PART A: SCIENTIFIC COUNCIL MEETING, 7–21 JUNE 2007

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REPORT OF SCIENTIFIC COUNCIL MEETING

7-21 JUNE 2007

Chair: Antonio Vázquez Rapporteur: Anthony Thompson

I. PLENARY SESSIONS

The Scientific Council met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 7-21 June 2007, 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, 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 7 June 2007.

The Chair welcomed the representatives, advisors and experts to the 28th session of the Scientific Council, held in Dartmouth, NS, Canada. The Chair also welcomed the two new NAFO Secretariat staff, George Campanis and Lisa Pelzmann, to the Scientific Council meeting. The NAFO Scientific Council Coordinator, Anthony Thompson, was appointed rapporteur. The Chair noted that the Reform of the NAFO Convention had been a major activity within NAFO last year and that there was still an expectation that an agreed text could be produced at the Annual Meeting in September. Additionally, the ecosystem approach is likely to play a larger role within Scientific Council over the next few years.

The Executive Secretary was invited to give an introductory presentation.

The Council was informed that authorization had been received by the Executive Secretary for proxy votes from Cuba, Iceland and Norway to record their abstentions during any voting procedures. Ukraine is currently a non-voting member of NAFO. France (in respect of Saint Pierre et Miquelon) and Republic of Korea did not convey their wishes to the Secretariat.

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

An application for observer status was made by WWF Canada – Atlantic Region for Robert Rangeley, Marty King and Susan Fudge. Having no objections, WWF-Canada was invited as an Observer to the meeting. WWF-Canada made an application to represent the global WWF network at the September 2007 Annual Meeting of the Scientific Council, and this was also approved by Scientific Council. It was agreed that the Scientific Council Coordinator would provide a draft amendment to the Rules of Procedure that simplified the observer approval process for consideration by Scientific Council at the Annual meeting.

The proposal of Carmen Fernandez as the new 3M Cod Designated Expert was approved by Scientific Council. The appointment will become effective upon confirmation from the Director of her institute. A designated expert for Squid SA 3 and 4 has still to be identified.

A Nominating Committee was established to identify and propose candidates for the upcoming two-year term of the Scientific Council Chair, and the four Standing Committee Chairs. Members of the Nominating Committee will be Vladimir Babayan (Russia), Manfred Stein (EU) and Bill Brodie (Canada).

Scientific Council noted with sadness that Dr. Ransom A. Myers (RAM) passed away on 27 March 2007. A noted fisheries scientist, RAM held the Killam Chair of Ocean Studies at Dalhousie University in Halifax at the time of his death. RAM attended several Scientific Council meetings over the years, most recently at the Scientific Council Special Session in September 2006, and contributed numerous papers to Scientific Council's work on fish and marine mammal stocks in the NAFO area. Scientific Council extends its condolences to his family and friends.

The opening session was adjourned at 1630 hours on 7 June 2007.

The Council through 7-21 June 2007 addressed various outstanding agenda items as needed.

The concluding session was called to order at 1000 hours on 21 June 2007.

The Council considered and **adopted** the STACFEN, STACPUB, STACREC and STACFIS Reports and Scientific Council Report of this meeting of 7-21 June 2007, noting changes as discussed during the reviews would be made by the Chair and the Secretariat.

The meeting was adjourned at 1345 hours on 21 June 2007.

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

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

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

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 2006

The Council noted recommendations made in 2006 pertaining to the work of the Standing Committees were addressed directly by the Standing Committees, while recommendations pertaining specifically to the Council's work will be addressed under each relevant topic of the Council agenda:

From Scientific Council Meeting, 1-15 June 2006

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

STATUS: No specific action taken by Fisheries Commission.

2. Scientific Council **recommended** that:

- *criteria are developed for identifying sensitive areas,*
- *the collection of biological information important for safeguarding habitats from CP fishing surveys be incorporated as a standard routine in the surveys in the area, and further studies on bycatch be undertaken,*
- *fishing in sensitive areas, for example on and around sea mounts, be monitored, possibly by the provision of summary information based on VMS, and*
- *Contracting Parties identify the expertise necessary to allow Scientific Council to address issues relating to safeguarding habitats.*

STATUS: Scientific Council noted that there has been an increase in the number of research vessels sampling invertebrates, and this is now routine on Canadian and EU surveys, with new sampling protocols for the collection of corals, etc. There has been considerable effort by the Secretariat, in using the VMS data, and by Canada, using published and unpublished data, on answering the seamount request.

3. Scientific Council **recommended** that *the proposal made by NAMMCO to formally join the ICES-NAFO Harp and Hooded Seals Working Group be rejected.*

STATUS: No further action required.

4. Scientific Council **recommended** that *scientific sampling by the NAFO Scientific Observer Programme should manage to cover sampling catches of those Contracting Parties that did not have their own programmes, and that the electronic recording forms designed by the Secretariat be adopted for use by in the NAFO Observer Programme for that purpose.*

STATUS: No formal NAFO Scientific Observer Program is currently in operation, as it is currently in the design and discussion phase. The electronic recording forms have been developed by the Secretariat and are available for use by the observers. Chapter VII of the NAFO Conservation and Enforcement Measures (2007), entitled "Electronic reporting, satellite tracking and observers", allows vessels to operate an alternative observer scheme that would provide daily transmissions of catch and effort. There is not mention of this being a scientific observer program and currently only four shrimp vessels and one redfish vessel opted for the scheme.

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

STATUS: This outcome of this recommendation was successful and will be further discussed under agenda item IX.1.

6. Scientific Council noted that the boundary definition of Division 3M does not include the south-western deeper part of the Flemish Cap. Certain deep-water species living on the south-western corner of the Flemish Cap are currently recorded under Division 3L. An exception has been made for shrimp by recording catches from the rectangular portion of 3L as 3M (see CEM 2006, Article 12, Fig. 1, p. I-8). Scientific Council **recommended** that *boundaries of Divisions 3M and 3L be re-defined so that 3M includes that small rectangle currently in 3L.*

STATUS: This item will be dealt with by the Fisheries Commission under Article XX Paragraph 2 of the Convention.

From Scientific Council Meeting, 18-22 September 2006

1. Scientific Council **recommended** that *the period of assessment be extended to the following assessment frequency for the following stocks:*

Two year basis	Three year basis
American plaice in Div. 3LNO	American plaice in Div. 3M
Capelin in Div. 3NO	Cod in Div. 3NO
Redfish in Div. 3M	Cod in Div. 3M
Thorny skate in Div. 3LNOPs	Northern shortfin squid in SA 3+4
White hake in Div. 3NOPs	Redfish in Div 3LN
Yellowtail flounder in Div. 3LNO	Redfish in Div. 3O
	Witch flounder in Div. 2J+3KL
	Witch flounder in Div. 3NO

STATUS: The above frequency of assessment is now being supported by Fisheries Commission in their requests for advice.

2. Firstly, Scientific Council reiterated its recommendation made in June 2006 that Contracting Parties identify the expertise necessary to allow Scientific Council to address issues relating to safeguarding habitats within the Ecosystem Approach to Fisheries framework and **recommended** that *Contracting Parties take active steps to ensure that support is made available to Scientific Council.*

STATUS: To date, no extra expertise on the Ecosystem Approach has been provided to Scientific Council. This will be discussed under agenda item XII.1.

III. FISHERIES ENVIRONMENT

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

STACFEN made no formal recommendations during this 2007 meeting.

IV. PUBLICATIONS

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

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

1. 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.*

2. 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.*

3. STACPUB discussed the term "Miscellaneous Papers" of JNAFS. It was generally felt that this formulation might have a negative meaning for the papers contained in such a JNAFS volume. STACPUB therefore **recommended** *not to use this classification of volumes in future, and instead discriminate between Symposium editions and editions of JNAFS.*

V. RESEARCH COORDINATION

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

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

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

2. STACREC **recommended** that *the appropriate method to estimate effort from twin trawls (bottom and mid-water) be referred to the ICES Fishing Technology Working Group.*

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

VI. FISHERIES SCIENCE

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

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

A **recommendation** made by STACFIS for the work of 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 Meeting as possible.*

VII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. Fisheries Commission

(Appendix V, Annex 1)

The Scientific Council noted that the Fisheries Commission requests for advice on northern shrimp (Northern shrimp in Div. 3M and Div. 3LNO (Item 1)) will be undertaken during Scientific Council Meeting on 24 October-1 November 2007)

a) Request for Advice on TACs and Other Management Measures for the Year 2008

The Scientific Council and the Fisheries Commission during the Annual Meeting of September 2006 agreed to consider certain stocks in 2008. This section presents reports for which the Scientific Council provided scientific advice for 2008 during this meeting.

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

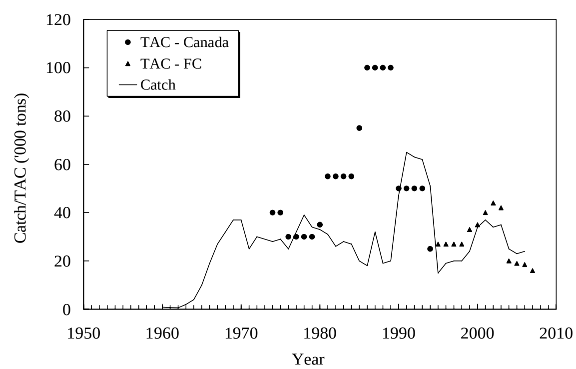
Background: The Greenland halibut stock in Subarea 2 and Div. 3KLMNO is considered to be part of a biological stock complex, which includes Subareas 0 and 1.

Fishery and Catches: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by Fisheries Commission. Catches increased sharply in 1990 due to a developing fishery in the NAFO Regulatory Area in Div. 3LMNO and continued at high levels during 1991-94. The catch was only 15 000 to 20 000 tons per year in 1995 to 1998 as a result of lower TACs under management measures introduced by the Fisheries Commission. The catch increased since 1998 and by 2001 was estimated to be 38 000 tons, the highest since 1994. The estimated catch for 2002 was 34 000 tons. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 tons to 38 500 tons. A fifteen year rebuilding plan for this stock has been implemented by Fisheries Commission. The catches in 2004 - 2006 have exceeded the rebuilding plan TACs by 27%, 22%, and 27% respectively, despite reductions in fishing effort.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	25	16	16	20
2005	23	18[1]	nr	19
2006	24	4[1]	nr	18.5
2007			nr	16

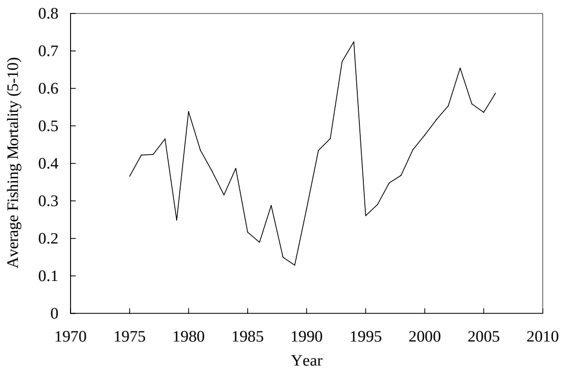
[1] Provisional
nr No recommendation

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. 2J+3KLMNO (1978-2006), EU in Div. 3M (1988-2006) and EU-Spain in Div. 3NO (1995-2006). Commercial catch-at-age data were available from 1975-2006.

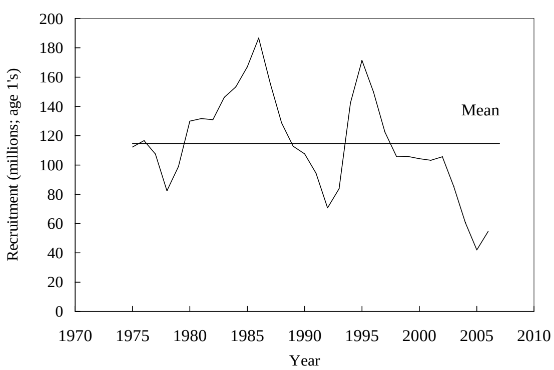


Assessment: An analytical assessment using Extended Survivors Analysis (XSA) tuned to the Canadian spring (Div. 3LNO; 1996-2005), and autumn (Div. 2J, 3K; 1996-2006) and the EU (Div. 3M; 1995-2006) surveys was used to estimate the 5+ exploitable biomass, level of exploitation and recruitment to the stock. Natural mortality was assumed to be 0.20 for all ages.

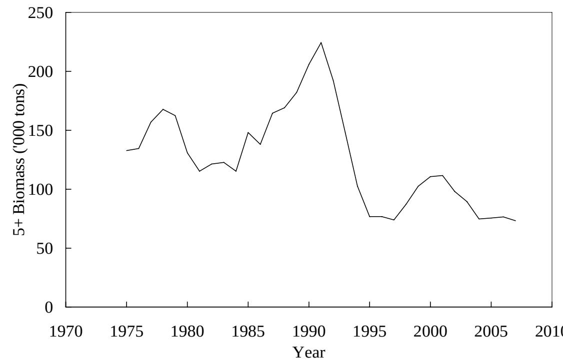
Fishing Mortality: High catches in 1991-94 resulted in average fishing mortality (ages 5-10: F_{5-10}) exceeding 0.50. F_{5-10} then dropped to about 0.20 in 1995 with the substantial reduction in catch. F_{5-10} increased since then and has remained high in spite of the Fisheries Commission Rebuilding Plan.



Recruitment: All recruiting year-classes since the 1996 year-class have been below average. The majority of the current exploitable biomass consists of year-classes that have been of below average strength. The contribution of recent year-classes 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 (2004-2007) estimates of exploitable biomass are amongst the lowest in the series.

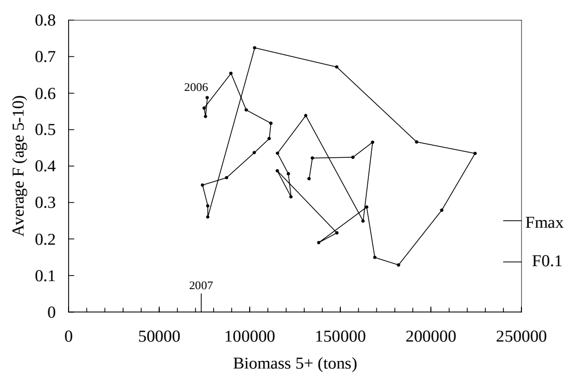


State of the Stock: The exploitable biomass has declined in recent years and the current estimates (2004-2007) are amongst the lowest in the series. Recent recruitment has been below average, and fishing mortality remains high.

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

For this stock F_{max} is estimated to be 0.25 and $F_{0.1}$ is 0.14 based upon average weights and partial recruitment patterns from the past 3 years.

A plot of these reference levels of fishing mortality in relation to stock trajectory indicates that the current average fishing mortality is more than twice the F_{max} level. Scientific Council also noted that the average fishing mortality has been below F_{max} for only five years of the time series, and been below $F_{0.1}$ only once.



Projections and Evaluation of the Management Strategy: Four projections were considered. The assumed catch levels correspond to a fishing mortality of $F_{0.1}$, catches corresponding to the current level of fishing mortality, a fixed 16 000 ton catch (Rebuilding Plan I), and catches decreasing by 15% annually from 16 000 tons, the 2007 TAC (Rebuilding Plan II). All projections assume that the catches for 2007 equal 20 000 tons, a 25% over-run on the 16 000 ton TAC. Scientific Council noted that the 2004 - 2006 catches have exceeded the rebuilding plan TAC by 27%, 22%, and 27% respectively.

F0.1				
Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)
2007			20000	0.445
2008	69883	6154	8057	0.138
2009	77374	9280	10191	0.138
2010	84088	17155	10749	0.138
2011	96257	30306	10612	0.138
2012	109528	41109		

Fcurrent				
Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)
2007			20000	0.445
2008	69883	6154	26102	0.588
2009	54735	5784	21224	0.588
2010	45453	5698	16440	0.588
2011	47541	5298	13653	0.588
2012	53864	4594		

Projection results (deterministic projection results tabulated below, see figures for stochastic projection results) indicate that the exploitable biomass will continue to decline if current levels of fishing mortality are maintained. If catches over 2008-2011 are constant at 16 000 tons, the exploitable biomass remains stable with minimal recovery. Exploitable biomass is projected to rapidly increase if fishing mortality is reduced to the $F_{0.1}$ level, or if the catches in 2008 and onward are decreased by 15% annually under the Rebuilding Plan.

Rebuilding Plan I				
Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)
2007			20000	0.445
2008	69883	6154	16000	0.305
2009	67411	7783	16000	0.283
2010	65963	11600	16000	0.303
2011	70396	16226	16000	0.346
2012	75610	17952		

Rebuilding Plan II				
Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)
2007			20000	0.445
2008	69883	6154	13600	0.250
2009	70422	8242	11560	0.181
2010	74773	13973	9826	0.145
2011	87444	24014	8352	0.120
2012	103032	34433		

Growth rates of the exploitable (5+) and 10+ biomass over the projection period (2012 relative to 2007), and since the beginning of the Rebuilding Plan (2012 relative to 2003) indicate that the 10+ biomass grows rapidly if fishing mortality or catches are substantially reduced ($F_{0.1}$ and Rebuilding Plan II).

F0.1	Biomass (t)	
	5+	10+
2012 relative to 2007	50%	529%
2012 relative to 2003	22%	377%

Fcurrent	Biomass (t)	
	5+	10+
2012 relative to 2007	-26%	-30%
2012 relative to 2003	-40%	-47%

Rebuilding Plan I	Biomass (t)	
	5+	10+
2012 relative to 2007	3%	175%
2012 relative to 2003	-16%	108%

Rebuilding Plan II	Biomass (t)	
	5+	10+
2012 relative to 2007	41%	427%
2012 relative to 2003	15%	300%

The level of the projected biomass in 2012 in relation to the Rebuilding Plan target indicates that the biomass remains below the Rebuilding Plan target under each scenario, but is more optimistic under $F_{0.1}$ and Rebuilding Plan II.

Scenario	Projected Biomass Relative to 140 000t
F0.1	0.78
F2006	0.38
Rebuilding Plan I	0.54
Rebuilding Plan II	0.74

Recommendation: Considering these results, and in order 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 $F_{0.1}$, or alternatively, catches over the next four years should be reduced by 15% annually from the 2007 TAC (16 000 tons).*

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.

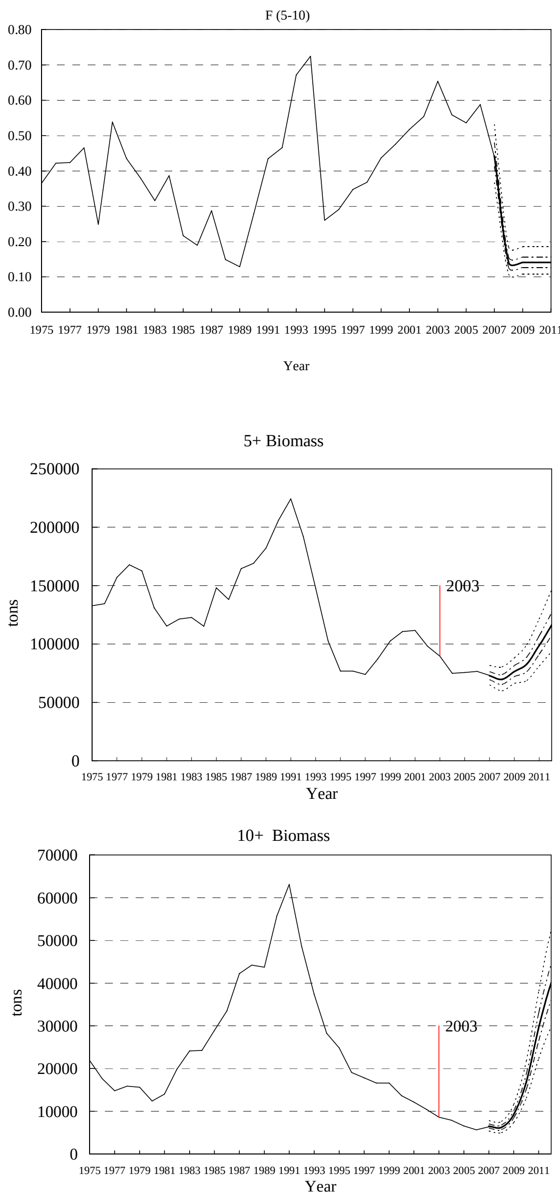
Scientific Council noted that the prospects of rebuilding this stock have, to date, been hampered by catches that have exceeded the Rebuilding Plan TACs.

Scientific Council noted that during recent assessments of this stock, the exploitable biomass has been underestimated and fishing mortality overestimated.

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.

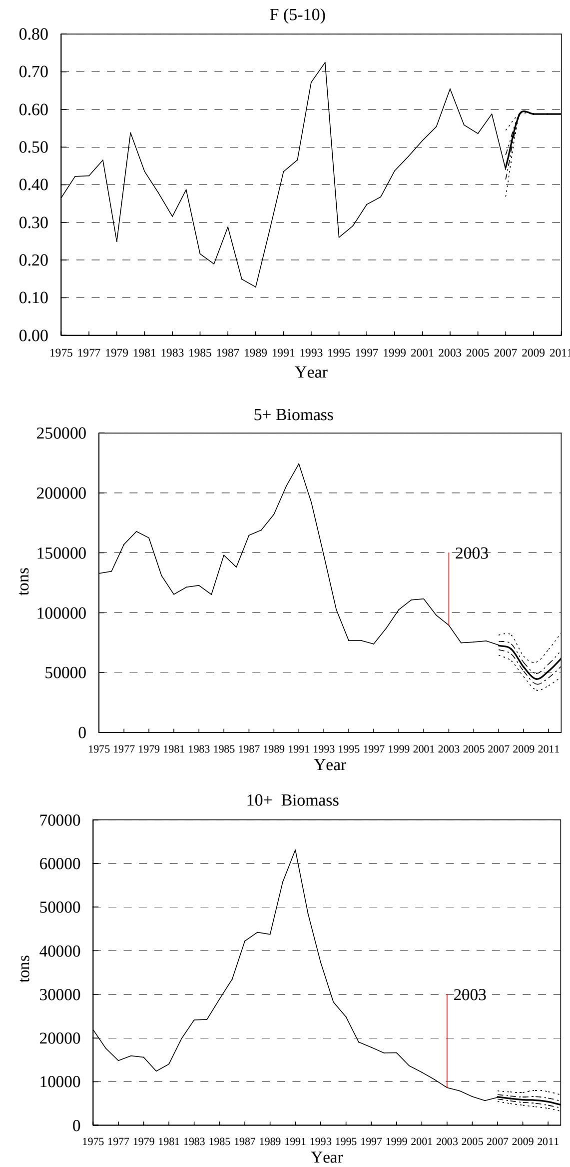
Sources of Information: SCR Doc. 07/10, 18, 23, 31, 35, 45, 50, 53, 54, 58, 59; SCS Doc. 07/, 6, 8, 9, 12; FC Doc. 03/13.

$F_{0.1}$



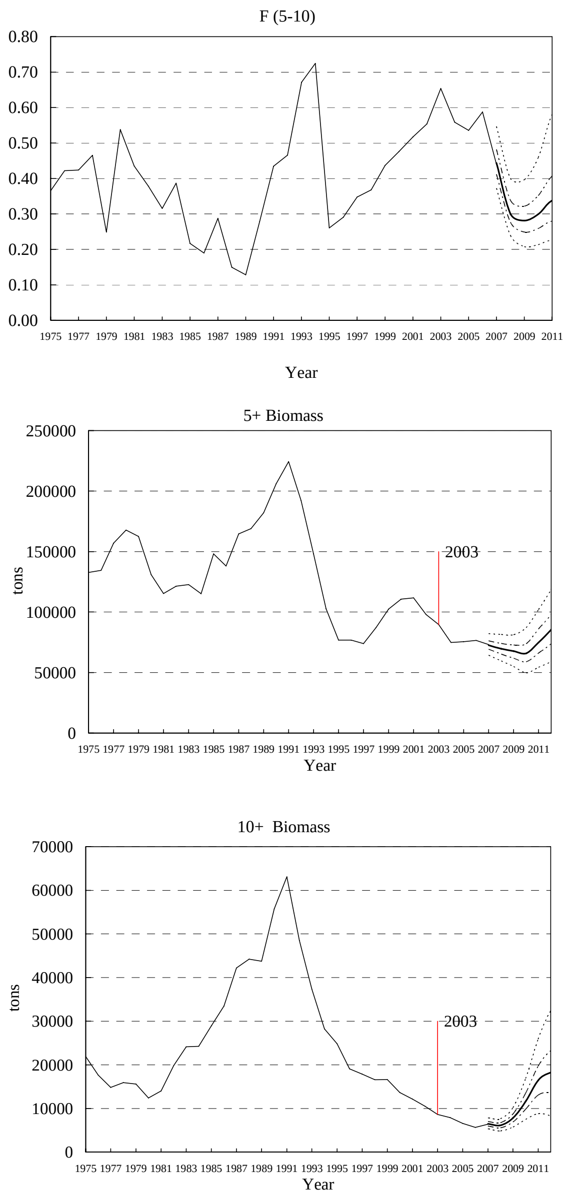
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2008-2012 assuming a catch of 20 000 tons in 2007, and a fishing mortality of $F_{0.1}$ thereafter. The biomass levels of 2003 (year in which Fisheries Commission Rebuilding Plan developed) are highlighted.

F_{2006}



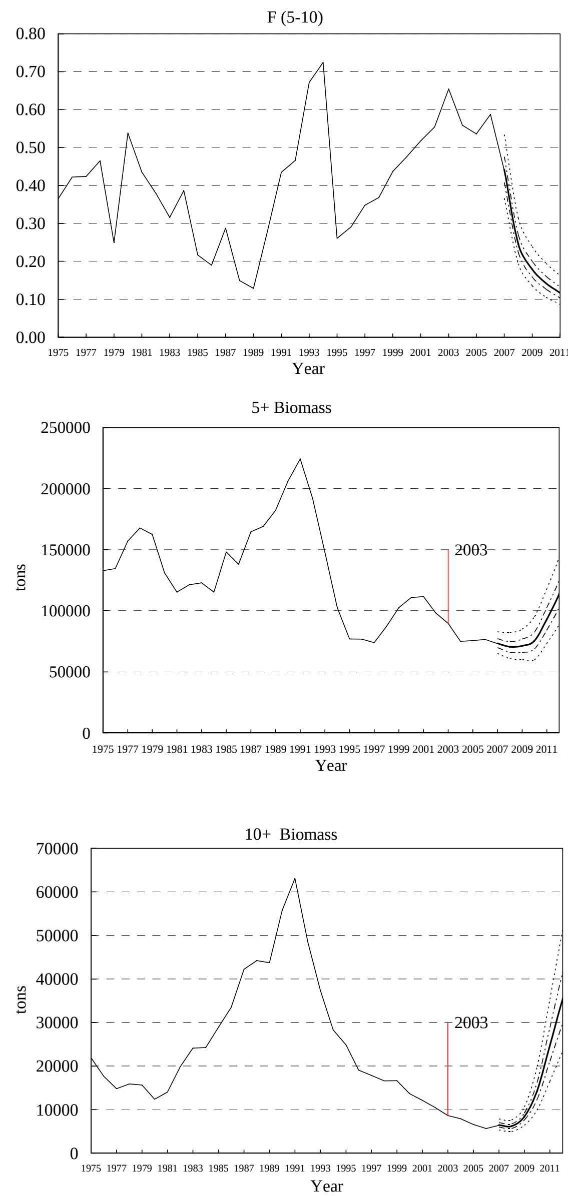
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2008-2012 assuming a catch of 20 000 tons in 2007, and a fishing mortality of F_{2006} thereafter. The biomass levels of 2003 (year in which Fisheries Commission Rebuilding Plan developed) are highlighted.

Rebuilding Plan I



A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2008-2012 assuming a catch of 20 000 tons in 2007, and fixed catches of 16 000 tons thereafter. The biomass levels of 2003 (year in which Fisheries Commission Rebuilding Plan developed) are highlighted.

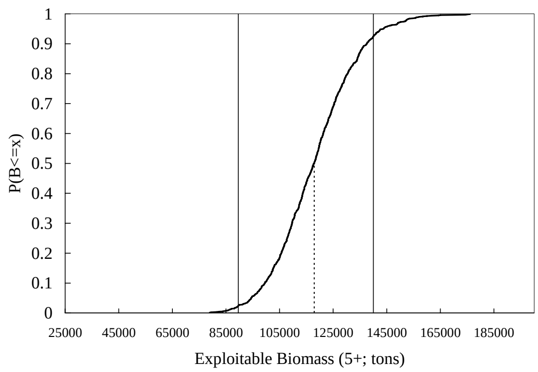
Rebuilding Plan II



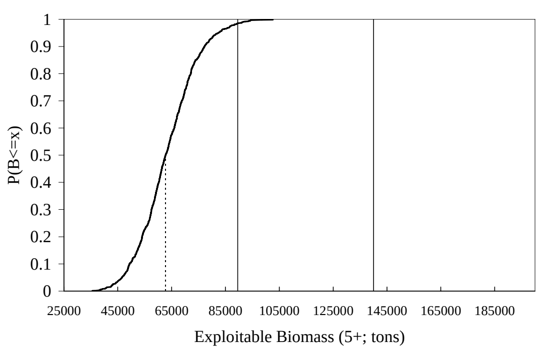
A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2008-2012 assuming a catch of 20 000 tons in 2007, and subsequent catches are reduced by 15% annually (2008 – 2011 catches of 13 600, 11 560, 9 830, 8 350 tons). The biomass levels of 2003 (year in which Fisheries Commission Rebuilding Plan developed) are highlighted.

The risk of the projected exploitable biomass in 2012 being below a reference level is given in the figures below. The solid vertical lines highlight the level of the exploitable biomass in 2003 (89 000 tons), when the rebuilding plan was implemented, and also 140 000 tons, the target identified in the rebuilding plan. For example, under the $F_{0.1}$ scenario, there is a high probability (>0.95) that the 2012 biomass will exceed the 2003 exploitable biomass, but a low probability (<0.05) that the rebuilding target will be attained by 2012.

$F_{0.1}$

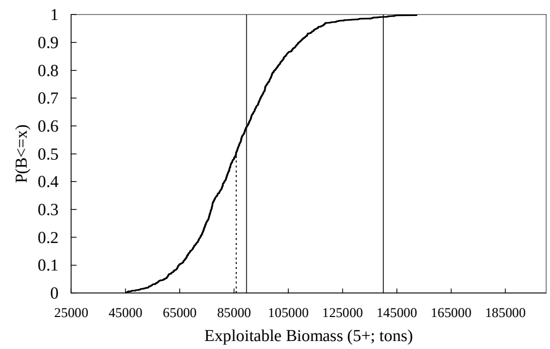


F_{2006}

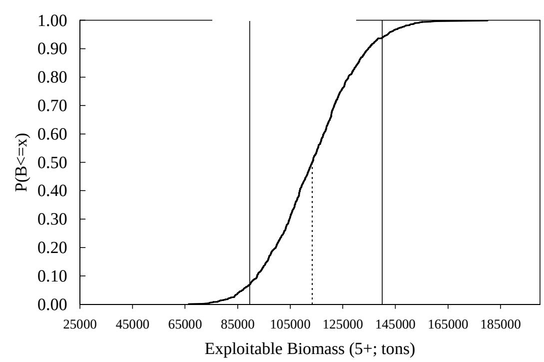


Probability profile of exploitable biomass in 2012. Vertical lines indicate the biomass levels in 2003 (year in which Fisheries Commission Rebuilding Plan developed) and the Rebuilding Plan target of 140 000 tons. The dashed vertical lines indicate the median exploitable biomass in 2012.

Rebuilding Plan I



Rebuilding Plan II



Probability profile of exploitable biomass in 2012. Vertical lines indicate the biomass levels in 2003 (year in which Fisheries Commission Rebuilding Plan developed) and the Rebuilding Plan target of 140 000 tons. The dashed vertical lines indicate the median exploitable biomass in 2012.

b) Request for Advice on TACs and Other Management Measures for the Years 2008 and 2009

The Scientific Council at its meeting of September 2006 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 2008 and 2009. The next assessment of these stocks will be in 2009.

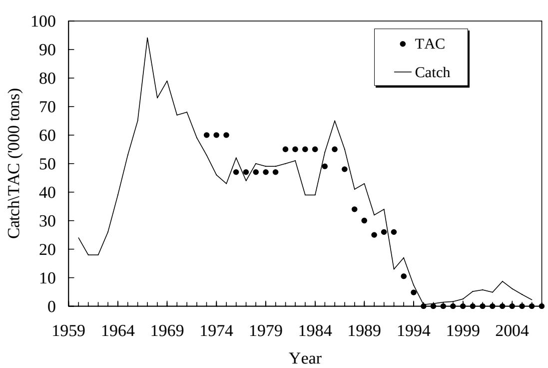
American Plaice* (Hippoglossoides platessoides) *in Div. 3L, 3N and 3O

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

Fishery and Catches: In most years the majority of the catch has been taken by offshore otter trawlers. There was no directed fishing in 1994 and there has been a moratorium since 1995. Catches increased after the moratorium until 2003 after which they began to decline.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	6.2	2.9	Ndf	ndf
2005	4.1	2.3[1]	Ndf	ndf
2006	2.8	0.9[1]	Ndf	ndf
2007			Ndf	ndf

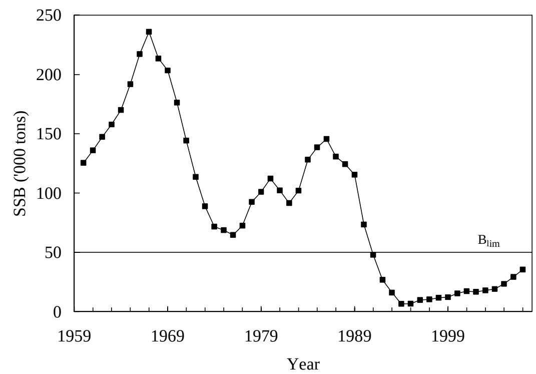
[1] Provisional
ndf No directed fishing.



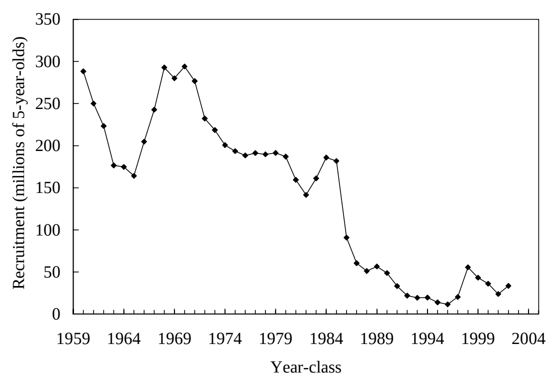
Data: Biomass and abundance data were available from several surveys. Age data from Canadian bycatch, and length data from bycatch from Russia, EU-Spain and EU-Portugal (2006 only), were available.

Assessment: An analytical assessment using the ADAPTive framework tuned to the Canadian spring, Canadian autumn and the Spanish Div. 3NO survey was used. Natural mortality was assumed to be 0.2 except from 1989 to 1996 where it was set at 0.53.

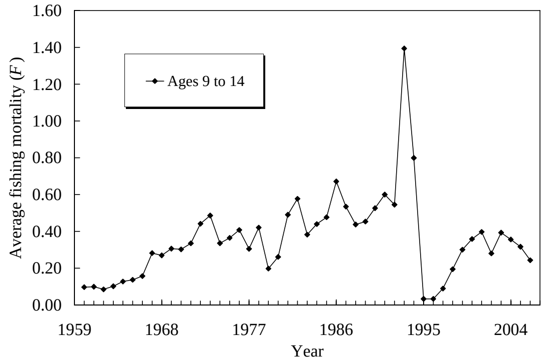
Biomass: Biomass and SSB are very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. It has increased since then but still remains very low at about 36 000 tons.



Recruitment: Estimated recruitment at age 5 indicates that all year classes since those of the mid-1980s have been very weak.



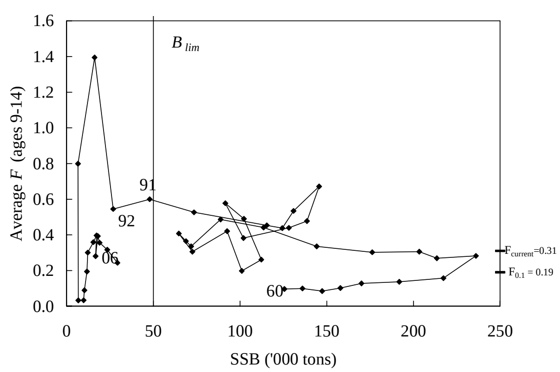
Fishing mortality: Since 1995, the average fishing mortality on ages 9 to 14 increased but since 2003 has declined.



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

Recommendation: There should be no directed fishing on American plaice in Div. 3LNO in 2008 and 2009. Bycatches of American plaice should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directing for other species. Efforts should be made to reduce current levels of bycatch.

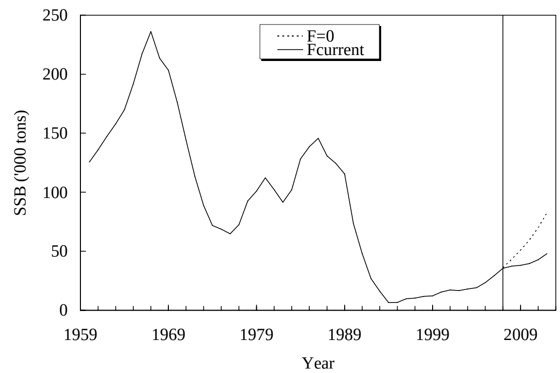
Reference Points: Good recruitment has not been observed in this stock when SSB has been below 50 000 tons and this is currently the best estimate of B_{lim}. The stock is currently below B_{lim}.

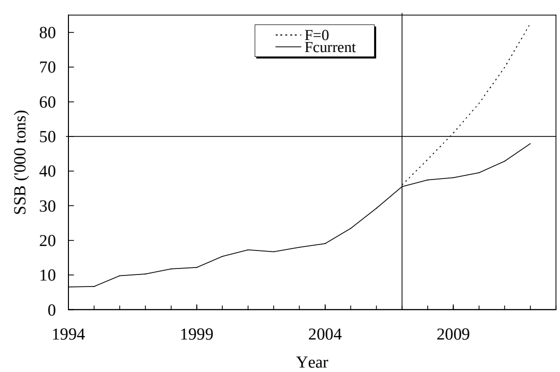


Medium term considerations: Deterministic projections were conducted to examine stock biomass over the next 5 years. Projections were limited to 5 years as extended projections are increasingly driven by recruitment assumptions. Spawner biomass was projected assuming F = 0 and under recently observed fishing mortality ($F_{current}$ = 0.31).

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

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





Special Comments: The next full assessment of this stock will be conducted in 2009.

Sources of Information: SCR Doc. 07/35, 56, 62. SCS Doc. 07/ 6, 8, 9, 12.

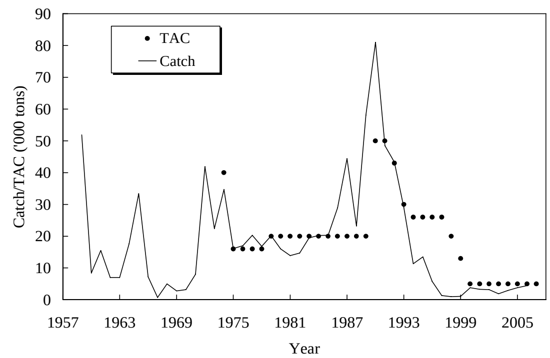
Redfish (Sebastes *spp.*) *in Div. 3M*

Background: There are 3 species of redfish, which are commercially fished on Flemish Cap: deep-water redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The present assessment evaluates the status of the Div. 3M beaked redfish stock, regarded as a management unit composed of two populations from two very similar species *(Sebastes mentella* and *Sebastes fasciatus*). The reason for this approach is that evidence indicates this is the dominant redfish group on Flemish Cap.

