olav Kjesbu (Norway), Gerd Kraus (Denmark), Joanne Morgan (Canada), Rosario Dominguez (Spain), Loretta O'Brien, (USA), Nathalia Yaragina (Russia), Yvan Lambert (Canada), Rick Rideout (Canada), Peter Witthames (UK), Hilario Murua (Spain), Peter Wright (UK), Holger Haslob (Germany), Rich McBride (USA), Fran Saborido-Rey (Spain) and Ed Trippel (Canada). A meeting of the EU COST Research Network Action Fish Reproduction and Fisheries (FRESH) (Coordinator: Fran Saborido-Rey) was also held during this period. Mutual benefits of having the two groups meet together were achieved as they have complementary science and management advice objectives. Local arrangements for the meeting made by Joao Periera (IPIMAR, Lisbon, Portugal) were greatly appreciated.

The objectives of the WG meeting were to review and discuss (i) material from 2nd set of ToRs (Co-Leaders providing brief overviews), (ii) findings of the NAFO/PICES/ICES Symposium on Reproductive and Recruitment Processes of Exploited Marine Fish Stocks held in Lisbon 1-3 October, (iii) break-out groups for discussion of final items of 2nd set of ToRs (data analyses, MS prep/edits, publications), (iv) new lines of research, for development of a 3rd set of ToRs to be presented to NAFO Scientific Council in June 2008, (v) selection of candidate new ToR Co-Leaders . The joint meetings with FRESH allowed the WG to be aware of the planned work of that group. The WG will follow the work of FRESH closely and incorporate the results of that group into its own work where appropriate. This will avoid duplication of effort between the groups and allow the WG to bring more results to the attention of Scientific Council.

Significant progress on the majority of the second set of ToRs was achieved over the previous year, both during the meeting and intersessionally, however ToRs 1 and 6 were relatively inactive (SCS Doc. 08/20).

Future Activities

The 8$_{th}$ Meeting of the NAFO Working Group on Reproductive Potential is proposed to be held in Palermo, Italy during 17-21 November, 2008. This will be the kick-off meeting for the 3rd Set of ToRs. It is proposed that this be a joint meeting with COST/FRESH to help facilitate mutual progress and collaboration where relevant on these important fishery science and management initiatives. The NAFO/PICES/ICES Symposium clearly confirmed the benefits that can be achieved by the integration of reproductive biology into the study and management of global marine stocks. The continued poor record of recruitment and stock recovery signals the importance of investing further energy into this area of fishery science and its application to NAFO scientific advice.

Discussion was made of the possible entry into a formal relationship between NAFO and COST/FRESH. It was recommended that the two groups maintain an informal working relationship as this type of relationship is adequate to develop the collaborations among scientists that would be beneficial towards addressing the ToRs.

3rd Set of Terms of Reference

ToR 1: Explore and conduct evaluation of underlying assumptions of protocols used to estimate total realized egg production of selected marine species and stocks. Co-Leaders: Rick Rideout (DFO, Canada) and Rosario Dominguez (CSIC, Spain). Several marine laboratories in the North Atlantic have initiated routine fecundity estimation for key fish stocks. This information is being used to (i) help improve the estimation of stock reproductive potential (ii) understand population productivity and (iii) predict stock recovery rates. However, there is a lack of standarization and calibration of various methods to estimate fecundity among laboratories. For example, some laboratories have only recently initiated the autodiametric method and are developing appropriate calibration curves. On the other hand, observations have been made that indicate atresia and timing of sampling can influence estimates of total egg production. Techniques to quantify atresia (vitellogenic oocyte resorption) will be developed and evaluated in this ToR. This will involve histological analyses accompanied by computerized image analysis.

Establish Standard Operating Procedures:

- Provide uniform and standarized procedures for routine fecundity analyses in laboratories using a variety of methods, i.e. autodiametric method, image analysis

- Evaluate histological techniques for assessment of atresia

Validation of Assumptions:

- Test assumptions of different fecundity methods (i.e. the autodiametric method) and parameters associated with fecundity estimation

- Estimate down regulation of fecundity and quantification of atresia and non-annual spawning

ToR 2: Explore and investigate the potential effects of changes in water temperature and food supply on reproductive success in selected marine species and stocks. Co-Leaders: Richard McBride (NMFS, USA) and Stylianos Somarakis (HCMR, Greece). Environmental factors can modify the reproductive potential of fish stocks and thereby influence recruitment. Annual variations in water temperature and potential increases due to climatic warming will presumably act strongly to influence gonadal development and reproductive success. Prey resources also vary and influence fish condition which in turn affects reproductive output. In this ToR, using data on specific stocks and laboratory experiments, the influence of specific abiotic and biotic factors on gonadal development and spawning will be evaluated pending available data.

Abiotic: Examine changes in water temperature (short and long-term) and their effects on timing and duration of spawning, fecundity, egg size and fertilization success

Biotic: Assess variation in prey resource type and abundance and their effects on egg production and gamete quality

ToR 3: Undertake appraisal of methods to improve fish stock assessments and fishery management advice that incorporate new biological data for highly exploited and closed fisheries. Co-Leaders: Joanne Morgan (DFO, Canada) and Loretta O'Brien (NMFS, USA). The depressed and age-altered state of many marine fish stocks has led to reduced landings and in some instances fishery closures. New biological data associated with these altered states will be used to forecast recruitment and improve the accuracy of stock assessment advice. Building on information from previous WG ToRs, the intrinsic rate of population increase will be utilized to assess the timeframe for selected stocks to recover under various fishing and environmental conditions.

Recruitment prediction: Improve prediction of incoming year class size and develop new stock-recruitment models and biological reference points based on better estimates of stock reproductive potential. This includes testing whether more complex indices of reproductive potential result in better estimates of recruitment and limit reference points. Develop scenarios which model population reproductive responses to extrinsic factor data developed in ToR 2.

Stock recovery: Evaluate the intrinsic rate of increase of selected stocks under differing conditions of reproductive potential and levels of fishing mortality to aid in the development of reopening criteria. Estimate recovery time for specific stocks to achieve target biomass levels.

Egg production methods can estimate spawner biomass and/or stock numbers independently of commercial fisheries data. Improved information on stock reproductive potential is improving the accuracy of these methods. The daily egg production method is being explored to evaluate adult stock size for determinate spawning species in the Baltic and North Seas. For this ToR a meta analysis/review of this topic will be conducted to inform Scientific Council of advances in this area.

ToRs will be explored for stocks in the NAFO area where possible (e.g. 3NO cod, 3LNO American plaice, 3M cod, 3LNO yellowtail flounder, 2+3KLMNO Greenland halibut; Georges Bank cod) but stocks from the northeast Atlantic will be included as additional sources of information.

NAFO Scientific Council approved the new set of ToRs and endorsed the development of a Workshop on ToR 3. This Workshop should be held in ~3 years to help facilitate the transfer of techniques developed by WG members to stock assessment personnel that routinely conduct NAFO stock assessments. It is anticipated that one of the outputs of this workshop will be a manual on the integration of data on reproductive potential into stock assessments.

2. Special Session in 2007: Reproductive and Recruitment Processes, Lisbon, Sep-Oct 2007

The Symposium was successfully concluded and the full report is available at Annex 1.

3. NAFO Scientific Council Study Group on Evaluation of Management Strategies for Greenland Halibut, Vigo, Feb 2008

Management Strategy Evaluation (MSE) involves evaluation of different management options and tradeoffs in performance over a suite of management objectives and uncertainties in stock dynamics. It requires collaboration with industry stakeholders and managers (Fisheries Commission) to translate objectives into quantifiable performance measures. MSE involves incorporating key uncertainties in determining effects of proposed management measures and strategies on these performance measures, as well as communicating the results to industry and managers in an effective manner. MSE also allows multiple objectives and uncertainties in prediction to be considered (NAFO SCS Doc. 08/13).

Evaluation of management strategies is based on developing Operating Models from a 'known' and computer-generated population that mimics what is believed to be the situation in the 'real' World. For Greenland halibut, these Operating Models included biological considerations such as natural mortality, maturity at age, and stock-recruit relationships. This known population is subjected to various harvest control rules to provide a set of results (performance measures) that can be used to evaluate and compare the various management strategies.

In 2007, Scientific Council established the "Study Group on Evaluation of Management Strategies for Greenland Halibut" to consider a comprehensive analysis of the performance of rebuilding strategies for the stock of Greenland halibut in NAFO Subarea 2 + Divisions 3KLMNO, including the one currently in place. This Study Group met in Vigo, Spain, on 21-23 February 2008 and developed models to assess the outcomes of various management strategies.

Recommendations of the Study Group, as contained in the Study Group Report (NAFO SCS Doc. 08/13):

1) *The Study Group should be continued, but only if appropriate expertise is available. The work on G. halibut MSE could be regarded as a 3-year project, currently nearing the end of year 1* (Scientific Council note- as of the Vigo meeting).

2) *Funding to continue the G. halibut MSE work should be pursued by Contracting Parties of NAFO. Ideally, the project could be housed at a host institute, where 2 dedicated persons could be funded to complete the study, although other options are possible.*

3) *Although Scientific Council has considered CPUE previously, this issue should be re-examined with respect to the Greenland halibut stock, and should be clarified whether a useable index of abundance can be derived from catch rate data.*

4) *The wiki site used by the Study Group in advance of the Vigo meeting should be maintained if possible to document further development work on Greenland halibut. Wiki software is open-source code; thus, the feasibility of using a NAFO-based server should be investigated.*

Scientific Council considered the detailed report of this meeting, as presented in SCS Doc.08/13. Scientific Council noted that the Study Group had addressed most of its Terms of Reference successfully, although it would be premature to recommend a preferred model at this time, as work remains to be done in several areas. Scientific Council recognized that the Study Group format (scientists, managers, industry) was effective, and involvement of all parties in the ongoing development of MSE is important. Scientific Council also noted that Greenland halibut management strategy evaluation provides a method by which CPUE can be incorporated into management considerations of the stock.

Developments of the MSE work, following on from the Vigo Study Group meeting, were presented in SCR Doc. 08/25. Based on recommendations from the Vigo meeting further changes have been incorporated into the Greenland halibut MSE. A reference set of 20 possible operating models (OMs) has been created, four of which were examined in detail. These OMs cover a broad range of hypotheses of the dynamics and current state of the 2+3LKMNO Greenland halibut stock. Results were obtained for four potential management strategies, covering a range of different fisheries pressures, tested on these four operating models. None of these strategies led to rapid rebuilding of the stock (i.e. to the rebuilding plan target within the rebuilding plan timeline), so a fifth strategy (50% of $F_{0.1}$) was examined. The successes of this MSE exercise were evaluated in the context of the NAFO Precautionary Approach framework for fisheries management. The potential for further progress with regard to the application of MSE on this stock and in general on other NAFO stocks was also considered.

Scientific Council is convinced of the importance of the MSE work. Next steps include further development of the MSE for this stock in 2008 and 2009, which will require ongoing, dedicated expertise. Further discussions should also be held with the NAFO Secretariat on the issue of the wiki site.

The Scientific Council Chair will present the results of the MSE approach to Fisheries Commission during his presentation of the Scientific Council advice at the Annual Meeting in September 2008. A commitment by Fisheries Commission to base management decisions on this approach would be ideal, and demonstrate support to Scientific Council in its efforts to complete the MSE work. Assuming successful development of the MSE approach for the Greenland halibut stock in Subarea 2 + Divisions 3KLMNO, Scientific Council proposes that advice in 2009 be provided in the form of the results from the MSE. This will require considerable interaction between Scientific Council and Fisheries Commission in the interim.

Scientific Council acknowledged the work of the Study Group and thanked the participants for their efforts. Scientific Council also thanked NAFO for their financial support for three invited experts (D. Butterworth, J. Iannelli, and R. Scott) to attend the Study Group meeting in Vigo, as the contribution of the invited experts was instrumental in the success of the Study Group.

4. Joint NAFO-ICES Joint Working Group on Deep Water Ecology, Copenhagen, March 2008

The ICES-NAFO Joint Working Group on Deep Water Ecology met at ICES Headquarters in March. The meeting was chaired by Robert Brock (NOAA, USA) and addressed 13 terms of reference, four of which directly relevant to NAFO (their ToRs b, c, g and h):

b) review the 'Guidelines for Management of Deep-sea Fisheries on the High Seas' that will be considered by FAO COFI in 2008 and consider for reflection by ICES and NAFO;

c) the types of advice that fisheries clients may request of ICES and NAFO, should the guidelines be implemented;

g) update compilations and maps of occurrence of structural habitats (hard and soft corals, large sponges) in the North Atlantic specifically identifying major coral concentrations in the Northwest Atlantic; and

h) identify or confirm the existence of coral concentrations in a specific area of NAFO Div. 3O, which roughly coincides with the zone between 400 and 2000 m deep (detailed map to be supplied by NAFO) and using the results of d)[1], evaluate whether this zone is the most important for coral in the Northwest Atlantic;

Other terms of reference were specific to Rockall and Hatton Banks or focussed on Northeast Atlantic areas but have relevance to the NAFO management area. One of these (their ToR i) could have been applicable to the NAFO area but was interpreted at the meeting to relate to the Northeast Atlantic:

i) examine patterns of fishing in deep-water areas other than Rockall and Hatton banks, such as the seamounts and continental slope, to determine where intensive fishing is occurring and evaluate the likelihood of sensitive habitats being present in those areas.

The meeting started with ten people and some members, most constructively with Peter Auster (USA), participated by correspondence. The expertise and knowledge of the group to address the ToRs was very high. Unfortunately for a variety of reasons by the end of the meeting there were only six people and the large number of ToRs meant that responses were necessarily minimal and some were not completed in session but were submitted afterwards through the ICES Sharepoint. The result was that the group was not fully engaged in reviewing all items. There was also the intent to have a joint meeting with the ICES Working Group on Biology and Assessment of Deep Sea Fisheries Resources (WGDEEP) on 14th March. For some reason this meeting did not happen despite the WGDEEP having met just prior to WGDEC.

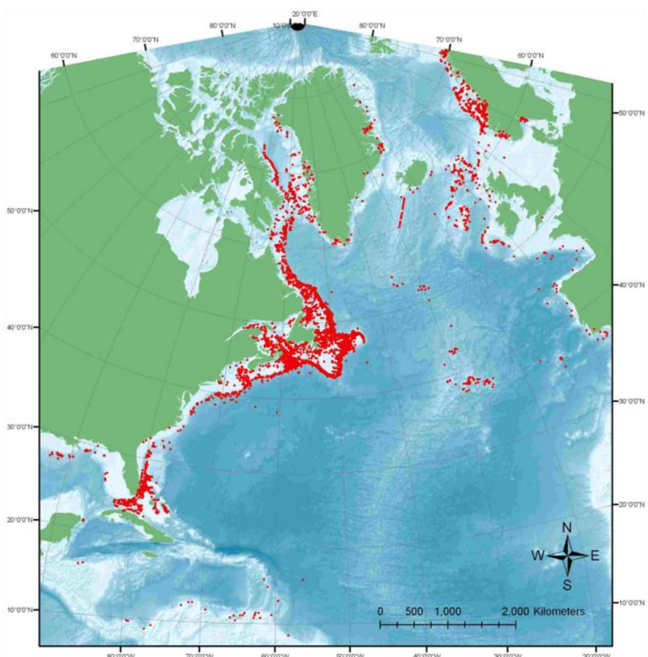


Fig. 8. Location of coral species used to inform the joint ICES-NAFO working group on Deep Water Ecology (WGDEC). Red dots indicate coral occurrences. Null records are also available for the Canadian territorial waters.

One of the major advances of the meeting was the compilation of the occurrence of coral species throughout the North Atlantic (Fig. 8). Data were obtained from Canada (NL and Maritimes Regions), the US (courtesy of Tom Hourigan, NOAA and Peter Auster, U. Conn.) and Greenland (courtesy of Ole Tendal, DK). This is the first time that these data have been compiled with most taxa being identified to genus or species, which allowed for the mapping of selected groups for various purposes. For the WGDEC report, ordinal level taxa which reflect to a

[1] TOR d) mentioned in TOR h above: d) the types of information and terms of reference that WGDEC and any other relevant expert groups may need in order to respond to requests as identified in i); and i) examine patterns of fishing in deep-water areas other than Rockall and Hatton banks, such as the seamounts and continental slope, to determine where intensive fishing is occurring and evaluate the likelihood of sensitive habitats being present in those areas.

certain degree morphology, were used (as per other publications such as the US Report on the State of Deep Coral Ecosystems in the US) as well as individual species distributions. As a result the dataset for the Northwest Atlantic is more comprehensive than that of the Northeast Atlantic which largely records the occurrence of *Lophelia* reefs. The data is in an ARCGIS relational database allowing for additional layers such as fishing effort to be readily mapped.

The report of the WG is available on line and has been through the ICES review process (http://www.ices.dk/reports/ACOM/2008/WGDEC/WGDEC_2008.pdf). Some of the conclusions of the report relevant to the NAFO ToRs are:

- it would be precautionary to consider 20% of the seafloor above 2000 m in each of the seamount closures as available for exploratory activities rather than 20% of the entire area most of which is unfishable;
- for the largest area embraced by the Div. 3O closure there is no information on the benthos and so there can be no verification that VMEs are being protected. In contrast, the closure protects only a small percentage of known VMEs in the vicinity. The upper boundary should be moved 1) to be consistent with the depth contour covered across the area (800 m); and 2) to include species living in shallower water (moving upper boundary to match shallower contour);
- four additional areas were identified along the NL continental margin which should be considered for protection. Two of these were previously identified in the Edinger *et al*. (2007) report and two other areas were proposed.

The known distribution of coral was used to support these conclusions and detailed maps are provided in the report. A further observation is the lack of benthic data from the Orphan Knoll and Newfoundland Seamounts. The Americans and to some extent the Spanish have been working on the New England Seamount Chain and the Corner Rise Seamounts. They have produced some first data to inform the review by NAFO in 2010 on future management measures which may include extending the application of the current measures for an additional period or making the closure(s) permanent. By conducting detailed surveys of selected seamounts within these systems they will have some very useful information to contribute on the degree of endemism and the relative connectivity within the seamount chains and with the adjacent continental slopes. Similar work on the Orphan Knoll and Newfoundland seamount chain should be commenced as soon as possible given the tight timelines. A ToR was proposed for 2009/2010 to identify species of sponges from the North Atlantic that should be considered as structure forming species with low recovery potential. This would then allow targeted data collection and subsequent mapping to provide an overview of the distribution of sponge-dominated VMEs.

The joint meeting was successful and would serve as a valuable and efficient mechanism for reviewing and presenting future analyses and advice. The group would benefit from fewer ToRs so that each one is given more thought by participating members, and to extend the meeting by one day if the number of ToRs cannot be reduced. It was hoped that NAFO encourage the attendance of more North American representatives in future meetings, as the time difference made it difficult to work trans-Atlantically through correspondence.

5. Ecosystem Approach to Fisheries Management Working Group, Dartmouth, May 2008

The report was presented by WG Chair, Antonio Vázquez (EU-Spain). It was noted that initial Terms of Reference (ToR) as set originally by the Scientific Council were late implemented taking into account some issues contained in the request for advice of the Fisheries Commission (Appendix V, Annex 1) as well as the supplementary request for advice to Scientific Council (FC Doc. 08/02) from the Fisheries Commission (FC) Intersessional meeting that took place April 30-May7, 2008. The added issues were those related to Vulnerable Marine Ecosystems (VMEs), which is an important aspect of any Ecosystem Approach. The urgency with those new issues made the Working Group be focused on them, making little progress in remainder of its ToRs (SCS Doc. 08/10).

The report was discussed and its proposals were considered to respond to Fisheries Commission items related to VMEs. It was noted that the Working Group also considered some candidate VME area not occurring in the NRA but in its proximity.

Scientific Council acknowledges the valuable work done by the Working Group in identifying VMEs in the NRA, and encourages the group in pursuing studies oriented to better assess EAFM issues.

Scientific Council agreed that the ToR for the next Working Group meeting contain those issues that were not yet considered in detail:

1: To identify regional ecosystems in the NAFO Convention Area.

2: To make an inventory of current knowledge on the components of each regional ecosystem.

3: To explore the feasibility of different tools (e.g. ecosystem indicators, modelling, etc.) that could be used in management advice in the NAFO area.

4: Data needs and sampling recommendations.

Scientific Council noted that the draft agenda could be amended during the September 2008 meeting if needed, and that date for the next meeting will be set then.

Mariano Koen-Alonso (Canada) and Andrew Kenny (UK-EU) were appointed Co-Chairs of the Working Group.

6. Meetings attended by the Secretariat

The Scientific Council Coordinator attended the following meetings:

Aquatic Science and Fisheries Abstracts (ASFA), Mombasa, Kenya, on 3-7 September 2007. The ASFA database has been the premier database for both primary and grey literature since 1971. The NAFO Secretariat now enters its own journal and reports metadata and is given in return free access to the ASFA database. The meeting discussed general issues regarding the management and use of ASFA.

The second meeting of the UN *ad hoc* Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction**,** New York, 28 April-2 May 2008. This meeting discussed UNGA resolution 61/222 on the protection of marine biodiversity. It provided a valuable insight in to current thinking at the policy level on to the likely future development of implements to protect biodiversity.

NAFO Fisheries Commission meeting on the Protection of Vulnerable Marine Ecosystems from Significant Adverse Impacts on 5-7 May 2008 in Montreal, Canada. This meeting of Fisheries Commissioned the ways in which NAFO will address the deadlines expressed in UNGA Resolution 61/105 regarding the fishing footprint and vulnerable marine ecosystems.

The NAFO Scientific Council Working Group on Ecosystem Approach to Fisheries Management held at the NAFO headquarters, Dartmouth, Canada on 26-30 May 2008. This meeting is discussed under item X.5**.**

As well, the Executive Secretary attended the FAO Workshop on Vulnerable Marine Ecosystems and Destructive Fishing (Rome, Italy, from 26 to 29 June 2007) and the FAO workshop on Knowledge and Data on Deep-sea Fisheries in the High Seas (Rome, Italy, 5 to 7 November 2007) . These workshops gave important input to the draft FAO Draft International Guidelines for the Management of Deep-Sea Fisheries in the High Seas.

The Information Manager and the IT Manager attended the second FIRMS Technical Working Group. Issues discussed related to the finalization of the Resource Module (to which NAFO submits the Summary Sheet information) and the first look at the Fisheries Module (to which NAFO submits the fishery information, ie. CEM). The FIRMS website is http://firms.fao.org. In addition the IT Manager completed an internship program with various departments within FAO.

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. NAFO Scientific Council Observership at ICES ACFM Meetings

NAFO was not represented at the 2007 ACFM meeting and no report has been received. NAFO is invited to send a representative to the ICES ACFM meeting. The restructuring of ICES has resulted in the dissolution of the three separate advisory committees (ACFM, ACE and ACME) and form a single Advisory Committee (ACOM) that meet primarily by correspondence. Nevertheless, ICES have confirmed that it an invitation to have a NAFO representative on ACOM would serve to strengthen the lines of communication between ICES and NAFO's Scientific Council. Scientific Council proposed that Fred Serchuk be the NAFO representative on ACOM, and he accepted this position.

2. Rules of Procedure

a) Observer Application Process

Scientific Council asked the Secretariat to provide suitable drafting for possible amendments to the *Scientific Council Rules of Procedure* (2004) to simplify the Observer Application Process following the guidelines given by Scientific Council (*NAFO Sci. Coun. Rep.*, 2007, p. 199). It was noted that the current rules regarding observers in the Scientific Council's Rules of Procedure are limited in extent, and that this contrasts with those for the General Council and Fisheries Commission which are extensive. Some simplification of the overall process will be investigated by the Secretariat.

Scientific Council **recommended** that *the following changes be made to the Scientific Council Rules of Procedure Rule 1 Representation:*

1.3 The Scientific Council may invite any non-Member Government and any ~~international,~~ public or private~~,~~ organization to be represented at meetings of the Scientific Council or its subsidiary bodies by an observer or observers.

To provide guidance to organizations applying for observer status to Scientific Council, Scientific Council suggested that the following text, possibly with any simplifications agreeable to General Council, Scientific Council and the Fisheries Commission, would be placed on the NAFO web page and in any covering letters sent to observer organizations:

- Non-Member Governments and public or private organization may be represented at meetings of the Scientific Council or its subsidiary bodies by an observer or observers.
- Applications for observer status to Scientific Council may be made according to the guidelines given below for attending meetings of Scientific Council.
- Upon acceptance, observer organizations will be granted permanent status by Scientific Council and thereafter only need inform the Executive Secretary of their intention to attend 30 days in advance of the meeting of Scientific Council.
- The permanent status could be revoked by Scientific Council at any time or if there is a lapse in attendance of three years.
- The permanent status does not apply to meetings of the General Council and Fisheries Commission.
- Meetings of Scientific Council, and especially meetings of its subsidiary bodies, can be highly technical in nature and are directed towards the participation of active scientists.

The guidelines referred to in the second bullet point would be similar to those currently found in General Council's Rule of Procedure No. 9 and Fisheries Commission Rules of Procedure No. 10.

In addition, Scientific Council would like to formalize the position of invited experts by the addition of a new rule and **recommended** that *the following rule be added under Representation Rule 1:*

1.4 The Scientific Council Chair may invite one or more "guest experts" to meetings of Scientific Council and its subsidiary bodies. The guest expert(s) would not represent a Party or Organization and would have no status at the meeting other than to provide specific advice and guidance to Scientific Council on particular issues.

b) Voting Procedures

The NAFO Secretariat undertook a review of the Scientific Council Rules of Procedure on voting, as requested at the October/November 2007 meeting (*NAFO Sci. Coun. Rep*., 2007, p. 220). Owing to time constraints, this item will be placed on the agenda for the next meeting of Scientific Council.

3. Cooperation with COST/FRESH

At the September meeting of the Scientific Council it was agreed to defer discussion and a decision on the appropriateness of NAFO participation in COST Action FAO601 (*NAFO Sci. Coun. Rep.*, 2007, p. 201) pending a proposal for the Working Group on Reproductive Potential. To date no proposal has been made and the Scientific Council considered this item closed.

4. General Plan of Work for Annual Meeting in September

The Secretariat is progressing well with plans for the Annual Meeting in Vigo and the Annual Meeting Special Session in Dartmouth.

5. Other Matters

a) Review of Structure of Scentific Council

The Scientific Council Chair has been working intersessionally with members of Scientific Council and the Scientific Council Coordinator to explore changes that would shorten the June meeting. It has generally been accepted that the June meeting, at 15 days, is too long. It is also felt that the various tasks assigned to Scientific Council and the standing committees are each dealt with efficiently and that it is not possible to shorten these without compromising standards. Further, it is realised that the work loads arising from the ecosystem approach will only increase in the future and soon it will become impossible to finish the work within the 15 day meeting period without some change. Also, with the development of an amended Convention, it is timely to review the terms of reference for the four standing committees to ensure they are meeting the current needs of Scientific Council. The Scientific Council Chair will continue to work intersessionally with members of Scientific Council and report back to Scientific Council at the Annual meeting.

XII. OTHER MATTERS

1. Designated Experts

Scientific Council has been unable to find a replacement Designated Expert for Northern Shortfin Squid in SA 3+4, despite repeated requests to various fisheries centers. The Chair noted that it is not possible to undertake a full assessment without a designated expert and will pass this message on to the Fisheries Commission during his presentation at the Annual meeting.

2. Meeting Highlights for the 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.

3. Classification Criteria for NAFO Stocks

Scientific Council agreed to attempt a classification of NAFO stocks according to the FIRMS Stock Classification descriptors (*NAFO Sci. Coun. Rep*., 2006, p. 54). The basic premise for such a classification was for use in a search engine on the FIRMS website. Criteria were added by SC to supplement the FIRMS descriptors at the September 2006 Scientific Council meeting (X.1, p. 190) in the hope that this would remove some of the subjectivity in assigning the descriptors to various stocks. The original intention was to use the added criteria, based on biomass and fishing mortality reference points, as guidance when available from stocks with analytical assessments and to use proxies for other stocks in determining a classification based on the FIRMS descriptors. Scientific Council requested that Designated Experts classify their stocks and published a classification table (October-November 2006 meeting, *NAFO Sci. Coun. Rep*., 2006, p. 222-223). Some modifications to the original classification were made (June 2007 meeting, *NAFO Sci. Coun. Rep*., 2007, p. 46-47) that reflected interpretation of the classification criteria more than any real changes in the stock. Scientific Council recommended in June 2007 that the stock classification is included in the summary sheets and that clarification be added to the classification table to record if the stock has references points (June 2007 meeting, *NAFO Sci. Coun. Rep*., 2007, p.47). Further discussions led to re-classifying all the shrimp stocks as B2 (October-November 2007 meeting, *NAFO Sci. Coun. Rep*., 2007, p. 219), based on the general view that stocks should be given a B2 classification (intermediate abundance, moderate fishing mortality) unless there was a good reason to move away from this classification. This approach seemed to offer some guidance and was generally accepted. Scientific Council also decided at their October-November 2007 meeting not to include the stock classification on the summary sheets pending further discussion with Designated Experts.

Scientific Council discussed the application of the classification and noted that the criteria were intended as guidance for both stocks having reference points, and as a proxy for those stocks without reference points. It was felt that "biomass" and "abundance" should be complemented with an idea of the age- (or size-) structure of the population. Other comments related more to the static nature of the classification – no history and no predictive power – and hence no management application.

Scientific Council **recommended** that *the FIRMS Stock classification is:*

- *next considered and updated by STACFIS in June 2009;*
- *not included in the summary sheets, the Scientific Council report, or any other published documentation, and;*
- *managed by the Secretariat and presented to FIRMS for use for search engine purposes only.*

4. VMS reporting intervals, speed and course

Scientific Council noted that the information contained in SCR Doc. 08/30 supports the Scientific Council recommendation made in item XII.5.a of the June 2007 Scientific Council meeting that stated "*position be reported at shorter intervals than the current 2 hours, and the NAF fields for speed (code SP) and course (code CO) be added to the POS reports transmitted to the Secretariat.*" Scientific Council requests the Secretariat to forward this SCR paper to STACTIC in order to support their previous recommendation.

Scientific Council noted that it is important to collect information on fishing gear, catch and discards using the VMS. It was noted that the "Electronic reporting, satellite tracking and observer" scheme allowed for the observer report (OBR, see Chapter VII Articles 55-60 and Annex XX(a) of the 2008 CEM), provided by observers of those vessels participating in the electronic observer program, to contain the required information. However, since participants under this scheme only require observers for 25% of the time, the 75% of time without observers and hence without OBR reporting would severely hamper the usefulness of this information for scientific catch assessment purposes. The daily catch report (CAX) that is always transmitted under this scheme contains the catch reporting and would be transmitted all the time from vessel may be used to supplement catch information during the majority of the time when observers were not on board.

5. NAFO Reform

On 28 September 2007, after a two-year process, NAFO adopted the *Amendment to the Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries* (GC Doc. 07/4, Serial No. N5453). This constitutes the first formal step towards an amended convention for NAFO. The adopted text now has to be ratified by at least three-fourths on NAFO Contracting Parties to become binding. The complete process is described in the current NAFO Convention, Article XX1. Canada and France have now agreed on a French translation of the Convention and the Contracting Parties can begin to ratify the amended Convention through their individual governments.

6. VMS data analyses

Upon request from the Scientific Council, the Secretariat used VMS data to map the distribution of trawl-fishing effort within the NRA (SCR Doc. 08/50) from 2003-2007. The analysis was based on the assumption that a vessel travelling at 2-4 knots was trawling. VMS position data was excluded from the analysis when the vessel was in more than 2000 m of water, in an attempt to remove mid-water trawling from the resultant maps. A midwater trawl redfish fishery is known to occur in Div. 3O, but this would not significantly contribute to effort since only 5% of the redfish catch was recorded to be from mid-water fishing trawls over the 2003-2006 period (STATLANT 21B).

Scientific Council accepted that the maps produced were likely to be reasonable but conservative estimates of the amount of bottom trawling occuring in the NRA. It was felt that the maps gave a good indication of the current fishing areas for bottom trawlers and would be useful when reviewing the Contracting Party submissions on fishing areas for the determination of the "existing fishing areas" footprint.

It was further noted that maps on an annual or quarterly time scale could be useful in examining spatial variations in fishing activity. However, it was again noted that difficulties in identifying gear type and target species limited the usefullness of the VMS data in assessing fish stocks.

7. Other Business

a) Scientific Merit Award

The Chair restated his support for scientific merit awards and suggested that Scientific Council consider two classes of award in recognition of Chair's contributions and of outstanding scientific contribution. The Chair further suggested that awards would be granted to all outgoing Chair's, and that the awards for outstanding scientific contribution would be made by the Chair and Scientific Council Coordinator supported by nominations from Scientific Council members. The awards will be presented at the Annual meetings. Nominations are requested for consideration for the 2008 Annual meeting in Vigo, Spain.

b) EU FW7 Project TXOTX

Phil Large (EU-UK) gave a presentation on the EU FW7 Project TXOTX (Technical eXperts Overseeing Third country eXpertise). This three-year project commenced in April 2008 and has the overall aim to contribute to a coherent approach towards research directed at assessment and management of marine resources, particularly in those areas where the European fleet is directly active, in international or third country waters, or where the EU has important development goals.

The principal objectives are the collation of information from relevant RFMO/RFOs, Fisheries Partnership Agreements (FPA), Commission, EU Member States, ICPC states & other states, and other international organizations such as FAO, on (1) Fisheries/scientific data collection & analysis, (2) stock assessment & fisheries management methods, and (3) dissemination of related information.The Scientific Council Coordinator, NAFO Secretariat, will act as the NAFO contact person.

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 19 June 2008, 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 5-19 June 2008 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 1420 hours on 19 June 2008.

ANNEX 1. REPORT OF SCIENTIFIC COUNCIL SPECIAL SESSION 2007

Joint NAFO/ICES/PICES Symposium on
"Reproductive and Recruitment Processes of Exploited Marine Fish Stocks"

This joint symposium by NAFO, PICES and ICES was held at the Altis Hotel in Lisbon, Portugal during 1-3 October 2007. The objective of this Symposium was to highlight recent advances in fish reproduction and early life stages and how these influence recruitment of a wide variety of species across a broad spectrum of marine ecosystems. The co-convenors were Ed Trippel (NAFO-Canada), Ric Brodeur (PICES-USA) and Mark Dickey-Collas (ICES-Netherlands). The Scientific Steering Committee consisted of Suam Kim, Fritz Köster, C. Tara Marshall, M. Joanne Morgan, and Tony Thompson.

The Chair of NAFO Scientific Council opened the meeting by welcoming participants and explaining the role of Scientific Council. The Chair also introduced the work plan and objectives. Co-convenor Ed Trippel also welcomed participants and gave a brief overview of the theme sessions and meeting arrangements.

Four theme sessions were held: 1) Age and Size at Sexual Maturation, 2) Fecundity and Spawning Success, 3) Survival of Eggs and Larvae and 4) Stock Assessment and Management Implications. Each theme session had two keynote speakers. Summaries of each session, as well as the symposium wrap-up, are contained below. A total of 151 people from 23 countries, and 52 papers were presented orally, and 70 as posters. Presenters were invited to submit their papers for publication, by 31 October 2007, in a special issue of the *Journal of Northwest Atlantic Fishery Science* (scheduled print date April 2009).

Ed Houde (USA) provided the symposium keynote address, which was very well received, outlining the historical evolution of research on recruitment processes and how we have only recently deviated from the single-purpose focus of searching for the holy grail of Johan Hjort's critical period hypothesis developed in the early part of the 20th century.

Session 1: Age and Size at Sexual Maturation. Session Convenor: Ed Trippel. The first session began with a theme keynote quantifying the relative influence of maturation on stock recovery. The next talk presented a model describing the relation between growth and reproductive investment for North Sea plaice and was given in the context of fisheries-induced evolutionary change and recruitment dynamics. The anticipated recovery of Flemish Cap cod was reported to be stifled in part due to low reproductive potential from the ever declining age at maturity, despite a ban on fishing in 1994. However, in recent years, size at maturity remained constant. The second keynote address of this theme session was then given, which reported declining trends in onset of maturation in accordance with predictions from life history theory under increased mortality, although it was acknowledged that conclusive evidence for evolutionary changes in fish stocks can never be obtained through this quantitative approach. Following this, a reaction norm analysis was described that included Fulton's condition factor in addition to body length and weight and explored the use of liver weight as an explanatory variable. An interesting study on cod in the Kattegat and the Sound (eastern North Sea) revealed how ecological conditions (bottom temperature and mean length at age) in the first year of life were largely responsible for regulating incidence of sexual maturity. Following this evidence, using an ecogenetic model, support was given for fisheries-induced rapid evolution of multiple life history traits, and how these responses have consequences for fishery landings. Warning was given that reversal of evolutionary changes in maturation is not always certain or equally rapid. A report was then made of the need to recognize stock structure when interpreting evolutionary fisheries-induced changes in age and size at maturation of Icelandic cod, since this stock is comprised of geographically distinct sub-stocks. In Baltic Sea cod stocks, it was reported that continued significant declines have occurred in the size at 50% maturity, with males being mainly smaller than females. In recent times, the spawning stock biomass has been highly dominated by males. The annual maturity ogives have been used to replace the constant ogives in stock assessments for three cod stocks in the Baltic Sea. Seven British Columbia herring stocks were examined for their mortality and catch curve data. Since the early 1980's, behavioural differences were recorded of virgin herring indicating they may not aggregate with older mature fish, and may actually spawn at different locations. Spatial segregation of herring based on age can violate assumptions underlying estimates of SSB and fishing harvest rates that now seem to be based on a flawed catch curve analysis. As a result, additional harvest pressure is being placed on older fish (4+) than should be. The final presentation reported on biochemical composition of oocytes and maternal fat reserves of sardines off western Portugal. Overall, the session reflected two main drivers in the area of fish maturation: (i) recent development of the probalistic reaction norm and modelling exercises that support fisheries-induced evolution and (ii) challenges to this new thinking by more traditional bio-energetic analysis of growth processes that regulate maturation and continued evidence that a wide phenotypic plasticity in maturation exists.

Session 2: Fecundity and Spawning Success. Session Convenor: Gudrun Marteinsdottir. The first keynote presentation given in this session gave compelling evidence of why governmental fishery departments should be closely monitoring fish fecundity and establishing methods to estimate fecundity annually. This will enable the estimation of intrinsic rate of population increase, *r,* used to estimate stock recovery and determine sustainable harvesting rates. This was followed by a monthly assessment of horse mackerel ovarian development and led to the species' characterization as an indeterminate spawner (i.e., vitellogenic oocytes present at all times). The largest cod stock, Northeast Arctic Cod, has been reduced to spawning primarily in the Lofoten area and no longer uses more southerly spawning banks. The earlier use of more southern banks by large adults (now fished down) had warm water benefits not afforded remaining adults spawning in the north and has implications for reproductive success. An interesting study on sperm cell reserves of female snow crab in the Eastern Bering Sea revealed that insufficient sperm are available for egg fertilization of the second clutch and this may be linked to the male-only fishery. Severe declines in the snow crab stock's mature biomass prior to 2000 has had severe consequences to natural recruitment and the fishery. Further studies are under way to assess male depletion and its ubiquitous nature.

The second keynote address was given and focused on snow crabs in the North Pacific, Eastern Bering Sea (EBS) and eastern Canada. The environmental conditions have been altered such that remaining snow crab in the depleted EBS stocks are now located down current of their historical distribution. How they may re-establish themselves from this location is unclear. A study has indirectly shown that Norwegian spring-spawning herring exhibit skipped spawning. That is, some individuals do not mature annually in one of the largest fish stocks in the world (up to 50% may skip the second year). Further gonadal sampling is underway to estimate specific levels. A second study on skipped spawning was given, this time for Northeast Arctic cod, and focused on energy reserves available at a critical time window during early vitellogenesis. Potential fecundities of three species of Northwest Atlantic flatfishes were reported for the 1993 to 1998 period, and represent the first fecundity data for these populations in the past 30-40 years. It was revealed for Icelandic cod that parental selection of spawning sites may be a crucial factor in determining offspring survival probabilities. To this end, an atlas of spawning sites was constructed which described egg production at each site. The dispersal of Icelandic cod eggs and larvae were estimated with tracking models and 0-group origin models based on back-calculated hatch data and offspring genetic composition. Using captive Japanese flounder, under a wide range of temperatures, a method was developed to accurately estimate spawning fraction at different water temperatures, which is essential to properly estimate SSB using the daily egg production method for indeterminate spawning species. The reproductive success of male cod was evaluated and males were determined to exhibit higher fertilization success when sperm motility and GSI were high. This trend was examined in relation to cultured and wild cod stocks. A combination of modeling and field experiments was used to demonstrate that size selective harvesting that protects rather than targets large female teleosts is a practical strategy that contributes to sustainable fisheries. An interesting study on the depleted Pacific Ocean perch off the western USA demonstrated that older females tend to spawn with multiple males, and that young females may abort maturation highlighting two factors that may have important implications to the establishment of old-age populations.

Session 3: Survival of Eggs and Larvae. Session Convenor: Mark Dickey-Collas. A keynote address was made that alerted us to how information on effects of fishing (via removal of spawning biomass and production of new eggs) and ecosystem variability can be used in the context of ecosystem-based management in predicting future fishery yields. It was made clear that we are only in the early stages of applying recruitment process knowledge to fisheries management. A talk was given on the significance of large, old spawners in increasing the breadth of the stock's spawning season, in particular the associated start of an individual's second spawning season can be critical to recruitment. By impacting the average lifetime spawning duration within a fish stock, fishing pressure could be increasing the variability in reproductive success and reducing its long-term reproductive potential. A mesocosm experiment showed that positive correlations exist between egg and larval size of cod. Moreover, at times of lowered food supply, growth suffered more of offspring which had previously attained larger size which suggests that large initial size may not always be advantageous. A report indicated that haddock egg mortality is greater than of cod, inferring that spawner abundance estimates from egg surveys based on a gadoid-wide equivalent egg mortality rate may be inaccurate. At the time of high haddock abundance, it is possible then to inflate the estimation of cod SSB. In the Baltic Sea, juvenile settling areas were determined by wind-induced drift of larval cod, which is controlled by local atmospheric conditions. Apparently, egg predation exists at these settling areas that coincide with high-density sprat and herring aggregations. A study on Japanese sea bass revealed the operation of density- dependent regulation through competition for prey resources during the post recruit period.

Modelling was performed to explore fitness consequences of time and place of birth, including larval behavioural strategies in which they frequently have to choose between maximizing growth-survival or retention through habitat selection. Analysis of recruitment processes of Baltic herring populations showed that spawning biomass in general is the most important factor in explaining recruitment variation, however recruitment is also affected by variable hydrography probably via its shaping of zooplankton abundance and species composition. The complexity of growth and temporal origin of juvenile sprat in the German Bight (North Sea) was documented from otolith microstructure analysis and indicated a mixing area comprised of juvenile sprat from a range of different North Sea areas. Otolith microstructure analysis was again used, this time for late larval and early juvenile Pacific sardine, to elucidate that larvae spawned in late May grew faster than those spawned earlier in the season and comprised a greater fraction of fish sampled as juveniles and pre-recruits. The recruitment dynamics of small pelagic fishes, particularly Pacific sardines, were documented through a rise and fall over the previous 20 years. Warming and cooling of the epipelagic ecosystem in the nursery grounds seemd to be linked to the recruitment fluctuations off Japan. A talk was given on the winter recruitment of YOY bluefish in northeastern Florida where habitat use, feeding ecology and energetics were studied to reveal heavy foraging on large mullet in inlets during winter residency. Report was made of an interesting seasonal field study over 4 years that tracked and sampled Icelandic cod eggs and larvae (2-4 weeks old) from the main southwest spawning grounds to the nursery grounds of the northern part of the island. Water temperature was found to influence growth, whereas larval retention occurred in low saline waters of coastal waters. The physical-biological interactions in the life history of small pelagic fishes (e.g., sardine and anchovy) in the western Iberian upwelling ecosystem were described. Processes were related to the ocean ‘triad’ (enrichment, concentration, and transport/retention) that could explain recruitment fluctuations of these populations. The match-mismatch hypothesis of availability of adequate prey during the larval stage as a key determinant of survival was approached from a finer-resolution perspective of taxonomy for mackerel in the Magdalen shallows (eastern Canada). The importance of *Pseudocalanus* sp. nauplii and cladocerans were key in density compensation and it was made clear that inappropriate use of the entire prey field concept in the assessment of match-mismatch can sometimes occur.

Session 4: Stock Assessment and Management Implications. Session Convenor: Ric Brodeur. The first keynote of this session gave an excellent overview of variation in reproductive characteristics in commercial fish species. It examined the impact of variable reproductive output on scientific advice to managing fish stocks. A stimulating talk was then given on the adequacy of biological reference points presently used by ICES to provide advice on Baltic cod stock status and the associated difficulties in providing this information for an ecosystem characterized by wide changing environmental conditions. A plea was made to include environmental variation such as present adverse environmental conditions for reproduction in scientific advice to assist with steps towards stock recovery as present methods are inadequate to lead to recovery. The potential application of marine protected areas was modelled to evaluate their effectiveness in avoiding evolutionary effects of fishing using a probability function of fish movement between protected and fished areas. It was found that the use of a reserve could reduce the chances of losing old large fish but was highly dependent on fish migratory patterns. An excellent field study was undertaken in Lofoten, northern Norway that found that cod embryonic lethal malformations occurred in areas dominated by first-time spawning female cod. The decline in age and size at maturity and increase of virgin spawners in the stock together with these results have consequences for the estimation of reproductive capacity and biological reference points.

The second keynote talk focused on the design of MPAs and how they protect stocks and increase fishery yields. It was shown that the MPAs operate well when the protected species has a dispersal distance up to the width of the MPA and that a network of MPAs covering a certain fraction of the coastline will protect species with all dispersal distances. The use of pelagic egg abundance estimates (1986-present) was made to estimate population size of Baltic cod using three methods. Despite a number of assumptions (e.g., batch fecundity and spawning frequency) the population size estimates matched well with expected numbers which supports provision for this approach for situations where VPA-based stock assessments are weak. A talk was given on the influences of maternal age of spawning, life history patterns, and recruitment variability on fisheries reference points of rockfish and cod. It was pointed out that mis-specified management reference points may result from the unrecognized effect of spawner age on larval viability. A meta analysis of anchovy egg production parameters revealed that daily egg production and SSB per unit surface area are 6 and 9 times higher respectively for species/populations in upwelling systems (California, Humboldt and Benguela current stocks) compared to those in less productive European Seas (Mediterranean and Bay of Biscay).

A talk on North Sea herring used medium-term simulation techniques to investigate whether changes in carrying capacity or productivity is more influential in determining risk to the population due to exploitation both inside and outside a precautionary approach. This stock has suffered recent poor recruitment despite a large SSB. Trends in intrinsic rate of increase r were compared among nine Atlantic cod stocks with time series ranging between 22-56 years. Cod west of Scotland had the highest r and northern Gulf of St. Lawrence the lowest r indicating significantly different potential for stock recovery which may be based in part on environmental conditions. Modeling effects were made using simulated data on 16 age classes of Norwegian spring spawning herring to explore how uncertainty about the stock abundance estimate affects factors like mean annual yield and risk of the population falling below a biomass limit reference point (B_{lim}). Reproductive habits were presented of the most important flatfish species along the Portuguese coast. These included differences in the timing and duration of spawning and GSI. In general, the highest fisheries landing from these species were recorded during the spawning period due to behavioural patterns of spawning aggregations.

Summing-up. Keith Brander. A summary was made of each session highlighting the findings made of presentations including general conclusions and recommendations. A large number of posters were given in each of the four sessions and were displayed throughout the symposium with the first evening devoted to poster presentations. The goal of having a single, non-overlapping session combined with the large interest in the symposium resulted in insufficient time to properly view and discuss all posters in one evening. However, the posters were available for viewing throughout the symposium. The symposium theme area has grown considerably in recent years and in particular the area of fish reproduction and how this knowledge can be used for fishery management. The next ten years should be a critical period in the study of recruitment processes as many stocks are depleted and are not showing signs of recovery.

Reproductive and Recruitment Processes of Exploited Marine Fish Stocks

Monday, 1 October 2007

0830-0900	Registration
0900-0915	Welcome by Antonio Vázqez, NAFO Scientific Council Chair
0915-1000	*KEYNOTE ADDRESS* - **Emerging from Hjort's Shadow -** Ed Houde
1000-1005	*SESSION 1 – ORAL* - **Age and Size at Sexual Maturation**
1005-1035	1-1 **Session 1 Keynote - Quantifying the relative influence of maturation on stock recovery -** Marshall, C. Tara
1035-1055	1-2 - **Estimating onset of reproduction, reproductive investment and growth rate from individual growth trajectories in fish** - Mollet, Fabian M., Thomas Brunel, Bruno Ernande, Adriaan D. Rijnsdorp
1055-1115	1-3 - **Age and size at maturity of Flemish Cap cod: where is the limit? -** Saborido-Rey, F., R. Domínguez-Petit, A. Alonso-Fernández and A. Pérez-Rodríguez
1115-1135	**Break**
1135-1205	1-4 **Keynote Address - Disentangling Sources of Variability in Age and Size at Maturation -** Mikko, Heino
1205-1225	1-5 - **Hepatosomatic index and the probabilistic maturation reaction norm of cod -** McAdam, Bruce J. and C. Tara Marshall
1225-1245	1-6 - **Trends in age and size based probabilistic maturation reaction norms of cod (*Gadus morhua* L.) in the Kattegat and Sound correlate with variability in juvenile growth -** Svedäng, H., Vitale, F and. Vainikka, A.
1245-1305	1-7 - **Effects of fisheries-induced adaptive changes on the reproductive characteristics of exploited stocks -** Dunlop, Erin S., Katja Enberg, Mikko Heino, and Ulf Dieckmann
1305-1425	**Lunch**
1425-1445	1-8 - **The Influence of Stock Structure on Fisheries-induced Evolution in Age and Size at Maturation of Icelandic Cod -** Pardoe, H., E. Dunlop, G. Marteinsdóttir, and U. Dieckmann
1445-1505	1-9 - **Changes in maturation pattern and reproductive potential of Baltic cod stocks -** Storr-Paulsen, Marie, Jonna Tomkiewicz and Fritz Köster
1505-1525	1-10 - **Catch curves are misleading, gonads are revealing: age of sexual maturation versus recruitment in Pacific herring (*Clupea pallasi*) -** Hay, Doug, Tom Therriault and Bruce McCarter
1525-1545	1-11 - **Effect of maternal fat reserves on the fatty acid composition of sardine (*Sardina pilchardus*) oocytes** Garrido, Susana, Rui Rosa, Radhouan Ben-Hamadou, Maria Emilia Cunha, Maria Alexandra Chícharo, Carl D. van der Lingen
1545-1605	**Break**
1605-1610	*SESSION 2 – ORAL* - **Fecundity and Spawning Success**
1610-1640	2-1 **Keynote Address - Reproductive Success in Marine Fish Populations: Why Should We Closely Monitor Fish Fecundity? -** Lambert, Yvan
1640-1700	2-2 - **Reproductive strategy of Atlantic horse mackerel *Trachurus trachurus* and the regulatory role of surplus energy and condition indices -** Ndjaula, Hilkka O.N., Tom Hansen, Maria Krüger-Johnsen, and Olav Sigurd Kjesbu
1700-1720	2-3 - **Can temperature benefits justify extensive up-current migrations in the Northeast Arctic cod? -** Opdal, Anders Frugård, Frode Vikebø and Øyvind Fiksen

1720-1740 2-4 - **Sperm reserves of primiparous snow crab (*Chionoecetes opilio*) females in the eastern Bering Sea: inter-annual variation and spatial patterns relative to available males -** Slater, Laura M., Kirsten A. Gravel, and Douglas Pengilly

1800-2100 **Poster Display** and Reception

Tuesday, 2 October 2007

0900-0930 2-5 **Keynote Address - Eggs and Larvae are Starting Ingredients in a Menu of Recruitment that Often Goes Wrong: Lessons from High Latitude Majid Crabs -** Armstrong, David, Lobo Orensanz, Bernard Sainte-Marie, and Billy Ernst

0930-0950 2-6 - **Frequency of skipped spawning in Norwegian spring-spawning herring -** Kennedy, J., Skjæraasen, J.E., Nash, R.D.M., Slotte, A. and Kjesbu, O.S.

0950-1010 2-7 - **Timing and determination of skipped spawning in Atlantic cod -** Skjæraasen, Jon Egil, James Kennedy, Anders Thorsen, Richard Nash, Olav S Kjesbu

1010-1030 2-8 - **Relationships between maternal body size, condition and potential fecundity for Northwest Atlantic flatfishes -** Rideout, R.M. and M.J. Morgan

1030-1050 2-9 - **An attempt to trace the contribution of different spawning components to the surviving population of juvenile cod in Icelandic waters -** Gudrun Marteinsdottir, , Christophe Pampoulie, David Brickman, Lorna Taylor, Kai Logemann and Daniel Ruzzante

1050-1110 2-10 - **A method to accurately estimate the daily spawning fraction of Japanese flounder *Paralichthys olivaceus* considering a wide range of ambient temperature -** Kurita, Yutaka, Yuichiro Fujinami and Masafumi Amano

1110-1130 **Break**

1130-1150 2-11 - **Understanding the effect of seasonal forcing on the reproductive traits of a multiple-batch spawner in the context of the Dynamic Energy Budget (DEB) theory: the Bay of Biscay anchovy (*Engraulis encrasicolus*) -** Pecquerie, Laure, Pierre Petitgas , Sebastiaan A.L.M. Kooijman

1150-1210 2-12 – **Maternal Effects and the Sustainability of Exploited Fish Stocks -** Venturelli, P. A., C. A. Murphy, T. A. Johnson, P. J. van Coeverden de Groot, P. T. Boag, J. M. Casselman, W. C. Leggett, R. Montgomerie, M. D. Wiegand, and B. J. Sutter

1210-1230 2-13 - **Maternal age-related influences on larval production of Pacific ocean perch (*Sebastes alutus*) -** Parker, Steven J., Robert W. Hannah, Donald M. Van Doornik, Steven R. Millard, Ewann A. Berntson and Paul Moran

1230-1250 2-14 - **Is spawning success of Atlantic cod escapees influenced by differences in sperm competition? -** Mayer, I., J. J. Meager, J. E. Skjæraasen, G. Rudolfsen, Ø. Karlsen, O. Moberg, A. Staby, O. Kleven & A. Fernø

1250-1410 **Lunch**

1410-1415 *SESSION 3 – ORAL* - **Survival of Eggs and Larvae**

1415-1445 3-1 **Keynote Address - Oceanography meets Fisheries Conservation - Opportunities for Success** - Brian MacKenzie

1445-1505 3-2 - **Fishery-induced demographic changes in the timing of spawning; consequences for reproductive success -** Wright, Peter, Ed Trippel and Jonna Tomkiewcz

1505-1525 3-3 - **Effects of egg size, parental origin and feeding conditions on growth of larval and juvenile cod (*Gadus morhua* L.) -** Paulsen, H., V. Bühler, R.A.J. Case, C. Clemmesen, G. Carvalho, W.F. Hutchinson, O. S. Kjesbu, E. Moksness, H. Otterå, A. Thorsen and T. Svåsand

1525-1545 3-4 - **Differential egg mortality of Georges Bank cod and haddock -** Lough, R. G., L. O'Brien, L.J. Buckley

1545-1606	3-5 - **Identification of Eastern Baltic cod nursery grounds: a hydrodynamic modeling approach -** Hinrichsen, Hans-Harald and Gerd Kraus
1605-1625	Break
1625-1645	3-6 - **Density-dependence in post-recruit Japanese sea bass in the Chikugo estuary, Japan -** Shoji, Jun and Masaru Tanaka
1645-1705	3-7 - **Behavioural adaptations of larval fish to vertical gradients and oceanography: predictions from evolutionary models -** Fiksen, Øyvind
1705-1725	3-8 - **Recruitment process of Baltic herring populations -** Cardinale, Max, Valerio Bartolino, Christian Möllmann, Michele Casini, Georgs Kornilovs and Tiit Raid
1725-1745	3-9 - **Growth and temporal origin of juvenile sprat in the German Bight (North Sea) -** Baumann, Hannes, Arne M. Malzahn, Rudi Voss, Axel Temming
1745-1805	3-10 - **Selection for fast development and growth for late larval and early juvenile Pacific sardine, *Sardinops sagx*, in the California Current region -** Takahashi, Motomitsu and David M. Checkley, Jr.
1805-2000	**Poster Display**

Wednesday, 3 October 2007

0900-0930	3-11 **Keynote Address - Recruitment variability of small pelagic fish populations in the western North Pacific -** Watanabe, Yoshiro, Motomitsu Takahashi, Akinori Takasuka, Yoshioki Oozeki
0930-0950	3-12 - **Winter recruitment of young-of-the-year bluefish: habitat use, feeding ecology and energetics -** Juanes, Francis, John Murt and Peter Clarke
0950-1010	3-13 - **Abundance and growth of larval cod around Iceland - Passive transport under variable environmental conditions and modelling approaches -** Jónasson, J. P., K. Logemann, B. Gunnarsson, D.Brickman, and G. Marteinsdóttir
1010-1030	3-14 - **Physical-biological interactions in the life history of small pelagic fish in the Western Iberia Upwelling Ecosystem -** Santos, A. Miguel P., Alexandra Chícharo, Antonina Dos Santos, Teresa Moita, Paulo B. Oliveira, Álvaro Peliz, Pedro Ré
1030-1050	3-15 - **Predation dynamics of mackerel foraging on populations of larval and juvenile anchovy: is survival of anchovy linked to growth? -** Robert, Dominique, Akinori Takasuka, Sayaka Nakatsuka, Hiroshi Kubota, Yoshioki Oozeki, Hiroshi Nishida and Louis Fortier
1050-1110	**Break**
1110-1115	SESSION 4 – ORAL - **Stock Assessment and Management Implications**
1115-1145	4-1 **Keynote Address - Integrating reproductive biology into scientific advice for fisheries management -** Morgan, M. Joanne
1145-1205	4-2- **Eastern Baltic cod recruitment depends on environment, can scientific advice on fisheries management ignore this ? -** Fritz Köster, Morten Vinther, Brian MacKenzie and Maris Pliksh s
1205-1235	4-3 - **Evolutionary effects of fishing and marine reserves on size at maturation and movement -** Miethe, Tanja, Calvin Dytham, Jon Pitchford
1235-1255	4-4 - **Variations in proportions of lethal malformations observed in recently spawned eggs from North East Arctic Cod explained by population parameters -** Korsbrekke, Knut, Valeri Makhotin and Per Solemdal
1255-1415	**Lunch**
1415-1435	4-5 **Keynote Address - Larval Dispersal and MPAs: Implications of the Distance Between Reproduction and Recruitment for Spatial Management -** Louis Botsford

1435-1455 4-6 - **Estimating Baltic cod (*Gadus morhua* L.) population sizes from egg production -** Kraus, Gerd, Hans-Harald Hinrichsen, Rüdiger Voss, Jonna Tomkiewicz, Eske Teschner, Matthias Schaber, Friedrich W. Köster

1455-1515 4-7 - **The influences of maternal age of spawning, recruitment variability, and life-history pattern upon harvest reference points and fisheries management -** Spencer, Paul D. and Yasmin Lucero

1515-1535 4-8 - **Meta-analysis of anchovy egg production parameters -** Somarakis, Stylianos, Eudoxia Schismenou and Athanassios Machias

1535-1555 4-9 - **When recruitment regimes vary, can we still manage North Sea herring in a precautionary manner? -** Simmonds, John (FRS), Mark Dickey-Collas (IMARES) and Richard Nash (IMR)

1555-1615 **Break**

1615-1635 4-10- **Using Life-History Models to Explore Environmental Effects on Stock Reproductive Potential of Several Cod Stocks -** L. O'Brien, N. Yaragina ,Y. Lambert, G. Kraus, T. Marshall, G. Marteinsdottir, H. Murua, F. Saborido-Rey, J. Tomkiewicz, and P.Wright

1635-1655 4-11 - **Managing fluctuating populations: what is the value of stock assessment? -** Myrseth, Johanna, Øyvind Fiksen and Mikko Heino

1655-1800 **SUMMING UP** - Keith Brander, ICES

POSTERS

COST – FRESH. Saborido-Rey, Fran

P1-1 Critical timing for reproductive allocation in an over-wintering capital breeder: experimental evidence from sandeels. Boulcott, P. and P.J. Wright

P1-2 Probabilistic maturation reaction norms of sockeye salmon spawning populations of Bristol Bay, Alaska. Kendall, Neala, Mikko Heino and Ulf Dieckmann

P1-3 Assessing the accuracy of macroscopically assigned maturity stages and the potential for skipped spawning in Northwest Atlantic Greenland halibut (*Reinhardtius hippoglossoides*). Rideout, R.M., M.J. Morgan, A.M. Cohen and J.H. Banoub

P1-5 Reproductive attributes of three exploited skate species on the Grand Banks and in surrounding Canadian waters. Kulka, D. W., C. Miri and M. Simpson

P1-6 Comparative analysis of fecundity in Coastal cod (*Gadus morhua*) along the Norwegian coast. M. Blom, A. Thorsen and O.S. Kjesbu

P1-7 Description and incidence of ovary cysts in two gadoids from the North Atlantic: *Merluccius merluccius* and *Gadus morhua.* Domínguez-Petit, Rosario, Alexandre Alonso-Fernandez and Fran Saborido-Rey

P1-8 Energy allocation related to spawning season in a temperate fish, *Trisopterus luscus* (Linnaeus, 1758). Alexandre, Alonso-Fernandez, Dominguez-Petit, Rosario and Saborido-Rey, Fran

P1-9 Addressing the influence of environmental and density-dependence factors on juvenile growth and maturation of anchovy (*E. encrasicolus*). Reglero, Patricia, Diego Alvarez-Berastegui, Magdalena Iglesias and Ana Giráldez

P1-10 Size at sexual maturity in females in the introduced red king crab (*Paralithodes camtschaticus*) from Finnmark, Norway. Hjelset, A. M., J. H. Sundet and E. M. Nilssen

P1-12 Assessment of the Red Seabream (*Pagellus bogaraveo*) off the Strait of Gibraltar: Sensitivity to the Application of Different Age Length Keys. Gil, J. and DEEPER Team (J.Baro, C. Burgos, J. Canoura, V. Díaz del Río, C. Farias, L. M. Fernández-Salas, Mª. C.Fernández-Puga, T. García, D. Palomino, V. Polonio, J.M. Serna-Quintero, M. Sayago)

P1-15 Minimum Size at Sexual Maturity of Mediterranean Swordfish Stock (*Xiphias Gladius*): A Comparison With North Atlantic Swordfish Stock. Macías, D., Lema, L., Gómez-Vives, M.J., Ortiz de Urbina J.M. and de la Serna J.M.

P1-16 Reproductive characterization of the Mediterranean Stock of albacore (*Thunnus alalunga*, Bonaterre 1788). Macías, D., Lema, L., Gómez-Vives, M.J., Ortiz de Urbina J.M. and de la Serna J.M.

P1-17 Time - space reproductive differences of black hakes, *M. polli* and *M. senegalensis* off the NW African coast. Fernández, Lourdes, César Meiners and Ana Ramos

P1-19 Size at Maturity of Southern Hake Stock (ICES Div VIIIc and IXa). Morgado, C., C. Chaves, E. Jardim, F. Cardador, P. Gonçalves, M. Sainza amd M. Santurun

P1-20 Age at 50% maturity and age structure as indicators of stock status of the Namibian horse mackerel *Trachurus trachurus capensis*. Wilhelm, M.R.

P 1-22 Size at sexual maturity of male and female South African hakes, *Merluccius capensis* and *M. paradoxus.* Osborne, Renée Felicia, Yolanda Melo and Luyanda Anthony

P1-24 Gonadal maturation of herring (*Clupea harengus* L.) assessed by histological and macroscopic characteristics. Bucholtz, Rikke Hagstrøm, Jonna Tomkiewicz and Jørgen Dalskov

P1-25 Reproduction and growth-dependent mortality of Pacific anchovy (*Engraulis japonicus*): application of size-based theory. Sukgeun, Jung, Sun Do Hwang, Joo Il Kim, Young-Il Seo, Jin-Yeong Kim

P1-26 Using the Otolith-Fish Size Allometric Relation to Determine Size at Maturation in Flemish Cap Cod. Pérez Rodríguez, Alfonso and F. Sabarido-Rey

P1-27 Effect of body size, condition and growth on sexual maturation of Japanese flounder *Paralichthys olivaceus* off the Pacific coast of northern Japan. Yoneda, Michio, Yutaka Kurita, Daiji Kitagawa and Masaki Ito

P2-1 Relative fecundity of Atlantic cod (*Gadus morhua*) on Georges Bank and in the Gulf of Maine: using new methods for an old problem. Klibansky, Nikolai and Francis Juanes

P2-2 The paternal contribution to the 'Stock Reproductive Potential' of North-East Arctic cod (*Gadus morhua*): are males important? Nash, Richard D.M., Olav S. Kjesbu, Edward A. Trippel, Audrey J. Geffen & Heidi Finden

P2-3 Long-term variability in maturation and fecundity of North Sea haddock and its implications to egg production. Wright, P.J. and I. M. Gibb

P2-4 Spatial gradients in fat content of North Sea herring (*Clupea harengus*). Davidson, Deborah, Christoph Konrad and C. Tara Marshall

P2-5 Reproductive success of mated and unmated multiparous female Tanner crab, *Chionoecetes bairdi*, mating or fertilizing eggs with stored sperm in Glacier Bay, Alaska. Webb, J. B.

P2-9 A quick method for an easy identification of ovarian structures: the use of autofluorescence. Saborido-Rey, F., R. Domínguez-Petit and A. Alonso-Fernández

P2-10 Atypical dynamics during the 2001-2002 sardine spawning season off Portugal. Nunes, C., A. Silva, M.M. Angélico and Y. Stratoudakis

P2-11 Diel Reproductive Periodicity in Haddock in the Southwestern Gulf of Maine. Katie Anderson, Rodney Rountree and Francis Juanes

P2-12 Reproductive strategy and oocyte recruitment process of European hake (*Merluccius merluccius*, L. 1758) in Galician shelf. Dominguez Rosario, Saborido-Rey Fran and Alonso-Fernandez Alexandre

P2-13 Spatial and temporal variability in Baltic sprat (*Sprattus sprattus balticus* S.) batch fecundity. Haslob, Holger, Jonna Tomkiewicz and Hans-Harald Hinrichsen

P2-14 Evidence of possible skipped spawning in Pacific halibut (*Hippoglossus stenolepis*) and its potential to impact effective spawning biomass. Loher, Timothy and Andrew C. Seitz

P2-15 The cod mating system and the risk of genetic introgression from farmed escapees. Skjæraasen, J. E., J. J. Meager, Ø. Karlsen, S. Løkkeborg, K. Michaelsen, I. Mayer, J. A. Hutchings, A. Fernø

P2-16 On the role of frontal systems of the Argentine Sea as spawning grounds for fishes. Macchi, Gustavo, Acha Marcelo, Pájaro Marcelo, Militelli María Inés and Rodrigues Karina

P2-17 Reproductive and Recruitment Processes of haddock (*Melanogrammus aeglefinus*) on the Rockall Bank. Filina E. A., Khlivnoy V. N., and V. I.Vinnichenko

P2-18 Spawning pattern and size at first sexual maturity of European hake off NW Africa: A geographical and environmental comparative approach. Meiners, César, Lourdes Fernández and Ana Ramos

P2-19 Reproductive potential of the Argentine hake, *Merluccius hubbsi*, in Patagonian waters. Gustavo, Macchi and Pájaro Marcelo

P2-21 Fecundity assessment of pouting, *Trisopterus luscus* (Linnaeus, 1758) in Galician shelf. Alonso-Fernández, Alexandre, Dominguez-Petit, Rosario and Saborido-Rey, Fran

P2-22 Do Greenland halibut, *R. hippoglossoides*, spawn in inshore Disko Bay, West Greenland? Fossen, Inge, Agnes C. Gundersen, Claus Stenberg, Bjarne Lyberth, Jesper Boje and Ole Jorgensen

P2-23 Fecundity and lipid content in autumn- and winter spawning North Sea herring (*Clupea harengus*). Van Damme, Cindy, Marcel Schouten, Jan Beintema, Deborah Davidson and Mark Dickey-Collas

P2-24 Advances in fecundity methodology applied to marine fish. Witthames, P.R., A .Thorsen, M. Fonn, L.N. Greenwood, F. Saborido-Rey, R. Dominguez, H. Murua, M. Korta and O.S. Kjesbu

P2-25 Spawning strategy of *Engraulis anchoita* (Pisces, Engraulidae) in the continental shelf waters off Argentine. Pájaro, Marcelo, Patricia Martos, Ezequiel Leonarduzzi and Gustavo J. Macchi

P2-27 Reproductive Biology of the Argentine anchovy (*Engraulis anchoita*) in the southwest Atlantic Ocean. Leonarduzzi Ezequiel, Pájaro Marcelo, Macchi Gustavo and Hansen Jorge

P2-28 Reproductive features of two Patagonian toothfish (*Dissostichus eleginoides*) aggregations in the Southwest Atlantic Ocean. Pájaro, Marcelo, Gustavo J. Macchi, Patricia Martinez and Otto C. Wöhler

P3-1 Does Frontal Residence Help Larval Fish? Growth and Abundance of Larval Dab, *Limanda Limanda*, within a Developing Frontal System in the North Sea. Olbrich, R., Peck, M.A., Munk, P.and St. John, M.A.

P3-2 Variations in Greenland halibut egg buoyancy during development at three temperatures. Ouellet, P., Lambert Y. and Bertolone, C.

P3-5 Dispersion of eggs, larvae and pelagic juveniles of White Hake (*Urophycis tenuis*, Mitchill 1815) on the Grand Banks of Newfoundland in relation to subsurface currents. G. Han, D.W. Kulka and M. He

P3-6 Long-term association between fish recruitment and temperature in the North east Atlantic. Brunel, Thomas

P3-7 Variations of the reproductive cycle of northern shrimp *Pandalus borealis* populations in the Estuary and Gulf of St. Lawrence. Savard, Louise and Patrick Ouellet

P3-10 Long-term changes in walleye pollock (*Theragra chalcogramma*) reproduction and stock abundance in the Tatar Strait (Japan Sea). Velikanov A. Ya. and Luchenkov A.V.

P3-11 Effect of climate and oceanographic conditions on sole larval transport towards the Tagus estuary, Portugal. Vinagre, C., M.J. Costa and H.N. Cabral

P3-12 The embryos of *Helicolenus dactylopterus dactylopterus* (Delaroche, 1809). Vila, S.; Sequeira, V.; Serrano-Gordo, L. and Muñoz, M.

P3-13 Identification of *Ichthyodinium chabelardi* - a lethal parasitic dinoflagellate infecting pelagic eggs of marine fishes. Skovgaard, Alf, Maria Manuel Angélico and Isabel Meneses

P3-14 *Ichthyodinium chabelardi* (Hollande et Cachon, 1952): an indiscriminate killer of pelagic fish eggs. Meneses, Isabel, Catarina Vendrell and Maria Manuel Angélico

P3-15 Tracking of chum salmon fingerling in stream and coastal area off the Korean Peninsula. Kang, Sukyung, Suam Kim, and Joo Kyung Kim

P3-16 Vertical distribution of cod at early life stages: positioning according to thermoclines in experimental columns. Vollset K.W., Ø. Fiksen and A. Folkvord

P3-17 Climate change and variation of hatching onset in Baltic herring (*Clupea harengus*) - a long-time analysis of spring spawning in the Greifswalder Bodden (ICES area 24). Stuermer, Ingo W., Feiser, Rainer, Assmuth, Christine and Christopher Zimmermann

P3-18 Body density of Conger eel larvae increase in the process of inshore migration. Hiroaki Kurogi, Noritaka Mochioka

P3-19 Maternal Effects of Egg Quality on Progeny Morphology, Survival and Growth in Larval Atlantic Cod (*Gadus morhua*). Bachan, M.M., Trippel, E.A., Fleming, I.A.

P3-20 Summerly Interannual Variability of *Engraulis* and *Sardinella* Fish Larvae along the Mediterranean Frontier Area (Spanish coastal waters). Ramos, Gloria and Juan Perez de Rubín

P3-21 Interannual variability of length distributions patterns of anchovy and gilt sardine larvae in coastal waters of Gulf of Cadiz and N.W. Alboran Sea. Ramos, Gloria and Juan P. Rubín

P4-1The evaluation of reference points and stock productivity in the context of alternative indices of stock reproductive potential. Morgan, M. J., H. Murua, G. Kraus, Y. Lambert, G. Marteinsdóttir, C. T. Marshall, L. O'Brien, J. Tomkiewicz

P4-2 Yield-per-recruitment analysis for Pacific anchovy (*Engraulis japonicus*) in Korean coastal waters. Sukgeun, Jung

P4-3 Temporal Changes in Size at Maturity and Their Implications for Fisheries Management for Eastern Bering Sea Tanner Crab. Zheng, Jie

P4-4 Rebuilding the stock of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*). Høines, Åge S. and Agnes C. Gundersen

P4-6 Adult parameters estimates of the European anchovy *Engraulis encrasicolus* (Linnaeus, 1758) from the Gulf of Cadiz obtained during a June 2005 Spanish DEPM survey. Vila, Y., Millán, M., Ramos, F., Bernal, M., and Tornero, J.

P4-8 Environmental variability and stock-recruitment relationships for European hake (*Merluccius merluccius* L.) off NW Africa. Meiners, César, Lourdes Fernández and Ana Ramos

P4-9 Regional variations of hogfish life history (Labridae: *Lachnolaimus maximus*) in Florida: consequences for spawning biomass and egg production models. McBride, Richard S., Paul E. Thurman, and Lewis H. Bullock

P4-11Genetic population structure of Pacific cod (*Gadus macrocephalus*) over broad and local geographic scales. Canino M. F., Cunningham K. M., Spies I. B. , Hauser, L.

P4-12 Spawning biomass and production of Pacific anchovy, *Engraulis japonicus*, in the southern coastal area of Korea. Kim, Joo Il Young-Il Seo, Sukgeun Jung

P4-13 Factors affecting the recruitment on Horse-Mackerel (*Trachurus trachurus*). Costa, A.; Gonçalves, P.; Palma, S.; Murta, A.

P4-14 Can a single-transect sampling strategy be reliable in monitoring sardine and anchovy spawning and recruitment off South Africa, in the southern Benguela Current region? Tsotsobe, Sakhile and Jenny Huggett

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

Chair: Gary Maillet Rapporteur: Eugene Colbourne

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 6 and 11 June 2008, 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 Greenland), European Union (France, Germany, Portugal, Estonia, Latvia, Lithuania and Spain), Russian Federation, USA and Japan.

1. Opening

The Chair opened the meeting by welcoming participants to this June 2008 Meeting of STACFEN. The Chair welcomed Dr. Rodolphe Devillers of Memorial University of Newfoundland and Labrador, St. John's, NL 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. 08/2, 3, 5, 12, 13, 14, 19, 24, 49. SCS Doc. 08/6, 12, 14.

Eugene Colbourne (Canada) was appointed rapporteur.

2. Highlights of Climate and Environmental Conditions in the NAFO Convention Area for 2007

The North Atlantic Oscillation (NAO) (Dec.-Feb.) index was above normal during the winter of 2007 as a result arctic air outflow during the winter to the Northwest Atlantic was stronger than in 2006.

Annual mean air temperatures cooled relative to 2006, but remained above normal over most of the NAFO Convention Area from West Greenland to the Grand Banks and the Gulf of St. Lawrence. In southern areas of the Scotian Shelf and the Gulf of Maine air temperatures were slightly below normal.

Sea-ice coverage remained below normal for the 13th consecutive year on the Newfoundland and Labrador Shelf. In the Gulf of St. Lawrence and on the Scotian Shelf sea-ice was also lighter than normal. Exceptions were in the inshore regions off NE Newfoundland and areas of southeast Greenland where there was an increase of in the amount of multi-year sea ice.

324 icebergs were detected south of 48^{o}N on the Northern Grand Bank, up from 0 in 2006 and 11 during 2005. The 2007 count was still below the 106-year average of 477.

Mean sea surface temperatures were warmer than normal from West Greenland, the Labrador Sea (>1^{o}C) and south to the northern Scotian Shelf. In southern areas of the western Scotian Shelf, Lurcher Shoals and Georges Bank SSTs were below normal.

Shelf water salinities, which increased to the highest observed in over a decade during 2002 in Newfoundland, remained above normal in most areas; however, there was considerable local variability. The stratification of the water column throughout the waters of eastern Canada increased to above normal values.

The waters over much of the Labrador Sea have become steadily warmer and more saline over the past six years and in 2007 the sea surface temperatures in the central and western Labrador Sea was about 0.6^{O}C above normal, cooler than the 2006 value but it represents 14 consecutive years of above normal conditions.

In the waters off West Greenland, warm conditions dominated from summer to autumn however, decreased over 2005 and 2006. Both Polar and Irminger inflows were above normal with pure Irminger water observed at the Cape Farewell and Cape Desolation sections and modified Irminger waters reached as far north as the Maniitsoq section.

Ocean temperatures on the Newfoundland and Labrador Shelf were mostly above normal; however, the water column average temperature at Station 27 off the east coast of Newfoundland decreased from a record high in 2006 to normal conditions in 2007.

Further south on the Scotian Shelf and in the Gulf of Maine temperatures were generally lower than the record highs of 2006 with values decreasing to near normal in the Bay of Fundy, Sydney Bight and eastern Scotian Shelf area. The central and western Shelf subsurface temperatures were below normal by about 1°C, with extreme anomalies as large as 6°C below normal over the upper continental slope.

In Subarea 5 on NW Georges Bank temperature conditions varied about the mean while salinities decreased in 2007 compared to the previous year.

Seasonal inventories of nutrients on the Newfoundland and Labrador Shelf were near or above the 1999-2006 average, whereas on the Scotian Shelf they were near or below normal.

The phytoplankton biomass levels on the Newfoundland Shelf were near or slightly below normal in northern areas and significantly above the long-term average in southern areas, particularly along the central and southwestern Scotian Shelf. The timing of the primary production cycle based on inshore fixed coastal stations ranged from normal to later than normal in most areas during 2007.

The seasonally-adjusted annual averaged phytoplankton abundances were above the long-term mean (1999-2006) except in northern regions of Div. 2J3K.

The abundance of *Calanus finmarchicus,* a key species in the transfer of energy through the lower trophic levels, was lower in 2007 compared to the previous year over much of NAFO Div. 2J to Subarea 4.

The abundance of total copepods was above normal in northern regions of Subarea 3, while abundance levels were below normal on the Scotian Shelf in Subarea 4. The non-copepod taxa were in general below normal from NAFO Div. 2J to Subarea 4 on the Scotian Shelf.

Overall, the seasonally-adjusted annual averaged zooplankton abundances in 2007 were below normal throughout much of NAFO Subareas 2-4.

3. Invited Speaker

(SCR Doc. 08/24)

The Chair introduced this year's invited speaker Dr. Rodolphe Devillers (Memorial University of Newfoundland and Labrador, St. John’s, NL; http://www.mun.ca/geog/people/faculty/rdevillers.php). During the past 2 years Dr. Devillers has chaired the GEOCOD study – “Geomatics for the Sustainable Management of Fish Stocks” which is one of the strategic investment initiatives of the Canadian Network of Centres of Excellence. One of the objectives of the GEOCOD study is to integrate various environmental and fisheries data using geographic information systems (GIS) and statistical approaches combined with the development of new spatial-temporal visualization tools. The following is an abstract of his presentation entitled *“*GeoCod - Integrating Fisheries and Environmental Data for a Better Understanding of Spatial and Temporal Changes of Four Key Species in the NW Atlantic Region*”.*

This presentation gives an overview of the Canadian project GeoCod, which aims at better understanding spatial and temporal changes in the abundance of four key fishery species (Atlantic Cod, Pandalid Shrimp, Snow Crab and Capelin) in the NW Atlantic region. GeoCod is a three-year research project involving three Canadian Universities and several Canadian and international partners from government, industry and NGOs. The project aims at (1) integrating existing environmental and fisheries data for the NW Atlantic region, (2) analyzing the data using spatial statistics to better understand the relationships between the four fish species and their environment, as well as the relationships amongst the species, and (3) develop new tools to visualise and analyse fisheries data. Fisheries scientific surveys (SS) and fisheries observer program (FOP) data of the four Canadian Atlantic regions (Quebec, New-Brunswick, Nova-Scotia and Newfoundland and Labrador), in addition to data from the USA, were collected and integrated into a single database which includes about one million records. This exercise has been challenging as data were typically stored and analysed separately by the different administrative regions and were hence very heterogeneous regarding the technologies used to collect them (e.g. gear type), time of year, etc. Preliminary results are presented, with a focus on spatial techniques that can provide insightful results not always identified by traditional statistical approaches. In addition, GIS-based visualisation tools have been developed to allow fisheries scientists, decision-makers, or even the general public, to easily view or analyse the data. These tools allow viewers to seamlessly connect the different datasets, visualise interpolated surfaces of species abundances (e.g. catch per unit effort), look at animations of changes over time, or perform different analyses on the data to better understand spatial and temporal dynamics of the stocks.

The presentation stimulated a wide variety of comments and questions from the committee and further discussions focused on the availability of GIS-statistical and visualization tools and scientific information on the GeoCod web site. Dr. Devillers indicated his willingness to collaborate with individuals interested in the application of geographical information systems analysis to enhance our understanding of fishery-environment interactions, a key activity of the standing committee on fisheries environment (STACFEN). The ability of the GIS-statistical tools to handle distributional shifts in fish populations and commercial fishing fleet dynamics was posed. Dr. Devillers indicated the need to consider carefully the spatial and temporal scales of the data to limit the uncertainty and bias in the analysis output. Bias in either of the spatial and temporal scales is an important consideration that may influence the interpretation and predictive ability and increase the level of uncertainty in forecasting future change in the ecosystem. The issue of how the GIS-tools can handle different sampling designs such as stratified random designs versus the monitoring of fixed sampling sites was raised. Dr Devillers indicated the GeoCod data was obtained from both scientific surveys and commercial fishing activities through observer programs.

A general question addressed the need to incorporate the activity and behaviour of the commercial fishing fleet in order to better understand and predict possible changes in the abundance and distribution of resource populations. Dr. Devillers suggested that one of the means to address this potential influence is in the use of multivariate GIS-statistical tools and proxy variables such as integrated fishing intensity. He also suggested the under utility at present in the use of GIS-based statistical and visualization tools to develop a better understanding of past changes in the marine ecosystem in addition to new insights into forecasting future state changes in the system. The committee agreed with the need to continue such efforts to better integrate existing environmental and fishery data sources and to offer continuing education opportunities in this area such as the geostatistical workshop that was sponsored by the NAFO Secretariat.

4. Integrated Science Data Management (ISDM formerly MEDS) Report for 2007

(SCR Doc. 08/29)

ISDM is the current regional environmental data centre for ICNAF and subsequently NAFO and as such is required to provide an inventory of all environmental data collected annually by contracting countries of NAFO within the convention area. The following is the inventory of oceanographic data obtained by ISDM during 2007 and updates on other activities in the NAFO Convention area.

a) Hydrographic Data Collected in 2007

Data from 1433 oceanographic stations collected in the NAFO area sent in delayed mode to ISDM in 2007 have been archived, of which 760 were CTDs, 214 were BTs and 460 were bottles. A total of 159,207 stations were received through the GTSPP (Global Temperature and Salinity Profile Programme) and have been archived, of which 1546 were BATHYs and 157,638 were TESAC messages.

b) Historical Hydrographic Data Holdings

Data from 6626 oceanographic stations collected prior to 2007 were obtained and processed during 2007, of which 1373 were vertical CTDs, 3713 were towed CTDs, 928 were BTs and 612 were bottle data.

c) 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. In 2007, we received 24598 surface observations of temperature and salinity from 7 cruises.

d) Drifting Buoy Data

A total of 177 drift-buoy tracks within NAFO waters were received by ISDM during 2007 representing 493,636 buoy messages. This is an increase of 44 buoys and 162,550 messages from 2007.

e) Wave Data

During 2007, ISDM 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 13 wave buoy stations were operational in the NAFO area during 2007.

f) Tide and Water Level Data

During 2007, ISDM 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. ISDM's archived observed heights with up to a 1-minute sampling interval, hourly heights and monthly instantaneous extremes collected around Canada. Approximately 1.3 million 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 435 million records with the earliest dating back before 1900. Data from 96 tide and water level gauges were processed during 2007 with 16 in the NAFO region.

g) Current Meter Data

A total of 28 current meter instruments were recovered in the NAFO area during 2007 and an additional 5 instruments were deployed. These included both conventional current meters and Acoustic Doppler Current Profilers (ADCPs). The recovered data are processed at the Bedford Institute of Oceanography (BIO) and are available on the web at: (http://www.mar.dfo-mpo.gc.ca/science/ocean/database/data_query.html).

h) Activity Updates

ISDM reported on other activities during 2007:

i) 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. The role of ISDM 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. During 2007, the Canadian Argo program deployed 29 Argo floats in the NAFO region, including 5 oxygen floats and produced 718 temperature and salinity profiles and 134 oxygen profiles.

ii) DFO has created a virtual Centre for Ocean Model Development and Application (COMDA) with a mandate to provide national leadership, coordination and advice in areas of ocean model development and application that are departmental priorities. One of the initial and major projects includes "Ocean Modelling for Benthic Habitat Mapping" in collaboration with NRCan. ISDM's involvement with COMDA will be to provide data streams of temperature and salinity for model initialization and data assimilation.

iii) In collaboration with the National Science Data Management Committee (NSDMC), ISDM is currently involved with multiple projects targeted at improved access to data and information, upgrading archives or inserting unarchived data, addressing data and metadata standards. The types of data included in various projects include bathymetric, pCO2 measurements, Arctic fisheries data, zooplankton, marine mammals and nutrients. Access projects addressed creation of inventory records and software, support to OBIS, a general access system to fisheries data and continuing development of a services oriented architecture.

iv) Aquatic Invasive Species are a major threat to Canada's fisheries and aquaculture industry and have been entering Canadian waters for centuries but never as rapidly as today. Every decade, some 15 alien species establish themselves in Canadian coastal or inland waters. In the absence of their natural predators, the most aggressive of them spread rapidly. They can radically alter habitat, rendering it inhospitable for native species. The zebra mussel and sea lamprey are examples of such species that have greatly affected the Great Lakes. The Canadian Aquatic Invasive Species database and web application was developed by ISDM in 2004-2005 with the objectives to provide a geo-referenced repository for all invasive species observations gathered in Canada and to create a decision making tool that would illustrate trends and movements over time and various locations for proactive management applications. Currently, there is data from the Great Lakes, the Maritimes and some from the Vancouver area. Most of the data are observations of location name, longitude, latitude, species name, date and any metadata provided.

v) The DFO Atlantic Zone Monitoring Programme (AZMP) activities include regular sampling for 7 fixed stations and 13 standard sections, and research missions in the northwest Atlantic to collect physical, chemical and biological data. ISDM continues to build and maintain the AZMP web site: www.meds-sdmm.dfo-mpo.gc.ca/zmp/main_zmp_e.html. The data and information on the site include:

- Physical and chemical data from 1999 to the present such as CTD, bottle and bathythermograph measurements.
- Climate indices showing long term trends of physical variables in the areas of seawater, freshwater, ice, and the atmosphere.
- Water level data for 9 gauges ranging from 1895 to 2007.
- Graphical representations of biological data (phytoplankton, zooplankton).
- Remote sensing links for ocean colour, SST and primary productivity imagery.

vi) Dalhousie University recently was funded to coordinate the Ocean Tracking Network (see http://oceantrackingnetwork.org/). This international project unites leading ocean scientists to conduct observations on the movements of marine species. Acoustic receivers will be arranged approximately every 800 metres apart in strategic locations along the sea floor to create invisible “listening lines, in 14 ocean regions off all seven continents. These receivers will detect coded acoustic signals identifying each tagged sea creature that passes over these lines. OTN listening lines will also include sophisticated sensors that measure the ocean’s temperature, depth, salinity, currents, chemistry, and other properties. OTN’s international partners collect this information and feed it back to a central database at Dalhousie. ISDM is collaborating with Dalhousie to support data collection off Canada's coasts and to act as the long term archive for these data.

5. 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 2007 was presented (SCR Doc. 08/14 and SCS Doc. 08/6). In 2007, the NAO index returned to a positive value, but only slightly above normal. A positive index implies stronger winds from the northwest, cooler air temperatures and increased heat loss from the ocean during winter over the Labrador Sea and partly over the Labrador and Newfoundland Shelf. The mean annual air temperatures decreased at standard monitoring sites from the northern Labrador Sea to the Gulf of Maine except Cape Hatteras, but still remained above normal by ~1^{o}C over the Labrador Sea and Shelf, 0.3^{o}C over the Grand Banks, and ~1^{o}C over the Gulf of St. Lawrence. On the other hand, annual air temperatures over the Scotian Shelf and Gulf of Maine were about 0.2^{o}C below normal. The average December-June Newfoundland and Labrador sea ice cover and ice volume were below normal respectively. However, ice persisted on the east coast north of Cape Bonavista for longer than it has in recent years. Below normal ice conditions prevailed on the Scotian Shelf with ice cover (January-April) the 15th least in 39 years. Three hundred and twenty-four icebergs reached the Grand Banks in 2007, a substantial increase from 2006 when none were observed but still well below the long-term mean. The average monthly values of SST anomalies in 2007 were used to monitor the Northwest Atlantic shelf and in offshore areas between 40°-55°N and 45°-70°W. The general feature of surface hydrological conditions in 2007 is the dramatic cooling of SST by 1.5°-2.5°C on average in the whole area compared with warm conditions observed in 2006. Intensification of the Arctic air mass transport from the north over the northwest Atlantic and increased transport of the Labrador Current are linked to the cooling in SST over Shelf and Slope waters. Further analysis of satellite data in 2007 indicates a northeast to southwest gradient of sea surface temperature anomalies similar to the air temperature anomaly distribution, i.e., generally above normal SST (by ~0.7^{o}C) to the northeast and below normal values

(-0.6°C) over the western Scotian Shelf, Lurcher Shoals and Georges Bank. Eighteen of twenty-three areas had positive annual SST anomalies; values ranged from -0.8°C (western Scotian Shelf) to 1.5°C (Labrador Shelf).

A review of meteorological, sea surface temperature and sea ice conditions around Greenland during 2007 was presented (SCR Doc. 08/3 and 5). The North Atlantic marine climate is in part regulated by the North Atlantic Oscillation (NAO), which is driven by the pressure difference between the Azores High and the Iceland Low pressure cells. We use wintertime (December–March) sea level pressure (SLP) difference between Ponta Delgada, Azores, and Reykjavik, Iceland, and subtract the mean SLP difference for the period 1961–1990 to construct the NAO anomaly. The winter NAO index during winter 2006/2007 was positive and among the 10% highest observed in the past 143 years. The Icelandic Low was during the winter months (December–March) centred south of Greenland over the Irminger Sea and Labrador Sea south of Greenland, which corresponds to a slight displacement towards the Labrador Sea. Both the Icelandic Low and the Azores High was strengthened resulting in an increased pressure difference over the North Atlantic sector above normal. The pressure difference has the effect to intensify westerlies over the North Atlantic Ocean south of the Nova Scotia/Great Britain line. Over the East Greenland Shelf, especially between Jan Mayen and Greenland, the mean wind direction was towards south. South of Iceland the wind anomaly was slightly deflected towards Greenland. Over the Labrador/Davis Strait area, the wind anomaly was normal, i.e. not strengthened/intensified winds from Canada onto the ocean, due to the displacement of the Icelandic low towards the Labrador Sea. Instead, the increased land-to-sea wind anomalies were displaced southward from Nova Scotia. West Greenland lies within the area which normally experiences cold conditions when the NAO index is positive. However, the annual mean air temperature for 2007 in Nuuk was -0.62°C which is about 1°C above average, despite a positive NAO index. The explanation is likely due to the displacement of the Icelandic Low towards Labrador Sea combined with general higher temperatures in the North Atlantic during recent years. The mean annual air temperature for 2007 was above normal for almost the entire North Atlantic region with anomalies above 1°C west of Greenland and even above 2°C over the Davis Strait region.

Sea-ice is important in Greenlandic Waters. The West Greenland area is mainly dominated by 2 types of sea-ice. “Storis” is multi-year ice transported from the Arctic Ocean through Fram Strait by the East Greenland Current to Cape Farewell, where it continues northward by the West Greenland Current. “Vestice” is first-year ice formed in the Baffin Bay, Davis Strait, and western part of the Labrador Sea during winter. Based on satellite derived ice charts for all months in 2007, sea ice conditions off West Greenland were much more extensive and sea ice formation in general occurred earlier than observed in 2006. Sea surface temperatures in West Greenland often follow those of the air temperatures, major exceptions are years with great salinity anomalies i.e. years with extraordinary presence of Polar Water. However, in 2007 the mean temperature (1.84ºC) and salinity (33.49) on top of Fylla Bank in the middle of June was close to normal conditions, despite air temperatures in Nuuk and Tasiilaq above normal. Surface temperatures below normal despite anomalous positive air temperatures over the Davis Strait and near-normal temperatures in the core of the Polar Water indicates normal to above normal inflow of Polar Water. The presence of both multi-year-ice and west-ice likely also has the effect, that the surface temperatures remain lower than normal.

A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2007 was presented (SCR Doc. 08/49). Surface air temperatures in 2007 were notably cooler over northeastern Canada than record conditions experienced in 2006, but continued warmer than normal over the Labrador Sea. The maximum air temperature anomalies occurred near Davis Strait, while near–normal conditions off northern Newfoundland. The air temperatures were 1-2ºC cooler in 2007 across the western Labrador Sea. The air temperature conditions showed little change in the eastern Labrador Sea. Sea surface temperatures also remained about 1°C warmer than normal over much of the Labrador Sea in 2007. The Labrador Sea SST in 2007 was approximately 1ºC above normal but cooler than conditions in 2006. The 2007 observation continues the decade-long period of warmer than “normal” SST but there was an overall decrease in SST in 2007 following record highs of 2003-2006. SST conditions were warmer in 2007 compared to 2006 on West Greenland side, but cooling occurred on the Labrador Shelf and adjacent Slope waters.

6. 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 oceanographic surveys in late June (Danish survey) and October-November (German survey) in 2007 (SCR Doc. 08/3 and 5). The results of the 2007 Danish survey show 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°C; S>34.5) is normally found at the surface at the three outermost stations on the Cape Farewell and Cape Desolation sections In 2007, the exent of modified Irminger Water just below a thin surface layer was not as pronounced as in 2006. At intermediate depths pure Irminger Water (T ~ 4.5°C; S > 34.95) was traced north to the Paamiut section. Modified Irminger Water (T > 3.5°C ; 34.88 < S < 34.95) was observed all the way north to Maniitsoq section. The northward extension of Irminger Water may indicate intensified inflow of water of Atlantic origin to the West Greenland area. Temperatures and salinities above normal may indicate the inflow of Irminger Water was stronger than normal. Similar time series west of the banks and further north at Maniitsoq and Sisimiut sections indicate temperature in the 400-600m depth layer was at a record high at Sisimiut and the third highest at Maniitsoq, while the salinity was the second highest observed in both time series. In general, the surface salinity over the Shelf seems to be close to normal and the multi-year-ice "Storis" was present off the southeast coast of Greenland and in the Julianehaab Bight in normal concentrations compared to the long-term average condition. In 2007, a well defined core of Polar Water, revealed by its low temperature, was observed west of Fylla Bank at 50–100 m depth. It was much more pronounced than in 2003–2005 but less pronounced than in 2006. The Polar Water core was also remarkably well defined on the Maniitsoq section and also seen at the Sisimiut section indicating above normal inflow and presence of Polar Water. West of Fylla Bank the salinity was about normal in the upper 400 m and slightly above normal below 400 m. However, the surface temperature (0–50 m) was slightly below normal, while the temperature in the core of the Polar Water in 50–150 m was about normal. Below 150 m, and especially below 400 m, the temperature was higher than normal. Generally, the same condition is seen further to the northwest, off the "Sukkertop Banke" and "Store Hellefiskebanke", but surface temperatures were lower than normal in the upper 150 m. On these northern stations, lower surface temperatures in the surface mixed layer (0–50 m) could be explained by the presence or nearby presence of west-ice. Surface temperatures below normal despite anomalous positive air temperatures over the Davis Strait and about normal temperatures in the core of the Polar Water indicates normal to above normal inflow of Polar Water. The presence of both multi-year-ice and west-ice may result in surface temperatures lower than normal. Results of the 2007 German autumn survey along the standard sections reveal anomalous warm SST conditions off Greenland and in the Labrador Sea in 2007 compared to the long-term average but lower surface temperatures overall compared to the previous year. The SST anomaly data reveal maximum warming occurred during July, least warming occurred in December. Based on autumn measurements (September-November) on the Fyllas Bank section, the temperature anomaly time series reveals a warming trend which has persisted since 1993.

Subareas 1 and 2. Labrador Sea hydrographic conditions (SCR Doc. 08/49) depend on a balance between heat lost to the atmosphere and heat gained from warm and saline Atlantic Waters carried northward into the Labrador Sea by the West Greenland Current. Severe winters under high North Atlantic Oscillation (NAO) conditions lead to greater cooling: in exceptional cases, the resulting increases in the surface density can lead to convective mixing of the water column to depths of 2 km. Milder winters lead to lower heat losses and an increased presence of the warm and saline Atlantic Waters. The 2007 survey encountered conditions generally similar to those observed in the past few years. Conditions in 2007 continue to be dominated by warm and saline Irminger Waters over the west Greenland slope and eastern Labrador Sea. The vertical extent of overturning during winter was limited to the upper 1000m similar to conditions observed in recent years. Both the upper ventilated layers of the Labrador Sea and deeper waters that have not recently been ventilated by winter convection continue to become warmer and saltier. All indicators suggest an increasing fraction of Atlantic waters from the south at the expense of polar waters. The chemical and biological effects of these changes in water masses are currently being investigated.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador Region during 2007 was presented (SCS Doc. 08/19 and 12). Physical oceanographic observations are routinely collected during fish assessment and research surveys in the Newfoundland and Labrador Region. The Atlantic Zonal monitoring program (AZMP) initiated in 1998 continued during 2007 with seasonal 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. Oceanographic observations in Subareas 2 and 3 on the Newfoundland and Labrador Shelf during 2007 showed bottom temperatures have remained above normal for the past 12 years but have decreased from the 3rd highest rank in 2006 to 16th highest in 2007. The annual surface temperatures at Station 27 have been above normal since 2002, reaching a 61-year high above the long-term mean in 2006 but decreased below normal in 2007. Vertically averaged values over various depths also set record highs above normal in 2006 but decreased to below normal values at other depths in 2007. At other locations, (Hamilton Bank, Flemish Cap and St. Pierre Bank) surface temperatures remained above normal in 2007 but decreased significantly from the 2006 values. On St. Pierre Bank, near-bottom temperatures decreased to below normal. Temperature data obtained from thermographs deployed at inshore sites at 10-m depth show considerable variability about the mean due to local wind driven effects. In general however, they show similar patterns, with mostly below normal anomalies during the first half of the 1990s and above normal during the latter half up to 2006. In 2007, 5 out of the 6 sites with data reported significant negative anomalies. Annual surface salinities at Station 27 decreased from the previous 5 years to about normal in 2007. The depth averaged values decreased from 2006 but remained slightly above normal in 2007. On the Flemish Cap, surface salinities were higher than normal during 2007, while on Hamilton Bank they were below normal. Salinities on the Flemish Cap have been above normal from 2001 to 2007.

Subarea 4. A description of environmental information collected on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas during 2007 was presented (SCR Doc. 08/13). A review of physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine and adjacent offshore areas during 2007 indicates annual average temperatures were generally lower than in 2006, one of the warmest years on record. This decline brought annual values to near normal at the mouth of the Bay of Fundy, Sydney Bight and eastern Scotian Shelf. The subsurface temperatures along the central and western Shelf during the July multispecies survey and the spring and fall AZMP sections generally featured below normal temperatures by about 1^{o}C, but with extreme anomalies as large as 6^{o}C below normal over the upper continental slope. The St. Andrews annual sea surface temperature was normal in 2007, a marked decline from 2006, the warmest year in the 87 year time series. The annual Halifax section sea surface temperature was 1^{o}C below normal, making 2007 the 10th coolest in 82 years. At Halifax Station 2, temperature anomalies were generally 1^{o}C below normal from 0 to 140 m; salinity anomalies were near normal from the surface to 100m, and about 0.5 above normal from 100 m to the bottom. The outstanding feature of the observations from standard sections in April and October on the Scotian Shelf was the widespread negative anomalies over the shelf, particularly at the shelf break on the spring sections. The intrusion of Labrador Slope Water into the deeper areas of the Shelf is the likely cause of the below normal temperature and salinity conditions. The overall temperature anomaly for the combined NAFO areas of 4Vn, 4Vs, 4W and 4X from the July groundfish survey was -0.8^{o}C, a decrease of 1.5^{o}C from the 2006 value and the largest decrease in the 38 year record. The overall stratification was above normal for the Scotian Shelf region in 2007. A composite index for the region indicates that 2007 was the 7th coldest overall of the past 38 years. This represents the largest single year decline of the composite index in the 38 year record.

Subareas 4- 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. 08/14). A total of 1809 CTD (conductivity, temperature, depth) profiles were made on NEFSC cruises during 2007. Of these, 1745 were obtained in NAFO Subareas 4 and 5. The CTD data were processed and archived in an ORACLE database accessible at: http://www.nefsc.noaa.gov/epd/ocean/MainPage/index.html. Reports of oceanographic conditions using these data are available at ftp://ftp.nefsc.noaa.gov/pub/hydro/cruise_rpts/2007/. Similar reports have been issued annually since 1991. The Environmental Monitors on Lobster Traps (eMOLT) project continues to collect hourly bottom temperatures from nearly 100 fixed locations in the Gulf of Maine and on the Southern New England Shelf. Lobstermen have been securing internally-recoding temperature probes to their traps since 2001. Data are typically downloaded once per year, but efforts are underway to telemetry data for each haul. Monitoring inter-annual changes in bottom temperature is the primary focus of the project, although salinity and current flow data have also been collected. For more information and data access, visit “http://emolt.org”. This site includes access to CTD data, moored bottom water temperature, drifters, trawl surveys, and along-track hull-mounted sensor measurements. Most notably, users can access area-averaged temperature and salinity data for various regions of the Shelf, including the anomalies relative to historical data. Reports of the oceanographic conditions indicated by these observations are available at: FTP directory /pub/hydro/cruise_rpts/2007/ at ftp.nefsc.noaa.gov. During 2007, zooplankton community distribution and abundance were monitored using 706 bongo net tows taken on ten 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 six transects across the Gulf of Maine from Cape Sable, NS to Boston and eleven transects across the mid-Atlantic Bight from New York to the Gulf Stream during the same time period.

NAFO Subareas 2-5 A description of nutrient, phytoplankton, and zooplankton indices collected in 2007 from fixed coastal stations, oceanographic transects, and ships of opportunity ranging from the southern Labrador-Newfoundland and Grand Banks Shelf (Subarea 2 and 3), extending south along the Scotian Shelf and the Bay of Fundy (Subarea 4) and into the Gulf of Maine (Subarea 5) is presented in SCR Doc. 08/12. In general, nitrate inventories on the Newfoundland-Labrador and Grand Banks Shelf and at fixed coastal stations were above normal, while the levels along the southern transects on the Scotian Shelf were generally below the long-term average (1999-

2006). A significant positive anomaly in deep nitrate inventories was noted for the southern Labrador Shelf while a large negative anomaly in shallow inventories was observed on the southwestern Scotian Shelf in 2007. The overall seasonally-adjusted annual average biomass levels of phytoplankton in 2007 were above the long-term average across all NAFO Subareas, with the exception of the northern-most transects on the Labrador-Newfoundland Shelf. The largest increase in phytoplankton biomass was observed along the central and southwestern Scotian Shelf. The magnitude and duration of the spring phytoplankton bloom at the fixed stations were near or above normal, while the timing of the spring bloom occurred slightly later in 2007. The seasonally-adjusted annual abundance anomalies of zooplankton was near normal along the northern transects on the Labrador-Newfoundland Shelf but consistently below the long-term average in 2007 south of the Grand Banks along the Scotian Shelf and into the Bay of Fundy. The average anomalies for zooplankton abundance indicated a significant decrease for all the main transects on the Scotian Shelf. The occurrence of potential harmful algal species from the CPR survey was above normal across all NAFO Subareas in recent years. The abundance of diatoms was below normal, particularly along the Scotian Shelf, while meroplankton (benthic invertebrate early life stages) was above normal. The abundance of macrozooplankton (euphausiacea, hyperiidea, and decapoda) increased significantly in the Gulf of Maine but showed negative anomalies farther north on the Scotian and Newfoundland Shelves.

7. Interdisciplinary Studies

An important role of STACFEN, in addition to providing climate and environmental 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 the committee recommends that further studies be directed toward integration of environmental information with changes in the distribution and abundance of resource populations.

The following study was considered at the June 2008 Meeting:

a) The effect of winter cooling on inter-annual changes of near-bottom water temperatures off southwest Greenland- a forecast option for bottom water temperatures on half year time scales. M. Stein and V.A. Borovkov. SCR Doc. 08/2. Understanding of the thermal conditions of marine habitats is essential for effective management of fisheries and marine resources. Since the management of fish stocks is a long-term process, it would be desirable to forecast ocean temperatures, e.g. on an intra-annual, annual or multi-annual time scale. The variability of monthly sea surface temperatures off southwest Greenland using the “Wavelet Power Spectrum” analysis was explored. We propose a method to forecast bottom water temperatures six months in advance. The method uses linear correlations of SST with bottom water temperature. The average January and April SST anomalies yield the best correlations (r^2=0.71) with autumn bottom water temperatures obtained from measurements off southwest Greenland during 1987-2007. Further enhancements of the method are planned to enhance the understanding of the response of fish and invertebrate resources to changes in the thermal environment. It was noted that current meter moorings in Davis Strait supported by Fisheries and Oceans at the Bedford Institute of Oceanography can provide in-situ temperature data to complement the modelling efforts.

8. An Update of the On-Line Annual Ocean Climate and Environmental Status Summary for the NAFO Convention Area

In 2003 STACFEN began production of an annual climate status report 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. An update of the on-line annual ocean climate status summary for the NAFO Convention Area will be posted shortly after the meeting. Eugene Colbourne is continuing to take the lead together with the physical oceanographers to produce the on-line annual climate status summary. This information will include contributions received from Subareas 0-1, West Greenland (M. Stein and M. Ribergaard), Subareas 2-3, Grand Banks and Labrador Sea / Shelf (E. Colbourne, R. Hendry, P. Pepin), Subareas 4-5, Scotian Shelf and Gulf of Maine (B. Petrie, Glen Harrison), and Subareas 5-6, Georges Bank and Gulf of Maine (D. Mountain, Maureen Taylor). In addition, it was discussed posting all of the oceanographic highlights derived from the SCR and SCS documents presented including the physical and biological summaries.

9. 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.

Continued efforts are encouraged to pursue correlative and mechanistic studies between marine species and trends in the environment. Statistical modeling studies remain ongoing with resource populations and are used as “indicators” in those specific assessments. The implications to fully implement ecosystem based management and integrated assessments will most likely necessitate the need to increase the level of environmental information required and therefore committee members are encouraged to submit ideas for integration of such information into this process.

10. The Formulation of Recommendations Based on Environmental Conditions

STACFEN made no formal recommendations during this 2008 meeting but the committee is 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.

11. 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), M. J. Garcia (Spain), B. F. Pristehepa (Russia), L. J. Rickards (United Kingdom), and K. J. Schnebele (USA).

12. Other Matters

No other matters were brought forward or discussed by the Committee.

13. 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 THE STANDING COMMITTEE ON PUBLICATIONS (STACPUB)

Chair: Manfred Stein Rapporteur: Philip A. Large

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 7 and 17 June 2008, to consider publication-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Norway, Japan and Russian Federation. The Scientific Council Coordinator was in attendance as were other members of the Secretariat staff.

1. Opening

The Chair opened the meeting at 0900 hours by welcoming the participants.

2. Appointment of Rapporteur

Philip A. Large (EU) was appointed rapporteur.

3. Adoption of Agenda

The agenda as presented in the Provisional Agenda was adopted with the exception that agenda item 9 STATLANT was deleted and transferred to STACREC.

4. Review of Recommendations in 2007

Recommendations from June

i) STACPUB **recommended** that catch data only be referred to as provisional in Scientific Council reports when STATLANT 21A dat*a have not been received with respect to any particular stock and year, and, that the Secretariat ensure that updates and changes to the STATLANT 21 databases are documented*.

Action has been taken on this recommendation under the management of the Executive Secretary. All 21A data submissions in the current year are provisional as these can be revised upon receipt of the 21B values. Historical 21A data for earlier years is updated according to the 21B submission and is no longer provisional. Any record from any year can be changed by instruction from a Contracting Party. There is an audit trail provided by paper records of changes made by Contracting Parties. The Secretariat agreed to investigate the possibility of including this trail in the database.

ii) STACPUB **recommended** that *the Secretariat work to improve the internet accessibility of the STATLANT 21 database and provide a report at the next June meeting.*

Action has not yet been taken on this recommendation under the management of the Executive Secretary because of other priorities.

iii) STACPUB **recommended** *not to use the classification ("Miscellaneous Papers") of volumes in future, and instead discriminate between symposium editions and regular editions of JNAFS.*

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

5. Report on "pre-STACPUB meeting" – NAFO Headquarters - 4th June 2008

This year the meeting provided a useful forum for reviewing the Editorial Board, technical and copyright issues. All NAFO publications adhere to international copyright protocols. All photographs are credited to photographers and it was decided to adopt this protocol for photographs taken by Secretariat staff.

6. Review of Publications

a) Journal of Northwest Atlantic Fishery Science

STACPUB was informed that: Two volumes of the Journal of Northwest Atlantic Fisheries Science (JNAFS) were published last year: Volume 38 (Regular- 7 articles) and Volume 39 (Symposium – 8 articles). Volume 40 (Regular) has not received any new submissions to date this year, although two earlier submissions are at the revision stage.

Volume 41 is a symposium issue for the recent joint NAFO, PICES and ICES symposium on "Reproductive and recruitment processes of exploited marine fish stocks". Around 25 submissions have been received, many of which were of a high scientific quality. It is likely that this volume will contain around 15 articles.

All past articles in the JNAFS volumes are being assigned DOIs. This has been completed back to about Volume 20 and will be completed by the end of 2008.

JNAFS is incorporated in the Aquatic Sciences and Fisheries Abstracts (ASFA) database and is now also included in the "Directory of Open Access Journals" (http:/www.doaj.org), a new free online database managed in Stockholm.

It was commented that with the increased profile of the Ecosystem Approach at Scientific Council, this might be a fertile area for future submissions. Although Associate Editors had been appointed for Social Science and Economics these fields had not, as yet, attracted any submissions.

b) NAFO Scientific Council Studies

STACPUB was informed that: A NAFO identification guide on wolfish, hake and rockling has been produced and will be useful aboard commercial vessels (Studies No. 40). The report of the Scientific Council Greenland halibut Ageing Workshop (Studies No. 41) held in Vigo has now been received and is in the proof stage. All past volumes of the Studies have been uploaded to the NAFO website and are available in the open access section. The general view of recent Studies publications was very positive.

Fisheries Commission had noted that NAFO does not have a corals key and the intention is to address this in the near future. It was suggested that relevant publications in this series should be made available to the Fisheries Inspectorate so that they can disseminate to fishers when boarding vessels.

Studies 41 – a review of the progress made and outcomes from a Greenland halibut ageing workshop provides an excellent catalogue of knowledge to date and is very useful as a reference document for fisheries laboratories. A total of 25 hard cover colour copies will be distributed and a DVD will be available.

c) NAFO Scientific Council Reports

STACPUB was informed that: A total of 80 printed copies of the NAFO Scientific Council Reports 2007 (Redbook) volume (279 pages) were produced in March 2008. The Redbook contained reports of the June, September, and November 2007 Scientific Council meetings, along with a list of NAFO publications relevant to the meetings and contact details for participants. Also included, were the NAFO shrimp stocks assessed at the NAFO/ICES *Pandalus* Assessment Group (NIPAG) meeting. This book was distributed to participants of Scientific Council meeting of June 2008. Approximately 200 copies of the Meeting Documentation CD 2007 were produced. This was enclosed at the back of the 2007 Scientific Council Reports and was distributed to a mailing list of libraries and Institutes.

d) Index and Lists of Titles

The provisional index and lists of titles of 92 research documents (SCR) and 19 summary documents (SCS) that were presented at the Scientific Council Meetings during 2007 were compiled and presented in SCS Doc. 08/4 for this June 2008 meeting.

7. Editorial Matters Regarding Scientific Publications

a) General Editors Report

The General Editor emphasized that the Associate Editors for Social Science and Economics were well known in their fields of expertise, however JNAFS had still had difficulties breaking into these fields. It is important that JNAFS covers all aspects of the fishery and the increasing profile in NAFO of the Ecosystem Approach may help. Associate Editors (of all fields) continued to have difficulty finding reviewers and there is generally a six-month turnaround between sending a manuscript to an Associate Editor and return to the General Editor. However, it was commented from the floor that some Journals are slower than this.

b) Review of Editorial Board

The Chair of STACPUB reported that a replacement for the position of Associate Editor for Invertebrate Fisheries Biology was required. Two potential names were suggested. These were discussed and members of the Scientific Council were asked to come up with additional ideas for a replacement during the course of the Scientific Council meeting. The Chair suggested that a new Associate Editor position be created with responsibility for benthic ecology. This was widely supported, and a suggestion for a further Associate Editor position covering the Ecosystem Approach was approved.

STACPUB **recommended** that *to widen the scope of JNAFS in order to cover the fields of benthic ecology and the Ecosystem Approach, it was agreed to create two new Associate Editor positions and to identify potential candidates to join the Editorial Board.*

c) Publication initiatives

The General Editor wants to advertise JNAFS. Sending copies to libraries had been considered but this was viewed as not very effective as copies are already available on the internet. 100 copies of a recent volume have been printed and these have been allocated to Associate Editors to disseminate and distributed to colleagues considered likely to publish. 50 copies have been made available to members of Scientific Council to distribute.

d) Short contributions/letters to the editor in JNAFS

The Chair indicated that there was a need to have a quick turnaround of short contributions/letters submitted to JNAFS, particularly. The General Editor confirmed that there remained a need for all short contributions/letters to be peer-reviewed by topic experts. The turnaround time was largely dependent on the speed of this process.

e) General discussion

There were no items of discussed of a general nature.

8. NAFO Website

Web Statistics (with focus on JNAFS). In 2006 a comprehensive overview of the JNAFS web-stats was conducted by the NAFO Secretariat and presented to STACPUB. In 2007 the NAFO web server was upgraded and moved to the Secretariat headquarters. Due to the upgrade some of the detailed log information was lost and so the stats for late 2006 and early 2007 are incomplete.

The complete webstats are now available from May 2007 to the present. As mentioned in the 2006 review a number of the hits made on the website were the web crawlers/spiders. This year the Secretariat endeavoured to remove the IP addresses of these crawlers before analyzing the data. This would give a more precise number of visitors to the site without having to use estimates. This became an enormous task as the IP addresses had to be identified and then stripped from the basic log file. But the result is a very clean file than can easily allow us to identify the main trends.

Since last May 2007, the monthly average number of visitors was 3100 (approximately 100 per day). This is less than the figures that were presented last time, due to our under estimation of the numbers of web spiders/crawlers to the site.

It was noted that there was a need to provide an easily available link directly to PDFs. The Secretariat agreed to investigate this.