Fishery and Catches: The redfish fishery in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, falling continuously since then until 1998-99, when a minimum catch around 1 100 tons was recorded mostly as bycatch from the Greenland halibut fishery. This decline was related with the simultaneous quick decline of the stock biomass and fishing effort. An increase in the fishing effort directed to Div. 3M redfish was observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. However, in 2003 Russian catch fell by 90% and in 2004 EU-Portugal consolidated its major role in the present fishery. A new fishery directed for golden redfish prosecuted by EU-Portugal and Russia has occurred in the last couple of years. TAC was overshot in November 2005 (6 550 tons) and 2006 (7 156 tons), with an estimated catch of beaked redfish of 3 784 tons and 4 430 tons respectively. The start in 1993 and further development of a shrimp fishery on Flemish Cap led to high levels of redfish bycatch in 1993-1994. In 2001-2003 the redfish bycatch in numbers from the Flemish Cap shrimp fishery was 78% of the total catch numbers, declining to 44% in 2004 and 15% in 2005.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	2.9	3.1	3-5	5
2005	3.8	6.6[1]	3-5	5
2006	4.4	7.2[1]	3-5	5
2007			3-5	5

[1] Provisional.



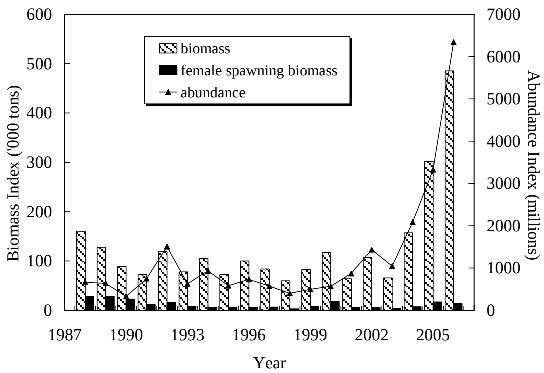
Data: Catch-at-age data were available from 1989-2006, including bycatch information from the shrimp fishery.

There are three bottom trawl survey series providing biomass indices as well as length and age data for the Flemish Cap redfish stocks; Russia (1983-1993, 1995-1996 and 2001-2002), EU (1988-2006) and Canada (1979-1985 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic component for the 1988-1992 period.

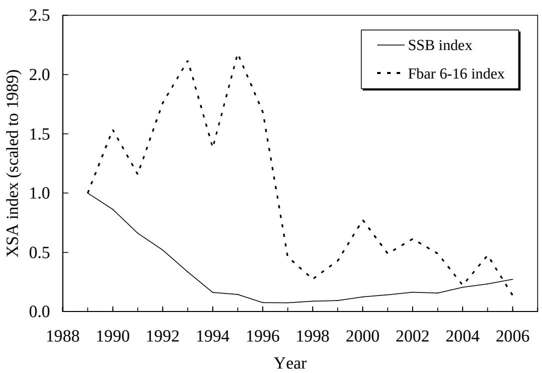
In June 2003 a new Spanish research vessel, the RV *Vizconde de Eza* (VE) replaced the RV *Cornide de Saavedra* (CS) that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 time series the original survey indices for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

Assessment: A virtual population analysis (XSA) was carried out for 1989-2006. The XSA assessment was not accepted and results were used for illustrative purposes only to indicate trends of fishing mortality, recruitment, stock biomass and female spawning biomass trends.

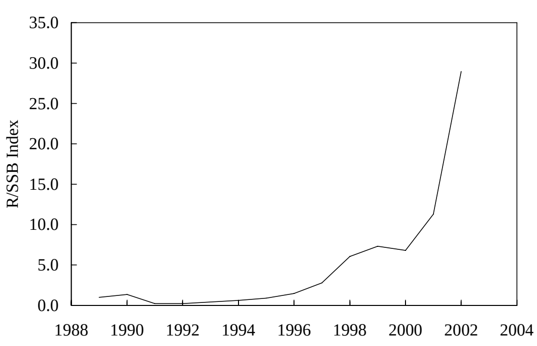
Survey bottom biomass and female spawning biomass were calculated from 1988-2006 EU surveys.



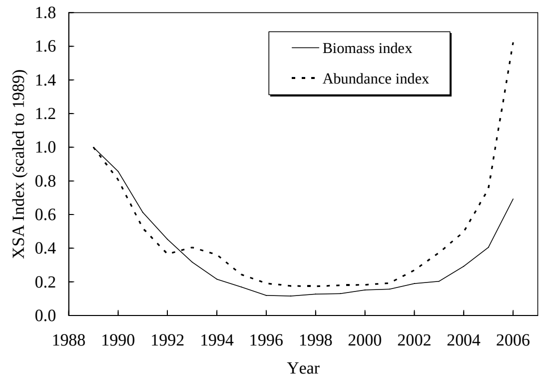
Fishing Mortality: Fishing mortality was at very high levels until 1996 and then dropped to relatively very low levels since 1997.



Recruitment: The recruits per SSB have increased since 1997, compensating for the low level of SSB. Based on XSA, the 1998-2002 year-classes are relatively abundant.



Biomass: The Div. 3M beaked redfish stock experienced a steep decline from the second half of the 1980s until 1996. From 1997 onwards, low fishing mortalities allowed a slow but continuous growth of both 4+ biomass and female SSB. Abundance was kept stable at a low level from 1996 to 2001. Over the most recent years biomass and abundance have increased at a faster rate. In 2006 female spawning stock biomass was still well below the SSB that produced the former pulse of strong recruitment in 1990.



State of the Stock: Scientific Council concluded that the stock biomass and spawning biomass are increasing. Nonetheless the spawning stock is currently still at a low level compared to the earlier period in the time series. At the low fishing mortalities of the most recent years and with growth of the relatively strong recent year-classes, spawning biomass should continue to increase.

Recommendation: In order to maintain low fishing mortalities so as to promote female spawning stock recovery, Scientific Council **recommended** that *catch for Div. 3M redfish in year 2008 and 2009 should not exceed 5 000 tons.*

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

Special Comments: The next assessment will be in 2009.

Sources of Information: SCR Doc. 07/47; SCS Doc. 07/6, 8, 9.

White hake* (Urophycis tenuis) *in Div. 3N, 3O and 3Ps

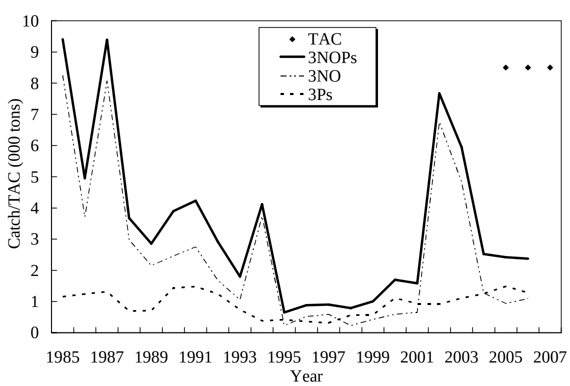
Background: The stock area, defined by Scientific Council as Div. 3NOPs, is mainly concentrated in southern Subdiv. 3Ps and on the southwestern Grand Bank. Scientific Council is asked to provide advice on the portion of the stock in Div. 3NO only.

Fishery and Catches: Catches in Div. 3NO peaked in 1985 at 8 100 tons, then declined from 1988 to 1994 (2 090-ton average). Average catch was at its lowest in 1995-2001 (464 tons); then increased to 6 752 tons and 4 841 tons in 2002-2003, respectively. Total catch decreased to an average of 1 102 tons in 2004-2006.

Catches of white hake in Subdiv. 3Ps were at their highest in 1985-1993, averaging 1 114 tons, decreasing to an average of 668 tons in 1994-2003. Subsequently, catches in Subdiv. 3Ps increased to an average of 1 338 tons in 2004-2006.

	Catch ('000 tons)			
	Div. 3NO		Subdiv. 3Ps	Div. 3NO
Year	STACFIS	21A	21A	TAC ('000 tons)
2004	1.3	1.9	1.3	-
2005	0.9	0.9[1]	1.51	8.5
2006	1.1	1.2[1]	1.31	8.5
2007				8.5

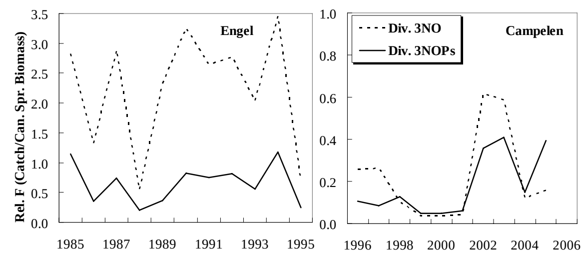
[1] Provisional.



Data: Length frequency data from the Canadian fishery (1994-2006), EU-Spain (2002, 2004), EU-Portugal (2003-2004, 2006), and Russia (2000-2006) were available. Biomass and abundance indices were available from annual Canadian spring bottom trawl surveys in Div. 3NOPs (1975-2005), autumn in Div. 3NO (1990-2006) and Spanish Div. 3NO survey in the NAFO Regulatory (2001-2006).

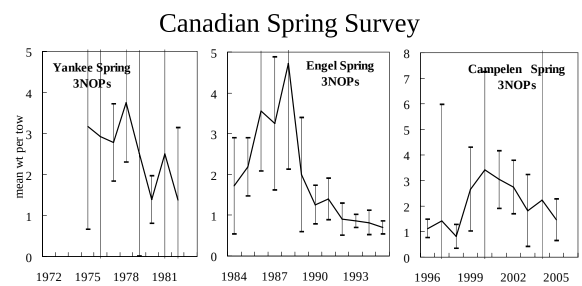
Assessment: No analytical assessment was possible.

Fishing Mortality: STACFIS catch/Canadian spring survey biomass ratio fluctuated in the 1980s then declined in the 1990s. The index then increased in 2002-2003, declined in 2004 then increased in 2005.

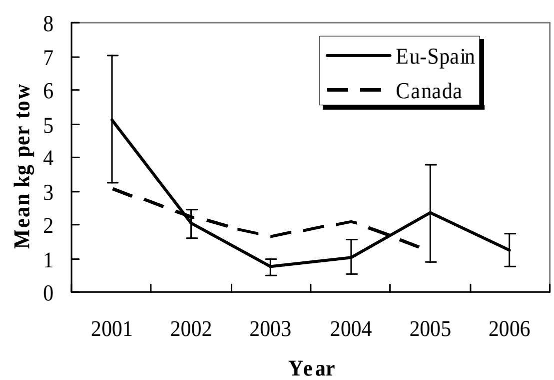


Recruitment: The 1999 year-class was large. Year-classes since then have been extremely low, as compared to the 1999 year-class.

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



Comparison of the Canadian spring survey in all of Div. 3NO and the Spanish Div. 3NO survey in the NRA.



State of the Stock: Following the dominance of 1999 fish in 2000, a progression of this year-class is observed through subsequent years leading to increased catches in the white hake fishery in 2002-003, when fish reached harvestable sizes, followed by a reduction in catches since. Both catches and survey biomass indices were much reduced in 2004-2005 relative to 2000-2001.

Recommendation: Given the recent declines in stock biomass indices and the current low recruitment, Scientific Council advises that catch of white hake in Div. 3NO, at the current TAC of 8 500 tons, is unrealistic and should not exceed their current level.

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

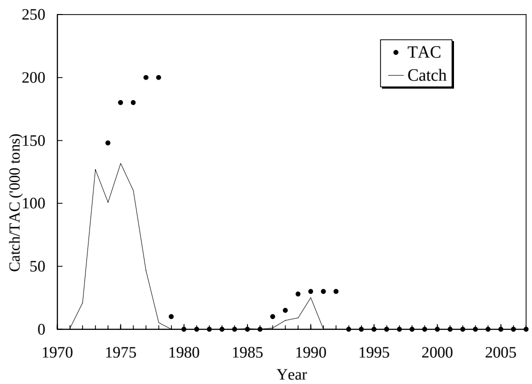
Special Comments: The next assessment of this stock will be in 2009.

Sources of Information: SCR Doc. 07/21, 37, 52; SCS Doc. 07/06, 08, 09, 12.

Capelin (Mallotus villosus) *in Div. 3N and 3O*

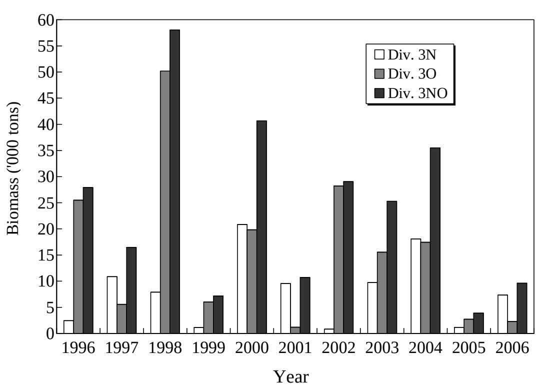
Fishery and catches: There has not been a directed fishery since 1993 when a moratorium was established, and no commercial catches have been reported since then.

Year	Catch ('000 tons)	TAC ('000 tons)
2004	0	0
2005	0	0
2006	0	0
2007		0



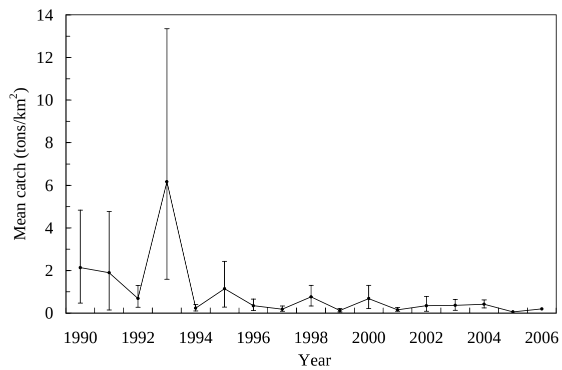
Data: Capelin catches from Canadian bottom trawl surveys conducted in 1990-2006, as well as historical data sets from Russian and Canadian trawl acoustic surveys directed to capelin.

Assessment: No analytical assessment was possible with current data.



Biomass: The only indicator of stock dynamics presently available is capelin biomass indices obtained during Canadian stratified-random bottom trawl surveys. In 1996-2006 survey biomass of capelin in Div. 3NO varied from 3 900 to 58 100 tons. In 2005-2006, this parameter was 3 900 and 9 600 tons respectively, when the average for the period from 1996 was estimated as 24 000 tons. Since 1994, capelin biomass has remained at a low level compared to late 1980s.

Mean catch index: In 1990-2006 the mean catch per km2 varied between 0.06 and 6.17. In 2005 and 2006, this parameter was 0.06 and 0.20 respectively. The estimate of 2006 corresponds to a low level of stock size that was observed in 1997, 1999 and 2001.



Recommendation: Scientific Council recommends no directed fishery on capelin in Div. 3NO in 2008 and 2009.

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

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

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

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

The next assessment will be in 2009.

Source of Information: SCR Doc. 07/12.

c) Request for Advice on TACs and other Management Measures for the Years 2008, 2009 and 2010

The Scientific Council at its meeting of September 2006 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 2008, 2009 and 2010. The next assessment of these stocks will be in 2010.

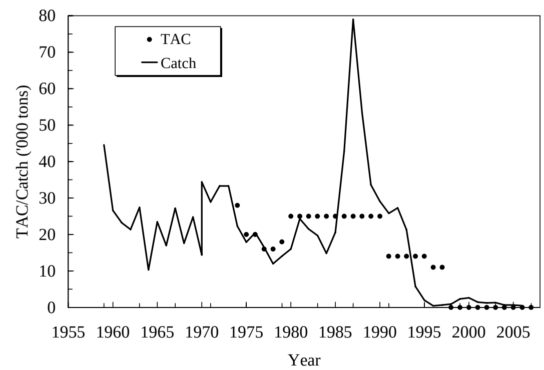
Redfish (Sebastes *spp.*) *in Div. 3L and 3N*

Background: There are two species of redfish, *Sebastes mentella* and *Sebastes fasciatus*, which occur in Div. 3LN and are managed together. These are very similar in appearance and are reported collectively as redfish in statistics. Most studies the Council has reviewed in the past have suggested a closer connection between Div. 3LN and 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 tons ranging between 10 000 tons and 45 000 tons. Catches increased sharply from about 21 000 tons in 1985, peaked at an historical high of 79 000 tons in 1987 then declined steadily to about 450 tons in 1996. Catch increased to 900 tons in 1998, the first year under a moratorium on directed fishing, with a further increase to 3 100 tons in 2000. Catches declined again in 2001-2003, were stable in 2004-2005 at 650 tons level and recorded an historic low of 496 tons in 2006. Since 1998 catches were taken as bycatch primarily in Greenland halibut fisheries by EU-Spain, EU Portugal and Russia.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	0.6	0.7	ndf	0
2005	0.7	0.7[1]	ndf	0
2006	0.5	0.2[1]	ndf	0
2007			ndf	

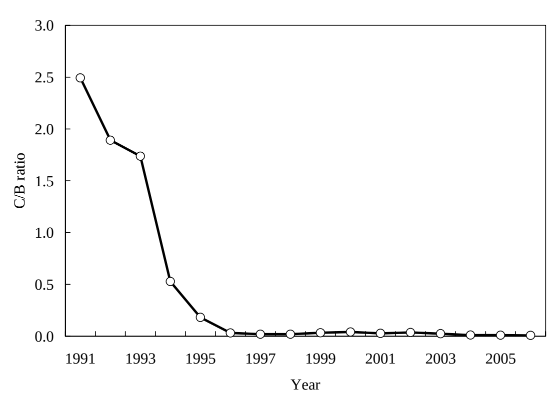
[1] Provisional
ndf No directed fishing



Data: Catches from 1959-2006 (conditioned on a 1959-1994 CPUE series from STATLANT data, used in the 1997 assessment), and spring and autumn survey biomass (1991-2006) were available.

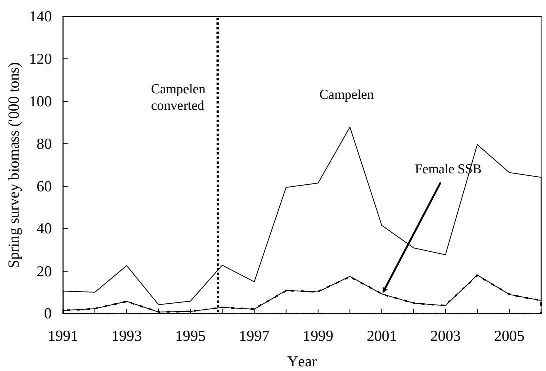
Assessment: The above information was incorporated in a non-equilibrium surplus production model (ASPIC), in order to assess the status of the stock. This analytical assessment was not accepted. Spring and autumn bottom trawl surveys conducted by Canada from 1991 to 2006 are the basis for the assessment of stock status.

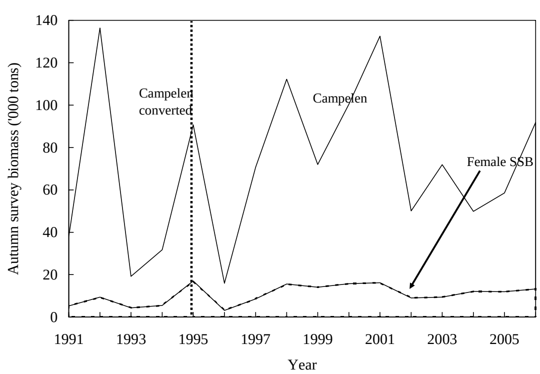
Fishing Mortality: Ratios of catch to spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy of fishing mortality. Catch/Biomass ratio declined continuously from 1991 to 1996, with a dramatic drop between 1993 and 1994. From 1996 onwards the proxy of fishing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



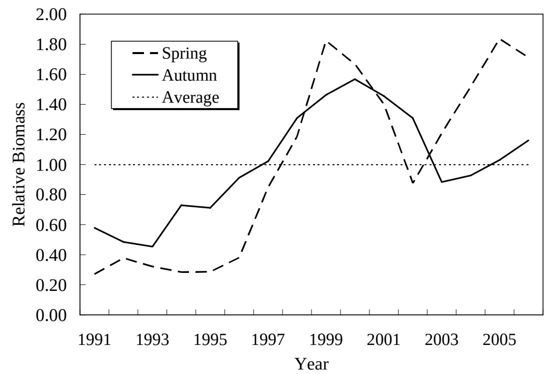
Recruitment: There was a relatively good pulse of recruitment observed in the Canadian autumn survey conducted in 1991-1992 in Div. 3LN. There is no sign of any good year-classes since then.

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





Redfish survey biomass in Div. 3LN increased from well below average in the first half of the 1990s, to well above average by the end of the 1990s, then declined to just below average in 2002-2003 before increasing again over the most recent years.



State of the Stock: The combined Div. 3LN survey indices suggests that the stock biomass, female spawning biomass and abundance is higher in 2006 than in the early 1990s. However the considerable inter-annual variability of the survey indices make the measurement of the relative magnitude of the stock increase, based on biomass indices alone, difficult to quantify. Stock length structure has been improving from small to medium size fish as well, confirming the survival of recent year-classes regardless their low sizes and the lack of good recruitment for more than a decade.

Recommendation: Scientific Council advises no directed fishing for redfish in Div. 3LN in years 2008, 2009 and 2010.

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

Special Comments: Bycatch of redfish in fisheries targeting other species should be kept to the lowest possible level. There is little information of the bycatch of redfish in the shrimp fishery in Div. 3L.

The next assessment will be in 2010.

Sources of Information: SCR Doc. 07/38; SCS Doc. 07/6, 8, 9.

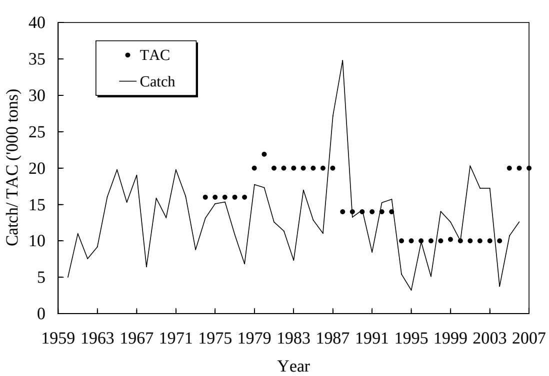
Redfish* (Sebastes *spp.*) *in Div. 3O

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

Fishery and Catches: Within Canada's fisheries jurisdiction redfish in Div. 3O have been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, whereas catch was only regulated by mesh size in the NRA of Div. 3O. The Scientific Council was unable to advise on a TAC in 2003. In September 2004, the Fisheries Commission adopted TAC regulation for redfish in Div. 3O, implementing a level of 20 000 tons per year for 2005-2007. This TAC applies to the entire area of Div. 3O. Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960. Up to 1986 catches averaged 13 000 tons then increased to 35 000 tons in 1988. From 2002-2003 catches averaged 17 200 tons then declined dramatically to about 3 800 tons in 2004. Catches in 2005 and 2006 were higher at about 11000 tons and 13 000 tons respectively.

	Catch ('000 tons)		TAC ('000 tons)
Year	STACFIS	21A	Agreed
2004	3.8	6.4	10
2005	10.7	11.9[1]	20
2006	12.6	12.9[1]	20
2007			20

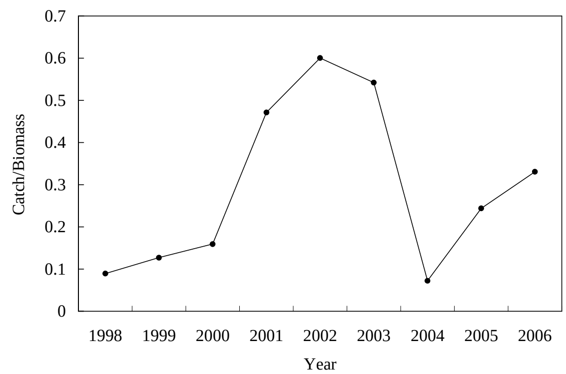
[1] Provisional.



Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring and autumn surveys during 1991-2006.

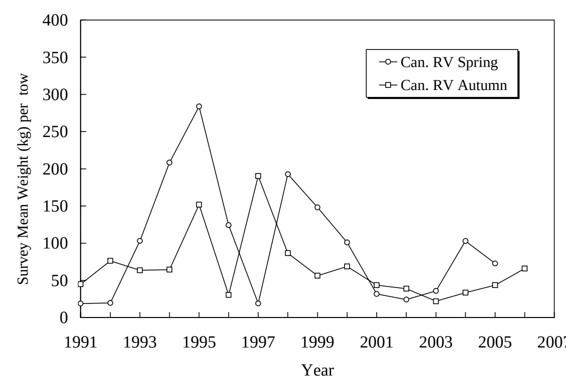
Assessment: No analytical assessment was possible.

Fishing Mortality: Catch/biomass ratios increased from 2000 to 2002 remained high in 2003, declined in 2004 and increased in 2005 to about the series average. The 2006 value is based only on the autumn survey.



Recruitment: Pulses of recruitment detected in the surveys between 2003 and 2006 were relatively small and their contribution to the population is not known. The 1988 year-class was the last good recruitment to the population.

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



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

Recommendation: Catches have averaged about 13 000 tons since 1960 and over the long term, catches at this level appear to have been sustainable. The Scientific Council noted that over the period from 1960 to 2006, a period of 47 years, catches have surpassed 20 000 tons in only three years. The Scientific Council noted there is insufficient information on which to base predictions of annual yield potential for this resource. Stock dynamics and recruitment patterns are also poorly understood. Scientific Council is unable to advise on an appropriate TAC for redfish in Div. 3O in 2008, 2009 and 2010.

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

The next assessment will be in 2010.

Sources of Information: SCR Doc. 07/55; SCS Doc. 07/6, 8, 9.

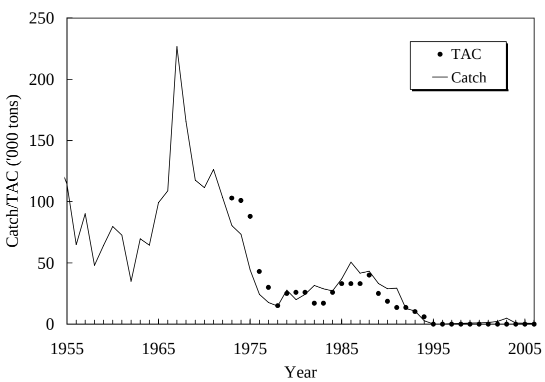
Cod* (Gadus morhua) *in Div. 3N and 3O

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

Fishery and Catches: There has been no directed fishery since mid-1994 but catches increased steadily during this moratorium to 2003.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	0.9	0.8	ndf	ndf
2005	0.7	0.6[1]	ndf	ndf
2006	0.6	0.3[1]	ndf	ndf
2007			ndf	ndf

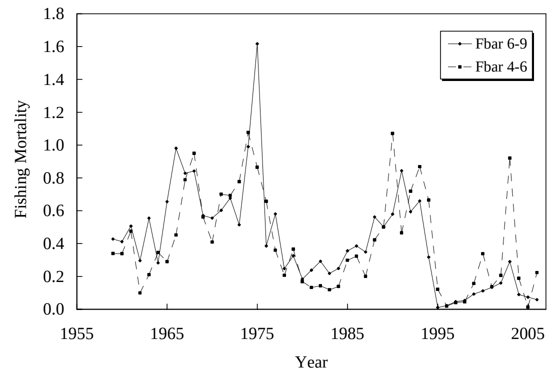
[1] Provisional.
ndf No directed fishing.



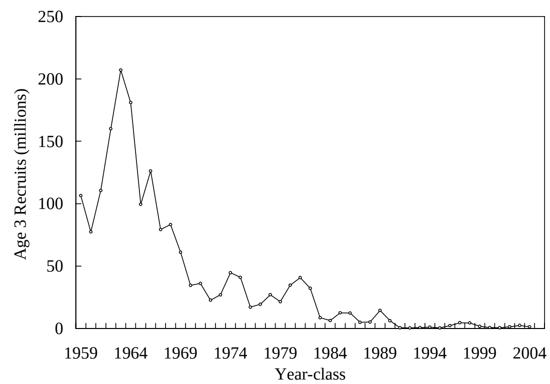
Data: Length and age composition were available from the 2005 and 2006 fisheries to estimate the total removals at age. Canadian spring (1984-2005) and autumn (1990-2006) survey data provided abundance, biomass and age structure information. Canadian juvenile research survey data were available up to 1994. Canadian Cooperative Industry surveys were available from 1996-2004. Spanish Div. 3NO surveys were available from 1997-2006.

Assessment: An analytical assessment was presented to estimate population numbers in 2007.

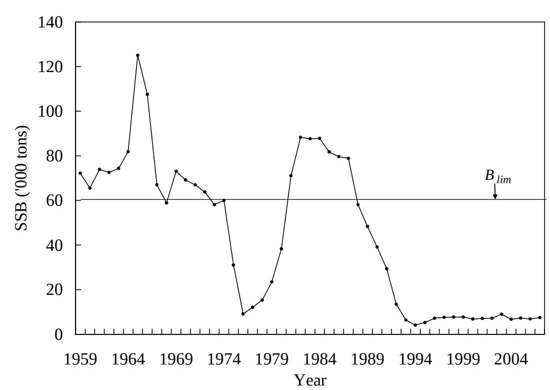
Fishing Mortality: Averaged 0.14 on ages 4-6 during 2004-2006, with a large increase to 0.22 on those ages in 2006.



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



Biomass: The 2007 total biomass and spawning biomass are estimated to be at extremely low levels.

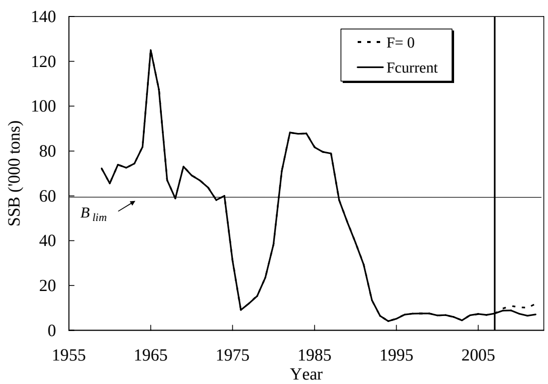


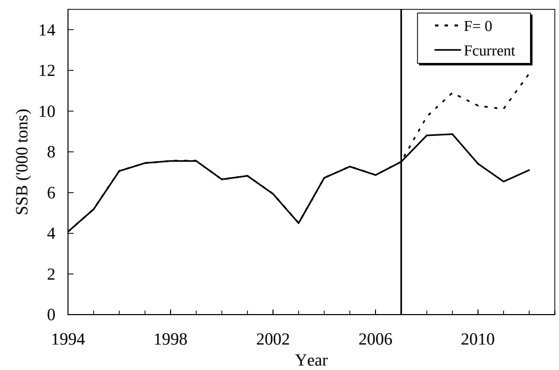
State of the Stock: The stock remains close to its historical low with SSB well below B_{lim} and weak representation from all year-classes.

Recommendation: There should be no directed fishing for cod in Div. 3N and 3O in 2008, 2009 and 2010. Bycatches of cod should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directed for other species. Efforts should be made to reduce current levels of bycatch.

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

Medium-term considerations: Deterministic projections were conducted to examine stock biomass over the next five years. Projections were limited to five years as extended projections are increasingly driven by recruitment assumptions. Spawner biomass was projected assuming F = 0, and under recently observed fishing mortality (F = 0.14). If there are no removals, spawner biomass is projected to increase 57% by 2012. If the stock continues to be fished at current rates, spawner biomass will decrease by 6% to about 7 100 tons by 2012. In the figure below the first panel gives the entire time series trajectory of the SSB, and the second panel highlights trends since 1994.





Special Comments: Scientific Council is concerned that fishing mortality is now at levels comparable to those during periods in the past when substantial fisheries existed, even though the stock is currently under moratorium and at a very low SSB.

The next assessment will be in 2010.

Sources of Information: SCR Doc. 07/3, 18, 24, 36, 40, 05/9; SCS Doc. 07/6, 8, 9.

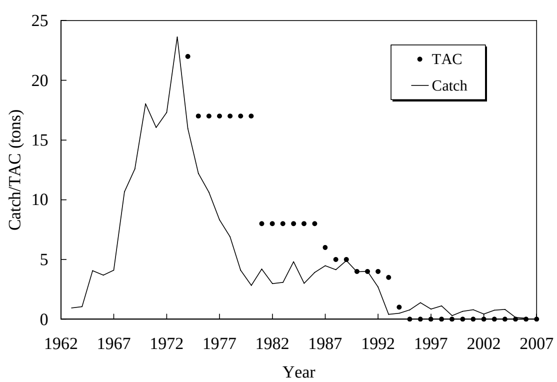
Witch flounder* (Glyptocephalus cynoglossus) *in Div. 2J, 3K and 3L

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

Fishery and Catches: The catches during 1995-2004 ranged between 300 and 1 400 tons including unreported catches. The 2005 catch declined to 155 tons and the 2006 catch was only 84 tons.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	0.3	0.8	ndf	ndf
2005	0.2	0.2[1]	ndf	ndf
2006	0.1	0.1[1]	ndf	ndf
2007			ndf	ndf

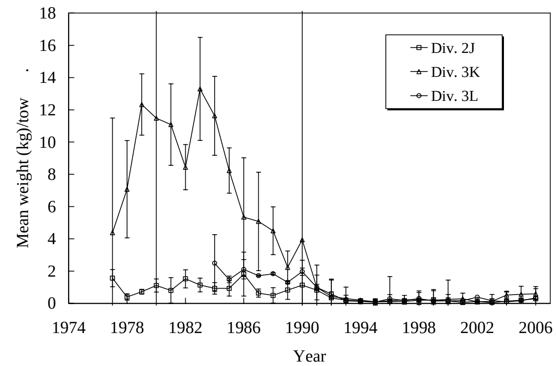
[1] Provisional
ndf No directed fishing.



Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian autumn surveys during 1977-2006. Age based data have not been available since 1993 and none are anticipated in the near future.

Assessment: No analytical assessment was possible.

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

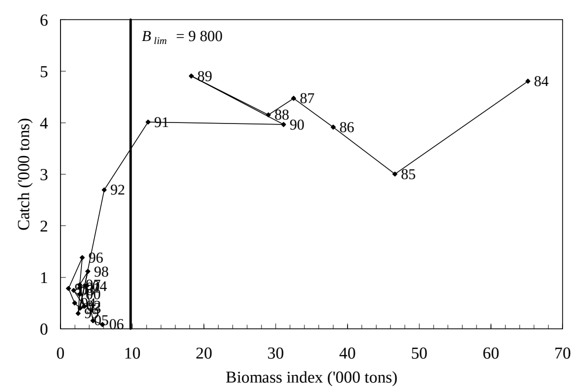


Recruitment: No information was available to this meeting.

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

Recommendation: No directed fishing on witch flounder in 2008, 2009 and 2010 in Div. 2J, 3KL to allow for stock rebuilding. Bycatches of witch flounder in fisheries targeting other species should be kept at the lowest possible level.

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



Special Comments: The next assessment will be in 2010.

Sources of Information: SCR Doc. 07/27; SCS Doc. 05/6, 8, 9.

d) Special Requests for Management Advice

i) ***The Precautionary Approach***

The Chair noted that the reference points indicated in the Fisheries Commission request were being applied to individual stock assessments. (Item 4)

ii) ***Evaluation of Recovery Plans***

Current assessment: Scientific Council noted 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 for which biomass is at very low levels. (Item 6)

Scientific Council **recommended** that *rebuilding or recovery plans for these stocks be considered, which should incorporate specific measures to reduce bycatch.*

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.*

Evaluation methods working group: A rebuilding plan was put in place for Greenland halibut by Fisheries Commission in 2003. Since 2003 new tools "Fisheries Library in R" (FLR) (http://www.flr-project.org) have become readily available for evaluating management strategies. Preliminary analyses (SCR Doc. 07/58) using these tools are promising. Scientific Council considered that in order to investigate and advise on appropriate management strategies for Greenland halibut, a working group should be formed to consider a comprehensive analysis of the performance of rebuilding strategies, including the one currently in place.

Bill Brodie (Canada) was identified as Chair. Participation will be sought from groundfish experts and quantitative fisheries researchers, both from within NAFO Contracting Parties and from outside, where such experts exist. It is anticipated that the WG will comprise about 15 members and will include at least 5 members with expert knowledge of FLR. Consultations will be held with industry and fisheries managers prior to the meeting to address their objectives in the Greenland halibut fishery. Spain has offered to host the meeting in Vigo in February 2008, immediately following a proposed Canada-Spain meeting on research vessel surveys on the Grand Bank. The WG will extend over 4 days and will be preceded by preparatory work by correspondence.

The following are the Terms of Reference for the Working Group:

1. Develop a full reference set of operating models for SA 2 + Div. 3KLMNO Greenland halibut conditioned on the most recent stock assessment and other available information.

2. Give consideration to appropriate levels of process error (P), observation error (O) and model error (M) following the ICES COMFIE report "POM" approach. Also give consideration to implementation error.

3. Develop an appropriate suite of performance statistics that cover sustainability, Precautionary Approach and industry objectives.

4. Evaluate a suite of management strategies that allow for both rebuilding of the stock to the target level and for sustainability thereafter.

5. Evaluate the performance statistics for each of the management strategies and rank the strategies on this basis.

6. Advise on applicability of this approach, in general, for possible use in developing rebuilding plans for other NAFO stocks.

The report of the WG will be presented by the Chair to the Scientific Council meeting in June 2008. Scientific Council requests support from the NAFO Secretariat in the form of assistance with pre-meeting logistics, as well as document handling, and report preparation at the meeting. Some financial assistance for invited experts outside of NAFO Contracting Parties' is also requested. Scientific Council also strongly encourages Contracting Parties to provide support for their invited experts to attend this WG meeting. These arrangements will be re-visited during the September 2007 Scientific Council meeting.

iii) *The Role of Seals in the Marine Ecosystem*

The Fisheries Commission requested: *Noting the desire of NAFO to apply ecosystem considerations in the conservation and management of fish stocks in the NAFO area, the Scientific Council is requested to provide the Fisheries Commission at its next annual meeting in 2007 with an overview of present knowledge related to role of seals in the marine ecosystem of the Northwest Atlantic and their impact on fish stocks in the NAFO area, taking into account the work of other relevant organizations, including ICES and NAMMCO.* (Item 7)

The Scientific Council responded: The impact of marine mammals, particularly seals, on the recovery of depleted fish stocks is a controversial issue and the focus of significant research efforts. Three species of seals are considered important predators in the northwest Atlantic: harp, hooded and grey seals. Between 1970 and the mid 1990s harp seals almost tripled their population while hooded seals remained fairly stable. In the past decade harp and hooded seals have shown little or no increase in abundance. Grey seals are residents of coastal waters that, after a number of decades of exponential growth, are beginning to show signs of density dependent reductions in growth rates. Consumption of important prey species by seals Atlantic Canada has been estimated using bioenergetics models. Harp seals are important predators in Divisions 2J3KL and 4RS while grey seals are the most important pinniped predator in Div. 4T and 4VsW. Hooded seals feed primarily in Div. 2J3KL and 3M. Recent advances in methods of estimating diet have provided new insights into the importance of individual prey species that will provide current estimates of consumption.

A number of studies have attempted to determine the impact of seals on fish stocks in the northwest Atlantic, particularly the impact of harp and/or grey seals on Atlantic cod. In general, these studies have indicated that although seals consume substantial amounts of commercial fish species and important forage species, the impact of these removals on particular fish stocks is difficult to quantify as a component of total mortality. Seals are important predators of both large and small cod and could be playing a role in the non-recovery of cod stocks, but seal predation can not account for a large component of mortality in most areas and therefore, the total impact of seal predation cannot be determined. Often, estimates of age specific cod consumption by seals which feed primarily on young fish, are inconsistent with the high mortality observed among older age groups.

In order to advance our understanding of the impact of seals on fish stocks, significant knowledge gaps must be addressed. Little is known about the functional response of seals to changes in abundance of prey, other sources of mortality, or possible ecosystem effects such as competition for forage fish and positive feedback through seal predation on piscivorous fish. Among other initiatives, the Canadian Department of Fisheries and Oceans, and NAFO, are organizing separate scientific meetings in the coming year to improve our understanding of the role seals are having on the population dynamics of their prey. Specifically, NAFO Scientific Council is proposing to hold a symposium, jointly with ICES if possible, on "The Role of Marine Mammals in the Ecosystem in the 21st Century" in late September 2008. There are scheduling and venue issues to be worked out, and Scientific Council will make a final decision on these in September.

iv) *Management Measures for Div. 3O Redfish Fishery*

Fisheries Commission requested Scientific Council to provide advice on: *Whether the following measures on Redfish in Division 3O, if applied in the NAFO Regulatory Area, are effective, in particular, in regard to addressing bycatch of species such as American plaice and Cod as conservation and management measure: 90 mm mesh size; Limiting the maximum permissible harvest of 15% (by number) of redfish 22 cm or smaller, imposing 5% limit on the bycatch of any other groundfish species in the fishery; Closure of fishing for a minimum of 10 days after reaching or exceeding of either the small fish or bycatch levels; and Re-opening of fishery through use of test fisheries.* (Item 8)

Three papers relevant to this request were presented to Scientific Council (SCR Doc. 07/07, 32, 60).

It was concluded that mesh sizes of 90-130 mm had similar selectivity patterns for the data presented, but it was believed that this was largely due to the lack of small redfish in the sampled populations. Therefore, Scientific Council concluded that mesh size was not the main factor determining mortality. Caution was expressed concerning the (implied minimum) landing size of 22 cm given in the request. This appears to be a compromise size that approximates to the length at 50% maturity for male and female redfish (*S. fasciatus* and possibly other species). Males mature at a slightly smaller size than females. It would appear that 90-130 mm mesh trawls catch redfish from around 19 cm TL, with 22 cm TL fish being well represented in the catch. In order to protect the spawning stock, the minimum sizes landed needs to be monitored, but as stated above, this may not be closely related to mesh size.

A 22 cm TL minimum landing size is appropriate to a 130 mm mesh size, the retention of that size by that mesh is less than 25%. However it is inappropriate for a 90 mm mesh size, since such retention is around 50% and it would imply a high mandatory discard.

A further and important consideration relates to the escapement of redfish through 130 mm when the net comes quickly to the surface. This happens because the swim-bladder expands as the trawl is hauled to the surface. The generated lift results in the meshes opening and allows for up to 30% of "half-dead" redfish to escape. This results in a high fishing mortality but a comparatively low catch being taken aboard the vessel, as many of the caught fish escape before the net is on the deck. A smaller mesh size results in lower escapement at sea and hence a higher proportion that can actually be landed on the deck. The escapement for a 90 mm mesh was estimated at 15%. It can be argued that a smaller mesh size actually reduces the overall fishing mortality and the TAC can be filled with less effort and less wastage. (SCR Doc. 06/17)

Data showed that, for bottom trawls, bycatch generally decreases with increasing mesh size, but again population structure may be a more important factor than mesh size. Evidence suggests that bycatches of American plaice and cod may be within the 5% limit given in the request. However, evidence also suggests that bycatch of other species, including non-commercial species, are likely to be above the 5% limit.

A further consideration is the very clean catch of redfish resulting from the mid-water trawls, where bycatch is virtually zero and independent of mesh sizes of 90-130 mm.

Scientific Council noted that they had no data for giving advice on the 10-day closure of the fishery or on criteria required to re-open the fishery after such a closure. It was felt these questions could be better answered by Fisheries Commission itself or by STACTIC, as they refer to the application of management measures.

v) *Information on Seamounts*

Fisheries Commission requested advice: *Regarding the precautionary closure to four seamount areas based on the ecosystem approach to fisheries (FC Doc. 06/5), using existing survey and commercial data from these seamount areas the Scientific Council is requested to provide the Fisheries Commission, at the 2007 Annual Meeting, recommendations on: 1) areas that could be fished on each seamount and, 2) a protocol for the collection of the data required to assess these seamounts, with a view to future recommendations on management measures for these areas.* (Item 9)

Scientific Council examined available information on the four seamount areas: Orphan Knoll, Newfoundland Seamounts, Corner Seamounts, and New England Seamounts. Scientific Council also noted that there are seamounts close to but outside the boundaries currently defined, including some seamounts immediately adjacent to the Corner Seamounts of the NAFO Convention Area, i.e. south of 35°N latitude, in the area under jurisdiction of the Western Central Atlantic Fisheries Commission (WECAFC).

In considering the issue of seamounts in general, Scientific Council noted that several studies found that seamounts have assemblages of species often not found in other deep-sea habitats, and generally feature high biodiversity. Many seamount fisheries in other areas have not been sustainable, and have resulted in well publicized stock crashes and substantial damage to vulnerable benthic habitat.

Scientific Council concluded that it does not have sufficient data on which to provide advice on the areas which could be fished on each seamount. Some seamounts are likely beyond the depth range of existing commercial fishing gear and have never been fished by bottom gears, while other seamounts have experienced heavy fishing in the 1970s and sporadic fishing since then. Before any fisheries are allowed to proceed in the closed areas, Scientific Council requires better information to be able to evaluate the consequences, including baseline studies, mapping data, and information on species distribution, stock structure, biology, population dynamics, and habitat.

Fishing activity in the four NAFO seamount areas was analyzed from VMS data in the period January 2003 to March 2007, provided by the NAFO Secretariat (SCR Doc. 07/6). These data indicated that there was no evidence of fishing on Orphan Knoll, and that a few exploratory tows probably occurred on the Newfoundland Seamounts. Limited commercial fishing activity was observed on the New England and Corner Seamounts, although one small area in the Corner Seamounts was repeatedly fished over several seasons. Scientific Council noted that the seamount areas were closed to all fishing activities involving demersal fishing gears, but that fishing was occurring in some of these areas using bottom trawls which were being fished as close to the bottom as possible without intent to actually contact the bottom. Scientific Council expressed concern about the possible impact of trawls fished close to the sea bottom, as these gears can touch the bottom and damage the benthic habitat.

Scientific Council examined data on the depth and number of individual peaks in or adjacent to the four seamount areas (SCR Doc. 07/61). This showed that the Orphan Knoll is a single peak, and that there were 6 peaks in the Newfoundland Seamounts, 19 peaks in the Corner Seamounts (some of these are connected), and 17 peaks in the New England Seamounts. The depths of many of the seamount peaks are greater than those accessible by conventional bottom trawling using current technology, e.g. no areas of the 6 peaks in the Newfoundland Seamounts were shallower than 2400 m, and almost all the area was deeper than 3 500 m. The shallowest seamount peaks occur between 800 and 900 m on Corner Rising, including the areas most heavily fished. Analysis of the depth on and around (to 5 500 m maximum depth) the 43 seamount peaks showed that only 0.46% of this area was shallower than 2 000 m. The amount of area less than 2000 m, in the seamounts in the 4 closed NAFO areas, is estimated to be about 1 900 square km, compared to the area <2 000 m on Flemish Cap, which is estimated to be about 64 000 square km.

Scientific Council did not have any information on results of any fishing or scientific surveys, if any occurred, for two of the areas (Orphan Knoll and Newfoundland Seamounts). Seismic surveys have occurred on the Orphan Knoll, and these results have suggested the presence of large (several hundred meters wide and 300 m tall) deepwater submarine mounds at depths between 1 800 and 2 300 m. The exact nature of these mounds is not known, but one scientific paper suggested that they may have organic origins (e.g. reef-like structures, or mounds connected to water bottom vents).

More extensive studies were available for the New England Seamounts and Corner Seamounts, including results of recent fishing activities in the latter area. Spanish fisheries information available in this area between 2005 and March 2007 (SCR Doc. 07/26) showed that one seamount in particular, and western Corner Rise in general, seem to have more species diversity and yield more catches than other Corner Rise seamounts. The most important species in the catches were alfonsino (*Beryx splendens*), black scabbardfish (*Aphanopus carbo*) and wreckfish (*Polyprion americanus*), comprising 98% of the total catch. Scientific Council reviewed some biological data on alfonsino from this recent Spanish fishery, including length frequency data which showed that fish caught in 2007 were in the range of 27 to 41 cm. It was noted that this fishery used both mid-water and bottom trawls, but that bottom trawls were fished such that they were not intended to actually touch the sea bottom.

Fishing activity has existed on the Corner Seamounts for many years, and catches over 10 000 tons were removed in the 1970s by USSR vessels, on seamounts both inside and outside the NAFO Convention Area, using a combination of bottom and mid-water trawling. The main species in most of these fisheries was alfonsino. Fishing since then has occurred sporadically, with reported catches being at much lower levels. There is evidence that fisheries which occurred in the past may not have been sustainable.

Given that Fisheries Commission has a provision in its closure of the seamount areas which deals with hard corals, Scientific Council noted the presence of hard corals and other coral species in some of the seamount research, but that data was limited. Information was also available which suggested fishing on the Corner Seamounts had encountered hard corals, that fixed gear (e.g. pots) had been used in some areas and was likely lost due to entanglement in corals, although exact locations were not available.

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.*

Scientific Council also **recommended** that *such information will be reviewed by the new NAFO Ecosystem Approach to Fisheries Study Group.*

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.*

e) Monitoring of Stocks for Which Multi-year Advice was Provided in 2006

The Scientific Council in 2006 provided 2-year advice (for 2007 and 2008) for six stocks (Cod in Div. 3M, American plaice in Div. 3M, Witch flounder in Div. 3NO, Yellowtail flounder in Div. 3LNO, Thorny skate in Div. 3LNOPs, Northern Shortfin Squid in SA 3+4). The Scientific Council reviewed the status of these six stocks (interim monitor) at this June 2007 meeting, and found no significant change in the status for any of these stocks to alter the advice. The next Scientific Council assessment of these stocks will be in 2008.

2. Coastal States

a) Request by Canada for Advice

(Appendix V, Annex 2)

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

Canada requested the Scientific Council to *advise on appropriate TAC levels for 2008, based on biomass distribution, for Greenland halibut in these areas separately: SA 2+ Division 3K and Divisions 3LMNO.* (Item 3)

The Scientific Council responded: Canadian research survey data covering depths to 1 500 m suggest reasonable stability in the proportion of biomass in SA2 + Div. 3K and Div. 3LMNO. 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 Greenalnd 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 TACs for the years 2004 to 2007 were set at 20 000, 19 000, 18 500, 16 000 tons. However, Scientific Council noted that the 2004 to 2006 TACs have been constantly exceeded by 25% on average. In order to review the potential of the Rebuilding Plan Strategy, a simulation was conducted assuming catches equalled the TACs for 2004 to 2007. This projection is compared to the results of the current assessment, which use the actual catches to 2006, and a one-year projection assuming a catch of 20 000 tons for 2007 (Rebuilding Plan TAC + 25% over-run). Input data were as follows :

- Stock Numbers at 1 January 2004 as estimated in the 2007 assessment
- Partial recruitment as estimated in the 2007 assessment for the years 2004 to 2006 and an average of those for 2007
- Catch and stock weights as computed for the years 2004 to 2006 and an average of those for 2007

Results are given in Table 1 and Figure 1.

Table 1. Summary of the Greenland Halibut simulation results, with comparison to the current assessment.

Rebuilding Plan	**2004**	**2005**	**2006**	**2007**	**2008**
Catch (t)	20000	19000	18500	16000	
5+B	74851	82791	88229	92836	96490
10+B	7892	8071	8522	12741	16428
F	0.41	0.35	0.32	0.22	
Actual	**2004**	**2005**	**2006**	**2007**	**2008**
Catch (t)	25486	23225	23531	200001	
5+B	74851	75573	76510	73199	69883
10+B	3090	2332	2129	6536	6154
F	0.56	0.54	0.59	0.45	
%diff /Actual	**2004**	**2005**	**2006**	**2007**	**2008**
5+B	0	10	15	27	38
10+B	155	246	300	95	167
F	-27	-35	-46	-50	
25% TAC overrun assumed for 2007					

Assuming the TACs had not been exceeded, the exploitable biomass in 2008 would be about 96 500 tons, 38% more than estimated from the current assessment (plus assuming 20 000 tons are removed in 2007). Under the Rebuilding Plan, the fishing mortality in 2007 would be of 0.22, half of the value projected from the current assessment assuming a 20 000 ton catch in 2007.

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. The fact that the TACs have been constantly overrun by 25% on average has lead to a further decrease in exploitable biomass and a continuing very high fishing mortality. Therefore the Rebuilding Plan has not yet been successful.

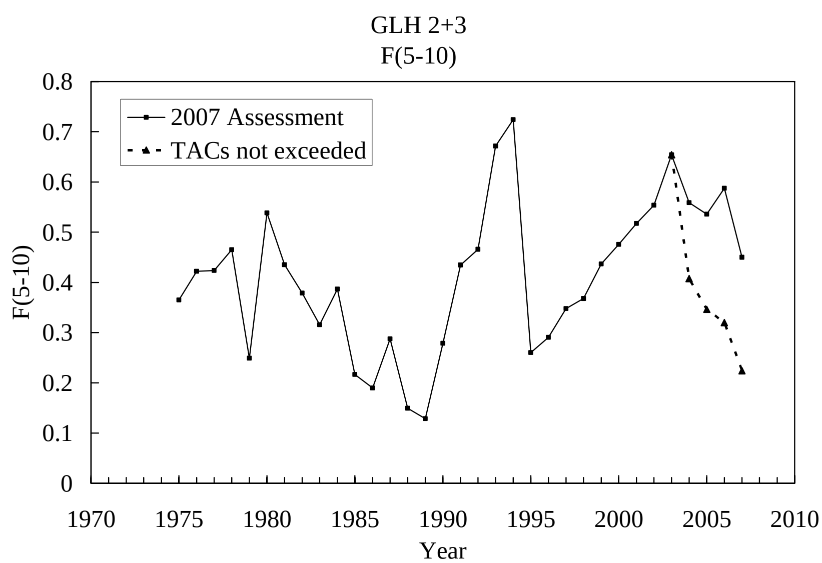


Fig. 1. Greenland halibut in SA 2+3 Fishing mortality under the Rebuilding Plan TACs and from the current assessment. Dashed line indicates an assumed 20 000 tons catch for 2007.

Agenda item VII.1.a) i) on Greenland halibut 2+3 under Projections and Evaluation of the Management Strategy is also relevant to this request.

b) Request by Denmark (Greenland) for Advice

(Appendix V, Annex 3)

i) *Roundnose Grenadier in Subareas 0 and 1*

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

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

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. At the 2006 Scientific Council asembly a schedule for providing triennial (every three years) advice was decided for redfish and other finfish in Subarea 1 for the advice in 2006-2008. Denmark, on behalf of Greenland, requests the Scientific Council to: C*ontinue to monitor the status of redfish (Sebastes spp.) and other finfish in Subarea 0+1 annually and, should significant change in stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate.* (Item 2)

The Scientific Council responded as follows:

Redfish

There has been no directed fishery offshore for redfish (golden redfish (*Sebastes marinus*) and deep sea redfish (*Sebastes mentella*)) in Subarea 1 since the mid-1980s. The survey biomass has been at a low level for more than two decades and the biomass and abundance is at present among the lowest observed. Further, the stock(s) are comprised almost entirely of fish <17 cm. Redfishes are slow growing species and Scientific Council does not expect any major change in the status of the stock(s) in the near future and is not changing its advice for 2008.

Other finfish

Fisheries for other finfish, such as American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*), thorny skate (*Amblyraja radiata*), have been prosecuted by longliners operating both inshore and offshore and by pound net and gillnet fisheries in inshore areas only. These species are also taken as bycatch in offshore trawl fisheries directed to shrimp, cod, redfish and Greenland halibut.

Biomass estimates for the species American plaice, Spotted and Atlantic wolfish, and thorny skate, from the offshore areas have all been at a very low level in the last decade and the stocks mainly consist of small fish. The species are slow growing and Scientific Council does not expect any major change in the status of the stocks in the near future and is not changing its advice for 2008.

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: *Continue to monitor the status of Greenland halibut in Subarea 1A inshore annually and, should significant change in stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate.* (Item 4)

The Scientific Council responded as follows:

Landings have been increasing in recent years mainly in Disko Bay. Landings in 2006 were, however, at the same level as 2005. In Disko Bay biomass and abundance indices from the gillnet survey have declined from 2005 to 2006, also the trawl survey abundance and biomass indices have declined, but are still around average of the time series. There are no significant changes in long line survey biomass and abundance indices compared to previous years in Uummannaq. Due to lack of survey data it is not possible to evaluate stock status in Upernavik. The lack of information on fishing effort makes it difficult to evaluate trends in landings relative to stock biomass or fishing effort. Scientific Council has no basis to change its advice for 2008.

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

(Appendix V, Annex 2 Item 1a and Annex 3 Item 3)

Canada requested the Scientific Council, subject to the concurrence of Denmark (on behalf of Greenland) as regards Subarea 1, to provide an overall assessment of status and trends in the total stock throughout its range and comment on its management in Subareas 0+1 for 2008, and to specifically:

a) advise on appropriate TAC levels for 2008, separately, for Greenland halibut in the offshore area of Divisions OA+1AB and Divisions OB+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:

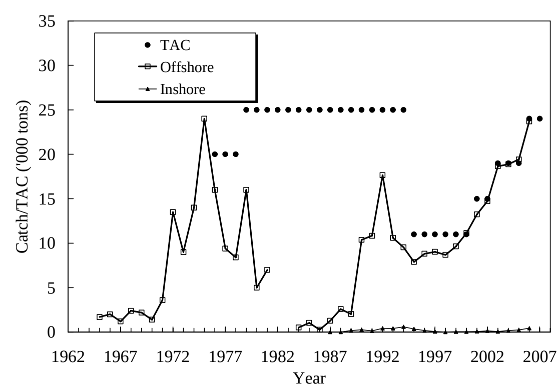
***Greenland Halibut* (Reinhardtius hippoglossoides)**
in SA 0 + Div. 1A Offshore and Div. 1B-1F

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 tons in 1989 to 18 000 tons in 1992 and have remained at about 10 000 tons annually until 2000. Since then catches have increased gradually to 19 000 tons 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 tons due to increased effort in Div. 0A and 1A.

	Catch ('000 tons)		TAC ('000 tons)	
Year	STACFIS	21A	Recommended	Agreed
2004	19	19	19[2]	19
2005	20	14[1]	19[2]	19
2006	24	14[1]	24[2]	24
2007			24[2]	

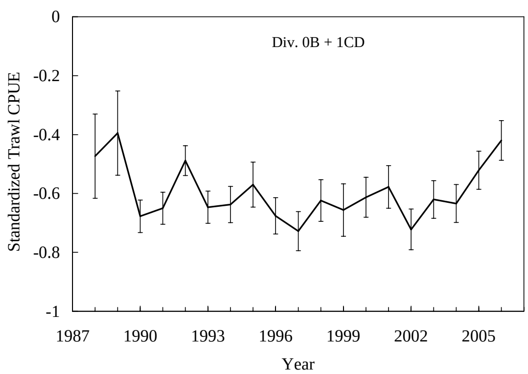
[1] Provisional
[2] Including 4 000 tons allocated specifically to Div. 0A and 1A in 2002, 8 000 tons from 2003 to 2005 and 13 000 tons from 2006.



Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized catch rates were available from Div. 0A, 1AB and 1CD. Standardized catch rates were available from Div. 0B and Div. 1CD. Biomass estimates from deep sea surveys in 2006 were available from Div. 0A and 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2006.

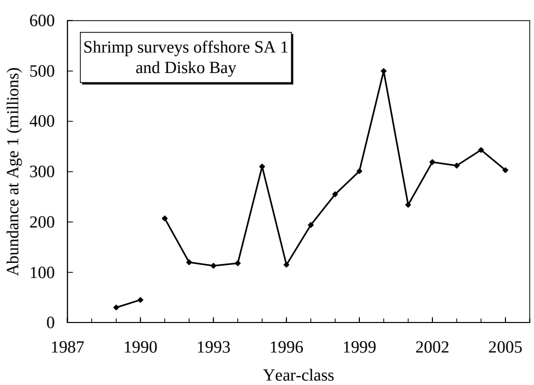
Assessment: No analytical assessment could be performed. The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but has increased again since then, and is in 2006 the highest seen since 1989.

Standardized catch rates in Div. 0B and 1CD have increased in recent years. Unstandardized catch rates in Div. 0A and 1CD increased slightly between 2005 and 2006, while unstandardized catch rates decreased slightly in Div. 1A.

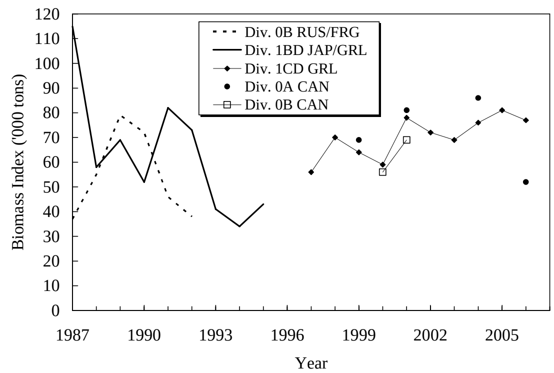


Fishing Mortality: Level not known.

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 2002-2005 year-classes were well above average.



Biomass: The biomass in Div. 1CD in 2006 was estimated at 77 000 tons, which is above average for the ten years time series. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has decreased in the last two years but the 2006 estimate is still the third highest in the time series. (1991-2006). The biomass in Div. 0A decreased to 52 000 tons in 2006. However, due to incomplete coverage the estimate is considered to be comparable to the 1999 estimate.



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

Recommendation: Considering the relative stability in biomass indices and CPUE rates, for Greenland halibut in Div. 0B and 1C-1F the TAC for year 2008 should not exceed 11 000 tons.

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 2008 should not exceed 13 000 tons.

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

Sources of Information: SCR Doc. 07/28, 29, 30, 41, 44; SCS Doc. 07/6, 11, 12, 15.

3. Scientific Advice from Council on its own Accord

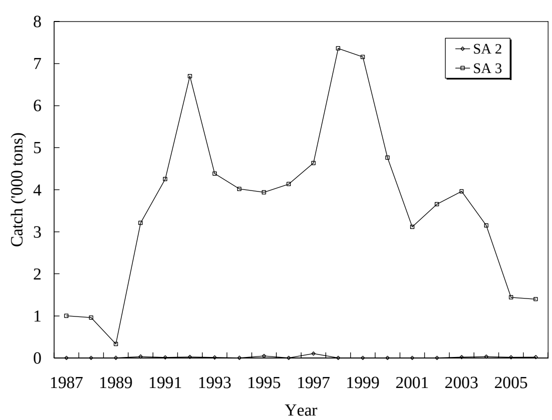
Roughhead Grenadier (Macrourus berglax) *in Subareas 2 and 3*

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

Fishery and Catches: There is no directed fishery for roughhead grenadier and most of the catches are taken as bycatches in the Greenland halibut fishery in Subareas 2 and 3. Roughhead grenadier is taken mainly in Div. 3LMN Regulatory Area. From 1993 to 1997 the level of the catches was around 4 000 tons. The highest level of observed catches (7 231 tons) was reached in 1998. From then until 2004 catches were around 3 000 tons. In 2005 and 2006, catches declined further to 1500 tons.

	Catch ('000 tons)	
Year	STATLANT 21A	STACFIS
2004	1.7	3.2
2005	1.3[1]	1.5
2006	0.3[1]	1.4
2007		

[1] Provisional

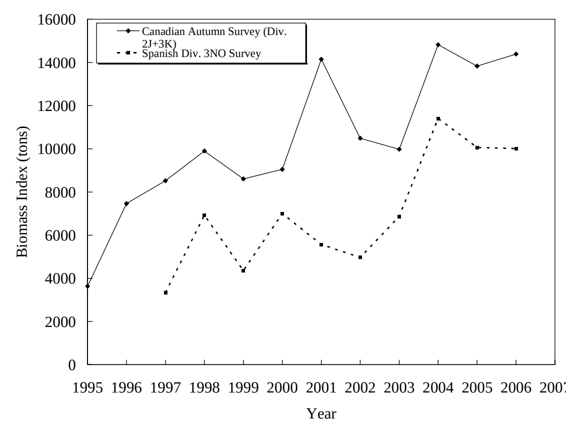


Data: Biomass indices were derived from: the Canadian stratified bottom trawl autumn surveys in Div. 2J and 3K since 1995, the Canadian stratified random bottom trawl spring surveys in Div. 3LNO since 1996, the EU (Spain and Portugal) Flemish Cap survey in Div. 3M since 1991 and the Spanish Div. 3NO survey since 1997.

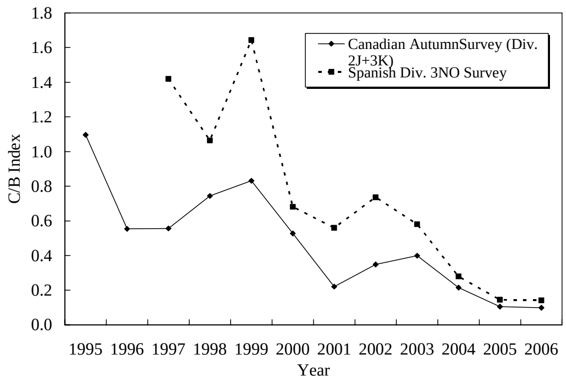
Length frequencies from the Spanish, Russian and Portuguese trawl catches in Div. 3LMNO are available since 1992, 1992 and 1996 respectively. Catch-at-age data from the total catches (applying the annual age length key (ALK) of Spanish commercial catches) in Div. 3LMNO are available since 1992.

Assessment: An analytical assessment was presented but it was not accepted due to the uncertainty in the results.

Biomass: Although the Canadian autumn survey series (Div. 2J+3K) and the Spanish survey in Div. 3NO do not cover the entire distribution of the stock, they are considered as the best survey information to monitor trends is resource status because their depth coverage is going down to 1 500 m. According to this survey information the roughhead grenadier total biomass indices indicate a general increasing trend from 1995 onwards, both surveys reaching its maximum in 2004 and remaining at this level in 2005 and 2006.



Fishing mortality: The catch / biomass (C/B) ratio obtained using the Canadian autumn survey and the Spanish Div. 3NO survey biomass index in the period 1997-2006 show a clear decreasing trend from 1995 to 2004, due to an increasing trend in the survey biomass and a decrease in catches. In 2005 and 2006 this ratio was stable at the lowest level of the time series with values of 0.10 for the Canadian autumn survey and 0.14 for the Spanish Div. 3NO survey.



Recruitment: The main feature is a strong 2001 year class, which can be tracked in 2003 and 2004 at ages 2 and 3 but was weaker than expected in 2005 and 2006 at ages 4 and 5.

State of the Stock: Current fishing mortality is the lowest of the available series and although the strong 2001 year class seems to be weaker than expected, the assessment results showed that current estimates of biomass are the highest of the time series.

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

Special Comments: It should be noted that the majority of the catches comprise of immature fish.

The next assessment will be held in 2010.

Sources of Information: SCR Doc. 07/10, 11, 18, 25, 34 and 37; SCS Doc. 07/06, 08, 09 and 12.

VIII. FUTURE SCIENTIFIC COUNCIL MEETINGS 2007 AND 2008

1. Scientific Council Meeting and Special Session, September–October 2007

The Council reconfirmed that the Annual Meeting will be held on 24-28 September 2007 at the Altis Hotel, in Lisbon, Portugal. The joint NAFO/PICES/ICES Symposium "Reproductive and Recruitment Processes of Exploited Marine Fish Stocks" will be held on 1-3 October 2007 at the same venue. (*NAFO Sci. Coun. Rep*., 2006, p. 188).

2. Scientific Council Meeting and NIPAG (shrimp), October–November 2007

Following discussions in November 2006, the Scientific Council reconfirmed the dates of 24 October – 1 November 2007 for this meeting to be held at the NAFO Headquarters, Dartmouth, NS, Canada. (*NAFO Sci. Coun. Rep*., 2006, p. 22).

3. Scientific Council Meeting, June 2008

Scientific Council agreed that its June meeting will be held on 5-19 June 2008. It was decided not to shorten this meeting, as suggested earlier (*NAFO Sci. Coun. Rep*., 2006, p.188), owing to time constraints experienced in this and previous meetings.

4. Scientific Council Meeting and Special Session, September 2008

Scientific Council noted that the Annual Meeting will be held 22 September – 1 October 2008. The Symposium will be held after the Annual Meeting during 29 September – 1 October 2008.

5. Scientific Council Meeting and NIPAG (Shrimp), November 2008

The dates and venue of the Scientific Council meeting will be decided at the October-November 2007 Meeting. Provisional dates and venue are 29 October – 6 November 2008 at the ICES HQ, Copenhagen, Denmark (*NAFO Sci. Coun. Rep.*, 2006, p.222).

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Progress Report on Special Session in 2007: Reproduction and Recruitment Processes

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

The following advances have been made for the meeting. Both PICES and ICES have accepted the invitation of the NAFO Executive Secretary to co-sponsor this symposium to be held in Lisbon, Portugal, October 1-3, 2007. Within this framework, it is proposed there be three Co-convenors and a Scientific Steering Committee (SSC). The three Co-convenors are Ed Trippel, Canada (NAFO), Richard Brodeur, USA (PICES) and Mark Dickey-Collas, UK (ICES) with their selection resting in part with each organization. Each organization has made financial contributions towards the symposium.

The Scientific Steering Committee is comprised of S. Kim, Korea (PICES), F. Köster, Denmark (ICES), C. T. Marshall, UK (ICES), M. J. Morgan, Canada (NAFO), H. Murua, Spain (NAFO), A. Thompson, (NAFO Secretariat), and J. Zheng, USA (PICES). The Scientific Council has assisted with the nomination of invited speakers for the keynote address and the Theme Sessions with the final selection noted below. A decision was made to have two invited speakers per session and reduce the original 8 theme sessions down to four sessions.

Keynote Address: Ed Houde (USA) “Emerging from Hjort's Shadow”

Session 1: Age and Size at Sexual Maturation: Tara Marshall (UK) “Quantifying the relative influence of maturation on stock recovery”: Mikko Heino (Norway) “Disentangling sources of variability in age and size at maturation”

Session 2: Fecundity and Spawning Success: Yvan Lambert (Canada) “Reproductive success in marine fish populations: Why should we closely monitor fish fecundity?”; David Armstrong (USA) "Eggs and larvae are starting ingredients in a menu of recruitment that often goes wrong: Lessons from high latitude majid crabs"

Session 3: Survival of Eggs and Larvae: Brian MacKenzie (Denmark) “Fisheries oceanography meets fisheries conservation – opportunities for success”; Yoshiro Watanabe (Japan) “Recruitment variability of small pelagic fish populations in the western North Pacific”

Session 4: Stock Assessment and Management Implications: Louis Botsford (USA) “Larval dispersal and MPAs: implications of the distance between reproduction and recruitment for spatial management”; Joanne Morgan (Canada) “Integrating reproductive biology into scientific advice for fisheries management”

Abstracts are invited to be submitted by June 30 on these topic areas (see NAFO website http://www.nafo.int/symposium.html). These will be appraised and modified as needed by the co-convenors and Steering Committee.

Presentations will encompass a number of species, stocks and ocean ecosystems including field and laboratory studies and analysis of existing data sets. Theoretical reviews and synthesis of concepts will be welcomed. Manuscripts are to be submitted at the symposium and will undergo scientific peer review. The co-convenors along with Anthony Thompson (technical assistance) will take on the editorial responsibilities of the proceedings. The resulting peer-reviewed manuscripts will be published in the Journal of Northwest Atlantic Fishery Science. It is anticipated that the Symposium will have a broad appeal and be well attended.

Administrative support for the symposium will be provided by the NAFO Secretariat, as is customary for NAFO led symposia. Oral and poster sessions will be planned within a single session so as to achieve the goal of integrating the various study areas and provide continuity in discussion items arising from the audience. Members of the NAFO Working Group on Reproductive Potential will meet immediately after the symposium and relevant items that arise at the symposium can be reviewed within this forum for possible action.

2. Progress Report on Special Session in 2008: Marine Mammals

A special session entitled “The Role of Marine Mammals in the Ecosystem in the 21st Century” is planned to be held in Dartmouth during 29 September – 1 October 2008. This is planned to follow the NAFO Scientific Council Meeting and the ICES Annual Science Conference both to be held on 22-26 September 2008. Provisional titles for the proposed four sessions are: Factors affecting life history traits, Foraging strategies and energetic considerations, and marine mammal-fisheries interactions, with the aim of presenting and discussion current advances since the successful 1995 NAFO/ICES marine mammal symposium. A draft poster has been produced, with the suggestion that the abstract deadline be moved forward to 1 April 2008. The deadline for paper submissions will be 31 October 2008.

It is hoped that the special session can be held jointly with ICES, and Garry Stenson (NAFO) and Tore Haug (ICES) have been invited to act as co-convenors. Informal approaches have been made to ICES and a formal application for joint sponsorship will be made in July for a decision to be made by ICES this September.

There are good reasons as to why Dartmouth is a suitable venue, and there is a suggestion that the venue may remain in Dartmouth even if there is an invitation by a Contracting Party to hold the Annual Meeting elsewhere. This would require further discussion, and perhaps STACFAD approval owing to additional cost implications.

The co-convenors wished Scientific Council to discuss the possibilities of publishing the proceedings in a journal that was more relevant to the marine mammal literature. After discussion, it was decided that publications of articles from NAFO symposia, or NAFO lead symposia, where NAFO is providing support before, during and after the symposia, should be published in the Journal of Northwest Atlantic Fishery Science. This has been the practice in the past, and it is the wish of Scientific Council to continue this in the future. The Scientific Council Coordinator was asked to forward this decision to the co-convenors.

3. Topics for Future Special Sessions

There were no new topics discussed at this meeting.

X. REPORTS OF WORKING GROUPS

1. Working Group on Reproductive Potential

(Chair: E. A. Trippel)

The report of the Reproductive Potential Working Group was provided E.A. Trippel (Chair) and presented to Scientific Council by Joanne Morgan (SCS Doc. 07/17). The WG noted that significant progress had been made on most of the current ToRs. A new set of ToRs will be discussed by the WG at and after the September 2007 Symposium, and presented to Scientific Council at the June 2008 meeting. Scientific Council expresses their best wishes and thanks to this WG and for their contribution to the Symposium at the 2007 Annual Meeting.

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

No specific report has been submitted to NAFO. The WGHARP report for the 2006 meeting can be found at http://www.ices.dk/reports/ACFM/2006/WGHARP/WGHARP06.pdf. The NAFO request for advice was not discussed at the 2006 meeting owing to confusion in getting the request included in the WG's ToRs. However, the group also noted that their competence lies mainly within the field of population assessments, and that this particular request may be more suited to another ICES Working Group. The next meeting of WGHARP will be in Tromsø, Norway probably during August 2008.

Scientific Council also noted that the joint NAFO-ICES Working Group on Harp and Hooded Seals is still active, and that Scientific Council may refer issues related to population dynamics of these species to this WG for consideration. The next meeting is tentatively scheduled for August 2008.

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. Election of Chairs

A nominating committee, established by the Council at the beginning of this meeting composed of Bill Brodie (Canada), Manfred Stein (EU-Germany), Vladimir Babayan (Russian Federation), proposed the following candidates. The Scientific Council noted these positions will be for a 2-year period beginning immediately after the September 2007 Annual Meeting.

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

For the office of Vice-Chair of the Scientific Council, Don Power (Canada) was nominated by the Committee. The Council elected him by unanimous consent.

The Rules of Procedure determine that the elected Vice-Chair of Scientific Council would take the office of the Chair of the Standing Committee on Research Coordination (STACREC) Don Power (Canada) was accordingly elected to the office.

For the office of Chair of the Standing Committee on Fisheries Science (STACFIS), Michael Kingsley (Denmark-Greenland) was nominated by the Committee. The Council elected him by unanimous consent.

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

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

2. NAFO Scientific Council Observership at ICES ACFM Meetings

No reports for 2006 have been received from the Scientific Council EU member from Estonia as he did not attend ACFM. Scientific Council is looking for a new NAFO representative that is currently also sitting on ACFM.

3. General Plan of Work for Annual Meeting in September

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

4. Other Matters

No items were raised.

XII. OTHER MATTERS

1. Ecosystem Approach to Fisheries Study Group

The Chair emphasized that the principles of the Ecosystem Approach to Fisheries Management are embedded in the new draft Convention and will be used to guide the future work of the Scientific Council. Because of the growing importance of the Ecosystem Approach and its relevance to Scientific Council, the Chair has had contact with the ICES Secretariat regarding possible future cooperation on this matter. The work of the Advisory Committee on Ecosystems, and of the Working Group on Ecosystem Effects of Fishing Activities (WGECO), Working Group for Regional Ecosystem Description (WGRED) and Working Group on Deep-water Ecology (WGDEC), are particularly relevant. The Chair of WGECO, Ellen Kenchington, gave a very interesting presentation on the history and work of WGECO and made many useful comments for consideration by Scientific Council.

The Scientific Council Chair proposed that Scientific Council establishes an Ecosystem Approach Study Group and suggested some draft ToRs concerned with the identification of eco-regions within the NAFO Convention Area and the development of ecosystem health indicators. There were concerns expressed over both the functions and membership of the Study Group. It was agreed that the Scientific Council Chair and Mariano Koen-Alonso would further investigate ToRs for the Study Group, contact possible future members, and report to Scientific Council at the September 2007 Annual Meeting. The membership of the group would remain open until appropriate ToRs are developed.

Any cooperation with ICES will require that NAFO Scientific Council contributes with its own people, data and analyses of the NAFO Area.

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. NAFO Reform

The Scientific Council and STACFIS Chairs represented Scientific Council at the General Council inter-sessional meeting on the Reform held in Montreal on 19-20 April 2007. The Scientific Council Coordinator was also present. The Scientific Council Chair presented the comments of Scientific Council in a document that is included in the report of that meeting (GC Doc. 07/1) and these were discussed and incorporated as appropriate. It was felt that the main issues offered improvements to the draft and were incorporated.

4. Classification Criteria for NAFO Stocks

Scientific Council agreed at their meeting in October 2006 to classification NAFO stocks according to the FIRMS stock status and the NAFO Criteria *(NAFO Sci. Coun. Rep.*, 2006, p. 222-223). The FIRMS Steering Committee met on 26 February – 2 March 2007 and noted that NAFO was the only organization that had accepted the FIRMS descriptors as search terms (FIRMS FSC4/2007/Report, p. 8). FIRMS decided to link other FIRMS Partners' descriptors to the FIRMS descriptors for search engine purposes only and that this would be strictly internal to the database.

Table 1. The proposed modified* FIRMS classification for the Relative Stock Status descriptors.

Stock abundance status			Exploitation rate status		
Code	Status	NAFO Criterion	Code	Status	NAFO PA
A	Virgin or high abundance	$B >> B_{buf}$	1	No or low fishing mortality	$F < F_{buf}$
B	Intermediate abundance	$B > B_{buf}$	2	Moderate fishing mortality	$F_{buf} \leq F \leq F_{lim}$
C	Low abundance	$B_{lim} \leq B \leq B_{buf}$	3	High fishing mortality	$F > F_{lim}$
D	Depleted	$B < B_{lim}$	0	Uncertain/Not assessed	
E	Uncertain/Not assessed				
*The modification is the utilization of numbers for exploitation rate status instead of letters					

Table 2. Updated classification of NAFO stocks.