9. STATLANT

This agenda item was transferred to STACREC.

10. Papers for Possible Publication

STACPUB Chair reminded the Committee to review the research documents submitted to the June 2008 meeting with the aim of identifying documents suitable for future publication. These should be notified to the Chair.

11. Other Matters

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 1130 hours on 7th June.

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

Chair: Ricardo Alpoim Rapporteur: Margaret Treble

The Committee met at Alderney Landing, at 2 Ochterloney Street, Dartmouth, Nova Scotia, during 9-19 June 2008 to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Russian Federation, and United States of America. The Executive Secretary and Scientific Council Coordinator were in attendance.

1. Opening

a) Appointment of Rapporteur

The Chair opened the meeting at 0900 hours on 9 June 2008. He welcomed all the participants, and thanked the Secretariat for providing support for the meeting. Margaret Treble was appointed as rapporteur. The Chair proposed some minor adjustments to the agenda, which was then adopted.

2. Review of Previous Recommendations

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.*

STATUS: This recommendation was implemented by the Secretariat.

Given the importance of estimates of effort to shrimp assessments STACREC **recommended** that *the appropriate method to estimate effort from twin trawls (bottom and midwater) be referred to the ICES Fishing Technology Working Group.*

STATUS: This recommendation was implemented by the Secretariat.

STACREC **recommended** that *survey indices be presented in the most appropriate form for each stock, rather than in a standard manner for all stocks.*

STATUS: This recommendation was implemented.

STACPUB **recommended** that *catch data only be referred to as provisional in Scientific Council reports when STATLANT 21A data have not been received with respect to any particular stock and year, and, that the Secretariat ensure that updates and changes to the STATLANT 21 databases are documented.*

STATUS: This recommendation was implemented.

STACPUB **recommended** that *the Secretariat work to improve the internet accessibility of the STATLANT 21 database and provide a report at the next June meeting.*

STATUS: This recommendation was implemented.

3. Fishery Statistics

a) Progress report on Secretariat activities in 2007/2008

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

In accordance with Rule 4.4 of the Rules of Procedure of the Scientific Council, as amended by Scientific Council in June 2006, the deadline dates for this year's submission of STATLANT 21A data and 21B data for the preceding year are 1 May and 31 August, respectively. The Secretariat produced a compilation of the countries that have submitted to STATLANT along with historical STATLANT catches and made this available to the meeting. This will be made into an SCS document to be a record of the catches available to this meeting. This includes the table of which countries have submitted to STATLANT at the date the working paper was compiled (Table 1). This will be useful in checking historic catches and in determining if zero catch from a country represents no catch or no submission.

Table 1. Dates of receipt of STATLANT 21A and 21B reports for 2004-2007 at the Secretariat up to 04 June 2008.

	STATLANT 21A				STATLANT 21B			
	2004	2005	2006	2007	2004	2005	2006	2007
CAN-CA	05-Jul-06	18-Aug-06	23-May-07	22-Feb-08	05-Jul-06	18-Aug-06	23-May-07	
CAN-M								
CAN-SF	11-May-05	26-Jun-06	22-May-07		26-Jun-06	22-May-07		
CAN-G	06-Jul-06	13-Mar-07	26-May-08	26-May-08	06-Jul-06	13-Mar-07	26-May-08	
CAN-N	02-Jun-05	03-May-06	21-Jun-07	21-May-08	29-Jun-06	29-Jun-06	03-Oct-07	
CAN-Q	22-Dec-04	20-Dec-05	05-Dec-06	20-Dec-07	01-Sep-06	01-Sep-06		
CUB	24-Sep-07	24-Sep-07	24-Sep-07	30-Apr-08	22-Feb-08	28-Feb-08	22-Feb-08	
E/EST	13-May-05	28-Apr-06	02-May-07	08-Apr-08	07-Jul-05	27-Jun-06	04-Sep-07	08-Apr-08
E/DNK	06-May-05	09-May-06	15-May-07	21-May-08	06-May-05	09-May-06	17-May-07	21-May-08
E/DEU	13-May-05	03-May-06	27-Apr-07	23-Apr-08	04-Jul-05	08-Sep-06	30-Aug-07	
E/LVA	13-May-05	24-Apr-06	24-Apr-07	08-Apr-08	13-May-05	24-Apr-06	27-Jun-07	
E/LTU	09-May-05	30-May-06	27-Apr-07	24-Apr-08		06-Jun-07	29-Jan-08	
E/POL	16-Feb-05	15-May-06	28-Feb-07		01-Mar-05	31-May-06	28-Feb-07	
E/PRT	07-Jun-05	30-Aug-06	02-May-07	29-Apr-08	19-Aug-05	10-Aug-06	28-Aug-07	
E/ESP	31-May-05	30-May-06	10-Oct-07	04-Jun-08	01-Jun-05	30-May-06	10-Oct-07	04-Jun-08
FRO	06-Sep-05	26-Jun-06		30-May-08	06-Sep-05	26-Jun-06		30-May-08
GRL	01-Sep-05				01-Sep-05			
ISL	17-May-05	15-May-06	31-May-07	30may08 (nf)	15-Jun-05	29-May-06	31-May-07	30may08 (nf)
JPN	13-May-05	08-May-06	13-Jun-07	25-Apr-08	27-Jun-05	23-Jun-06	21-Nov-07	25-Apr-08
NOR	11-May-06	11-May-06	03-Jul-07	30-Apr-08	01-Jul-06	01-Jul-06	28-Apr-08	
RUS	06-Jun-05	16-May-06	26-Apr-07	20-May-08	05-Jul-05	21-Aug-06	03-Jul-07	
USA								
FRA-SP	12-May-05	29-May-06	21-Feb-07			27-Mar-07	21-Feb-07	
UKR	16-May-05	26Sep07 (nf)	13-Apr-07		27-May-05	26Sep07 (nf)	13-Apr-07	

During 2007 the Secretariat began a review of the accessibility of the STATLANT 21 data on the website and the feasibility of harmonizing the 21A and 21B databases. STACREC noted that there are additional sources of information concerning catches that may be used in the assessments and that this should be indicated on the web site. STACREC **recommended** that *data be easily accessible on the web site in both aggregated (as in 21A) and dis-aggregated (as in 21B) formats*. In addition STACREC **recommended** that *the website contain information on missing data and information on additional sources of catch data, collated on the basis of stock, that are used by Scientific Council.*

The Contracting Party catch submissions are entered on forms STATLANT 21A and STATLANT 21B. The paper form has a list of some 66 'primarily' commercial species along with their alpha and NAFO numeric code. The instructions refer the compiler to the "enclosed NAFO list of species", though it is not clear if this refers to the list included on the forms. A further list of some 180 species of finfish and shellfish, and their alpha codes, is given in Annex II of the CEM. This does not appear to be linked to STATLANT reporting. A complete list of species and their alpha codes is given in the FAO ASFIS species list. All lists include codes for various species groupings.

Data is sent to the NAFO Secretariat on catch with species identified by alpha code and/or NAFO numeric code and entered on to the STATLANT database. This goes smoothly as long as the numeric code exists in the reference list within the database. A problem occurs when the numeric code is not in the reference list, and this occurs when NAFO has not assigned a numeric code to a species. For example, Northern Wolffish (alpha code CAB) was only given a NAFO numeric code (of 191) in 2007. The species list for the STATLANT database is under the general supervision of Scientific Council, who controls the species on this list. For example, tuna catch recording was discontinued in September 2003. Currently, the reporting of a species not on the list is solved by using the most appropriate available code, for example, Oilfish (*Ruvettus pretiosus*, alpha code OIL) does not have a NAFO numeric code and so was entered as Groundfish nei (numeric code 199). Another example is Angler (=Monk) (*Lophius piscatorius*, alpha code MON) which does not have a numeric code, and so is entered as American angler (*Lophius americanus*, alpha code ANG, numeric code 132). Submitting Contracting Parties are informed of such changes and given the chance to correct the entry.

The Secretariat noted that statistics are usually submitted in electronic format that vary considerably across Contracting Parties requiring a significant amount of time and effort to standardize the formats prior to inclusion in the STATLANT 21 databases.

STACREC **recommended** that *the Secretariat discuss the following with Contracting Parties: i) dropping the numeric codes for species and using the appropriate alpha codes provided by FAO ASFIS species list;; ii) the harmonization of electronic data submissions.*

ii) Possible Sub-division of the Statistical Areas

During the 22nd Session of the Coordinating Working Party on fishery statistics there was discussion on the recent decision by ICES and Eurostat to distinguish between national EEZs and international waters (excerpt from meeting minutes is given below).

> ***17.3 Separation of catch taken in EEZs and in high seas***
>
> 73. ICES and Eurostat explained to the meeting the recent separations of the statistical subdivisions distinguishing between national EEZs and international waters. These changes have recently been passed in European legislation and catch data will be reported accordingly as of 2006. It was noted that since these new separations apply only to sub-divisions of statistical areas, a formal approval would not be needed. However, the CWP statistical handbook should be updated accordingly and the meeting agreed to these changes. Eurostat and ICES will provide the definition of this new sub-divisions.
>
> 74. The meeting considered the development undertaken by ICES/Eurostat important – in particular in the light of the recommendations of the UNGA to improve data for management of straddling and migratory stocks – and other members were encouraged to investigate to implement similar measures for distinguishing between catches in national and international waters.

STACREC noted that there was no background information or analysis concerning implications of such an initiative on the work of the Scientific Council and that STACREC had not received a formal request to consider this matter and is unable to comment further on this item.

iii) Information collected by the NAFO Secretariat

The Secretariat presented a summary of data sources and information that is available upon request from the Secretariat; STATLANT 21, list of biological sampling, list of tagging activities, research vessel surveys, commercial fisheries sampling, biological surveys, provisional catches by month, at-sea inspection reports, port inspection reports, observer reports, VMS, vessel registry and NAFO publications. Some of these data sources contain confidential information and therefore have restrictions placed on their distribution. STACREC noted that not all research activities have been reported to the Secretariat for example research surveys done by non-government parties using commercial vessels.

STACREC **recommended** that *the Secretariat maintain a list of information sources and this list be made more accessible on the web site. In addition STACREC encourages Contracting Parties to continue reporting research activities in the NRA, including those conducted by commercial vessels.*

4. Research Activities

a) Biological Sampling

i) Report on Activities in 2007/2008

STACREC reviewed the list of Biological Sampling Data for 2007 (SCS Doc. 08/15) 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 2008 Meeting.

ii) Report by National Representatives on Commercial Sampling Conducted

Canada-Newfoundland (SCS Doc. 08/12**):** Information was obtained from the various fisheries taking place in all areas from Subareas 0, 2, 3 and portions of Subarea 4. Information on fisheries and associated sampling for Greenland halibut (SA 0 + 1 (except Div. 1A inshore), SA 2 + Div. 3KLMNO), Atlantic salmon (SA 2+3+4), Arctic charr (SA 2), Atlantic cod (Div. 2GH, Div. 2J+3KL, Div. 3NO, Subdiv. 3Ps), American plaice (SA 2 + Div. 3K, Div. 3LNO, Subdiv. 3Ps), witch flounder (Div. 2J3KL, 3NO, 3Ps), yellowtail flounder (Div. 3LNO), redfish (Subarea 2 + Div. 3K, 3LN, 3O, Unit 2), northern shrimp (Subarea 2 + Div. 3K, 3LMNO), Iceland scallop (Div. 2HJ, Div. 3LNO, Subdiv. 3Ps, Div. 4R), sea scallop (Div 3L, Subdiv. 3Ps), snow crab (Div. 2J+3KLNO, Subdiv. 3Ps, Div. 4R), squid (SA 3), thorny skate (Div 3LNOPs), white hake (Div. 3NOPs), lobster (SA 2+3+4), and capelin (SA 2 + Div. 3KL), was included.

EU-Portugal (SCS Doc 08/5): Data on catch rates were obtained from trawl catches for Greenland halibut (Div. 3LMNO), redfish (Div. 3M and 3O), roughhead grenadier (Div. 3M and 3O), skates (Div. 3MNO). Data on length composition of the catch were obtained for cod (Div.3MNO), redfish (Div. 3LMNO), American plaice (Div. 3LMNO), yellowtail flounder (Div. 3N), Greenland halibut (Div. 3LMNO), roughhead grenadier (Div. 3LMNO), witch flounder (Div. 3LMNO), white hake (Div. 3O), thorny skate (Div.3LMNO), spinytail skate (Div. 3LMN) and monkfish (Div. 3O).

EU-Spain (SCS Doc. 08/7): All effort and catch information in the Spanish Research Report are based on information from NAFO observers on board. In 2007 information from 1677 days was available while total effort of the Spanish fleet in NAFO Regulatory Area was 1677 days (100% coverage). All length, age and biological information presented were based on sampling carried out by IEO Scientific Observers: in 2007, 262 samples of different species were taken, with 48 024 individuals examined. These samples were made in 281 working days that it means 17 % of the Spanish total effort.

Subarea 1 and 2: A total of 2 Spanish pelagic trawlers operated in NAFO Regulatory Area (NRA) Subarea 1 and 2 (Div. 1F and 2J) during 2007, amounting 7 days of fishing effort. Catches in NRA Div. 1F and 2J were 13 t of pelagic redfish (*Sebastes mentella*).

Subarea 3: The Spanish fleet has, at least, four different fisheries in NAFO Subarea 3 characterized by different mesh size, target species, depth and fishing area. The Spanish fleet effort in NAFO area is mainly directed to Greenland halibut (mostly in Div. 3LM), alternating with the skate fishery in the second half of the year (Div. 3NO), shrimp fishery (Div. 3LM), and in less degree redfish (Div. 3O).

In 2007 a total of 21 Spanish trawlers operated in NAFO Regulatory Area, Div. 3LMNO, amounting to 1 677 days (25 163 hours) of fishing effort. Data on catch, length and age composition of he trawl catches were obtained for Greenland halibut and roughhead grenadier. Catches length composition were obtained for cod, yellowtail flounder, witch flounder, American plaice, skates and redfish.

Denmark/Greenland (SCR Doc. 08/35, 38): Length frequencies and CPUE data were available from the Greenland trawl fishery in Div. 1A and 1CD. Length and age compositions were available from the inshore long line and gill net fishery in inshore in Div. 1A.

EU-Estonia: In 2007, as in earlier years, the fishery was mainly directed on northern shrimp. Observers (employed by the Estonian Marine Institute) measured and sexed 17 7562 specimens of shrimp from 892 hauls. Bycatch of redfish (63 350 specimens measured, 1 490 aged, 1 419 sexed) and capelin (3 767 measured) was analysed in shrimp fishery. In addition, Greenland halibut in 3LMN (1 947 specimens measured, 928 aged, 1 453 sexed), American plaice in Div. 3LNO (215, 163, 149) and redfish in Div. 3MO (1 932, 1 045, 1 513) were sampled.

EU-Germany (SCS Doc 08/8): In 2007, demersal fishing effort increased in Division 1D inside the Greenland EEZ from July until November. The fishery was directed towards Greenland halibut (*Reinhardtius hippoglossoides*). By end of the year, reported landings amounted to 1536 t of Greenland halibut. The by-catch of roundnose grenadiers was 4.25 t in 2007 compared to 4 t in 2005 and 2.2 t in 2006. Wolffish and skates were not reported as bycatch (presumably less than 1 t).

While the demersal fishery for Greenland halibut is a normal activity, the pelagic fishery from 2000 to 2006 for pelagic redfish (*Sebastes mentella*) appeared as an intermezzo only. It 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.

After 2000, the fishery was conducted in the NAFO Regulatory Area and Greenland EEZ in Div. 1F during the 3rd quarter at depths above 500 m and targeted almost exclusively mature redfish with almost no discard and no by-catch of other species. In comparison to 2000 when total landings of 4 476 t were reported, both landings and effort decreased substantially after 2003, and no fishery was reported in 2007.

EU-Latvia: Latvian fishery in NAFO area in 2007 was conducted by 2 vessels, mainly by bottom trawl. Catches: redfish in areas 2+1F+3K – 186 tons, Pandalid shrimps in Div. 3 M – 1940.4 t and in Div. 3 L – 309.4 tons.

Latvian length/weight sampling of catches and discards by species in 2007 from bottom trawl Pandalid shrimps catches in the Div. 3 M and Div. 3L was carried out by NAFO/scientific observers.

Total number of samples taken – 37 and individuals examined - 2 650 (1 550 of Pandalid shrimps, 650 of redfish and 450 of Greenland halibut).

EU-Lithuania: Lithuanian vessels in 2007 have been operated in Divisions 1F, 2J and 3LMN. The main fishing targets were redfish in Divisions 1F, 2J and 3M (total catch of 542 t) and Northern shrimps in 3LM (total catch of 2 237 t). Other species are taken as a bycatch. Due to insignificant quantities of catches of cod (12 t) or Greenland halibut (22 t) samples were not collected. Nevertheless, the information on discards rates for all species and all types of fishery is available. In 2007 Lithuania sampled catches of shrimps only and in total 147 samples for length measurement were taken.

Russia (SCS Doc. 08/6): In 2007 Russian fishing vessels operated in Subareas 1, 2 and 3. The fishery was mainly directed on Greenland halibut in Div. 1CD, 3LM and deep-water redfish in Div. 1F, 2HJ, 3MO. Data on catch, sex, maturity, age, individual weight and length composition were obtained from trawl catches for Greenland halibut (Div. 1D, Div. 3LMO) and redfish (Div. 1F, 2J). Data on catch, sex, maturity and length composition from bottom trawl catches were available for redfish (Div. 3LMO). Data on catch and length composition were presented for cod (Div. 3MO), roughhead grenadier (Div. 3LMNO), American plaice (Div. 3LMO), threebeard rockling (Div. 3LM), thorny skate (Div. 3LMO), witch flounder (Div. 3LMNO), American plaice (Div. 3M), white hake (Div. 3O), black dogfish (Div. 3LM), northern wolfish (Div. 3LM), blue hake (Div. 3LMO), Atlantic halibut (3LMNO) and common grenadier (Div. 3LMO).

iii) Report on Data Availability for Stock Assessments

Designated Experts were reminded to provide available data from commercial fisheries to the Secretariat for inclusion on the password protected website.

b) Biological Surveys

i) Review of survey activities in 2007 (by National Representatives and Designated Experts)

Canada (SCS Doc. 08/12): No stratified-random otter trawl surveys were conducted in the NAFO Convention Area by Canada (C&A) in 2007. 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 2007 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 488 tows, (295 in Div. 3LNO) with the Campelen 1800 trawl, by the research vessels *Wilfred Templeman* and *Teleost*. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to January, and consisted of 631 tows with the Campelen 1800 trawl. Two research vessels were used: *Teleost* and *Wilfred Templeman,*. This survey continued a time series begun in 1977. Additional surveys during 2007, directed at various species using a variety of designs and fishing gears, were described in detail in SCS Doc. 08/12 and in other documents. Oceanographic surveys were discussed in detail in STACFEN.

EU-Spain: The Spanish bottom trawl survey in NAFO Regulatory area Div. 3NO was conducted in May and June 2007 on board R/V Vizconde de Eza using Campelen gear with a stratified design. A total of 111 hauls were carried out up to a depth of 1 450 m, one of which was null. The results of the Spanish 3NO bottom trawl survey, including biomass indices with their errors and length distributions, as well as the calculated biomass based on conversion of length frequencies for Greenland halibut and American plaice; Atlantic cod and yellowtail flounder; Thorny skate, white hake and roughhead grenadier are presented as Scientific Council Research documents.

Feeding studies on the main species continued to be conducted, and material for histology (Cod, American place, Greenland halibut and redfish) and aging (Cod, American place, Greenland halibut, redfish, roughhead grenadier, yellowtail and which flounder) studies were taken. Sixty nine hydrographic profile samplings were made in a depth range of 44 - 1393 m, one which was null.

In 2003 it was decided to extend the Spanish 3NO survey toward Div. 3L (Flemish Pass). In 2007, the bottom trawl survey in Flemish Pass (Div. 3L) was carry out on board R/V Vizconde de Eza using the usual survey gear (Campelen 1800) from July 23rd to August 11th. The area surveyed was Flemish Pass to depths up 800 fathoms (1463 m) following the same procedure as in previous years. The number of hauls was 99 and 5 of them were nulls. Survey results including abundance indices and length distributions of the main commercial species are presented as Scientific Council Research documents. Survey results for Div. 3LNO of the northern shrimp (Pandalus borealis) were presented in SCR Doc. 07/79.

Feeding studies on Greenland halibut and American plaice continued to be performed and samples for histological (Greenland halibut, American plaice) and aging (Greenland halibut, American plaice and cod) studies were taken. Ninety one hydrographic profile samplings were made in a depth range of 116-1140 m.

In 2007 the Spanish administration obtained a license from Canadian Authorities to carry out a research survey inside of the Canadian waters in 3L Division. This survey was made by the R/V Vizconde de Eza, covering 13 strata in the north of Div. 3L, using a Campelen survey gear up to 1451 meters depth and following the same procedures as in 3NO survey. Problems about the delay with the fishing license did not permit to carry out the total of hauls planned and only were made 26 valid hauls. Due to the low number of hauls results should be considered with caution.

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 June 23rd to July 19th 2007. 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 179 and two of them were nulls. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, roughhead grenadier and Greenland halibut are presented as Scientific Council Research documents. Flemish Cap survey results for northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 07/78. Samples for histological assessment of sexual maturity of cod, redfish, Greenland halibut and roughhead grenadier were taken. Oceanography studies continued to take place.

Denmark/Greenland: The West Greenland standard oceanographic stations were surveyed in 2007 as in previous years. Further, a number of oceanographic stations were taken in three different fjord systems at Southwest Greenland (SCR Doc. 08/3).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2007. In July-August 254 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. 08/28).

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 1997-2006 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 2007 50 valid hauls were made. During the survey about 8000 Greenland halibut were tagged with floy-tags. (SCR Doc. 08/28).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2006 the longline survey was conducted in Uummannaq and Disko Bay (SCR Doc. 08/39).

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2007 a total of 30 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. 08/39).

EU-Germany (SCR Doc. 08/16): During the fourth quarter of 2007, stratified random surveys covered shelf areas and the continental slope off West Greenland (Divisions 1B-1F) outside the 3-mile limit to the 400 m isobath. In October-November 2007, 49 valid hauls were carried out while covering about 75 % of the standard survey area. Based on this survey information, assessments of the stock status for demersal redfish (*Sebastes marinus, S. mentella*), American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), and thorny skate (*Raja radiata*) are documented.

ii) Surveys Planned for 2008 and Early 2009

An inventory of biological surveys planned for 2008 and early 2009, 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 2008 Meeting.

c) Stock Assessment Spreadsheets – Update

Almost nothing has changed since the last meeting with only 10 of 26 stocks having completed spreadsheets. 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 *when there is a change in Designated Expert the Secretariat and Chair of Scientific Council contact the past Designated Experts to ensure that the stock assessment data is submitted to the Secretariat so this data continues to be available to STACFIS and Scientific Council.*

d) Length and Maturity Studies

Russia (SCR Doc. 08/15): The data on Greenland halibut collected by Russian observers aboard fishing vessels in the area of the Western Greenland, Divs. 1AD, in 2003-2007. Length-age composition, sex ratio, the ratio of mature and immature individuals were analysed, as a whole, all over the surveyed area.

STACREC noted that the data should be split by Division in order to observe differences in maturity between regions.

Russia (SCR Doc. 08/18): The data on the length-age composition of the commercial catches of Greenland halibut from the Grand Newfoundland and Flemish Cap Banks in 2007 are given as well as a comparison of these data with data from the Russian fishery for 2004-2006. The length-age and sex composition of fished concentrations was analysed.

e) Consideration of a revisited edition of the Manual of Groundfish Surveys

At the June 2007 meeting it was decided that the "Manual on Groundfish Surveys in the Northwest Atlantic" (Doubleday, 1981) does not reflect the current status of surveys in the NAFO areas and it was decided that it should be revised. A Working Group was struck that is currently chaired by Bill Brodie (Canada) as Chair. As a first step it was decided to establish a template and fill it in using the Canadian surveys as an example but no progress has been made since 2007. STACREC noted continued interest in this project and encouraged the Working Group to develop this survey manual.

5. FAO Cooperation

a) Report of the Fisheries Resources Monitoring System (FIRMS) Steering Committee (FSC)

No meeting was held since the last Scientific Council report in June 2007. The next meeting will be held in July 2008 at the NAFO Headquarters.

b) Report of the Coordinating Working Party on Fishery Statistics (CWP)

No meeting was held since the last Scientific Council report in June 2007. The next intersessional meeting will be held in July 2008 at the NAFO Headquarters at the same time as the FIRMS meeting. The theme for this meeting is new data requirements and sources of data, for example the potential for VMS to provide additional scientific data that could be useful to Scientific Council.

6. Review of SCR and SCS Documents

SCR Doc. 08/4. V.V. Paramonov. Migrations of adult beaked redfish *(Sebastes mentella*) in North Atlantic in 2007

One of major commercial objects of North Atlantic – beaked redfish *Sebastes mentella* - accomplishes the prolonged and extensive migrations from Northeastern to Northwestern Atlantic and back. These migrations were studied on movement of fishing ship, following after the redfish concentrations. Redfish in the Labrador Sea mainly comes from the Irminger Sea. In 2007 new information about possibility of migration from Canadian offshore waters was found. Reductions of volume of migrations of redfish to Northwest Atlantic from Northeast Atlantic are observed in last years.

SCR Doc. 08/1. G. Campanis, A. B. Thompson, J. Fischer and R. Federizon. The Geographical Distribution of the High-Seas Commercial Greenland Halibut Fishery in the Northwest Atlantic.

The Secretariat presented the results of the analysis of the effort of the Greenland halibut fishery in the NRA using position data transmitted by commercial fishing vessels. The analysis assumed that vessels were trawling at speeds of 1-6 knots and that the Greenland halibut fishery is confined to the 700-2000 m depth zone. The calculated effort from the VMS data showed a steady decline and was strongly and positively correlated with the number of vessels fishing and with the TACs (taken to be a proxy for the catch). The spatial plots of the fishing effort provide valuable information on the exact locations of the effort. Visual inspections of these plots can be used to identify spatio-temporal changes in fishing patterns.

SCR Doc. 08/30. A.B. Thompson. Requirements to estimate fishing effort from VMS transmissions.

The Scientific Council has requested that commercial fishing vessels change their transmission frequency of the vessel position from two hours to one hour and that speed and course be included. This paper uses a simulated Monte Carlo sampling regime to sample from a population with known characteristics (five hours trawling and one hour steaming). The variables tested were the transmission frequency (from 3 hours down to 10 minutes), if the vessel was or was not transmitting speed, the speed at which the vessel is deemed to be fishing (1-5, 2-4 and 3 kts), and if the vessel was traveling at 12 kts or between 1-12 kts during the one hour steaming period. The greatest issue was one of bias that is related to the need to calculate speed when it is not transmitted and from the choice of the trawling speed range. The results confirm that a shorter reporting period will improve the accuracy and that the transmission of speed and the use of a narrow 'trawling" speed range will remove most of the bias.

7. Other Matters

a) Tagging Activities

Information on tagging activities in the Northwest Atlantic will be published by the Secretariat in SCS Doc. 08/16. Participants were reminded to submit any information on tagging activities to the Secretariat for the completion of this document.

b) Research Activities

Canada (SCS Doc. 08/12): A summary of Phase I of a Canadian research initiative to increase knowledge of marine ecosystems, sensitive marine areas and species, and straddling and highly migratory fish stocks which began in 2005 was presented. This research program will continue with Phase II beginning in 2008.

USA (SCS Doc. 08/14): Brief summaries were provided on the status of fisheries for major species of finfish and shellfish in Subareas 5 and 6. Detailed information on these species and other species found in the Northeast Region can be found at http://www.nefsc.noaa.gov/sos/.

Approximately 45 000 age determinations for 11 species of finfish were completed in 2007 by Woods Hole Laboratory staff in support of resource assessment analyses. In addition to Atlantic cod (7 072), haddock (8 542), yellowtail flounder (10 129), and summer flounder (5 462) were aged. Age determinations for Atlantic herring, pollock, goosefish, Acadian redfish, witch flounder, winter flounder and white hake totalled 13 626. The NEFSC continued studies of trophic dynamics based on an integrated program of long-term (since 1973) monitoring and process-oriented predation studies. Modeling and analytical efforts focused on species interactions among small pelagics, flatfish, elasmobranchs, and gadids. Apex Predators research focused on determining migration patterns, age and growth, feeding ecology, and reproductive biology of both coastal and highly migratory species, particularly Atlantic sharks.

Population dynamics research conducted within the Northeast Fisheries Science Center (NEFSC) supports a number of domestic and international fisheries management authorities. Atlantic salmon in eight rivers of Maine have been formally listed as endangered under the United States Endangered Species Act, and a biological review of the remaining Atlantic salmon populations in the State has recently been finalized. Field research on salmon in 2007 focused on obtaining smolt production estimates and monitoring fishery removals on the high seas.

The NEFSC also continued its cooperative Study Fleet research program in the northeast USA in which commercial fishing vessels provide more accurate, detailed (temporally and spatially), and comprehensive data using an electronic logbook system which facilitates the real-time recording of haul-based catch, effort, location, and environmental data. Limited Study Fleet deployments in 2007 focused on small, data-poor fisheries to improve the fishery-dependent information used in stock assessments.

Work continued in 2007 in improving the NOAA Fisheries Toolbox (NFT) which incorporates a wide range of assessment programs and methods (such as virtual population analysis, reference point estimation, surplus production and forward-projection models) into a stable environment with tested software products. The NFT is used for many routine assessment tasks.. A total of 16 packages are now included in the toolbox, and additional modules are under development. The population simulator has been enhanced to allow for model testing with multiple stochastic realizations of simulated datasets containing the same error structure for multiple models. New programs expected to be included in the NFT in 2008 include a length-based approach to estimate total mortality and a combination of packages to allow Management Strategy Evaluations. The complete package may be accessed at http://nft.nefsc.noaa.gov (note that a password is no longer required).

c) ICES WGFTFB, April 2008, a ToR referred from NAFO on effort from twin trawls

STACREC (NAFO *Sci. Coun. Rep*., 2007, p. 80) and Scientific Council (NAFO *Sci. Coun. Rep*., 2007, p. 218) responded to the request of the NIPAG (SCS 06/27, p. 47) to forward the question of the efficiency of single and double trawls to April 2008 meeting of the ICES/FAO WGFTFB. The group discussed this issue and noted that:

Efficiency in terms of the amount of shrimp caught was more dependent on the horizontal spread of the net than on the area of the opening. Hence, the counting of meshes around the circumference of the net was not likely to be the best measure for efficiency comparisons.

Herding effects on finfish are so different from those on shrimps that the efficiency results for double trawls used to catch finfish can not be used as a basis to assess efficiency issues for shrimp trawls.

An analysis of data from one national fleet fishing in one area over a number of years showed twin trawls to have greater catch rates than single trawls, but this analysis did not produce a single conversion factor, and there appear to be few, or no, other good data collections that can be examined.

There was no evidence to suggest that the industry uses, or prefers, twin trawls as a means of landing a higher quality of shrimp; the objective appears to be catch rate.

d) Other Business

i) Oceanic (Pelagic) Redfish Catch Data

Concerns have been raised at the ICES NWWG regarding the timely availability of STATLANT 21 catch data for their April meetings. NAFO Scientific Council experiences difficulties in receiving catch submissions before its June meeting and notes that it is not possible for Contracting Parties to provide Oceanic (Pelagic) Redfish catch data in time for the NWWG meeting in April.

The Scientific Council Coordinator will contact the Scientific Council Chair and the ICES North-Western Working Group regarding the provision of catch data from additional sources, such as provisional letters and the VMS catch-on-entry and catch-on-exit.

ii) Other Matters

There were no other additional items.

iii) Closing

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 2008 STACREC Meeting.

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

Chair: Michael Kingsley Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, from 5 to 19 June 2008, 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 the Faroe Islands and Greenland), the European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Norway, the Russian Federation, and the United States of America. Various members of the Committee, notably the designated stock experts, were significant in the preparation of the report considered by the Committee.

The Chairman, Michael Kingsley (Denmark in respect of the Faroe Islands and Greenland), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The provisional agenda was adopted with some changes to types of assessment: because it has been difficult to find a Designated Expert for Northern shortfin squid in Subareas 3 and 4, this stock was moved from item VI.3.a)i) to VI.3.a)ii) as a monitored stock in 2008; it was also observed that the terms of the request for advice made by Denmark in respect of Greenland for the stocks listed in item VI.3.b) of the provisional agenda implied that they would all be fully assessed stocks in 2008.

II. GENERAL REVIEW

1. Review of Recommendations in 2006 and 2007

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 general recommendations and stock-specific recommendations were as follows:

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.*

STATUS: The Chair noted that most catch estimates were available before the meeting and were reviewed by correspondence by an *ad hoc* working group comprising representatives from Canada, EU-Spain, EU-Portugal, and the Russian Federation, and convened by the Chairman of STACFIS. Differences in catch estimates were resolved for all stocks with little difficulty. However, some STATLANT 21A reports were received as late as the first days of the meeting, and some were not received at all, so that catch data had to be supplied by Provisional Letters, Research Reports, or Quota Reports. It was noted by STACREC that moving the nominal deadline for STATLANT 21A submission from 15 May to 1 May has not had success in hastening the arrival of STATLANT 21A data.

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** in 2006 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.*

STATUS: It was reported in 2007 that the stock assessments of Greenland halibut in Subarea 2 and Divisions 3KLMNO and of American plaice in Divisions 3LNO had both incorporated presentations generated by FLEDA, an exploratory data analysis package within the FLR. In 2008, standardized indices were presented in the assessments of Greenland halibut in Subarea 2 and Divisions 3KLMNO, cod in Division 3M and of redfish in Divisions 3LN.

i) **Greenland halibut (*Reinhardtius hippoglossoides*) in Subarea 0 and Div. 1A Offshore and Div. 1B–F**

In 2007, as in previous years, STACFIS **recommended** that *investigations of the by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued and the results should be made available before the assessment in 2005.*

STATUS: It was reported to STACFIS in November 2007 (SCR Doc. 07/88) that finfish discard in the shrimp fishery in the Greenland EEZ had been studied in 2006 and 2007 by sending a special scientific observer on 12 trips on 9 different commercial shrimp trawlers. He collected and weighed all finfish bycatch from 332 hauls in ICES Subarea XIVb and NAFO Div. 1B–E. Bycatch, as weighed, was on average similar to the captains' (and the routine fishery observers') logbook reports, but higher than average levels previously reported from the fishery in the absence of a special observer. This perhaps indicated an observer effect on the judgement of both the captains and the routine observers. Average observed bycatch rate of Greenland halibut was about 0.24% of the shrimp catch.

ii) **Greenland Halibut (*Reinhardtius hippoglossoides*) in Div. 1A Inshore**

In 2007, STACFIS reiterated its **recommendation** that *the study to calibrate the gill net survey should be continued in order to allow use of the whole time series for Greenland halibut in Disko Bay.*

STATUS: The data so far available is inadequate for a satisfactory calibration; more may be acquired.

In 2007, STACFIS reiterated its **recommendation** that *investigations of by-catch of juvenile Greenland halibut in the commercial shrimp fishery in Subareas 0+1 be continued.*

STATUS: As for Greenland halibut in Subarea 0 and Divisions 1A Offshore and Div.1B–F (see above).

In 2007, STACFIS reiterated its **recommendation** that *the discard rate of 'small Greenland halibut' (scil. in the directed fishery) in Div. 1A be investigated.*

STATUS: Data on length distributions both in the catch and in the landings exists for some segments of the fishery, so comparative analyses are possible.

iii) **Atlantic Cod (*Gadus morhua*) in Div. 3M**

In 2007, STACFIS made a **recommendation** to *further develop and explore the potential of the Bayesian model for the assessment of this stock in 2008. This should include comparisons with standard XSA and the survey-based method.*

STATUS: An age-structured model fitted, using Bayesian methods, was presented and discussed. The analysis of results included comparisons with the results of the XSA formulation that had been accepted by STACFIS in 2002 and with a survey-based assessment method. STACFIS's earlier concern that cohort analysis of stocks subject to very low F might be sensitive to the value(s) assumed for M was addressed by including uncertainty in this parameter in the formulation of the model.

In 2007, STACFIS **recommended** that *efforts be made to conduct commercial sampling for this stock.*

STATUS: In 2006 length sampling of commercial catches was conducted by EU-Portugal and Russia, and in 2007 by EU-Portugal, Russia and EU-Spain. For the assessment presented in 2008, an attempt was made to derive catch numbers at age for these two years from the commercial length samples, using age-length keys derived from scientific samples from the survey executed by EU.

In 2007, STACFIS made a **recommendation** to *revisit candidates for* B_{lim}*, as the current value is based on estimates of* SSB *and recruitment obtained from standard XSA, which is not the method currently being used to assess the status of this stock.*

STATUS: Given that the Bayesian model used for the assesment of the stock this year gives very similar answers to XSA, the validity of the current value for B_{lim}, 14 000 t would not seem to be in question. A stock-recruitment plot showed that only low recruitments have been observed with *SSB* below this level whereas both low and high recruitments have been observed at higher *SSB* values.

iv) **Redfish (*Sebastes mentella* and *S. fasciatus*) in Div. 3M**

In 2007, STACFIS reiterated its **recommendation** 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: No progress reported.

v) **American Plaice (*Hippoglossoides platessoides*) in Div. 3M**

In 2006, STACFIS **recommended** that *the utility of the XSA must be re-evaluated and the use of alternative methods (e.g. survey-based models, stock-production models) be attempted in the next assessment of Div. 3M American plaice.*

STATUS: Efforts have been made to apply to this stock the survey-based method that was used in some earlier assessments of Atlantic cod in Div. 3M, but this work has not yet been completed. At the same time, work was done in trying to run an ASPIC model, but in order to go further with this the available data must be further explored in order to create a CPUE time series.

vi) **Redfish (*Sebastes mentella* and *S. fasciatus*) in Div. 3L and 3N**

In 2007, STACFIS **recommended** that *a revised ASPIC model utilizing (1) the original values of CPUE and survey indices and (2) incorporating additional Canadian Div. 3L summer and Russian Div. 3LN survey series be evaluated during the assessment of redfish in Div. 3LN at the June 2008 Scientific Council meeting.*

STATUS: An ASPIC model revised as suggested was evaluated by STACFIS for the specially requested full assessment of this stock, but not accepted as a quantitative basis for the assessment.

vii) **American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO**

In 2005, 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: The options considered in 2007 included shortening (Campelen data only) and splitting (Engel and Campelen) the Canadian spring and fall survey series as input datasets, and omitting the Spanish Div. 3NO survey index. It was decided to continue using the full Campelen-converted Canadian series and to retain the Spanish Div. 3NO survey series as a tuning index.

In 2008, the outstanding issues were addressed, natural mortality (M) being varied in conjunction with the dataset options described above. There was a period of high total mortality (Z) in the late 80s and early 90s for this stock. In the present ADAPT formulation, $M = 0.2$ in all years and for all ages, except that $M = 0.53$ in 1989–1996. Two methods were used to explore whether this increase in M during this period is justified: analyses of Z from the spring and autumn Canadian RV surveys, and exploratory analyses using ADAPT. Survey Z increased around 1989 and remained high even after the moratorium, declining only in 1997. Estimates of M from Canadian spring and autumn RV survey Z and modified catch-curve analysis ranged from 0.53 to 1.49.

Several exploratory ADAPT runs were carried out using 2 sets of formulations, one using the Campelen-converted series from 1985, and the other using separate Engel/Campelen series. ADAPT was allowed to estimate M for 1989–1996; the value was 0.56 from the converted series and 0.7 from the separate series. When various values of M were set, model fits were poor for $M = 0.2$, and generally improved as M was increased, for either set of inputs. The best fits came from the runs where $0.6 > M > 0.45$ for the converted series and $0.7 > M > 0.6$ for the separate series. The abundance and biomass trajectories for the runs were similar to those from the surveys but for the runs where $M > 0.7$ they tended to look less similar. The residuals for Canadian spring RV surveys were improved with the separate Engel/Campelen series and $M = 0.7$ during 1989–1996, but the improvement was not big enough to warrant a change in model formulation, so the converted series will be retained. Most of the estimates of *M* from survey *Z* and from ADAPT were at least as high as the currently used value (0.53). Therefore STACFIS agreed that the current model formulation captured the increase of *M* during 1989–1996 and should not be changed for the next assessment.

In 2007, STACFIS reiterated its **recommendation** that *investigation be carried on the sensitivity of the estimation of* F_{msy} *to these parameters (scil.* PR, S-R *and* M*).* (Because: *PR* in a bycatch fishery may well be different from *PR* in a directed fishery; *S-R* relationships cannot easily be extrapolated outside the past range of *SSB*; and *M* for this stock is thought to have varied, with time, over a wide range of values.)

STATUS: Some analyses have been conducted; work will continue with the expectation of presenting results in June 2009.

viii) **Yellowtail Flounder (*Limanda ferruginea*) in Div. 3LNO**

In 2005, STACFIS **recommended** that *further exploration of the cohort model continue and results be presented in 2007.*

STATUS: Uncertainty in the age data for yellowtail flounder has not been resolved and no further exploration of the cohort model has been attempted.

In 2007, STACFIS **recommended** that *further investigations be conducted on the effect of excluding the Russian spring time series 1972-1991 from the standard formulation, as well as including the Canadian juvenile time series (1985-1994.*

STATUS: The model was run with different sets of survey data series as inputs and the results were presented in 2008. STACFIS decided to omit the earlier part, 1972–1983, of the Russian survey series.

In 2007, STACFIS **recommended** that *a comparative evaluation of the parameter estimates, levels of precision, model fits and diagnostics derived from ASPIC versions 3.81, used in past assessments, with those derived from the latest version (5.0 or higher) be conducted.*

STATUS: A comparison of runs using the 2006 assessment formulation and identical input data series, but two versions of ASPIC, was presented. Model outputs using ASPIC version 5.24 were nearly identical with those from version 3.81, used for the assessment accepted in 2006. As well, the older version 3.81 is no longer supported and therefore the 2008 assessment of yellowtail flounder will use ASPIC version 5.24.

In 2007, STACFIS **recommended** that *other sources of survey and fishery data for the time period before 1971 be explored to gather information on the state of the stock which could affect the choice of model formulation that best describes the time period 1965-1970.*

STATUS: No progress has been reported.

In 2007, STACFIS reiterated its **recommendation** that *in future assessments of Div. 3LNO yellowtail founder, the risk of the stock being below* B_{lim} = *30%* B_{msy} *be expressed.*

STATUS: Present risk that the stock is below B_{msy} is estimated as negligible.

ix) **Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3N and 3O**

In 2006, STACFIS **recommended** that *work should continue in developing precautionary reference points, including* B_{lim}, *for this stock.*

STATUS: 15% of the highest observed biomass estimate is used as a proxy for B_{lim} for some stocks, but is considered inappropriate for this stock. Stock-production modelling has been tried, without success, as a means of estimating reference points. No other proposals have been investigated.

x) **Capelin (*Mallotus villosus*) in Div. 3N and 3O**

In 2007, 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: This recommendation has not been acted on.

In 2007, STACFIS **recommended** that *for capelin in Div. 3NO investigations be undertaken to incorporate survey sets which do not contain capelin, including analyses of capelin distribution.*

STATUS: this recommendation has not yet been acted on.

xi) **Redfish (*Sebastes mentella* and *S. fasciatus*) in Div. 3O**

In 2007, STACFIS **recommended** that *additional work be undertaken to explore the application of surplus production models to this stock.*

STATUS: No progress to date: this recommendation will be acted on as a part of the next full assessment of the stock, planned for 2010.

xii) **Thorny Skate (*Amblyraja radiata*) in Div. 3LNO and Subdiv. 3Ps**

In 2006, STACFIS **recommended** that *further work be conducted for estimation of reference points.*

STATUS: Further work and simulation are presently in progress.

In 2006, STACFIS **recommended** that *further testing and sensitivity analysis be conducted on surplus production modeling employing ASPIC 3.8 in addition to ASPIC 5.1.*

STATUS: Version 3.8 of ASPIC is no longer supported.

xiii) **White Hake (*Urophycis tenuis*) in Div. 3N and 3O and Subdiv. 3Ps**

In previous years, STACFIS has repeatedly **recommended** that *the genetic analyses in 2003 of Div. 3NO versus Subdiv. 3Ps samples be continued; in order to help determine whether Div. 3NOPs white hakes comprise a single breeding population.*

STATUS: Work on genetic analysis and stock identification is continuing, but results are not yet available.

In previous years, STACFIS has repeatedly **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: White hake otoliths continue to be collected but have not been read.

xiv) **Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3**

In 2007, STACFIS made a **recommendation** to *explore the XSA model configuration of the analytical assessment presented (definition of the plus group, catchability model and the shrinkage options), as well as the incorporation of new survey information into the model.*

STATUS: No progress to date: this recommendation will be acted on as a part of the next full assessment of the stock, planned for 2010.

xv) **Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J, 3K and 3L**

In 2007 STACFIS observed that a slight increase from 2005 to 2006 in survey biomass and mean weight per tow was not evident in the abundance indices, suggesting that growth, and not recruitment, was responsible, and **recommended** that *length frequency data from the survey be examined.*

STATUS: An analysis of length-frequency data was included in the Interim Monitoring Report. This analysis confirmed a shift toward larger fish in 2006, supporting the suggestion.

xvi) **Greenland Halibut (*Reinhardtius hippoglossoides*) in Div. 2J, 3K, 3L, 3M, 3N and 3O**

In 2007, STACFIS **recommended** that *stock-recruitment relationships using an index of SSB derived from estimates of maturity at age and exploitable 5+ biomass at age be explored.*

STATUS: Assessments of Subarea 2+Div. 3KLMNO Greenland halibut done in 2001–2006 and retrospective runs of the 2006 assessment were examined for relationships between mature stock and recruitment. Starting with the 2003 assessment, and in the retrospective analyses of the 2006 assessment, there appeared to be a relationship between mature stock and recruits, best described by a Ricker function, regardless of whether mature stock was measured by 10+ biomass or SSB (estimated by applying maturity ogives to biomass at age). It seemed that the *S-R* relationship had only become clear when the assessment model was reformulated in 2003.

The results of the 2007 assessment were examined for an *S-R* relationship when different methods of calculating the numbers in the plus group were used; different methods resulted in different relationships. However, in most cases a relationship was still evident except under the conditions that estimation of the plus group did not take *F* into account and mature stock was measured by *SSB*; then the relationship was difficult to discern. In all cases model fit seemed to be better for the Ricker stock-recruit model than for other commonly used candidates. When mature stock was measured by 10+ biomass, the recruitment values at high levels of mature stock biomass were less scattered than when estimated *SSB* was the measure, giving both a more steeply descending right-hand limb of the *S-R* function and a lower residual sum of squares for the fit of the Ricker curve. However, as an index of mature stock, 10+ biomass will obviously never respond to possible future changes in age of maturation.

In 2007, STACFIS **recommended** that *exploratory deep-water surveys for Greenland Halibut in Subarea 2 and Divisions 3KLMNO be conducted using gears other than bottom trawls to complement existing survey data.*

STATUS: No progress was reported on this recommendation.

In 2007, STACFIS reiterated its **recommendation** that *research continue on age determination for Greenland halibut in Subarea 2 and Div. 3KLMNO to improve accuracy and precision.*

STATUS: Research on this topic is continuing.

In previous years, 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: No progress was reported

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 2007. In order to confirm estimates of catches for the various stocks, various other sources of information were considered along with reported catches available to 6 June 2008 as compiled from STATLANT 21 reports.

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 1998-2006 will be found in the introductory catch table within the report for each stock. A summary for 2007 is as follows:

Stocks	Catches ('000 t)	
	STATLANT 21A[1]	STACFIS
Stocks off Greenland and in Davis Strait		
Greenland halibut in Subarea 0, Div. 1A Offshore and Div. 1B-1F	15.6	23.0
Greenland halibut in Div. 1A Inshore		20.6
Roundnose grenadier in Subareas 0 and 1	0.01	0.03
Demersal Redfish in Subarea 1	0	0.12
Other finfish in Subarea 1	0	0.60
Stocks on the Flemish Cap		
Cod in Div. 3M	0.13	0.34
Redfish in Div. 3M	5.6	6.7
American plaice in Div. 3M	0.08	0.08
Stocks on the Grand Banks		
Cod in Div. 3N and 3O	0.60	0.84
Redfish in Div. 3L and 3N	0.20	1.7
American plaice in Div. 3L, 3N and 3O	1.4	3.6
Yellowtail flounder in Div. 3L, 3N and 3O	4.4	4.9
Witch flounder in Div. 3N and 3O	0.23	0.22
Capelin in Div. 3N and 3O	--	--
Redfish in Div. 3O	7.6	5.2
Thorny skate in Div. 3LNOPs (3LNO portion)	6.2	3.6
White hake in Div. 3NOPs (3NO portion)	0.60	0.73
Widely Distributed Stocks		
Roughhead grenadier in Subareas 2 and 3	0.44	0.66
Witch flounder in Div. 2J+3KL	0.07	0.05
Greenland halibut in Subarea 2 and Div. 3KLMNO	14.8	22.7
Short-finned squid in Subareas 3 and 4	0.23	0.23
[1] Provisional		

STACFIS noted the advances made by the *ad hoc* working group on catch estimates by conducting pre-meeting deliberations, thereby enabling finfish catch estimates by stock, Division and Contracting Party to be available soon after the meeting commenced. In order to expedite the work of the Scientific Council, STACFIS **recommended** that *all Contracting Parties take measures to improve the accuracy of their catch estimates and present them as far in advance of future June Meeting as possible.*

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. Winter heat loss to the atmosphere in the central Labrador Sea is offset by warm water 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. Within the 1500 m depth range over much of the Labrador Sea temperatures have become steadily higher and salinity also higher over the past number of years compared with 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^{o}C and salinities >34.5 is normally found at the surface offshore off the shelf break in this area. Historical data from the Fyllas Bank revealed cold "polar events" in 1983, 1992 and 2002. During these years, cold and diluted waters from the West Greenland banks reached well out to the slope regions of Fyllas Bank in the upper water column.

The 2007 hydrographic survey in Subareas 0 + 1 show 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. Modified

Irminger Water (T > 3.5°C ; 34.88 < S < 34.95) was observed all the way north to Maniitsoq section. The northward extension of Irminger Water may indicate intensified inflow of water of Atlantic origin to the West Greenland area. Water of Atlantic origin (T>3°C; S>34.5) is normally found at the surface at the three outermost stations on the Cape Farewell and Cape Desolation sections. In 2007 this water was found just below a thin surface layer, but not as pronounced as in 2006. At intermediate depths pure Irminger Water (T ~ 4.5°C; S > 34.95) was traced north to the Paamiut section. Results of the 2007 autumn survey along the standard sections reveal anomalously high SST off Greenland and in the Labrador Sea compared with the long-term average but lower surface temperatures overall than in the previous year. Based on autumn measurements (September-November) on the Fyllas Bank section, the temperature-anomaly time series reveals a warming trend which has persisted since 1993.

Temperature and salinity within the 1500 m depth range over much of the Labrador Sea continued warmer and more saline over the past six years and in 2006 sea surface temperatures were 1°C above normal, only slightly cooler than the record-setting 2004 and 2005 values. The northward extension of modified Irminger Water as far north as the Maniitsoq Section indicates about normal inflow of water of Atlantic origin to the West Greenland area during 2006, although Irminger Water temperatures were warmer-than-normal. The time series of mid-June temperatures on top of Fyllas Bank was about 0.9°C above average, the 6th highest on record, while the salinity was the third lowest on record. Oceanographic data collected during autumn survey on 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, Div. 1A Offshore and Div. 1B-1F

(SCR Doc. 08/17, 28, 35; SCS Doc. 08/6, 8, 11, 12, 15)

a) Introduction

The annual catches in Subarea 0 and Div. 1A offshore and Div. 1B-1F were below 2 600 t from 1984 to 1988. From 1989 to 1990 catches increased from 2 200 t to 10 500 t, remained at that level in 1991 and then increased to 18 100 t in 1992. During 1993-2000 catches fluctuated between 8 300 and 11 400 t. The catches increased gradually from 13 300 t in 2001 to about 19 000 t in 2003 and stayed at that level in 2004-2005. In 2006 catches increased to 24 000 t. Catches declined slightly to 23 400 t in 2007 (Fig. 1.1).

In Subarea 0 catches peaked in 1992 at 12 400 t, declined to 4 300 t in 1994 and stayed at that level until 1999, to increase to 5 400 t in 2000. Catches increased further to 7 700 t in 2001, primarily due to an increase in effort in Div. 0A. Catches remained at that level in 2002 but increased again in 2003 to 9 200 t and stayed at that level in 2004-2005. Catches increased to 12 200 t in 2006 due increased effort in Div. 0A. Catches decreased slightly to 11 500 t in 2007.

Catches in Div. 0A increased gradually from a level around 300 t in the late 1990s and 2000 to 4 100 t in 2003, declined to 3 800 t in 2004 but was back at the 2003 level in 2005. In 2006 catches increased to 6 600 t, due to increased effort. Catches stayed at that level in 2007, -6 200 t.

Catches in Div. 1A offshore and Div. 1B-1F fluctuated between 900 and 2 400 t during the period 1987-91. After then catches have fluctuated between 3 900 and 5 900 t until 2001. Catches increased gradually from 5 700 t in 2001 to 9 500 t in 2003, primarily due to increased effort in Div. 1A. Catches stayed at that level in 2004 and 2005. In 2006 catches increased to 12 000 t due to increased effort in Div. 1A. Catches were at the same level, - 11 900 t, in 2007. Prior to 2001 catches offshore in Div. 1A and in Div. 1B have been low but they increased gradually from 110 t in 2000 to 4 000 t in 2003 and stayed at that level in 2004-2005. Catches in that area increased further in 2006 to 6 200 t. Catches were at the same level, - 6 300 t, in 2007.

Recent catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	11	11	15[1]	15[1]	19[2]	19[2]	19[2]	24[3]	24[3]	24[3]
TAC	11	11	15[1]	15[1]	19[2]	19[2]	19[2]	24[3]	24[3]	24[3]
SA 0	5	5	8	7	9	10	10	12	11	
SA1 exl. Div. 1A inshore	5	6	6	7	10	10	10	12	12	
Total STATLANT 21A	17[4]	8	13	16[5]	20[6]	19	14	16	16	
Total STACFIS	10	11	13	15	19	19	20	24	23	

1 Including a TAC of 4 000 t allocated specifically to Div. 0A and 1A.
2 Including a TAC of 8 000 t allocated specifically to Div. 0A and 1AB.
3 Including a TAC of 13 000 t allocated specifically to Div. 0A and 1AB
4 Including 7 603 t reported by error from Subarea 1.
5 Including 780 t reported by error from Div 0A.
6 Including 1 366 t reported by error from Div. 1A.

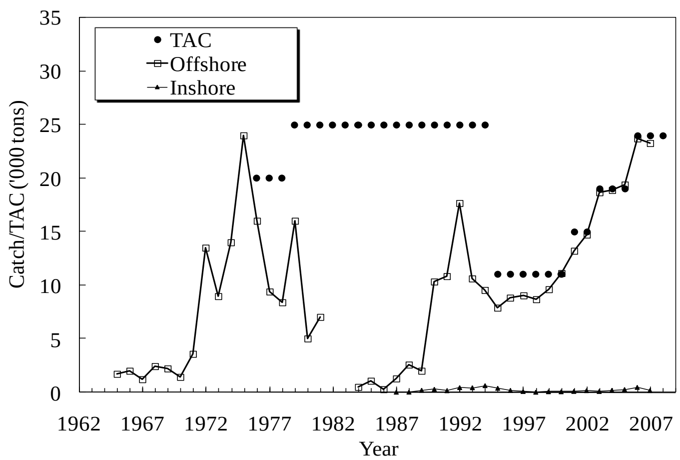


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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 2007, 58 t were taken by longlines, 1 750 t by gillnet and 3 514 t 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 have been taken by Canadian vessels. In 2007, trawlers caught 3 379 t and 2 771 t were taken by gillnetters. The longline fishery in the area, which took about 1/3 of the catches in 2003, has apparently ceased.

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 2007. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 t in 2004 and there has not been any gill net fishery in the area since then. An offshore longline fishery in Div. 1CD took place during 1994-2002. Since then longline fishery has only taken place irregularly and with small catches, about 20 t in the recent two years. Inshore catches in Div. 1B-1F amounted to 154 t, which were mainly taken by gillnets.

Throughout the years there has been a certain amount of research fishing offshore in Div. 1A but the catches have always been less than 200 t per year. Catches increased gradually from about 100 t in 2000 to about 6 200 t in 2006 and 2007. All catches in recent years were taken by trawlers from Greenland, Russia and Faroe Islands.

b) Input Data

i) Commercial fishery data

Information on length distribution was available from the gillnet fishery in Div. 0AB and the trawl fishery in Div. 0B. The bulk of the catches in the gillnet fishery in Div. 0AB were between 50 and 80 cm with a mode around 63 in Div. 0A and 65 cm in Div. 0B. The modes in the gillnet fishery have been in this range in recent years. The length distributions in the trawl fishery showed a mode of 49 cm which resembled the length frequency seen in previous years.

Information on length distribution of catches was available from trawlers from Russia and Greenland fishing in Div. 1A, from Greenland and EU-German trawlers fishing in 1C and 1D together with length distributions from Russian and Norwegian trawlers fishing in Div. 1D. Further, length distributions from the small Norwegian longline fishery in Div. 1D were available.

The length distributions in the Russian and Greenland fisheries in Div. 1A showed modes at 48 cm and 50-52 cm, respectively. Catches in Div. 1C were dominated by fish between 45 and 50 cm. The mode was around 50-52 cm in Greenland, Russian and, Norwegian trawl fishery in Div. 1D, respectively, while fish were generally slightly smaller in the EU-German catches. The mode in the trawl fishery in Div. 1D has been at 47-51 cm in the last decade. The catches in the Norwegian longline fishery in Div. 1D were dominated by fish between 50 and 80 cm as in previous years.

Age distributions were available from the Russian fishery in Div. 1A and 1D. Age 6-7 dominated the Russian trawl catches in both areas.

Unstandardized catch rates from Div. 0A have generally increased between 2000 and 2004, decreased between 2004 and 2005 but increased again in 2006 for both single- and twin trawl, and catch rates were among the highest in the time series, which dates back to 1996 and 2000 for single and twin trawl, respectively. In 2007 the catch rates decreased for both single - and twin trawlers. The standardized catch rate also showed a minor decrease between 2006 and 2007 (Fig. 1.2).

Unstandardized catch rates in Div. 1A from Greenland twin trawlers, which have been taking the majority of the catches, have been increasing during 2003-2005 to 1.11 t/hour in 2005, but catch rates declined slightly to 1.06 in 2006 and further to 0.96 t/hr in 2007. The Russian catch rates (Div. 1AB, small and large trawlers combined) was stable between 2006 and 2007.

The unstandardized CPUE series for Div. 0B, based on log books data from Canadian authorities, from Newfoundland trawlers showed a decrease for single trawlers and an increase for twin trawlers in catch rates between 2006 and 2007. The standardized index decreased gradually from 1995 to 2002, but has been increasing since until 2005. The catch rates have declined slightly since then, but are still above the level seen during 1999-2004 (Fig. 1.2).

Unstandardized catch rates from all fleets fishing in Div. 1CD all showed minor increases between 2004 and 2006 except the Norwegian that showed a decrease between 2005 and 2006. Norwegian catch rates increased again in 2007 to the 2005 level. EU- German and Russian catch rates were stable between 2006 and 2007, while Greenlandic catch rates decreased slightly. Standardized catch rate series, based on log book data from the Greenland authorities for the period 1988-2007 and data from the EU German trawl fishery for 1996-2007, were available for the offshore trawl fishery in Div. 1CD. 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 since 2003. The index also increased slightly between 2006 and 2007 (Fig. 1.2).

The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but increased again until 2006. In 2007 the combined catch rated decreased slightly, but it is the second highest in the time series seen since 1989 (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. 0A and 1A, both the unstandardized and the standardized indices of CPUE should, however, be interpreted with caution.

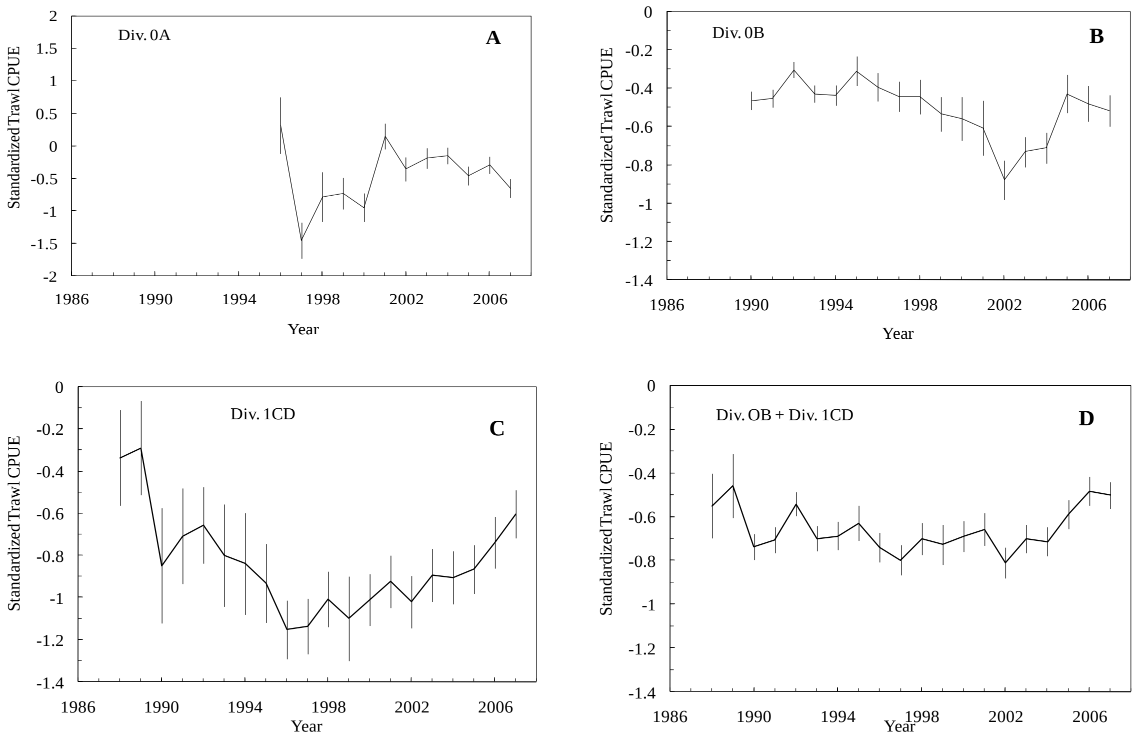


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): **A**: Standardized trawler CPUE from Div. 0A with ± S.E. **B**: Standardized trawler CPUE from Div. 0B with ± S.E **C**: Standardized trawler CPUE from Div. 1CD with ± S.E. **D**: Combined standardized trawler CPUE from Div. 0B 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). 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 74 000 t in 2007 which is a slight decrease compared to 2006, but the decrease was due to a slightly smaller areal coverage in 2007 compared to 2006 (Fig. 1.3).

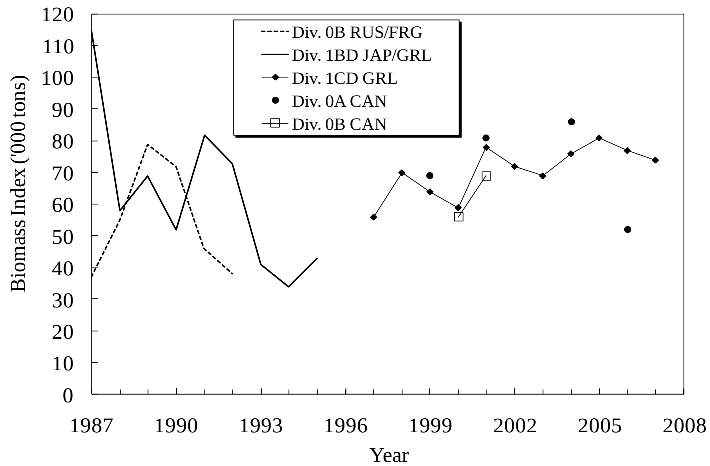


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from bottom trawl surveys. Note, incomplete coverage of the 2006 survey in Div. 0A.

Canadian deep sea survey in Baffin Bay (Div. 0A). Canada conducted surveys in the southern part of Div. 0A in 1999, 2001, 2004 and 2006. The biomass has increased gradually from 68 700 t via 81 000 t to 86 200 t in 2004. The biomass decreased to 52 271 t in 2006 (Fig. 1.3). However, the survey coverage was not complete and two of the four strata missed fell within the depths 1001-1500 m and accounted for 11 000 – 13 000 t of biomass in previous surveys. Therefore, the current estimate is lower than the most recent surveys but may be similar to the estimate from 1999 when considering the biomass in the strata not covered in 2006. The mode in the catches was at 39 cm compared to 45 cm in 2004. The decrease in mode might reflect the poor coverage in the deeper strata where fish generally are larger. There was no survey in 2007.

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 t) was the highest in the time series. The biomass decreased gradually to 19 000 t in 2007, which is still above the averaged for the time series (17 000 t). The survey gear was changed in 2005, but the 2005-2007 figures are adjusted for that. The biomass and abundance estimates were recalculated in 2004 based on better depth information and new strata areas.

The number of one-year-old fish in the total survey area including Disko Bay increased gradually from 1996 to a peak of 500 million in the 2001 survey. The number of one-year-olds declined in 2002 but increased in 2003 to 319 million and has stayed at that level since then (337 mill. in 2007), which is well above the average level (Fig. 1.4). The figures were recalculated in 2007, based on the new strata, but it did not change the overall trends in the recruitment.

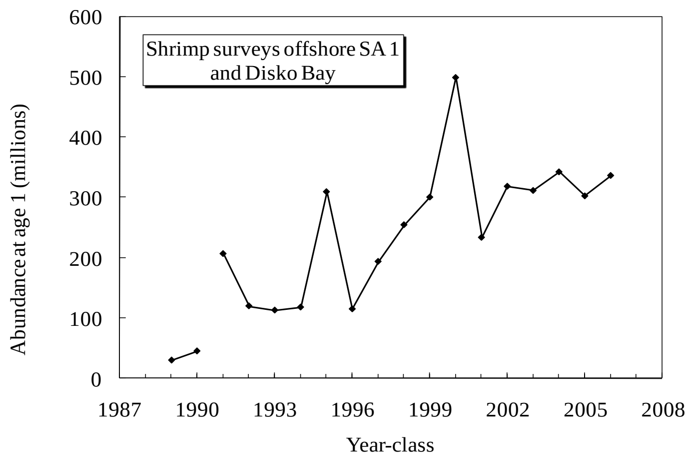


Fig. 1.4. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated at age 1).

A recruitment index (number caught per hour at age 1) for the traditional offshore nursery area in Div. 1AS-1B declined between 2003 and 2004 but increased again in 2005 and increased further in 2006. The 2007 estimate of the 2006 year-class as age one is at the same level as the 2005 year class and is above 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).

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. The XSA was not updated this year due to lack of catch-at-age data.

A Greenland halibut age determination workshop concluded that the current production methods underage old fish. About half of the catches in SA0 come from fixed gears, mainly gill net that generally catches larger and older fish. Therefore, no ages will be determined for SA0 until we have a method that is reliable for catches from both trawl and gillnet.

In connection to a tagging experiment conducted in the southern part of Baffin Bay in 2007 about 3 500 Greenland halibut had $SrCl_2$ injected in the stomach cavity. $SrCl_2$ is incorporated in the otoliths as a mark visible using scanning electron microscopy and it should hence be possible to investigate growth of otoliths and relate this to growth of the fish. Different staining methods are also being tested in order to improve age reading of older Greenland halibut.

An update of the unsuccessful ASPIC from 1999 was attempted in 2007, but results were not tabled as the outcome of the analysis did not improve significantly.

d) Assessment Results

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

The southern part of Div. 0A was surveyed in 1999, 2001, 2004 and 2006 and the southern part of Div. 1A and Div. 1B was surveyed in 2001. The biomass increased gradually from 68 700 t via 81 000 t to 86 200 t in 2004. The biomass decreased to 52 271 t in 2006. However, the survey coverage was not complete and two of the four strata missed fell within the depths 1001-1500 m and accounted for 11 000 – 13 000 t of biomass in previous surveys. Therefore, the current estimate is lower than the most recent surveys but may be similar to the estimate from 1999 when considering the biomass in the strata not covered in 2006. 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 be 46 000 t and 54 000 t, respectively, in the two areas. These surveys in the northern part of Baffin Bay have not been repeated since then. 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 the Greenland Shrimp Survey has been decreasing gradually since 2004 but the 2007 estimate is still above average for the time series.

The length distribution in the trawl fishery in Div. 0A has been stable during 2002-2006 (no data from 2007) with a mode around 48-50. The mode in the gill net fisheries has been around 63 cm in recent years. The length distribution in the trawl fishery in Div. 1A has been stable during 2002-2007, with a mode around 48-54 cm. except in 2006 where the mode in Russian fishery was 42 cm, whereas it was around 50 cm in 2004 (no data from 2005) and 48 cm in 2007.

A standardized catch rate for Div. 0A has showed a slightly decreasing trend since 2001 and the 2007 estimate is about average for the time series.

Unstandardized trawl CPUE from Div.1A showed a gradual increase from 2003 to 2005 for the fleet that takes the majority of the catches. The CPUE decreased slightly for this fleet during 2006 and 2007 and is in 2007 at the 2004 level. Another fleet showed stability between 2006 and 2007.

Divisions 0B + 1C-1F

The bottom trawl survey biomass index in Div. 1CD increased between 2003 and 2005 where the estimate was 81 000 t, which is the highest for the time series. The trawlable biomass in Div. 1CD decreased to 74 000 t in 2007, but is still above the average for the time series (70 000 t). Although the survey series from 1987-95 is not directly comparable with the series from 1997-2006, 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 catches from Div. 0B was at 49 cm and resembled the length frequency seen in previous years.The mode in the trawl fishery in Div. 1D has been around 47-52 for the last decade and the modes were within the same range in 2007.

A standardized CPUE series from Div. 0B showed an increase between 2002 and 2006, but decreased slightly in 2007. A standardized CPUE series from Div. 1CD has been gradually increasing since 1996. The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but has increased again until 2006. In 2007 the combined catch rated decreased slightly, but it is the second highest in the time series seen since 1989.

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

Assessment: No analytical assessment could be performed.

Standardized catch rates in Div. 0A and Div. 0B and unstandardized catch rates in Div. 1A decreased slightly between 2006 and 2007. The standardized catch rate from Div. 1CD has been increasing gradually since 1996. The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but has increased again until 2006, decreased slightly in 2007 but is the second highest seen since 1989.

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 2002-2006 year-classes were well above average. The recruitment of the 2006 year-class in the offshore nursery area (Div. 1A (to 70°N) - Div. 1B) was above average.

Biomass: The biomass in Div. 1CD in 2007 was estimated at 74 000 t, which is above average for the eleven-year time series. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has decreased in the last three years but the 2007 estimate is still above the average of the time series (1991-2007).

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 by-catch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued and the results should be made available before the assessment in 2009.*

STATUS: Fish discard in the shrimp fishery in the Greenlandic EEZ was studied in 2006 and 2007 by sending a special scientific observer on 12 trips on 9 different commercial shrimp trawlers. He collected and weighed all finfish by-catch from 332 hauls in ICES Subarea XIVb and NAFO Div. 1B–E. By-catch, as weighed, was on average similar to the captains' (and the routine fishery observers') logbook reports, but higher than average levels previously reported from the fishery in the absence of a special observer. This perhaps indicates an observer effect on the judgment of both the captains and the routine observers. Average observed by-catch rate of Greenland halibut was about 0.24% of the shrimp catch. (Reported to STACFIS in Nov. 2007: SCR Doc. 07/88)

This stock will next be assessed in 2009.

2. Greenland halibut (*Reinhardtius hippoglossoides*) in Div. 1A inshore

(SCR Doc. 08/28, 38; SCS Doc. 08/11)

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 t in the late 1980s then increased until 1998 when the landings were almost 25 000 t. Since 1999 landings have declined to 16 900 t in 2001 but increased again the following years reaching 23 200 t in 2006 but decreased to 20 600 t in 2007 (Fig. 2.1).

From 1998 a fishery licence has been required to land Greenland halibut. The total number of licences is about 1 300 which involves about 200 registered vessels and an unknown number of smaller boats. From 2008 TAC regulations were introduced, with a TAC of 12 500 t in Disko Bay, and 5 000 t each in Uummannaq and Upernavik.

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 implications on the recruitment to the inshore stocks.

Landings ('000 t) in Div. 1A inshore are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Disko Bay	10.6	7.6	7.1	11.7	11.6	12.9	12.5	12.1	10.4	
Recommended TAC			7.9	7.9	7.9	Na	ni	ni	ni	ni
TAC										12.5
Uummannaq	8.4	7.6	6.6	5.4	5.0	5.2	4.9	6.0	5.3	
Recommended TAC			6.0	6.0	6.0	Na	5.0	5.0	5.0	5.0
TAC										5.0
Upernavik	5.3	3.8	3.2	3.0	3.9	4.6	4.8	5.1	4.9	
Recommended TAC			4.3	4.3	4.3	Na	na	na	na	na
TAC										5.0
Unknown[1]	-	-	2.2				0.8			
STATLANT 21A	24.3	21.1[2]	16.7[2,3]	17.6[2]	20.6[2]					
STACFIS	24.3	21.0	16.9	20.1	20.5	22.7	22.9	23.2	20.6	

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

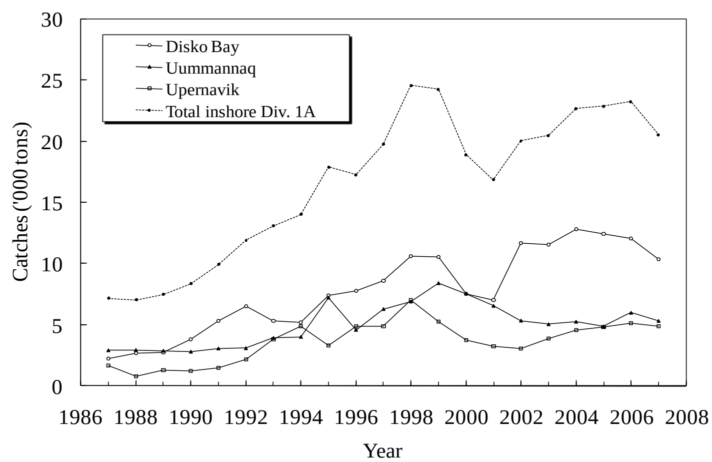


Fig. 2.1. Greenland halibut in Div. 1A inshore: landings by area.

This fishery takes place in the inner parts of the ice fjords at depths between 300 to 1400 m. Longlines are set from small boats, or in winter through the ice. Since the mid-1980s gillnets have been used in the fishery. Some restrictions on the use of gillnets have been in force since 2000. At present gillnets are allowed in certain areas in Disko Bay, And the outer parts in the fjords in Uummannaq and Upernavik. The minimum mesh size allowed is 110 mm (half meshes).

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, Torssukattak, 90 km north of Ilulissat. The landings in Disko Bay increased from about 2 300 t in 1987 to a high level of about 10 500 t in 1998. Thereafter landings declined to 7 000 t in 2001, after that landings have increased every year until 2004 where landings reached a record high of about 12 900 t, the landings have since then gradually decreased to 10 400 t in 2007.

Uummannaq. The fishery is conducted in a large system of ice fjords. 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 t before 1987 to a record high in 1999 of 8 425 t. The landings decreased to 5 400 t in 2002 and have remained around that level since then.

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).

The landings in the Upernavik area have increased steadily from about 1 000 t in the late 1980s to about 4 000 t in 1995 and reached the highest on record in 1998 at 7 000 t (Fig. 2.1). Landings gradually decreased to 3 000 t in 2002, since then, landings have increased reaching about 5 100 t in 2006 and 4 900 t in 2007.

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 gill nets from the summer and winter fisheries in Disko Bay and Uummannaq and from the winter fishery in Upernavik.

In 2006, logbooks became mandatory for vessels more than 30 feet long in all inshore areas, representing roughly 60% of the catches, but effort data are still not available.

Disko Bay: Length measurements (Fig. 2.2) of the commercial longline landings from 1993 to 2007 indicated that the fisheries take place on smaller sub-components of the stock, as size distribution differs between summer and winter.

Mean lengths in the summer fishery have fluctuated between 1993 and 2001 with a slightly increasing trend, but have thereafter been decreasing every year from 63 cm in 2001 to 54 cm in 2007. The mean length in the winter fishery showed an increasing trend until 2001; except for winter 2000 when weather conditions prevented the traditional ice-fishery. Mean length in the winter fishery decreased overall from about 80 cm in 2001 to 66 cm in 2007, and is now below the average level for the time series 1993-2007.

The proportion of fish being 10 years and younger increased every year from 64% in 2002 to 81% in 2007.

Uummannaq: Mean length in landings from the summer fishery decreased from 1993 to 1995, but have thereafter remained stable at about 63 cm until 2004. Since then it has decreased overall to 60 cm in 2007. Mean length in landings from winter fishery has fluctuated around 66 cm until 2004 decreased to 63 cm in 2005 and 2006 and increased again in 2007 to 65 cm.

The age composition in the commercial catches has fluctuated around 70% being 10 years and younger.

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 available from the commercial fishery. Samples from the 2005 and 2006 winter fishery show that mean length remain stable.

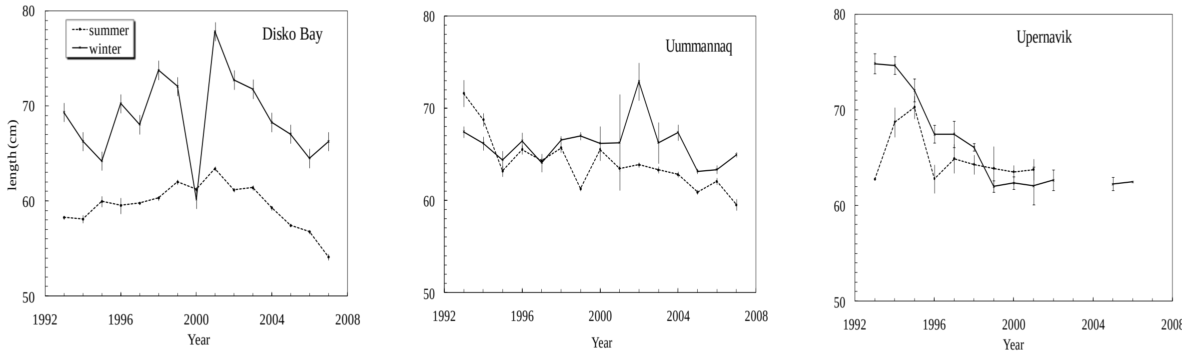


Fig. 2.2 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Ilulissat, Uummannaq and Upernavik with 95% conf. Int.

ii) Research survey data

Longline surveys. 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. Disko Bay: 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. There have been no longline settings in Disko Bay since 2005. Uummannaq: Revisions of data in 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. Standardised CPUE has been decreasing from 1999 to 2003, followed by an increase in 2004, since then, CPUE has remained relatively stable (Fig. 2.3).

However none of the changes in standardised CPUE were significant.

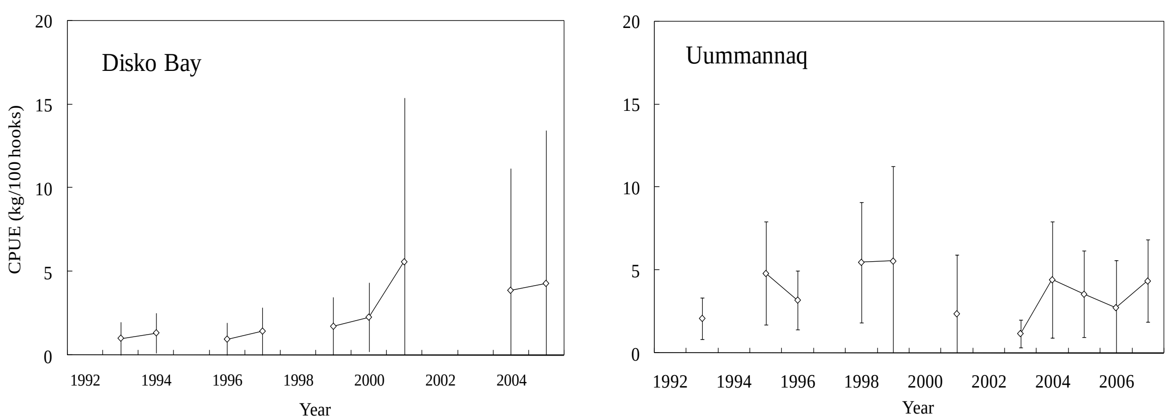
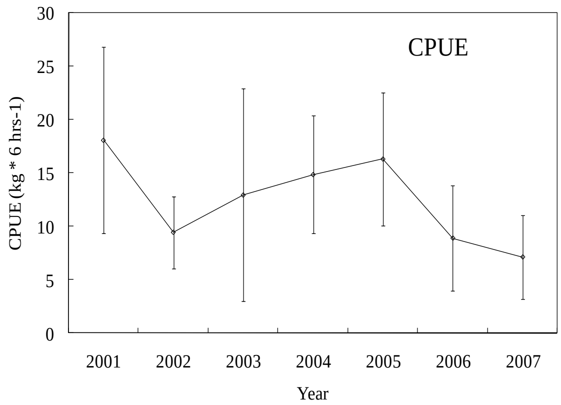


Fig. 2.3. Greenland halibut in Div. 1A inshore: standardised CPUE from longline surveys in Disko Bay 1993-2005 and Uummannaq 1993-2007, re-transformed values given as kg/100 hooks.

Disko Bay gill net survey. 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, from 2005 to 2007 CPUE has decreased. NPUE has decreased every year from 2004 to 2007 (Fig. 2.4).



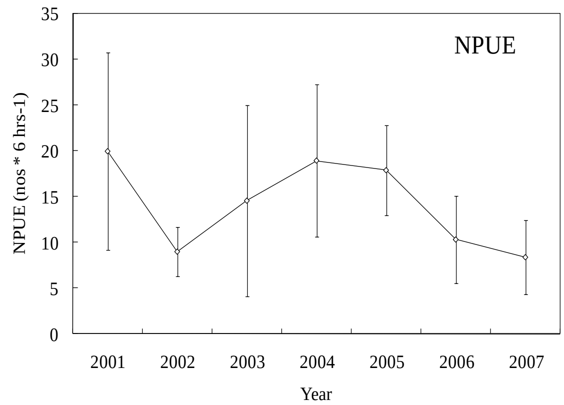


Fig. 2.4. Greenland halibut in Div. 1A inshore: CPUE and NPUE from gillnet survey Disko Bay 2001-2004.

Disko Bay trawl surveys. Since 1988 annual 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. Biomass indices of Greenland halibut in Disko Bay have increased since 1991. The majority of catches in the survey consist of juveniles at age 1, except for 2004 where catches contained an unusually high number of 2-3 year olds (Fig. 2.5): from 2005 to 2007 biomass indices have been decreasing every year. Standardized recruitment indices based on the survey were presented as catch-in-numbers per age per hour, for the Disko Bay area (Fig. 2.6). 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. There has been a gradual decrease in recruitment of the year-classes 2002-2005, however recruitment has increased again and the 2006 YC is the third strongest in the time series.

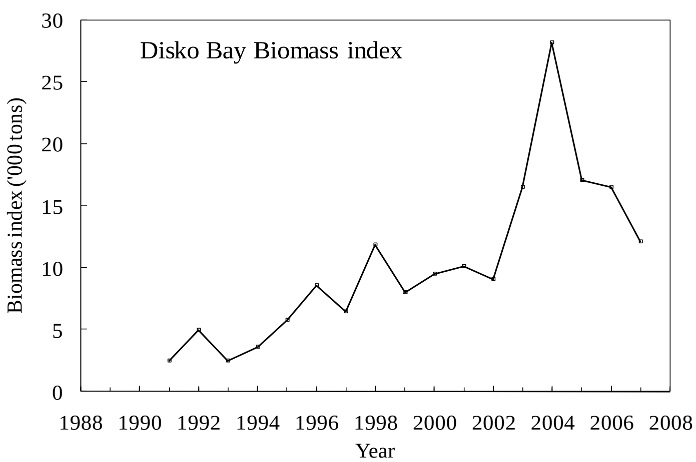


Fig. 2.5 Greenland halibut in Disko Bay: biomass indices from the West Greenland trawl survey.

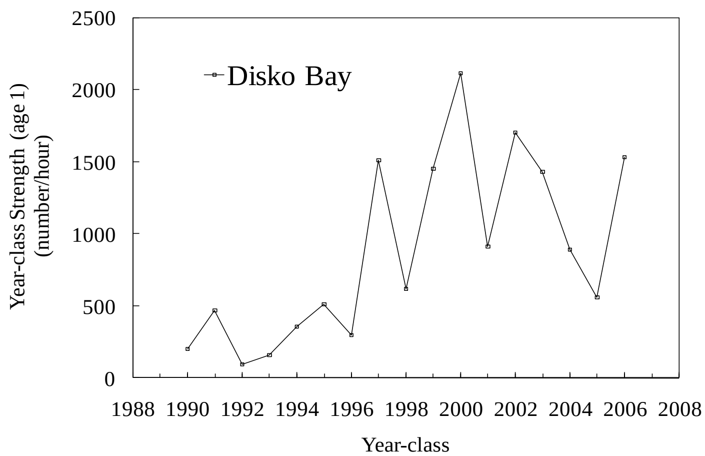


Fig. 2.6 Greenland halibut in Disko Bay: recruitment at age 1 from the West Greenland trawl survey.

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. Landings have been declining since 2004, especially between 2006 and 2007. Mean length in the landings have been gradually declining since 2001. CPUE (kg) in the gill net survey has been declining since 2005 and NPUE (number) has been declining since 2004. The decline in mean length in the commercial fishery is hence unlikely to be caused by incoming new young year-classes to the fishery. These trends are a cause of concern. Trawl survey biomass has been declining since 2004 but is still above the level in the 1990's. Recruitment has varied since the good 1997 year-class, but has been above the level in early and mid 1990's. The recruitment of the 2006 year-class was the third largest in the time series.

Information from the fishing industry and fishermen about the fishery in 2002 and 2003 suggests that: the increase in landings in Disko Bay in 2001-2002 is a result of a rise in effort. Also some effort shifted from Uummannaq to Disko Bay.

Uummannaq. Landings have remained stable since 2002. Mean lengths from the commercial fishery have been relatively stable until 2007. Abundance indices in the longline survey indicate an increase until 1999, from 2001 to 2003 abundance indices decreased and in the same period landings declined, since 2004 abundance indices have remained stable.

Both survey indices and mean lengths in the commercial fishery indicate a stable stock in the Uummannaq area.

Upernavik. Landings have remained relatively stable since 2004. It is difficult to evaluate the Greenland halibut stocks in that area since no surveys and sampling from landings has been conducted in Upernavik from 2002 until winter 2005 and 2006. However mean length in 2005 and 2006 is unchanged compared to 1999-2001.

d) Reference Points

Precautionary reference points could not be given.

e) Research Recommendations

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

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

STACFIS reiterated its **recommendation** that *the discard rate of 'small Greenland halibut' in the Greenland halibut fishery in Div. 1A be investigated.*

The next full assessment of this stock is expected to be in 2010.

3. Roundnose Grenadier (*Coryphaenoides rupestris*) in Subareas 0 and 1

(SCR Doc. 08/17; SCS Doc. 08/8, 11)

a) Introduction

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is taken as by-catch in the Greenland halibut fishery. A total catch of 30 t was estimated for 2007 compared to 16 t for 2006. Catches of roundnose grenadier have been reported from inshore areas and Div. 1A where roundnose grenadier is known not to occur. These catches must be roughhead grenadier and are therefore excluded from totals for roundnose grenadier, but it is also likely that catches from the offshore areas south of Div 0A-1A reported as roundnose grenadier may include roughead grenadier.

Recent catches and TAC's ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Agreed TAC	3.4	3.4	3.4	4.2	4.2	4.2	4.2	4.2		
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.04	0.1	0.06	0.03	0.04	0.02	0.01	0.02	0.01	
STACFIS	0.04	0.1	0.06	0.03	0.04	0.02	0.01	0.02	0.03	

ndf no directed fishery

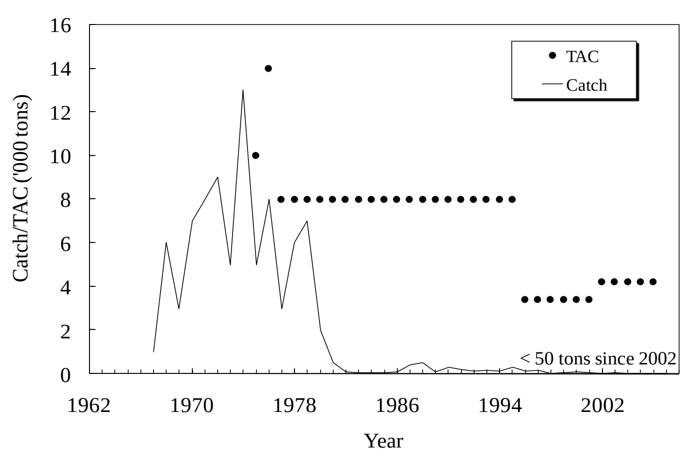


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007.

b) Data Overview

Research survey data

In the period 1987-1995 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. (The survey area was restratified and the biomasses recalculated in 1997). Russia has in the period 1986-1992 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 1997-2007 Greenland has conducted a survey in September - November covering Div. 1CD at depth between 400 and 1500 m. Canada conducted surveys in Div. 0A in 1999, 2001, 2004 and 2006 and Div. 0B in 2000 and 2001 at depths down to 1500 m. roundnose grenadier was not observed in Div 0A.

In the Greenland survey in 2007 the biomass in Div. 1CD was estimated at 838 t, which is only slightly above the lowest estimate on 633 t from 2004. The biomass has hence remained at the very low level observed since 1993. Most of the biomass was found in Div. 1C at 800-1000 m and in Div. 1D >800 m. The fish were generally small, between 3 and 8 cm pre-anal-fin length. The Canadian surveys in Div. 0B in 2000 and 2001 also showed very low biomasses, 1 660 and 1 256 t, respectively.

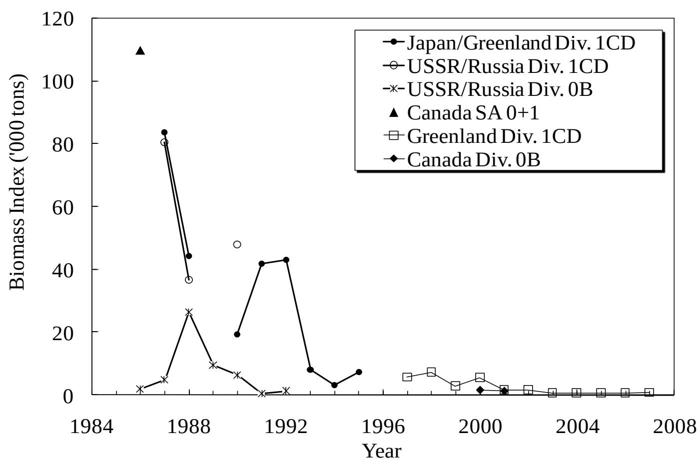


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/ Greenland, Canadian and Greenland surveys in Div. 0B and Div. 1CD.

c) Precautionary Reference Points

STACFIS is not in a position to determine biological reference points for roundnose grenadier in SA 0+1 at this time. Previously STACFIS has considered a survey estimate of 111 000 t from 1986 as $B_{virgin.}$ However, given that roundnose grenadier is probably a long living species and that fishery stopped around 1979, it is uncertain whether the stock could be considered as virgin in 1986. Although the biomass estimates from the 80s and early 90s are not directly comparable with recent estimates these are far below what was seen previously. The survey time series from the 80s and the early 90s are, however, too short to be used for estimation of reference points.

d) Assessment Results

In the Greenland survey in 2007 the biomass in Div. 1CD was estimated at 838 t, which is only slightly above the lowest estimate of 633 t from 2004. The biomass has hence remained at the very low level observed since 1993. Almost all the biomass was found at depths > 800 m.

The next assessment will be in 2011.

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

(SCR Doc. 08/16, 17, 28, 37. SCS Doc. 08/11)

a) Introduction

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

Historically, redfish were taken mainly as by-catch in the trawl fisheries for cod and shrimp. However, occasionally during 1984-86, a directed fishery on redfish was observed for German and Japanese trawlers. With the collapse of the Greenland cod stock during the early-1990s, resulting in a termination of that fishery and catches of commercial sized redfish has been taken inshore by long lining or jigging and offshore by shrimp fisheries only. To reduce the substantial number of juvenile redfish discarded in the trawlfishery targeting shrimp, sorting grids have been mandatory since October 2000. (Sorting grids were not fully implemented until 2002). Redfish caught in the Greenland shrimp fishery are discarded, amounting to ~0.6% of the shrimp catch and composed mainly of small redfish between 6 and 13 cm.

In 1977, total reported catches peaked at 31 000 t (Fig. 4.1). During the period 1978-83, reported catches of redfish varied between 6 000 and 9 000 t. From 1984 to 1986, catches declined to an average level of 5 000 t due to a reduction of effort directed to cod by trawlers of the EU-Germany fleet. With the closure of this offshore fishery in 1987, catches decreased further to 1 200 t, and have remained at a low level since then. The estimated catch figure in 2006 and 2007 of redfish in Subarea 1 is less than 500 t. Recent and historical catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp.

Recent catches (‘000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TAC	19	19	19	19	8	1	1	1	1	1
STATLANT 21A	0.8	1.0	0.1	0.1	0	0.3	0	0	0	
STACFIS Catch	0.8	1.0	0.3	0.5	0.5	<0.5	<0.5	<0.5	<0.5	

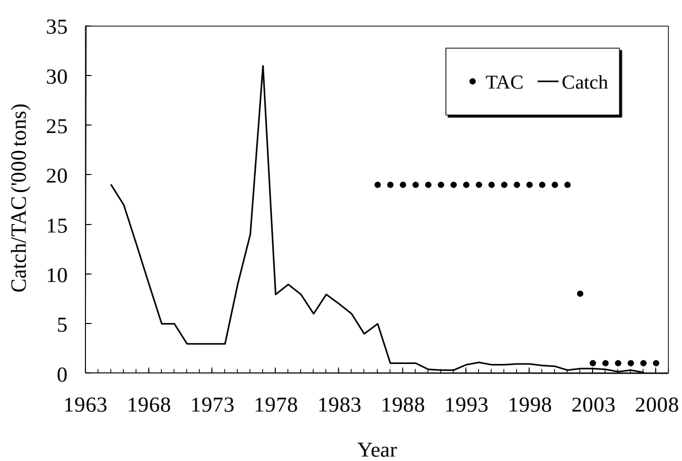


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

b) Input Data

i) Commercial fishery data

For the directed fishery on this stock, no data on length distribution or CPUE were available. Also no new quantitative information on the amount of juvenile fish in the by-catches of the shrimp fishery was available. Information on historical length composition was derived from sampling of German commercial catches of golden redfish during 1962-90 covering fresh fish landings as well as catches taken by freezer trawlers. These data revealed significant mean length reductions of fish caught from 45 to 35 cm, with the biggest reductions occurring during the 1970s. There are no data available to estimate the size composition of historical catches of deep-sea redfish.

ii) Research survey data

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400 m isobath of Div. 1B to 1F and were primarily designed for cod as target species. Therefore, the high variation of the estimates for redfish could be caused as a result of the incomplete survey coverage in terms of depth range and pelagic occurrence of redfish. Nonetheless, the survey results indicated that both abundance and biomass estimates of golden redfish (≥17 cm) decreased by more than 90% until 1990. However, since 2002 a limited but steady increase in both survey biomass index and GLM index has been observed, although substantial recovery back to historical levels do not appear (Fig. 4.2). In 2007 the stock was mainly composed of three length groups: 17-20, 25-35 and 40-45 cm in body length. The size group 17-20 cm was particularly strong and indicating potential for recovery.

Estimates for deep-sea redfish (≥17 cm) varied without a clear trend (Fig. 4.3). Since 1996, the survey abundance has increased, but the stock consists mainly of juvenile fish below 25 cm length. It must be noted, that the survey design hardly covers the distribution area of deep sea redfish, and the survey results should be carefully interpreted.

Juvenile redfish <17 cm *Sebastes spp.* has varied over a wide range since 1982 (Fig. 4.4). More recent indices since 2001 are among the lowest. The length composition of the stock has reiterate revealed peaks at 6-7, 10-12 and 14-16 cm, an indication of sizes at ages 0, 1 and 2 years. Comparisons between the survey results off West and East Greenland revealed that all three redfish components were almost exclusively distributed off East Greenland.

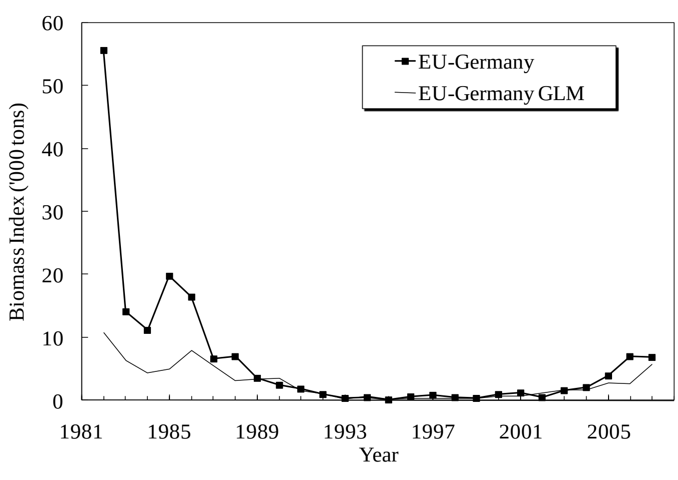


Fig. 4.2. Golden redfish in NAFO Subarea 1: survey biomass index.

Greenland-Japan and Greenland deep-sea surveys. During 1987-95, cooperative trawl surveys directed towards Greenland halibut and roundnose grenadier were conducted on the continental slope in Div. 1A-1D at depths between 400 and 1 500 m. This deep-water survey was discontinued in 1996 but conducted again since 1997 by Greenland with another vessel and changed gear. Deep-sea redfish were mainly caught in Div. 1C and at depths less than 800 m. In 2000 and 2002, the survey did not cover the shallow areas (<800 m) sufficiently. Therefore, no abundance and biomass indices were calculated. From 1997 and until 2006 the biomass has been stable at about 2 000-2 500 t (Fig. 4.3). The 2007 estimate of only 574 t is however based on only 7 hauls shallower than 800 m of depth where the majority of the fish normally is found. Length measurements revealed that immature individuals <30 cm presently dominate the size composition of the stock. None of the redfish in surveys since 2002 have shown any sign on maturity.

Greenland groundfish/shrimp survey. Since 1988, a shrimp survey has been conducted by Greenland covering the Div. 1A to 1F down to 600 m depth. Due to changes in survey strategy and sampling of fish, determinations of abundance and biomass indices and length composition were considered comparable since 1992. Redfish was found in all the survey areas, but was most common in Div. 1B and 1C. The abundance and biomass estimated in the period 1992-1996 have fluctuated without a clear trend between 0.9-2.4 billion individuals and 14.000-38.000 t. From 1997–2004 biomass and abundance have decreased to between 165-719 million individuals and 11.000-23.000 t. In 2007 both biomass and abundance reached a historic low level (Fig. 4.4).

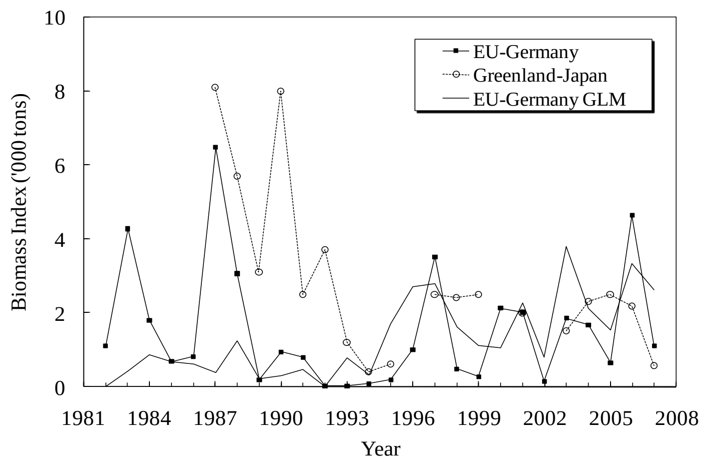


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass indices.

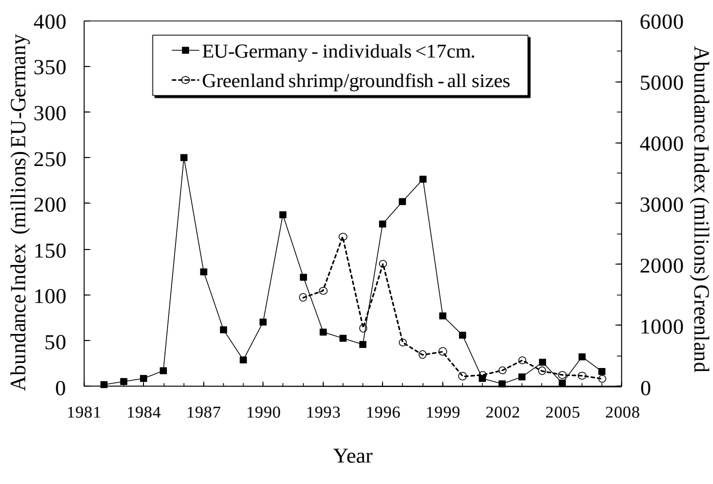


Fig. 4.4. Juvenile redfish (deep-sea redfish and golden redfish combined) in Subarea 1: Survey abundance indices.

c) Estimation of Parameters

The golden redfish SSB was assessed assuming knife-edge maturity at 35 cm applied to the length-disaggregated abundance indices derived from the EU-German groundfish survey. The length group 17-20 cm was chosen as recruitment indices. SSB and recruitment indices decreased drastically from 1982. However, SSB has increased since 2002 and in 2007 an increase in recruitment at age five is seen, although recovery back to historical levels does not appear (Fig. 4.5).

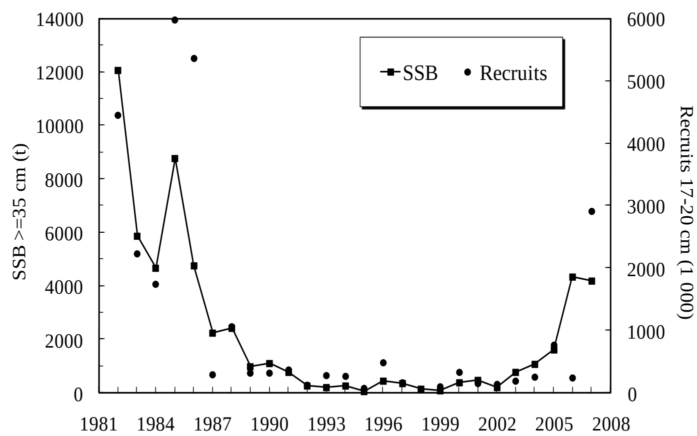


Fig. 4.5. Golden redfish Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey in the given years.

The German survey biomass of fish ≥35 cm and the abundance of length groups 17-20 cm were taken as proxies for deep sea redfish SSB and recruitment, respectively. The SSB has been extremely low since 1989, although slowly increasing since 2001 (Fig. 4.6). The recently depleted status of the SSB is confirmed by the lack of adult fish in the Greenland deep-water survey. Recruitment variation is high, and the 1997, 2000 and 2001 estimates were above average, but since 2002 recruitment indices have remained low.

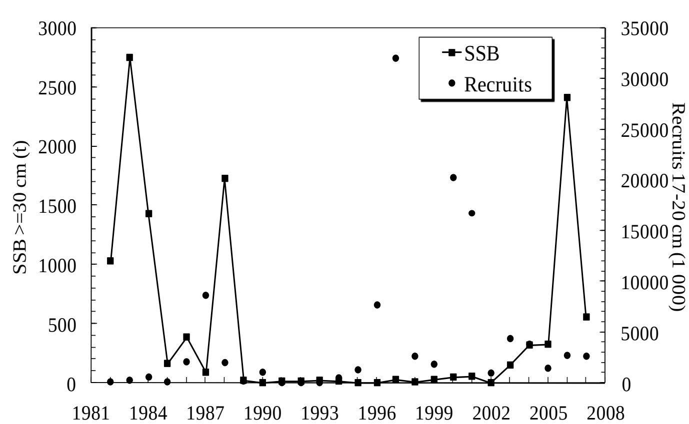


Fig. 4.6. Deep-sea redfish in Subarea 1: SSB and recruitment indices as derived from the Germany groundfish survey in the given years.

d) Assessment Results

Although some signs of recovery are seen in the golden redfish SSB and recruits at age 5, substantial recovery back to historical levels does not appear. The Greenlandic groundfish/shrimp survey reveals the lowest abundance and biomass estimates seen since the beginning of the survey in 1992 and the EU-German groundfish survey reveals only minor improvements in the abundance and biomass of redfish below 17 cm. It seems likely that this is related to the substantial numbers of redfish that are caught and discarded by the shrimp fishery, and concern must be expressed about the continuing failure of the juveniles to rebuild the pre-mature and mature stock components. Although the by-catch of juvenile redfish, since the implementation of sorting grids, is only ~0.6% of the shrimp catch, this can still add up to a significant reduction of several hundred tonnes of redfish below 13 cm, due to the high catches of shrimp (above 100.000 tonnes per year).

Therefore, there are no indications of any imminent change in the status of the redfish stocks in SA1 based on indices from the three bottom-trawl surveys conducted in 2007. Both the deep-sea and the golden redfish stocks are still considered to be in a poor condition.

e) Reference Points

Given the lack of long enough time-series of spawning stock and recruitment data and the uncertainties regarding reproduction and maturation of redfish in this area, STACFIS was unable to propose any limit or target reference points for fishing mortality or spawning stock biomass for the stocks of golden and deep sea redfish stocks in Subarea 1.

f) Research Recommendation

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

This stock will next be assessed in 2011.

5. Other Finfish in Subarea 1

(SCR Doc. 08/16, 28, 41; SCS Doc. 08/11)

a) Introduction

Fisheries for other finfish in Subarea 1 such as, American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*) and thorny skate (*Amblyraja radiata*) have been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas. These stocks are also taken as by-catch in offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut. Both wolffish species are included in the catch statistics, since no species-specific data are available. The recent increase in wolffish catches is mainly observed in the inshore areas, which are not covered by the trawl surveys. Whether this increase in catches is due to an increase in abundance or effort is unknown. In recent years, no catch data was available for American plaice and thorny skate.

To reduce the substantial number of juvenile finfish discarded in the trawl fishery targeting shrimp, sorting grids have been mandatory since October 2000, resulting in a nearly complete protection of individuals larger than 20 cm. (Sorting grids were not fully implemented until 2002). The by-catch of juvenile finfish discarded in the shrimp fishery after the implementation of sorting grids has been estimated to ~0.24 % American plaice, ~0.01% Atlantic wolffish and ~0.001% spotted wolffish, of the shrimp catch. The catch figures do not include the weight of fish discarded by the trawl fisheries directed to shrimp.

Recent nominal catches (t) for wolffish are as follows:

	1999	2000[1]	2001[1]	2002[1]	2003[1]	2004[1]	2005	2006	2007	2008
STATLANT 21A		5	7				25	11	1	
STACFIS	33	64	82	118	393	342	273	655	604	

[1] Provisional

b) Input Data

i) Commercial fishery data

For other finfish fishery no data on length distribution or CPUE were available. Also no quantitative information on the amount of juvenile fish discarded in the by-catches of the shrimp fishery was available.

ii) Research survey data

EU-German groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982. These surveys covered the areas from the 3-mile limit to the 400 m isobath of Div. 1B to 1F, and were primarily designed for cod as target species. In general, all stocks sizes have declined significantly until the early 1990s and remained low since then (Fig. 5.1). Whereas American plaice and Atlantic wolffish are presently composed of small and mainly juvenile individuals, spotted wolffish shows large variation in body length as a result of low catches.

Greenland groundfish/shrimp survey. Since 1988, a shrimp survey has been conducted by Greenland covering Div. 1A to 1F down to 600 m depth. Due to changes in survey strategy and sampling of fish, determinations of abundance and biomass indices and length composition were considered comparable only since 1992. Abundance and biomass indices of American plaice, Atlantic wolffish and thorny skate have been low since the beginning of the survey (Fig. 5.1). Abundance and biomass indices of spotted wolffish increased in 2003 and have remained stable, although a minor decrease is observed in 2007. All stocks mentioned were dominated by juveniles as derived from length measurements, except for spotted wolffish. As in the EU-German groundfish survey, spotted wolffish showed high variation in body length without signs of dominating year-classes.

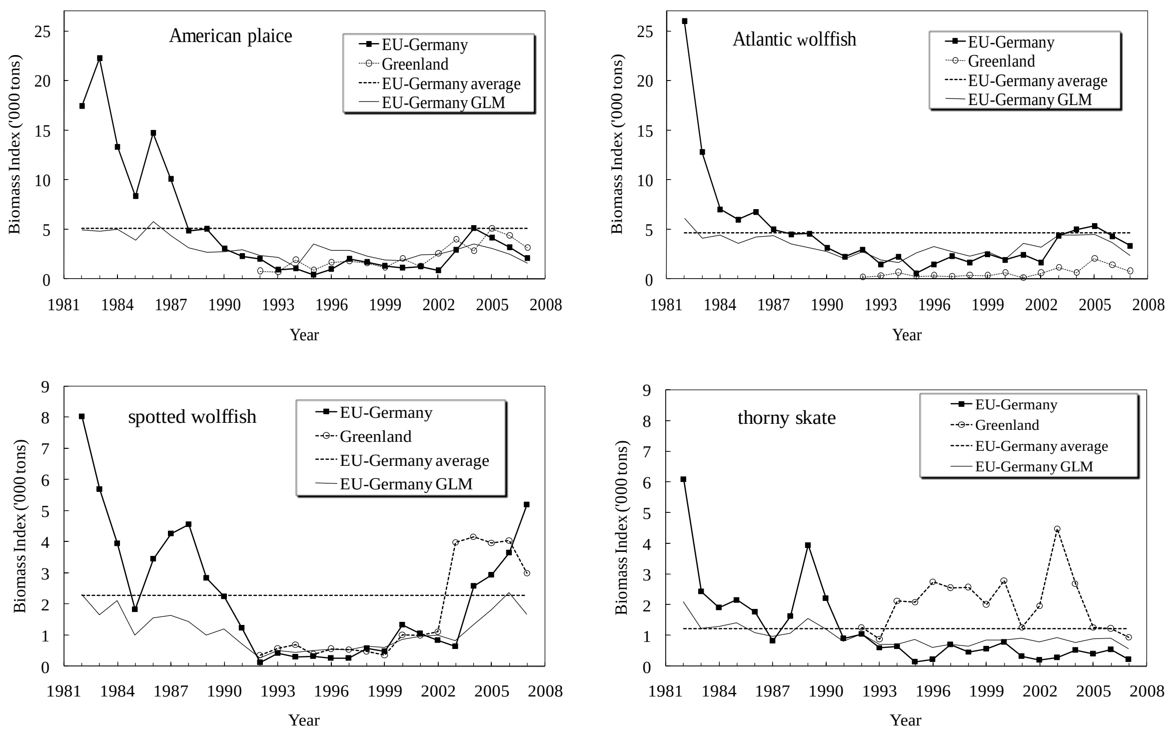


Fig. 5.1. Finfish in Subarea 1: survey biomass indices.

c) Estimation of Parameters

American plaice SSB was derived from German length-disaggregated abundance indices to which a length-maturity ogive was applied. During 1982-91, the SSB decreased continuously and remained low until 2002 (Fig. 5.2). SSB increased in 2003 and 2004, but is still considered to be at low level compared to the early and mid-1980s. Recruitment is presented as abundance of small fish 15-20 cm representing age group 5 and indicates an increase above the average level in 2003 and 2004. However, since 2005, both SSB and recruitment has decreased to pre 2003 levels.

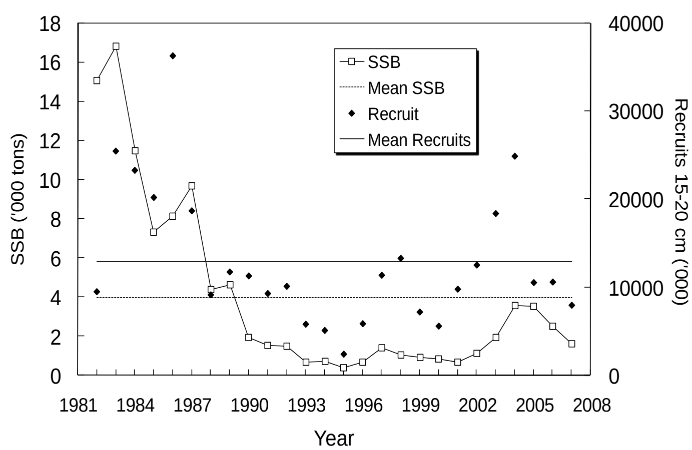


Fig. 5.2. American plaice in Subarea 1: SSB and recruitment indices as derived from the EU-Germany groundfish survey.

The estimation of Atlantic wolffish SSB and recruitment was performed in the same manner as for American plaice, i.e. using a length-maturity ogive and fish of 15-20 cm representing 3 year old recruits. Since 1982, the SSB decreased drastically and remained severely depleted until the early 1990s (Fig. 5.3). In contrast, recruitment increased almost continuously until 1994 and has varied considerably since then. The stock is mainly composed of small fish below 40 cm, which might imply a certain recovery potential. However, years with abundant recruits have yet to contribute significantly to the SSB.

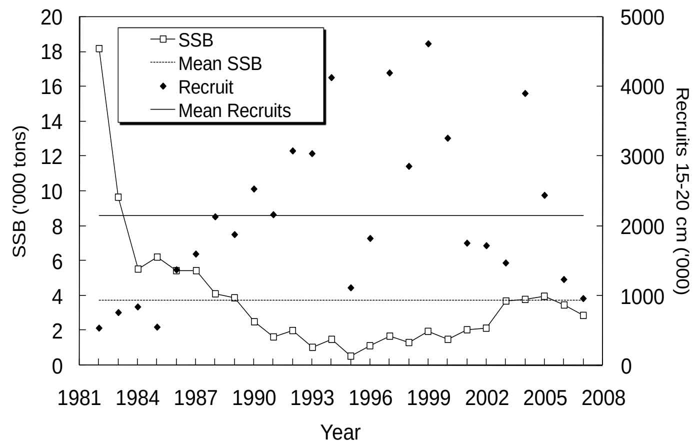


Fig. 5.3. Atlantic wolffish in Subarea 1. SSB and recruitment indices as derived from the EU-Germany groundfish survey.

Biomass and abundance indices for spotted wolffish derived from the German groundfish survey and the Greenland shrimp/groundfish survey, have increased since 1999 to recent levels at or above the series mean (Fig. 5.1). However, both the Greenland shrimp/groundfish survey and the EU-German groundfish survey GLM model show a decrease in abundance and biomass in 2007.

The German groundfish survey biomass indices for thorny skate show a decrease since 2000, but data derived from the Greenland shrimp/groundfish survey fluctuated without trend since 1995. The stock is dominated by small fish below 25 cm.