Stock	NAFO Stock Classification	
	Stock Abundance Status	Exploitation Rate Status
American plaice Div. 3LNO	D	3
American plaice Div. 3M	D	1
Capelin Div. 3NO	E	0
Cod Div. 3M	D	1
Cod Div. 3NO	D	3
Thorny skate Div. 3LNO	C	0
Greenland halibut SA 0+1 offshore+1B-F	E	0
Greenland halibut Div. 1A inshore	E	0
Greenland halibut SA 2 + Div. 3KLMNO	D	3
Redfish Div. 3O	E	0
Redfish Div. 3LN	B	1
Redfish Div. 3M	A	1
Redfish SA1	D	0
Roughhead grenadier SA 2+3	E	0
Roundnose grenadier SA 0+1	D	0
Roundnose grenadier SA 2+3	E	0
Northern shortfin squid SA 3+4	C	1
Witch flounder Div. 2J+3KL	E	0
Witch flounder Div. 3NO	D	0
Yellowtail flounder in Div. 3LNO	A	2
White hake Div. 3NO	D	0
Northern shrimp Div. 3LNO[1]	A	1
Northern shrimp SA 0+1[1]	A	2
Northern Shrimp 3M[1]	A	0
Northern shrimp in Denmark Strait[1]	E	1
[1] Status not updated		

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.*

5. Other Business

a) VMS data

In response to a Scientific Council request to identify the usefulness of the NAFO VMS, fishing effort for 2006 in the NRA was presented by the NAFO Secretariat (SCR Doc. 07/48). The Chair, on behalf of Scientific Council, requests the Secretariat to undertake an analysis of fishing effort within Subareas and Divisions, and of the spatial and temporal distribution of fishing effort at a finer scale, each year to help answer the Fisheries Commission requests relating to stock assessment.

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.*

b) Scientific Merit Award

A proposal was brought to the attention of the Scientific Council to install a NAFO Scientific Merit Award Program.

NAFO faces many challenges in the 21st century. Such challenges bring outstanding contributions, service, on-going professionalism, and a consistently high level of performance from Chairs of Scientific Council committees and conveners of NAFO symposia. A formal recognition program supports participant identification within NAFO by show-casing Committee Chairs' and Symposia Conveners' contributions, performance, innovation and service in a timely manner and is extremely important in fostering pride in our achievements. This Merit Award program provides recognition by NAFO of the contribution and commitments made by the recipients' institutes and countries.

The Scientific Council welcomed this Award Program and decided to follow up on this issue by next years June meeting.

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 21 June 2007, 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 7-21 June 2007 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 1130 hours on 21 June 2007.

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

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

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 8 and 14 June 2007, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Russian Federation and United States of America.

1. Opening

The Chair opened the meeting by welcoming participants to this June 2007 Meeting of STACFEN. The Chair welcomed Dr. Andrew Kenny of the CEFAS Laboratory, Lowestoft, Suffolk, UK as this year's invited speaker.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 07/01, 05, 09, 13, 14, 15, 16, 19, 20, 21, 22, 24, 41, 42, 43 and 46. SCS Doc. 07/06, 07, 11, 12 and 15.

Gary L. Maillet (Canada) was appointed rapporteur.

2. Invited Speaker

The Chair introduced this year's invited speaker Dr. Andrew Kenny (CEAFS Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk, UK, http://www.cefas.co.uk/default.aspx). During the past 4 years Dr. Kenny has chaired an ICES Regional Ecosystem Group for the North Sea (REGNS). The study work undertook an Integrated Ecosystem Assessment of North Sea ecosystem data, essentially to investigate the trends and links between abiotic (climate) pressures (including nutrients), plankton, commercial fish populations, fisheries and seabirds over the last 30 years. The REGNS process took the holistic approach for the North Sea with its efforts focused towards furthering our understanding of ecosystem dynamics and its value in helping identify important components to monitor for management purposes. The following is an abstract of his presentation entitled “Integrated Assessments in Support of Large Marine Ecosystem Science, Management & Advice: beyond quality status reporting” and the subsequent discussion. (SCR Doc. 07/19)

A meeting of the ICES Regional Ecosystem Group for the North Sea (REGNS) took place in May 2006 with the ambitious task of drawing together different types of data relating to pressure and state changes in the North Sea Ecosystem and to undertake an integrated ecosystem assessment. The assessment provided some valuable insights in relation to; (1) furthering our scientific understanding of large scale ecosystem dynamics, (2) informing the appropriate selection of indicators for management purposes and (3) supporting effective policy advice. With regard to the first point, an assessment of all variables reveals two relatively stable states in the North Sea, one pre-1983 and the other post-1997. The intervening years are dominated by high ecosystem variability which may represent a transition from one state to another and in part may explain the large variation in timing for regime shifts described by other studies. We conclude that defining such shifts is sensitive to both the number and type of variables included, and the time-scales over which trends are observed. By better understanding the relationship between the causes of change at different scales it should be possible to set more realistic targets for the management of human pressures and to improve procedures which can mitigate for unmanageable climate change effects. The significance of this in relation to fish stock assessment data, fisheries (fish landings), sea bird species densities and habitat status was further explored.

The data used in the assessment covered a period of 1973 to 2004 and was spatially resolved at the scale of ICES statistical rectangle (30 km by 30 km). A temporary assessment database was created containing 8,433,120 spatially and temporally explicit ecosystem observations. This is the first time such a comprehensive data set and analysis had been undertaken. A total of 12 abiotic parameters equating to 18 variables were used and a total of 100 biological variables equating to 14 species of zooplankton, 20 species of phytoplankton, 19 fish abundance species, 21 stock assessment metrics, 9 fish landings species and 17 seabird species were included in the analysis. For the initial analysis two types of data matrices were constructed, one for the spatial analysis (for each parameter an average for each ICES grid cell over all years was performed) and one for the time-series analysis (for each parameter annual averages over all squares was performed). Some of the results of the analysis included:

- Abiotic sub-regions for the North Sea have been defined using readily available monitoring data & verified.
- Variations in nutrients, salinity and wave stress are the most significant parameters in terms of explaining assemblages of Plankton, Fish and Seabird – but the causal links (if they exist) require further explanation.
- Boundaries are consistent with other scientific studies, but not current policy assessment and management boundaries. This difference requires further quantification and assessment.
- Also how spatial trends change over different time periods requires further investigation.
- The North Sea ecosystem does not change abruptly.
- An increase in NAO coupled to an increase in negative seawater flux in 1988/1989 and a sharp increase in surface and bottom sea water temperatures.
- A 10 year period of increased ecosystem variability between the two regimes from 1987/1988 to 1997/1988.
- In 1991 a change in the commercial fish stock community, from one where whiting was a dominant species to one where sprat became more dominant.

The presentation stimulated a wide variety of comments and questions from the committee and further discussions focused on recently published studies using smaller spatial scales compared to the large-scale ordination analysis presented in the integrated assessments may better capture dynamics of fish stocks in the North Sea. Dr. Kenny indicated the importance of the frontal boundary demarking the northern region from the southern zone in the North Sea for a large number of biological, chemical, and physical indices. Consideration will be made in future work to focus the analysis at smaller spatial scales within these frontal zones to evaluate changes in the fish community in the North Sea.

The issue of time scales and possible lag times of very different input variables between different trophic levels and environmental components describing the North Sea ecosystem was raised. The issue of combining numerous dependent variables with very different time scales of variability into a multivariate analysis used in the integrated assessment of the North Sea ecosystem is an important consideration. Dr. Kenny indicated that differences in the rate of change among the variables chosen in the study is clearly an important constraint in the analysis but the initial efforts were directed to focus over the entire North Sea area. 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.

A general comment was made that integrated assessment and the ecosystem approach are sometimes used synonymously but distinction should be made that integrated assessments is an important part of the ecosystem approach. The lack in importance of the flatfish component in the bottom trawl survey (IBTS) in the North Sea analysis was questioned. Dr. Kenny indicated that the fish community structure recorded in the trawl survey's may be biased by the type of trawl gear utilized and this point was confirmed that the trawl used in the IBTS survey is not efficient for capture of flatfish species. A general question was raised about our ability to have predicted the significant decline in demersal stocks in the North Sea in 1983 based upon fishing effort and abiotic and biotic variables. Dr. Kenny suggested that recent climatic variability and anthropogenic factors are resulting in forcing that has not occurred in the past and has resulted in large uncertainty in our ability to predict and forecast future ecosystem state changes. Another point was made about how "abrupt change" is defined in context of the North Sea study. Dr. Kenny indicated that detection of abrupt ecosystem state changes would likely require many years to decadal periods although; some components in the ecosystem may change rapidly from year to year. Lastly, a comment was made regarding the use of principal component analyses which are largely exploratory and correlative in nature which does not provide insights into the possible mechanisms resulting in these changes in the state of the ecosystem. Dr. Kenny agreed that further efforts are ongoing to utilize a systems approach to address causality to aid in prediction and forecasting ability of future state changes in the ecosystem.

3. Integrated Science Data Management (ISDM formerly MEDS) Report for 2006

During the year, MEDS and the Engineering and Geomatics Services section of the Canadian Hydrographic Service were combined together and renamed ISDM. (SCR Doc. 07/16)

Since 1975, MEDS, now ISDM, has been the 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 2006 and updates on other activities in the area.

a) Hydrographic Data Collected in 2006

Data from 3 014 oceanographic stations collected in the NAFO area sent in delayed mode to ISDM in 2006 have been archived, of which 1 684 were CTDs, 872 were BTs and 458 were bottles. A total of 86 295 stations were received through the GTSPP (Global Temperature and Salinity Profile Programme) and have been archived, of which 1 368 were BATHYs and 84 927 were TESAC messages.

b) Historical Hydrographic Data Holdings

Data from 23 536 oceanographic stations collected prior to 2006 were obtained and processed during 2006, of which 1 331 were vertical CTDs, 4 752 were towed CTDs, 8 659 were BTs and 8 794 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 2006, ISDM did not receive any data in the Northwest Atlantic while in 2005, almost 32 000 stations were received.

d) Drifting Buoy Data

A total of 177 drift-buoy tracks within NAFO waters were received by ISDM during 2006 representing 331 086 buoy messages. This is an increase of 79 buoys and 154 338 messages from 2005.

e) Wave Data

During 2006, 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 15 wave buoy stations were operational in the NAFO area during 2006 which is 4 more than in 2005.

f) Tide and Water Level Data

During 2006, 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 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 422 million records with the earliest dating back before 1900. Data from 92 tide and water level gauges were processed during 2006 with 17 in the NAFO region.

g) Current Meter Data

A total of 45 current meter instruments were recovered in the NAFO area during 2006 and an additional 32 instruments were deployed. These included both conventional current meters and Acoustic Doppler Current Profilers (ADCPs). The recovered data are processed at the Bedford Institute of Oceanography (BIO) and are available on the web (http://www.mar.dfo-mpo.gc.ca/science/ocean/home.html).

h) Activity Updates

ISDM reported on other activities during 2006:

a) Argo is an international program to deploy profiling floats on a 3 by 3 degree grid in the oceans of the world. Each profiling float samples and reports both temperature and salinity from 2000m to the surface every 10 days. Some of the newer floats now also report oxygen. Data are distributed on the Global Telecommunications System (GTS) within 24 hours of collection and made available on two Global servers located in France and the US. ISDM role is to carry out the processing of the data received from Canadian floats, to distribute the data on the GTS and the global servers within 24 hours and to handle the delayed mode processing. During 2006, the Canadian Argo program deployed 15 Argo floats in the NAFO region, including 4 oxygen floats and produced 888 temperature and salinity profiles and 144 oxygen profiles.

b) 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.

c) To improve management of DFO science data, a national committee was formed called the National Science Data Management Committee (NSDMC). The NSDMC, chaired by Bob Keeley of ISDM with representatives from each administrative region in DFO, was charged with developing a strategy, completed last year, and an implementation plan, currently under review. These documents will first guide the development of a national data system and document the work required to realize the objectives of the strategy. The committee has been in place for 2 years and has received significant funding to undertake a number of projects including a modernization of the handling of trawl survey data, standardization of data handling procedures, acquiring historical data not currently maintained in formal archive systems, and improving access to the data.

d) 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. 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.

e) The DFO Atlantic Zone Monitoring Programme activities include regular sampling for 7 fixed stations and 13 standard sections, and research cruises in the AZMP area to collect other physical, chemical and biological data. As part of ISDM activities in data management, 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 includes:

- 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, Atmosphere
- Water level data for 9 gauges ranging from 1895 to present.
- Graphical representations of biological data (phytoplankton, zooplankton).
- Remote Sensing links for Ocean Color, SST and Primary Productivity products

4. Physical, Biological and Chemical Environment in the NAFO Convention Area during 2006

a) Highlights of Environmental Conditions in the NAFO Convention Area for 2006

(1) The North Atlantic Oscillation (NAO) (Dec.-Feb.) index was below normal during the winter of 2006 as a result arctic outflow during the winter to the Northwest Atlantic was weaker than normal.

(2) Annual mean air temperatures were above normal over the entire NAFO Convention Area from West Greenland to the Gulf of Maine, record high values occurred over Labrador and Southern Baffin Island.

(3) Sea-ice coverage during 2006 remained below normal for the 12th consecutive year on the Newfoundland and Labrador Shelf. In West Greenland Waters, the Gulf of St. Lawrence and on the Scotian Shelf sea-ice was also lighter than normal.

(4) No icebergs were detected south of 48ºN on the Northern Grand Bank in 2006 and only 11 during 2005, the lowest numbers since 1966, well below the 106-year average of 477.

(5) Mean sea surface temperatures during 2006 were warmer than normal from West Greenland, the Labrador Sea (>1ºC) and south to the Scotian Shelf and to Georges Bank and Bay of Fundy.

(6) Shelf water salinities which increased to the highest observed in over a decade during 2002 remained above normal in some areas in 2006; however there was considerable local variability. The stratification of the water column throughout the waters of eastern Canada increased to above normal values.

(7) The waters over much of the Labrador Sea have become steadily warmer and more saline over the past five years and in 2006 the sea surface temperatures in the central and western Labrador Sea was about 1ºC above normal, only slightly cooler that the 2004 and 2005 values. The 2004 values were the warmest in the past 45 years.

(8) In the waters off West Greenland, warm conditions dominated from summer to autumn however a decreased over 2005 was noted. Polar inflows were about normal and the inflow of Irminger water was slightly above normal. Pure Irminger water was observed at the Cape Desolation section and modified Irminger waters reached as far north as the Maniitsoq section.

(9) The warm ocean conditions observed during 2003 to 2006 off West Greenland coincided with an increase in the production of haddock and cod.

(10) Ocean temperatures on the Newfoundland and Labrador Shelf remained well above normal in 2006, continuing the warm trend experienced since the mid-to-late 1990s. The 2006 values reached record highs off eastern Newfoundland.

(11) Annual mean nutrient inventories in the upper layer were below the long-term mean (1993-2006) in 2006 on the Newfoundland and Labrador Shelf, deep inventories also remained lower than the long-term mean in 2006, continuing a trend that started in the late 1990s.

(12) Annual mean chlorophyll-a inventories, a proxy of phytoplankton biomass, declined slightly below the long-term mean (1993-2006) in 2006.

(13) The abundance of zooplankton species (*Calanus glacialis*, *C. hyberboreus*) at Station 27, in the inshore waters of Newfoundland, in 2006 reached their lowest levels encountered since routine collections began in the late 1990s. In contrast, the abundance *C. finmarchicus*, *Metridia* spp. and euphausiids appeared to increase substantially in 2006.

(14) The abundance of many copepod species were generally at their highest levels on the northeast Newfoundland Shelf along oceanographic transects above 48ºN in 2006.

(15) Further south, on the Scotian Shelf, ocean temperatures increased over 2005 values to above normal conditions over all areas except on Georges Bank at 50 m depth, making 2006 the warmest year overall in 37 years of measurements.

(16) In Subarea 5 temperature and salinity have increased steadily from the low values that occurred in late 2004 and early 2005, with about a 3ºC and 0.5 increase in temperature and salinity over that period relative to the 1978-1987 mean.

b) 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 2006 was presented (SCR Doc. 07/13). After 4 consecutive years (2001-2004) of below normal anomalies and a small positive value in 2005, the NAO index returned to a slightly, below normal value (-3.3 mb) in 2006. A negative index implies weaker winds from the northwest, warmer air temperatures and reduced oceanic heat loss during winter over the Labrador Sea and partly over the Labrador and Newfoundland Shelf. The air temperatures were warmer than normal throughout the area: annual average values were above normal by 1.8º-3.1ºC over the Labrador Sea and Shelf, 1.7ºC over the Newfoundland Shelf, 2.3ºC in the Gulf of St. Lawrence, 1.4ºC over the Scotian Shelf and 0.8º-.3ºC in Gulf of Maine. The Newfoundland sea ice cover (Dec-June) was the 2nd lowest in 37 years and its duration was 20-60 days less than average depending on location. The Gulf of St. Lawrence ice cover (Dec-Apr) in 2006 was the lowest in the 38 year record; the ice season was the 2nd shortest in 38 years. Below normal conditions also prevailed on the Scotian Shelf: the ice cover (Jan-Apr) was the 3rd least in 38 years and its duration was 40-50 days less than normal. No icebergs reached the Grand Banks in 2006, only the second year since 1880 when none were reported. The analysis of satellite data indicates a north-south gradient of sea surface temperatures similar to the air temperature distribution. In 2006, there were positive annual SST anomalies from ocean Station Bravo in the Labrador Sea and Hudson Strait on the northern Labrador Shelf to eastern Georges Bank and the Bay of Fundy. Annual anomalies ranged from 0.05ºC (Georges Bank) to 2.04ºC (eastern Grand Bank). A graphical summary of several time series indicates that the periods 1972-1975 and 1985-1993 were predominantly colder-than-normal and 1998-2006 was warmer than normal. In 2006 all variables indicated warmer-than-normal conditions and 10 of the 22 greater than 2.5 standard deviations greater than average; 2006 was truly an exceptional year on the basis of these data series.

A review of meteorological and sea ice conditions around Greenland during 2006 was presented (SCR Doc. 07/01 and 05). The North Atlantic marine climate is largely controlled by the so-called North Atlantic Oscillation (NAO), which is driven by the pressure difference between the Azores High and the Iceland Low pressure cells. The wintertime (December–March) sea level pressure (SLP) difference between Ponta Delgada, Azores, and Reykjavik, Iceland was negative referenced to the mean SLP difference for the period 1961–1990. On the other hand the December-January index in relation to the 1961-1990 mean was slightly positive. The Icelandic Low during the winter months (December–March) was deflected slightly to the southwest with its new center south of Greenland. Both the Icelandic Low and the Azores High was weakened resulting in a lower than normal pressure difference over the North Atlantic sector. This pressure difference resulted in weaker-than-normal westerlies over the North Atlantic Ocean, i.e. the wind anomaly was towards west including the waters southwest of Greenland. Over the Julianehaab Bight in the southwest, the mean wind was southwestward and over the East Greenland shelf including the Denmark Strait area, the average wind condition was close to normal. West Greenland lies within the area which normally experiences warm conditions when the NAO index is negative. During 2006, January was the coldest month off West Greenland, while at Egedesminde temperatures, except for November, were above normal. Air temperatures at Nuuk revealed colder-than-normal conditions during January and November. Except for July and November, Angmagssalik experienced climatic conditions which were at or above the climatic mean throughout the year. The annual mean air temperature for 2006 in Nuuk was -0.21ºC which is about 1.5ºC above average, reflecting the negative NAO value. The mean annual air temperature for 2006 was above normal for almost the entire North Atlantic region with anomalies above 2°C West of Greenland and even above 3°C over the Davis Strait region. These values represent a continuation of a series of warmer-than-normal years since 1996 in the West Greenland area, with 1999 being the only exception when air temperatures were slightly colder-than-normal.

Satellite derived ice charts for 2006 indicate that winter sea ice conditions were light during 2006 off West Greenland. The sea ice drift has a significant offshore component which is called the “West Ice”. The southernmost location of the ice edge of “West Ice” was found around mid-January off Maniitsoq/Sukkertoppen, one and a half month earlier than during 2005. Multi-year sea ice, coming from the Arctic Ocean via the East Greenland current to the Cape Farewell area, is called “Storis”. During early-July, the East Greenland coast was surrounded by sea ice with concentrations ranging from 3-10 tenth. There was also a tongue of newly formed ice in the Cape Farewell region. Sea ice formed again in Baffin Bay in the third week of November when 3-10 tenth of ice concentration was observed north off Baffin Island. This was two weeks later than during 2005. Off East Greenland first sea ice formation was only encountered in the Angmagssalik area and to the north at Storfjord Deep during the first week of October.

A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2006 was presented (SCR Doc. 07/46). Annual mean 2006 surface air temperatures from representative land stations bordering the Labrador Sea in the west and northwest were about 3°C warmer-than-normal, reaching record-high values in the context of a decade-long period of warmer than normal conditions. The annual anomalies were dominated by exceptionally warm winter months. Annual mean 2006 surface air temperatures at Nuuk on the West Greenland coast were about 1.5°C above normal, slightly cooler than in 2005. Monthly averages sea surface temperature data for the Labrador Sea were extracted from the global HadISST1 data set produced by the UK Met Office Hadley Centre on a 1-degree latitude-longitude grid. A space-time plot of HadISST1 SST anomalies shows significant warming in the Labrador Sea during recent years, particularly on the western side. A SST time series from the west-central Labrador Sea represented by an average over the 320–520 km distance range on the AR7W section shows values >0.8ºC above average, the 3rd highest since 1989. NOAA Extended SST estimates of the 2006 annual mean for the Labrador Sea and adjacent North Atlantic and the associated anomalies relative to 1971-2000 show that 2006 was considerably warmer-than-normal, by about 1oC in the west-central Labrador Sea and about 0.5ºC in the eastern Labrador West Greenland coastal areas.

In 2006, monitoring of sea-surface temperature (SST) at locations in the Labrador, Gulf Stream and the North Atlantic Currents were completed (SCS Doc. 07/06). For this purpose the mean monthly SST deviation from the long-term mean values at 13 locations in NAFO Divisions 2J, 3KLMN, 4VWX and adjacent open-sea area were examined. In the Labrador Current positive anomalies of SST were observed during all months with the maximum values (2°-2.8°C) in spring-summer and minimum (0.1°-0.8°C) in December-March. In the Labrador Sea SST anomalies were positive and ranged from 0.8°-1.8°C throughout the year. In the North Atlantic Current branch SST was 1°-2.8°C warmer than normal. In the Grand Bank area SST was 2.6°-3.4°C warmer than normal in summer months and 0.8°-1.6°C warmer in the winter period. On the Scotian Shelf the monthly SST values were either above or near to normal. The highest anomalies were recorded here in June (1.9°C) and in July (1.6°C), the lowest in September (-0.3°C) and in October (0.2°C). On the Scotian Shelf and in Slope waters the SST fluctuations principally depend on the advection of Slope waters to the shelf, i.e. on latitudinal fluctuations of the north boundary of the water mass. It seems likely that SST in January and February at these locations was 1°-1.4°C warmer-than-normal. In other months SST values were near normal on the Shelf slope and ranged from –1.2°-1.2°C in the Slope waters. At the north edge of the Gulf Stream front SST differed little from normal during the year. In general, the analysis of monthly mean sea surface temperature showed a continuing warm trend with 2006 SST values significantly warmer than the corresponding values in 2005.

The climatology of near-bottom potential temperature, salinity and potential density in the area of the Northwest Atlantic based on historical oceanographic data was presented (SCR Doc. 07/09). It was showed that the temperature, salinity and density increase rapidly with depth in areas of shelves and upper parts of continental slopes. On the lower part of the continental slopes and in the oceanic depressions potential temperature decreased while both salinity and potential density increased. The border between these zones is located close to maximum of bottom temperatures at depths of about 400-500 m. In the upper zone the shelf thermal, haline and density frontal zones are located. They have a common source and are formed by the interaction between the sub-arctic and modified Atlantic waters. Haline and density near-bottom frontal zones located in the shallow areas along the coasts of West Greenland and Labrador are specific for conditions of increased salinity variations in combination with relative stability of potential water temperature close to minimal values of these characteristics. In the lower structural area of the near-bottom layer under the low variability of the near-bottom salinity and density, not extended slope thermal frontal zones are present, which are connected with the heightened thermal contrasts between warm intermediate and cold deep waters and attached to limited bottom areas close to the southern part of Greenland and off the Flemish Cap bank at the depth of 1 000-2 500 m.

c) Physical, Biological and Chemical Oceanographic Studies in the NAFO Convention Area

Subareas 0 and 1. Hydrographic studies were conducted along standard sections and within several Fjords off the west coast of Greenland during an oceanographic survey in the summer of 2006. The survey was carried out according to the agreement between the Greenland Institute of Natural Resources and Danish Meteorological Institute during the period July 14-27, onboard the Danish naval ship "TULUGAQ". During the period July 3-30, 2006 the Greenland Institute of Natural Resources also carried out a trawl survey from Sisimiut to the Disko Bay area and further north onboard "R/V PAAMIUT". A further survey was conducted during the period March 23–26, 2006 by the Danish Meteorological Institute and Greenland Institute of Natural Resources onboard “R/V Adolf Jensen” and “Erisaalik. During these surveys CTD measurements were carried out on national oceanographic standard stations (SCR Doc. 07/01, SCS Doc. 07/15). During October and November 2006 the Institut für Seefischerei in Hamburg, Federal Republic of Germany conducted oceanographic observations at NAFO standard oceanographic sections Cape Desolation and Fylla Bank and along a new oceanographic section between Canada and Greenland (Holsteinsborg Section) aboard the FRV “Walther Herwig III”. During the German groundfish autumn survey oceanographic measurements were also performed at 49 fishing stations off West Greenland using a CTD-Rosette system (SCR Doc. 07/05, SCS Doc. 07/11).

The results of the 2006 Danish survey show cold low salinity conditions close to the coast off Southwest Greenland reflecting the inflow of Polar Water carried to the area by the East Greenland Current. Water of Atlantic origin (T>3ºC; S>34.5) is normally found at the surface at the three outermost stations on the Cape Farewell and Cape Desolation sections but this year the salinity of these surface waters was lower than observed the last few years. At intermediate depths pure Irminger Water (T ~ 4.5ºC; S >34.95) was traced north to the Cape Desolation section. Modified Irminger Water (T >3.5ºC; 34.88< S <34.95) was observed as far north as the Maniitsoq section. The northward extension of Modified Irminger Water indicates normal inflow of water of Atlantic origin to the West Greenland area. However, the temperature of the Irminger Water was in general higher-than-normal. The average salinity and temperature at 400–600 m depth west of Fylla Bank (Station 4), which is where the core of the Irminger Water normally is found was about 4.67°C, which is 0.5°C higher than normal, whereas the average salinity of 34.84 was just above normal by 0.03. The high temperatures combined with normal salinities indicate that the Irminger Water was warmer than normal in 2006. In all sections, including the southernmost at Cape Farewell and Cape Desolation, a low saline water lid of (modified) Polar Water was observed extending towards the interior of the Labrador Sea most likely formed by abnormal easterlies over the southwest Greenland waters combined with normal inflow of Polar Water. In 2006, a well defined core of Polar Water, revealed by its low temperature, was observed west of Fylla Bank at 50–100 m depth while a weaker Polar Water core was also observed on the Sisimiut section. Measurements west of Fylla Bank indicate a normal inflow of Polar Water and Atlantic Water. The salinity was about normal in the upper 150 m and slightly above normal below 150 m. The surface temperature (0–50 m) was more than 1°C above average, while the temperature in the core of the Polar Water in 50–150 m was a little above normal by 0.44°C. At intermediate depth at 150–400 m the temperature was 0.66°C higher than normal and the temperature at 400–600 m was more than half a degree above average. Mid-June temperatures on top of Fylla Bank (Station 2) were about 0.9°C above average while the salinity was the third lowest (0.35) in the 56 year time series.

Results of the 2006 German autumn survey to the standard sections along the west coast of Greenland show temperature and salinity values along the Cape Desolation Section in the West Greenland Current core of 5.61°C and 34.967 at 119 m depth and at depths of 2 991 m potential temperature of 1.51°C was observed with salinities of 34.902. Based on autumn measurements (September-November) at station 4 of the Fyllas Bank section, the temperature anomaly time series reveals a warming trend which is persistent since 1993. Since Station 4 of the Fyllas Bank section is situated at the bank slope, it happened in the past decades that cold surface waters from Fyllas Bank were moved westward and influenced the upper 200 m of the water column. This happened during autumn 1983, 1992 and 2002, and these events will be called here “polar events”. Mean temperature of the upper layer 0-200 m again indicates cooling after 2003 which was the record warm year in the entire time series. However, being 1.28°C warmer-than-normal, the thermal conditions off Fyllas Bank still indicates similar warm conditions as in the 1960s. The Holsteinsborg-Baffin Island Section crosses the Baffin Island Current and the core of the West Greenland Current. On the eastern side of the section, the West Greenland Current flows along the shelf break and transports heat (core temperatures >5.8°C) into the Baffin Bay. Recent data collected by a US survey in October and the German survey indicates a warming in the West Greenland Current core between early-October 2006 and early-November 2006, which amounted to about 1°C. On the western side of the section, the cold Baffin Island Current characterizes the thermal fields of the upper ocean. Whereas the US data indicate minimum temperatures of -1.62°C, our data yield minimum temperatures of -1.56°C. There is a sub-surface tongue of warm West Greenland Current water (>3°C) located under the cold Baffin Island Current which extends westward from the West Greenland Current core. Compared to mean autumn conditions, the temperatures in the West Greenland Current core and on the West Greenland shelf as measured during autumn 2006, are up to 2°C warmer-than-normal.

Two stratified random surveys were carried out in NAFO Division 0A from August 26 to September 5, and from October 27 to November 7, 2007 (SCR Doc. 07/22, 41). This was a collaborative effort between Fisheries and Oceans Canada, the Nunavut Wildlife Management Board, Baffin Fisheries Coalition, Government of Nunavut, Nunavut Tungavik Inc., and the Greenland Institute of Natural Resources. The Greenlandic research vessel Paamiut was used to carry out the surveys. In addition the Northern Shrimp Research Foundation conducted surveys in Divisions 0B and 2G during the summer of 2005 and 2006 from the FPI stern trawler Cape Ballard Three oceanographic sections were completed during two surveys conducted in Division 0A, Baffin Bay, during August-September and November, 2006. One was at Cape Christian on August 31 and two were at Broughton Island, Sept. 3 and Nov. 4. This is the first time that the Broughton Island Section has been surveyed. Temperature, salinity and fluorescence data were collected at 5-6 stations along each transect. In addition bottom water temperatures were obtained at each fishing station distributed between 100 m and 1500 m bottom depth. Cold arctic polar water (<0ºC) was clearly apparent between approximately 50 to 300 m in the sections taken along the Baffin coast and a majority of surveys stations had bottom water temperatures <2ºC. Bottom water temperature maps show cold polar water extending south into Div. 0B with warmer Atlantic water (3º-4ºC) found in deeper waters. Oceanographic data collected by the shrimp surveys in 2005 and 2006 show similar temperature patterns, however, the 2006 data indicates that bottom temperatures in some areas decreased compared to those in 2005. In both years, however, bottom water temperatures in Div. 0B looks similar to average conditions, however, farther south in Div. 2G bottom water temperatures in 2006 were colder than average. In general, the influence of the cold (<0ºC) Arctic Current waters is seen along the coast and temperatures warmed to 4ºC as depth increased.

Subareas 1 and 2. Hydrographic conditions in the Labrador Sea (SCR Doc. 07/46) depend on a balance of atmospheric forcing, advection and ice melt. Wintertime heat loss to the atmosphere in the central Labrador Sea is offset by warm waters carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried by the Labrador Current, freshwater from river run-off and ice melt. Wintertime cooling and evaporation increase the density of surface waters in the central Labrador Sea. Wind mixing and vertical overturning form a mixed layer whose depth increases through the cooling season. The winter heat loss, the resulting density increase, and the depth to which the mixed layer penetrates vary with the severity of the winter. In extreme winters, mixed layers deeper than 2 000 m have been observed. Labrador Sea Water formed by these deeper overturning events spreads throughout the northern North Atlantic. During milder years, the vertical stratification of temperature, salinity, and density is re-established. The late-1980s and early-1990s saw relatively cold winters and high heat fluxes over the Labrador Sea. Recent years have shown generally warmer conditions with convective overturning limited to the top 1 000 m.

The Ocean Sciences Division, DFO Maritimes Region has monitored hydrographic properties along a section crossing the Labrador Sea (AR7W line) in the early summer of each year since 1990. The 17th annual AR7W survey took place in late May and early June 2006. Between 1990 and 2006 the upper layers of the Labrador Sea have become warmer and saltier. Conditions in 2006 continued warm and saline, generally similar to conditions in the previous 2–3 years. The upper 2000 m of the water column averaged across the AR7W section at stations where the bottom depth was at least 2000 m in the Labrador Sea was more than 0.6°C warmer in 2006 than the average for the period 1990-1995. The corresponding 2006 average upper 2000 m salinity was about 0.4 higher than the 1990-1995 average. The 2006 survey generally encountered conditions similar to those observed in 2004 and 2005. Warm and saline waters in the offshore branch of the West Greenland Current dominated the upper layers of the eastern Labrador Sea. A layer of reduced vertical stratification centered near 950 m was observed in the west-central Labrador Sea. This layer could be interpreted as a remnant of vertical mixing during the winter of 2005-2006. There has been a gradual decrease in upper-layer density since the end of the deep convection of the early 1990s. The net density changes over the upper 2000 m during the past few years have been relatively small, with changes linked to temperature and salinity nearly in balance. This layer is about 0.03 kg/m^3 less dense than the average for 1990-1995. These changes in hydrographic conditions largely account for observed changes in sea level from satellite altimetry.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador Region during 2006 was presented (SCS Doc. 07/12). 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 2006 with three physical and biological oceanographic offshore surveys carried out along several cross-shelf NAFO and AZMP sections from the Southeast Grand Bank to Hamilton Bank on the southern Labrador Shelf. The first was conducted on the CCGS Teleost from April 21 to May 3, the second on CCGS Templeman from July 24 to August 7 and the last on CCGS Hudson from November 18 to

December 4. This program was established to include biological and chemical oceanographic sampling at a fixed coastal site (Station 27) at biweekly intervals and along offshore sections at seasonal time scales. The main objectives are to establish the seasonal temporal and spatial distribution and abundance of plant pigments, nutrients, microzooplankton and mesozooplankton in relation to the physical environment. Physical, biological and chemical variables being monitored include temperature, salinity, dissolved oxygen, ocean currents as well as measures of primary and secondary production and biomass, species composition of phytoplankton and zooplankton and nutrients. The oceanographic monitoring program currently conducted on the Newfoundland and Labrador Shelf should allow an understanding of changes in ecosystem productivity and changes in ecosystem structure over time. Data from this effort are used to produce annual physical, chemical and biological state of the ocean reports and in studies relating environmental conditions to marine resources.

Oceanographic observations in Subareas 2 and 3 on the Newfoundland and Labrador Shelf during 2006 referenced to their long-term (1971-2000) means were presented in SCR Doc. 07/20. At Station 27 off St. John's, the depth-averaged annual water temperature increased over 2005 setting a new record high of nearly 1ºC above normal. Annual surface temperatures at Station 27 were also the highest in 61 years at 1.7ºC above normal. Bottom temperatures were also above normal by 0.8ºC, the 3rd highest in the 61-year record. Annual surface temperatures on Hamilton Bank were 1ºC above normal, the 10th highest on record; on the Flemish Cap they were 2.5ºC above normal, the 3rd highest in 57 years. Upper-layer salinities at Station 27 were above normal for the 5th consecutive year. The area of the Cold-Intermediate-Layer (CIL) water mass on the eastern Newfoundland Shelf during 2006 was below normal for the 12th consecutive year and the 3rd lowest since 1948. The near-bottom thermal habitat on the Newfoundland and Labrador Shelf continued warmer than normal in 2006, with bottom water temperatures remaining at >2ºC, about 0.5ºC above normal on Hamilton Bank off southern Labrador during the fall. Bottom water temperatures during the fall however decreased substantially from 2005, particularly in northern areas. The area of bottom habitat on the Grand Banks covered by sub-zero water has decreased from >50% during the first half of the 1990s to near 15% during the past 2 years, ranking the 3rd lowest in 2006. In general, except for late fall values, water temperatures on the Newfoundland and Labrador Shelf increased from 2005 values, continuing the warm trend experienced since the mid to late-1990s. Newfoundland and Labrador Shelf water salinities, which were lower-than-normal throughout most of the 1990s, increased to the highest observed in over a decade during 2002 and have remained above normal in most areas during 2006.

Biological oceanographic observations from a fixed coastal station and oceanographic sections in Subareas 2 and 3 during 2006 were presented and referenced to previous information from earlier periods when data were available (SCS Doc. 07/12, SCR Doc. 07/15). Overall, the seasonality of chemical and biological variables at Station 27 and along the major AZMP sections in 2006 was similar to previous years (1999-2005). The timing of events on the Newfoundland Shelf (south of Seal Island) was once again similar to conditions observed in the early part of the program but in contrast to 2001 when the onset of the spring phytoplankton bloom was delayed. However, satellite information indicates the onset of the spring bloom, at least since 2002, has become gradually earlier throughout the region of the Newfoundland Shelf and Labrador Sea. Biological oceanographic observations from a fixed coastal station and oceanographic transects in NAFO Subareas 2 and 3 during 2006 were presented and referenced to previous information from earlier periods when data are available. The information concerning the seasonal and inter-annual variations in inventories of nutrients (nitrate), chlorophyll a, as well as the abundance of major taxa of zooplankton collected as part of the Atlantic Zone Monitoring Program (AZMP) were reviewed. The seasonally-adjusted annual mean nitrate inventories in the upper (0-50 m) and lower (50-150 m) water column on the Newfoundland and Labrador Shelf were generally below the long-term mean in 2006. Although there were statistically significant inter-annual variations in nitrate inventories across all NAFO Divisions, this appears to be primarily driven by elevated levels during the late-1990s and early-2000s. The seasonally-adjusted annual mean chlorophyll a inventories across all NAFO Divisions were slightly below the long-term mean in 2006 and all Divisions displayed significant inter-annual variation. The abundance of *Calanus glacialis*, *C. hyperboreus*, and larvaceans in the Avalon Channel reached their lowest levels encountered since routine collections began in the late-1990s on the Grand Banks. In contrast, the abundance of *C. finmarchicus*, *Metridia* spp., and euphausiids increased substantially in 2006 following earlier declining trends. The seasonally-adjusted annual mean abundance of the dominant copepod species showed large north-to-south differences in the significance of inter-annual variations. While many of the dominant copepod species were at or near their lowest abundance along the southern transect across the Grand Banks, the standing stocks generally increased on the NE Newfoundland and Labrador Shelf along oceanographic sections above 48º N in 2006. The differences between the abundance of inshore (Station 27, Div. 3L) and offshore (oceanographic transects, Div. 3LNO, 3K, 3M, 2J) zooplankton standing stocks may be related to highly dynamic coastal processes in contrast to broad oceanographic bio-physical interactions that govern the patterns of abundance further on the Shelf.

Subarea 4. A description of environmental information collected on Scotian Shelf and in the Eastern Gulf of Maine and adjacent offshore areas during 2006 was presented (SCR Doc. 07/14). A review of physical oceanographic conditions on the Scotian Shelf and in the Gulf of Maine and adjacent offshore areas during 2006 indicates that the temperatures were generally ~1ºC above normal. This contrasts with 2005 when cooler conditions prevailed. St. Andrews sea surface temperature was 1.31ºC above normal making 2006 the warmest in 86 years. At Prince 5, which is 90 m deep, monthly mean temperatures were generally above normal by about 1.1º-1.3ºC. The annual temperatures at 0 and 90 m were the second warmest and warmest in 82 years. Salinities anomalies were -0.02 (0 m) and 0.14 (90 m). Halifax sea surface temperature was 0.3ºC above normal, making 2006 the 17th warmest in 81 years. At Halifax Station 2 from 0 to 140 m, temperature anomalies were generally 1ºC above normal; salinity anomalies were near normal. Sydney Bight and Misaine Bank had typical temperature anomalies of 1.3ºC and 0.7ºC in the upper 100 m; Emerald Basin, 0.8ºC from 0-250 m, Lurcher Shoals, 1.4ºC from 0-50 m, Georges Basin, 0.6ºC from 0-300 m, and eastern Georges Bank, 0.1ºC from 0-50 m, all showed positive anomalies at most depths. Observations from standard sections in April and October on the Scotian Shelf support the conclusion of generally above normal temperatures over the shelf. The overall temperature anomaly for the combined areas of 4Vn,s, 4W and 4X from the July groundfish survey was 0.74ºC, an increase of 2.1ºC from the record cold values in 2004 and the third warmest year in 37. The overall stratification was above normal for the Scotian Shelf region in 2006. A summary of several time series of climate indices indicates that the periods 1987-1993 and 2003-2004 were predominantly colder-than-normal and 1999-2000 was warmer-than-normal. The period 1979-1986 also tends to be warmer-than-normal but, except for 1984, not as dominantly so as during 1999-2000. In 2006, all variables except Georges Bank 50 m temperature were above normal making it the warmest year in 37 years of data records.