In general, stocks sizes have declined significantly until the early 1990s and remained low. However, the stocks of Atlantic and spotted wolffish have indicated some recovery potential due to increased recruitment.

d) Assessment Results

The stocks of Atlantic and spotted wolffish indicate some recovery potential due to increased recruitment as well as the observed slight increases in biomass for the whole length range in the recent 5 years. The Atlantic wolffish stock is mainly composed of small and juvenile individuals and spotted wolffish shows high variation in body-length with no signs of distinct yearclasses.

Taking the poor stock status of American plaice and thorny skate into account and the apparent lack of new incoming spotted wolffish yearclasses, even the low amounts of fish taken and discarded by the shrimp fishery might be sufficient to retard the recovery of these stocks. The continued failure of the recruits to rebuild the spawning stocks indicates high mortality rates in excess of the sustainable level. Minimising the bycatch of finfish in SA1 would enhance the probability of stock recovery.

The survey estimates from 2007 did not alter the perception of the status of the American plaice, Atlantic wolffish and thorny skate stocks. Although minor improvements have been observed in the Atlantic wolffish stock in recent years, the stock is still at a low level. Biomass indices for spotted wolffish have increased in recent years to levels near or above the series means, but strong year-classes that might explain the increase have not been observed.

e) Reference Points

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

f) Research Recommendation

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

STACFIS **recommended** that *the distribution of these species in relation to the main shrimp-fishing grounds in Subarea1 be investigated, in order to further discover means of reducing the amount of discarded by-catch.*

These stocks will next be assessed in 2011

B. STOCKS ON THE FLEMISH CAP: Subarea 3, Div. 3M

Environmental Overview

The water masses characteristic of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water, generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3^o to 4^oC 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 eastward north of the Cap and then 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.

Along the Flemish Cap section surface temperatures remained above normal in 2007 but decreased significantly from the 2006 values. On the Flemish Cap, surface salinities were higher than normal during 2007. Salinities on the Flemish Cap have been above normal from 2001 to 2007. On the Grand Bank along the 47^oN section, the summer CIL area was below normal for the 10^{th} consecutive year (1998-2007) and along the southeast Grand Bank section the spring CIL area was above normal after the record low value of the spring of 2006. Salinities continued to be above normal over the Flemish Cap in 2006 and 2007. The baroclinic transport in the offshore branch of the Labrador Current was above normal during 2007 off southern Labrador and off the Grand Bank through the Flemish Pass, continuing an 8-year trend.

6. Cod (*Gadus morhua*) in Div. 3M

(SCR Doc. 08/26, 34; SCS Doc. 08/5, 6, 7)

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 directed fishery has been under moratorium since 1999.

ii) Nominal catches

From 1963 to 1979, the mean reported catch was 32 000 t, showing high variations between years. Reported catches declined after 1980, when a TAC of 13 000 t 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 t, 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. Yearly catches between 2000 and 2005 were below 60 t and then rose to 339 and 345 t in 2006 and 2007, respectively.

Recent TACs and catches ('000 t) are as follow:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1[1]	
STACFIS	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.3	

[1] Provisional.
ndf No directed fishery.

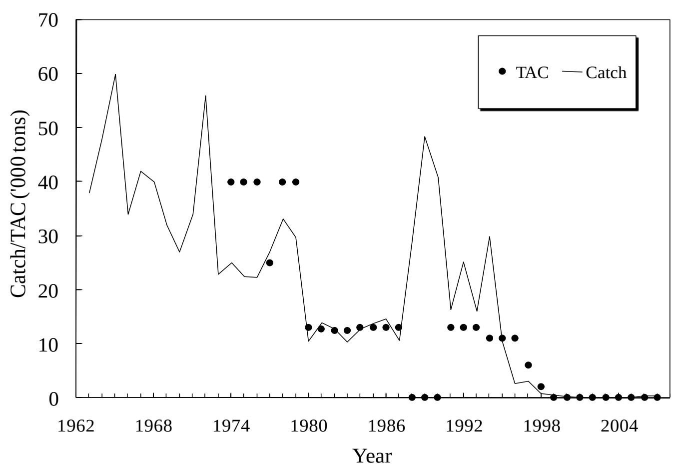


Fig. 6.1. Cod in Div. 3M: catches and TACs, catch figures include estimates of misreported catches since 1988.

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 and for years 2006 and 2007. Length distributions in 2006 and 2007 were rather different from each other, with the distribution from 2006 narrower and concentrating on smaller lengths (with a single modal value at 60 cm) and the distribution from 2007 more dispersed and reaching greater lengths (with two modes at 54 and 72 cm, respectively). There are, however, some concerns about the accuracy of these length distributions, as the sampling levels in 2006 and 2007 have been rather limited. Even though catch in weight is very similar in the two years, the difference in length composition means that the number of fish caught is considerably larger in 2006 (136 000 individuals) than in 2007 (80 000 individuals). Length-to-age conversions were performed using age-length keys from the EU survey, since they were the only ones available. In 2006, almost half of the individuals caught were of age 4, whereas in 2007 ages 3 and 5 were the most abundant in the catch.

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 t in 1978 and a minimum of 8 000 t 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 t in 1989; a minimum 2 500 t in 1992, and a decline from 8 300 t in 1995 to 700 t in 1996. The estimates in 2001 and 2002 were 800 and 700 t, respectively.

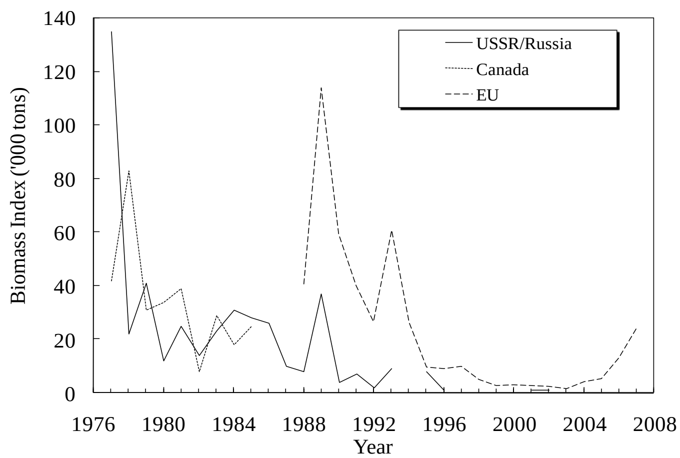


Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

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 t. 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 have been conducted by the EU since 1988. Since 2003 the survey has used a new vessel and in order to make the series comparable fishing trials were performed with both vessels in 2003 and 2004 (Casas and González Troncoso, 2005). The EU survey indices also showed a decline in trawlable biomass going from a peak value of 114 000 t in 1989 to 27 000 t in 1992. This was followed by an increase to 61 000 t in 1993, then a decrease to around 10 000 t for the 1995 to 1997 period and then a steady decrease until the lowest observed level of 1 600 t in 2003. Biomass increased in 2004 and 2005 to around 5 000 t. The indices for 2006 and 2007 show a strong increase in biomass, with values of 13 000 and 24 000 t, respectively. There is also an increase in abundance, but it is less strong, reflecting the fact that stock weights in recent years are estimated to be higher than they were towards the beginning of the survey series.

After a consistent series of above average recruitments (age 1) during 1988-1995, the EU survey indicates poor recruitments during 1996-2004, even obtaining observed zero values in 2002 and 2004. Since 2005, above-average recruitments have again been observed. In particular, the age 1 index in 2006 is the fourth largest in the EU series.

Examining the EU survey indices (in log scale) standardized by age (each age standardized separately to have 0 mean and standard deviation 1 through time) shows that the survey tracks cohorts very well.

iii) Biological data

Mean weight at age in the stock, derived from the EU survey data, shows a strong increasing trend since the late 1990's.

New annual maturity ogives are provided this year, since maturity data for years 2000-2006 have been analysed. Logistic regression models for proportion mature at age have been fitted separately for each year for which data are available. There are no major differences between the new maturity ogives provided this year and the ones used until last year. There has been a continuous decline of the A_{50} (age at which 50% of fish are mature) through the years, going from above 5 years of age in the late 1980's to just above 3 years of age since about year 2000.

c) Estimation of Parameters

The last sequential population analysis (XSA) was carried out in 2002, for ages 1 to 8+ and using the EU survey indices at age for tuning. Catch-at-age data were not available for the period 2002 to 2005, impeding further analyses using XSA. In addition, the reliability of the XSA results was put into question since fishing mortality was estimated to be at very low levels, raising concerns about a potential lack of robustness in the model results to the assumed natural mortality value.

Since 2003, the yearly indices of abundance from the EU survey have been scaled to population estimates of SSB based on the method accepted in the 2004 assessment. This method allows to judge the current level of SSB in relation to the 14 000 t accepted as a preliminary value of B_{lim} for this stock. Transforming from survey indices to absolute SSB values involves catchability-at-age parameters. These parameters were calculated based on an XSA analysis using catch data between 1988 and 1999, which is a period for which XSA is considered to provide reliable catchability estimates. The method estimates an entire probability distribution for SSB, so the probability that SSB is above or below any reference value (such as B_{lim}) can be calculated. The method has the advantage of not requiring commercial catch information after the initial period used to estimate catchabilities. A weakness is that it does not impose a cohort structure on the population, so there is no guarantee that abundance estimates decrease along cohorts. Related to this point, year effects in the survey (if they exist) will go largely undetected, biasing the abundance estimates for such years.

In 2007 an alternative VPA-type Bayesian model for the assessment of this stock was briefly presented to STACFIS, which recommended that the method be developed and its potential for the assessment of this stock explored. This recommendation has been followed and the method has been developed and explored for the assessment this year. A description of the model follows, with full technical details provided in SCR Doc. 08/26.

The model is age structured and follows cohorts. Modelling starts by setting prior distributions on survivors at age at the end of the final assessment year and survivors from the last true age (age 7) at the end of each year prior to the final assessment year. From the survivors, cohort abundances at age are reconstructed backwards in time until reaching either the beginning of the cohort (recruitment at age 1) or the first assessment year. When reconstructing cohorts, a distinction is made between years for which catch numbers at age are available and years for which they are not, as described next:

If catch numbers at age are available in year y, then abundances at age in that year are found from the usual cohort analysis equation: $N(y,a) = N(y+1,a+1)\ exp(M) + C(y,a)\ exp(M/2)$, where M is the assumed natural mortality rate and $C(y,a)$ catch numbers at age a in year y.

If y is a year for which catch numbers at age are not available, abundances at age in that year are derived from the equation $N(y,a) = N(y+1,a+1)\ exp(\ M + F(y,a)\ )$, where $F(y,a)$ is fishing mortality at age a in year y. The value of this fishing mortality is unknown and must be estimated. As this is a Bayesian model, a (log-normal) prior distribution is set on $F(y,a)$. For the Div. 3M cod stock, in years when no catch numbers at age are available, total catch in weight is nevertheless known. This information is used by setting a (log-normal) observation equation linking the known catch weight to the value predicted by the model, similarly to what is done in statistical catch at age models. The observation equation for catch weight complements the abundance index coming from the EU survey, hence aiding in the estimation of fishing mortality for years in which no catch numbers at age are available.

The EU survey provides abundance-at-age relative indices, which are linked to the average population abundances at age during the survey period by log-Normal observation equations.

Hence, the input data for the Bayesian model are: catch numbers at age for the years in which they are available, total catch weight as well as some proxy for mean weight at age in the catch for the remaining years and indices of abundance at age from the EU survey. Model parameters are survivors at age at the end of the final assessment year, survivors from the last true age at the end of every year prior to the final assessment year, fishing mortalities at age for years without catch numbers at age, catchabilities at age and precisions at age of the survey. In a Bayesian analysis prior distributions must be set for all unknown parameters. These priors have been chosen to be centered at values that were considered reasonable according to the knowledge we had about this stock, while incorporating a fair amount of dispersion so as to prevent them from having unduly strong influence on the assessment results.

To start with, four different runs of the Bayesian model were performed, all with M=0.2. Three of these runs differed on the prior distributions set on survivors and on fishing mortality at age for the years with no catch numbers at age. These three runs were quite consistent with each other in terms of the results obtained. They all showed an increasing SSB since 2004, although there were discrepancies between them as to the exact extent of the increase. They also estimated an increase in F_{bar} (ages 3-5) in 2006, although F_{bar} is estimated to have come back down to very low levels again in 2007. A fourth run differed in the input data for 2006 and 2007, years for which it used only total catch weight instead of catch numbers at age. This was done because the level of commercial catch length sampling in 2006 and 2007 was low and the EU survey age-length keys had been used. This run showed comparable results to the other three, but was more optimistic in terms of current SSB levels and did not show the increase in F_{bar} in 2006 estimated by the other runs.

Concerns remained about results being potentially overly sensitive to the assumed value of the natural mortality rate. To explore this issue, two more runs were performed (both using catch numbers at age in 2006 and 2007) incorporating uncertainty in M via a (log-normal) prior distribution. The first prior distribution had a median value of 0.2 and 0.75 as coefficient of variation, hence it was a rather wide prior distribution. The second prior distribution was chosen to be more in accordance with biological knowledge about this stock, and had modal value at 0.2 and coefficient of variation equal to 0.3. The results showed that there is rather limited (albeit there is some) information in the data to estimate M, so the posterior distributions of M were quite dependent on the prior chosen. However, the results from the assessment in terms of SSB, F and recruitment, generally displayed little sensitivity to the assumptions made about M.

Results from all six Bayesian runs were compared with those from XSA analyses using data until 1999 and until 2001 and with the same settings as the last approved XSA assessment in 2002. Results for the common period were very similar. This is not surprising since the Bayesian model uses catch numbers at age while following cohorts in time and tunes the analysis with the survey index, similarly to what XSA does.

Finally, an analysis with the survey-based method used between 2003 and 2007 was also done for comparison purposes. Results from the survey-based method showed generally less agreement with XSA than did the Bayesian results. The survey-based method estimated SSB in 2007 to be at a level very similar to the one obtained in the most optimistic of the Bayesian runs (which was the run performed using only total catch weight for 2006 and 2007).

After the extensive exploration of settings and results, it was decided that the most realistic settings were those of the Bayesian run with uncertainty in M reflecting biological knowledge about the stock (prior mode at 0.2 with coefficient of variation 0.3). Consequently, the outputs from that run were adopted as the assessment results.

d) Assessment Results

After a series of recruitment failures between 1996 and 2004, recruitment values in 2005-2007 are better, although still below the levels estimated for the earlier period (Fig. 6.3). There is considerable uncertainty associated with these three most recent values, as indicated by the wide 90% probability limits.

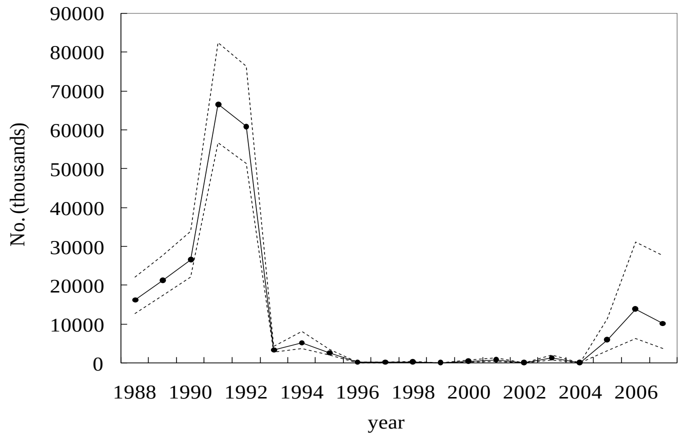


Fig. 6.3. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2007 estimated from the Bayesian model with uncertainty in M.

Estimates of SSB (Fig. 6.4) indicate yearly increases starting from 2004, with the biggest increase taking place during 2007. Whereas SSB at the beginning of 2007 is estimated to be 7 200 t with 90% probability interval of (5 200, 10 100) t, current SSB (that is, SSB at the start of 2008) is estimated to be 17 700 t with 90 % probability interval of (11 100, 29 500) t, and 80% probability of being above 14 000 t, which is B_{lim}. The big increase from 2007 to 2008 is largely due to two reasonably abundant recent cohorts: individuals recruited in 2006, of which approximately 20% are mature at age 3 in 2008, and individuals recruited in 2005, of which approximately 90% are mature at age 4 in 2008.

Although SSB is now at a level which is not much lower than some of the values seen until 1995, this is not reflected in a similar increase in population numbers, which remain much lower than the numbers estimated for the years until 1995. The estimated number of individuals in the 2+ group (aged 2 or older) averaged over years 1991-1995 is 63 million, whereas in 2008 it is only 22 million. Very substantial contributors to the rise in SSB are the larger weight at age and the younger age of first maturity observed in recent years with respect to what is assumed to have applied in the earlier period. As an example, if SSB in 2008 had been computed using the weight at age and maturity at age values from 1988 (values typical of the earlier years), its estimated value would have been 7 600 t, much lower than the current estimate of 17 700 t. As a result of these changes, it is unclear whether the meaning of SSB as an indicator of stock status in recent years is the same as in the earlier period.

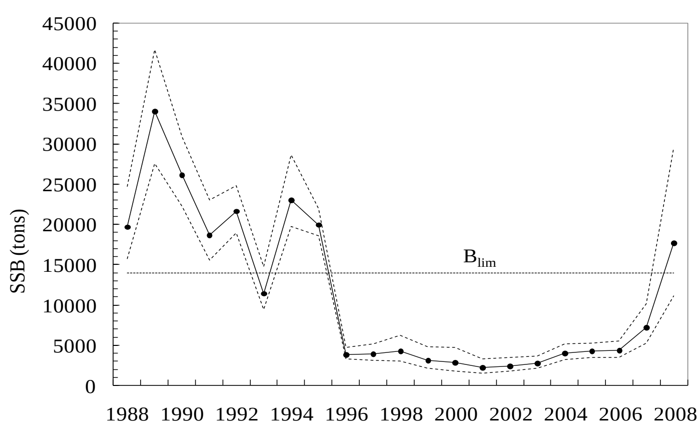


Fig. 6.4. Cod in Div. 3M: SSB estimates and 90% probability intervals for years 1988 to 2008 estimated from the Bayesian model with uncertainty in M. The horizontal dashed line is the B_{lim} level of 14 000 t.

F_{bar} (ages 3-5) is estimated to have been at very low levels since 2001 (Fig. 6.5). An increase is observed in 2006, which is mainly due to high fishing mortality rates at ages 3 and 4 (posterior medians at 0.41 and 0.13, respectively). In 2007, the F_{bar} level is again very low. Although catch in weight is very similar for 2006 and 2007, the length distribution of catches is concentrated on lower lengths in 2006, hence corresponding to more individuals caught and higher fishing mortality rates than in 2007. However, as has already been indicated, the low levels of commercial sampling cast some doubt as to the accuracy of the length distributions.

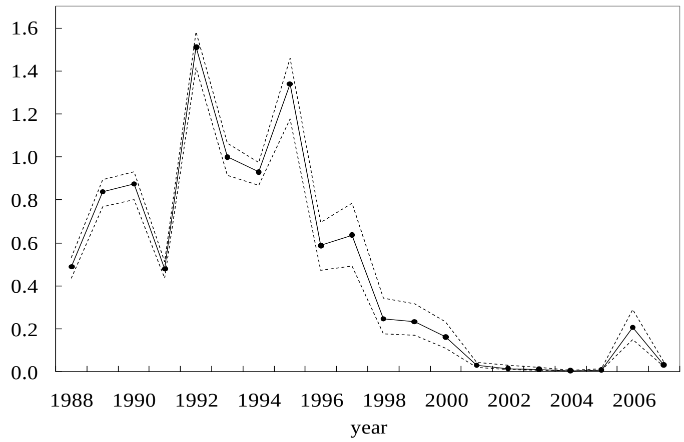


Fig. 6.5. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2007 estimated from the Bayesian model with uncertainty in *M*.

e) Reference Points

A B_{lim} value for this stock has been estimated at 14 000 t. In 2007 STACFIS recommended to revisit candidates for B_{lim} as this value is based on estimates of SSB and recruitment obtained from standard XSA, which is not the method currently being used to assess this stock. Given that the Bayesian model used for the assessment of the stock this year gives very similar answers to XSA for the common period, the validity of the current B_{lim} value would not seem to be in question. Fig. 6.7 shows a stock-recruitment plot, with 14 000 t indicated by the dashed vertical line. The value still appears as a reasonable choice for B_{lim}: only low recruitments have been observed with SSB below this level whereas both high and low recruitments have been observed at higher SSB values.

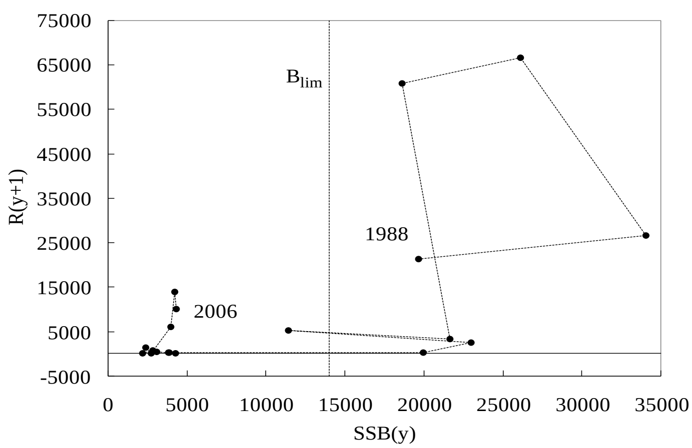


Fig. 6.6. Cod in Div. 3M: Stock-Recruitment (posterior medians) plot from the Bayesian assessment with uncertainty in *M*.

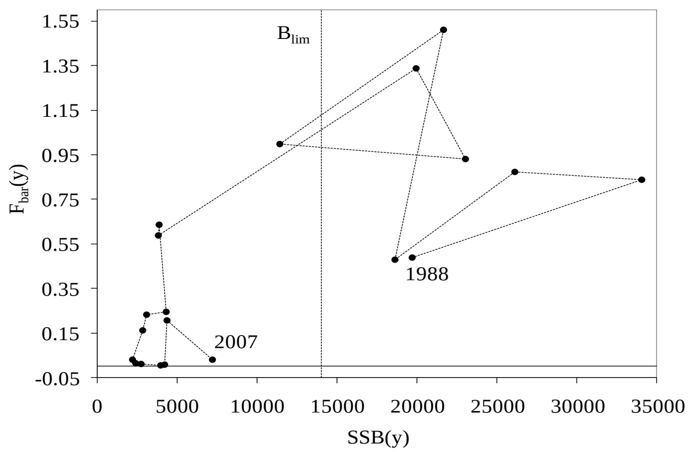


Fig. 6.7. Cod in Div. 3M: F_{bar} versus SSB (posterior medians) plot from the Bayesian assessment with uncertainty in M.

f) Stock projections

Stochastic projections of the stock dynamics over a 3 year period (2009-2011) have been performed. The variability in the input data is taken from the results of the Bayesian assessment. Input data for the projections were chosen on the basis of the last three assessment years (2005-2007), except when there was some reason to consider this unrealistic. Input data are as follows:

Numbers aged 2 to 8+ in 2008: estimates from the assessment.

Recruitments for 2008-2011: Recruits per spawner were estimated for each of the assessment years. As the last 3 years have a much higher value than the average, recruits per spawner were drawn randomly from the values in all of the assessment years.

Maturity ogive: Drawn randomly from the maturity ogives (with their associated uncertainty) of years 2004-2006 (2007 was not used since no data were available to estimate an ogive for that year).

Weight-at-age in stock and weight-at-age in catch: Drawn randomly from the values in 2005-2007.

PR at age for 2008-2011: Average of the PRs estimated for 2005-2007.

F_{bar}(ages 3-5): Three scenarios were considered:

(Scenario 1) Average of F_{bar} in 2005-2007 (median value = 0.08). Projection results are in Fig. 6.8 and 6.9.

(Scenario 2) $F_{0.1}$ (median value = 0.17). Projection results are in Fig. 6.10 and 6.11.

(Scenario 3) Average of F_{bar} in 1988-1995 (median value = 0.93), as, excepting 1993, these years correspond to the period when SSB was above B_{lim} (Fig. 6.7). Projection results are in Fig. 6.12 and 6.13.

Projection results indicate that fishing at the very low F_{bar} value estimated for the average over 2005-2007 or even fishing at the higher value corresponding to $F_{0.1}$, SSB during the next 3 years has a high probability of reaching levels higher than those estimated for the late 1980s (Fig. 6.8 and 6.10). However, similarly to what was indicated in the presentation of the assessment results, the huge increase predicted for SSB does not have a counterpart in terms of population abundances, which are projected to remain at levels well below those of the late 1980s. This mismatch is largely due to the fact that weight-at-age and maturity-at-age values used for the projection period are much higher than those assumed to have applied at the end of the 1980s. The removals associated with these F levels are lower than those in the period before 1995 (Fig. 6.9 and 6.11).

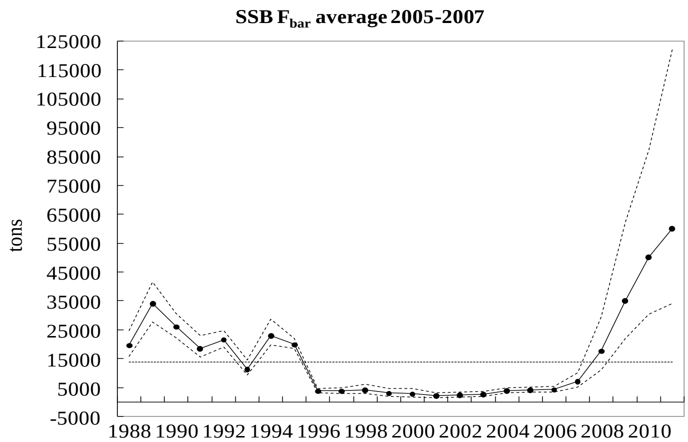


Fig. 6.8. Cod in Div. 3M: Projected SSB under Scenario 1 for F_{bar} (medians and 90% probability intervals).

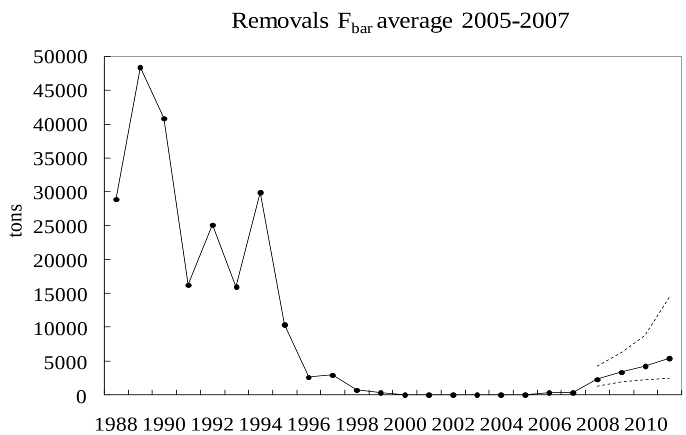


Fig. 6.9. Cod in Div. 3M: Projected Removals under Scenario 1 for F_{bar} (medians and 90% probability intervals).

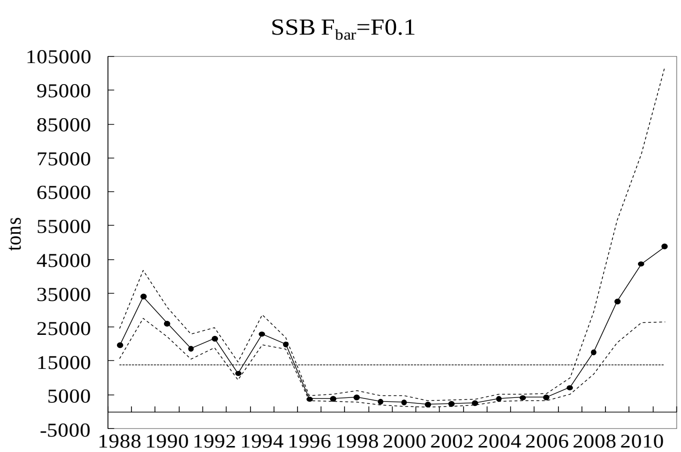


Fig. 6.10. Cod in Div. 3M: Projected SSB under Scenario 2 for F_{bar} (medians and 90% probability intervals).

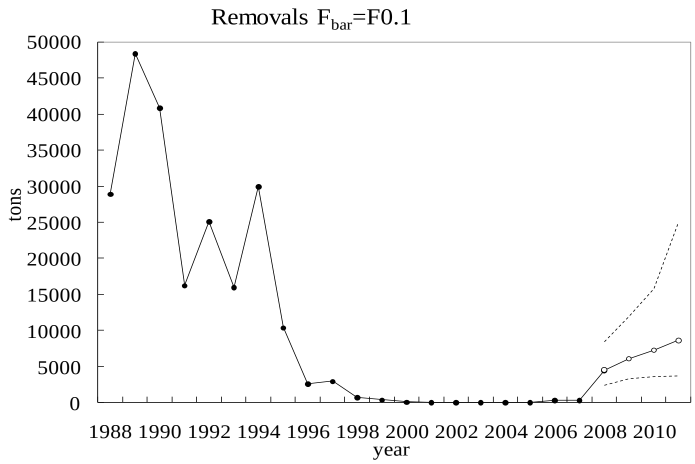


Fig. 6.11. Cod in Div. 3M: Projected removals under Scenario 2 for F_{bar} (medians and 90% probability intervals).

Projections scenario 3 corresponds to the level of fishing mortality seen during the late 1980s and beginning of the 1990s. Results indicate that under such fishing pressure decline of the stock can be expected.

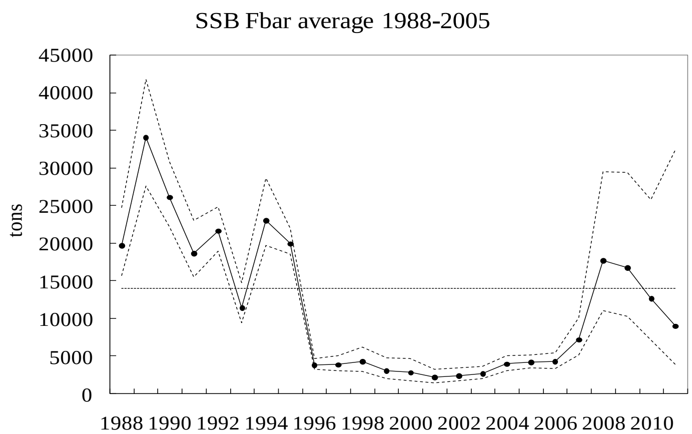


Fig. 6.12. Cod in Div. 3M: Projected SSB under Scenario 3 for F_{bar} (medians and 90% probability intervals).

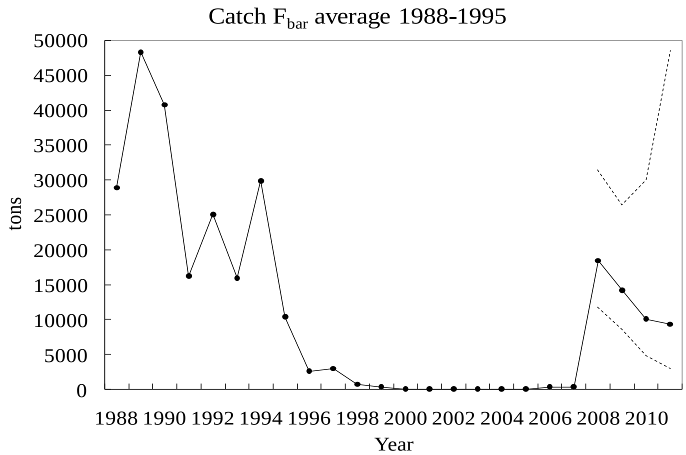


Fig. 6.13. Cod in Div. 3M: Projected removals under Scenario 3 for F_{bar} (medians and 90% probability intervals).

The projected values for the period 2009-2011 are heavily reliant on the relatively abundant three most recent cohorts, namely those recruited in 2005-2007, rather than on healthy population abundances across all ages, making the stock much more fragile than suggested by SSB values alone.

As a redfish fishery has developed in recent years in depths of less than 350 m, and as cod is a bycatch species of that fishery, it may be surmised that bycatch levels of cod will continue to rise during the next few years.

g) Research recommendations

STACFIS **recommended** that *retrospective analyses be performed as a standard diagnostic of the assessment with the Bayesian model.*

Following from the recommendation made last year, STACFIS **recommended** that *efforts be made to increase the levels of commercial sampling for this stock.*

STACFIS noted that the short term development of this stock will be dependent on recent year classes and therefore it **recommended** that *the stock be fully assessed in 2009*.

7. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3M

(SCR Doc. 08/34; SCS Doc. 08/5, 6, 7)

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 300m, golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*) preferring shallower waters of less than 400m. 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 most of the redfish EU survey biomass.

The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-1999, when a minimum catch around 1 000 t was recorded mostly as by-catch of the Greenland halibut fishery. There was a relative increase of the catch on 2000-2002 to a level above 3 000 t but in 2003 the overall catch didn’t reach 2 000 t. Beaked redfish catch increased continuously since 2004 and was at a 6 700 t level in 2007. EU-Portugal consolidates its major role in the fishery over most recent years. A new fishery directed for golden redfish prosecuted by Portugal and Russia has occurred in the last couple of years. TAC was overshot in

November 2005 (6 550 t) and 2006 (7 156 t), with an estimated catch of beaked redfish of 3 784 t and 4,430 t respectively. No information on the pursuing of this golden redfish fishery is available for 2007 and so, for the time being, STACFIS assumes the whole 2007 catch is of beaked redfish.

From Canadian observer data, the redfish by-catch on the 2005 Div. 3M shrimp fishery was reduced to 80 t, reflecting a 75% reduction of the shrimp catch from 2004 to 2005. No length sampling of this by-catch is available since then.

Recent TACs, catches and by-catch ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	13	5	5	5	5	5	5	5	5	7.5
STATLANT 21A	0.8	3.81	3.21	3.01	2.01	3.11	6.6	7.2	5.6	
STACFIS Catch[1]	1.1	3.7	3. 2	2.9	1.9	2.9	3.8	4.4	6.7	
By-catch[2]	0.1	0.1	0.74	0.77	1	0.47	0.1			
Total catch[3]	1.2	3.8	3.9	3.8	2.9	3.4	3.9	4.4	6.7	

[1] Estimated beaked redfish catch.
[2] In shrimp fishery, not available from 2006 onwards.
[3] Total STACFIS catch + by-catch.

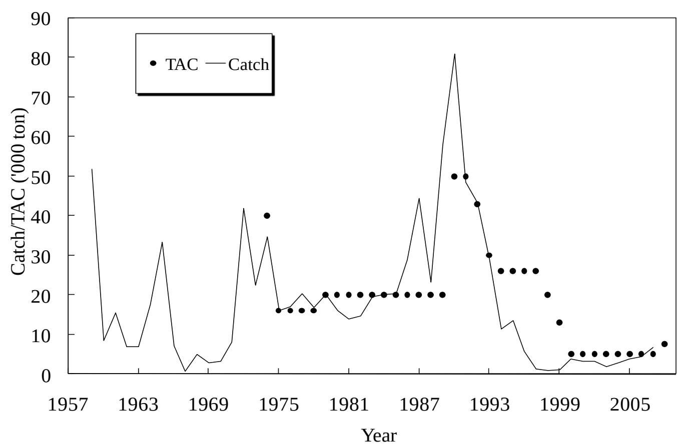


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

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.

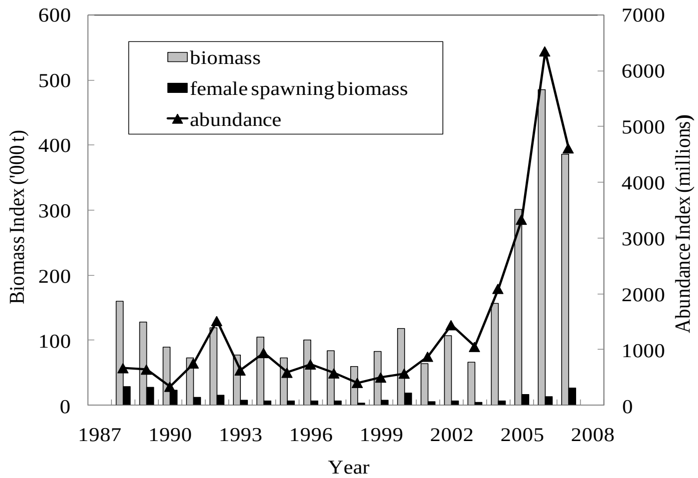


Fig. 7.2. Beaked redfish in Div. 3M: survey biomass, female spawning biomass and abundance from EU surveys (1988-2007).

The 1988-2007 interval covered by the EU Flemish Cap survey, started with a continuous decline of bottom biomass till 1991, followed by a period of biomass fluctuation with no apparent trend between 1992 and 1996. A further decline occurred in 1997 and 1998, when the lowest survey biomass was recorded. The index increased in 1999 and 2000, recovering to the 1992 level, but between 2001 and 2003 returned to wide oscillations. Since 2004 survey biomass rise continuously to an historical maximum in 2006, three times above the level at the beginning of the survey series in 1988. Biomass in 2007 records a 20% decrease from previous year, being kept at a high level (second highest of the series). Female spawning biomass is also growing though at a slower pace, being in 2007 at the level observed on the beginning of the EU survey (Fig. 7.2).

A similar pattern is observed on survey abundance. After falling by half from the 1988-1989 level, reaching in 1990 the minimum of the series, the index was pushed up to a local peak in 1992 by the strong 1990-year class. Abundance was kept at a low level between 1993 and 2000, with the 1990 year-class as the most abundant cohort in the survey catch for seven consecutive years. From 2001 onwards a sequence of abundant year classes (2000-2003) and generalized high survival rates through the age spectrum drive the stock survey abundance to the historical high of 2006-2007.

c) Conclusions

No significant changes occurred in the stock in 2007: survey biomass and abundance continue at a high level, supported by the survival and growth of recent year classes. These survey results are consistent with the results of the full assessment of this stock carried out last year. The next full assessment of the stock is planned for 2009.

d) Current and Future Studies

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

STACFIS **recommended** that *an update of the recent Div. 3M golden redfish fishery information be compiled on an annual/fleet basis, including estimated catch and size distribution of the golden redfish catches.*

This stock will next be assessed in 2009.

8. American Plaice (*Hippoglossoides platessoides*) in Div. 3M

(SCR Doc. 08/34, 40; SCS Doc. 07/6, 9, 08/5, 6)

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 by-catches in trawl fisheries directed to other species in this Division.

Nominal catches increased during the mid-1960s, reaching a peak of about 5 341 t in 1965, followed by a sharp decline to values less than 1 100 t until 1973. Since 1974, when catches of this stock became regulated, catches ranged from 600 t (1981) to 5 600 t (1987). After that catches declined to 275 t in 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. Catch for 2007 was estimated to be 76 t.

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

Recent catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1[1]	
STACFIS	0.3	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.1	

ndf No directed fishing.
[1] Provisional

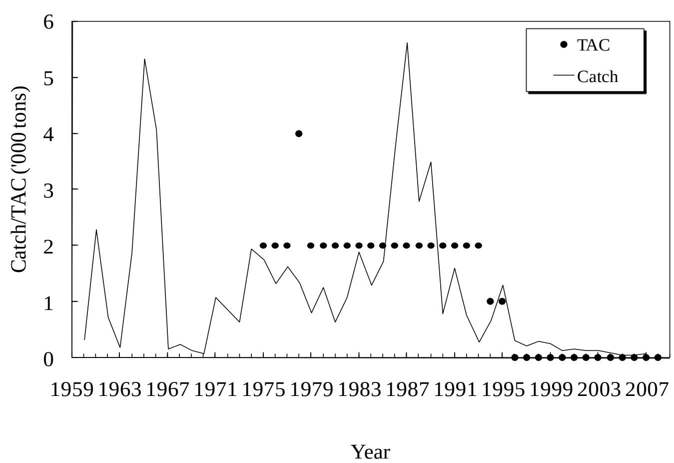


Fig. 8.1. American plaice in Div. 3M: STACFIS catches and agreed TACs.

b) Input Data

i) Commercial fishery data

EU-Portugal and Russia provided length composition data for the 2006 and 2007 trawl catches. EU-Portugal and Russia length compositions were used to estimate the length and age compositions for the 2006 and 2007 total catch. Ages 4 and 5 in 2007 were the most abundant ones.

ii) Research survey data

The series of research surveys conducted by the EU since 1988 was continued in July 2007. 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 with the RV *Vizconde de Eza*. The methodology for convert the series 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.

A continuous decreasing trend in abundance and biomass indices was observed from the beginning of the EU survey series. The 2007 abundance and biomass were the lowest of the series. 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 t 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).

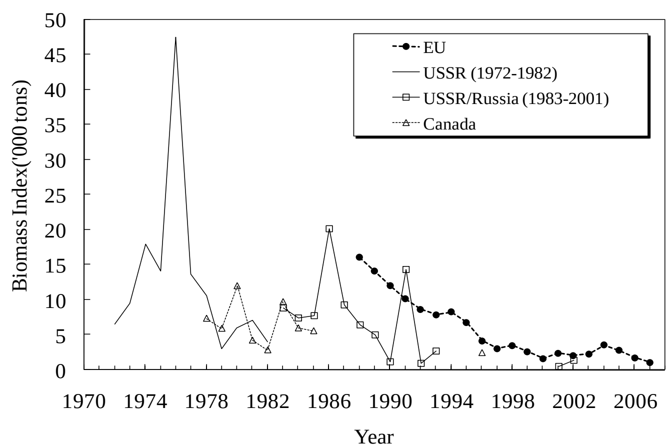


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys.

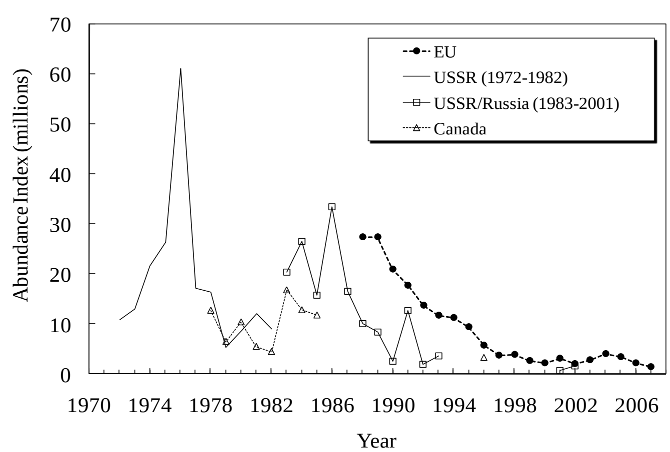


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys.

Ages 1 and older than 15 were dominant in the 2007 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. The apparent good recruitment (age 1) in 2007 remains to be confirmed in the next years.

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 2007.

c) Estimation of Parameters

A proxy for fishing mortality (*F*) is given by the catch and 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 1989-2007 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 1988-2007 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 *F* in the most recent years is very low (Fig. 8.4). If average *F* continues to be much lower than *M*, STACFIS considers that the utility of this method must be re-evaluated.

d) Assessment Results

Both proxy to fishing mortality (C/B) and XSA fishing mortality declined from the mid-1980s to the mid-1990s (Fig. 8.4) and then fluctuated between 0.05 and 0.1 from 1996 to 2007 with the exception of 2005. Recent *F* is at a very low level.

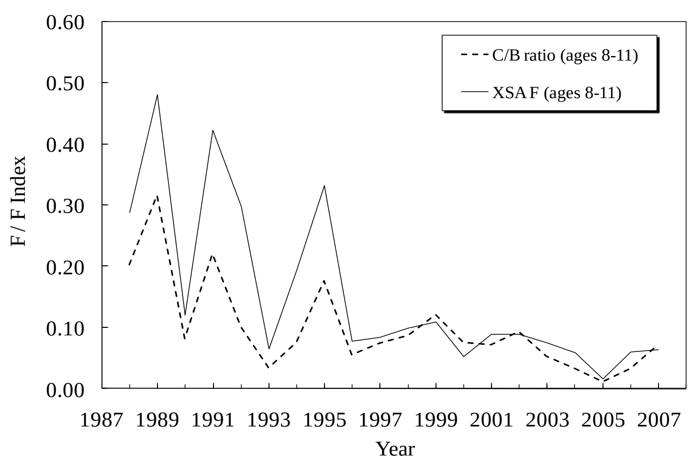


Fig. 8.4. American plaice in Div. 3M: fishing mortality (catch/biomass) index from EU survey (ages 8-11) and XSA estimated fishing mortality (ages 8-11).

Despite the apparent good recruitment of the 2006 year class that remains to be confirmed in the next years, indices from the EU survey and XSA indicates no sign of recruitment from 1991 to 2005 year class, with only weak year-classes expected to be recruited to the SSB for at least the next four years. Stock biomass and the SSB are both 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).

Because the value estimated by the XSA for the age 1 in 2007 is determined by one point from the EU-survey, the strength of the 2006 year class (age 1 in 2007) should be considered preliminary (Fig. 8.5 and 8.6).

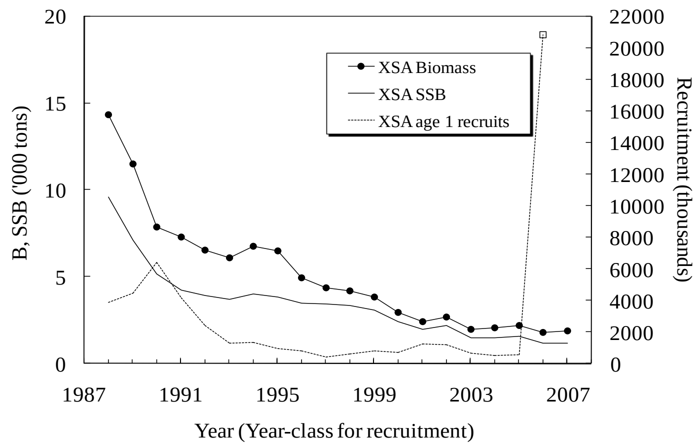


Fig. 8.5. American plaice in Div. 3M: biomass, spawning stock biomass (SSB) and corresponding recruitment from XSA

e) Reference Points

Based on the 18 years data available from the XSA to examine a stock/recruitment relationship, a proxy for B_{lim} will be 5 000 t of SSB (Fig. 8.6).

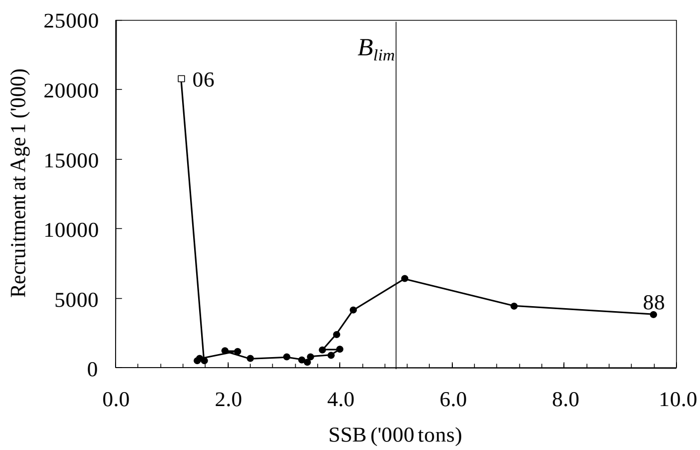


Fig. 8.6 American plaice in Div. 3M: SSB-Recruitment scatter plot.

Current XSA assessment estimates of fishing mortality are quite low, average F (ages 8-11) is 0.0641, but despite this the spawning stock biomass remains at a very poor level (Fig. 8.7).

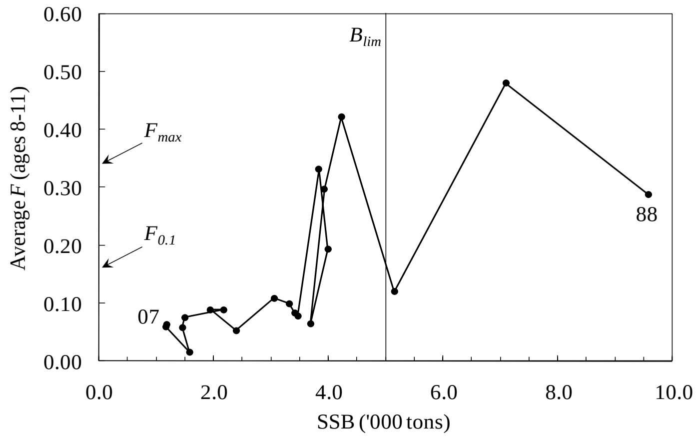


Fig. 8.7. American plaice in Div. 3M: stock trajectory within the NAFO PA framework.

The following set of parameters was used for the yield-per-recruit analysis: M = 0.2; exploitation pattern described above; 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 1988-2007. This analysis gave a $F_{0.1}$ = 0.162 and a F_{max} = 0.346.

f) Research Recommendations

Average *F* in recent years has been very low relative to *M*. Therefore in 2006 STACFIS recommended that the utility of the XSA must be re-evaluated and the use of alternative methods (eg. survey based models stock production models) be attempted in the next assessment of Div. 3M American plaice.

Efforts have been made to apply to this stock the survey-based method that was used in previous Div. 3M cod assessments, but so far this task has not yet been completed. At the same time, work was done trying to run an Aspic model, but in order to go further with this more exploratory research of the available data in order to create a CPUE time series must be done.

At this moment the use of other methods than XSA is not expected to change the perception of the Div. 3M American plaice stock due to its very poor condition. Nevertheless STACFIS reiterates the recommendation *that the utility of the XSA must be re-evaluated and the use of alternative methods (eg. survey based models stock production models) be attempted in the next assessment of Div. 3M American plaice.* .

Because ages below 3 are not well selected in the EU survey series STACFIS also **recommended** that *exploratory runs of the XSA should be done with the input data starting at age 3 or 4.*

This stock will be fully assessed in 2011.

C. STOCKS ON THE GRAND BANK: Subarea 3, Div. 3LNO

Environmental Overview

The water masses characteristic of 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^{o}C during spring and 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^{o}-4^{o}C in southern regions of 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^{o}-8^{o}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 proportion of bottom habitat on the Grand Banks covered by <0^{o}C water has decreased from near 50% during the first half of the 1990s to <15% during 2004 and 2006.

The annual surface temperatures at Station 27 have been above normal since 2002, reaching a 61-year high in 2006, but decreased below normal in 2007. Vertically averaged values over various depths also set record highs in 2006 but decreased to below-normal values at other depths in 2007 on the Grand Banks. Sea surface and near-bottom temperatures remained above normal in 2007 on the Grand Banks but decreased significantly from the 2006 values. Temperature data obtained from thermographs deployed at inshore sites at 10-m depth show considerable variability about the mean due to local wind-driven effects. In general however, they show similar patterns, with mostly below-normal anomalies during the first half of the 1990s and above-normal during the latter half up to 2006. In 2007, 5 out of the 6 sites with data reported significant negative anomalies. Annual surface salinities at Station 27 decreased from the previous 5 years to about normal in 2007. The summer CIL area on the Grand Banks was below normal for the 10th consecutive year (1998-2007) and along the southeast Grand Bank section the spring CIL area was above normal after the record low value of the spring of 2006.

9. Cod (*Gadus morhua*) in Div. 3N and 3O

(SCR Doc. 08/8; SCS 08/5, 6, 7)

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 2007 in Div. 3NO from all fisheries was estimated to be 845 t.

Recent nominal catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	Ndf	ndf	ndf	Ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.5	0.5	0.9	1.2	1.6	0.8	0.6	0.3[1]	0.6[1]	
STACFIS	0.9	1.1	1.3	2.2	4.3-5.5[2]	0.9	0.7	0.6	0.8	

1 Provisional.

2 STACFIS could not precisely estimate the catch. Figures are the range of estimates.

ndf No directed fishery and bycatches of cod in fisheries targeting other species should be kept at the lowest possible level.

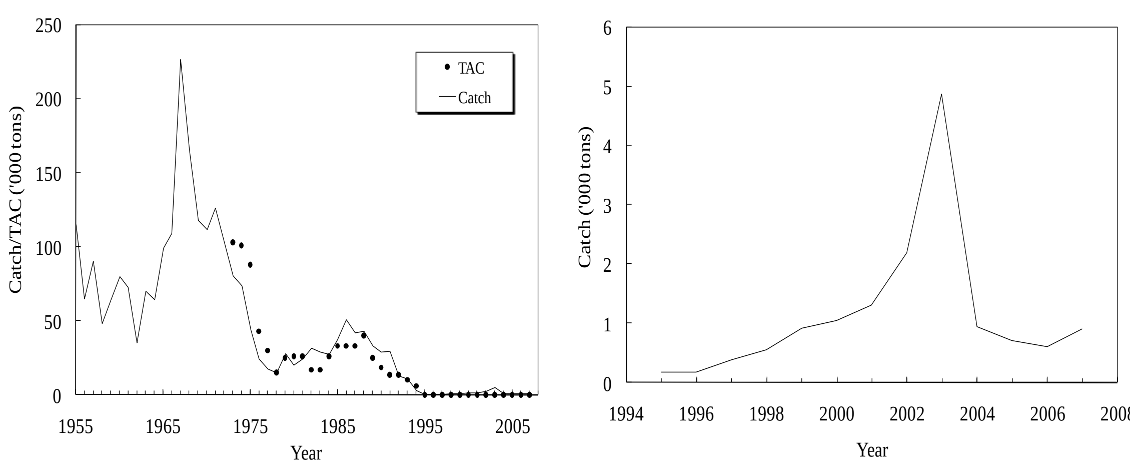


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

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 1971-2007 period, with the exception of 1983, and in Div. 3O for the years 1973-2007 with the exception of 1974 and 1983. Survey coverage of Div. 3NO in 2006 was poor and is not considered to be representative of stock size. 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.

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 indices were the lowest observed in the series, showed improvement from 1998 to 2000 then subsequently declined to 2004. The 2007 survey estimate is the highest since 1993 but still at a very low level compared to earlier in the time series (Fig. 9.2). Most of this increase is the 2006 year class at age 1, although the 2005 year class at age 2 is also higher than the average number at that age for cohorts since 1998.

Stratified-random surveys have been conducted by Canada during **autumn** since 1990. 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 1990 to autumn 1994. 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 2007 survey estimate is the highest since 1992 but still at a very low level compared to earlier in the time series (Fig. 9.2). Most of this increase is the 2006 year class at age 1 and the 2005 year class at age 2.

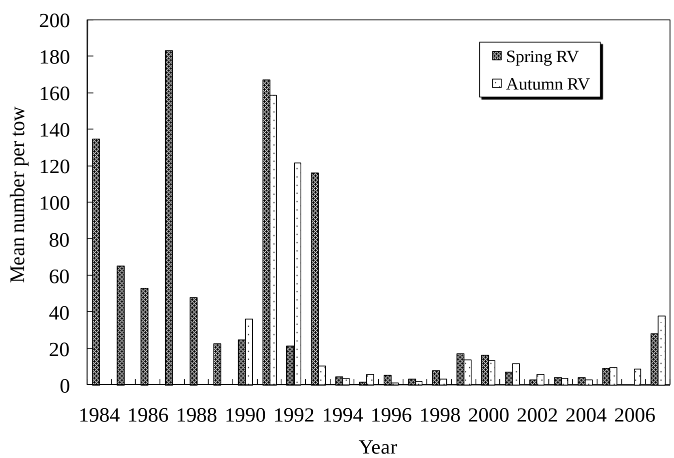


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian spring and autumn research surveys.

Survey by EU-Spain. Stratified-random surveys were conducted by Spain in the NRA area of Div. 3NO in June from 1995-2007 to a maximum depth of 1 462 m (since 1998). The series began utilizing a Pedreira trawl on the C/V Playa de Menduiña then converted to a Campelen 1800 trawl on the R/V Vizconde de Eza in 2001. The 1997-2000 data were converted into Campelen units by modeling data collected during comparative fishing trials in 2001. The data for 1995-96 are not presented because the deeper strata in the area of coverage were not sampled. The time series has been quite variable with no clear trend (Fig. 9.3). The estimates from 2006 and 2007 are among the highest in the time series. The 2006 and 2005 year classes also appear strong compared to recent cohorts in the survey by EU-Spain for 2007. The 2003 year class appears to be more strongly represented in the survey by EU-Spain than in the surveys by Canada.

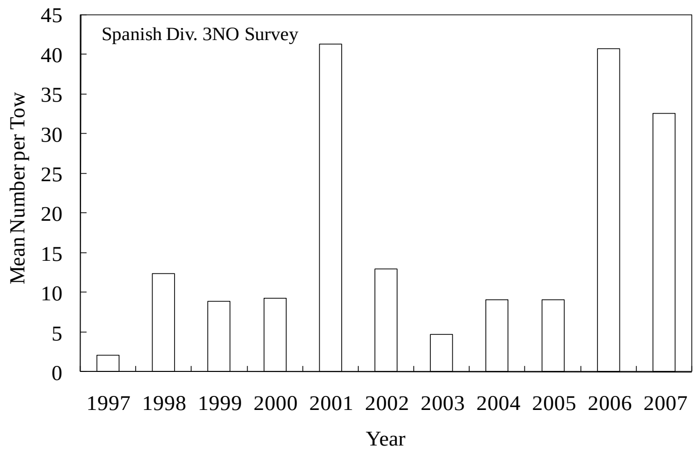


Fig. 9.3. Cod in Div. 3NO: mean number per tow from EU-Spain spring surveys.

c) Conclusion

In 2007 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. It is too early to determine if the 2006 and 2005 year classes are larger than other recent cohorts.

The next full assessment of this stock is planned to be in 2010.

10. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3L and 3N

(SCR Doc. 08/21, 33; SCS Doc. 07/5, 6, 7)

a) Introduction

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

Reported catches from Div. 3LN declined from 45 000 to 10 000 t on the first years of catch records (1959-1964) and oscillated over 21 years afterwards (1965-1985) around 21 000 t average level. Catches increased sharply to a 79 000 t high in 1987 and fell steadily afterwards to 450 t in 1996. From 1986 till 1993 reported catches exceeded TACs, but in the rest of the years prior to the close of the fishery catches fell well below annual TACs. The NAFO Fisheries Commission implemented a moratorium on directed fishing for this stock in 1998. Catch increased to 900 t in 1998, the first year under a moratorium on directed fishing, with a further increase to 3 100 t in 2000. Catches declined in 2001-2003 and were stable in 2004-2005 at 650 t level. Catch almost reached the historic low level in 2006 with 496 t, but recorded over a three fold increase in 2007, with a STACFIS catch estimate of 1 664 t (Fig. 10.1).

Recent catches and TACs are:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT	1.8	1.5	0.9	1.0	1.3	0.7	0.7	0.2	0.2	
STACFIS	2.3	3.1	1.4	1.2	1.3	0.6	0.7	0.5	1.7	

ndf No directed fishing.

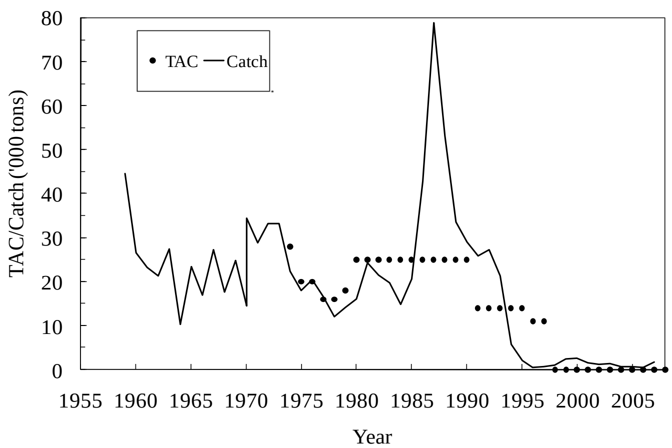


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

b) Input Data

i) Commercial fishery data

Most of the commercial length sampling data available for the Div. 3LN beaked redfish stocks came, since 1990, from the Portuguese fisheries. Length sampling data from EU-Spain and from Russia were used to estimate the length composition of the by-catch for those fleets in 2003 and 2005 and 2003-2007 respectively. The overall mean length of the 1990-2007 catch was used to derive the anomalies of the mean length on the Div. 3LN beaked redfish commercial catch over this period. The proportion of small redfish in the catch (less than 20cm) was calculated as well. Stability in the length structure of the catch/by-catch is observed through the 1990-2007 interval, with no clear pattern on length anomalies detected over time. Higher negative anomalies are coupled with higher proportions of small redfish in 1991, 1998, 2003 and 2006 suggesting in those years, above average recruitments to the exploitable stock, from year classes 4-5 years back in time.

ii) Research survey data

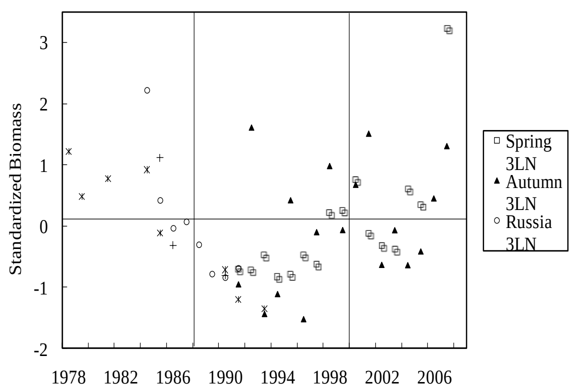
Results of bottom trawl surveys for redfish in Div. 3LN indicated a considerable amount of variability. From 1978 onwards several stratified-random bottom trawl surveys have been conducted by Canada in various years and seasons in Div. 3L and in Div. 3N. Since 1991 two Canadian series of annual stratified-random surveys covered both Div. 3L and Div. 3N on a regular annual basis: a spring survey (May-Jun.) and an autumn survey (Sep.-Oct. in Div. 3N and Nov.-Dec. in Div. 3L for most years). No survey was carried out in spring 2006 in Div. 3N.

The design of the Canadian surveys was based on a stratification scheme down to 732 m for Div. 3LN. From 1996 onwards the stratification scheme has been updated to include depths down to 1 464 m (800 fathoms) but only the autumn surveys have swept strata below 732 m depth, most in Div. 3L. Until the autumn of 1995 the Canadian surveys were conducted with an Engel 145 high lift otter trawl with a small mesh liner (29 mm) in the codend and tows planned for 30 minute duration. Starting with the autumn 1995 survey in Div. 3LN, a Campelen 1800 survey gear was adopted with a 12 mm liner in the codend and 15 minute tows The Engel data were converted into Campelen equivalent units in the 1998 assessment (*NAFO Sci. Coun. Rep*., 1998, p. 76).

The 1992 autumn biomass index for Div. 3N and the 1995 autumn index for Div. 3L have anomalously high magnitude while staying between low indices from the neighbouring years, and occurring within a period where the general overview, both from surveys and commercial CPUE, was that the stock had been severely reduced. Moreover the original mean weights per tow are associated anomalously high errors, the highest for the two series and divisions. These two points were so considered outliers of the respective time series. No survey was carried out in spring 2006 on Div. 3N.

Since 1983 Russian bottom trawl surveys in NAFO Div. 3LMNO turn to stratified-random, following the Canadian stratification for Sub area 3. In 1984 standard tows were set to half an hour at 3.5 knots, with a standard gear. From 1984 until 1990, vessels conducting this survey were of the same tonnage class with the exception of 1985, when a vessel of smaller tonnage class was employed. This smaller category was later employed on the 1991 and 1993 surveys. On 1992 and 1994 Russian survey was carried out only in Div. 3L. In 1995 the Russian bottom trawl series in NAFO Subarea 3 was discontinued.

Div. 3L and Div. 3N biomass and female SSB indices from Canadian spring and autumn surveys have been combined to give a picture of their relative sizes for this redfish management unit as a whole. In order to smooth the wide inter-annual variability of the indices, make the survey series comparable and facilitate the detection of trends within stock dynamics, the available survey biomass series and the female SSB survey series were standardized (difference between each observation and the mean scaled to the standard deviations of the series) and so presented on Figure 10.2.



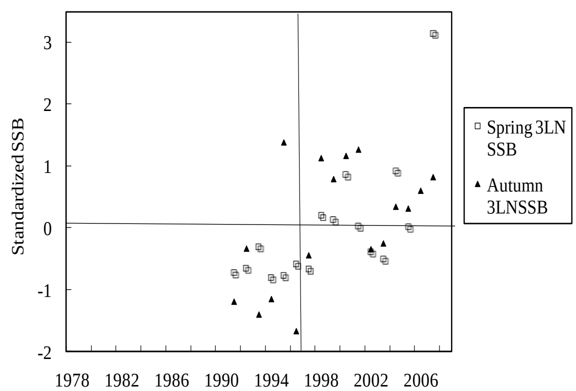


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2007) and female spawning biomass (1991-2007) .Each series standardized to zero mean and unit standard deviation.

From the mid-1980s to the beginning of the 1990s, when catches quickly rose from a previous average level of 21 000 t (1965-1985) to a much higher level of 41 500 t (1986-1992), Canadian survey data in Div. 3L and Russian bottom trawl surveys in Div. 3LN suggests that stock size suffered a substantial reduction. Redfish survey biomass in Div. 3LN remained below the average level until 1998 and increased to above average levels afterwards. A punctual decline is observed in 2002-2004, followed by a consistent increase of the remaining biomass indices over the most recent years. The 1991-2007 standardized female SSB series showed patterns similar to correspondent total survey biomasses series over the years, with most observations below average before 1998 and most above average afterwards.

The overall 1991-2007 mean length for each survey abundance at length matrix was used to derive the spring and autumn length anomalies for the Div. 3LN beaked redfish stock over this period (Fig. 10.3). On both survey series all/most of the anomalies during the first half of the 1990’s were negative while all were positive between 1996 and 2000. This shift on the survey catch length structure to larger individuals could reflect a relatively high survival of the year classes through the second half of the 1990’s. From 2001 onwards length anomalies are either positive or negative with no clear pattern on the spring survey, whereas on the autumn survey most became closer to the overall mean. The lack of a clear pattern on length residuals from both surveys suggests stability on population structure over recent years. With the exception of 1991 and 1992 on the autumn survey, when a couple of large negative residuals are observed probably as a consequence of a pulse on recruitment from the late 1980’s, no further signs of other pulses on recruitment are detected.

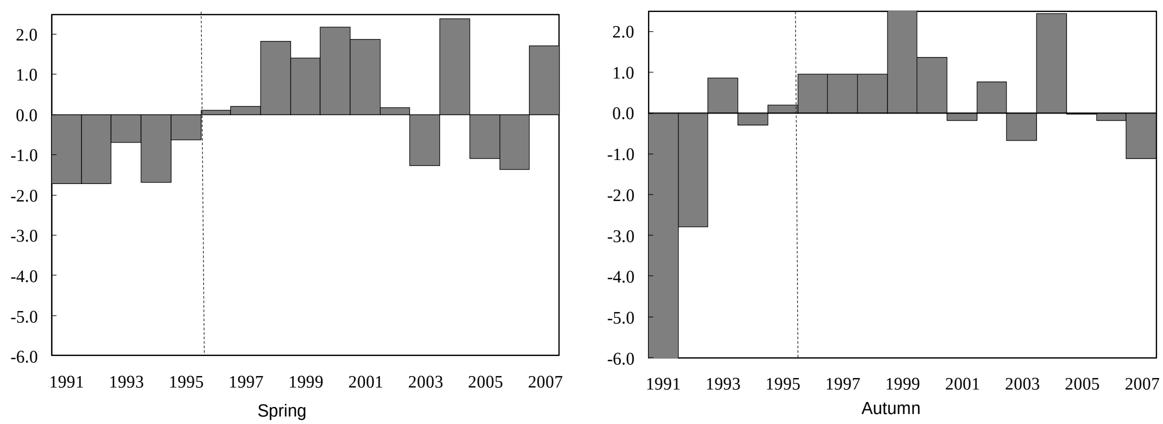


Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2007.

iii) Recruitment

There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN in the range of 12-14 cm for 1991 and 15-18cm for 1992. From Canadian survey data there is no sign of any good year-classes since then.

c) Estimation of Stock Parameters

i) Relative exploitation

Ratios of catch to spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy for fishing mortality. Spring survey series was chosen since is usually carried out on Div. 3L and Div. 3N during May till the beginning of June, and so can give an index of the average biomass at the middle of each year. The 3LN STACFIS catch was used together with a spring survey biomass series smoothed by 3- year interval moving averages (Fig. 10.4).

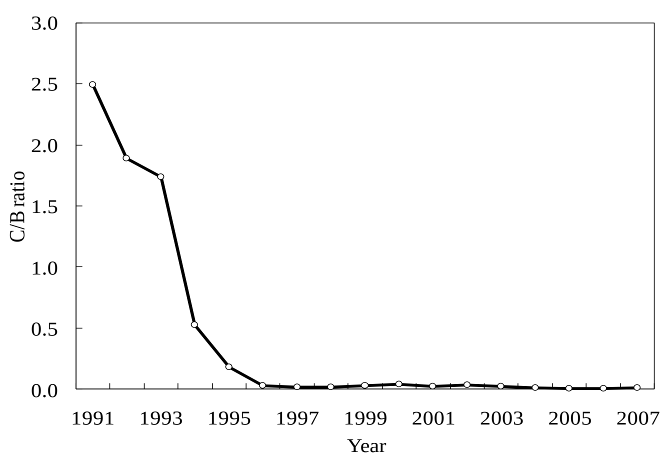


Fig. 10.4. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (moving average biomass, 1991-2007).

Catch/Biomass ratio declined continuously from 1991 to 1996, with a dramatic drop between 1993 and 1994. From 1996 onwards this proxy for fishing mortality has kept at a level close to zero.

ii) Size at maturity

Maturity ogives indicate L_{50} for females in Div. 3L is 30.5 cm and in Div 3N is 30.2 cm. Males mature at a much smaller size than females and there are differences between Div. 3L (L_{50} = 23.9) and Div. 3N (L_{50} = 20.3 cm).

d) Assessment Results

A revised ASPIC model (Prager, 1994, 2004 and 2007) was, as recommended in 2007, evaluated at the June 2008 meeting. The model incorporates catches from 1959-2007 (conditioned on a 1959-94 *cpue* series from Statlant data), and most of the stratified-random bottom trawl surveys conducted by Canada and Russia in various years and seasons in Div. 3L and Div. 3N, from 1978 onwards. All input series consist of annual observed values and were given equal weight in the analysis. In this assessment the ASPIC version 5.16 fitted the logistic form of the production model (Schaefer, 1954).

STACFIS agreed that the fitted biomass trajectory from the ASPIC revised model agreed with the input index series at a qualitative level, reflecting a period of apparent stability from the 1960s to the late 1980s, a sharp decline through the mid-1990s associated with high catches, and an increase in the general level of biomass indices from 1995 to date.

However STACFIS had serious concerns about the results of the ASPIC model and these were:

The biomass/B_{msy} ratio in the most recent years is estimated at about 1.8, with a very rapid recent growth which seems inconsistent with the life history of a long-lived and slow-growing species.

STACFIS observed that the diagnostic fit of the model was poor and there were low correlations between model and input data. The ASPIC model was not accepted as a quantitative basis for the 2008 assessment of this stock.

Biomass indices for redfish, derived either from commercial or survey catch rates, typically show large inter-annual variability, too drastic to be only explained by changes in stock size from one year to the next. These fluctuations, caused not only by the schooling behaviour of redfish but also by a wide and "non-uniform" spatial distribution, turn the measurement of the relative magnitude of the stock increase, based on biomass indices by their own, difficult to quantify. Nonetheless, both *cpue* and survey biomass indices available for the early 1990's are considerably lower than those from the 1980's, indicating a reduced stock size. The assemblage of the available survey indices suggests that stock has increased from the mid 1990 to present in terms of biomass, female spawning biomass and abundance. The survey indices available for 2007 are in line with this upward trend.

Stock length structure has been improving over the 1990's and remain stable since then, confirming the survival of incoming year-classes regardless their general low sizes and the lack of good recruitment for more than a decade.

Estimates of exploitation rate suggest that fishing mortality should be at a very low level when compared to the first half of the 1990s and that recent level of catches have not altered the upward trend of the stock, as shown by both spring and autumn surveys.

STACFIS noted that available survey indices indicate an increase in stock in recent years broadly to level seen in the late 1970s and first half of the 1980's.

e) Reference Points

At present, it is not possible to determine limit or other reference points for either fishing mortality or biomass for redfish in Div. 3LN.

The next full assessment of the stock is planned for 2010.

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3L, 3N and 3O

(SCR Doc. 08/7, 42; SCS Doc. 08/5, 6, 7, 12)

Interim Monitoring Report

a) Introduction

This fishery has been under moratorium since 1995. Total catch in 2007 was 3 620 t, mainly taken in the Regulatory Area and as by-catch in the Canadian yellowtail flounder fishery (Fig. 11.1). Since 1995, catch increased, but has been lower in the past three years.

Recent nominal catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	nf	ndf	ndf	Ndf	Ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	2.4	2.6	3.0	3.1	3.8	2.9	2.3	0.9[1]	1.0[1]	
STACFIS	2.6	5.2	5.7	4.9	6.9-10.6[2]	6.2	4.1	2.8	3.6	

[1] Provisonal
[2] In 2003, STACFIS could not precisely estimate catch

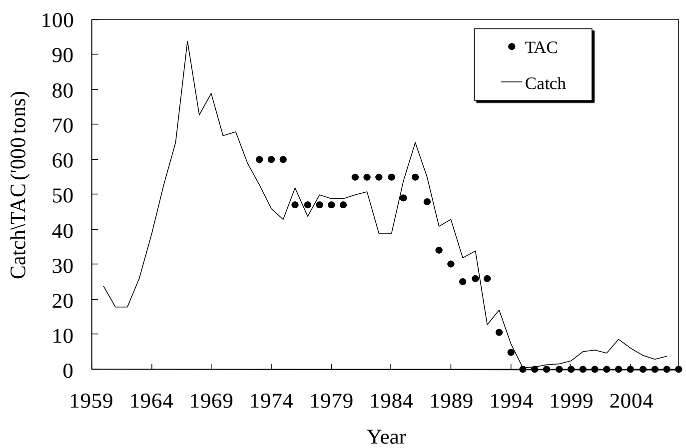


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs

b) Data Overview

Canadian stratified-random bottom trawl surveys. Data from **spring surveys** in Div. 3L, 3N and 3O were available from 1985 to 2007 with poor coverage in the 2006 survey. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 2007, the depth range has been extended to at least 731 m in each survey.

In the 2007 spring survey the mean weight per tow estimates for 3L, 3N and 3O were 8.7, 58.5 and 17.4 kg, respectively. The values for Div. 3LNO combined are about the same or slightly higher than the past few years. From 1996 to 1998 the estimate for Div. 3N biomass was approximately half of the estimate for Div. 3O, then for a period of time, estimates in the two Divisions were similar, but in recent years the estimate in Div. 3N is larger than Div. 3O (estimate of Div. 3N 77% of the total of Div. 3NO). Biomass in Div. 3LNO combined has increased somewhat since 1996 but is only 31% (Campelen estimates compared to Campelen equivalents) of that of the mid 1980s (Fig. 11.2).

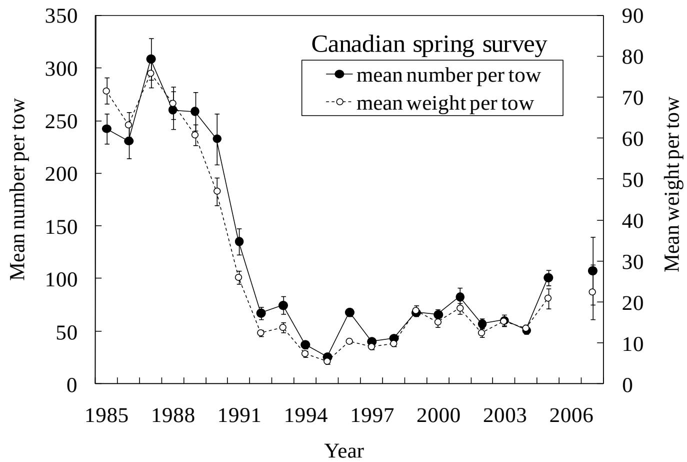


Fig. 11.2 Mean number per tow and mean weight per tow (± 1 standard deviation) of American plaice in Div. 3LNO from Canadian spring RV surveys from 1985-2007 (Campelen and Campelen-equivalents). Survey coverage was poor in 2006 and the result was not included in 2007 assessment.

From Canadian **autumn surveys** the biomass 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 2005-2007 being 37% of the level of 1990. Mean weight per tow in 2007 was 21.2 kg (Fig. 11.3). Mean weight per tow in Divisions 3L and 3O underwent a large decline from 1990 to 1994 and has remained low since then. In Div. 3N, mean number per tow has been increasing since 1995 and is currently at the same level as in 1990. During 1995 to 1997, the biomass in Div. 3N constituted on average 40% of the Div. 3NO total and since 2000 it has been at least 63% of the Div. 3NO total.

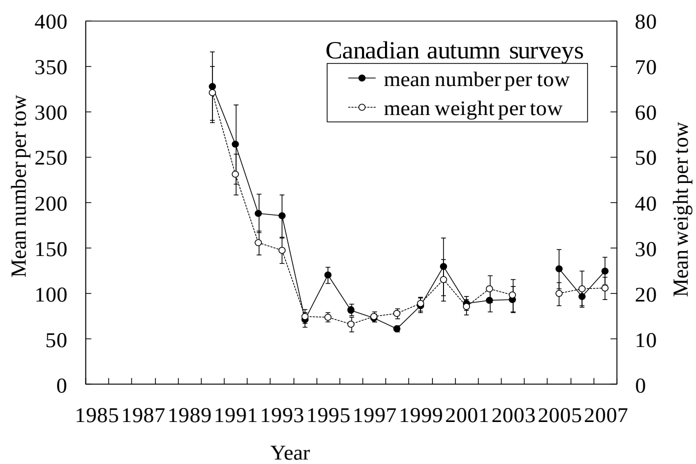


Fig. 11.3 Mean number per tow and mean weight per tow (± 1 standard deviation) of American plaice in Div. 3LNO from Canadian autumn RV surveys from 1985-2007 (Campelen and Campelen-equivalents). Survey coverage was poor in 2004 and the result was not included in 2007 assessment.

Spanish Div. 3NO Survey. Surveys have been conducted annually from 1995 to 2007 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 (R/V *Playa de Menduiña*) and gear (Pedreira) were replaced by the R/V *Vizconde de Eza* using a Campelen trawl (SCR Doc. 05/25). The mean weight per tow value was highest in 2006 from this survey (Fig. 11.4).

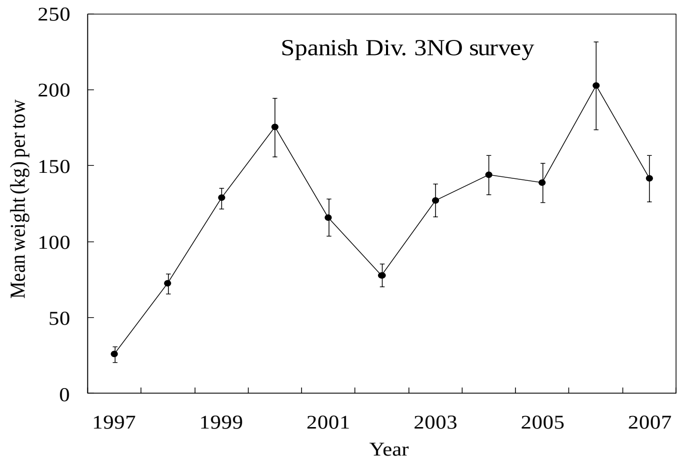


Fig. 11.4 Mean weight per tow (± 1 standard deviation) of American plaice in Div. 3NO from Spanish RV surveys from 1997-2007 (Campelen and Campelen-equivalents).

Biomass is very low compared to historic levels and there has been no good recruitment since the mid-1980s.

c) Conclusion

Based on overall survey indices for the current year, there is nothing to indicate a change in the status of this stock.

The next full assessment of this stock is planned to be in 2009.

12. Yellowtail flounder (*Limanda ferruginea*) in NAFO Divisions 3LNO

(SCR Doc. 08/8, 44, 45; SCS Doc. 07/6, 8, 9; 08/5, 6, 8)

a) Introduction

Since the fishery re-opened in 1998, catches have increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches since then have ranged from 11 000 to 14 000 t, except in 2006 and 2007, when catches were well below the TACs due to corporate restructuring and a labour dispute in the Canadian fishing industry

Recent catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	6.0	10.0	13.0	13.0	14.5	14.5	15.0	15.0	15.5	15.5
TAC	6.0	10.0	13.0	13.0	14.5	14.5	15,0	15.0	15.5	15.5
STATLANT 21A	7.0	10.6	12.8	10.4	13.0	13.4	13.9	0.6[1]	4.4[1]	
STACFIS	7.0	11.0	14.1	10.8	13.5-14.1[2]	13.4	13.9	0.9	4.6	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.

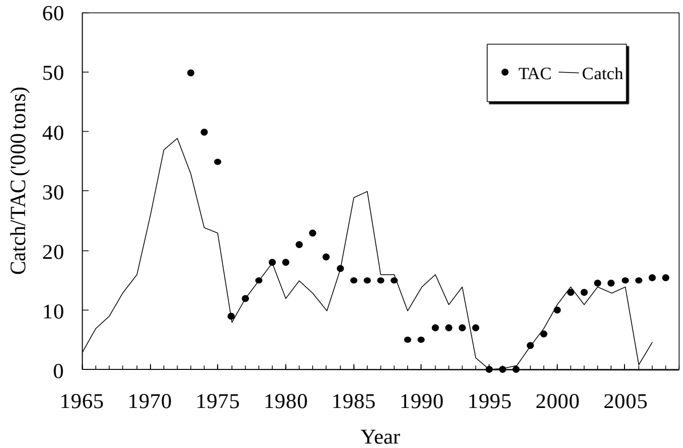


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs.

b) Input Data

i) Commercial fishery data

There were no catch and effort data available from the 2006 Canadian commercial fishery, but 2007 data were included in an updated multiplicative model to analyze the CPUE series from 1965 to 2007. 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 1998-2007 CPUE values are not directly comparable to CPUE indices from previous years because of changes in the 1998-2007 fishing patterns. The 1998-2007 catch rates are related to the Canadian fleet's fishing pattern, which because of the 5% by-catch 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. Excluder grates have been used by the Canadian fleet in recent years in an attempt to control by-catch levels, particularly cod. In 2007, the main bycatches in the Canadian fishery were of 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 2007, and has shown little variation during recent years.

There was sampling of yellowtail flounder from by-catches by EU-Portugal in the Regulatory Area of Div. 3N in 2006 and 2007, EU-Spain in the Regulatory Area of Div. 3NO and Russia (Regulatory Area of 3LNO) in 2007. The minimum codend mesh size in the Canadian fleet is 145 mm while Spain uses a minimum of 130 mm mesh size. In 2007, the mean length in the Spanish yellowtail by-catch was 33 cm. In skate fisheries of Portugal and Spain, where a minimum codend mesh size of 280 mm is used, the mean length in the 2006 Portugal by-catches of yellowtail was 39 cm but shifts to a higher mean length of 41 cm in 2007. The mean length in the 2007 Spanish by-catches showed a shift to smaller fish at 36 cm.

ii) Research survey data

Canadian stratified-random spring surveys (SCR Doc. 08/44). Problems with the Canadian survey vessel resulted in incomplete coverage, particularly in Div. 3N, in the 2006 spring survey. In 2007, most of the trawlable biomass of this stock continued to be found in Div. 3N. The index of trawlable biomass in 2007 decreased from the 2006 value but was the second highest in the survey series.

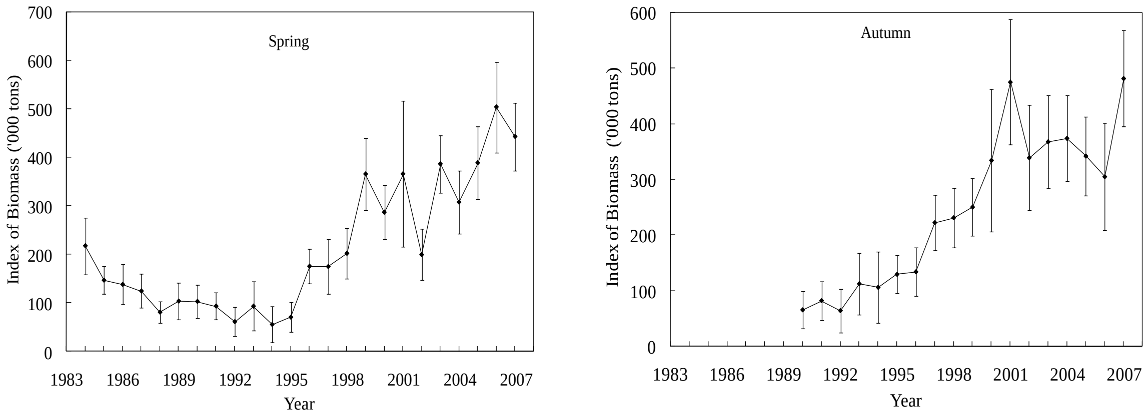


Fig. 12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx 95% confidence intervals, from Canadian spring and autumn surveys.

Canadian stratified-random autumn surveys (SCR Doc. 08/44). Most of the biomass from the autumn survey in 2007 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 a peak value in 2001, biomass in 2002-2006 remained relatively stable, and then increased to the series high in 2007.

Spanish stratified-random spring surveys in the Regulatory Area of Div. 3NO. (SCR Doc. 08/8) 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 Menduiňa* and *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 2000-2007 (Fig. 12.3). The 1995-2002 results are in general agreement with the Canadian spring series for all of Div. 3LNO. Most (83%) of the biomass comes from strata 360 and 376 similar to other years. Length frequencies in the 2006 and 2007 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.

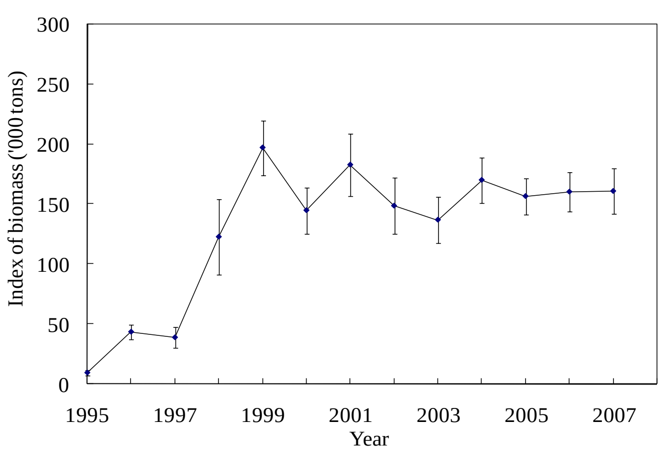


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the Spanish spring surveys in the Regulatory Area of Div. 3NO. Data are in Campelen equivalents ±1SD.

Stock distribution (SCR Doc. 06/29, 41; SCR Doc. 08/44). 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 1999-2007 surveys than in previous years, and the northward distribution of the stock has again extended in Div. 3L, similar to the 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. The previous assessment of this stock showed a relationship between 1990-2005 spring and fall 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.

iii) Biological studies

(SCR Doc. 08/45)

Maturity at size was estimated for each sex separately, using Canadian spring research vessel data from 1984-2007. 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). Although there have been short term fluctuations, there has been little overall trend since 2000, with L_{50} averaging just under 25 cm. Female L_{50} has been fairly stable until the last 5 years which have all been estimated below the long term average of 33 cm.

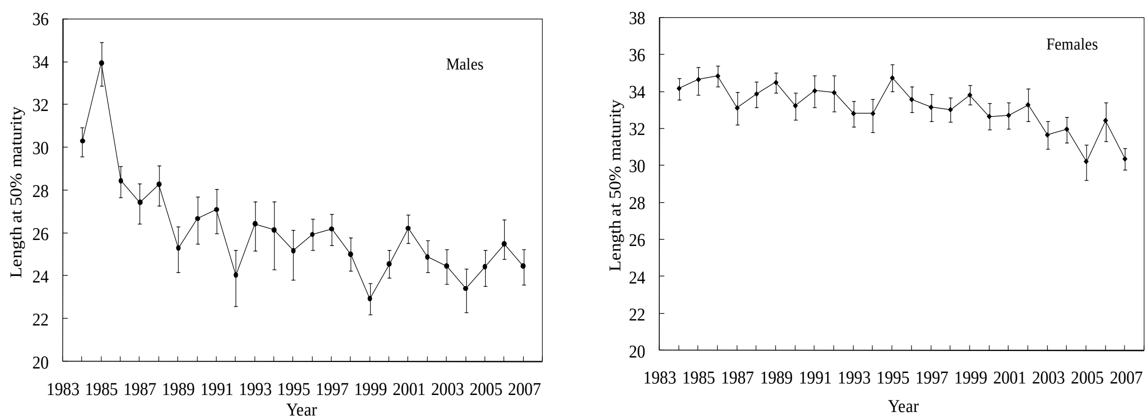


Fig. 12.4. Yellowtail flounder in Div. 3LNO: length at 50% maturity.

A length-based female SSB index was derived from the 1984-2007 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. The 2002 to 2007 average is 163 000 t, substantially higher than that of the mid-1980's. In general, the female SSB index mirrors the trend in the total survey biomass index.

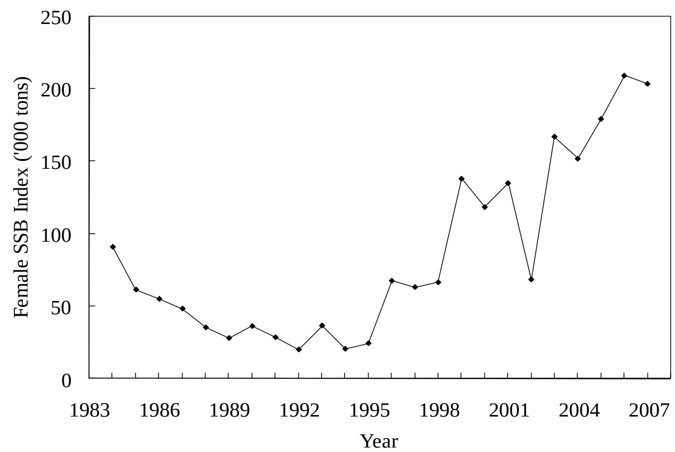


Fig. 12.5. Yellowtail flounder in Div. 3LNO: female spawning stock biomass index estimated from 1984 to 2007 annual spring surveys.

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 either the Canadian or Spanish spring series (Fig. 12.6). In the recent two years, the number of juveniles in the Canadian autumn series, although higher than the two spring series, is more comparable to values seen in the past. No clear trend in recruitment is evident.

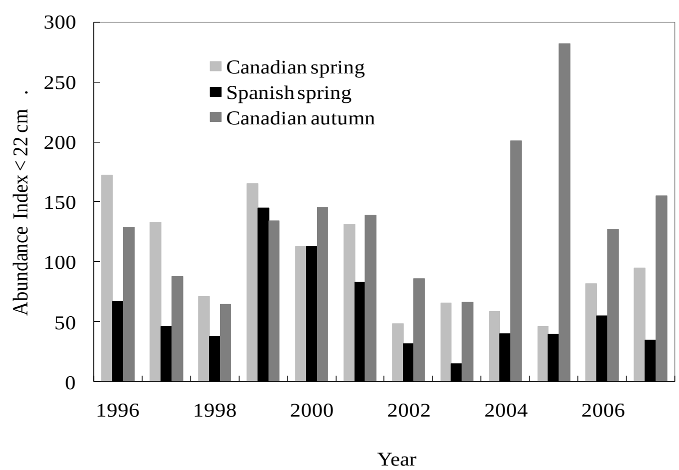


Fig. 12.6. Yellowtail flounder in Div. 3LNO: Juvenile length index estimated from 1996 to 2007 annual spring and autumn surveys by Canada and annual spring surveys by Spain.

c) Estimation of Parameters

(SCR Doc. 08/45)

Previous assessments (2002, 2004 and 2006) used an older version of a non-equilibrium surplus production model (ASPIC) to assess the status of yellowtail flounder in Div. 3LNO. In order to investigate potential differences in estimation of parameters by an updated version of ASPIC (version 5.24), the previously accepted model formulation of ASPIC version 3.81 was run with the 2006 assessment data in both ASPIC versions and compared. Both versions of ASPIC produced nearly identical parameter estimates and population trajectories, and STACFIS accepted version 5.24 of ASPIC to assess the current state of this stock.

Several model formulations were considered using ASPIC to assess the state of the stock in 2008. The 2006 model formulation was presented, with catch and survey data updated for 2006 and 2007, and TAC of 15 500 t included as catch in 2008. As in 2006, the catch and indices used were as follows: Catch data (1965-2007), Russian spring surveys (1972-91), Canadian spring surveys (1971-82), Canadian spring (1984-2007) and autumn (1990-2007) surveys and the Spanish spring (1995-2007) surveys. As in previous assessments, ASPIC noted poor r^2 and strong residual patterns in the Russian time series.

In order to investigate the effect of the Russian survey series on the model fit and parameter estimation, three other treatments of this series were considered. Given that the Russian survey used different methodologies in different time periods, it was decided to use the Russian survey series as a split series (1972-1982; and 1984-1991) in one run; to look at the latter period only (1984-1991), as the survey method in this time period followed the Canadian survey methodology; and to remove the Russian series from the model formulation. In all runs, all surveys were given equal weight in the analysis.

Given that using the Russian series split into two tuning indices (1972-1982; and 1984-1991) produced a strong negative correlation with model fit, STACFIS considered using this dataset inappropriate for modelling population dynamics. Omitting the entire Russian series, and using the Russian series from 1984-1991, both improved model fit and changed parameter estimates moderately. Since there was no strong reason to exclude the entire Russian series presented, and using the latter part of the series improved model fit, STACFIS accepted the updated 2006 model formulation, with the early part of the Russian time series excluded.

As well, concerns were raised regarding coverage of the Canadian spring survey. Stratum 373, in Div. 3N, was not surveyed in 2006 and in recent years had contributed a significant amount to the biomass estimate in the stock area. The number of sets in other important strata was also lower in this survey than in other years, and likely impacted estimates as well. STACFIS decided to remove the 2006 estimate from the Canadian spring survey series for the 2008 assessment ASPIC model formulation.

The accepted model formulation for 2008, then, was: Catch data (1965-2007, TAC 15 500 t in 2008), Russian spring surveys (1984-91), Canadian spring surveys (1971-82), Canadian spring (1984-2007 omitting 2006) and autumn (1990-2007) surveys and the Spanish spring (1995-2007) surveys.

d) Assessment Results

The surplus production model results are consistent in trend with the assessment in 2006, 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 18 820 t can be produced by total stock biomass of 73 580 t (B_{msy}) at a fishing mortality rate of 0.26 (F_{msy}). The analysis showed that relative population size (B_t/B_{msy}) was below 1.0 from 1973 to 1998. Biomass (B_t) has been estimated to be above B_{msy} since then, and the ratio is estimated to be 1.51 at the beginning of 2008 (Fig. 12.7). The parameter estimates and fit indicators for the 2006 accepted assessment and the 2008 accepted formulation are given in Table 12.1.

Table 12.1 Parameter estimates from the 2006 accepted assessment (SCR 06/48) and the 2008 accepted formulation (Russia 1984-1991; 2006 Can. Spring out).

Model	2006 Accepted Model Results	2008 Accepted Model Results
B1/K		0.87
B1R	2.15	
MSY	17.68	18.82
r	0.44	
r^2 (Catch/Canadian Spring)	0.83	0.87
r^2 (Yankee survey)	0.80	0.80
r^2 (Canadian fall)	0.88	0.85
r^2 (Russian 1972-1994)	0.29	
r^2 (Russian 1984-1991)		0.56
r^2 (Spanish)	0.56	0.62
K	159.00	147.20
Bmsy	79.50	73.58
Fmsy	0.22	0.26
B (2009)/Bmsy	1.33	1.64
F (2008)/Fmsy	0.64	0.49
Total Objective function	10.32	6.10
sum of N (GOF)	81.00	75.00
p (number of parameters B1R, MSY, r, qs)	8.00	9.00
restarts	43	42

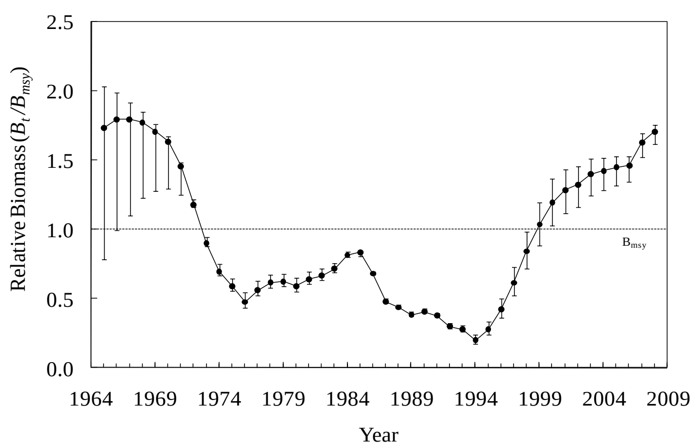


Fig. 12.7. Yellowtail flounder in Div. 3LNO: bias corrected relative biomass trends with approximate 80% confidence intervals.

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 2007, F is estimated to be 15% of F_{msy}, and if the TAC of 15 500 t is caught in 2008, F is projected to be 49% of F_{msy}.

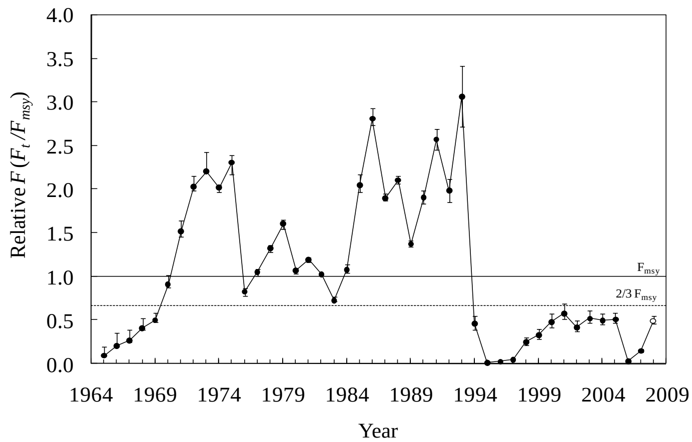


Fig. 12.8. Yellowtail flounder in Div. 3LNO: bias-corrected relative fishing mortality trends with approximate 80% confidence intervals.

Since the moratorium (1994-97) was put in place, the estimated catch has been below surplus production levels (Fig. 12.9).

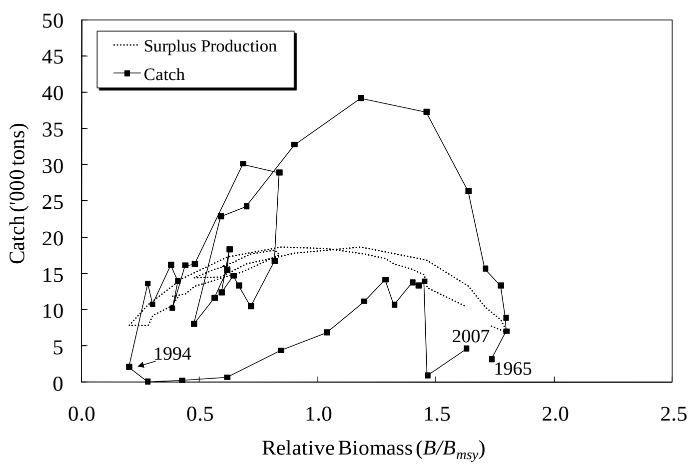


Fig. 12.9. Yellowtail flounder in Div. 3LNO: catch trajectory.

The model was bootstrapped (500 iterations) to derive estimates of catch projections for 2009 and 2010 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 2008 would equal the TAC of 15 500 t. However, the TACs have not been taken in recent years, and in particular, catches in the last two years were much lower than the TAC at 6% and 30%, respectively.

Table 12.2. Management options for 2009-2010. F multipliers are applied to F_{2008}. The F multiplier is estimated by dividing F/F_{msy} (0.49 for 2008) into the %F_{msy}.

	F-multiplier	2009 F percentiles 5	25	50	75	95
Status quo	1.00	0.100	0.123	0.126	0.129	0.135
2/3 Fmsy	1.35	0.135	0.166	0.170	0.174	0.182
75% Fmsy	1.52	0.152	0.187	0.192	0.196	0.205
85% Fmsy	1.72	0.172	0.211	0.2172	0.222	0.232
Fmsy	2.03	0.203	0.249	0.256	0.262	0.273

	F-multiplier	2010 F percentiles 5	25	50	75	95
Status quo	1.00	0.100	0.123	0.126	0.129	0.135
2/3 Fmsy	1.35	0.135	0.166	0.170	0.174	0.182
75% Fmsy	1.52	0.152	0.187	0.192	0.196	0.205
85% Fmsy	1.72	0.172	0.211	0.2172	0.222	0.232
Fmsy	2.03	0.203	0.249	0.256	0.262	0.273

	F-multiplier	2009 Catch percentiles 5	25	50	75	95
Status quo	1.00	14.873	14.939	14.988	15.073	15.263
2/3 Fmsy	1.35	19.684	19.779	19.849	19.964	20.276
75% Fmsy	1.52	21.951	22.060	22.142	22.275	22.657
85% Fmsy	1.72	26.655	26.657	26.6581	26.658	26.659
Fmsy	2.03	31.460	31.462	31.463	31.463	31.463

	F-multiplier	2010 Catch pecentiles 5	25	50	75	95
Status quo	1.00	14.502	14.588	14.659	14.786	15.098
2/3 Fmsy	1.35	18.626	18.739	18.839	19.004	19.542
75% Fmsy	1.52	20.463	20.598	20.704	20.888	21.561
85% Fmsy	1.72	24.559	24.688	24.7831	24.935	25.408
Fmsy	2.03	28.478	28.640	28.761	28.954	29.549

	F-multiplier	2010 Biomass/B_{msy} percentiles 5	25	50	75	95
Status quo	1.00	1.520	1.573	1.595	1.613	1.634
2/3 Fmsy	1.35	1.465	1.518	1.539	1.555	1.577
75% Fmsy	1.52	1.439	1.492	1.512	1.529	1.550
85% Fmsy	1.72	1.411	1.461	1.4810	1.497	1.518
Fmsy	2.03	1.367	1.415	1.434	1.450	1.474

	F-multiplier	2011 Biomass/Bmsy percentiles 5	25	50	75	95
Status quo	1.00	1.499	1.547	1.567	1.584	1.604
2/3 Fmsy	1.35	1.410	1.457	1.475	1.492	1.514
75% Fmsy	1.52	1.367	1.413	1.432	1.448	1.473
85% Fmsy	1.72	1.318	1.364	1.3821	1.398	1.430
Fmsy	2.03	1.247	1.291	1.307	1.322	1.364

Medium-term projections were carried out by extending the ASPIC bootstrap projections forward to the year 2018 under an assumption of constant fishing mortality at 2/3 F_{msy}, 0.75 F_{msy} and 0.85 F_{msy}. The projections are conditional on the estimated values of r, the intrinsic rate of population growth and K, the carrying capacity. Catch and biomass decrease slightly over the projection period at 2/3 F_{msy}, 0.75 and 0.85 F_{msy} (Tables 12.2- 12.4, Fig. 12.10). At all levels of F considered for medium term projections (2/3 F_{msy}, 75% F_{msy} and 85% F_{msy}), the probability that the biomass in 2009 and 2010 will below B_{msy} is negligible. Cumulative catch at all levels of F considered are given in Table 12.6 and shown in Figure 12.10.

Table 12.3. Medium-term projections for yellowtail flounder. The 5, 50 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 15 500 t (TAC) in 2008.

F	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135	0.135
50	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170
95	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182	0.182
Fmsy	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256
2/3 Fmsy	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171

B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	112.53	105.14	100.64	97.85	96.07	94.93	94.20	93.72	93.39	93.18
50	120.46	113.08	108.38	105.33	103.20	101.68	100.65	99.92	99.41	99.02
95	152.86	145.63	140.75	137.38	135.01	133.32	132.10	131.23	130.59	130.13

Y	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	19.68	18.63	17.98	17.58	17.32	17.13	17.00	16.89	16.82	16.76
50	19.85	18.84	18.18	17.74	17.44	17.23	17.09	16.99	16.93	16.88
95	20.28	19.54	19.03	18.64	18.37	18.16	18.01	17.92	17.85	17.81

Br	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	1.55	1.46	1.41	1.37	1.34	1.32	1.31	1.29	1.29	1.28
50	1.64	1.54	1.48	1.43	1.40	1.39	1.37	1.36	1.36	1.35
95	1.68	1.58	1.51	1.48	1.46	1.44	1.43	1.42	1.41	1.41

Table 12.4. Medium-term projections for yellowtail flounder. The 5, 50 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 15 500 t (TAC) in 2008.

F	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152
50	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192
95	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205	0.205
Fmsy	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256
75% Fmsy	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192	0.192

B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	112.53	103.24	97.65	94.17	91.94	90.48	89.50	88.86	88.42	88.13
50	120.46	111.06	105.15	101.23	98.51	96.61	95.27	94.29	93.60	93.14
95	152.86	143.56	137.33	133.02	129.98	127.80	126.23	125.07	124.23	123.60

Y	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	21.95	20.46	19.56	19.00	18.61	18.32	18.10	17.93	17.79	17.69
50	22.14	20.70	19.77	19.15	18.71	18.42	18.21	18.07	17.97	17.90
95	22.66	21.56	20.77	20.23	19.84	19.57	19.34	19.21	19.13	19.07

Br	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	1.55	1.44	1.37	1.32	1.28	1.25	1.23	1.22	1.20	1.19
50	1.64	1.51	1.43	1.38	1.34	1.32	1.30	1.29	1.28	1.27
95	1.68	1.55	1.47	1.43	1.40	1.38	1.37	1.35	1.35	1.34

Table 12.5. Medium-term projections for yellowtail flounder. The 5, 50 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 15 500 t (TAC) in 2008.

F	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172
50	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217
95	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232
Fmsy	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.256
85% Fmsy	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217

B	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	112.53	101.03	94.22	89.96	87.17	85.31	84.10	83.28	82.70	82.29
50	120.46	108.76	101.43	96.57	93.21	90.85	89.15	87.86	86.93	86.29
95	152.86	141.16	133.39	128.02	124.22	121.48	119.47	117.98	116.88	116.05

Y	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	24.56	22.49	21.25	20.46	19.89	19.45	19.09	18.81	18.61	18.44
50	24.78	22.77	21.47	20.59	19.98	19.57	19.28	19.06	18.90	18.79
95	25.41	23.79	22.70	21.93	21.37	21.02	20.74	20.50	20.32	20.18

Br	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
5	1.55	1.41	1.32	1.25	1.21	1.17	1.15	1.13	1.11	1.10
50	1.64	1.48	1.38	1.32	1.27	1.24	1.22	1.20	1.19	1.18
95	1.68	1.52	1.43	1.37	1.33	1.31	1.29	1.28	1.27	1.26

Table 12.6. Table of cumulative catch ('000 t) of yellowtail flounder under three projected *F* scenarios in the medium term (2009-2018). The results are derived from an ASPIC bootstrap run (500 iterations) with a catch constraint of 15 500 t (TAC) in 2008.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
2/3 Fmsy	19.85	38.69	56.87	74.60	92.04	109.27	126.36	143.36	160.28	177.16
75% Fmsy	22.14	42.85	62.62	81.76	100.47	118.89	137.10	155.18	173.15	191.05
85% Fmsy	24.78	47.55	69.02	89.61	109.59	129.16	148.44	167.50	186.41	205.20

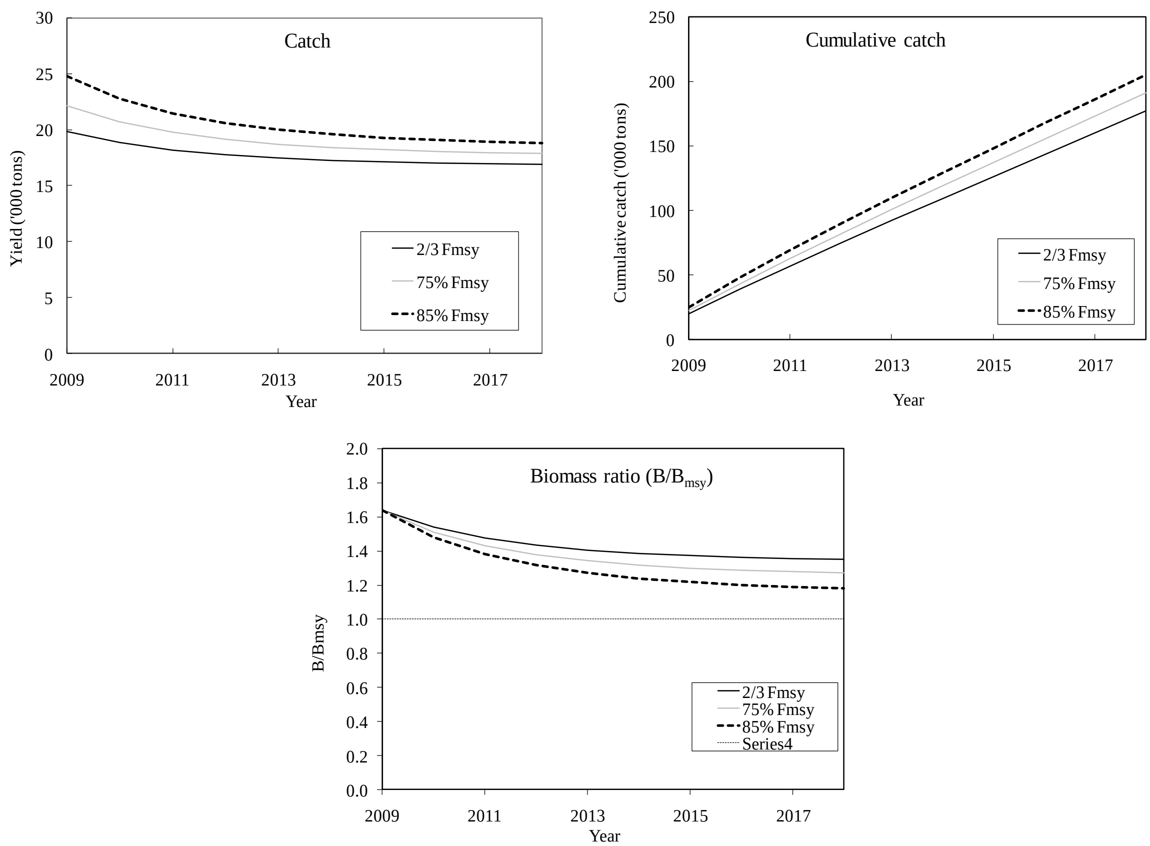


Fig. 12.10. Yellowtail flounder in Div. 3LNO: medium term projections at three levels of F (2/3 F_{msy}, 75% and 85% F_{msy}). Projected catch, cumulative catch, and relative biomass ratios (B/B_{msy}) are shown. Results are derived from an ASPIC bootstrap run (500 iterations) with a catch of 15 500 t assumed in 2008.

e) Reference Points

Precautionary approach. The surplus production model outputs indicate that the stock is presently above B_{msy} and below F_{msy}. Results are displayed within the NAFO precautionary approach framework in Figure 12.11. 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. 12.11. 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 1999 onward. At present, the risk of the stock being below B_{lim} = 30% B_{msy} is approximately zero.

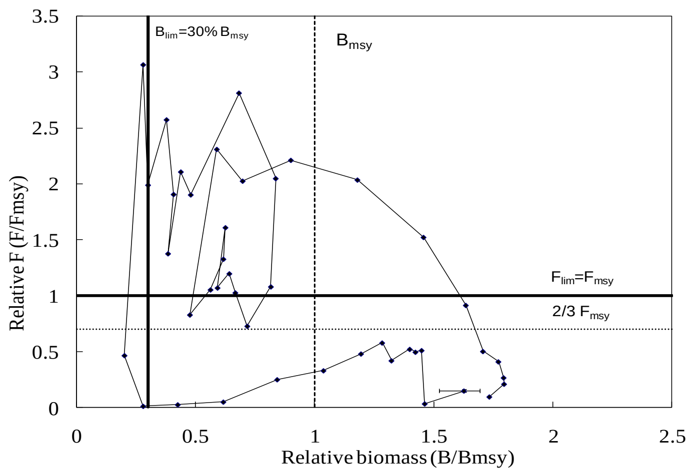


Fig. 12.11. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in the surplus production analysis, under a precautionary approach framework.

f) Conclusion

Based on results of the ASPIC production model, STACFIS concluded that the yellowtail flounder stock in NAFO Div. 3LNO is above B_{msy} and F is below 2/3 F_{msy}.

The next full assessment of this stock is planned to be in 2010.

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3N and 3O

(SCR Doc. 08/39; SCS Doc. 08/5, 6, 7, 12)

a) Introduction

Reported catches in the period 1972-84 ranged from a low of about 2 400 t in 1980 and 1981 to a high of about 9 200 t in 1972 (Fig. 13.1). With increased by-catch in other fisheries, catches rose rapidly to 8 800 and 9 100 t in 1985 and 1986. The increased effort was concentrated mainly in the NAFO Regulatory Area (NRA) of Div. 3N. From 1987 to 1993 catches ranged between about 4 500 and 7 500 t and then declined in 1994 to less than 1 200 t when no directed fishing on the stock was agreed. Since then, catches have averaged about 500 t; in 2007 the catch was about 220 t, taken mainly in the NRA of Div. 3O.

Recent catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TAC	ndf	ndf	Ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.9	0.7	0.5	0.7	0.9	0.6	0.3	0.5[2]	0.2[2]	
STACFIS	0.8	0.5	0.7	0.4	0.9-2.2[1]	0.6	0.3	0.5	0.2	

[1] In 2003, STACFIS could not precisely estimate the catch
[2] Provisional
ndf no directed fishery.

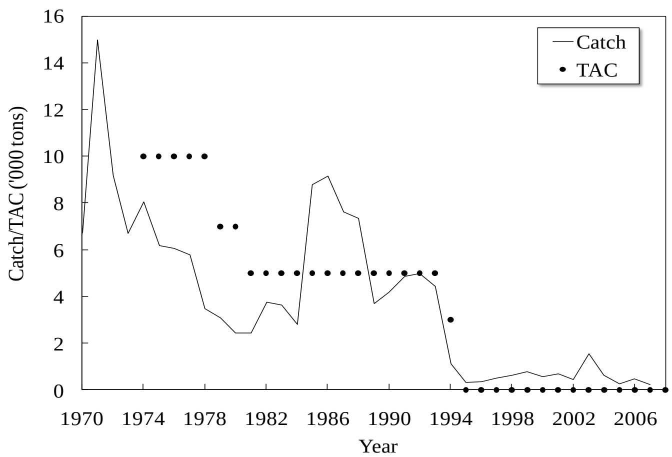


Fig. 13.1. Witch flounder in Div. 3N and 3O: catches and TAC.

b) Data Overview

i) Research survey data

Canadian spring RV survey mean weight per tow. For Div. 3N, mean weights per tow in the Canadian spring survey ranged from as high as 0.96 kg in 1984 to a low of 0.07 kg in 1996 and have been variable since then with the 2007 value about 0.60 kg. In Div. 3O, the spring survey estimates have been variable, but show a decreasing trend from 9.67 kg in 1985 to 0.83 kg in 1998. Since then mean weights per tow have remained variable but increased slightly in 2003 to 6 kg and then decreased to 2.3 kg in 2007. Although the combined index in Div. 3NO spring surveys (Fig 13.2) appeared higher in 2003 than in other recent years, it was driven by one large set. Since then the index has been variable, but similar to the value from 1999. The value in 2006 is not included because of poor survey coverage.