Subareas 5 and 6. The United States Research Report listed several ongoing oceanographic, plankton and benthic studies conducted by the Northeast Fisheries Science Center (NEFSC) in NAFO Subareas 5 and 6 (SCS Doc. 07/07). A total of 1950 CTD (conductivity, temperature, depth) profiles were made on NEFSC cruises during 2006. The data from these cruises are accessible at http://www.nefsc.noaa.gov/epd/ocean/MainPage/. 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://ftp.nefsc.noaa.gov/pub/hydro/cruise_rpts/2006/. During 2006, zooplankton community distribution and abundance were monitored using 674 bongo net tows taken on seven surveys. Each survey covered all or part of the continental shelf region from Cape Hatteras northeastward through the Gulf of Maine. The Ship Of Opportunity Program (SOOP), completed thirteen transects across the Gulf of Maine from Cape Sable, NS to Boston and seven transects across the mid-Atlantic Bight from New York to the Gulf Stream during the same time period. During 2005 and 2006, temperature and salinity have increased fairly steadily from the minimums which occurred in late 2004 and early 2005, with about a 3ºC and 0.5 increase in temperature and salinity over that period relative to the characteristic annual cycles (referenced to 1978-1987 MARMAP decade). The co-variation of the temperature and salinity suggest variation in the mixing ratio of Scotian Shelf Water and Slope Water entering the Gulf of Maine as a cause (i.e., more warm, saline Slope Water). However, the increase in temperature is about double what would be expected for a 0.5 increase in salinity, given the characteristic T/S relationships of the two water masses. Therefore some changes in the source water mixing ratio and warming relative to the reference decade occurred in 2006 (D. Mountain, personal communication).

5. Interdisciplinary Studies

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

The following studies were considered at this June 2007 Meeting:

(a) *Distribution of 0-group cod off West Greenland during Walther Herwig III cruise in autumn 2006 in relation to a warming ocean environment. M. Stein.* The survey is primarily a stratified random sampling bottom trawl survey, lasting from 12 October to 24 November 2006 which is aiming at cod, and depth strata 0-200 m and 200-400 m are surveyed off East and West Greenland. The survey design is kept constant since 1982. Results show that findings of 0-group cod specimen in the 140 bottom trawl used during the cruises since 1982 were most abundant in 1984 and 1985, as well as during 2003-2006. It was emphasized that these findings are not representative for the abundance of 0-group cod in these waters, since the net is primarily designed for the catch of adult cod. With the use of a cod end liner with 10 mm mesh size, 0-group cod were sampled qualitatively. Despite this, it was argued that these data may be taken as index for recruitment to the Greenland cod stock. It was questioned whether the 0-group cod found as far north as near the Polar Circle off West Greenland, may have come from East Greenland spawning sites, or whether they originate from spawning sites off West Greenland. No clear answer could be found during the presentation of the data. It is hoped, however, that otoliths taken from 0-group cod might clarify this question in future times. Abundance and biomass data from cod indicate that the 2006 situation for the cod stocks off Greenland are at higher levels as during 1986, however not as high as the 1987 conditions. Compared to the historical scenario however, this trend can only be seen as minor recovery based on the 2003 year-class which clearly dominates the other age groups. Additionally, warming of water masses in West Greenland waters as observed since the mid-1990s and no directed fishery on cod seem to play important roles in the observed recovery.

(b) *An examination of growth and condition of Div. 3NO cod at different environmental temperatures. M. J. Morgan, E.B. Colbourne and P.A. Shelton (SCR Doc. 07/24).* From 1984-1997 there was a large increase in the area of <0ºC water on the Grand Bank reaching near 60% in some years. Since 1997, with the exception of 2003, there was a significant decrease in the percentage area of the bottom covered by <0ºC water reaching minimum values in 1999, 2004 and 2006. It appears that higher biomass of cod in Div. 3NO are found in the warmer portion of the available habitat, predominately in the 0ºC-3ºC temperature range. There are exceptions however, the most notable, in the years 1985-1990 during the spring when the catch rates from the surveys appeared to peak. During these years the distribution of cod extended into northern areas of Div. 3NO where bottom temperatures were generally <0ºC. Both the average temperature occupied and the area weighted temperature (available temperature) increased in the spring starting in about 1990. The average temperature occupied since 1990 has been 2.2ºC vs. 1.2oC from 1978-1989. The average temperature available increased from 0.8º-1.2ºC. Trends are less clear in the autumn data which only begins in 1990. Average temperature occupied by cod in Div. 3NO was highly correlated with that available to the fish. However, temperature occupied tended to be higher than the average available. All tests of the effect of growth were done using both measures of temperature but since the two are highly correlated and results were generally the same, only those for temperature occupied were presented. There was no significant effect of temperature on the residuals from a model of weight increment *vs.* age. This was true regardless of the age range analyzed (1-10, 3-10, 4-6) and regardless of whether temperature was treated as a continuous or class variable. Previous studies found that increased temperature resulted in increased growth in weight in cod in Div. 2J3KL and when populations are compared those inhabiting warmer waters have higher weight-at-age. It is possible that the range of variation in temperature in the present study was not sufficient to result in and increase in weight increment. Div. 3NO has less variable temperatures than the area further north (Div. 2J 3KL). Applying the modified von Bertalanffy model there was a significant effect of temperature on growth in length, but the effect was negative, with fish growing less when temperatures were higher. Such a decrease in growth could be expected if the warmer temperatures experienced by cod in Div. 3NO were above their optimum for growth. Although there have been no studies of optimum growth temperatures for this population, studies with fish from other populations indicate that the optimum is actually much higher than those temperatures in Div. 3NO. There was also a significant effect of temperature on relative body and relative liver condition. Examination of the data indicated that the effect was not continuous so temperature was analyzed as a class effect. Except for the analyses of condition in autumn with autumn temperatures, the condition was higher at low and high temperatures than at intermediate temperatures. The effect of temperature on growth is not independent of food availability. As ration level (food availability) declines, the most efficient growth occurs at lower temperatures where requirements for maintenance are lower because of lower metabolic rate. Food availability was not taken into account in this study. There is little information on capelin, one of the major prey species for cod. However, for the period since the early 1990s capelin in Div. 3NO is thought to be at a very low population size.

(c) *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 and D. W. Kulka (SCR Doc. 07/21).* White hake (*Urophycis tenuis*, Mitchill 1815) is a temperate bottom dwelling fish with the northern extent of its distribution on the southern Grand Banks. There they are found at bottom depths from 50-800 m, associated with 40-80C ambient temperatures. They are restricted to a narrow band along the southwest edge and into the Laurentian and Hermitage

Channels where local bottom temperatures are warmest (>4Cº). Potential dispersion patterns of eggs, larvae and juveniles under climatological monthly-mean circulation fields, M2 tidal currents and associated turbulent mixing, which was computed from a three-dimensional regional ocean circulation model were examined. Effects of spawning locations (horizontal and vertical) and timing (monthly and yearly) were investigated. Interannual variability in the strength of the Labrador Current may have profound impacts on the destination of the eggs and larvae and the first year juveniles since the major spawning area is located at the shelf-edge. Previous studies have suggested that the shelf-edge Labrador Current was intensified off central Labrador in 1995/1996. This intensified pulse passed the southwest Newfoundland Slope in 1997 and intruded onto the Scotian Shelf in late 1997 and early 1998. The flow through the Flemish Pass was much weaker in 1998/1999. To show potential impacts of the weakened Labrador Current in the 1999 on egg and lava distribution and their final settlement of young-of-the-year juveniles, drogues were released under a reduced (by 50%) monthly mean currents. The distribution pattern at the 50-m release indicates that there were significant increases of the particles that are available to settle over the south Grand Bank nursery area. More particles can reach the shallow portion of the Grand Bank, providing a high chance for the young of the year juveniles to reach inshore bays along northern Avalon. The present particle tracking study under the model monthly-mean circulation fields, tidal currents and associated mixing indicates that a weaker Labrador Current can increase the likelihood of the juvenile settlement on the southern shallow extent of the Grand Bank, the "nursery area" in the fall. This area corresponds to location where the large majority of the very large 1999 year class settled. The SW slope (an identified major spawning location in spring) spawning has much lower availability for the fall settlement than the Grand Bank spawning. Nevertheless, the species is capable of producing a very large numbers of eggs in spring. As a result, it can maintain a sufficient number of small juveniles settling into the nursery area in fall. The simulated results also suggest that juveniles from the late spring spawning have higher potential to settle there.

(d) *Variations in the Labrador Current Transport and Zooplankton Abundance on the Newfoundland and Labrador Shelf. G. Maillet and E. Colbourne (SCR Doc. 07/42).* Variation in the volume transport of the Labrador Current at the shelf break has important implications for recruitment of calanoid copepods on the continental shelf in the Northwest Atlantic. During the past several decades the ocean climate on the Newfoundland and Labrador Shelf have been characterized by several extremes, from the warm 1960s, cold early 1970s, mid-1980s and early-1990s and the recent warm trend from mid-1990s to early-2000s. As a result of the variations in stratification and the baroclinic currents the volume transport of the Labrador Current at the shelf break also show large interannual variations with an increasing trend in recent years along the Hamilton Bank and Flemish Cap sections. Variations in ocean circulation are hypothesized to influence the distribution and recruitment of zooplankton populations. In this study a focus on the response of the calanoid copepod, *Calanus finmarchicus* to variations in the volume transport of the Labrador Current was made. Prior to reaching maturity, this species undergoes a transition to deep waters (500-2 000 m) and a dormancy period during autumn and winter. In order to re-populate the shelf, advective transport of individuals across the shelf-break front from nearby deep slope waters must occur. The results indicate that volume transport variability of the Labrador Current is significantly correlated with the relative abundance of *Calanus finmarchicus*, and may impact recruitment of calanoid copepods in shelf ecosystems in the NW Atlantic. In particular, the relative abundance of the dominant calanoid copepod *Calanus finmarchicus* has declined from the 1960-1970s to the recent decade across the Northwest Atlantic inferred from the CPR survey data. The abundance of *C. finmarchicus* declined substantially by approximately 20 % during the intervening gap in the time series (1978-1990). Our analysis indicate that the relative abundance of *Calanus finmarchicus* in the Northwest Atlantic is strongly negatively correlated ($r = -0.59$) with the volume transport of the Labrador Current across the Flemish Cap section, followed by the Seal Island section ($r = -0.44$). Although we lack information regarding the relative abundance of *C. finmarchicus* during a substantial extent of the time series from 1978 through 1990, variability in transport may be an important mechanism to account for the interannual variation in the standing stocks of calanoid copepods.

6. Annual Ocean Climate Status Summary for the NAFO Convention Area

At its June 2002 Meeting, STACFEN recommended that beginning in 2003 an annual climate status report be produced to describe environmental conditions during the previous year. This web-based annual summary for the NAFO area includes an overview that summarizes the overall general climate changes for the previous year and a regional overview that provided climate indices from each of the Subareas. The 2006 review of environmental conditions covered most of the NAFO Convention Area based on contributions received for Subareas 0-1, West Greenland (M. Stein and M. Ribergaard), Subareas 2 and 3 (E. Colbourne and R. Hendry), Subareas 4 and 5 (B.

Petrie) and Subareas 5 and 6 (D. Mountain). The 2006 annual summary will be updated and posted on the NAFO website (http://www.nafo.int/science/frames/ecosystem.html) shortly after this STACFEN meeting.

7. Environmental Indices (Implementation in the Assessment Process)

In addition to providing reviews of ocean climate and its effects on marine resources STACFEN provides advice on how relationships between ocean climate and marine production may be used to help improve the assessment process. A review of how Atlantic Canada currently incorporates environmental information into the regional fish stock assessment process and how this information is disseminated to scientists, managers and stakeholders in the fishing industry was presented at the STACFEN meeting in June of 2004. It was concluded that a significant research effort is required to move forward, including identifying functional (causal) relationships underlying environment-stock associations, incorporating more information on primary and secondary production into stock assessments, and to evaluate the importance of environmental effects relative to fishing and natural mortality. At the 2005 meeting it was noted that the multi-species models currently under development in support of Ecosystem Based Management (EBM) may offer new opportunities to make further advances in this area.

At the 2007 meeting Dr. Andrew Kenny from the CEFAS Laboratory, Lowestoft, UK presented the results of recent work by the ICES Regional Ecosystem Group for the North Sea (REGNS). They conducted an integrated assessment of the North Sea Ecosystem using a total of 12 abiotic parameters amounting to 18 environmental variables (SCR Doc. 07/19). In addition a paper entitled "Investigating the effects of variation in surplus production, stock biomass, catch and climate on the Grand Bank yellowtail flounder population" by S. Walsh and E. B. Colbourne (SCR Doc. 07/43) was presented. In this paper a 38 year time series of biomass, surplus production and nominal catch of yellowtail flounder on the Grand Bank in NAFO Divisions 3LNO, for the period 1969-2006 and climate data were examined. Annual surplus production and annual average stock biomass were generated using a Schaefer surplus production model from the computer software program ASPIC commonly used by NAFO Scientific Council to assess stock trends and yields for the fishery. The relationships between surplus production, biomass and catch were explored. High surplus production often coincided with low biomass (and low surplus production at high biomass) as expected from the surplus production model assumption of density dependence responses. However, this trend was not always clear when a semi-independent estimate of surplus production was used in the analysis indicating the factors other then density dependence could be influencing the production indices. The effects of large-scale and regional-scale environmental variability on surplus production, stock biomass and nominal catches from the fishery using correlation and multiplicative regression analyses were also examined. The results suggest that biomass, but not surplus production, was influenced by the negative phase of the NAO which is associated with warm bottom temperatures on the Grand Bank. Both surplus production and stock biomass estimates of yellowtail flounder were strongly influenced by regional scale bottom temperatures on the Grand Bank suggesting that stock enhancement occurs during warm periods. Long term changes in stock biomass are often explained by changes in fishing mortality, but now there is evidence to suggest that in yellowtail flounder on the Grand Bank environmental effects could play a large contributing role. The strength of the temperature relation suggests that it should be incorporated into the logistic surplus production model used in the assessment of yellowtail flounder on an annual basis.

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

8. The Formulation of Recommendations Based on Environmental Conditions

STACFEN made no formal recommendations during this 2007 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.

9. National Representatives

The Committee was not informed of any changes in the national representative responsible for hydrographic data submissions. They are: E. Valdes (Cuba), S. Narayanan (Canada), E. Buch (Denmark), J.-C Mahé, (France), F. Nast (Germany), H. Okamura (Japan), H. Sagen (Norway), J. Janusz (Poland), J. Pissarra (Portugal), A. Viloria (Spain), B. F. Pristehepa (Russia), L. J. Rickards (United Kingdom), and K. J. Schnebele (USA).

10. Other Matters

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

11. Acknowledgements

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

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

Chair: Manfred Stein Rapporteur: Margaret A. Treble

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 9 and 19 June 2007, 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,), Japan, Russian Federation and United States of America. 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. The Committee was informed of a "Pre-STACPUB" meeting held on 6 June at the NAFO Secretariat to discuss the provisional agenda and plan of action. The agenda as presented in the Provisional Agenda was adopted. Margaret A. Treble (Canada) was appointed rapporteur.

2. Review of Recommendations in 2006

Recommendations from June

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

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

ii) STACPUB **recommended** to a*dopt the Creative Commons license for the Journal and Studies as proposed by the NAFO Secretariat.*

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

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

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

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

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

3. Review of Publications

a) Journal of Northwest Atlantic Fishery Science

STACPUB was informed that:

Several submissions received recently were data rich and concerned single stock issues. The Editors felt they were not suitable for publication in the Journal of Northwest Atlantic Fishery Science (JNAFS) and the General Editor asked the Committee for guidance concerning the type of papers best suited for JNAFS. The Committee agreed that the objective was to improve the quality of JNAFS and that there are other options for data rich papers such as the Scientific Council Research Documents (SCR). The Committee further noted that until now the SCR documents have only been available on the website for the most recent 3 years and that now they should now not be removed from the website.

STACPUB accepted a proposal by the General Editor to provide hard-bound copies of Symposium volumes to participants at cost.

A review of citations using SCOPUS showed that JNAFS were getting about 1-2 citations per paper per year. This compares to approximately 3 citations per paper per year for other top fisheries journals so we are improving in this regard.

An application was made on 15 May 2007 for JNAFS to be evaluated in the Thomson Web of Knowledge products. Success will provide JNAFS with an impact factor that is important to many publishing researchers. The selection process is extensive and thorough and will probably take over a year to complete. Back issues are not evaluated, and so it is very important to keep constantly uploading articles to the web and to adhere to the print publication deadlines proposed for Volumes 38 and 39 above.

All JNAFS volumes have now been posted to the web.

b) NAFO Scientific Council Studies

STACPUB was informed that:

It is intended to start an identification series (Number 40) to track any identification guides produced by NAFO. The first of these will be the wolfish, hake and rockling guide that was presented to STACPUB. This new issue for the Studies Series will be kept open for other items for a short time.

Studies No. 30–39 are presently available on the public NAFO website and past issues will be uploaded as time permits.

c) NAFO Statistical Bulletin

STACPUB was informed that:

Catch statistics by country, species and Division are available on the NAFO website for 1960-2006. This is the most up-to-date information available at the Secretariat and is updated as new information becomes available. No Statistical Bulletin has been published since the publication and circulation of Vol. 49 containing 1999 data in January 2002. Recent catches are currently referred to as provisional in STACFIS documents. In the past, catch statistics were considered no longer provisional once they were published in the Statistical Bulletin. This Bulletin is no longer published in paper copy, and has become an electronic publication only. Therefore, the guideline to consider when referring to data as provisional in Scientific Council reports should be based on whether Contracting Parties have submitted STATLANT 21A data with respect to a particular stock and year.

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.*

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.*

d) NAFO Scientific Council Reports

STACPUB was informed that:

A total of 90 printed copies and CDs of the NAFO Scientific Council Reports 2006 (Redbook) volume (311 pages) were produced in March 2007. The Redbook contained reports of the June, September, and November 2006 Scientific Council meetings, along with a list of NAFO publications relevant to the meetings and contact details for participants. This book was distributed to participants of Scientific Council meeting of June 2007.

The Committee reviewed a proposal from the Secretariat for format changes to the Scientific Council meeting reports. STACPUB accepted all but one proposal concerning the formatting of variables and abbreviations (SCS Doc. 07/18).

The Website publication of Reports of all Scientific Council Meetings held in 2006 was issued in January 2007. It differs from the print versions mentioned in above paragraph in that it contains navigation tools to access various sections of the reports of meetings that took place in 2006.

e) Index and Lists of Titles

STACPUB was informed that:

The provisional index and lists of titles of 83 research documents (SCR Docs) and 28 summary documents (SCS Docs) that were presented at the Scientific Council Meetings during 2006 were compiled and presented in SCS Doc. 07/5 for this June 2007 Meeting.

An electronic database containing a searchable index and list of titles will be made available in the near future.

4. NAFO Website

Web Statistics (with focus on JNAFS). There have been some issues with the web-server last year and changes had been made. Due to the shift in servers the web stats are incomplete. The NAFO websites are currently being hosted in the NAFO Secretariat. The stats will be updated for next June meeting.

5. Editorial Matters Regarding Scientific Publications

STACPUB discussed the term "Miscellaneous Papers" of JNAFS. It was generally felt that this formulation might have a negative meaning for the papers contained in such a JNAFS volume. STACPUB therefore **recommended** *not to use this classification of volumes in future, and instead discriminate between Symposium editions and editions of JNAFS.*

a) Review of Editorial Board

The Chair of STACPUB reported that a replacement for the bio-mathematics editor has not been found. The General Editor has not received any papers on this topic in recent years. There was only one manuscript during the past years dealing with bio-mathematics, STACPUB agreed to delete this position from the Board.

b) Progress Report of Publications of JNAFS Vol. 36

Two further articles were uploaded to the web and the hardcopy compilation of 10 articles printed in December 2006. One paper was rejected by the Associate Editor following negative reviews, and one paper was not accepted by the General Editor as the paper had been previously published in almost identical form in a technical report publication series.

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

Six further papers were published on the NAFO website since June 2006 and the hardcopy compilation was printed in April 2007. One paper was rejected earlier and one paper was withdrawn in April 2007. This volume took over 2½ years to complete due to various delays.

d) Progress Report of Publications of JNAFS Vol. 38

A total of 15 papers have been submitted for consideration for this volume. Three were submitted in 2004 and 2005 and all have recently been withdrawn by the authors. Four of the remaining 12 were rejected by the General Editor as being unsuitable for the journal. One was based on just a couple of observations and fell well short of the content required for a paper, and the remaining three were NAFO SCR documents that had been submitted without modification. The General Editor contacted the journal's Associate Editors to discuss these papers and then asked the authors to condense their findings into a single more ecologically-based paper for re-submission. Four papers are under review or revision and three have been accepted, of which one is available on the web and two are at the proof stage and should be uploaded soon. The planned print date for this volume is December 2007.

e) Progress Report of Publications of JNAFS Vol. 39, Symposium "Environmental and Ecosystem Histories in the Northwest Atlantic - What Influences Living Marine Resources?"

A total of 15 papers have been submitted, though unfortunately four of these have been rejected by symposium editors following negative reviews and two have been withdrawn by the authors. Six are under review or revision, two have been uploaded to the web, and one is at the proof stage. The planned print date for this volume is April 2008.

g) Progress Report of Publications of book by Michael P. Fahay

The two volume 1 696 page set entitled "Early Stages of Fishes in the Western North Atlantic Ocean (Davis Strait, Southern Greenland and Flemish Cap to Cape Hatteras)" by Michael P. Fahay was published in December 2006. Reviews have been, or are in the process of being, written for JNAFS, Bulletin of Marine Science. and Copeia. Seventy-five of the 200 copies printed have been sold to date.

h) General Discussion

STACPUB was informed that most journals are including a digital object identifier (doi) on their publications and NAFO is now doing this as well.

Until recently the DFO Huntsman Marine Lab was posting JNAFS abstracts to the ASFA Scientific Abstracts and Cambridge Scientific Instruments and that the NAFO Secretariat was now looking after this.

6. Papers for Possible Publication

STACPUB Chair reminded the Committee to review the research documents submitted to the June 2007 meeting.

STACPUB was informed that a research document from the June 2006 meeting concerning a Greenland halibut age determination workshop will be submitted for consideration for the Studies Series.

7. Other Matters

Closing. The Chair thanked the participants for their valuable contributions, the rapporteur for taking the minutes and the Secretariat for their support. The meeting was adjourned at 1500 hours on 19 June.

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

Chair: Konstantin Gorchinsky Rapporteur: Joanne Morgan

The Committee met at Alderney Landing, at 2 Ochterloney Street, Dartmouth, Nova Scotia, during 11-20 June 2007 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 11 June 2007. He welcomed all the participants, and thanked the Secretariat for providing support for the meeting. Joanne Morgan was appointed as rapporteur. The Chair pointed out some minor adjustments to the agenda, which was then adopted.

2. Review of Previous Recommendations

STACREC noted the difficulty of some contracting parties in meeting the deadline for submission of STATLANT data but recognized that the acquisition of 21A data in advance of the June meeting is very important to the work of the Scientific Council and **recommended** that *the deadline of May 1 for the acquisition of STATLANT 21A data be maintained but that the deadline for STATLANT 21B be changed to August 31*.

This recommendation was implemented.

Given the potential value of these VMS data to Scientific Council in assessing the status of stocks, STACREC **recommended** that *approval be sought from the Fisheries Commission for the Secretariat make catch and effort data (days at sea) from VMS available to Scientific Council.*

Approval has been received for the Secretariat to make VMS data available to Scientific Council in a summarized form.

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.*

This recommendation will be regularly implemented after each June Scientific Council meeting.

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

This has not been adopted by the Fisheries Commission for control. The issue has been discussed in STACTIC and they feel that there should be some more testing. Nevertheless this is still the mesh gauge recommended by Scientific Council for scientific use. Concerns about the cost of this gauge still exist.

3. Fishery Statistics

a) Progress report on Secretariat activities in 2006/2007

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

No problems were reported with the acquisition of STATLANT 21A data.

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 years submission of STATLANT 21A data and 21B data for the preceding year are 1 May and 31 August, respectively. Table 1 provides the current status of data submissions received so far by the Secretariat. No problems were reported with the acquisition of STATLANT 21A data.

Table 1. Dates of receipt of STATLANT 21A and 21B reports for 2004-2006 at the Secretariat to 20 June 2007.

	STATLANT 21A (deadline, 1 May)				STATLANT 21B (deadline, 31 August)		
Country/ Component	2004	2005	2006		2004	2005	2006
CAN-CA	-	18 Aug 06	5 Jul 06		18 Aug 06	23 May 07	
CAN-M	11 May 05	22 Jul 06					
- CAN-SF		13 Mar 07	22 May 07		26 Jun 06	22 Jul 06	
- CAN-G					06 Jul 06	13 Mar 07	
CAN-N	02 Jun 05	03 May 06			-	03 May 06	
CAN-Q	22 Dec 04	20 Dec 05	Dec 06		Sep 06	Sep 06	
CUB	-	-			-	-	
E/EST**	13 May 05	28 Apr 06	2 May 07		7 Jul 05	27 Jun 06	
E/DNK	6 May 05	9 May 06	15 May 07		6 May 05	9 May 06	15 May 07
E/FRA-M	-				-		
E/DEU	13 May 05	3 May 06	27 Apr 07		04 Jul 05	8 Sep 06	
E/NLD	No fishing	No fishing			No fishing	No fishing	
E/LVA**	13 May 05	24 April 06	24 Apr 07		13 May 05	24 Apr 06	
E/LTU**	9 May 05	30 May 06	27 Apr 07		-	6 Jun 07	
E/POL**	16 Feb 05	15 May 06	28 Feb 07		1 Mar 05	31 May 06	28 Feb 07
E/PRT	7 Jun 05	30 Aug 06	2 May 07		19 Aug 05	10 Aug 06	
E/ESP	31 May 05				01 Jun 05	30 May 06	
E/GBR	No fishing	No fishing			No fishing	No fishing	
FRO	6 Sep 05	16 Jun 06			6 Sep 05	26 Jun 06	
GRL	1 Sep 05				1 Sep 05		
ISL	16 May 05	15 May 06	31 May 07		15 Jun 05	29 May 06	31 May 07
JPN	13 May 05	8 May 06	13 Jun 07		27 Jun 05	23 Jun 06	
KOR	-				-		
NOR	11 May 06	11 May 06	2 May 07		4 Jul 05	1 Jul 06	
RUS	6 Jun 05	16 May 06[1]	26 Apr 07		5 Jul 05	21 Aug 06	
USA	22 Jun 06	16 Jun 06			-		
FRA-SP	12 May 05	30 May 06	21 Feb 07		-	21 Feb 07	
UKR	17 May 05		13 Apr 07		27 May 05		13 Apr 07

* Note Bulgaria has not reported in recent years but records indicate there was no fishing.
** Accession to the European Union (EU) 1 January 2005.
[1] Received 21B corrected 22 Aug 06

The Secretariat produced a compilation of the countries that have submitted to STATLANT along with data entry dates and historical catches to be a record of the catches available to this meeting (SCS Doc. 07/16). This will be useful in checking historic catches and in determining if zero catch from a country represents no catch or no submission.

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) last year. 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) 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 will investigate the following options and report back to STACREC at its June 2008 meeting.

1. To avoid looking for substitute codes and lessening the quality if the data, it is suggested that the Secretariat enters the submitted species and can hence extend the species list and numeric codes as required. If required, the Secretariat can acquire retrospective approval from SC to add such codes to the NAFO numeric species code list.

2. Consideration should be given to dropping the numeric codes for species and using the appropriate alpha codes provided by FAO (CWP). It is suggested that the Secretariat contacts the statistical submitting agencies to investigate the practicality of this.

3. To facilitate data input, consideration should also be given to having separate "country" codes for Canada-Scotia Fundy and Canada–Gulf and dropping the Canada-Maritime code, as data is submitted separately by these two regions.

4. What do we do with the species codes on the (electronic) forms? Options:

- No list given;
- Mainly commercial species listed (as happens now);
- Full list of all species previously caught (as FISHSTAT NS1);
- Full list of species occurring in the NAFO Convention Area.

b) Report of the Coordinating Working Party on Fishery Statistics (CWP)

Twenty-seven representatives from 14 organizations participated at the 22nd session of the CWP meeting held in Rome, Italy on 26 February -2 March 2007, which was chaired by Johanne Fischer (NAFO Secretariat). CWP discussed a number of matters relevant to global fishery statistics (and to the UN recommendations to this regard), such as the current inability in most cases to separate between catches taken in EEZs and the high seas, the necessity to improve data collections on incidental catches, data requirements for ecosystem management, etc. Currently, CWP is receiving much attention and was again requested to address the FAO Committee on Fisheries on 5 March 2007 and highlight important conclusions of the meeting for FAO members to discuss.

Some important topics were the following:

- Difference in reporting agencies is quite a complex issue as there are countries in which different institutions are in charge of reporting capture data to FAO and NAFO. A possible solution may be that data submitted to NAFO, at least those for the principal species, be considered as the valid ones for all countries. To make this operational, NAFO should provide FAO with a compilation of annual capture data as soon as they are ready and should also request representatives of its Contracting Parties to inform, in the case of differences, the relevant authorities of their country that FAO will replace the statistics for Area 21 received by its national correspondent with those provided by NAFO. CWP welcomed the initiative taken by NAFO and FAO as a step in the right direction and encouraged other organizations to also undertake efforts to consolidate their data with those of FAO. However, it was cautioned that the solution found by NAFO and FAO might not always be the right solution in other cases as the causes for data differences are quite diverse and require individual consideration.

- FAO was asked to consolidate regional bodies catch data into one database under general guidance of the CWP;

- CWP highlighted the importance of exploring the utilization of VMS data for scientific and statistical purposes, in addition to their uses in Monitoring, Control and Surveillance. The development of the North Atlantic Format was reviewed in this context;

- CWP welcomed an initiative by ICES and Eurostat to modify (subdivide) statistical areas of the Northeast Atlantic (ICES, Eurostat) to allow a distinction between catches within EEZ and those in international waters for statistical purposes.

- CWP was informed that in addition to CCAMLR, now many tuna commissions have started to implement trade documentation schemes to help combat IUU.

CWP decided to have an intersessional meeting in June or July 2008, hosted by NAFO in Dartmouth, NS, Canada. For this meeting, a focus on "New Data Requirements and New Data Sources" was chosen with the intention to address VMS data and data requirements of an Ecosystem Approach including incidental-catch data collection, socio-economic information, and data in relation to area closure, and consolidation of global records.

There was some discussion of the views of the CWP on the use of VMS data for purposes other than enforcement. The Executive Secretary reported that the CWP is of the opinion that VMS is an important data source for stock assessments. However, standardization of data collection format (such as the North Atlantic Format) would be helpful. This format has been presented to Scientific Council previously for input on the type of data that should be collected. Such input would still be useful.

c) Data consistency

Data discrepancies between the NAFO and the FAO catch data have been addressed by NAFO, FAO and EUROSTAT in the mid-1990s and many historical discrepancies between different databases could be then eliminated. The group, however, concluded that some of the discrepancies could not be removed due to two main reasons; a) difference in sources of data provision (e.g. the Canadian federal agency informs FAO whereas regional branches of the federal agency inform NAFO), and b) difference in timing of data provision including availability of regular revising/updating mechanism for previously reported data.

In 2006, the issue of data inconsistencies was revisited. The difference in timing of data provision between NAFO and FAO has meanwhile been eliminated by NAFO moving its deadline for the submission of 21B data to 31 August. Other sources of data inconsistencies were not as easy to remove. Therefore, the NAFO Secretariat and FAO concurred that the more comprehensive data from NAFO should supersede the FAO data in case of discrepancies provided that:

(a) the NAFO Contracting Parties that also report to FAO agree to this proposal, and

(b) this scheme is applied for a defined list of species only (those reliably reported to NAFO).

The NAFO-FAO initiative was endorsed by CWP in February 2007 as a step in the right direction and CWP encouraged other organizations to also undertake efforts to consolidate their data with those of FAO.

The proposed scheme will not change the reporting requirements of NAFO Contracting Parties to NAFO or to FAO in any way. However, NAFO Contracting Parties have to agree that the data they submit to FAO could be replaced by data they submit to NAFO.

Concern was expressed about the amount of time that would be required of the Secretariat to complete this data consistency exercise. STACREC noted that the best course of action would be to standardize the forms that are used to collect data in the various areas. STACREC also raised some concern about the ability to determine which data are the most complete for any particular year/species.

4. Research Activities

a) Biological Sampling

i) *Report on Activities in 2006/2007*

STACREC reviewed the list of Biological Sampling Data for 2006 (SCS Doc. 07/10) 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 2007 Meeting. Currently the document only includes information from Russia, EU-Spain, and EU-Portugal. Canada and Denmark (with respect to Greenland) reported that it would submit a list soon.

ii) *Report by National Representatives on Commercial Sampling Conducted*

Canada-Newfoundland (SCS Doc. 07/12): 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 07/9): Data on catch rates and length composition were obtained from trawl catches for Greenland halibut (Div. 3LMNO). Data on length composition of the catch were obtained for cod (Div.3MNO), redfish (Div. 3LMNO), American plaice (Div. 3LMNO), yellowtail flounder (Div. 3NO), roughhead grenadier (Div. 3LM), witch flounder (Div. 3LMNO), white hake (Div. 3NO), thorny skate (Div.3LMNO), spinytail skate (Div. 3LMNO) and monkfish (Div. 3NO).

EU-Spain (SCS Doc. 07/08): All effort and catch information of the 2006 Spanish Research Report are based on information from NAFO observers on board with a coverage of the 98% of the total effort. All length, age and biological information presented were based on sampling carried out by IEO scientific observers with a 12% of coverage of the Spanish total effort: in 2006, more than 400 samples were taken, with more the 74 000 individuals of different species examined.

Subareas 1 and 2: A total of 11 Spanish pelagic trawlers operated in NAFO Subarea 1 and 2 (Div. 1F and 2J) during 2006. Catches in Div. 1F and 2J were 3186 tons of pelagic redfish (*Sebastes mentella*).

Subarea 3: The Spanish fishery in NAFO Div. 3LMNO is mainly directed to Greenland halibut (mainly in Div. 3LM), alternating with the skate fishery in the second half of the year (Div. 3NO), shrimp fishery (Div. 3LM), and other species (Div. 3NO).

A total of 23 Spanish trawlers operated in NAFO Regulatory Area, Div. 3LMNO, during 2006, amounting to 2 557 days (44 044 hours) of fishing effort.

Data on catch, length and age composition of the trawl catches were obtained for Greenland halibut and roughhead grenadier. Data on length composition of the trawl catches were obtained for cod, yellowtail flounder, witch flounder, American plaice, skates and redfish.

Subarea 6: One Spanish trawler operated in January 2006 in NAFO Subarea 6, Division 6G, amounting to 6 days of fishing effort. The most important species in the catches were *Aphanopus carbo* and *Beryx* spp. in this order.

Denmark/Greenland (SCR Doc. 07/44): Length and age frequencies and CPUE data were available from the Greenland trawl fishery in Div. 1A and 1D.

EU-Estonia: Data on length, sex and age structure of trawl catches were collected for Greenland halibut (Div. 3LN) and redfish (Div. 3M). Also, some data on length, sex and age were collected for yellowtail flounder (Div. 3N, bycatch in skate fisheries). For shrimp, length and sex data were obtained from Div. 3LM. Length data of fishes discarded in shrimp fishery (Div. 3LM) were also collected.

EU-Germany (SCS Doc 07/11): Subarea 1 - In 2006, demersal fishing was conducted with low effort in Division 1D inside the Greenland EEZ from September until November. The fishery was directed towards Greenland halibut (*Reinhardtius hippoglossoides*). By end of the year, reported landings amounted to 544 tons of Greenland halibut. There was negligible by-catch of roundnose grenadiers of 2.2 tons compared to 4 tons in 2005, wolffish and skates reported (less than 1 ton).

While the demersal fishery for Greenland halibut is a normal activity, the pelagic fishery for pelagic redfish (*Sebastes mentella*) occurred for the first time off Southwest Greenland in 1999 and increased substantially in 2000 due to a change in distribution patterns of the stock in westerly direction as derived from a biennial international hydro-acoustic surveys conducted in June/July 2001-2005 by Iceland, Russia and Germany. 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 with 2000 when total landings of 4 476 tons were reported, both landings and effort decreased substantially after 2003, when 2 536 tons were caught. In 2004 and 2005, catches declined to 1000 tons and to 794 tons, respectively, when CPUE reached a record low.

In 2006, catch and CPUE increased little to 990 tons and 937 kg/h (Greenland EEZ) and 468 kg/h (NRA). Information on effort, landings, and non-standardised pelagic redfish CPUE by area, year and quarter were presented.

Subarea 2 - In 2006, one catch of 4 tons redfish was recorded for Div. 2 H.

EU-Latvia: Latvian fishery in NAFO area in 2006 was conducted by 2 vessels, mainly by bottom trawl. Catches: redfish in Div. 3 M – 250 tons and in SA 1 – 342 tons, northern prawn in Div. 3 M – 120 tons and in Div. 3 L – 244 tons, Greenland halibut in Div. 3 LMNO – 18 tons.

All Latvian length/weight sampling of catches and discards by species in 2006 from bottom trawl catches for northern prawn in the Div. 3 M was carried out by NAFO/scientific observers.

Total number of samples taken – 72 and individuals examined - 6248 (2900 of northern prawn, 2536 of redfish and remaining – other species).

EU-Lithuania: Lithuanian vessel(s) commonly target redfish in Divisions 1F, 2J, 3M and Northern shrimp in Divisions 3LM. Other species are taken as a bycatch during these fisheries. In 2006 biological sampling only for shrimps from directed bottom trawl shrimp fishery was conducted. Overall, 83 samples from shrimp catches were taken and 8 278 individuals were measured.

Russia (SCS Doc. 07/6): In 2006 Russian fishing vessels operated in Subareas 1, 2 and 3. The fishery was mainly directed on Greenland halibut in Div. 1ABCD, 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 invited by the Chair to report any problems with data availability. No problems were reported. Designated Experts were reminded to provide available data from commercial fisheries to the Secretariat.

NAFO/ICES *Pandalus* Assessment Group (NIPAG) reported that there was an issue with misreporting of shrimp and the Fisheries Commission has recommended implemented changes to the reporting of shrimp to reduce this problem (CEM 2007 Article 19.1; FC Doc. 06/12).

Prior to the June 2006 Scientific Council meeting, there was a working group to discuss catch information and catch estimates were finalized prior to the start of the meeting. Such a process could be implemented for the shrimp assessments and allow Designated Experts to discuss issues such as this prior to the meeting.

b) Biological Surveys

i) *Review of Survey Activities in 2006*

Canada (SCS Doc. 07/12, SCR Doc. 07/18): Two stratified-random otter trawl surveys were conducted by Canada (C&A) with the Greenland Institute of Natural Resources research vessel Pâmiut in southern Division 0A (Baffin Bay) in 2006. The first was conducted with a cosmos shrimp trawl in shallow water (100 m to 800 m) from August 26 to September 5 and all 75 stations were successfully completed with an additional 13 experimental stations added during the trip. The second survey was the fourth in a series begun in 1999. An Alfredo III bottom trawl was used to survey deep water strata (400 m to 1500 m) from October 27 to November 7 and 62 of 75 planned stations were successfully completed. Additional detail on methods and results for the deepwater survey are available in SCR Doc. 07/41. 2006 was year 2 of NAFO Div. 0B survey conducted by the Northern Shrimp Research Foundation in partnership with DFO. The original Div. 0B study area however was changed to provide better scientific advice on management issues in the area. The standard trawl survey will produce abundance and biomass indices of shrimp in this division. Oceanographic information collected during these surveys was discussed in STACFEN. Information about other biological studies on marine mammals (bowhead whales, beluga and narwhal) was presented.

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 2006 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 246 tows, (195 in Div. 3LNO) with the Campelen 1800 trawl, by the research vessels *Wilfred Templeman* and *Alfred Needler*. Survey coverage in Div. 3P and 3NO was severely limited. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to January, and consisted of 704 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 2006, directed at various species using a variety of designs and fishing gears, are described in detail in SCS Doc. 07/12 and in other documents. Oceanographic surveys were discussed in detail in STACFEN.

EU-Spain: Subarea 3 - The Spanish bottom trawl survey in NAFO Regulatory area Div. 3NO was conducted in June 2006 on board R/V *Vizconde de Eza* using Campelen gear with a stratified design. A total of 120 valid hauls were carried out up to a depth of 1 450 m. The results of the Spanish Div. 3NO bottom trawl survey for all the period studied (1995-2006), 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 (SCR Doc. 07/35, 36 and 37).

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 witch flounder) studies were taken.

Ninety-two hydrographic profile samplings were made in a depth range of 44 – 1 393 m.

In 2003 it was decided to extend the Spanish 3NO survey toward Div. 3L (Flemish Pass), and 39 and 50 valid hauls were carried out in 2003 and 2004 respectively. In 2006 a total of 100 valid hauls were made by the R/V *Vizconde de Eza*, covering 24 strata of the Flemish Pass area in Div. 3L, using a Campelen survey gear up to 1451 meters depth, and following the same procedure as in previous years. The results of this extension will be present in the future.

Survey results for Div. 3LNO of the northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 06/69.

EU-Spain and Portugal: A stratified random bottom trawl survey on Flemish Cap was carried out from June 28th to July 27th 2006. The area surveyed was extended up to depths of 800 fathoms (1400 m) following the same procedures as in previous years and increasing the number of hauls planned (195). The survey was carried out by the R/V *Vizconde de Eza* with the usual survey gear (Lofoten). A total of 179 valid hauls were made by the vessel R/V *Vizconde de Eza*, 115 up to 730 m depth and 64 up to 1 400 m. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, Greenland halibut and Shrimp are presented to the in SCR Doc. 07/10 and 07/25. The general indexes for this year are estimated taken into account the traditional swept area (strata 1-19, up to depths of 730 m.) and the total area surveyed (strata 1-34, up to depths of 1 400 m.).

Denmark/Greenland: The West Greenland standard oceanographic stations were surveyed in 2006 as in previous years. Further, a number of oceanographic stations were taken in three different fjord system at Southwest Greenland (SCR Doc. 07/01).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2006. In July-August 244 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. 07/28).

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 2006 61 valid hauls were made (SCR Doc. 07/29).

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 (See interim monitoring report on Greenland halibut inshore in Div. 1A).

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2006 a total of 44 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) (See interim monitoring report on Greenland halibut inshore in Div. 1A).

EU-Germany (SCR Doc. 07/17): During the fourth quarter of 2006, stratified random surveys covered shelf areas and the continental slope off West Greenland (Div. 1B-1F) outside the 3-mile limit to the 400 m isobath. In October-November 2006, 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 (*Amblyraja radiata*) are documented.

ii) *Surveys Planned for 2007 and Early 2008*

An inventory of biological surveys planned for 2007 and early 2008, 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 2007 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 *Designated Experts be reminded by the Secretariat following each June Scientific Council meeting to fill in the assessment data spreadsheets.*

During the discussion it was suggested that the information that comes into the Secretariat is varied and that not everyone may know its full extent and may be missing some useful information. The Secretariat will produce a document detailing the sources and types of information so that Scientific Council will be aware of all sources of information available.

d) Selectivity Studies

Russia (SCR Doc. 07/32): On minimal trawl codend mesh size in redfish fishery in Div. 3O of NAFO Regulatory Area. Russia presented the results from research conducted in Div. 3O of the NAFO Regulatory Area in August-October 2006, on selectivity by the codends with 90-130 mm mesh size used for redfish in the bottom trawl fishery. Redfish of the two species, *S. fasciatus* (85%) and *S. mentella* (15 %) were fished. In the catches, the ratio of those species was the same, prevailing were *S. fasciatus*. The largest girth of redfish from both species, with the same length, did not differ statistically. In the fishery of redfish by bottom trawls rigged with 90-130 mm mesh size codends, the bycatch of each regulated species did not exceed 3%.

Given were the calculations of possible yield per recruit in the fishery by bottom trawls with 90-130 mm mesh size, with and without allowance for traumatic mortality of redfish escaped from the codend during the lifting of trawl to the surface. Without allowance for such traumatic mortality, with fishing mortality of 0-0.3, when selectivity of mesh varies from 130 to 121 and 86 mm, the average yield per recruit will be 0.96 and 0.66 from the catch by 130 mm mesh size codend, respectively. With allowing for traumatic mortality of redfish due to barotraumas of fish escaped from the codend during the lifting, with the same conditions of calculations, the average yield per recruit will increase in 1.3 times for 121 mm mesh size and in 7.8 times for 86 mm mesh size. The results of calculations are suitable for estimation of yield per recruit during the fishing by midwater trawls with the same mesh size in codends.

A positive long-term effect for midwater trawl redfish fishery in Div. 3O had been predicted when reducing the mesh size to 90-100 mm (SCR Doc.05/18).

There was some concern expressed by STACREC that the inclusion of traumatic mortality as an effect additive to natural mortality in yield per recruit calculations might overestimate its impact on yield.

This study was presented in response to item 8 in the Fisheries Commission request to Scientific Council and the results should be considered by Scientific Council when addressing this request.

e) Consideration of a Revisited Edition of the Manual of Groundfish Surveys

At the last June 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 with Steve Walsh (Canada) as Chair. There was some correspondence between WG members on a template for the sections of the manual and one was agreed on. As a first step it was decided to fill in the template using the Canadian surveys as an example but this is not complete but should be finished by September. The Chair of the WG intends to retire later this year and it was decided that Bill Brodie (Canada) should take over the chair of this group at that time. It will likely be early 2008 before this manual will be finished. Therefore, STACREC decided to designate Bill Brodie as the new chair and ask the WG to try to have the manual completed by the June 2008 meeting.

5. FAO Cooperation

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

FIRMS now has 11 Partners (CCAMLR, CCSBT, EUROSTAT, FAO, IATTC, ICCAT, ICES, NAFO, SEAFDEC, GFCM and NEAFC) who were all present at the 4th session held in Rome, Italy on 26 February – 2 March 2007. The meeting was chaired by Victor Restrepo (ICCAT). The group was informed about the contributions to FIRMS by the 3 new members (SEAFO, GCFM, and NEAFC). Also, the FIRMS stock status descriptions for search purposes were discussed with the result that the categories for exploitation rate status and stock abundance status will be used as proposed in FSC3 (and supported by Scientific Council) with one exception: the stock abundance category ‘virgin or high abundance’ will be changed into ‘pre-exploitation biomass or high abundance’. Otherwise, participants reviewed the FIRMS webpage and suggested a number of improvements that will be implemented by the FIRMS Secretariat (FAO) over the next year. It was decided to call a meeting of the FIRMS Technical Working Group later in 2007, particularly for CMS (Content Management System) training for Partners as well as for validation of the fisheries module and its related data model. The new Chair is Johanne Fischer (NAFO Secretariat).

b) ICES–FAO Working Group on Fishing Technology and Fish Behaviour Group

A sub-group of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour Group (WGFTFB) continued to work by correspondence through 2006/2007 and at the Working Group meeting in Dublin in April 2007 on updating the 1971 FAO Technical Report 222 on Gear Classification that is used worldwide today including NAFO. This is the second meeting of the sub-group. The 13 member group representing 12 countries produced a second but not final draft form of new gear descriptions and gear classification codes, which have been modified to include gear designs that have evolved since the publication of original document e.g. twin and multiple trawls. The group has completed text for approximately 80% of the gear categories and concluded that it needs to continue work for a further year. A timetable for the production of a draft was reviewed and the final draft will be presented at the ICES-FAO WGFTFB during its annual meeting in 2008 for approval. FAO Secretariat will publish the new gear classification document as a joint FAO-ICES report in all FAO languages.

Reference: ANON 2007. Report of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). *ICES CM* 2007/FTC:06, 197p

STACREC noted that there will be some confusion with older data caused when the classification is updated.

STACREC noted that some gears are used in other than there intended use (*ie*. Fishing bottom trawls without actually touching the bottom). The committee was informed that in this case in the proposed new classification the trawl should be classed as a midwater trawl.

STACREC noted that Steve Walsh will be unable to represent NAFO in the future at this WG and STACREC thanked him for all his work on NAFO's behalf at this group.

6. Review of SCR and SCS Documents

SCR Doc. 07/3. V. A. Rikhter. On the Dynamics and Prospects of Some Commercial Fish Stocks Recovery in NAFO Area (the Northwestern Atlantic Ocean).

A qualitative analysis of stock-recruitment relationships (SRR) in cod (*Gadus morhua*) in Div. 2J+3KL, 3NO and American plaice (*Hippoglossoides platessoides*) in Div. 3LNO and 3M was performed. Main similar features of the stocks, which allowed to combine the stocks into the same group for analysis are the following: the decrease of the spawning stock biomass (SSB) in the early 90's to extremely low levels, the absence of any indications of the stock recovery and a positive correlation between recruitment and spawning stock biomass. It was assumed that there was a spawning stock biomass threshold (Bcoll) in every of the above populations which indicated a boundary of a collapse zone. During last period of time and up to now SSBs of the four discussed stocks remained in this zone. General reasons which have led these stocks to depression were investigated. It was assumed that this was caused by united influence of unfavorable environmental conditions, density dependence effects and fishery. It was noted that because of no evidences of improvement in the status of the discussed cod and American place stocks have been observed for a long time, a probability of their natural recovery seemed to be minimal. Possible measures which could initiate a process of recovery for the above mentioned stocks were discussed in brief.

SCR Doc. 07/18. W. Brodie and D. Stansbury A brief description of Canadian multispecies surveys in SA2+Divisions 3KLMNO from 1995-2006.

Stratified random multispecies trawl surveys have been conducted by the Department of Fisheries and Oceans in the Newfoundland and Labrador Region annually in spring since 1971, and in autumn since 1977. Spring surveys cover NAFO Div. 3L, 3N, 3O, and 3P. Since 1990 the autumn surveys have covered the offshore areas of NAFO Div. 2J, 3K, 3L, 3N, and 3O. During 1995, the Campelen 1800 shrimp trawl was adopted as the standard survey gear, and coverage was extended to include the inshore areas of Div. 3K and 3L, parts of Div. 3M, Div. 2GH, and areas deeper than 1 000 m.

Some changes, planned and unplanned, have occurred to both survey series since 1995. Many of these unplanned changes have occurred because vessel breakdowns have not allowed full or timely completion of the entire survey area. The main problems with the 2004-06 autumn surveys were the complete absence of survey sets deeper than 731 m in Div. 3LMNO, the lack of coverage in several other strata in Div. 3L, the reduction in coverage in some strata in Div. 3K, and the extension of the timing into January in 2005 and 2006. The approximately 650 sets completed in 2004 and 2005 surveys were the lowest numbers since the 1995 survey, although the number of sets in 2006 improved to 704. Coverage in the spring survey series has generally been more consistent, although the 2006 survey had minimal coverage in Div. 3NO, and at a later time than usual.

There are at least three sources of uncertainty resulting from the problems encountered during the surveys of recent years: gaps in coverage (missed strata, reduced numbers of sets); changes in timing (survey coverage extended later, coverage of some strata/Divisions often spread out over a much longer period than planned); and vessel effects (few direct comparisons of the 3 vessels used, using vessels in areas where they have little or no coverage in previous years).

Careful attention to survey gear and fishing protocols, along with set-by-set monitoring with trawl sensors ensures minimal variability during tows. However, the problems with survey coverage and timing have introduced a further degree of uncertainty into the survey estimates, and therefore stock assessment advice, for many species.

STACREC discussed the problems with coverage of the survey and noted that for roughhead grenadier in SA 2+3 and Greenland halibut in SA2+ Div. 3KLMNO, only the Div. 2J3K portion of the survey is useful as an index. The use of a multiplicative model to fill in missing strata is not considered appropriate since such large areas were not covered in the surveys.

Canadian surveys are an extremely important source of information for Scientific Council. STACREC expressed serious concern with the ongoing difficulties with timing and coverage of the Canadian spring and autumn research vessel surveys in recent years. This greatly diminishes the quantity and quality of the data which forms the basis of a large number of stock assessments. This decreases the quality of the scientific advice that can be provided. It would be useful to consider some coordination between the EU survey conducted in the Regulatory Area and the spring survey conducted by Canada.

7. Other Matters

a) Tagging Activities

Information on tagging activities in the Northwest Atlantic will be published by the Secretariat in SCS Doc. 07/4. Participants were reminded to submit any information on tagging activities to the Secretariat for the completion of this document.

b) Research Activities

VMS: There was some discussion of the usefulness of these data to Scientific Council. Information on changes in the fishing pattern of the fleet derived from this could be very useful. This issue will be addressed further in Scientific Council.

Canada (SCS Doc. 07/12): In 2005, Canada announced an initiative, part of which will focus on scientific research to increase knowledge of marine ecosystems, sensitive marine areas and species, and straddling and highly migratory fish stocks.

The program is primarily focused on Sustainable Fisheries Technologies and Practices and Research on Sensitive Areas and Species. The following table gives a list of the projects and the researchers involved.

List of International Governance Projects	
Project Leader(s)	Title
K. Gilkinson D. Hamoutene G. Veinott	The ecology of deep-sea corals of Newfoundland and Labrador waters: biogeography, life history, biogeochemistry, and role as critical habitat
N. Cadigan J. Morgan	Accounting for mis-reported catches in stock assessment models
J. Banoub	Improving our knowledge of the reproductive potential of Greenland halibut
D. Kulka	Ecology and life history of the skate complex (Rajidae) in the Northwest Atlantic
B. Dempson	Use of stable isotopes to assess long term changes in trophic ecology of Atlantic salmon (*Salmo salar*)
P. Pepin	To assess the roles of onshore transport and on-shelf production to annual cycle of *Calanus* spp. on the Newfoundland Shelf and Grand Banks
P. Shelton	Developing precautionary harvesting strategies for high seas straddling stocks
K. Dwyer S. Walsh	Improving the accuracy of stock assessment and the precautionary approach framework for grand bank yellowtail flounder using age-based analysis
D. Power	Temporal verification of stock structure and identification of strong year classes by species to investigate recruitment synchronization in Redfish based on genetic analysis of archived otoliths
J. Carscadden M. Koen-Alonso E. Colbourne G. Lilly P. Pepin	Comparison of Marine Ecosystems (NORCAN and ESSAS)
J. Payne J. Lawson	Effect of seismic energy on selected marine species of commercial importance or identified as Species at Risk
F. Mowbray J. Carscadden E. Hynick K. Gilkinson	Forage fish on the Southeast Shoal, an ecologically and geo-politically sensitive area of the Grand Banks
G. Stenson	Habitat use by hooded seal (*Cystophora cristata*) in the Northwest Atlantic
J. Lawson	Aerial survey of marine megafauna on the Continental Shelf from Baffin Island to the Scotian Shelf

USA (SCS Doc. 07/07): 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 33 000 age determinations for nine species of finfish were completed in 2006 by Woods Hole Laboratory staff in support of resource assessment analyses. In addition to Atlantic cod (7 824), haddock (5 671), and yellowtail flounder (6 204), 6 862 summer flounder and 2 459 scup were aged. Age determinations for Atlantic herring, pollock, goosefish, and white hake totaled 3 804. 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 highly migratory species, particularly large Atlantic sharks.

Population dynamics research conducted within the 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. NEFSC researchers have been collaborating with other NOAA fisheries scientists to develop a standardized suite of methods collected into a software toolbox. The NOAA Fisheries Toolbox (NFT) incorporates classical methods such as ADAPT -VPA, reference point estimation, surplus production and forward-projection methods into a stable environment with tested software products. A total of 14 packages are now included in the toolbox. The complete package may be accessed at http://nft.nefsc.noaa.gov (username: nft, password: nifty).

c) Efficiency of Shrimp Trawls

(NIPAG Report 2006, Item 4)

During the NIPAG assessments in 2006 there was a discussion of the use of double trawls in the shrimp fishery and how best to represent the effort of these trials. They may not exert twice the effort as a single trawl. STACREC noted the importance of this issue and encouraged Contracting Parties to study the efficiency of twin shrimp trawls. STACREC noted that for bottom trawls one factor in standardizing effort is to count the number of meshes in the circumference of the trawl opening. 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.*

d) International Mechanism of Scientific Expertise on Biodiversity (IMoSEB)

The meeting of the Consultative Process towards International Mechanism of Scientific Expertise on Biodiversity (IMoSEB), held in Montreal on 30-31, January 2007, was called to establish the need for a 'new group' to promote improved decision-making abilities of decision makers in order to halt and reverse the observed decline in biodiversity. It was attended mainly by senior natural scientists under the premise that their recommendations are not effectively influencing decision-makers, and that there is a perceived problem in communication at the science-policy interface. The meeting was also attended by Johanne Fischer and Anthony Thompson from the NAFO Secretariat.

The meeting itself tried to identify needs and provide options for establishing IMoSEB. The topics discussed drifted between the need for more science and science funding, the need for multi-stake holder involvement to operate at the science-policy interface, and comments as to the ineffectiveness of existing established bodies and mechanisms. There was little clear agreement at the end of the meeting on the need to establish an IMoSEB group.

Organizations managing exploitation of living resources, say, fisheries, forestry, and often agriculture, have been a little slow in adopting many of the biodiversity conservation initiatives. However, this is now changing in response to increased awareness by many of the stake-holders involved. It was also felt that increased public support would help to provide a degree of accountability to many of the decisions that seemed to focus on the short-term gains rather than the long-term losses.

The main benefit of the meeting, with respect to NAFO, is that it very quickly and efficiently gave NAFO an understanding of the main actors in the biodiversity arena. The following were perhaps the most important groups mentioned:

The Convention on Biodiversity (CBD) (http://www.biodiv.org) programme was established by UNEP out of the CBD signed at the 1992 Earth Summit in Rio de Janeiro. The programme is coordinated by a Secretariat in Montreal. Currently, 187 countries have ratified the CBD. The main bodies mentioned at the meeting were the the Conference of the Parties (CPD) and its intergovernmental subsidiary scientific advisory body known as the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA). CRD's 2010 Biodiversity Target is outlined in their Global Biodiversity Outlook 2 report (http://www.biodiv.org/GBO2/).

The Millennium Ecosystem Assessment (MA) (http://www.maweb.org) was a project undertaken mainly from 2001-2005 following a UN initiative in 2000. A set of published recommendations appeared in 2005 and are seen to be central in the understanding biodiversity conservation.

Intergovernmental Panel on Climate Change (IPCC) (http://www.ipcc.ch/) was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). IPCC is an independent scientific body assessing all aspects of climate change and in some ways was seen to be a possible model for IMoSEB.

The World Conservation Union (IUCN) consists of 82 States, 111 government agencies, more than 800 non-governmental organizations (NGOs), and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership. The membership is wide and it operates largely in an intergovernmental capacity supporting decision-makes and funding projects.

e) Other Business

i) *Distribution of Species Identification Guide*

STACREC was informed that a species identification guide for wolfish, hake and rockling has been produced, and was asked for suggestions for means of distribution. It was suggested that it could be bundled with package sent to NAFO observers and given to NAFO inspectors to give to fishing captains. STACREC members were encouraged to forward any other ideas on distribution of this guide to the Secretariat.

ii) *Presentation of Survey Indices in Council Reports*

In 2002 STACFIS made a recommendation that survey indices be presented as means per tow. For some stocks abundance and biomass estimates are more appropriate if survey coverage changes. Therefore, STACREC **recommended** that *survey indices be presented in the most appropriate form for each stock, rather than in a standard manner for all stocks.*

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 2007 STACREC Meeting.

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

Chair: Don Power Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 7-21 June 2007, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain fish stocks. Representatives attended from Canada, Denmark (in respect of Greenland and the Faroe Islands), European Union (Estonia, France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Russian Federation, and the United States of America. Various scientists, notably the designated stock experts, were significant in the preparation of the report considered by the Committee.

The Chair, Don Power (Canada), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The provisional agenda was adopted.

II. GENERAL REVIEW

1. Review of Recommendations in 2005 and 2006

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 catch estimates were available prior to the meeting and reviewed via correspondence prior to the meeting by the ad hoc working group. Differences in catch estimates were resolved for all stocks with minimum difficulty.

STACFIS agreed that for all stocks, survey indices should be subject to quality validation, prior to inclusion into any population model and, accordingly, STACFIS **recommended** that *candidate indices for inclusion in population models should be subject to analyses of their ability to indicate trends in population size and that, suggestions for appropriate analyses be presented and evaluated at the June 2007 meeting.*

STATUS: The stock assessments of Greenland halibut in Subarea 2 and Divisions 3KLMNO, and American plaice in Divisions 3LNO both incorporated presentations generated by FLEDA, an exploratory data analysis package within the FLR (www.flr-project.org; Kell *et al*., 2007). The FLEDA package is aimed at data screening, inspection of data consistency (within and between data series) and extracting signals from the basic data.

Reference:

Kell, L. T., Mosqueira, I., Grosjean, P., Fromentin, J.-M., Garcia, D., Hillary, R., Jardin, E. et al. 2007. FLR: an open-sorce framework for the evaluation and development of management strategies. *ICES Journal of Marine Sceince*, **64**: 640-646.

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

STACFIS **recommended** that *the investigations of the bycatch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued and the results should be made available before the assessment in 2007.*

STATUS: Greenland Institute of Natural Resources is currently sampling the bycatch of, among others, Greenland halibut in the Greenland shrimp fishery and the results will be reported to NAFO in the near future.

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

STATUS: There was a change in the technician responsible for age determination in SA0 in 1996 and the ages produced for 1996-1999 were contradictory to previous ages (SCR Doc. 99/45 and 02/46). Interpretation of otolith structure for Greenland halibut is difficult, particularly at older ages and can vary between readers. A Greenland halibut age determination workshop (SCR Doc. 06/49) concluded that current production methods underage old fish. About half of the catches in SA0 come from fixed gears, mainly gillnet that generally catches larger and older fish. Therefore, it was decided that no ages will be determined for SA0 until we have a method that is reliable for catches from both trawl and gillnet.

The location and distribution of the catches in SA0 from 2003-2006 was provided in SCS Doc. 07/12 Part 2 and in SA1 in 2006 (SCS Doc. 07/15).

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

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

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

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

STATUS: Greenland Institute of Natural Resources is currently sampling the bycatch of, among others, Greenland halibut in the Greenland shrimp fishery and the results will be reported to NAFO in the near future.

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

STATUS: No progress

iii) Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3M

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

STATUS: No progress.

iv) American Plaice (*Hippoglossoides platessoides*) in Division 3M

Average *F* in recent years has been very low relative to M. Therefore STACFIS **recommended** that *the utility of the XSA must be re-evaluated and the use of alternative methods (for e.g. survey based models, stock production models) be attempted in the next assessment of Div. 3M American plaice.*

STATUS: No progress reported, this will be attempted in the next assessment.

v) Cod (*Gadus morhua*) in Divisions 3NO (2005 Recommendation)

In 2005 STACFIS noted the poor model fit in the SPA to the Canadian juvenile survey series and considered that an improvement may be realized by excluding the index from the ADAPT, accordingly, STACFIS **recommended** that *a sensitivity analysis be conducted to investigate the impact of excluding the Canadian juvenile survey index from the SPA.*

STATUS: This recommendation was addressed at the June 2006 meeting. The sensitivity analysis revealed a slightly worse model fit with the exclusion of the index and, therefore, the index remained in the SPA in the 2007 assessment.

In addition to the survey indices currently used to tune the SPA, there is available a survey conducted by EU-Spain in the Regulatory Area of Div. 3NO. STACFIS noted the availability of the converted Spanish spring survey data from the NRA area of Div. 3NO and **recommended** that *the utility of the converted mean per tow at length data from the spring survey series conducted by EU-Spain in the NRA of 3NO since 1997 be explored as an additional index in the SPA calibration.*

STATUS: This recommendation was addressed at the June 2006 meeting. The sensitivity analysis revealed a worse model fit with the inclusion of the index to the base model, and, therefore, the index was not incorporated into in the SPA in the 2007 assessment.

vi) Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N

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

STATUS: No update was available for this meeting.

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

STACFIS noted that the cohort model for relative year-class strength was not updated in 2006 due to uncertainty in the modeling the age data and **recommended** that *further exploration of the cohort model continue and results will be presented in 2007.*

STATUS: No progress due to unavailability of some of the age data.

STACFIS noted that alternate formulations of the surplus production model (ASPIC) using various combination of the indices can change with the addition of new data from fishery catches and survey time series, accordingly, STACFIS **recommended** that *further exploration of the ASPIC surplus production model, including sensitivity analysis on various input indices, be presented in 2007.*

STATUS: Sensitivity analysis and alternate model formulation were conducted and showed that with an additional 4 years of index data, the currently accepted formulation of the model is now robust enough to exclude the Russian time series. Results of the sensitivity analyses also suggests that the *B1* ratio in the currently accepted model should be constrained so that the starting biomass in the first year is not greater than *K*. An alternate formulation of the standard model to include the Canadian juvenile groundfish series offers some promise as a new formulation.

STACFIS noted that at present, the risk of the stock being below B_{lim} = 30% Bmsy has not been explored. However, the estimated probability of the current (beginning of 2007) stock size being below Bmsy is so small (less than 3%), that the probability of being below B_{lim} is negligible. STACFIS recommended that in future assessments of Div. 3LNO yellowtail founder, the risk of the stock being below B_{lim} = 30% B_{msy} be expressed.

STATUS: Not applicable until the next full assessment to be conducted in 2008 .

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

STACFIS **recommended** that *work should continue in developing precautionary reference points, including* B_{lim}*, for this stock.*

STATUS: No progress.

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

STACFIS reiterates its **recommendation** that *initial investigations to evaluate the status of capelin in Div. 3NO utilizing trawl acoustic surveys to allow comparison with the historical time series.*

STATUS: The recommendation was not implemented in 2006.

x) Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Division 3O

STACFIS noted estimates of size at maturity from various recent studies were not precise because species mixtures could be a confounding factor, accordingly, due to the importance of size at maturity for assessment purposes, STACFIS **recommended** that *future studies should be continued and be analyzed by species*.

STATUS: A size at maturity study was presented for *Sebastes fasciatus* at this meeting (SCR Doc. 07/ 07).

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

STACFIS **recommended** that *further work be conducted for estimation of reference points*.

STATUS: No progress.

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: No progress.

STACFIS noted sampling of commercial fisheries was available for a number of years and accordingly **recommended** that *an annual series of commercial catch at length be constructed if sufficient sampling exists*.

STATUS: No progress.

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

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

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

STACFIS **recommended** that *research continue on age determination for Greenland halibut in Subarea 2 and Div. 3KLMNO to improve accuracy and precision.*

STATUS: No progress. Since the Feb 2006 workshop held in St. John's, Newfoundland and Labrador (see *NAFO Sci. Coun. Rep*., 2006, Appendix III:4.d, p. 84) concluded that current production methods underage old fish, no progress has been made on ageing issues of Greenland halibut. An alternate method using thin-sectioning of otoliths will be explored in 2007 and results will be made available when sufficient progress warrants evaluation.

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

For northern shortfin squid in Subareas 3+4, STACFIS **recommended** that *abundance and biomass indices from the Canadian multi-species bottom trawl surveys conducted during spring and autumn in Div. 3LNO, beginning with 1995, be derived using the two subsets of strata listed in SCR Doc. 06/45 in order to improve the decision of the indices.*

STATUS: No progress. A Designated Expert is required for this stock.

xiii) American plaice (*Hippoglossoides platessoides*) in Divisions 3LNO (2005 recommendation)

STACFIS **recommended** that *a number of ADAPT formulations be explored for Div. 3LNO American plaice, including shortening or splitting the tuning indices in conjunction with varying natural mortality that is included in the current model.* In addition, further comparisons between the Canadian surveys of Div. 3LNO and the survey by EU-Spain in the NRA of Div. 3NO should be carried out, including comparisons of trends in overall abundance, age by age abundance and a comparison of retrospective patterns for VPA formulations including and excluding the survey by EU-Spain.

STATUS: Progress was made on some of these research recommendations, the following alternative input datasets were explored using the same model formulation as in the 2005 assessment:

Exclusion of converted data set (Campelen data only)

No conversion of survey data (separate Engels and Campelen data)

Inclusion of Spanish Div. 3NO survey

All three alternates showed reasonably good fits to the data, but separating or shortening the converted time series data did not improve the fit of the model to the data STACFIS agreed to include the Spanish Div. 3NO to the current ADAPT model (2005) formulation for the 2007 assessment. There will be a further re-working of ADAPTs next year when varying M is examined in more detail as well as the timing of the change in M. This may require model formulations as noted above to be revisited.

$F_{lim} = F_{msy}$ was suggested as a possible reference point for this stock by the Limit Reference Point Study Group (SCS Doc. 04/12).STACFIS **recommended** that *investigation be carried out on the sensitivity of the estimation of* F_{msy} *to these parameters. (exploitation pattern (PR), stock recruitment model and natural mortality rate).*

STATUS: No progress.

xiv) White hake (*Urophycis tenuis*) in Divisions 3N, 3O and Subdivision 3Ps (2005 Recommendation)

STACFIS **recommended** that *the genetic analyses in 2003 of Div. 3NO versus Subdiv. 3Ps samples be continued; in order to help determine whether Div. 3NOPs white hakes comprise a single breeding population.*

STATUS: Genetic analyses of white hake populations off Canada are presently being undertaken. Results of these analyses will be available later in 2007.

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

STATUS: Collection of information on commercial catches of white hake, including sampling for age and sex is being conducted on a regular basis.

STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2005+); thereby allowing age-based analyses of this population.*

STATUS: No Progress. White hake otoliths continue to be collected but resources are not available for analysis.

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 2006 In order to derive estimates of catches for the various stocks, estimates from various sources were considered along with reported catches available to 1 June 2007 as compiled from STATLANT 21 reports. (SCS Doc. 07/16)

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 stock by stock summary for 2006 is as follows:

	Catches ('000 tons)	
Stocks	STATLANT 21A[1]	STACFIS
Stocks off Greenland and in Davis Strait		
Greenland halibut in Subarea 0 and 1 offshore and Div. 1B-1F	14	24
Greenland halibut in Div. 1A inshore	0.64	23.2
Roundnose grenadier in Subareas 0 and 1	0.0	0.01
Demersal Redfish in Subarea 1	0.0	<0.5
Other finfish in Subarea 1	--	0.64
Stocks on the Flemish Cap		
Cod in Div. 3M	0.1	0.3
Redfish in Div. 3M	7.2	4.4
American plaice in Div. 3M	0.1	0.05
Stocks on the Grand Banks		
Cod in Div. 3N and 3O	0.3	0.6
Redfish in Div. 3L and 3N	0.2	0.5
American plaice in Div. 3L, 3N and 3O	0.9	2.8
Yellowtail flounder in Div. 3L, 3N and 3O	0.9	0.9
Witch flounder in Div. 3N and 3O	0.5	0.5
Capelin in Div. 3N and 3O	--	--
Redfish in Div. 3O	12.9	12.6
Thorny skate in Div. 3LNOPs (3LNO portion)	5.0	5.8
White hake in Div. 3NOPs (3NO portion)	1.2	1.1
Widely Distributed Stocks		
Roughhead grenadier in Subareas 2 and 3	0.3	1.4
Witch flounder in Div. 2J+3KL	0.1	0.1
Greenland halibut in Subarea 2 and Div. 3KLMNO	4.3	24
Short-finned squid in Subareas 3 and 4	<0.1	6.9
[1] Provisional		

STACFIS noted the advances made by the ad hoc working group on catch estimates by conducting pre-meeting deliberations, thereby enabling several finfish stock catch estimates to be available a few days before 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. Wintertime heat loss to the atmosphere in the central Labrador Sea is offset by warm waters carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried south by the east Baffin Island Current. Temperature and salinity within the 1 500 m depth range over much of the Labrador Sea have become steadily warmer and more saline over the past number of years compared to the early 1990s. The low temperature and salinity values in the inshore region of southwest Greenland reflect the inflow of Polar Water carried by the East Greenland Current. Water of Atlantic origin with temperatures >3ºC and salinities >34.5 is normally found at the surface offshore off the shelf break in this area. Historical data from Fylla Bank revealed several cold "polar events" during 1983, 1992 and 2002. During these years, cold and diluted waters from the West Greenland banks reached well out to the slope regions of Fylla Bank in the upper water column.

Temperature and salinity within the 1 500 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 1oC 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 Fylla 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 to the standard sections along the west coast of Greenland show temperatures in the West Greenland Current and on the Western Greenland Shelf continuing the warmer than normal trend since 1993.

1. Greenland Halibut (*Reinhardtius hippoglossoides*) in Subarea 0, Div. 1A Offshore and Div. 1B-1F

(SCR Doc. 07/28, 29, 30, 41, 44; SCS Doc. 07/6, 11, 12, 15)

a) Introduction

The annual catches in Subarea 0 and Div. 1A offshore and Div. 1B-1F were below 2 600 tons from 1984 to 1988. From 1989 to 1990 catches increased from 2 200 tons to 10 500 tons, remained at that level in 1991 and then increased to 18 100 tons in 1992. During 1993-2000 catches fluctuated between 8 300 and 11 400 tons. The catches increased gradually from 13 300 tons in 2001 to about 19 000 tons in 2003 and stayed at that level in 2004-2005. In 2006 catches increased to 24 000 tons (Fig. 1.1).

In Subarea 0 catches peaked in 1992 at 12 400 tons, declined to 4 300 tons in 1994 and stayed at that level until 1999, to increase to 5 400 tons in 2000. Catches increased further to 7 700 tons 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 tons and stayed at that level in 2004-2005. Catches increased to 12 200 tons in 2006 due increased effort in Div. 0A.

Catches in Div. 0A increased gradually from a level around 300 tons in the late 1990s and 2000 to 4 100 tons in 2003, declined to 3 800 tons in 2004 but was back at the 2003 level in 2005. In 2006 catches increased to 6 600 tons, due to increased effort.

Catches in Div. 1A offshore and Div. 1B-1F fluctuated between 900 and 2 400 tons during the period 1987-91. After then catches have fluctuated between 3 900 and 5 900 tons until 2001. Catches increased gradually from 5 700 tons in 2001 to 9 500 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 due to increased effort in Div. 1A. Prior to 2001 catches offshore in Div. 1A and in Div. 1B have been low but they increased gradually from 110 tons in 2000 to 4 000 tons in 2003 and stayed at that level in 2004-2005. Catches in that area increased further in 2006 to 6 200 tons.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	11	11	11	15[1]	15[1]	19[2]	19[2]	19[2]	24[3]	24[3]
TAC	11	11	11	15[1]	15[1]	19[2]	19[2]	19[2]	24[3]	24[3]
SA 0	4	5	5	8	7	9	10	10	12	
SA1 exl. Div. 1A inshore	5	5	6	6	7	10	10	10	12	
Total STATLANT 21A	9	17[4]	8	13	16[5]	20[6]	19	14	14	
Total STACFIS	9	10	11	13	15	19	19	20	24	

[1] Including a TAC of 4 000 tons allocated specifically to Div. 0A and 1A.
[2] Including a TAC of 8 000 tons allocated specifically to Div. 0A and 1AB.
[3] Including a TAC of 13 000 tons allocated specifically to Div. 0A and 1AB
[4] Including 7 603 tons reported by error from Subarea 1.
[5] Including 780 tons reported by error from Div 0A.
[6] Including 1 366 tons reported by error from Div. 1A.

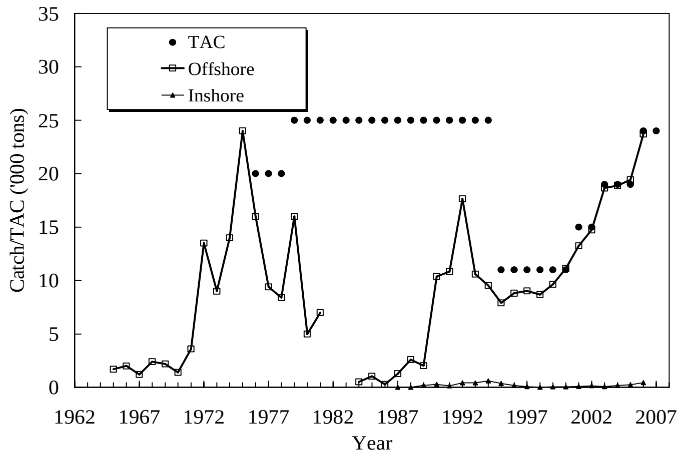


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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 2006, 193 tons were taken by longlines, 2 445 tons by gillnet and 2 895 tons by trawlers.

Besides Canadian trawlers, a number of different countries participated in the trawler fishery in Div. 0A from 2001 to 2003 through charter arrangements with Canada. Since then all catches have been taken by Canadian vessels. In 2006, trawlers caught 3 634 tons and 3 001 tons 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 and 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 (main ly Germany). These countries, except Japan, were also engaged in the fishery in the area in 2006. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 tons 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 and 237 and 20 tons were taken in 2005 and 2006 by longlines. Inshore catches in Div. 1B-Div. 1F amounted to 444 tons, which were mainly taken by gillnets.

Throughout the years there have been a number of research fisheries offshore in Div. 1A but the catches have always been less than 200 tons annually. Catches increased gradually from about 100 tons in 2000 to about 6 200 tons in 2006. All catches were taken by trawlers primarily from Greenland, Russia and Faroe Islands.

b) Input Data

i) *Commercial fishery data*

Information on length distribution was available from the trawl and gill net fishery in Div. 0AB. The length distributions in the trawl fishery were almost identical in Div. 0A and 0B with modes at 48-50 cm and resembled the length frequency seen in previous years. The bulk of the catches in the gillnet fishery in Div. 0A were between 50 and 70 cm with a mode around 62-56 cm, while the catches were comprised of slightly larger fish (50-80 cm) in Div. 0B with a mode at 66 cm.

Information on length distribution of catches was available from trawlers from Russia and Greenland fishing in Div. 1A and 1D and the Norwegian trawl fishery in Div. 1D. The length distribution in the Greenland fishery in Div. 1A (which constitutes about 90% of the fishery) showed a mode around 48-54 cm while the mode was at 42 cm in the Russian trawl fishery. The mode was around 49-52 cm in Greenland, Russian and, Norwegian trawl fishery in Div. 1D, respectively. The mode in the trawl fishery in Div. 1D has been at 47-51 cm in the last decade.

Age distributions were available from the Greenland, Russian and Norwegian trawl fishery in Div. 1D. Age 6-8 dominated the trawl catches from Greenland and Norway as in previous years. In 2006 ages 5-6 dominated the Russian catches while ages 6-7 dominated in 2005. This change in age composition was seen even though the mode in the Russian fishery moved from 48 cm in 2005 to 52 cm in 2006. The change could be caused by change in age reader.

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 are among the highest in the time series, which dates back to 1996 and 2000 for single and twin trawl, respectively.

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 tons/hour in 2005, but catch rates declined slightly to 1.06 in 2006. The Russian catch rates (Div. 1AB, small and large trawlers combined) also decreased slightly between 2004 and 2006.

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.

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

Standardized catch rate series, based on logbook data from the Greenland authorities for the period 1988-2005 and data from the EU German trawl fishery for 1996-2006, 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. The index also increased slightly between 2005 and 2006 (Fig. 1.2).

The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but has increased again since then, and is in 2006 the highest 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.