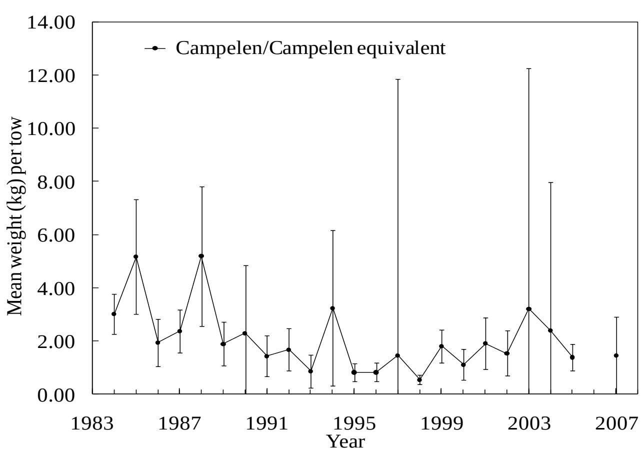


Fig. 13.2. Witch flounder in Div. 3NO: mean weights per tow from Canadian spring surveys (95% confidence limits are given. Note that the full range of confidence limits is not displayed where they extend below zero). Value in 2006 not included due to inadequate survey coverage.

Canadian autumn RV survey mean weight per tow. Mean weights per tow in the autumn survey in Div. 3N ranged from 1.22 kg in 1992 to a low of 0.07 kg in 1996. Estimates have been variable throughout the series but show a slightly increasing trend to 2005. The past three years have shown a decrease in the index, with the 2007 value estimated at 0.55 kg per tow. Trends in the autumn survey are complicated by variable coverage of the deeper strata from year to year. The autumn survey index in Div. 3O increased from 2001 to 2004 but has gradually decreased to about 2.3 kg per tow in 2007. Although the combined index in Div. 3NO autumn surveys (Fig 13.3) has shown a general increasing trend since 1996, it has declined to a low value of 1.4 kg per tow in 2007.

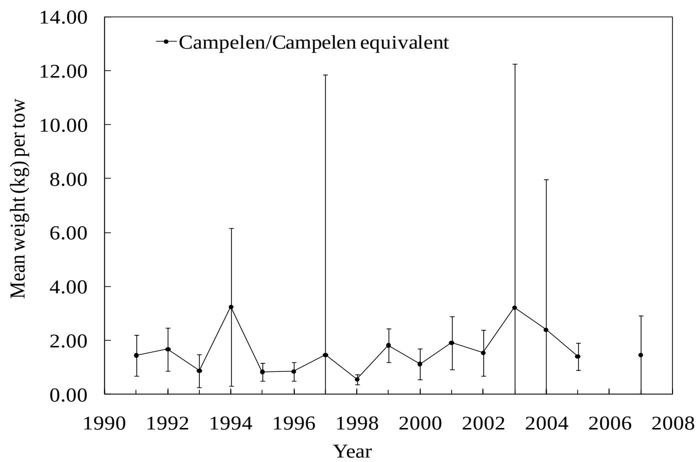


Fig. 13.3. Witch flounder in Div. 3NO: mean weights per tow from Canadian autumn surveys (95% confidence limits are given. Note that the full range of confidence limits is not displayed where it extends below zero).

Length Frequency data: Fish caught in the Canadian surveys ranged from 8 to 65 cm in length with modal lengths usually near 40 cm. Smaller fish (less than 20 cm) were evident in the catches in 1995-2000 and in 2002 and perhaps contributed to an apparent increase in stock biomass from 2000 to 2003. There has been no sign of the less than 20cm size group in surveys since 2002.

Spanish Div. 3NO RV survey biomass. Surveys have been conducted annually from 1995 to 2007 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1462 m (since 1998). In 2001, the research vessel (R/V *Playa de Menduiña*) and survey gear (Pedreira) were replaced by the R/V *Vizconde de Eza* using a Campelen trawl (SCR Doc. 05/25). Data for witch flounder in Div. 3NO prior to 2001 have not been converted and therefore data from the two time series cannot be compared. In the Pedreira gear time series, the biomass increased markedly between 1995 and 2000, decreasing slightly from 2000 to 2001; in the Campelen gear time series, the biomass index has been variable but has decreased since 2004 (Fig. 13.4).

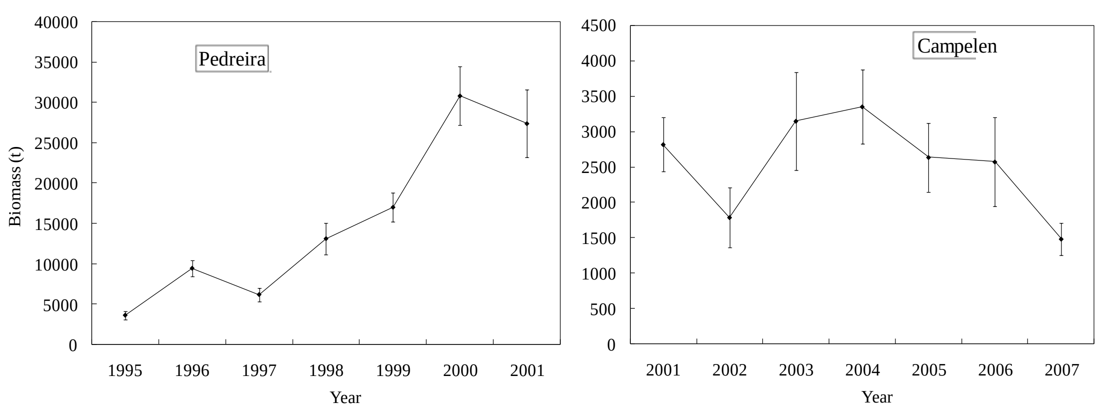


Fig. 13.4. Witch flounder in Div. 3NO: biomass from Spanish Div. 3NO surveys (± 1 standard deviation). Data from 1995-2001 is in Pedreira units; data from 2001-2007 is Campelen units. Both values are present for 2001.

c) Assessment Results

There is no analytical assessment for this stock, as there has been no ageing conducted for a number of years. In 2006, exploratory investigations using an ASPIC non-equilibrium production model were attempted but the results indicated poor model fit and are not thought to describe the dynamics of this stock (NAFO SCR Doc. 06/37).

Precautionary reference points have not been developed for this stock.

Biomass: Survey biomass decreased since the mid-1980s until 1998, after which the Canadian spring RV index increased slightly and remains stable. The Canadian autumn RV and Spanish Div. 3NO survey indices show a decreasing trend in recent years. In general, the survey series indicate no clear trend since 1990 and the stock remains at a low level compared with the 1980s.

Spawning stock biomass: There is no information on SSB for this stock.

Recruitment: Recruitment (fish less than 20cm) has been poor since 2002.

Fishing mortality: The ratio of catch to survey index, a proxy for F, suggests fishing mortality has been low since a moratorium on directed fishing was imposed in 1995.

d) Conclusion

Based on the most recent survey data, STACFIS considers that the overall stock remains at a low level.

The next full assessment of this stock is planned to be in 2011.

14. Capelin (*Mallotus villosus*) in Div. 3N and 3O

Interim Monitoring Report

a) Introduction

The fishery for capelin started in 1971 and total catch was maximal in mid-1970s with the highest catch of 132 000 t in 1975. The directed fishery was closed in 1992 and the closure has continued through 2008 (Fig. 14.1). No catches have been reported for this stock since 1993.

Nominal catches and TACs (‘000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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 estimated for this stock,
na no advice possible.

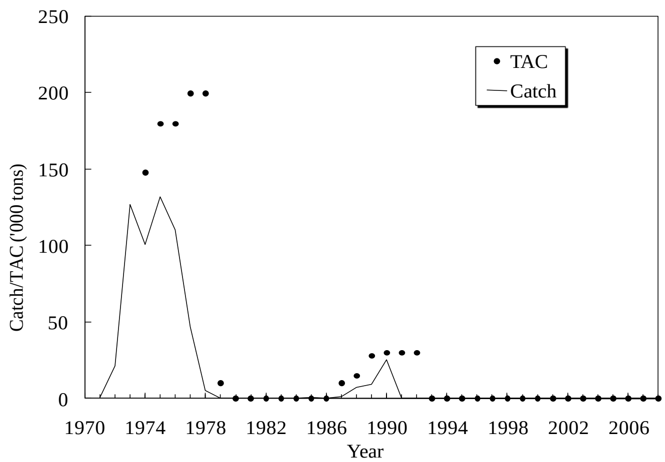


Fig. 14.1. Capelin in Div. 3NO: catches and TACs.

b) Data Overview

Research survey data. Trawl-acoustic surveys of capelin on the Grand Bank previously conducted by Russia and Canada on a regular basis have not been undertaken since 1995. In recent years, STACFIS has several times advised to conduct investigations of the capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this advice has not been followed. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random spring trawl surveys. In 1996-2007, when Campelen was used as sampling gear, survey biomass estimate of capelin in Div. 3NO varied from 3 900 to 58 100 t (Fig.14.2), averaging 24 455 t. In 2005, survey biomass of capelin in Div. 3NO was 3 900 t, the lowest level of the stock since 1996, and in 2006 survey biomass slightly increased to 9 600 t. In 2007 the biomass index increased to 29.2 thousand t. This index conforms with 1996 and 2002 levels.

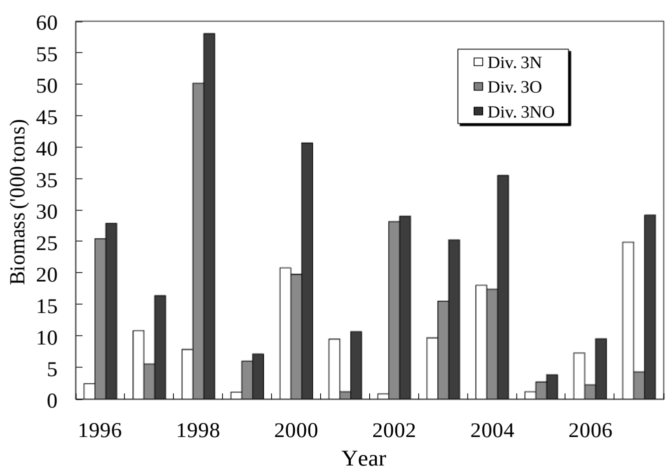


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates in 1996-2007.

c) Estimation of Stock Condition

Since interpolation by density of bottom trawl catches to the area of strata for such pelagic fish species as capelin can lead to significant deviation of the total biomass, the average value of all non-zero catches was used as an index for evaluation of the stock biomass in 1990-2007. However, if the proportion of non-zero catch changes, the index may not be comparable between years.

Survey catches were standardized to 1 km^2 for combining Engel and Campelen trawl data. Sets which did not contain capelin, was not included in account. The confidence intervals around the average catch index were obtained by bootstrapping of standardized catch values. According to data from 1996-2007, the mean catch varied between 0.06 and 0.76 kg/km^2. In 2006 and 2007, this parameter was 0.19 and 0.41, respectively (Fig. 14.3).

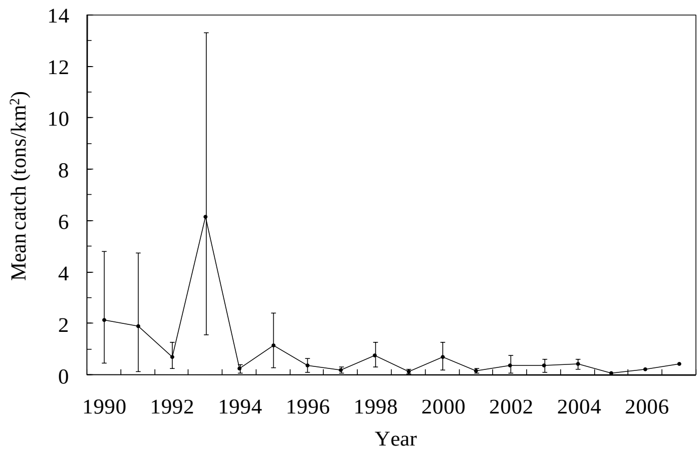


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km^2) in 1990-2007. (Means of sets with non-zero catch of capelin only).

d) Assessment Results

It is not clear how the data reflects the real stock distribution and stock status. Nevertheless, STACFIS considered that the stock is still at low level relative to that of the late 1980s. Based on available data, there is nothing to suggest a change in the status of this stock.

e) Research recommendations

STACFIS reiterates 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.*

STACFIS **recommended** that *for Capelin in Div. 3NO investigations be undertaken to incorporate survey sets which do not contain Capelin, including analyses of Capelin distribution.*

This stock will next be fully assessed in 2009.

15. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3O

(SCS Doc. 08/5, 6, 7)

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 t per year for 2005-2007. This TAC applies to the entire area of Div. 3O.

Nominal catches have ranged between 3 000 t and 35 000 t since 1960 and have been highly variable (Fig. 15.1). Up to 1986 catches averaged 13 000 t, increased to 35 000 t in 1988, exceeding TACs by 7 000 t and 21 000 t, respectively in 1987 and 1988. Catches declined to 13 000 t in 1989, increased gradually to about 16 000 t in 1993 and declined further to about 3 000 t in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 20 000 t by 2001 and have been lower since then. Total catch of redfish in 3O was estimated to be 5 200 t in 2007.

Nominal catches and TACs ('000 t) for redfish in the recent period are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC[1]							NR	NR	NR	NR
TAC	10	10	10	10	10	10	20	20	20	20
STATLANT 21A	12.6	12.8	22	19.4	21.5	6.4	11.9	12.9[2]	7.6[2]	
STACFIS	12.6	10	20.3	17.2	17.2	3.8	10.7	12.6	5.2	

[1] 1997-2004 only applied within Canadian EEZ.
[2] Provisional.
nr Scientific Council was unable to advise on an appropriate TAC

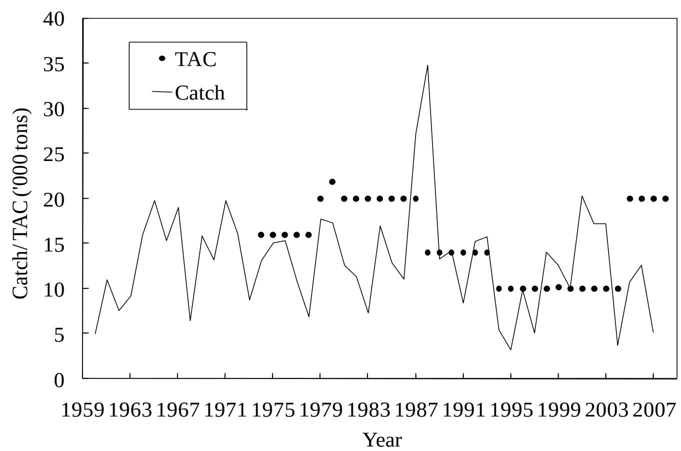


Fig. 15.1. Redfish in Div. 3O: catches and TACs. The TAC for 1997-2004 applied only within the Canadian EEZ

b) Data Overview

Surveys

Canadian spring and autumn surveys were conducted in Div. 3O during 2007. The survey mean weight (kg) per tow estimates have been increasing in the autumn survey since 2004. There is also an increasing trend in the spring survey (Fig. 15.2). The recent trend in abundance from the surveys is very similar to the trend in biomass.

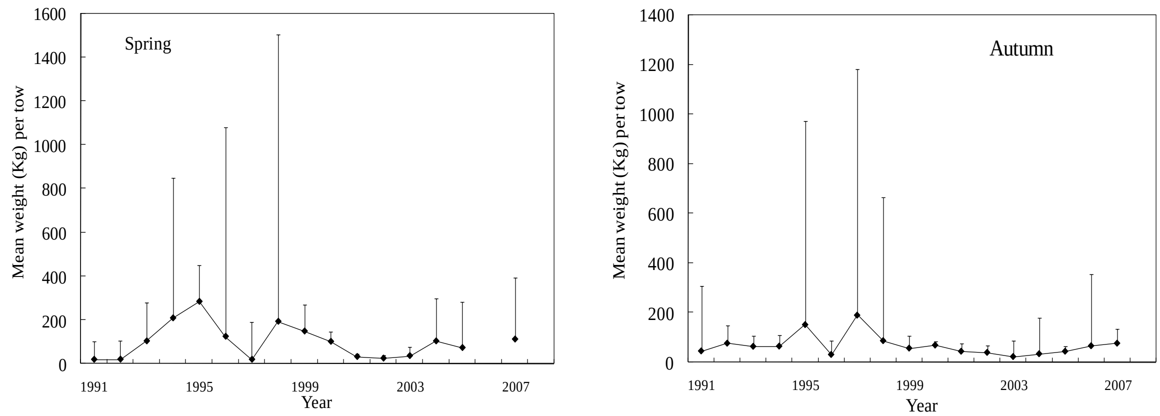


Fig. 15.2. Redfish in Div. 3O: Mean weight (kg + 97.5% CL) per tow from Canadian surveys in Div. 3O (Campelen or Campelen equivalents).

Since catches declined in 2007 while survey indices increased, fishing mortality likely declined in 2007 compared to 2005 and 2006.

c) Conclusion

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

The next full assessment of this stock is planned to be in 2010.

16. Thorny Skate (*Amblyraja radiata*) in Div. 3L, 3N, 3O and Subdiv. 3Ps

(SCR Doc. 08/9, 21, 43; SCS Doc. 08/5, 6, 7)

a) Catch History

Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skate taken in the Canadian and EU-Spain catches. Thus, the skate fishery on the Grand Banks can be considered as a directed fishery for thorny skate.

Nominal catches increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this fishery 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.

Prior to the mid-1980s, this species was commonly taken as a by-catch in other fisheries and continues to be taken as a by-catch, mainly in the Greenland halibut fishery and in the Canadian mixed fishery for thorny skate, white hake and monkfish in Div. 3NOPs in the Canadian zone. Catches in Div. 3LNOPs peaked at about 36 000 t in 1991 (STATLANT 21A). From 1985 to 1991, catches averaged 25 000 t but were lower during 1992-1995 (9 600 t). Catch levels after 2000 as estimated by STACFIS averaged about 9 000 t (Fig. 16.1). There is a TAC of 13 500 t for thorny skate within Div. 3LNO for 2005-07 and 1 050 t in Subdiv. 3Ps. Current catch estimates for Div. 3LNO are 3 600 t.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Div. 3LNO:										
TAC							13.5	13.5	13.5	13.5
STATLANT 21A	11.9	18.3	14.9	11.8	14.3	11.8	3.5	5.5[1]	5.4[1]	
STACFIS	11.9	14.1	10.4	11.5	13.4	9.3	4.2	5.8	3.6	
Subdiv. 3Ps:										
TAC[3]							1.05	1.05	1.05	1.05
STATLANT 21A	1.2	1.0	2.0	1.5	2.0	1.2	0.9	1.2[1]	1.1[1,2]	
STACFIS	1.2	1.0	2.0	1.5	2.0	1.2	0.9	1.2[1]	1.1[1, 2]	

[1] Provisional for 2006-2007
[2] Based on Canadian Statistical landings data (STATLANT 21A not available)
[3] TAC in Subdivision 3Ps is set by Canada

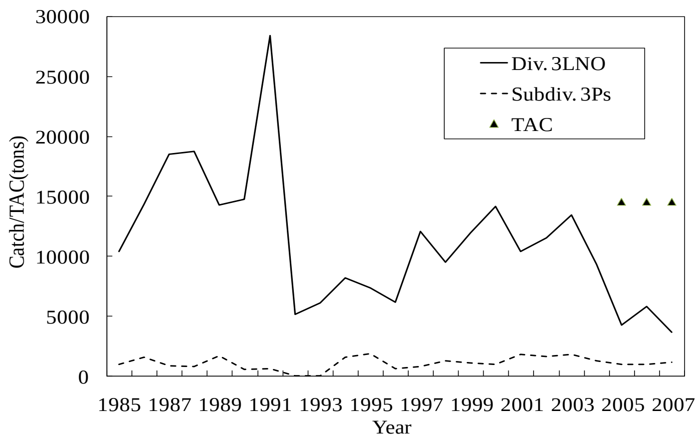


Fig. 16.1. Thorny skate in Div. 3LNOPs: catches in Div. 3LNO and Subdiv. 3Ps, 1985-2007 and Div. 3LNOPs TAC.

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 1997-2007), EU-Portugal (2002-2004, 2006-2007), Canada (1994-2006) and Russia (1998-2007).

Length distributions from Canada, EU-Portugal, EU-Spain, and Russia in the directed skate (280 mm mesh size) and bycatch (130-135 mm mesh size) trawl fisheries of the NRA indicated that the range of sizes caught did not vary for each country during 2006-2007 and were similar to those reported in previous years (Kulka and Miri 2007). One exception was the 12-15 cm young-of-the-year skates caught by Russia as bycatch in Div. 3LO during 2006. However, a comparison of length distributions between countries shows that EU-Portugal consistently catches an abbreviated range of smaller skates at 18-47 cm (modes of 38-40 cm); while EU-Spain usually catches 30-90 cm skates (modes of 56-58 cm), and Russia catches 24-96 cm fish (modes of 60-63 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 1971-2007 by Canada in Div. 3L, 3N, 3O and Subdiv. 3Ps using the Yankee 41 trawl from 1972-1982, the Engel bottom trawl from 1983 to 1995 and the Campelen 1800 shrimp trawl since. Maximum depth surveyed was 366 m before 1991 and ~750 m since.

An index from 1972-1983 (Yankee 41 otter trawl series) fluctuated without trend (Fig. 16.2a).

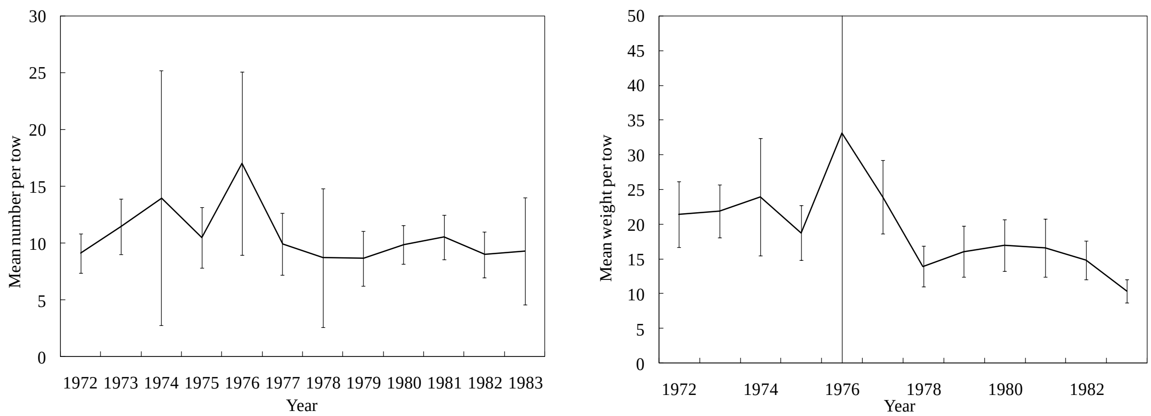


Fig. 16.2a. Thorny skate in Div. 3LNOPs: Estimates of Yankee 41 otter trawl mean numbers and mean weights per tow from Canadian spring surveys.

Standardized mean number and weight per tow are presented in Fig. 16.2b for Div. 3LNOPs. Catch rates of thorny skate in Div. 3LNOPs declined from the mid-1980s until the early 1990s. Since 1996, the indices have been relatively stable at low levels and have increased slightly over the past 3 years (Fig. 16.2b).

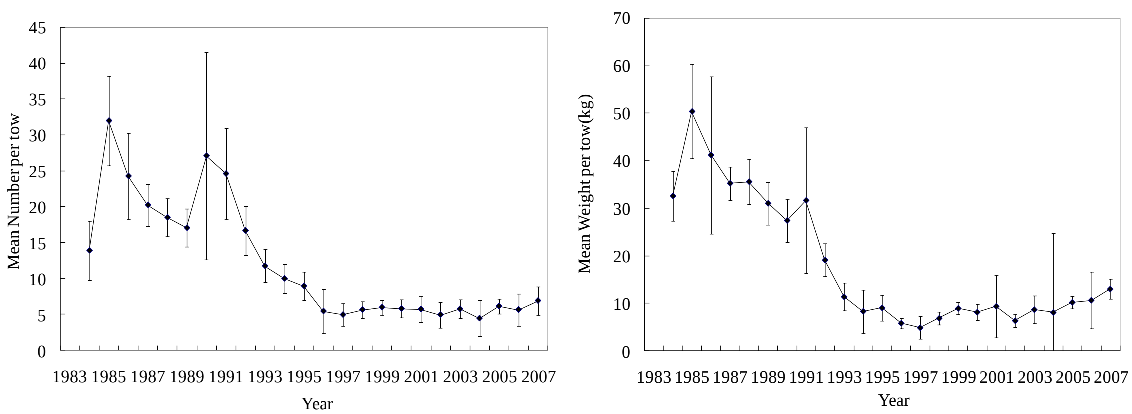


Fig. 16.2b. Thorny skate in Div. 3LNOPs: Estimates of Campelen and Campelen equivalent mean numbers (left panel) and mean weights (right panel) per tow from Canadian spring surveys.

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 shrimp trawl from 1995 to present.

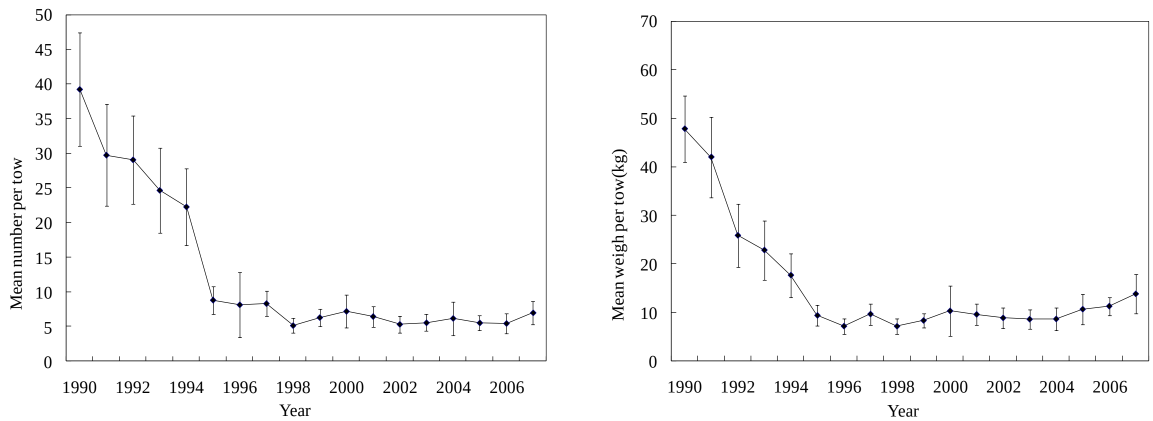


Fig. 16.2c Thorny skate in Div. 3LNOPs: estimates of Campelen equivalent mean numbers and mean weights per tow from Canadian autumn surveys.

Autumn survey catch rates, similar to the spring survey estimates declined during the early 1990s. The autumn estimates of biomass and abundance 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 (~750 m) and are more deeply distributed during the winter/spring. Autumn survey indices have increased during recent years.

Spanish surveys. Spanish survey biomass indices in Div. 3NO were available for the period 1997-2007. The Spanish Div. 3NO survey was conducted in the NRA portion of Div. 3NO while the Canadian survey covered the extent of Div. 3NO. The biomass trajectory from the Spanish Div. 3NO survey did not show the increase in 2007 observed in the Canadian spring survey (Fig. 16.3). A new survey series carried out by EU-Spain in Div. 3L has been added to the assessment. The Spanish Div. 3L survey did indicate an increase in the recent biomass of thorny skate.

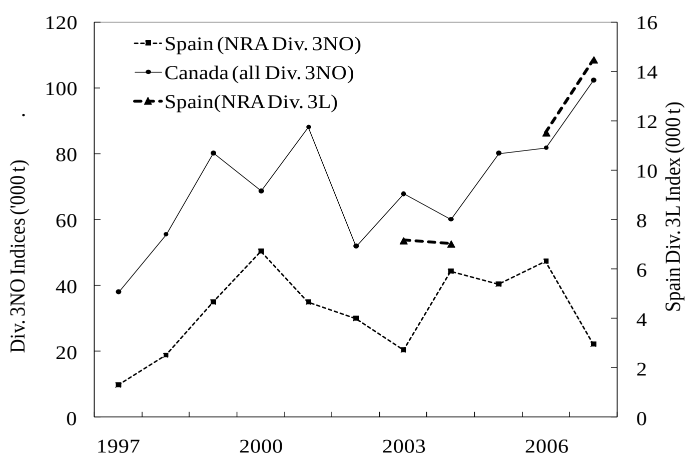


Fig. 16.3. Thorny skate in Div. 3LNOPs: Comparison of thorny skate biomass indices in 1997-2007 from the Canadian spring survey in Div. 3NO, the Spanish 3NO, and the Spanish 3L surveys.

iii) Biological studies

Staged abundances were calculated, from the Canadian spring survey. Mature, immature and young-of-the-year (YOY) thorny skate abundances were stable at low levels since the mid-1990s. Since 2002, the abundance of both adult male and female thorny skate appears to have increased, while the abundance of YOY skate appears to have remained stable. Abundance of immature skate during the same period appears to have declined.

The ratio of male to female thorny skate has been relatively consistent, with some fluctuations over time for YOY, juvenile and mature adults. Young of the year (YOY) averaged close to 1:1 males to females. Ratio of immature males to females was about 0.75 and adults 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.

Variation in number of recruit per spawner (YOY/adult females) was relatively low and in most years was between 0.5 and 1.5. Values were highest during the period of the decline of the stock. Thorny skate have low fecundity and long reproductive cycles. These characteristics result in low intrinsic rates of increase and may result in low resilience to fishing mortality.

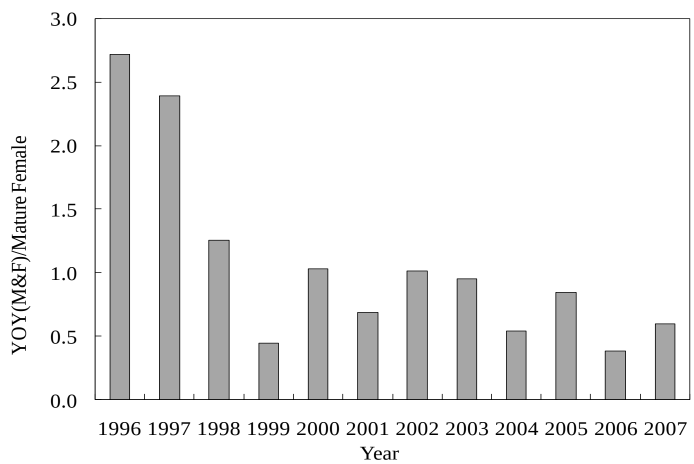


Fig. 16.4. Thorny skate in Div. 3LNOPs: Ratio of staged YOY males and females to mature female thorny skate in NAFO Div.3LNOPs from Spring campelen surveys (Note: Subdiv. 3Ps was not surveyed in 2006).

c) Assessment Results

There is no analytical assessment model for this stock,. Non-equilibrium production modeling was conducted and not accepted at this time for a quantitative assessment of this stock.

An exploitation index (catch/Canadian spring survey biomass) was used to examine relative changes in the impact of fishing mortality (Fig. 16.5). This index increased from ~ 7% in the mid-1980s to an average of ~15% in the late 1990s. This index has declined to approximately 5% in 2005-2007.

Thorny skate biomass in NAFO Div. 3LNOPs remained stable at low levels from 1996-2004. During recent years, with a reduced exploitation index relative to previous years, the biomass of thorny skates has increased slightly. Recent catch levels were approximately 25% of the existing TAC in Div. 3LNO.

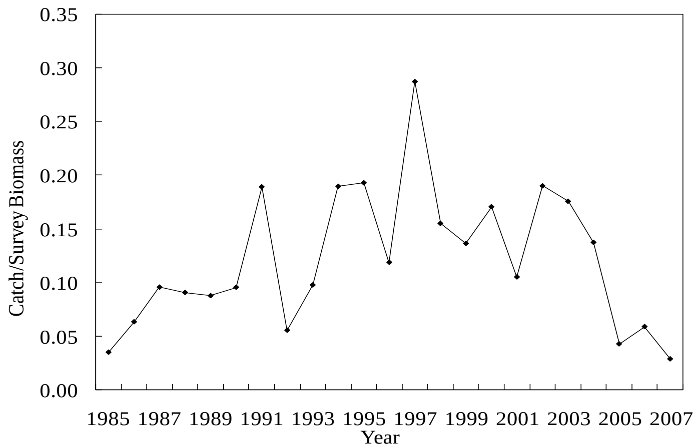


Fig. 16.5. Thorny skate in Div. 3LNOPs:Temporal changes in the fishing mortality index (estimated catch/spring survey biomass) for NAFO Div. 3LNO.

d) Reference Points

Proxies for precautionary limit reference points were calculated but not accepted at this time. Further research and simulation of limit reference points are required and presently in progress.

e) Recommendations

For thorny skate in Div. 3LNOPs, STACFIS **recommended** that *further testing of quantitative models be conducted on this stock.*

For thorny skate in Div. 3LNOPs, STACFIS reiterates its **recommendation** that *further work be conducted for the estimation of reference points.*

The next full assessment of this stock is planned to be in 2010.

17. White hake (*Urophycis tenuis*) in Div. 3N, 3O and Subdiv. 3Ps

(SCR Doc. 08/9, SCS Doc. 08/5, 6, 7)

Interim Monitoring Report

a) Introduction

From 1985-2007, catches in Div. 3NO averaged aproximately 2 332 t, exceeding 5 000 t in only three years during that period. Catches peaked in 1985 and 1987 at approximately 8 100 t; then declined from 1988 to 1994, averaging 2 090 t during that period (Fig. 17.1). Average catch was at its lowest in 1995-2001 (455 t); then increased to 6 718 t in 2002 and 4 823 t in 2003, with a steady decline afterwards. From 2004-2007, the average catch was 949 t.

Catches of white hake in Subdiv. 3Ps were greatest in 1985-1993, averaging 1 115 t, then decreased to an average of 436 t in 1994-1999. Subsequently, catches increased to an average of 1 252 t in 2000-2007.

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 the NAFO Regulatory Area (NRA) of Div. 3NO, but there was no directed fishery by EU-Spain in 2004, by EU-Portugal in 2005, or Russia in 2005 or 2006.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Div. 3NO										
Recommended TAC							5.8[4]			
TAC	-	-	-	-	-	-	8.5	8.5	8.5	8.5[3]
STATLANT 21A	0.4	0.6	0.6	5.4	6.2	1.9	1.0	1.1[1]	0.6[1]	
STACFIS	0.4	0.6	0.6	6.7	4.8	1.3	0.9	1.1	0.7	
Subdiv. 3Ps										
STATLANT 21A	0.6	1.1	0.9	0.9	1.1	1.5	1.7	1.5[1]	1.2[1,2]	

1 Provisional
2 Based on Canadian Statistical landings data(STATLANT 21A not available)
3 TAC applicable to 2008 and 2009
4 Scientific council (2004) recommended that "To avoid potential overfishing and by-catch problems, catches in the directed fishery for white hake should be limited to catches of the recent two years which averaged 5 800 t."

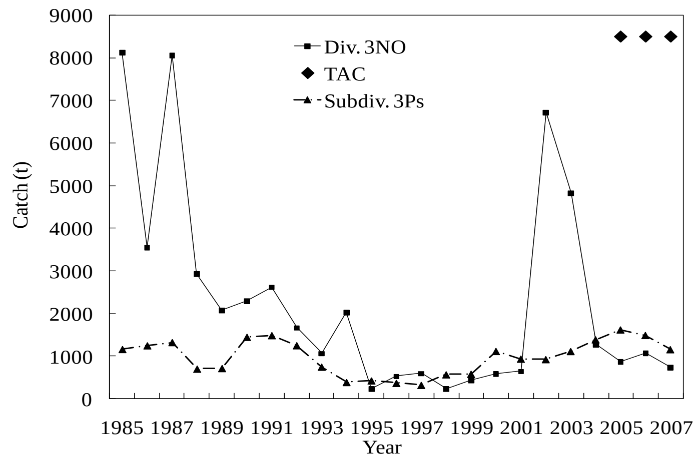


Fig. 17.1. White hake in NAFO Div. 3NO and Subdiv. 3Ps: total catches and TACs.

b) Data Overview

i) Research surveys

Stratified-random research surveys have been conducted in spring 1972-2007 by Canada in Divisions 3L, 3N, 3O and Subdivision 3Ps. The survey was conducted using the Yankee 41.5 trawl from 1972-1983, the Engel bottom trawl from 1984 to 1995 and the Campelen 1800 shrimp trawl since 1996. During the autumn, Canada has conducted a stratified-random survey since 1990 in Div. 3LNO. The Engel bottom trawl was used prior to 1995 and the Campelen 1800 trawl after. The results of the 2007 stratified-random bottom trawl surveys did not alter the perception of stock status by STACFIS. Catch rates in both the Canadian spring Div. 3NOPs surveys (Fig. 2a) and Canadian autumn Div. 3NO (Fig. 2b) surveys remain at low levels.

EU-Spain has conducted a stratified-random survey from 1995-2007 in the NRA of Div. 3NO. The Spanish Div. 3NO survey for this species started in 2001 with a Campelen 1800 trawl and is limited to the NRA; whereas Canadian surveys cover the extent of Div. 3NO. Similar to the Canadian spring 2007 survey in Div. 3NOPs, catch rates of the Spanish survey remain at low levels (Fig. 17.2c).

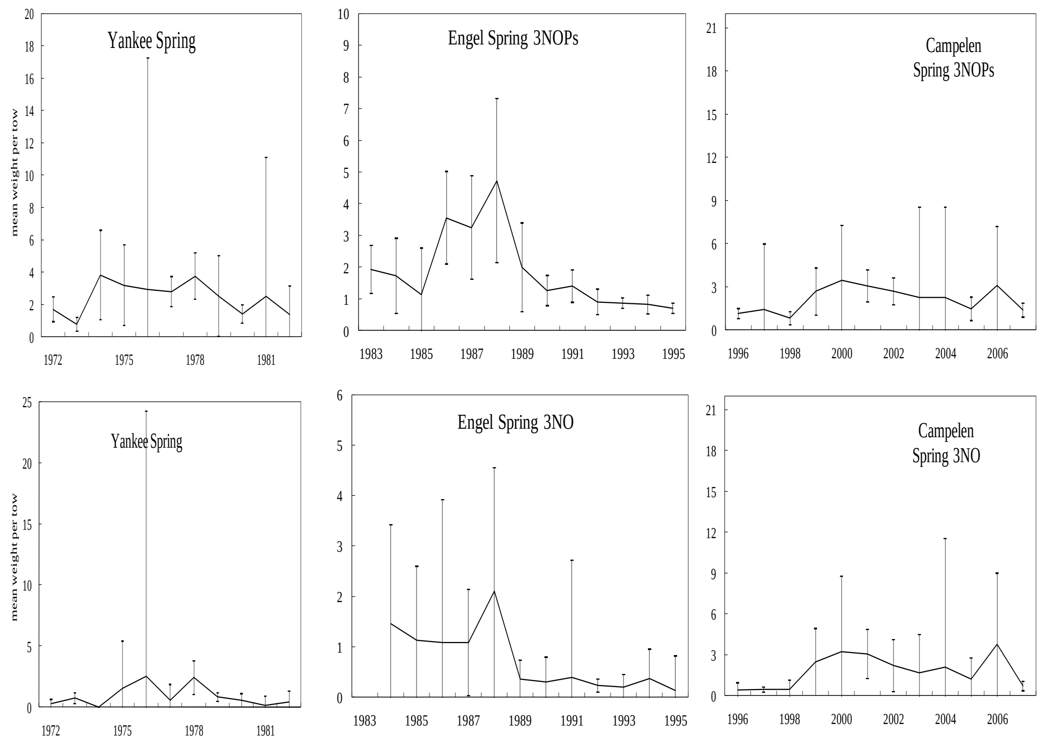


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: Biomass indices from Canadian spring surveys, 1972-2007. The Yankee, Engel, and Campelen time series are not standardized. Error bars represent 95% Confidence Intervals. Note: No survey was conducted in Div. 3O during 1972 and 1974, in Div. 3NO during 1983, and in Subdiv. 3Ps in 2006; only shallow strata in Div. 3NO were surveyed in 2006.

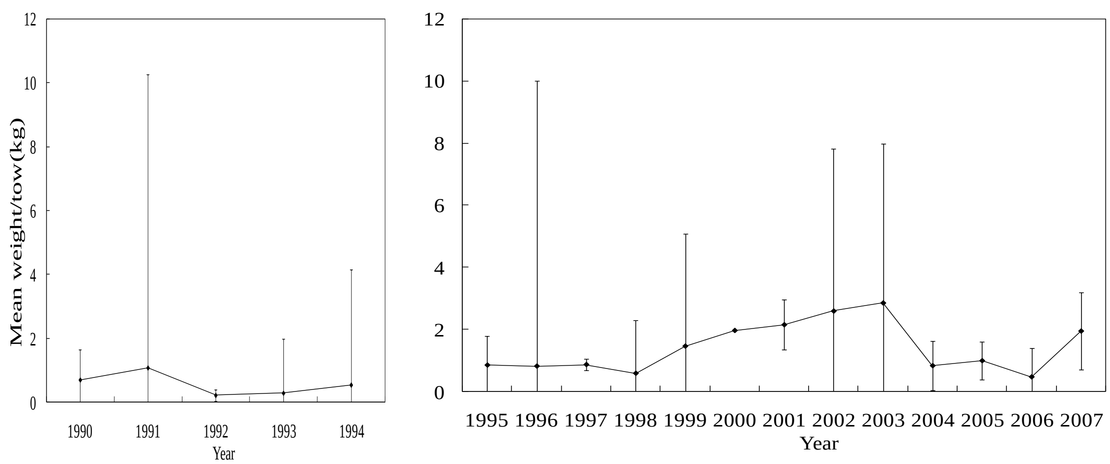


Fig. 17.2b. White hake in Div. 3NO: Biomass indices from Canadian autumn surveys, 1990-2007. The Engel and Campelen time series are not standardized. Error bars represent 95% Confidence Intervals.

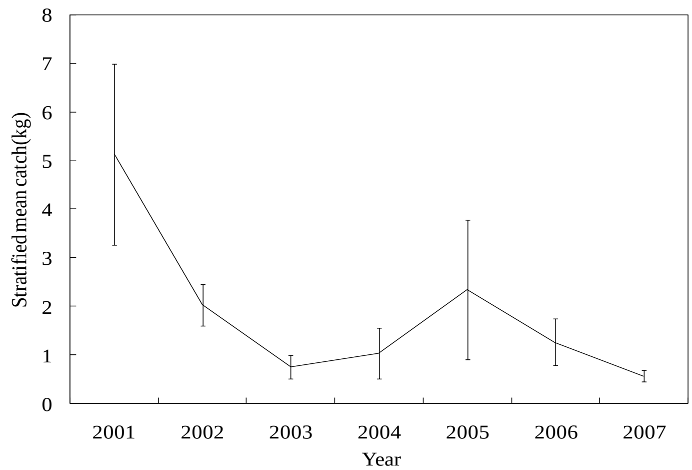


Fig. 17.2c. White hake in Div. 3NO and Subdiv. 3Ps: Stratified mean catch by year from the Spanish Div. 3NO survey in the NRA of Div. 3NO, 2001-2007. Error bars represent 1 Standard Deviation.

c) Conclusions

There is nothing to indicate a change in the status of the stock.

The next full assessment of this stock is planned to be in 2009.

D. WIDELY DISTRIBUTED STOCKS: Subareas 2 + 3 + 4

Environmental Overview

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1º-2ºC 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 their 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 to 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 2007 cooled but remained above normal. At Station 27 off St. John's, the depth-averaged annual water temperature decreased from the record high observed in 2006 to about normal. Annual surface temperatures at Station 27 also decreased from the 61-year record of 1.7°C above normal in 2006 to 0.2°C above normal in 2007. Bottom temperatures decreased from 0.8°C above normal in 2006 to 0.4°C above normal in 2007. Annual surface temperatures on Newfoundland-Labrador and Grand Banks Shelf were still above normal in 2007 although lower than in 2006. Upper-layer salinities at Station 27 were above normal for the 6th consecutive year. The area of the Cold-Intermediate-Layer (CIL) water mass on the Newfoundland Shelf during 2007 was below normal for the 13th consecutive year and the 14th lowest since 1948. Bottom temperatures during the spring of 2007 remained above normal on the Grand Banks but were below normal on St. Pierre Bank. During the autumn they were significantly above normal in NAFO Div. 2J and 3K and most of Div. 3L, but were below normal in the shallow areas of Div. 3NO. The proportion of bottom habitat on the Grand

Banks covered by sub-zero water decreased from >50% during the first half of the 1990s to near 15% during 2004-06 but increased to near-normal at about 30% in 2007. In general, water temperatures on the Newfoundland and Labrador Shelf decreased from 2006 values but remained above normal in most areas. Notable exceptions were on St. Pierre Bank during spring where temperatures were below normal and in northern areas of NAFO Div. 2J and 3K where bottom temperatures were significantly above normal during the autumn of 2007. A review of physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine and adjacent offshore areas during 2007 indicates annual average temperatures were generally lower than in 2006, one of the warmest years on record. This decline brought annual values to near normal at the mouth of the Bay of Fundy, in the Sydney Bight and on the eastern Scotian Shelf. The subsurface temperatures along the central and western Shelf during the July multispecies survey and the spring and Autumn AZMP sections generally featured below normal temperatures by about 1^{o}C, but with extreme anomalies as large as 6^{o}C below normal over the upper continental slope. The outstanding feature of the observations from standard sections in April and October on the Scotian Shelf was the widespread negative anomalies over the shelf, particularly at the shelf break on the spring sections. The intrusion of Labrador Slope Water into the deeper areas of the Shelf is the likely cause of the below normal temperature and salinity conditions. The overall stratification was above normal for the Scotian Shelf region in 2007. A composite index for the region indicates that 2007 was the 7^{th} coldest overall of the past 38 years. This represents the largest single year decline of the composite index in the 38 year record.

18. Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3

(SCR Doc. 08/9, 27; SCS Doc. 08/5, 6, 7 ,12)

Interim Monitoring Report

a) Introduction

Before 1996, much roughhead grenadier caught in SA 3 was erroneously reported in official statistics as roundnose grenadier, but the two species have been correctly reported since 1997. STACFIS has approved for use in assessments a catch series since 1987 that includes corrections for misreporting in the earlier period. Catches of roughhead grenadier increased sharply from 1989 (333 tones) to 1992 (6 725 t). Since then until 1997 total catches has been about 4 000 t. In 1998 and 1999 catches increased and were in the level of 7 000 t. After then, catch decreased to the level 3 000 – 4 000 tones in the period 2001-2004, and to 1 400 t in 2005-2006. A total catch of 664 t was estimated for 2007. (Fig. 18.1).

Recent catches ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
STATLANT 21A	7.2	8.9	2.0	1.7	1.8	1.7	1.3	0.6[1]	0.4[1]	
STACFIS	7.2	4.8	3.1	3.7	4.2-3.8[2]	3.2	1.5	1.4	0.7	

1 Provisional,

2 In 2003, STACFIS could not precisely estimate the catch.

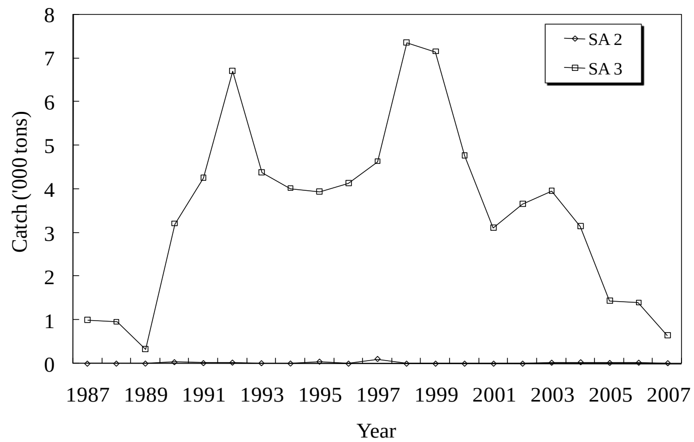


Fig. 18.1 Roughhead grenadier in Subarea 2 and 3: catches and TACs.

b) Data Overview

Surveys

Mean weight per tow from the Canadian autumn survey Div. 2J3K, Spanish Div. 3NO survey and EU bottom trawl on Flemish Cap (up to 750 m.) survey series with ± their SD are presented in Fig. 18.2. Although the Canadian autumn survey (Div. 2J+3K) and the Spanish Div. 3NO survey do not cover the entire distribution of the stock, they are considered as the best survey information to monitor trends in resource status because their depth coverage is going down to 1 500 meters. The Canadian autumn Div 2J3K index reached its maximum value since 1995 in 2007, but the Spanish Div. 3NO index dropped from its maximum value in 2006 to the mean value of the time series in 2007.

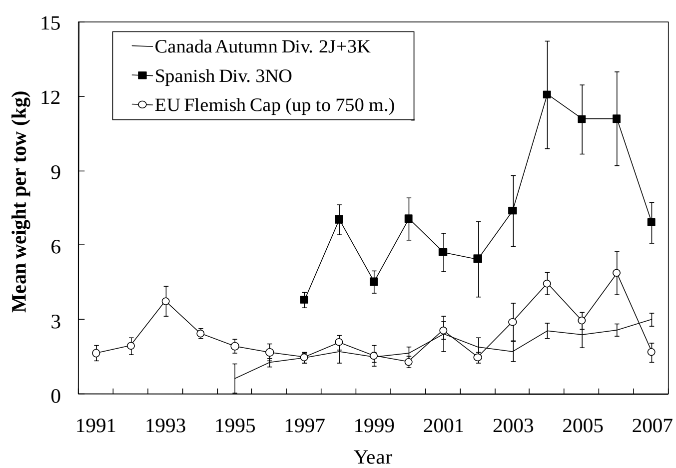


Fig. 18.2. Roughhead grenadier in Subareas 2+3: mean weight per tow from the Canadian autumn (Div. 2J+3K) survey, Spanish Div. 3NO survey and EU Flemish Cap survey.

The strong 2001 year class can be tracked in 2003 and 2004 at ages 2 and 3 but was weaker than expected since 2005.

Although the Spanish Div. 3NO index decreased in 2007, the catch/biomass (C/B) indices from the Canadian autumn survey and the Spanish Div. 3NO survey in the period 1995-2007 have not changed the decreasing trend, noted in the last year assessment.

c) Conclusion

Based on overall indices for the current year, there are no major changes to modify the last assessment.

The next full assessment of this stockis planned to be in 2010.

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

(SCS Doc. 08/5, 6)

Interim Monitoring Report

a) Introduction

The fishery for witch flounder in this area began in the early 1960s and increased steadily from about 1 000 t in 1963 to a peak of over 24 000 t in 1973 (Fig. 19.1). Catches declined rapidly to 2 800 t by 1980 and subsequently fluctuated between 3 000 and 4 500 t to 1991. The catch in 1992 declined to about 2 700 t, the lowest since 1964; and further declined to around 400 t 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 t, 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 t, 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 t. In 2005, catch decreased to 160 t, and further declined in 2006 and 2007 (84 and 53 t respectively) to the lowest catch in the time series.

Recent catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.4	0.5	0.6	0.7	0.5	0.3	0.2	0.1[1]	0.1[1]	
STACFIS	0.3	0.7	0.8	0.4	0.7	0.8	0.2	0.1	0.1	

[1] Provisional
ndf no directed fishing

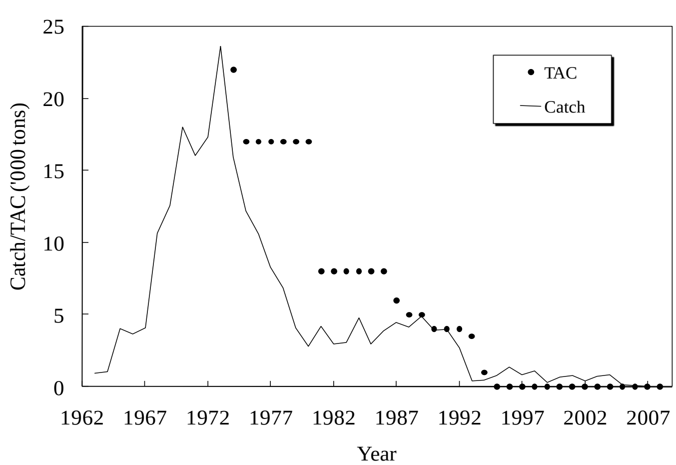


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) Data Overview

i) Surveys

Canadian surveys were conducted in Div. 2J3KL during autumn 2007. The survey estimates show very slight improvement over 2006 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 to other years.

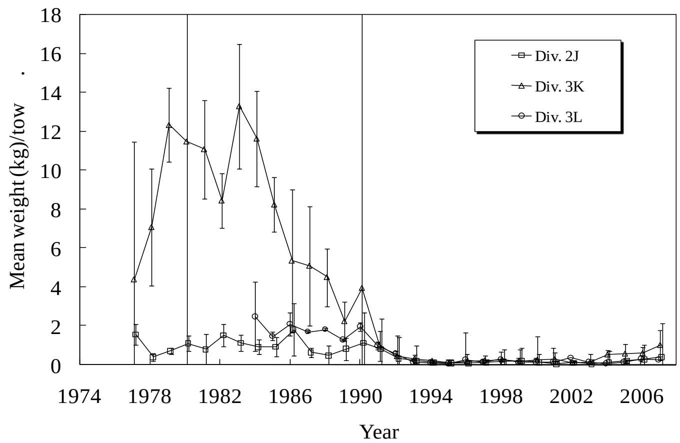


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow (with 95% confidence limits) from Canadian autumn surveys.

Abundance at length. In 2007, STACFIS noted that slightly increasing trends in survey biomass and mean weight (kg) per tow indices for the stock area as a whole were not seen in abundance indices, suggesting increasing trends are due to growth and not recruitment. To further investigate recruitment status, STACFIS **recommended** that *length frequency data from the survey be examined.*

Abundance at length from the Canadian autumn surveys 2005-2007 are given in Fig. 19.2. The slight increase, from 2005 to 2006, in biomass and mean weight (kg) per tow was not evident in the abundance indices, suggesting growth, and not recruitment, was responsible for the change. The length frequencies confirm this, and show a shift toward larger fish in 2006, while the peak of smaller fish seen in the 2005 survey, did not appear strong in the 2006 survey. In 2007, both abundance and biomass indices increased from 2006, and the length frequency shows 3 modes. The smallest fish are likely recruits; the middle mode shows growth of the smaller peaks seen in 2005-2006 and the mode of larger fish shifts to the right indicating growth.

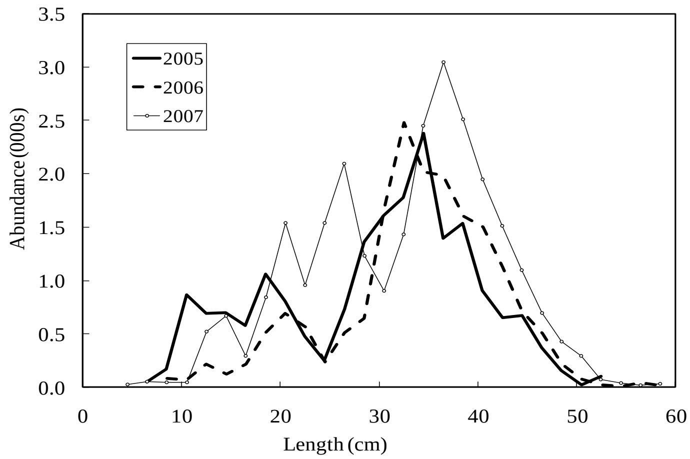


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: abundance at length from Canadian autumn surveys in 2005-2007.

c) Conclusion

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

The next full assessment of this stock is scheduled for 2010.

20. Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 2 and Div. 3KLMNO

(SCR Doc. 08/1, 7, 18, 20, 25, 31, 32, 34, 46, 47, 48; SCS Doc. 08/5, 6, 7, 12, 13; FC Doc. 03/13)

a) Introduction

Catches increased from low levels in the early 1960s to over 36 000 t in 1969, and ranged from less than 20 000 t to 39 000 t 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 t annually, although estimates in some years were as high as 75 000 t. Beginning in 1995, TACs for the resource were established by the Fisheries Commission, and the catch declined to just over 15 000 t 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 t per year. Subsequently catches increased and by 2001 had reached 38 000 t before declining to 34 000 t in 2002. The total catch for 2003 was believed to be within the range of 32 000 t to 38 500 t; for assessment purposes, STACFIS used a catch of 35 000 t.

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.

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, and established TACs of 20 000, 19 000, 18 500 and 16 000 t, respectively for the years 2004 to 2007.During the first four years of the rebuilding plan, estimated catches for 2004 – 2007 have exceeded the rebuilding plan TACs by 27%, 22%, 27%, and 42%, respectively.

Recent catches and TACs ('000 t) are as follows:

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Recommended TAC	30	30	40	40	36	16	nr*	nr*	nr*	nr*
TAC	33	35	40	44	42	20[3]	19[3]	18.5[3]	16[3]	16[3]
STATLANT 21A	23	32	34	31	31	16	18[1]	17[1]	15[1]	
STACFIS	24	34	38	34	32-38[2]	25	23	24	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).

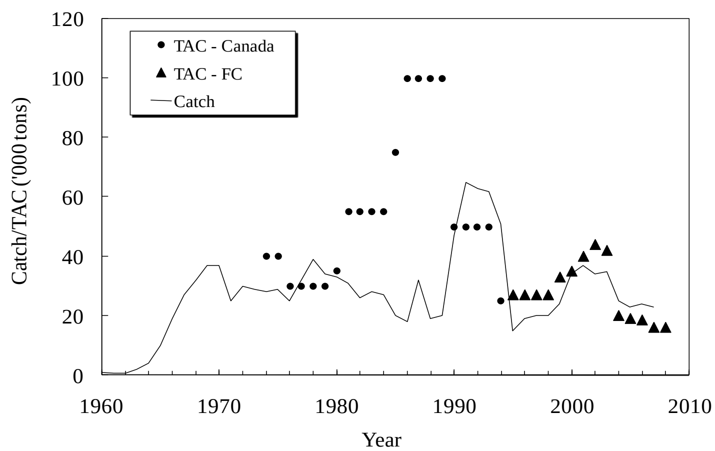


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) Input Data

i) Commercial fishery data

Catch and effort. Analyses of otter trawl catch rates from Canadian vessels operating inside of the Canadian 200 mile limit, using hours fished as the measure of effort, indicated a general decline between the levels of the mid-1980s to the mid-1990s. The 2006 and 2007 estimates of standardized CPUE indicate a sizeable increase compared to recent years.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN over 1988-2007 declined sharply in 1991 from initial levels. Consistent increases were estimated over the mid-1990s until 2000. CPUE has increased substantially since 2004, although STACFIS noted that most recent estimate is imprecise.

Catch-rate information for the Spanish otter trawl fleet in 2007 was unavailable. Recent spatial analysis of catch and effort trends of the Spanish fleet (SCR Doc. 07/54) indicated the area being fished by this fleet has contracted as effort has been substantially reduced since 2003 under the FC rebuilding plan. Fishing is now concentrated in the northeastern portion of Div. 3L, north of the Flemish Pass. Throughout the time period analyzed, this area has generally had the highest annual CPUE compared to other fishing grounds. Analysis of VMS data suggests the spatial patterns for Spanish effort are probably reflective of the entire NRA fleet.

A comparison of the standardized CPUE series (Spanish series to 2006 only) demonstrates that trends in standardized catch rates from each fleet have not been completely consistent over time (Fig 20.2). However, recent increases in CPUE have been detected in all fleets.

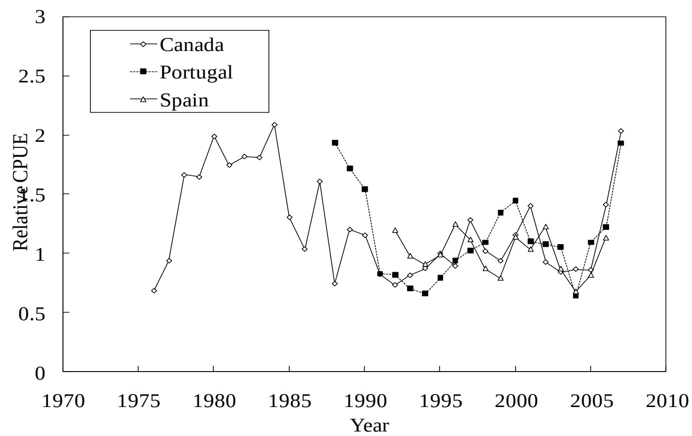


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each series of standardized CPUE estimates is scaled to the 1992-2006 average.)

STACFIS previously recognized that trends in commercial catch per unit effort for Greenland Halibut in Sub-Area 2 and Divisions 3KLMNO should not be used as indices of the trends in the stock (NAFO, 2004). It is possible that by concentration of effort, commercial catch rates may remain stable or even increase as the stock declines.

STACFIS again reviewed the issue of using CPUE indices in the assessment of the Greenland halibut stock in Subarea 2 + Divisions 3KLMNO. STACFIS confirmed its views, expressed in 2004 and 2007, that CPUE indices for this stock should not be interpreted to reflect stock size, and they were therefore not used in the current population model.

Catch-at-age and mean weights-at-age. The catch-at-age data for Canadian fisheries in 2007 were presented. Length samples for the 2007 fishery were provided by EU-Spain, EU-Portugal, Russia and Canada. Aging information was available for Russian, EU-Spain and Canadian fisheries. Due to aging inconsistencies, an age-length key from Canadian commercial samples was applied to calculate catch-at-age for all catches in 2007 as in previous assessments.

Ages 6-8 dominated the catch throughout the entire time period and the proportion of the catch from these age groups has been increasing. Age groups 10+ currently contribute less than 10% to the total annual landings, much lower than the long-term average (24%). Mean weights-at-age exhibit variable patterns in the earliest period likely due to poor sampling. Mean weights-at-age for age groups 5-8 during the recent period were relatively stable. For older fish they were variable but indicate a declining trend over the past decade.

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 3KLMNO. The Canadian autumn survey index provides the longest time-series of abundance and biomass indices (Fig. 20.3; mean weight (kg) and numbers per tow) for this resource. Biomass 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. Since then, the index has increased in each of the past five 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 except for the decline in 2005. The age-compositions of the 2005-2007 surveys have shown relatively few recruits and unexpectedly high numbers of older individuals of cohorts which were estimated to be below average from survey information at younger ages.

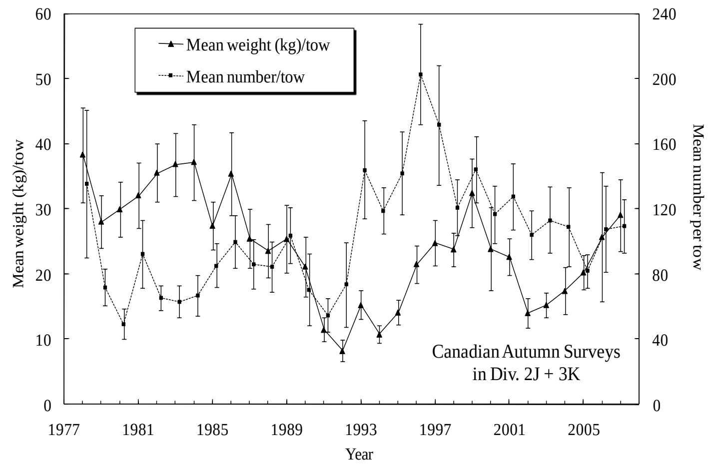


Fig. 20.3.Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

Fig. 20.4 characterizes a significant increase in fish that are 30-70 cm which was not preceded by any evidence of recruitment (in the <30 cm length class). The 2007 biomass per tow result for the 30-70 cm grouping is more than 2.5 times the 2002-2004 average. Such increases are consistent with indications of improvement in the commercial CPUE from various fleets throughout the stock area.

During the late 1970s and early 1980s large Greenland halibut (greater than 70 cm) contributed almost 20% to the estimated biomass (Fig. 20.4). However, after 1984 this size category declined and by 1988 virtually no Greenland halibut in this size range contributed to the index. Since then, the contribution to the index from this size group has been extremely low, often zero.

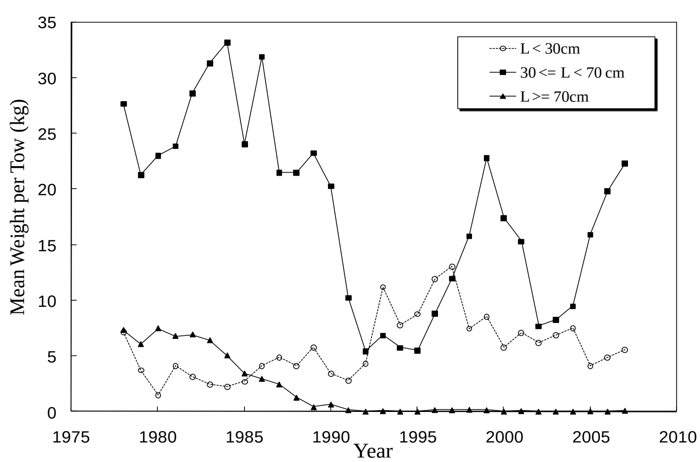


Fig. 20.4 Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass indices (mean weight (kg) per tow) by size class from Canadian autumn surveys in Div. 2J and 3K.

The Canadian autumn survey in Div. 3L has generally shown trends that are consistent with those from Div. 2J+3K. Autumn surveys within Div. 3NO have varying deep-water coverage. Canadian autumn surveys in Div. 3M indicated a general decline over 1998 to 2003. The Div. 3M was not surveyed in the autumn of 2004 or 2005; the 2006 and 2007 estimates of abundance and biomass are relatively low.

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 might have been 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. However, since the mid-1990s, survey indices both in the Regulatory Area and in Div. 2J and 3K has generally shown similar trends suggesting that emigration does not appear be a significant contributing factor to the overall trends in the indices. 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 spring surveys in Div. 3LNO. 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 remained relatively stable until 2005 (Fig. 20.5). The 2007 biomass index is estimated to be approximately twice the 2005 level (although with low precision). Divs. 3NO were not surveyed in the spring of 2006.

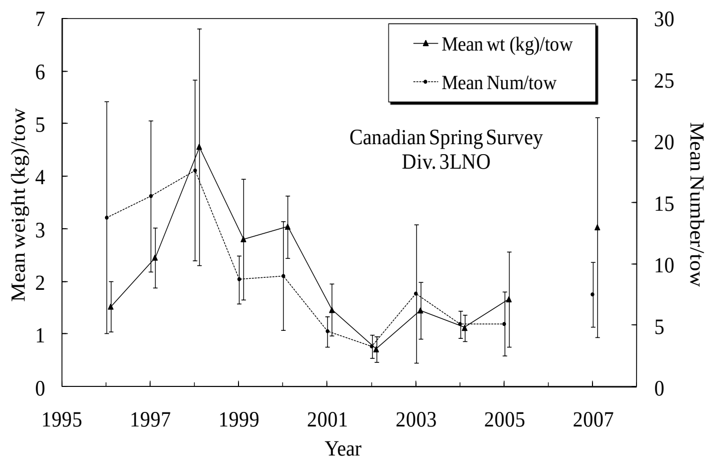


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M (Flemish Cap). Surveys conducted by the EU in Div. 3M during summer indicate that the Greenland halibut biomass index (mean weight (kg) per tow) in depths to 730 m, increased in the 1988 to 1998 period (Fig. 20.6) to a maximum value in 1998. This biomass index declined consistently over 1998-2002. The 2002 – 2007 results have been relatively stable, with the exception of an anomalously low value in 2003. The Flemish Cap survey has covered depths to 1460 m since 2004. Biomass estimates including all depths from this survey (i.e. to 1460 m) have increased over 2005-2007.

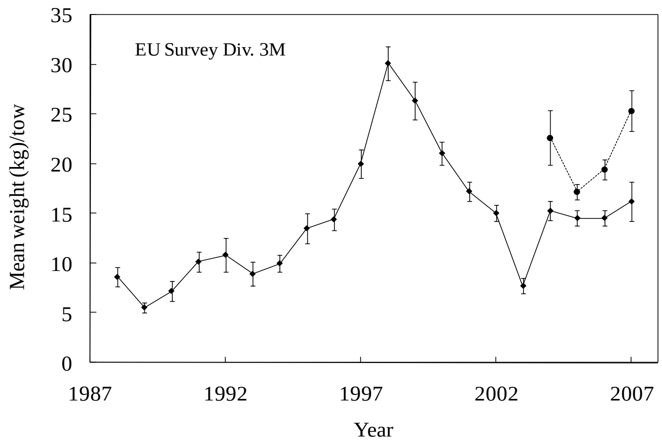


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (mean catch per tow ± 1 S.E.) from EU summer surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

EU-Spain stratified-random surveys in NAFO Regulatory Area of Div. 3NO. The biomass index (mean weight (kg) per tow; converted to Campelen trawl equivalents) for this survey of the NRA increased from 1997 to 1998, but there has been a general decline from 1999 to 2007 (Fig. 20.7).

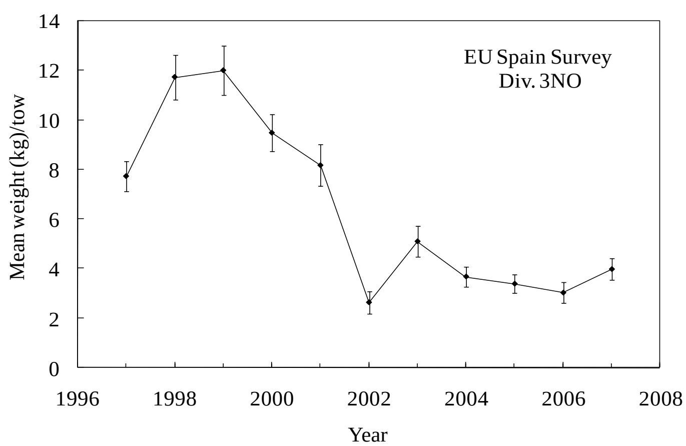


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in Div. 3NO.

Survey evaluation and consistency. Ideally, age-disaggregated survey indices should measure cohorts consistently at several ages. The consistency of standardized indices for all age-disaggregated survey series was evaluated. In addition, correlation coefficients as a measure of the age over age cohort-consistency in the survey series that are used to calibrate the virtual population analysis (VPA) were updated. The results are consistent with those noted in previous assessments: reasonably good up until ages 6 to 7; at ages 7 to 8, all of the survey series had poor correlations; and the correlations improved at the older ages. Potential explanations of the poor correlations could include: changing fishing mortality, immigration or emigration to/from the survey area, ageing problems, catchability issues or even a combination of these factors. Nonetheless, cohort analyses (such as VPA) of this stock are still considered appropriate.

Summary of research survey data trends. Over the past decade, indices from the majority of the surveys have generally provided a consistent signal as to the dynamics of the stock biomass. Following an increase from 1996 to 1998, they generally have been decreasing at or below 1996 levels. Within the recent period however, the Canadian autumn biomass index in Div. 2J+3K (Fig. 20.5) has increased considerably. The increase in Div. 2J+3K is, however, consistent with an increasing trend in commercial CPUE from Canadian, Spanish and Portuguese fleets (Fig. 20.4). At the same time, the EU Flemish Cap (Fig. 20.6) and Spanish Div. 3NO (Fig 20.7) biomass indices have shown limited increase in biomass in the recent period. Canadian spring surveys in Div. 3LNO remain lower than the levels of the late 1990's, but have increased slightly in recent years.

These surveys provide coverage of the majority of the spatial distribution of the stock and the area from which the majority of catches are taken. Few fish above 70 cm were caught in any of the surveys. The lack of consistency in the survey results at older age groups remains problematic.

c) Estimation of Parameters

The results of the 2007 assessment were examined for the presence of a stock-recruit relationship (SCR Doc. 08/46). The analyses showed that there is clearly a relationship between biomass of older fish and recruitment. Further, for all years in the retrospective analyses there appears to be a relationship between stock and recruits, best described by a Ricker function.

Survey and catch data were used to estimate numbers at age using the 2007 agreed XSA formulation. Model diagnostics and sensitivity analyses 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 2007, ages 1 to 14+

Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1995	2007	1	12
Canadian autumn survey (Div. 2J3K)	1996	2007	1	13
Canadian spring survey (Div. 3LNO)	1996	2007	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. 20.8): 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, relatively high catches and fishing mortality since then accompanied by poorer recruitment has caused it to decline again, and the 2004 to 2008 estimates are amongst the lowest in the series. Estimates of 2008 survivors from the XSA are used to compute 2008 biomass assuming the 2008 stock weights are equal to the 2005-2007 average. The 2008 5+ biomass is estimated to be about 79 000 t. The 10+ biomass peaked in 1991 and has since declined.

Fishing Mortality (Fig. 20.9): High catches in 1991-94 resulted in average fishing mortality over ages 5 to 10 (F_{5-10}) exceeding 0.50. F_{5-10} then declined to about 0.25 in 1995 with the substantial reduction in catch. F_{5-10} increased since then with some decline after 2003 but remains high in spite of the Fisheries Commission rebuilding plan. F_{5-10} in 2007 is estimated to be 0.43.

Recruitment (Fig. 20.10): The current assessment indicates that all recent year-classes are of below average strength. The estimated abundance of those year-classes which will recruit to the exploitable biomass in the next few years (2003-2005 year-classes) are estimated to be the lowest values in the time series.

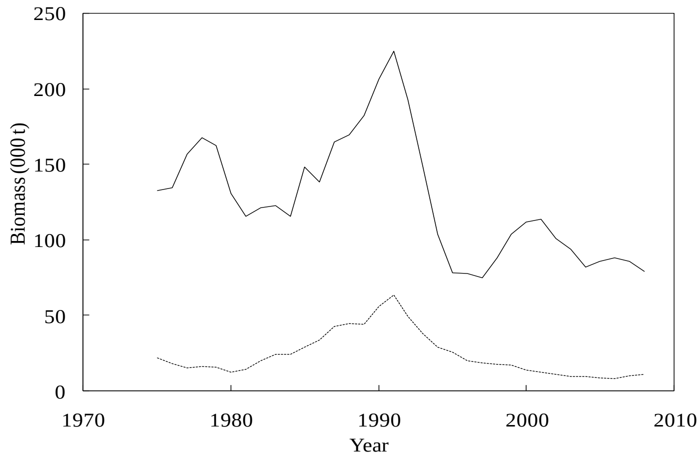


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated exploitable (5+ biomass; solid line) and 10+ biomass (dashed line) from XSA .

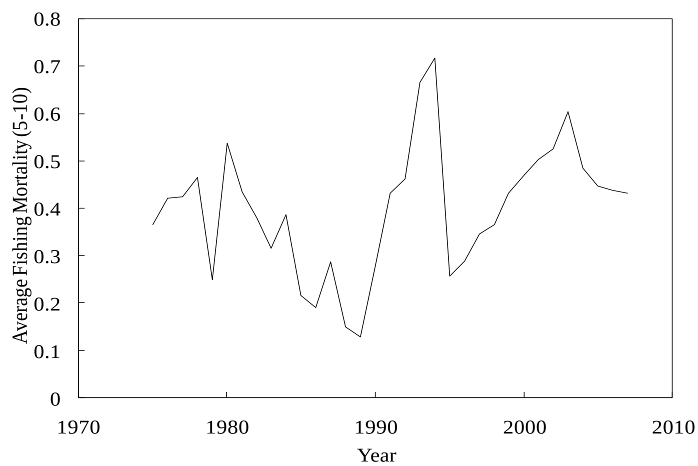


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: Estimated fishing mortality (5-10) from XSA.

Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA.

e) Retrospective Analysis

A five-year retrospective analysis of the XSA was conducted by eliminating successive years of catch and survey data. Fig- 20.11 - 20.13 present the retrospective estimates of 5+ biomass, average fishing mortality at ages 5-10 and age 1 recruitment.

In recent years biomass has been underestimated (Fig. 20.11), and the fishing mortality in recent years has been over-estimated (Fig. 20.12). The upward revisions of the 1996-2000 cohorts are in large part caused by higher than anticipated commercial and survey catches of these year-classes, which had been measured as relatively weak at younger ages. Although the estimated strength of these earlier year-classes has been revised over time, STACFIS noted that the below average abundance of the 2003-2005 cohorts as estimated from survey information has been consistent in recent assessments(Fig. 20.13).

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

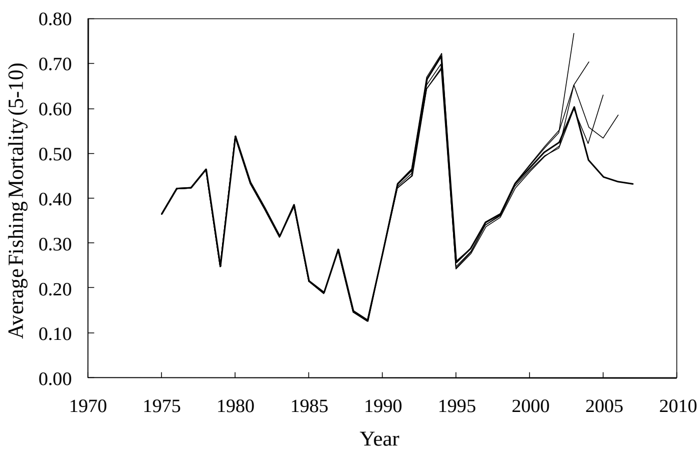


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

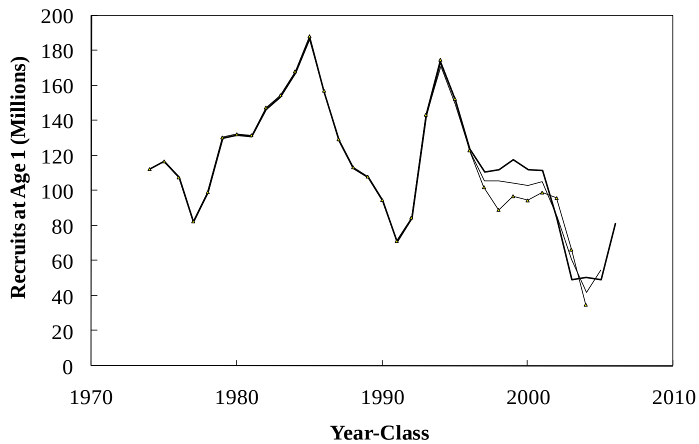


Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

f) Reference Points

i) Precautionary approach reference points

Precautionary approach reference points could not be determined for this stock at this time.

ii) Yield per recruit reference points

F_{Max} is computed to be 0.34 and $F_{0.1}$ is 0.18 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. 20.14) indicates that the current average fishing mortality is more than 50% above the F_{Max} level. STACFIS also noted that the average fishing mortality has been below F_{Max} for only ten years of the 33-year time series, and below $F_{0.1}$ only twice. Under the Fisheries Commission rebuilding plan, fishing mortality has decreased but remains high while the exploitable biomass is relatively low.

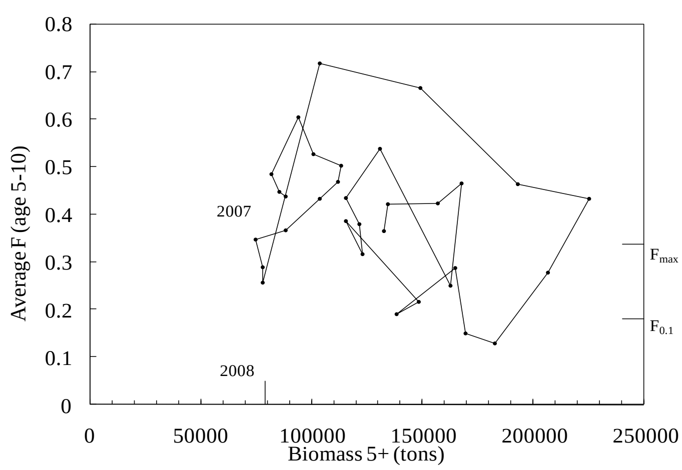


Fig. 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory with relation to yield per recruit reference points. The 2008 estimate of biomass (73 000 t) is indicated on the biomass axis.

g) Projections

STACFIS emphasizes that all projections are contingent on the accuracy of the estimates of survivors. This is especially so for the deterministic projections, which do not include uncertainties around the XSA estimates of terminal year survivors. In particular, assessments of year-class strength of this stock have been subject to retrospective revisions. Notwithstanding these revisions in the recent period, the long-term history of stock status remains unchanged. Further, as the projection period lengthens, an increasing proportion of the age composition is composed of year-classes that may be poorly estimated (limited survey data available) or are assumed (recruits in the projection period). Attention is also 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.

In order to evaluate the population trends in the medium term, five-year deterministic and stochastic projections to 2013 were conducted assuming average exploitation pattern and weights-at-age from 2005 to 2007, and with natural mortality fixed at 0.2.

All projection scenarios assume a status quo fishing mortality rate for 2008, as the 2008 TAC is unchanged from that in 2007. Using average weights and selection patterns, this produces an assumed catch of approximately 24 150 t. (The F_{2007} catch for 2008 is larger than the 2007 landings of 22 750 t due to higher selection of older, larger fish relative to that in 2007.) For projected catch in years 2009 – 2012, four scenarios with either constant fishing mortality or catch were evaluated:

i) constant fishing mortality at $F_{0.1}$ (0.180)
ii) constant fishing mortality at F_{2007} (0.432)
iii) constant landings at 16 000 t, and
iv) constant landings at 22 750 t.

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 2008 and corresponding CVs are computed from the XSA output. Deterministic projections were conducted assuming a recruitment value fixed at the 2000-2005 geometric mean of the age 1 XSA estimates. For the stochastic projections, recruitment was bootstrapped from the 2000-2005 age 1 numbers from the XSA; more recent recruitment levels were not included as these estimates are less certain. Scaled selection pattern and corresponding CVs are derived from the 2005 to 2007 average from the XSA. Weights at age in the stock and in the catch and corresponding CVs are computed from the 2005-2007 average input data. Natural mortality was assumed to be 0.2 with a CV of 0.15. 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.

Table 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: Inputs for projections.

Name	Value	Uncertainty (CV)	Name	Value	Uncertainty (CV)
Population at age i		2008	Selection pattern		(2005-2007
N1	Bootstrap (2000-2005)		sH1	0.000	0.000
N2	66676	0.63	sH2	0.000	0.000
N3	33098	0.33	sH3	0.000	0.000
N4	27852	0.22	sH4	0.014	0.494
N5	22053	0.22	sH5	0.073	0.417
N6	30374	0.15	sH6	0.380	0.280
N7	28468	0.14	sH7	1.608	0.027
N8	10621	0.14	sH8	1.867	0.117
N9	3664	0.16	sH9	1.251	0.181
N10	1449	0.20	sH10	0.820	0.068
N11	1046	0.21	sH11	0.628	0.325
N12	526	0.19	sH12	0.547	0.685
N13	381	0.20	sH13	0.554	0.502
N14	418	0.20	sH14	0.554	0.502
Weight in the catch		(2005-2007)	Weight in the stock		(2005-2007
WH1	0.000	0.00	WS1	0.000	0.00
WH2	0.000	0.00	WS2	0.000	0.00
WH3	0.187	0.99	WS3	0.000	0.00
WH4	0.281	0.06	WS4	0.000	0.00
WH5	0.397	0.02	WS5	0.397	0.02
WH6	0.583	0.04	WS6	0.583	0.04
WH7	0.832	0.02	WS7	0.832	0.02
WH8	1.159	0.07	WS8	1.159	0.07
WH9	1.562	0.07	WS9	1.562	0.07
WH10	2.000	0.08	WS10	2.000	0.08
WH11	2.569	0.06	WS11	2.569	0.06
WH12	3.220	0.07	WS12	3.220	0.07
WH13	3.960	0.07	WS13	3.960	0.07
WH14	4.960	0.05	WS14	4.960	0.05
Natural mortality pattern			Maturity ogive pattern		
M1	0.20	0.15	MT1	0.000	0.000
M2	0.20	0.15	MT2	0.000	0.000
M3	0.20	0.15	MT3	0.000	0.000
M4	0.20	0.15	MT4	0.000	0.000
M5	0.20	0.15	MT5	0.000	0.000
M6	0.20	0.15	MT6	0.000	0.000
M7	0.20	0.15	MT7	0.000	0.000
M8	0.20	0.15	MT8	0.000	0.000
M9	0.20	0.15	MT9	0.000	0.000
M10	0.20	0.15	MT10	1.000	0.000
M11	0.20	0.15	MT11	1.000	0.000
M12	0.20	0.15	MT12	1.000	0.000
M13	0.20	0.15	MT13	1.000	0.000
M14	0.20	0.15	MT14	1.000	0.000

Deterministic Projection Results

For each of the four scenarios considered, projection results (Tables 20.2, 20.3) of exploitable biomass (see also Fig. 20.15), fishing yield, and average fishing mortality (Fig. 20.16) are presented. Results indicate that of the scenarios considered, the exploitable biomass will increase throughout the projection period only if fishing mortality is reduced to the $F_{0.1}$ level. Subsequent to initial declines, the exploitable biomass is projected to increase slightly in each of the F_{2007} and 16 000 t projection scenarios by 2011. This is caused by the recruitment of the 2006 year-class to the exploitable biomass. The average fishing mortality under 16 000 t catches, however, continues to increase due to over-exploitation of the weak 2003-2005 year-classes.

If catches of 22 750 t are taken over 2009 to 2012, the population is projected to decline substantially, with a corresponding increase in fishing mortality. The projected declines under the F_{2007}, 16 000 t and 22 750 t are caused by the recruitment of the weak 2003-2005 year-classes into the exploitable biomass.

Table 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: Results of Deterministic projections under various catch levels and fishing mortality options.

F0.1

Year	5+ Biomass (t)	Yield (t)	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	10471	0.180
2010	71477	10652	0.180
2011	80184	10389	0.180
2012	90180	10755	0.180
2013	100757		

F2007

Year	5+ Biomass (t)	Yield	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	21252	0.432
2010	58341	16573	0.432
2011	58946	14251	0.432
2012	63078	14169	0.432
2013	68182		

16,000 t

Year	5+ Biomass (t)	Yield	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	16000	0.298
2010	64737	16000	0.343
2011	66507	16000	0.406
2012	68977	16000	0.439
2013	72132		

22,750 t

Year	5+ Biomass (t)	Yield	Fbar (5-10)
2008	79050	24154	0.432
2009	67937	22750	0.475
2010	56517	22750	0.734
2011	49533	22750	1.394
2012	42699	22750	2.798
2013	35401		

Table 20.3 and Table 20.4 provides growth rates of the exploitable and 10+ biomass in relation to those in 2003 (as estimated in the current assessment), when the rebuilding plan was implemented, and in 2008, the terminal year of the assessment. Note that if fishing mortality is reduced to the $F_{0.1}$ level, the projected biomass grows considerably, due in part to substantial increases in the 10+ age groups.

Table 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass growth (%) under various projections. The exploitable (5+) at the end of the projection period (2013) is compared to the biomass at the beginning of the projection (2008; 79 000 t) and the biomass in 2003, when the rebuilding plan was instituted (93 800 t).

Exploitable Biomass	F0.1	F2007	16 000t	22 750t
[B(2013)-B(2008)] / B(2008)	27%	-14%	-9%	-55%
[B(2013)-B(2003)] / B(2003)	7%	-27%	-23%	-62%

Table 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass growth (%) under various projections. The 10+ biomass at the end of the projection period (2013) is compared to the biomass at the beginning of the projection (2008; 10 900 t) and the biomass in 2003, when the rebuilding plan was instituted (9 200 t).

10+ Biomass	F0.1	F2007	16 000t	22 750t
[B(2013)-B(2008)] / B(2008)	199%	4%	38%	-92%
[B(2013)-B(2003)] / B(2003)	253%	23%	63%	-91%

Table 20.5 presents the ratio of the exploitable (5 +) biomass at the end of the projection period to the target identified in the rebuilding plan. Note that if catches are maintained at the current TAC level (16 000 t), the biomass in 2013 is projected to be 52% of the target level with only six years remaining in the rebuilding plan.

Table 20.5 Greenland Halibut in Subarea 2 + Div. 3KLMNO: Comparison of the biomass at the end of the projection period to the rebuilding plan target of 140 000 t.

Scenario	**Projected Biomass Relative to 140 000t**
F0.1	0.72
F2007	0.49
16,000 t	0.52
22,750 t	0.25

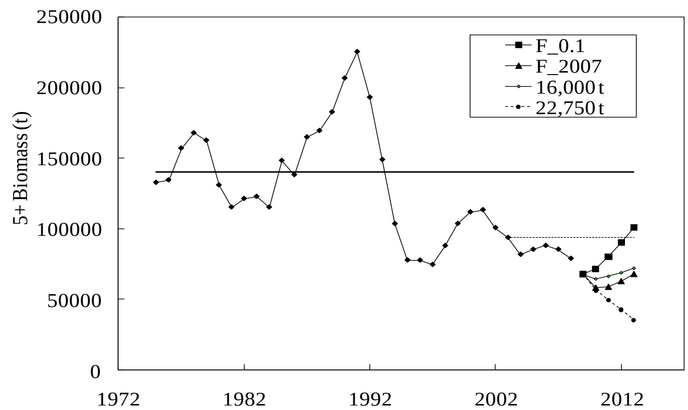


Fig. 20.15. Greenland halibut in Subarea 2 + Div. 3KLMNO: Deterministic projection of 5+ biomass to 2013 (see text for description of projection scenarios). The solid horizontal line represents the rebuilding plan target biomass of 140 000 t; the dashed horizontal line is the level of the exploitable biomass in 2003, when the rebuilding plan was implemented.

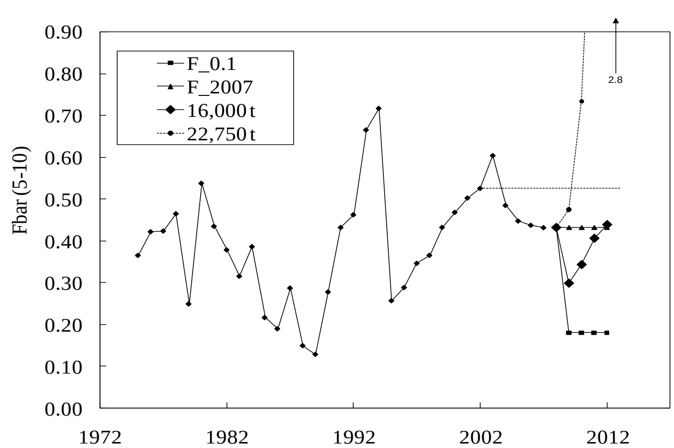


Fig. 20.16. Greenland halibut in Subarea 2 + Div. 3KLMNO: Deterministic projection of average fishing mortality to 2012 (see text for description of projection scenarios). The horizontal dashed line indicates the level of fishing mortality when the rebuilding plan was implemented.

Stochastic Projection Results

The results of the stochastic projections (average fishing mortality, 5+ biomass and 10+ biomass) conducted under the four scenarios described above are plotted in Figures 20.17 - 20.20, and are similar to those from the deterministic projections. The trend in age 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. As in the deterministic projections, the status quo fishing mortality (F_{2007}) is assumed to generate 2008 yield.

In addition, probability profiles of the biomass in 2013, the end of projection period (Fig. 20.21) are compared to the 2003 level (as estimated in the current assessment), when the rebuilding plan was implemented, and also to 140 000 t, the target level identified in the rebuilding plan. These illustrate the risk of the projected exploitable biomass in 2013 being below a reference level. Again, only the $F_{0.1}$ scenario provides a high (>90%) probability that the exploitable biomass will have recovered to the 2003 level by 2012. Even under this most optimistic scenario, there is a low (<10%) probability that the 2013 biomass will have reached the 140 000 t target.

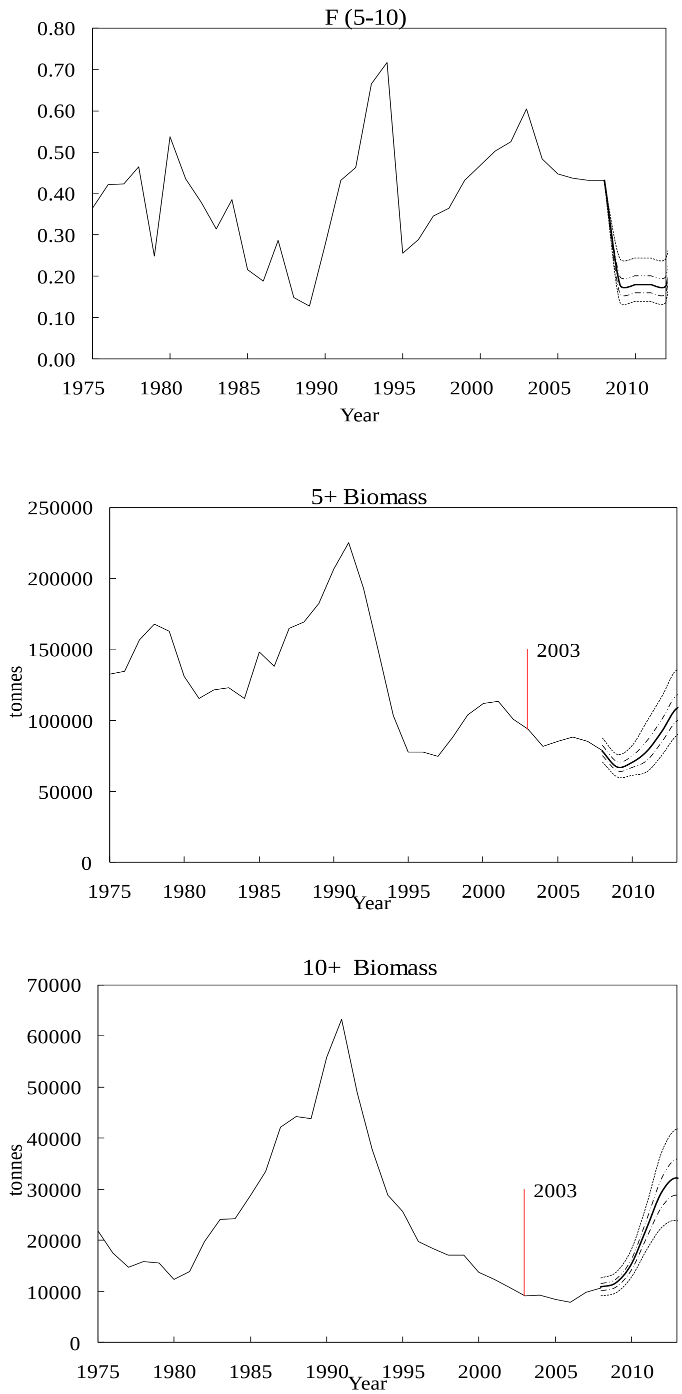


Fig. 20.17. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2009-2013 assuming catches correspond to the $F_{0.1}$ level. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5^{th}, 25^{th}, 50^{th} (thick line), 75^{th}, and 95^{th} percentiles are shown.

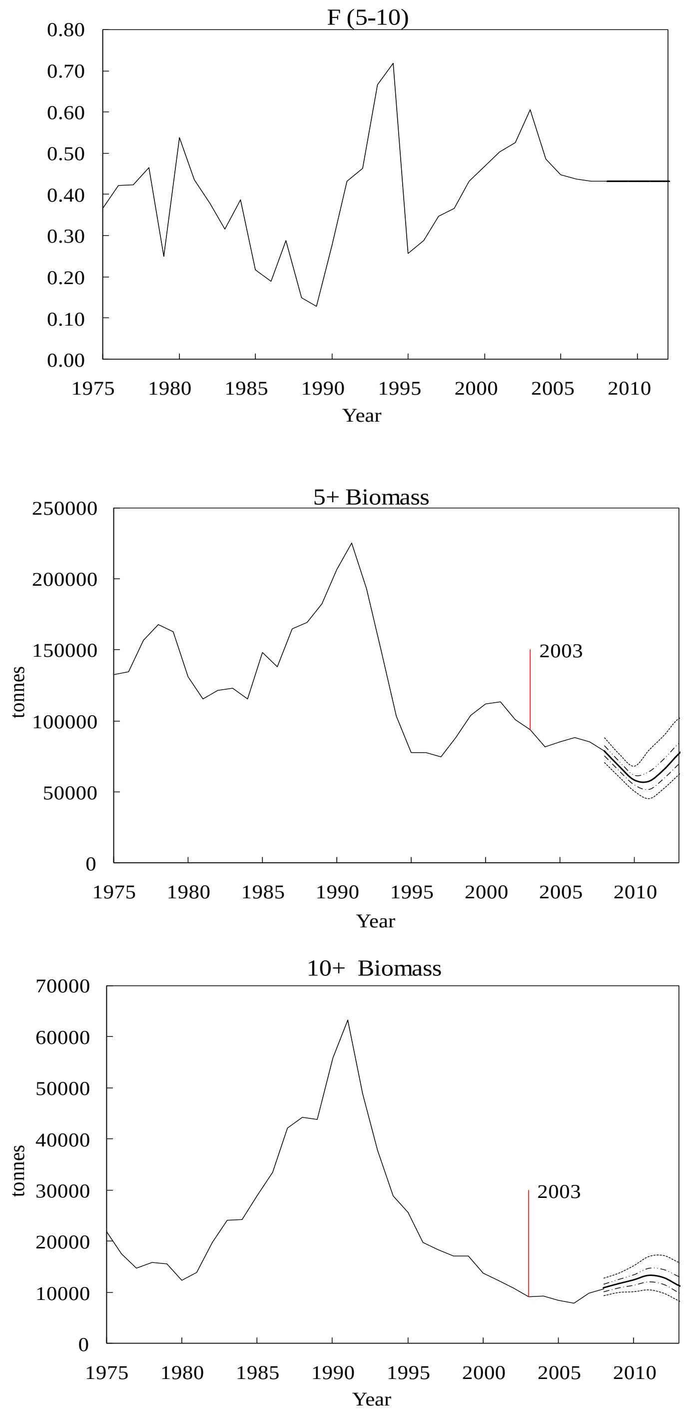


Fig. 20.18. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2009-2013 assuming catches correspond to the F_{2007} level. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

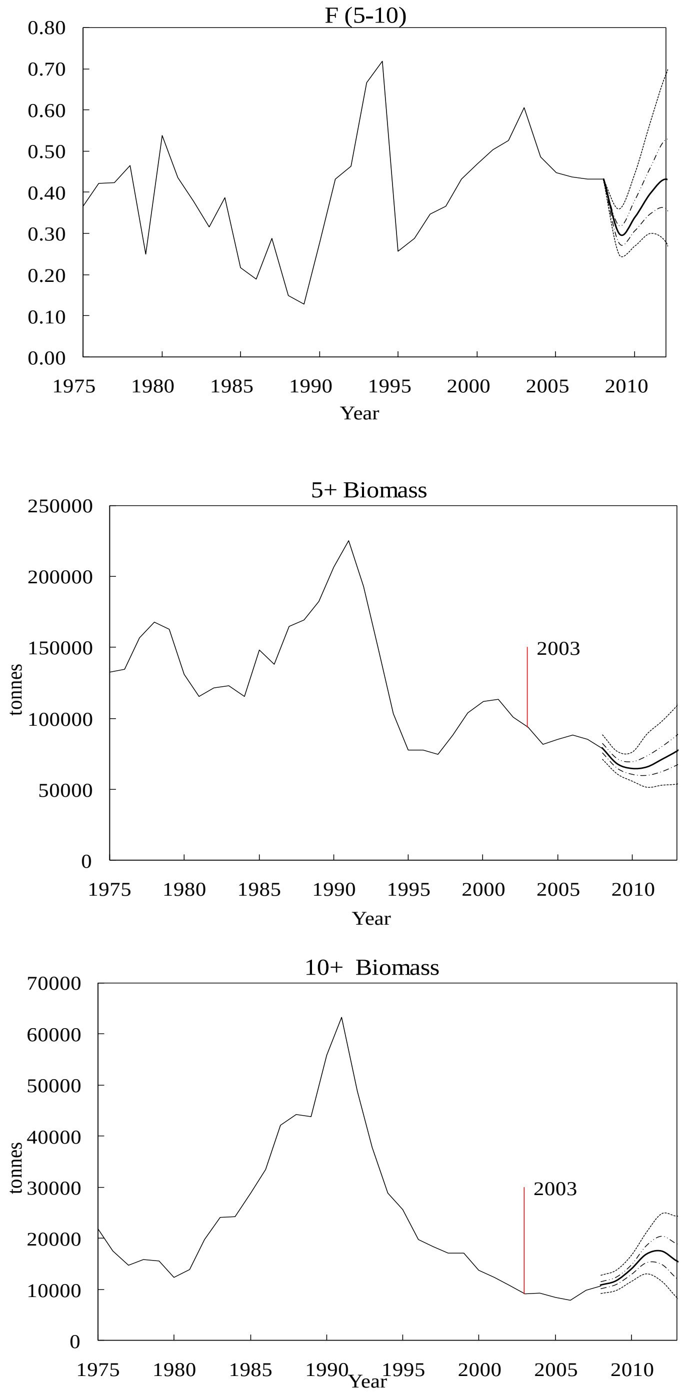


Fig. 20.19. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2009-2013 under constant removals of 16, 000 t. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

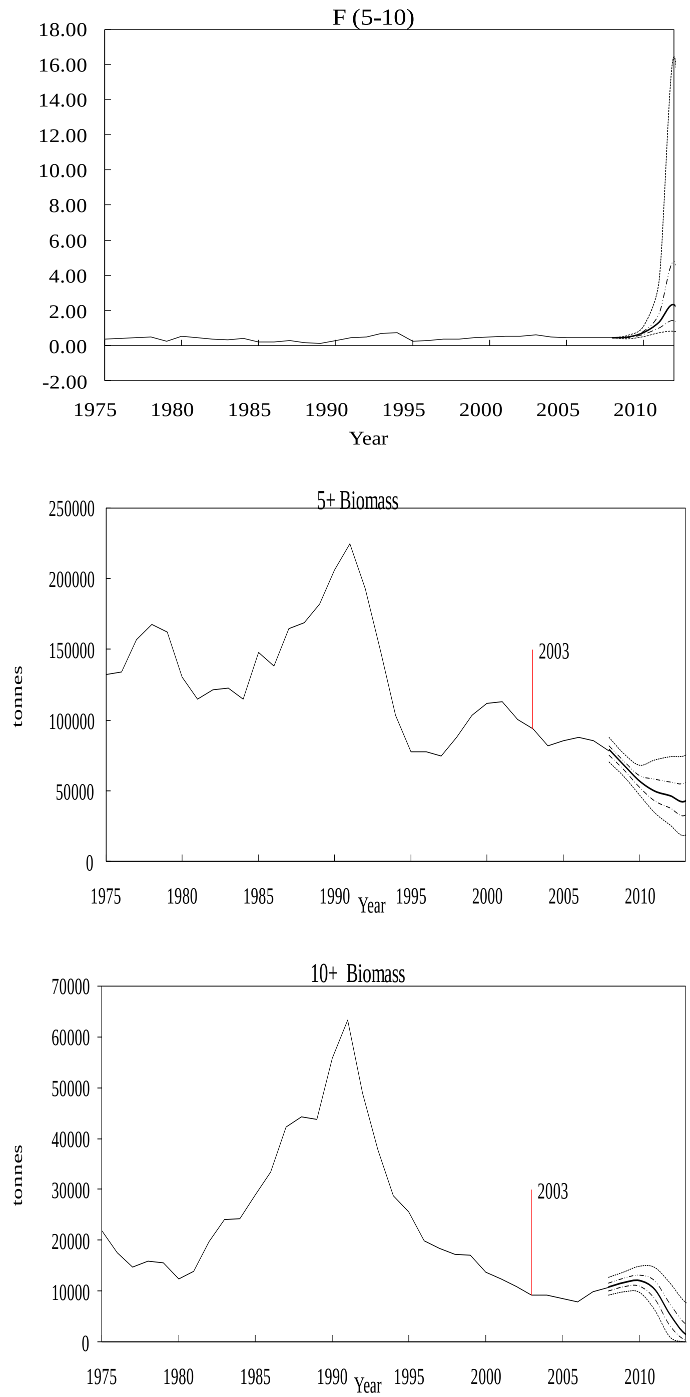


Fig. 20.20. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2009-2013 under constant removals of 22, 750 t. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

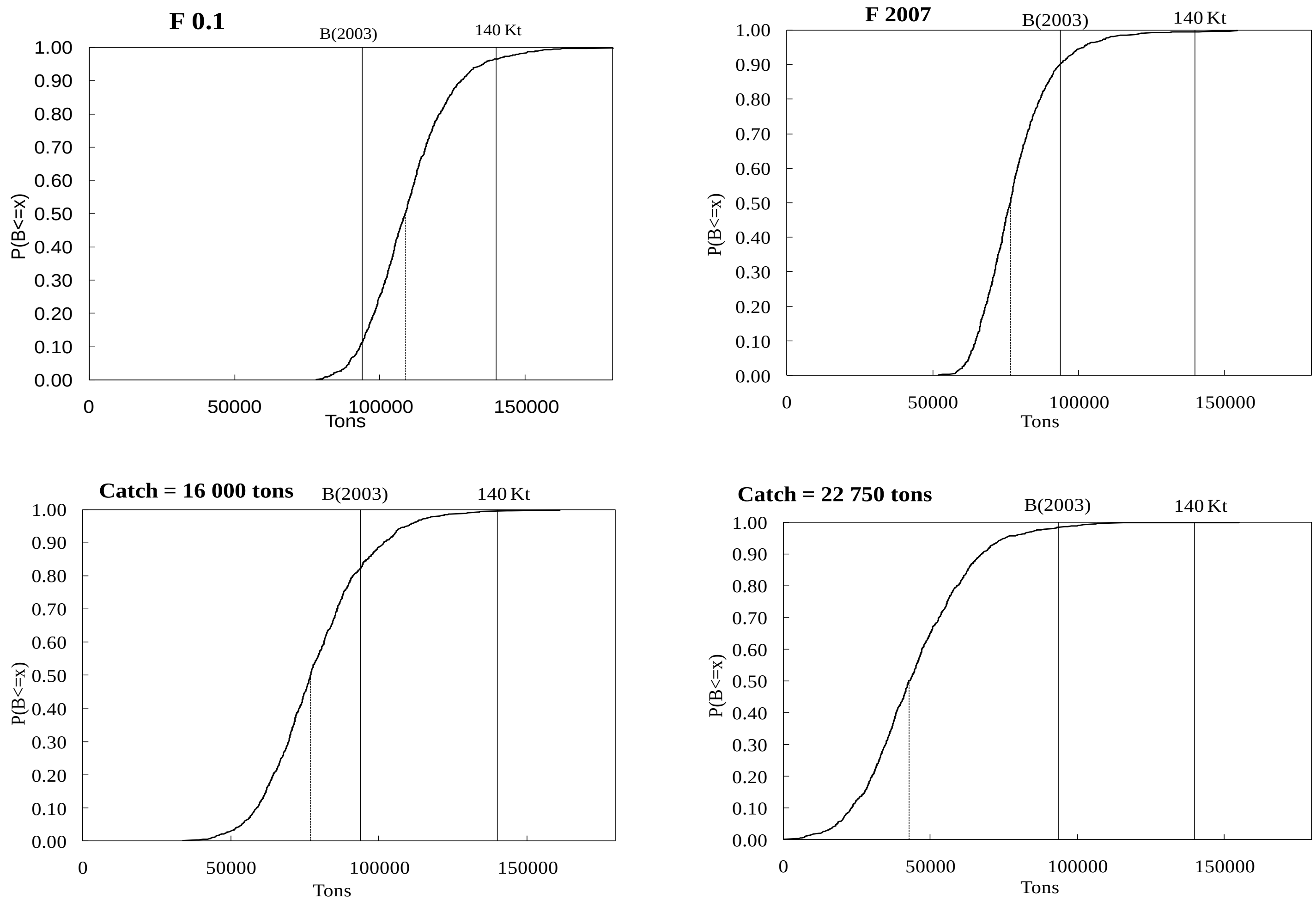


Fig. 20.21. Greenland halibut in Subarea 2 + Div. 3KLMNO: Probability profile of exploitable biomass in 2013 for each of the four projection scenarios. Solid vertical lines demarcate the biomass level in 2003 (93 800 t) and the rebuilding plan target (140 000 t). The dashed vertical line indicates the median projected biomass level in 2013.

In summary, projections conducted assuming either (i) current fishing mortality, (ii) fixed catch of 16 000 t or (iii) fixed catch of 22 750 t are pessimistic, since the majority of the year-classes which recruit to the exploitable biomass are estimated to be well below average. If a fishing mortality corresponding to $F_{0.1}$ is achieved, the exploitable biomass is projected to grow in the medium term.

References

Patterson,K.R., R.M.Cook, C.D.Darby, S.Gavaris, B.Mesnil, A.E.Punt, V.R.Restrepo, D.W.Skagen, G.Stefansson, M.Smith. 2000. Validating three methods for making probability statements in fisheries forecasts. ICES CM 2000 V:06

NAFO 1993. *NAFO Sci. Coun Rep*., Part A, Appendix 1 (STACFIS).

NAFO 2004. *NAFO Sci. Coun Rep*., Part A, Appendix 1 (STACFIS)..

h) Research Recommendations

STACFIS **recommended** that *research continue on age determination for Greenland halibut in Subarea 2 and Div. 3KLMNO to improve accuracy and precision.*

Previous survey experiments have noted that the depth distribution of Greenland halibut extends beyond 1500m, the maximum depth of the survey information currently available to assess this stock. In addition, fisheries for Greenland halibut have at times fished at depths beyond 1500m. Therefore, STACFIS **recommended** that *exploratory deep-water surveys for Greenland halibut in Subarea 2 and Divisions 3KLMNO be conducted using gears other than bottom trawls to complement existing survey data.*

The next full assessment of this stock is expected to be in 2009.

21. Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4

Interim Monitoring Report

a) Introduction

The Subareas 3+4 catch in 2007 (230 t) was substantially lower than the catch in 2006 (6 900 t) and similar to low catches, of less than 1 000 t, observed from 1999 to 2002 (Fig. 21.1). Most of the catch in Subareas 3+4 in 2007 (99%) was from Div. 3KL.

Recent catches and TACs ('000 t) are as follows:

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
TAC SA 3+4	150	75	34	34	34	34	34	34	34	34
STATLANT 21A SA 3+4	1.9	0.3	0.3	<0.1	0.2	1.1	2.3	0.6[1]	6.9[1]	0.2[1]
STATLANT 21A SA 5+6[2]										
STACFIS SA 3+4	1.9	0.3	0.4	<0.1	0.2	1.1	2.3	0.6	6.9	0.2
STACFIS SA 5+6	23.6	7.4	9.0	3.9	2.8	6.4	25.2	12.0	13.9	9.0
STACFIS Total SA 3-6	25.5	7.7	9.4	4.0	3.0	7.5	27.5	12.6	20.8	9.2

[1] Provisional.

[2] Statistics for SAs 5&6 are included because there is no basis for considering separate stocks in Subareas 3+4 and Subareas 5+6

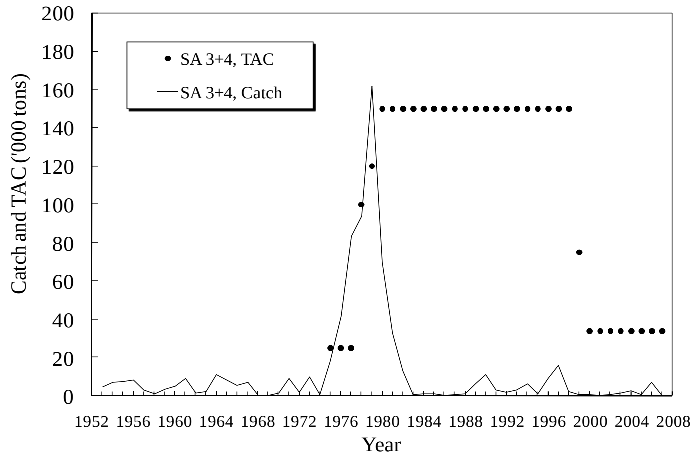


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

b) Data Overview

The index of relative biomass is the Div. 4VWX July survey series mean weight per tow. The 2007 value (1.5 kg) was substantially lower than that of 2006 (10.2 kg). This index has fluctuated in the most recent years, including low values, typical of those generally seen since 1982, but also including, in 2004 and 2006, two of the highest in the series (Fig. 21.2).

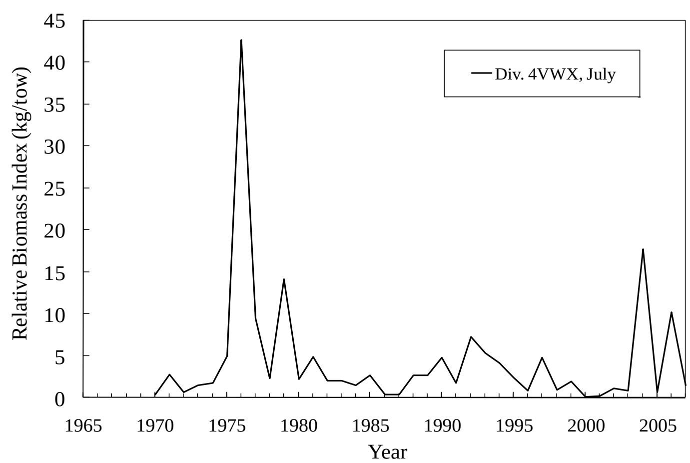


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices from the July survey in Div. 4VWX.

The mean weight of squid from the Div. 4VWX survey in 2007 (98 g) was lower than that in 2006 (137 g) but remained higher than most values since 1982 (Fig. 21.3).

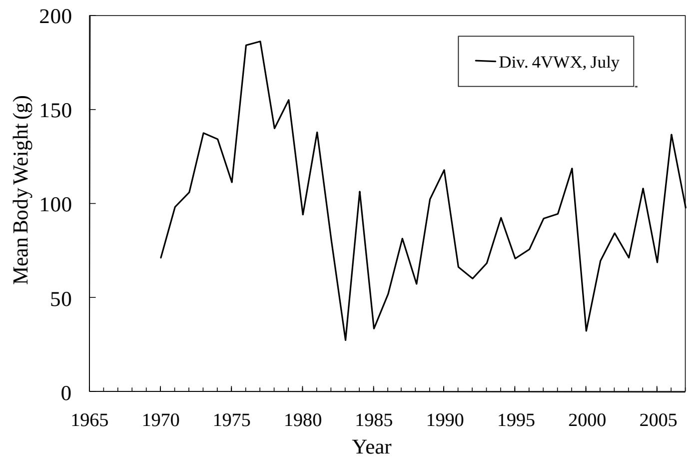


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX.

c) Conclusion

The survey biomass index decreased substantially in 2007 from the fourth highest value on record to a value more typical of the low-productivity period that began around 1982. Mean body weight also decreased in 2007, but remained higher than most values observed since 1982.

The available data does not show any significant change in the state of the stock.

d) Special Comment

STACFIS is unable to plan further assessments or monitoring of this stock until an assessment expert can be designated.

IV. OTHER MATTERS

1. Other Business

a) Designated Experts.

STACFIS has been under difficulties in presenting even an Interim Monitoring Report for Northern Shortfin Squid owing to the lack of candidates for Designated Expert for this stock. STACFIS was enabled to consider an Interim Monitoring Report for this stock in 2008 through the voluntary help, obtained at short notice, of Dr Earl G. Dawe of DFO, St John's, NL, Canada for which STACFIS thanks both him, and the Chairman of Scientific Council for enlisting his help. STACFIS considers that it can not plan further assessments or interim monitoring of this stock until an assessment expert can be designated, and has requested the Chairman of Scientific Council so to inform the Fisheries Commission at an early opportunity.

2. Acknowledgements

STACFIS thanks Dr Dawe for help at short notice in the matter of Northern Shortfin Squid (see above), Designated Experts for their competence and hard work, and the Secretariat for navigational help through the up to four drafts of its numerous documents. The Chairman of STACFIS, experiencing his first June meeting, thanks Designated Experts, the Chairman of Scientific Council, and the Scientific Council Coordinator for their help in keeping the meeting on track