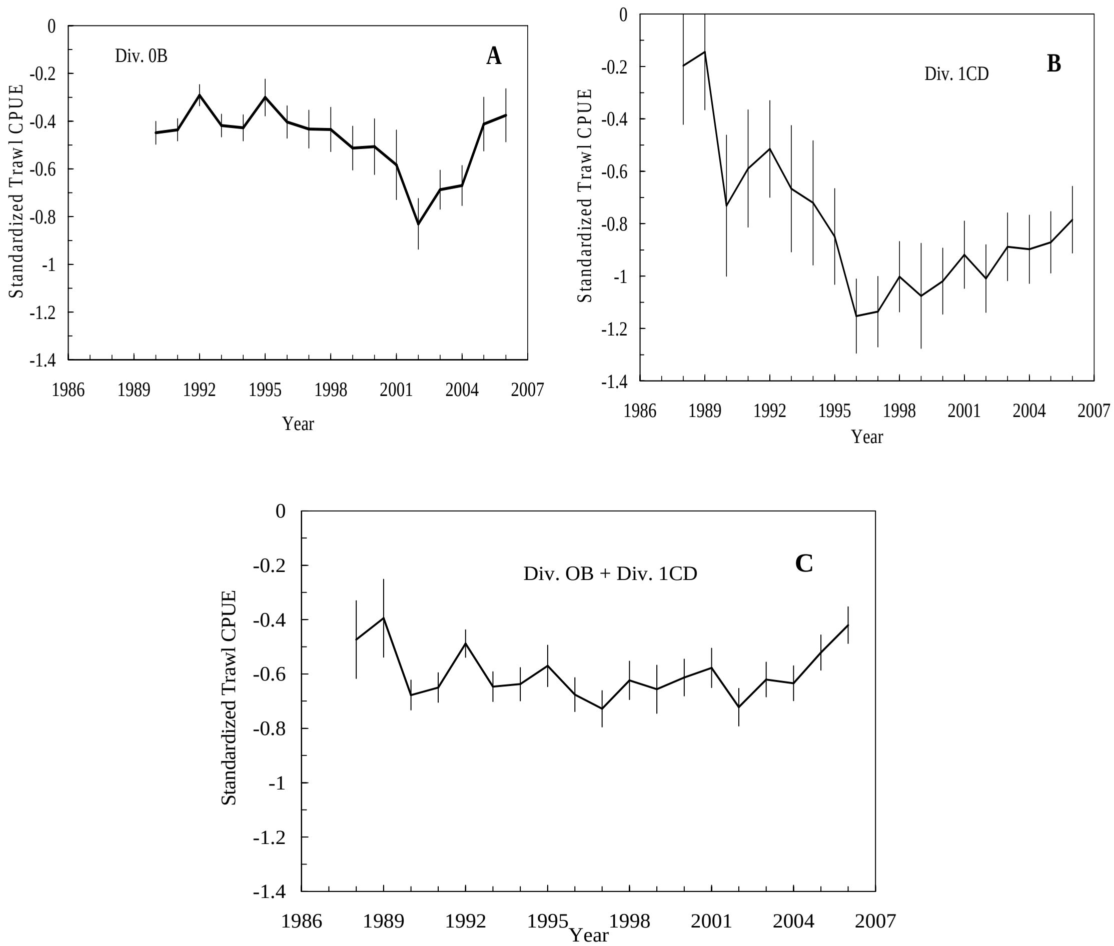


Fig. 1.2. Greenland halibut (excluding Div. 1A inshore):A: Standardized trawler CPUE from Div. 0B with ± S.E., B: Standardized trawler CPUE from Div. 1CD with ± S.E., and C: Combined standardized trawler CPUE from Div. 0B and Div. 1CD.

ii) *Research Survey Data*

Japan-Greenland and Greenland Deep-sea surveys. During the period 1987-95 bottom trawl surveys were conducted in Subarea 1 jointly by Japan and Greenland (the survey area was re-stratified and the survey 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 77 000 tons in 2006 which is a slight decrease compared to 2005, but still above the average for the time series (Fig. 1.3)

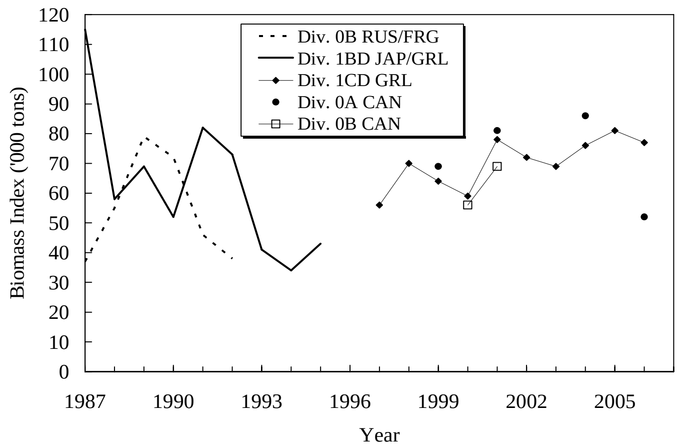


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from bottom trawl surveys. Note: incomplete coverage of the 2006 survey in Div. 0A.

Canadian deep sea survey in Baffin Bay (Div. 0A). Canada has conducted surveys in the southern part of Div. 0A in 1999, 2001, 2004 and 2006. The survey biomass index has increased gradually from 68 700 tons via 81 000 tons to 86 200 tons in 2004. The biomass decreased to 52 271 tons 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 tons of biomass in previous surveys. Therefore, the current estimate is lower than the most recent surveys but may be comparable 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.

Greenland shrimp survey. Since 1988 annual surveys have been conducted with a shrimp trawl off West Greenland between 59ºN and 72º30'N from the 3-mile boundary to the 600 m depth contour line. The survey biomass in the offshore area has been stable on a relatively high level in recent years and the estimate for 2004 (31 100 tons) was the highest in the time series. The biomass decreased gradually to 24 500 tons in 2006, which is the third highest in the time series. The 2004 estimate included a relatively high proportion of age 3+ fish not seen in 2005 and 2006. The survey gear was changed in 2005, but the 2005-2006 estimates were adjusted for this change. 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 (303 million in 2006), which is well above the average level (Fig. 1.4). The estimates were recalculated in 2007, based on the new strata, but it did not change the over all trends in the recruitment.

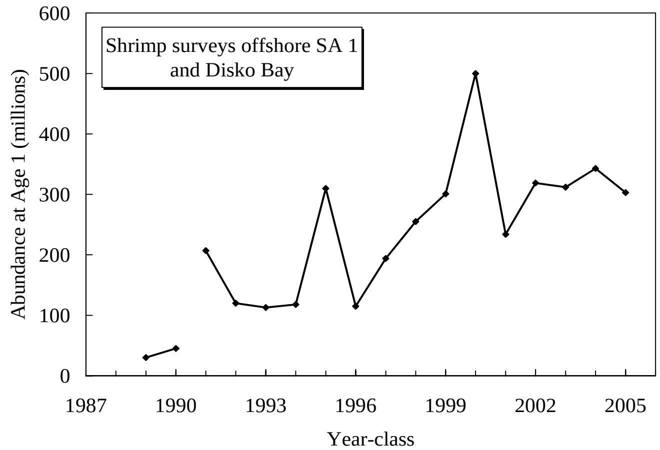


Fig. 1.4.Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (The 1989 and 1990 year-classes are poorly estimated as age 1).

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1AS[AB1][P2]-1B declined between 2003 and 2004 but increased again in 2005 and increased further in 2006 and the 2005 year-class as age one was well 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. STACFIS considered the analysis was provisional (*NAFO Sci. Coun. Rep*., 2003:239) 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, primarily from SA0.

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.

An update of the unsuccessful application of a non-equilibrium stock production model (ASPIC) in 1999 was attempted for this assessment, but results were not tabled as they were still not considered appropriate to describe the dynamics of the stock.

d) Assessment Results

Divisions 0A + 1A (offshore) + Div. 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 index has increased gradually from 68 700 tons via 81 000 tons to 86 200 tons in 2004. The biomass decreased to 52 271 tons in 2006. However, the survey coverage was not complete and two of the four strata missed fell within the depths 1 001-1 500 m and accounted for 11 000-13 000 tons of biomass in previous surveys. Therefore, the current estimate is lower than the most recent surveys but may be comparable 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 tons and 54 000 tons, respectively, in the two areas. These surveys in the northern part of Baffin Bay have not been repeated since 2004. Further, the Greenland Shrimp Survey has covered, among others, Div. 1B and part of Div. 1A (to 72º30'N) annually since 1992. The biomass, which is mainly found in Div. 1AB, estimated in Greenland Shrimp Survey has been relatively high and stable in recent years. It decreased slightly between 2005 and 2006 but is still the third highest observed in the time series.

The length distribution in the trawl fishery in Div. 0A has been stable during 2002-2006, with a mode around 48-50 cm. The mode was around 48-54 cm in the Greenland fishery. In the Russian fishery the mode was around 42 cm in 2006, where as it was around 50 cm in 2004 (no data from 2005).

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 are among the highest in the time series for both single and twin trawl. 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 in 2006. Another fleet showed a decrease between 2004 and 2006.

Div. 0B + 1C-1F

The bottom trawl survey biomass index in Div. 1CD increased between 2003 and 2005 where the estimate was 81 000 tons, which is the highest for the time series. The trawlable biomass in Div. 1CD decreased to 77 000 tons in 2006, but is still above the average for the time series. 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 fishery in Div. 0B was at 48-50 cm and resembled the length frequency seen in previous years. The mode in the trawl fishery in Div. 1D has been around 47-51 cm for last decade and the modes were the same range in 2006.

A standardized CPUE series from Div. 0B showed an increase between 2002 and 2006 and is now at the level seen in the 1990s. A standardized CPUE series from Div. 1CD has been increasing slightly since 1996. The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001, declined somewhat in 2002 but has increased again since then, and is in 2006 the highest seen since 1989.

Subarea 0 + Div. 1A (offshore) + Div. 1B-1F

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 but has increased again since then, and is in 2006 the highest seen since 1989.

Standardized catch rates in Div. 0B and 1CD have increased in recent years. Unstandardized catch rates in Div. 0A and 1CD increased slightly between 2005 and 2006, while 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 2002-2005 year-classes were well above average. The recruitment of the 2005 year-class in the offshore nursery area (Div. 1A (to 70ºN) - Div. 1B) was above average.

Biomass: The biomass in Div. 1CD in 2006 was estimated at 77 000 tons, which is above average for the ten years time series. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has decreased in the last two years but the 2006 estimate is still the third highest in the time series (1991-2006). The biomass in Div. 0A decreased to 52 271 tons in 2006. However, the survey coverage was not complete and two of the four strata missed fell within the depths 1 001 - 1 500 m and accounted for 11 000 - 13 000 tons of biomass in previous surveys. Therefore, the current estimate is lower than the most recent surveys but may be comparable to the estimate from 1999 when considering the biomass in the strata not covered in 2006.

e) Precautionary Reference Points

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

f) Research Recommendation

STACFIS **recommended** that *the investigations of the bycatch of Greenland halibut in the shrimp fishery in Subareas 0 and 1 should be continued and the results should be made available before the assessment in 2008.*

This stock will next be assessed in 2008.

2. Greenland halibut (*Reinhardtius hippoglossoides*) in Div. 1A inshore

(SCR Doc. 07/28, SCS Doc. 07/15)

Interim Monitoring Report

a) Introduction

The inshore fishery for Greenland halibut in Div. 1A is concentrated in Disko Bay, and around Uummannaq and Upernavik. 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.

Total landings in the three areas have increased until 1998 to 25 000 tons. In 2001 landings decreased to 17 000 tons but have since then increased again to 23 000 tons in 2004-2006. The increase in landings was mainly seen in Disko Bay, where annual landings have increased from around 7 000 tons in 2001 to around 12 000 tons in 2002 and have remained at that level to 2006.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC[1]				7.9	7.9	7.9	na	ni	ni	ni
Disko Bay[2]	10.7	10.6	7.6	7.1	11.7	11.6	12.9	12.5	12.1	
Recommended TAC[1]				6.0	6.0	6.0	na	5.0	5.0	5.0
Uummannaq	6.9	8.4	7.6	6.6	5.4	5.0	5.2	4.9	6.0	
Recommended TAC[1]				4.3	4.3	4.3	na	na	na	na
Upernavik	7.0	5.3	3.8	3.2	3.0	3.9	4.6	4.8	5.1	
Unknown[3]	-	-	-	2.2				0.8	-	
STATLANT 21A	19.7	24.3	21.5[4]	17.3[4]	2.0[4]	5.2[4]	3.7[4]	0.6[4]	0.6[4]	
STACFIS	24.6	24.3	21.0	16.9	20.1	20.5	22.7	22.9	23.2	

na no advice.
ni no increase in effort.
[1] No TAC established
[2] Formerly named Ilulissat.
[3] Landings from unknown areas within Div. 1A.
[4] Includes catches from the offshore area.

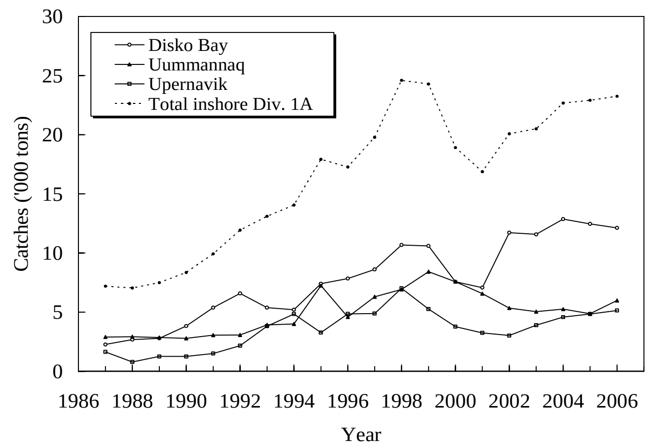


Fig. 2.1. Greenland halibut in 1A inshore: Landings in the three main fishing areas and in total.

b) Data Overview

Research survey data

The inshore Greenland halibut longline survey has been conducted since 1993 in Disko Bay and Uummannaq, and the gillnet survey in Disko Bay has been conducted since 2001. No surveys have been conducted in Upernavik since 2001. Since 1991 the Greenland bottom trawl survey for shrimp has also included the Disko Bay. The survey also estimates the biomass and abundance of, mainly, juvenile (1-3 years old) Greenland halibut.

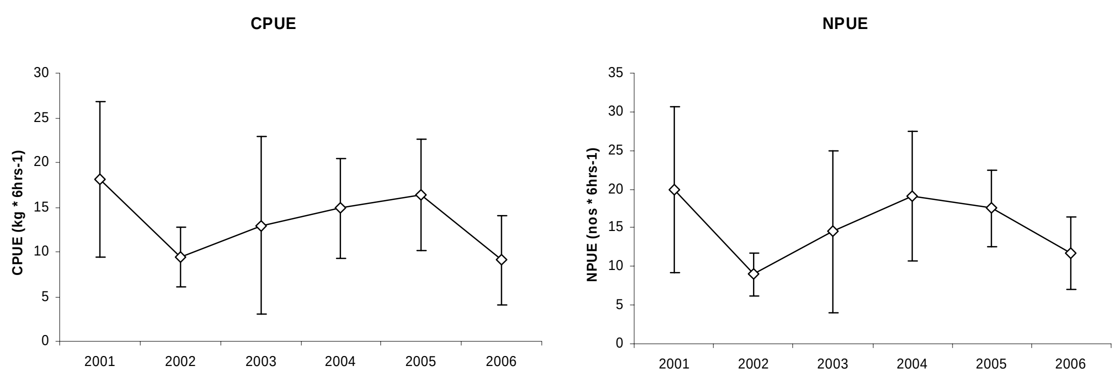


Fig 2.2. Greenland halibut in 1A inshore: CPUE/NPUE for gillnet survey in Disko Bay 95% CI indicated.

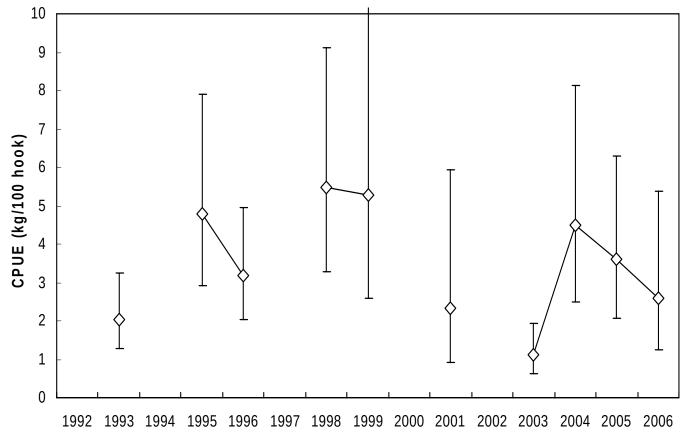


Fig 2.3. Greenland halibut in 1A inshore: Longline survey index (CPUE) for Uummannaq 1993-2006 95% CI indicated.

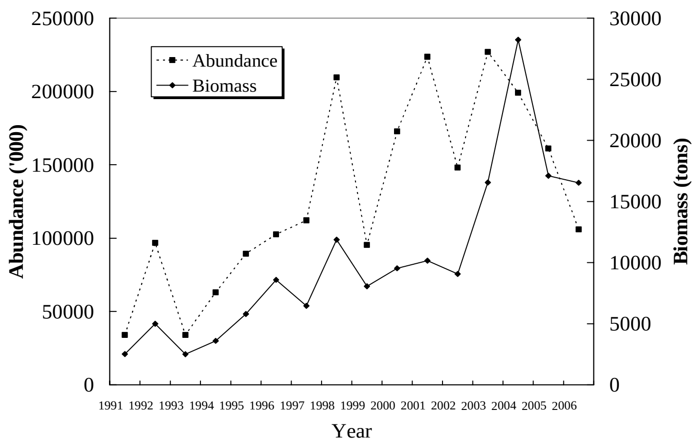


Fig 2.4.Greenland halibut in 1A inshore: abundance ('000) and biomass (tons) indices of Greenland halibut from the Paamiut trawl survey in Disko Bay.

c) Conclusion

Landings in 2006 are at the same as 2005 level in all three areas. In Disko Bay biomass and abundance indices from the gillnet survey have declined from 2005 to 2006, also the trawl survey abundance and biomass indices have declined, but are still around average of the time series. There are no significant changes in long line survey biomass and abundance indices compared to previous years in Uummannaq. Due to lack of survey data it is not possible to evaluate stock status in Upernavik.

d) Research Recommendations

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

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

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

This stock will next be assessed in 2009.

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

(SCR Doc. 07/29; SCS Doc. 07/11)

Interim Monitoring Report

a) Introduction

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is taken as bycatch in the Greenland halibut fishery. A total catch of 9 tons was estimated for 2006 compared to 23 tons for 2005.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.031	0.04	0.1	0.06	0.03	0.04	0.02	0.01	0.00	
STACFIS	0.031	0.04	0.1	0.06	0.03	0.04	0.02	0.01	0.01	

[1] Includes 30 tons roughhead grenadier from Div. 1A misreported as roundnose grenadier.
ndf No directed fishing

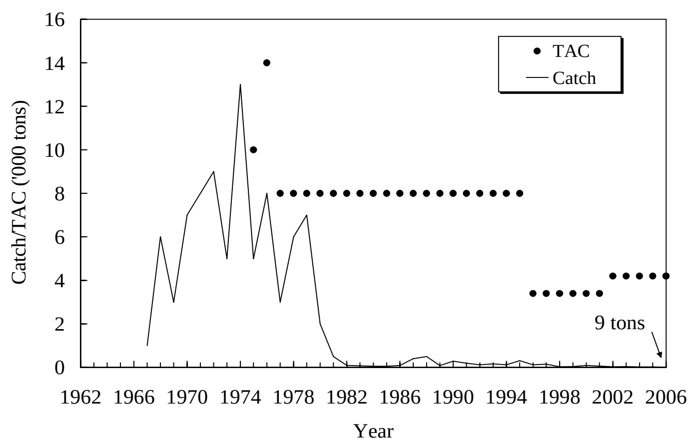


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs .

b) Data Overview

Research survey data

In the period 1987-95 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. (The survey area was restratified and the biomass indices were recalculated in 1997). Russia has in the period 1986-92 conducted surveys covering Div. 0B and Div. 1CD at depths down to 1 250 m until 1988 and down to 1 500 m from then on. The surveys took place in October-November. During 1997-2006 Greenland has conducted a survey in September-November covering Div. 1CD at depth between 400 and 1 500 m. Canada conducted surveys in Div. 0A in 1999, in Div. 0B in 2000 and in Div. 0AB in 2001 at depths down to 1 500 m. Roundnose grenadier was not observed in Div. 0A.

In the Greenland survey in 2006 the biomass in Div. 1CD was estimated at 659 tons, the second lowest in the time series, and hence the biomass has remained at the very low level observed since 1993. Most of the biomass was found in Div. 1C, 800-1 000 m and in Div. 1D >1 000 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 biomass indices at 1 660 tons and 1 256 tons, respectively.

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

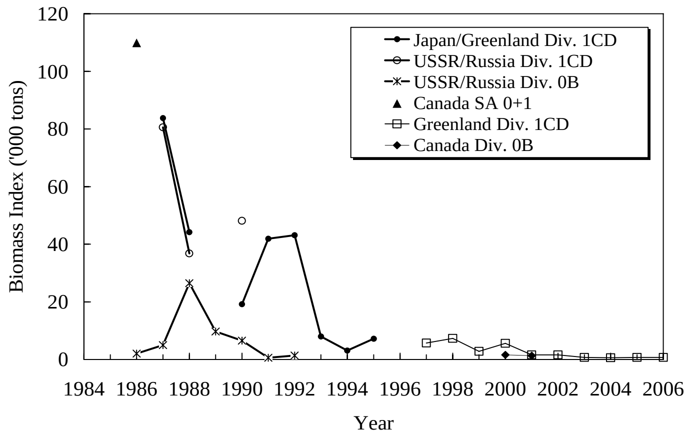


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/ Greenland and Greenland surveys in Div. 0B and Div. 1CD.

c) Conclusion

Recent survey data indicate that the stock biomass is on a very low level and the 2006 survey did not indicate a change.

This stock will next be assessed in 2008.

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

(SCR Doc. 07/17, 28, 29; SCS Doc. 07/15)

Interim Monitoring Report

a) Introduction

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

Reported catches of golden redfish and redfish (unspecified) in Subarea 1 have been less than 1 000 tons since 1987. Redfish is mainly taken as bycatch by the offshore shrimp trawlers; reported bycatches since 2001 were less than 500 tons, however, this must be considered an underestimate. Smaller vessels take a minor amount inshore mainly golden redfish.

Recent catches ('000 tons) of demersal redfish are as follows:

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
TAC	19	19	19	19	19	8	1	1	1	1
STATLANT 21A	0.9	0.8	1.0	0.1	0.1	0	0.3	0	0	
STACFIS Catch	0.9	0.8	1.0	0.3	0.5	0.5	<0.5	<0.5	<0.5	

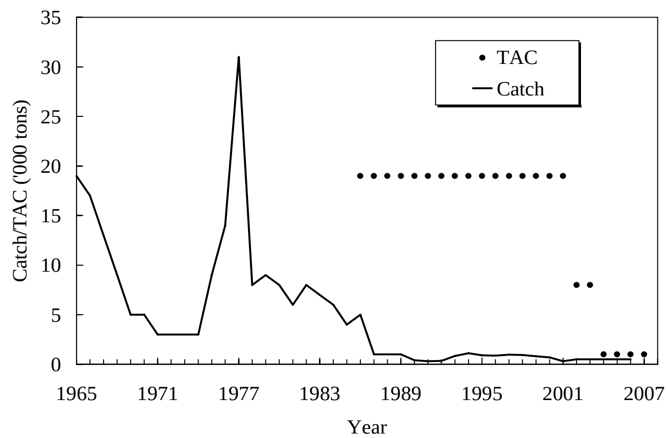


Fig. 4.1. Redfish in Subarea 1: catches and recommended TAC.

b) Data Overview

The Greenland bottom trawl and shrimp trawl surveys, the Greenland deep-sea survey and the EU-Germany survey were conducted during 2006. All three surveys showed only minor changes compared to recent years. The EU-Germany survey indices have been revised and standardized. However, the survey estimates did not alter the perception of the status by STACFIS (Fig. 4.2, 4.3, and 4.4).

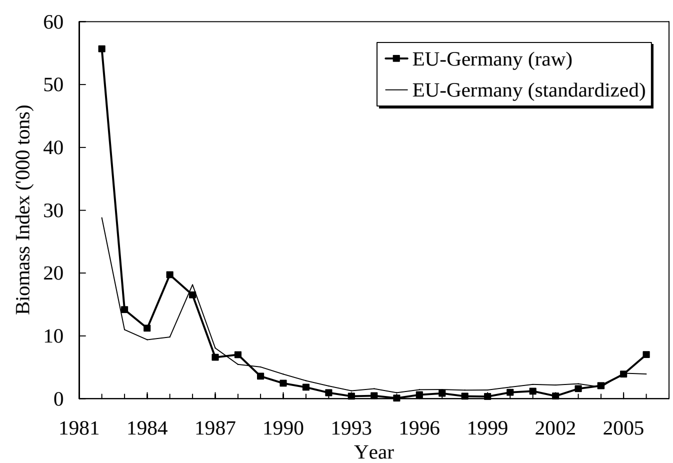


Fig. 4.2. Golden redfish in Subarea 1: survey biomass index

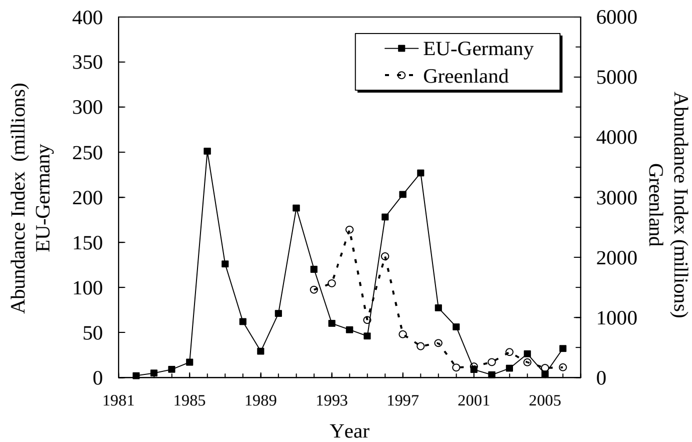


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass index

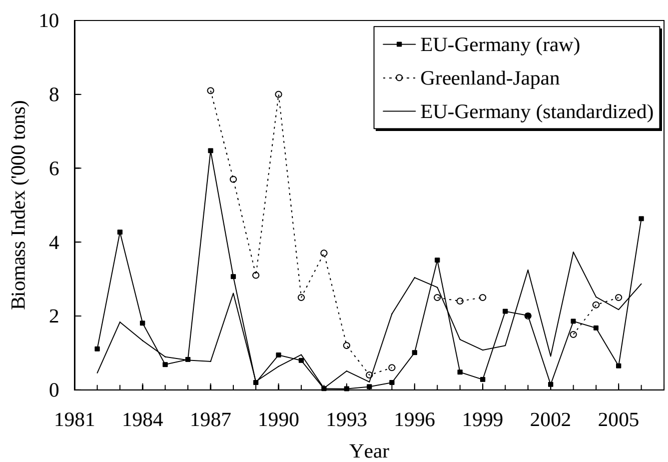


Fig. 4.4. Juvenile redfish (<17 cm) (deep-sea redfish and golden redfish combined) in Subarea 1: survey abundance indices. The Greenland survey data include the entire length range, but very few fish were >16 cm.

c) Conclusion

There is nothing that indicates a change in the status of the redfish stocks in Subarea 1 based on indices from three bottom trawl surveys conducted in 2006. Both the deepsea redfish and the golden redfish stocks are still considered to be in a poor condition.

This stock will next be assessed in 2010.

5. Other Finfish in Subarea 1

(SCR Doc. 07/17, 28; SCS Doc. 07/15)

Interim Monitoring Report

a) Introduction

Other finfish in Subarea 1 are Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*A. minor*), American plaice (*Hippoglossoides platessoides*), and thorny skate (*Amblyraja radiata*) (Fig. 5.1). Both wolffish species are included in the catch statistics since no species-specific data are available. In recent years there has been no report on catches of American plaice and thorny skate.

Recent catches of wolffish (tons) are as follows:

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
STATLANT 21A	30	33	52	65	87	311	244			
STACFIS	30	3	52	65	87	311	244	278	644	

b) Data Overview

The Greenland bottom trawl and shrimp surveys, the Greenland deep-sea survey and the EU-Germany survey were conducted during 2006. The EU-Germany survey indices have been revised and standardized . The survey estimates did not alter the perception of the status by STACFIS (Fig. 5.1).

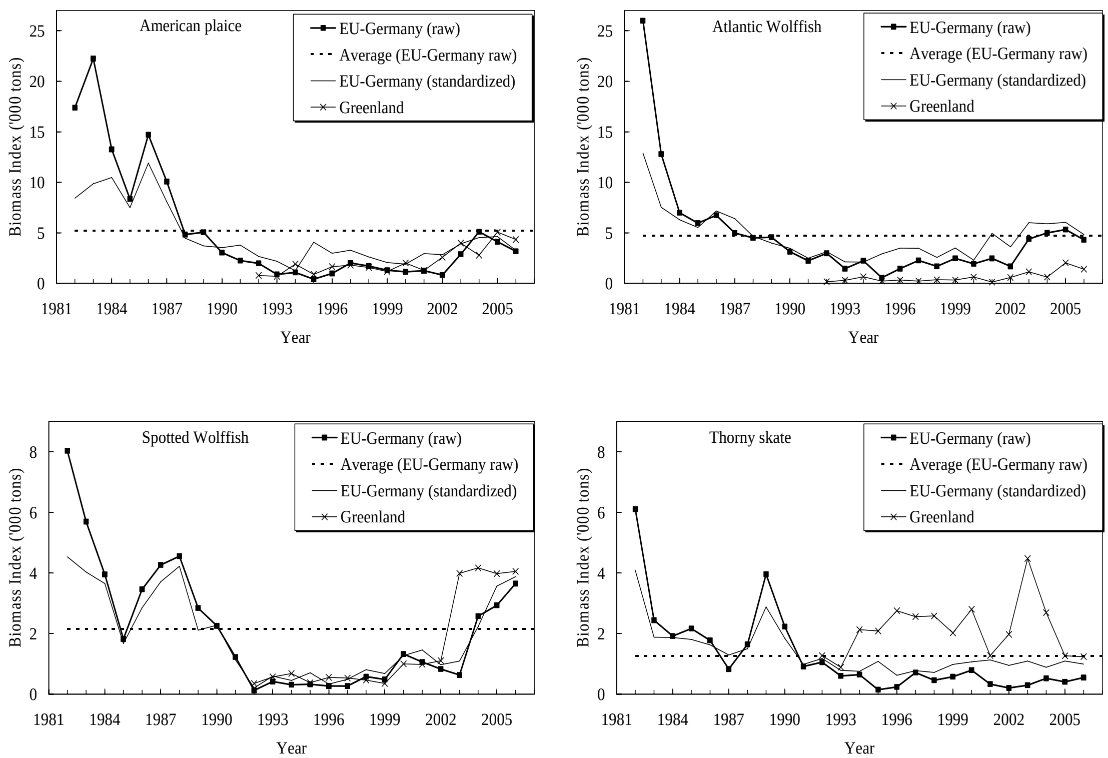


Fig. 5.1.Other Finfish in Subarea 1: survey biomass indices of various finfish species. The average is derived from the EU-Germany survey 1982-2006.

The stocks of Atlantic wolfish, spotted wolfish and American plaice indicate recovery potential due to increased recruitment as well as the observed slight increases in biomass for the whole length range in the recent years. They are presently composed of small and mainly juvenile specimens. Taking the poor stock status of American plaice, Atlantic wolffish, spotted wolffish and thorny skate into account, even low amounts of fish taken and discarded by the shrimp fishery might be sufficient to retard the recovery potential of these stocks. The continued failures of the recruits to rebuild the spawning stocks indicate high mortality rates in excess of the sustainable level. The probability of stock recovery would be enhanced by minimizing the bycatch of finfish in Subarea 1 to the lowest possible level.

c) Conclusion

The survey estimates from 2006 did not alter the perception of the status of the American plaice, Atlantic and spotted wolfish and thorny skate stocks. Although minor improvements have been seen in the stock status of some of the stocks in recent years the stocks are still at a very low level.

These stocks will next be assessed in 2010.

B. STOCKS ON THE FLEMISH CAP: Subarea 3, Div. 3M

Environmental Overview

The water mass characteristics of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3º to 4ºC and salinities in the range of 34 to 34.75. The general circulation in the vicinity of the Flemish Cap consists of the offshore branch of the Labrador Current which flows through the Flemish Pass on the Grand Bank side and a jet that flows to the east, north of the Cap which then flows southward east of the Cap. To the south, the Gulf Stream flows to the northeast to form the North Atlantic Current and influences waters around the southern areas of the Cap. In the absence of strong wind forcing the circulation over the central Flemish Cap is dominated by a topographically induced anticyclonic gyre. The stability of this circulation pattern may influence the retention of ichthyoplankton on the bank and is probably a factor in determining the year-class strength of various fish and invertebrate species, such as cod, redfish and shrimp.

A clockwise gyre circulation with an increase in strength dominated the circulation pattern around the Cap during the summer of 2006, compared to that of 2005. In general, the colder-than-normal temperatures experienced over the continental shelf and on the Flemish Cap from the late 1980s up to the mid-1990s moderated by the summer of 1996 and continued to warm until 1999, after which they decreased slightly until 2002. From 2003-05 most areas of the water column again experienced an increase in both temperature and salinity with near bottom temperatures exceeding 4°C, which were above normal by 1°C. By the summer of 2006 near-bottom temperatures had decreased slightly over 2005 values, while surface temperatures increased to a near-record value of 3°C above the long-term average. Salinities over most of the water column during the summer of 2002-05 were generally saltier-than-normal but decreased to near-normal values in 2006. During 2006 chlorophyll levels in the upper 100 m of the water column were higher compared to the adjacent Grand Bank indicating enhanced productivity potential over the Flemish Cap.

6. Cod (*Gadus morhua*) in Div. 3M

(SCR Doc. 07/10, 39)

Interim Monitoring Report

a) Introduction

The fishery is under moratorium since 1999. Estimated catches in 2006 have been 339 tons (Fig. 6.1). This represents more than a ten-fold increase over the yearly average catch during the period 2000-2005.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1[1]	
STACFIS	0.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.3	

ndf No directed fishery
[1] Provisional

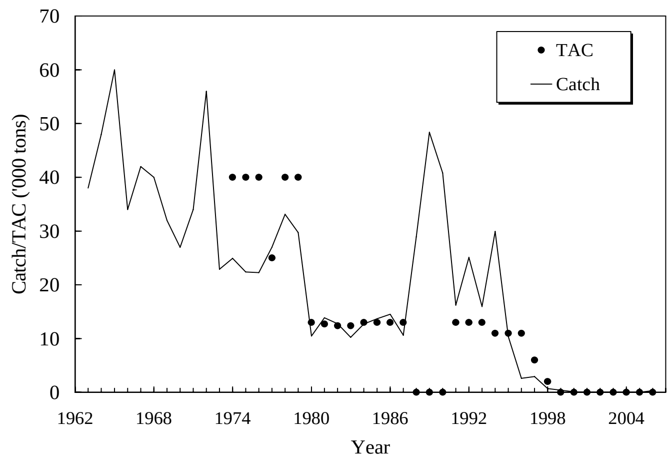


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch figures include estimates of misreported catches since 1988.

b) Data Overview

The EU-Flemish Cap bottom trawl survey was conducted in 2006. Survey results indicate a biomass increase starting in 2004 (Fig. 6.2) and good age 1 abundances in 2005 and 2006.

The survey-based assessment method employed in the 2006 assessment was also used to monitor the stock. The results indicate a significant increase in SSB in 2006.

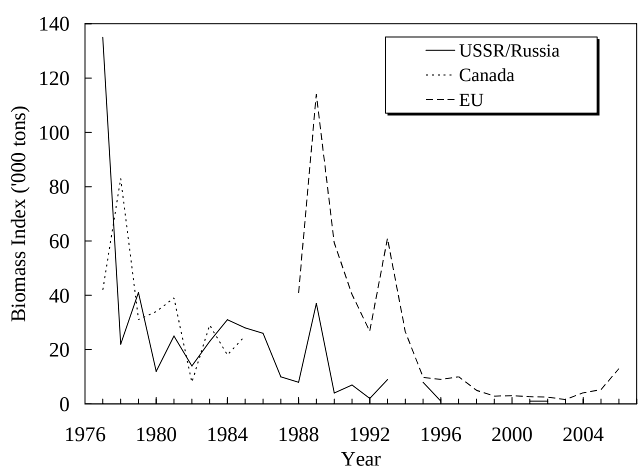


Fig. 6.2.Cod in Div. 3M: total biomass estimates from surveys.

c) Exploration of alternative assessment models

A new Bayesian Extended Survivors Analysis (XSA) model was also explored. Overall, results from this model were in agreement with those obtained from the last approved standard XSA (corresponding to the assessment in 2002) and from the survey-based method. The Bayesian model indicated good age 1 abundances in 2005 and 2006 and an increasing trend in SSB starting in 2004, albeit this increase was less pronounced than the one estimated from the survey-based method.

d) Conclusion

The SSB estimate has increased starting from 2004, but it still remains below B_{lim}. Results indicate good age 1 abundances in 2005 and 2006. However, although there are signs that the stock may be starting to improve, there is no major change to the perception of the stock status.

e) Research recommendations

STACFIS **recommended** 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.*

STACFIS **recommended** to *revisit candidates for* B_{lim}*, as the current value in 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.*

Given the increase in catch in 2006, STACFIS **recommended** that *efforts be made to conduct commercial sampling for this stock.*

This stock will next be assessed in 2008.

7. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3M

(SCR Doc. 07/47; SCS Doc. 07/ 6, 8, 9)

a) Introduction

There are three species of redfish that are commercially fished on Flemish Cap; deep-sea redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The term beaked redfish is used for *S. mentella* and *S. fasciatus* combined. Because of difficulties with identification and separation, all three species are reported together as ‘redfish’ in the commercial fishery. All stocks have both pelagic and demersal concentrations as well as a long recruitment process to the bottom, extending to lengths up to 30-32 cm. All redfish species are long lived with slow and very similar growth. Female sexual maturity is reached at a median length of 26.5 cm for Acadian redfish, 30.1 cm for deep-sea redfish and 33.8 cm for golden redfish.

i) *Description of the fishery*

The redfish fishery in Div. 3M increased from 20 000 tons in 1985 to 81 000 tons in 1990, falling continuously since then until 1998-99, when a minimum catch around 1 000 tons was recorded mostly as bycatch of the Greenland halibut fishery. The drop in the Div. 3M redfish catches from 1990 until 1999 was related both to the decline of the stock biomass and the abrupt decline of fishing effort deployed in this fishery by the fleets responsible for the high level of catches in the late 1980s-early 1990s (former USSR, former GDR and Korean crewed non-Contracting Party vessels).

There was a relative increase of the catch on 2000-2002 to a level above 3 000 tons but in 2003 the overall catch did not reach 2 000 tons. In 2004, catch raised again near 3 000 tons. An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. From 2004 onwards Portugal consolidated its major role in the present fishery.

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 tons) and 2006 (7 156 tons), with an estimated catch of beaked redfish of 3 784 tons and 4 430 tons respectively.

A rapid increase in the shrimp fishery at the Flemish Cap since 1993 has lead to high levels of redfish bycatch in 1993-94. From 1995 onwards bycatch in weight fell to apparent low levels but since 2001 increase again, reaching 1 006 tons in 2003. That increase does not reflect any recent expansion of the 3M shrimp fishery and was supported by above average year-classes occurring since late 1990s. From Canadian observer data, the redfish bycatch on the 3M shrimp fishery declined to 471 ton in 2004 and again to 80 ton in 2005, reflecting an important reduction of the 3M shrimp catch observed in recent years. The level of the 2006 redfish bycatch remains unknown. Length sampling of this bycatch for 2005 and 2006 is also unavailable. In terms of numbers the redfish bycatch from the Flemish Cap shrimp fishery accounted for 78% of the total 3M redfish catch in 2001-2003. In 2004 shrimp fishery bycatch represented 44% of the catch numbers and just 15% of the catch numbers in 2005.

Recent TACs, catches and bycatch ('000 tons) are as follows (Fig. 7.1):

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	20	13	5	5	5	5	5	5	5	5
STATLANT 21A	1.0	0.8	3.81	3.21	3.01	2.01	3.11	6.6	7.2	
STACFIS Catch[1]	1.0	1.1	3.7	3. 2	2.9	1.9	2.9	3.8	4.4	
Bycatch[2]	0.19	0.1	0.1	0.74	0.77	1	0.47	0.1		
Total catch[3]	1.2	1.2	3.8	3.9	3.8	2.9	3.4	3.9	4.4	

[1] Estimated beaked redfish catch.
[2] In shrimp fishery - not available for 2006.
[3] Total STACFIS + bycatch.

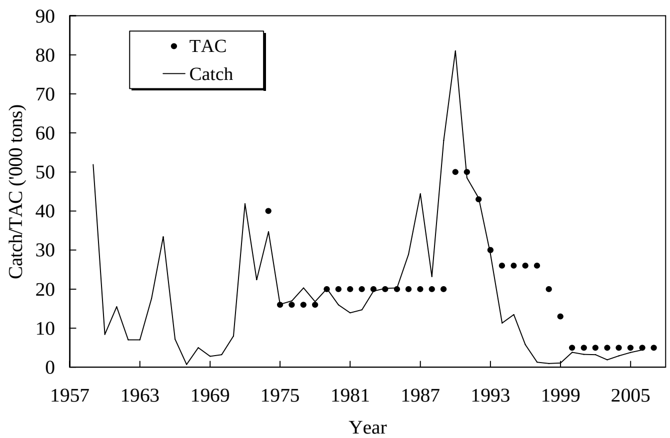


Fig. 7.1.Redfish in Div. 3M: catches and TACs.

b) Input Data

The Div. 3M redfish assessment is focused on the beaked redfish, regarded as a management unit composed of two populations from two very similar species: the Flemish Cap *S. mentella* and *S. fasciatus*. The reason for this approach is the historical dominance of this group in the Div. 3M redfish commercial catch. During the entire series of EU Flemish Cap surveys (1988-2006) beaked redfish also represents the majority of redfish survey biomass (77%). But at present this majority is down to 61% due to the rise of golden redfish survey indices in most recent years (2003-2006).

i) *Commercial fishery and bycatch data*

Sampling data. Most of the commercial sampling data available for the Div. 3M redfish stocks since 1989 are from the Portuguese fisheries. Length sampling data from Russia, Japan and Spain were also available for several years and used to estimate the length composition of the commercial catches for those fleets in those years. The annual length composition of the Portuguese trawl catch was applied to the rest of the commercial catches. The 1998-2006 3M beaked redfish commercial length weight relationships from the Portuguese commercial catch were used to compute the mean weights of all commercial catches and corresponding catch numbers at length.

Redfish bycatch in numbers at length for the Div. 3M shrimp fishery were available for 1993-2004 based on data collected on Canadian and Norwegian vessels. These numbers at length were recalculated in order to fit bycatch in weight with the annual length weight relationships derived from EU-survey data. The commercial and bycatch length frequencies were then summed to establish the total removals at length. These were converted to removals at age using the *S. mentella* age-length keys from the 1990-2006 EU surveys. Annual length weight relationships derived from Portuguese commercial catch were used for determination of mean weights-at-age.

On the first years of the assessment, before 1993, age group 8 was the most abundant and consecutive 1981-1984 cohorts were the most important in the commercial catch when passing through this age. In 1993-1995 the most abundant age group in the catch (including redfish bycatch) moved back to age 4 and 5, targeting prematurely the above average 1989 and 1990 cohorts at the beginning of the Div. 3M shrimp fishery. The implementation of sorting grids on shrimp trawl lead to even younger modal age groups: between 1996 and 2004 ages 1 and 2 were the most abundant on the redfish catch. Finally the drop of the shrimp catch to a low level over the last couple of years allowed the most abundant age group of the redfish catch to grow older again, to age 6. The above average year-classes of 1999 and 2000 were the most abundant in 2001-2002 (still from the redfish bycatch) and again in 2005 and 2006 (already as commercial catch).

ii) *Research survey data*

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.

Survey bottom biomass and survey female spawning biomass of Div. 3M beaked (*S. mentella* plus *S. fasciatus*) redfish were calculated based on the abundance at length from EU bottom trawl survey for the period 1988-2006 and on the Div. 3M beaked redfish length weight relationships from EU survey data for the same period. Female spawning biomass was calculated applying length maturity ogives derived from data collected during the 1992-94 and 1999 EU surveys.

Age compositions for Div. 3M beaked redfish EU survey stock and mature female stock in 1989-2006 were obtained using the *S. mentella* age length keys from the 1990-2006 EU surveys with both sexes combined. Mean weights-at-age were determined using the EU survey annual length weight relationships.

Survey results. Biomass indices (swept area method) from EU surveys are presented in the following table ('000 tons):

Year	Adult *S. mentella*	Adult *S. fasciatus*	Juvenile beaked redfish[1]	Total beaked redfish[1]
1988	-	-	-	160.4
1989	-	-	-	127.8
1990	-	-	18.1	89.1
1991	-	-	4.5	72.3
1992	80.5	6.0	32.4	118.9
1993	21.6	5.0	51.1	77.7
1994	40.1	8.8	55.8	104.7
1995	66.5	5.6	0.4	72.5
1996	87.3	12.4	0.5	100.2
1997	62.9	19.6	1.2	83.7
1998	50.9	7.2	1.6	59.7
1999	73.2	8.9	0.4	82.5
2000	100.2	14.5	3.0	117.7
2001	43.3	12.9	7.8	64.0
2002	46.0	26.0	35.2	107.2
2003	28.8	15.0	21.9	65.7
2004	46.0	76.2	34.8	157.0
2005	105.1	123.3	63.3	291.7
2006	105.8	319.4	35.8	461.0

[1] *S. mentella* and *S. fasciatus* mixed catch and referred to collectively as "beaked" redfish.

Total survey biomass, spawning biomass and abundance. The 1988-2006 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 has risen continuously to an historical maximum in 2006, three times above the level at the beginning of the survey series in 1988. Female spawning biomass is also growing though at a slower pace (Fig. 7.2).

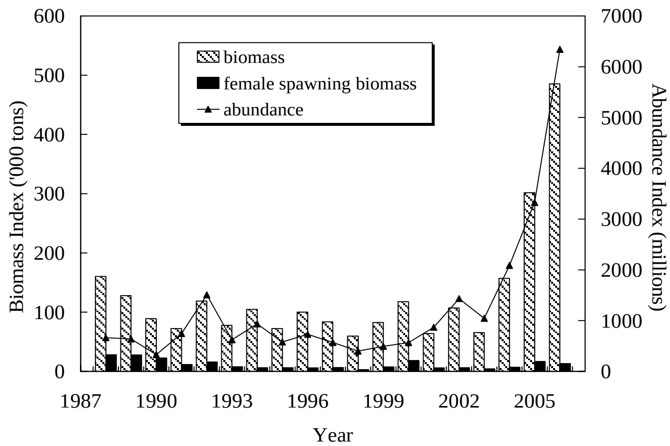


Fig. 7.2 Beaked redfish in Div. 3M: survey biomass, female spawning biomass and abundance from EU (1988-2006) surveys.

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 a minimum recorded in 1998 and 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 supported a rapid increase in stock (and exploited stock) survey abundance: historical high have also been attained in 2006. Since 1996 till 2004 the 1990 year-class was dominant within female spawners. The increasing number of maturing females from the 1990 year-class was responsible for the increase of the survey female spawners on 1999-2000 but it quickly fell afterwards till 2004, with the decline in the size of this cohort. In 2005 and 2006 the portion of young maturing females at age 6 from the 1999 and 2000 year-classes, together with an increasing number of mature female survivors from the previous cohorts, pull up this survey index to the vicinity of its high level on 1989-1990.

c) Estimation of Parameters

The expected proportion of mature females found at each age for Div. 3M beaked redfish was calculated using the mean proportion of mature females found in survey stock abundance-at-age. This female "maturity ogive" was used in the Extended Survival Analysis to get female spawning biomass estimates.

An Extended Survivors Analysis (XSA) (Shepherd, J. G. 1999 Extended survivors analysis: an improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci.*, **56**(5):584-591) for the period 1989-2006 was run. Natural mortality was assumed constant at 0.1. The input catch-at-age was as described above as was the observed female mature proportion at age. The month of peak spawning (larval extrusion) for Div. 3M S. mentella, was taken to be February, and was used for the estimate of the proportion of fishing mortality and natural mortality before spawning. It should be noted however that according to the data of Russian research for 1983-2002 (SCR Doc. 05/4) the peak of larvae extrusion took place in March-April. EU survey abundance at age was used for calibration. The XSA model specifications are given below:

Catch data from 1989 to 2006, ages 4 to 19+

Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1989	2006	4	18
Natural mortality is assumed 0.1 per year for all years, ages. Tapered time weighting not applied Catchability independent of stock size for all ages Catchability independent of age for all ages Terminal year survivor estimates not shrunk towards a mean *F* Oldest age survivor estimates not shrunk towards the mean *F* of previous ages Minimum standard error for population estimates from each cohort age = .500				

d) Assessment Results

XSA diagnostics show high standard errors associated to the average catchability at age and year patterns in catchability residuals, reflected on retrospective bias on fishing mortality, biomass and recruitment at age 4 (namely on the 1990 year-class, the most abundant cohort from the 1994-2001 period). Therefore STACFIS did not accept the XSA assessment but did consider the results for illustrative purposes only to indicate trends in the resource over time.

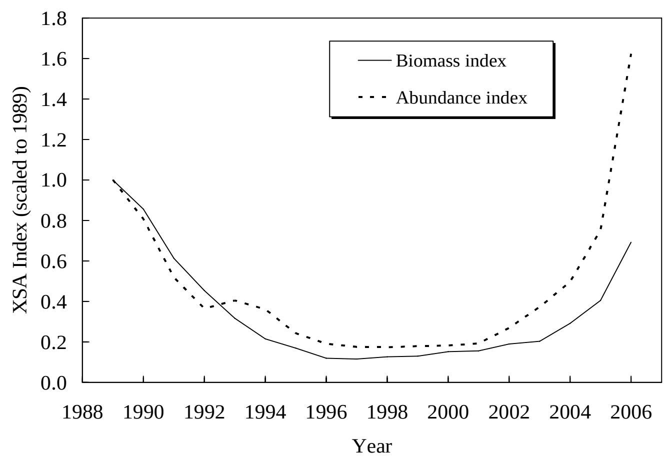


Fig. 7.3. Beaked redfish in Div. 3M: age 4+ biomass and Age 4+ abundance trends from XSA.

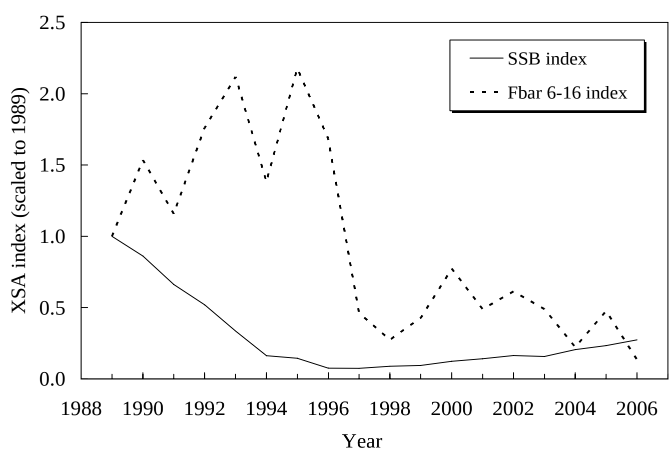


Fig. 7.4. Beaked redfish in Div. 3M: female spawning biomass and fishing mortality trends from XSA.

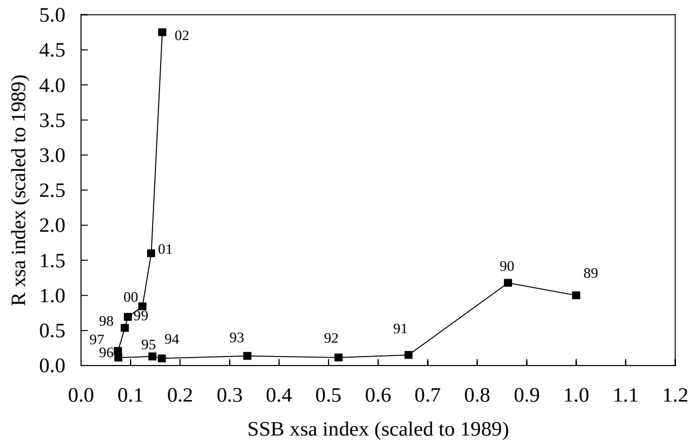


Fig. 7.5. Beaked redfish in Div. 3M: relative recruitment from XSA (year-classes indicated).

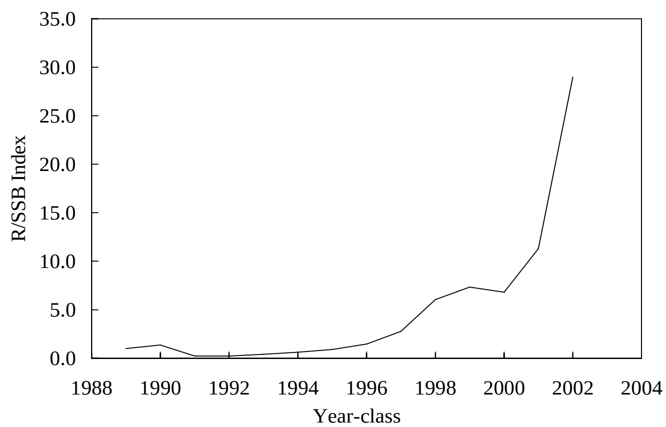


Fig. 7.6. Beaked redfish in Div. 3M: recruitment per thousand tons of SSB trend from XSA (recruits at age 4 four years later than SSB).

Biomass and abundance (Fig. 7.3): The fishable biomass experienced a steep decline from the 1989 to 1996. Biomass is growing since 1998 but at a slow rate until 2003, basically still supported by the biomass of those 1989 and 1990 cohorts and the biomass growth of incoming weak year-classes (1991-1997), that despite their small size survived at much higher rates than their predecessors. Abundance was kept stable at low level between 1996 and 2001. Over the most recent years biomass and abundance are increasing at a fast growth, putting exploitable biomass at a level only surpassed in 1989 and 1990 and abundance at the beginning of 2006 on the maximum of the assessment interval.

Fishing Mortality (Fig. 7.4): High commercial catches, at an historical maximum level between 1989 and 1993, lead to fishing mortalities at the top through the first half of the 1990s. Between 1996 and 1997 fishing mortality dropped and since then has been kept at a low level.

Spawning stock biomass (Fig. 7.4 and 7.5): Female SSB is growing continuously from 1998 onwards, still at a slow pace. Meanwhile the stock reproductive potential has increase substantially and above average year-classes are being generated by parental female stock with biomass sizes well bellow the ones that produced the previous abundant 1989-1990 cohorts.

Recruitment (Fig. 7.5 and 7.6): The 1993-1994 high bycatches in numbers at age 4 at the beginning of the 3M shrimp fishery depressed too early the abundant cohorts of 1989 and 1990, reducing their contribution to stock recovery. Since 2002 recruitment to exploitable stock comes from year-classes not only above the 1985-2002 average at age 4 but with their size increasing each year.

These trends from the XSA don't change the perception of previous assessments that this is still an unbalanced stock strongly leaning to the younger age groups, and that female spawning stock biomass should be allowed to recover to the former 1989-1990 level in order to stabilize the stock and the fishery at a safe zone.

With the recent growth of stock abundance and biomass, coupled with a significant decline of the 3M shrimp fishery, this goal becomes foreseeable in a closer future: it is now basically dependent on keeping fishing mortality stabilized at its present low level on the next coming years, and therefore allowing high survival rates through the 1998-2002 cohorts.

e) Reference Points

No updated information on biological reference points was available.

f) Research Recommendations

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

This stock will next be assessed in 2009.

8. American Plaice (*Hippoglossoides platessoides*) in Div. 3M

(SCR Doc. 07/10; SCS Doc. 07/6, 9)

Interim Monitoring Report

a) Introduction

A total catch of 46 tons was estimated for 2006 (Fig. 8.1).

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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	0.2	0.3	0.2	0.2	0.1	0.1	0.1[1]	0.1[1]	
STACFIS	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.05	0.05	

ndf No directed fishing.
[1] Provisional

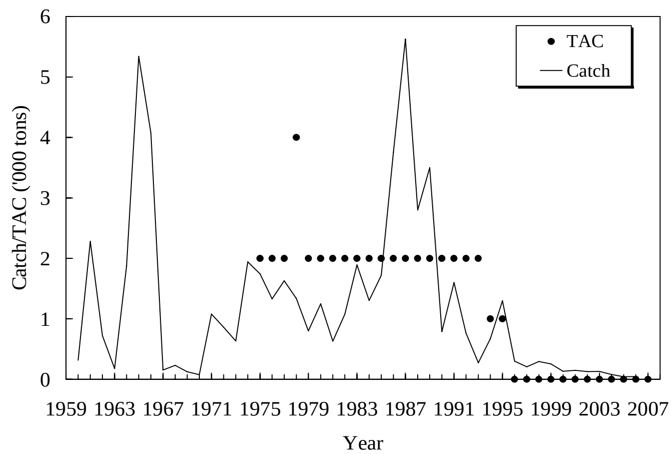


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs.

b) Data Overview

The EU bottom trawl survey on Flemish Cap was conducted during 2006. The survey estimates did not alter the perception of the stock status by STACFIS (Fig. 8.2 and 8.3). Recruitment has been poor since the 1990 year-class.

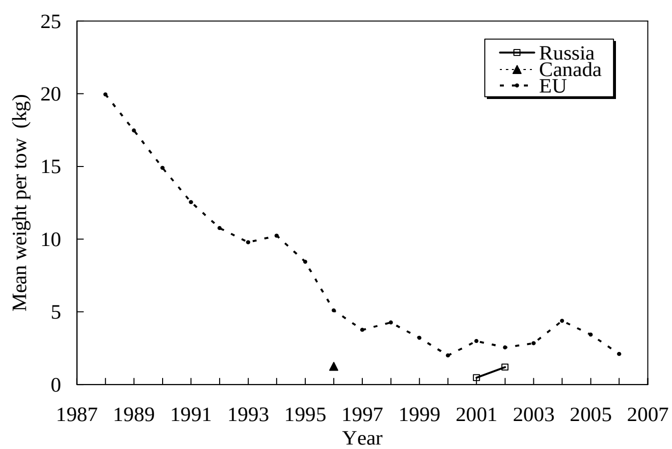


Fig. 8.2. American plaice in Div. 3M: mean weight per tow in the surveys.

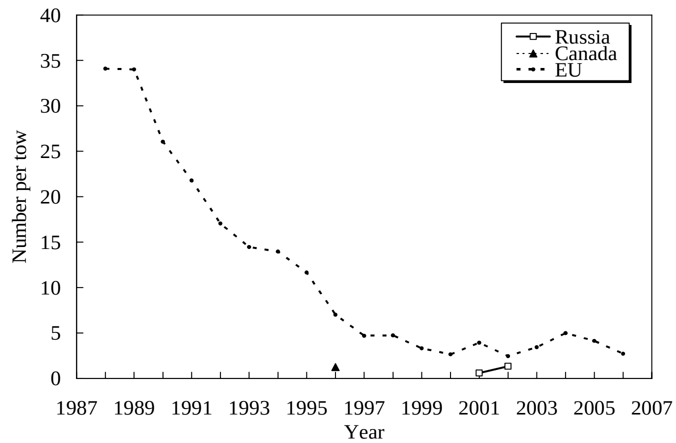


Fig. 8.3. American plaice in Div. 3M: mean number per tow in the surveys.

c) Conclusion

STACFIS noted that this stock continues to be in very poor condition, with only poor year-classes expected to recruit to the SSB for at least five years. Although the level of catches and fishing mortality since 1992 appear to be relatively low, survey data indicate that the stock biomass and the SSB are at a very low level. Due to the consistent year to year recruitment failure since the beginning of the 1990s there is no sign of recovery of this stock.

d) Research Recommendations

Average fishing mortality (F) in recent years has been very low relative to natural mortality (M). Therefore STACFIS reiterates its **recommendation** 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 for the next assessment of Div. 3M American plaice.*

This stock will next be assessed in 2008.

C. STOCKS ON THE GRAND BANK: Subarea 3, Div. 3LNO

Environmental Overview

The water mass characteristics on the Grand Banks are typical Cold-Intermediate-Layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0ºC during spring through to autumn. The winter formed CIL water mass is a reliable index of ocean climate conditions in this area. Bottom temperatures increase to 1-4ºC 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 4-8ºC due to the influence of warm slope water from the south. The general circulation in this region consists of the relatively strong offshore Labrador Current at the shelf break and a considerably weaker branch near the coast in the Avalon Channel. Currents over the banks are very weak and the variability often exceeds the mean flow. The area of bottom habitat on the Grand Banks covered by <0ºC water has decreased from near 50% during the first half of the 1990s to <15% during 2004 and 2006.

On the Grand Bank the winter formed CIL water mass, which is a robust index of ocean climate conditions, was below normal (implying warm conditions) across the Grand Bank for the ninth consecutive year in 2006. Spring bottom temperatures in Div. 3L ranged from <0ºC in the inshore regions of the Avalon Channel, from 0.5ºC to 1ºC over most of the shallow northern Grand Bank to >3ºC at the shelf edge. Over the central and southern areas bottom temperatures ranged from 1-3.5ºC and generally >3.5ºC along the southwest slopes of the Grand Bank in Div. 3O. The spring of 2006 had the third lowest area of <0ºC water in Division 3L since the surveys began in the early 1970s. In general, bottom water temperatures were above normal in most areas of the Grand Banks by 0.5-1ºC.

9. Cod (*Gadus morhua*) in Div. 3N and 3O

(SCR. Doc. 07/3, 18, 24, 36, 40, 05/9; SCS Doc. 07/6, 8, 9)

a) Introduction

Nominal catches increased during the late 1950s and early 1960s, reaching a peak of about 227 000 tons in 1967. During the period from 1979 to 1991, catches ranged from 20 000 to 50 000 tons. The continued reduction in recommended TAC levels contributed to the decline in catches to a level of about 10 000 tons in 1993 (Fig. 9.1). This stock has been under moratorium to all directed fishing both inside and outside the Regulatory Area since February 1994. Since the moratorium was introduced, the catch increased from 170 tons in 1995 and peaked at about 4 800 tons in 2003. The 2003 catch could not be precisely estimated but is believed to be between the range of 4 300-5 450 tons. The 2004 catch was estimated to be about 900 tons. This was the first year since 1999 that the catch was below 1 000 tons. The catch in 2005 and 2006 was estimated to be 736 tons and 601 tons, respectively.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.5	0.5	0.5	0.9	1.2	1.6	0.8	0.6[1]	0.3[1]	
STACFIS	0.5	0.9	1.1	1.3	2.2	4.3-5.5[2]	0.9	0.7	0.6	

[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.

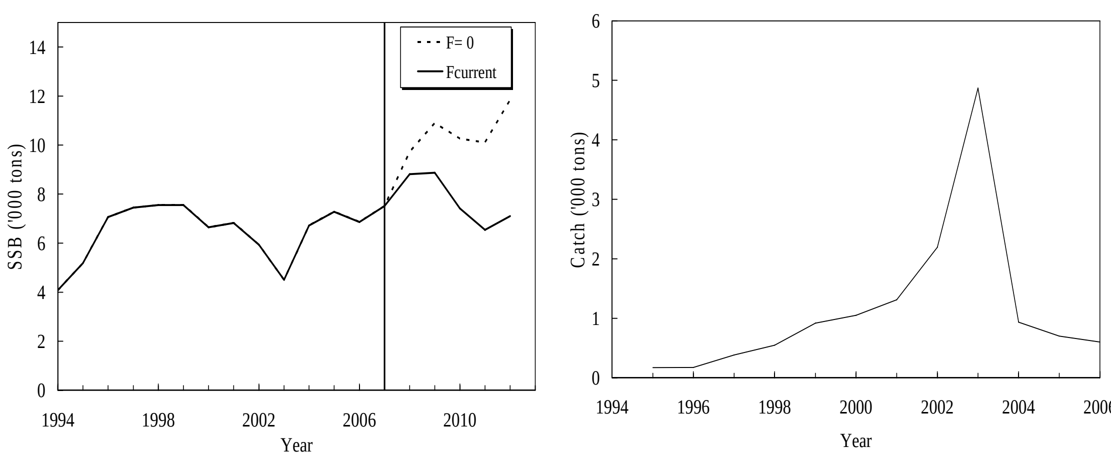


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) Input Data

i) *Commercial fishery data*

Catch rates. There was no catch rate information from cod directed fisheries since 1994.

Catch-at-age. Length and age sampling was available for Canada for 2005 and 2006. Age sampling was very sparse for the Canadian fleets for 2006. Length sampling was available for 2005 from EU-Spain and Russia and 2006 from EU-Portugal. Catch-at-age from 2005 and 2006 for EU-Portugal, Russia and EU-Spain was obtained by applying Canadian survey age length keys to length frequencies collected each year. The catch in 2005 was dominated by ages 7-9 while in 2006 it was dominated by ages 3-5.

ii) ***Research survey data***

Canadian spring surveys Stratified-random surveys have been conducted in spring by Canada in Div. 3N during the 1971-2005 period, with the exception of 1983, and in Div. 3O for the years 1973-2005 with the exception of 1974 and 1983. Coverage in the 2006 survey was too limited to be used as an index of this stock.

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

The Canadian spring mean number per tow series declined from 1984 to 1989, with the exception of 1987, when the largest value in the time series was observed. The 1991 and 1993 spring surveys indicated increased catches of cod. Over the period from 1994 to 1997, the Canadian spring index was the lowest observed in the series, showed improvement from 1998 to 2000 then subsequently declined to 2004. There was an increase in 2005, but all values since 1993 have been very low (Fig. 9.2).

Canadian autumn surveys Additional stratified-random surveys have been conducted by Canada during autumn since 1990. Results from 1990 to 1992 surveys were the largest in the time series (Fig 9.2). The trend since 1993 is similar to the spring series. The period from 1996-1997 was the lowest in the series showing an increase to 2000 then a subsequent decline to 2004. Estimates in 2005 and 2006 are higher but still well below the levels of 1990-92.

Canadian juvenile surveys Canadian autumn juvenile survey data were available for the period 1989-94. The index increased from 1989 to 1991, and declined steadily from 1992 to 1994 (Fig. 9.2).

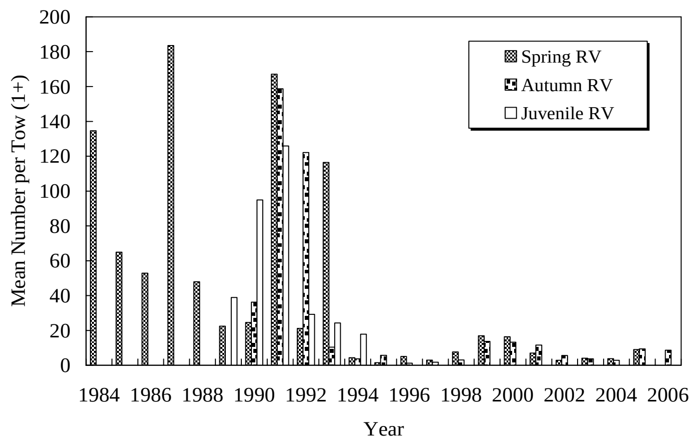


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian RV surveys.

Canadian Cooperative Industry surveys. Fixed station grid surveys conducted in July by a Canadian based fishing company in cooperation with the Canadian Department of Fisheries and Oceans were available for the period 1996 to 2004 for Div. 3NO. These surveys were designed to gather information for yellowtail flounder but also record information for cod. The area of coverage is about 9 500 square nautical miles or approximately 27% of the area of Div. 3NO less than 200 fathoms. The surveys conduct one hour tows at the stations with the same trawl and configuration throughout the series. Catch rate of cod (kg/hour) increased from about 70 kg in 1997 to 193 kg in 1999, declined sharply to about 70 kg in 2000 and was stable to 2002. Catch rate declined to 2004 at the lowest level in the time series at about 36 kg (Fig. 9.3). These surveys have been discontinued.

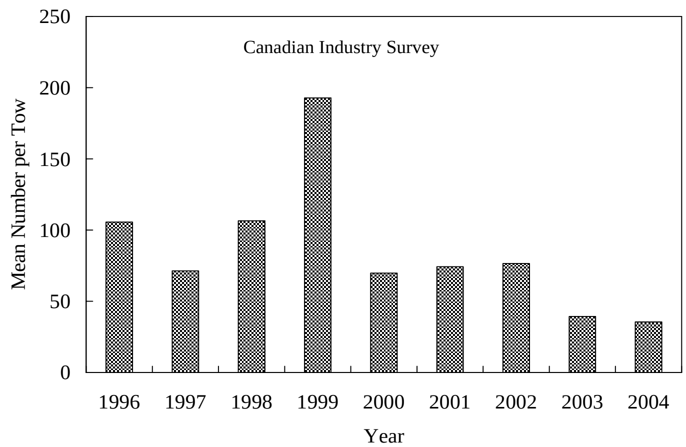


Fig. 9.3 Cod in Div. 3NO: mean number per tow from Canadian Industry surveys conducted in July.

Spanish Div. 3NO surveys. Stratified-random surveys were conducted by Spain in the NRA area of Div. 3NO in June from 1995-2006. The series began utilizing a Pedreira trawl on the C/V Playa de Menduiña then converted to a Campelen 1800 trawl on the R/V Vizconde de Eza in 2001. The 1997-2000 data were converted into Campelen units by modeling data collected during comparative fishing trials in 2001. The data for 1995-96 were not presented because the deeper strata in the area of coverage were not sampled. The mean weight per tow increased from 2.5 kg in 1997 to 19.5 kg in 1998 then declined to 3.5 kg in 1999 (Fig. 9.4). The index increased again to 37 kg in 2001 then declined rapidly to 11 kg in 2002. Estimates for 2003-2005 varied between 4 and 6 kg. There was a large increase in 2006 to 23 kg/tow.

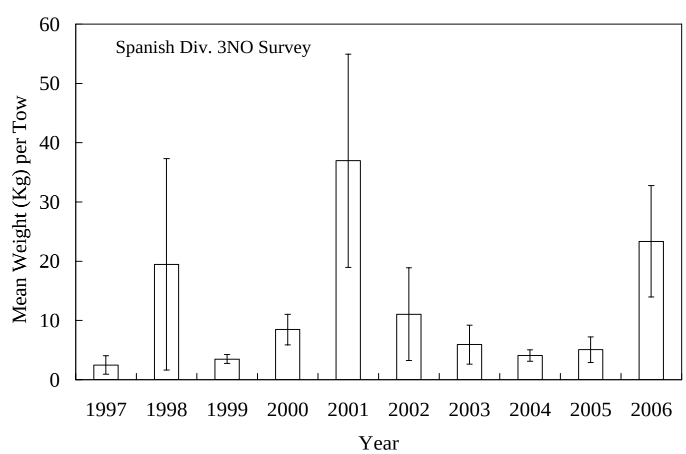


Fig. 9.4. Cod in Div. 3NO: mean number per tow from Spanish Div. 3NO surveys.

c) Biological Studies

The stock recruit relationship was examined for cod in Divisions in comparison with cod in 2J+3KL, and American plaice in Divisions 3LNO and 3M. All these stocks have been at a very low level for more than 10 years. The similarity of the population dynamics pattern were examined. The stock recruit relationships were examined to determine the SSB zone where collapse occurs. It was concluded in this study that prospects for recovery of cod in Div. 3NO are minimal.

The effect of temperature on growth and condition of cod in Div. 3NO was examined. Both the average temperature occupied and the area weighted temperature (available temperature) increased in the spring starting in about 1990. Trends are less clear in the autumn data which only begins in 1990. There was no significant effect of temperature on the residuals from a model of weight increment vs. age applying time-invariant parameters. When temperature was included as a factor in a modified Von Bertalanffy growth model there was a significant effect of temperature on growth in length, but the effect was negative, with fish growing less when temperatures were higher. There was also a significant effect of temperature on relative body and relative liver condition. Condition was generally higher at low and high temperatures than at intermediate temperatures.

d) Estimation of Parameters

Sequential population analysis (SPA). An ADAPT was applied to catch-at-age calibrated with the Canadian spring, autumn and juvenile survey data (ages 2-10) to estimate population numbers in 2007. Numbers at age 12 were also estimated from 1994-2006. In the estimation, an F-constraint was applied to age 12 from 1959-93 by assuming that fishing mortality was equal to the average fishing mortality over ages 6-9. Natural mortality was assumed fixed at 0.2 for all years and ages.

e) Assessment Results

The SPA results calibrated with the three survey indices indicate that the stock is estimated to be at an extremely low level. The estimated spawner biomass for 2007 is 7 500 tons (Fig. 9.5).

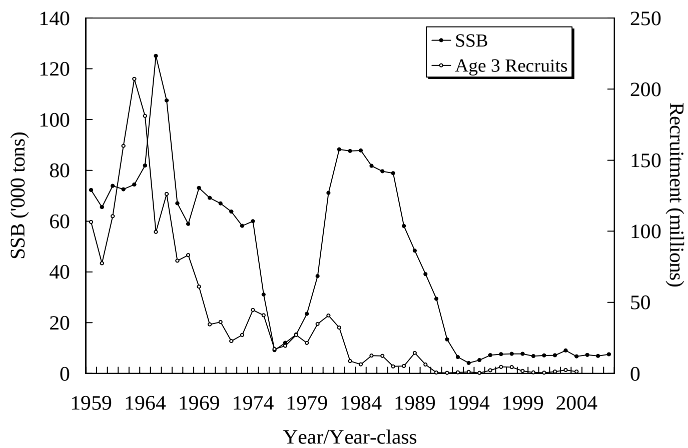


Fig. 9.5. Cod in Div. 3NO: time trend of spawner stock biomass (SSB) and corresponding recruitment from the SPA.

Prior to 1990, fishing mortality was usually higher on older ages (6-9). Since then, *F* has generally been higher on younger ages (4-6) (Fig. 9.6). The fishing mortality averaged over 2004 to 2006 for ages 4 to 6 is 0.14, but in 2006 it was 0.22. The level of fishing mortality in 2006 is comparable to that 1980s when catch averaged over 30 000 tons. The SSB increased slightly in 2003 as a result of slightly better recruitment in 1997 and 1998, but this was reduced by 25% by the large catch in that year (a 4 800 tons catch was used in the SPA which was the midpoint in a range that could not be precisely estimated). Population abundance and SSB have been relatively stable since then. The current assessment is consistent with the assessment conducted in 2005. Projections in 2005 indicated that at $F = 0$ the SSB would grow slightly to 2009 before declining. At the *F* at that time (F_{bar} 4-6 = 0.5) the population was projected to decline. Since the last assessment Fbar 4-6 has been much lower than 0.5.

Estimates of recent year-class size indicate that recruitment has been very low since the 1990 year-class. Low spawner biomass, low recruitment and the current level of fishing mortality point to poor prospects for this stock in the future. Recovery will require a number of relatively strong year-classes that survive to maturity, rebuilding the spawner biomass.

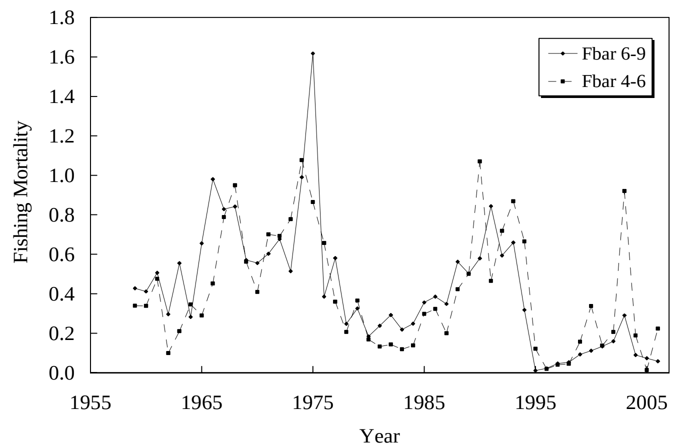


Fig. 9.6. Cod in Div. 3NO: time trend of average fishing mortalities from the SPA.

f) Reference Points

In April 2003 the Scientific Council re-iterated that 60 000 tons is the current best estimate of B_{lim} (Fig. 9.7). In the recent period of low productivity (since 1982), there is an indication of even further reduction in recruitment at about half the B_{lim} level. In view of the difficulty in determining if the current low productivity will persist in the immediate future, a detailed review of the biological reference points in the context of the PA framework when the SSB has reached half the current estimate of B_{lim}. The current estimate of SSB is 7 500 tons which is 12% of B_{lim}.

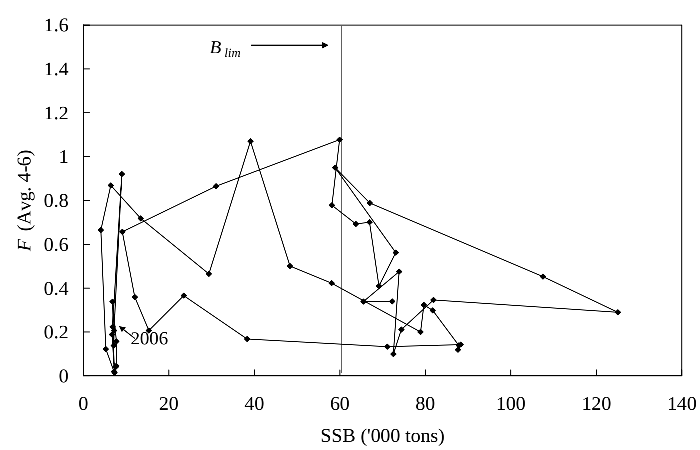


Fig. 9.7.Cod in Div. 3NO: stock trajectory 1959-2006.

Medium-term considerations. Deterministic projections were carried out to project spawning stock biomass over five years assuming fixed recruits-per-spawner rate, weight-at-age, natural mortality, and current fishing mortality (all averages over final three years of SPA) as well as F = 0. Input data for the projections are tabled below. The partial recruitment vector was computed by averaging the PR vector over the last three years, then re-scaling this vector by the mean values over ages 4 to 6. The average R/S from 2001-2003 is about 0.17 compared to a historical average of 0.72 from 1959-2003.

Table 9.1. Cod in Div. 3NO: input data for Deterministic Projections.

	Age	3	4	5	6	7	8	9	10	11	12
M		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Avg wt (3yrs)		0.40	0.85	1.41	2.16	2.91	3.70	4.82	7.03	8.81	11.13
Mats at age 2008-2012		0.01	0.04	0.34	0.89	0.99	1	1	1	1	1
Projection PR		0.41	0.89	1.28	0.82	0.67	0.87	0.70	0.46	0.34	0.28
$F_{current}$(3 yrs)		0.14									
Avg R/S (3 yrs)		0.17									

The projections indicate that after some small increase under conditions of current F, SSB declines slightly by the end of the projection period (Fig. 9.8). Under the F = 0 scenario there is some increase in SSB over the time period of the projection with SSB reaching 11 800 tons by 2012. The SSB is 1.6 times higher at the end of the projection period under the F = 0 scenario than at F = current. In both scenarios SSB remains at extremely low levels compared to historic values and well below Blim.

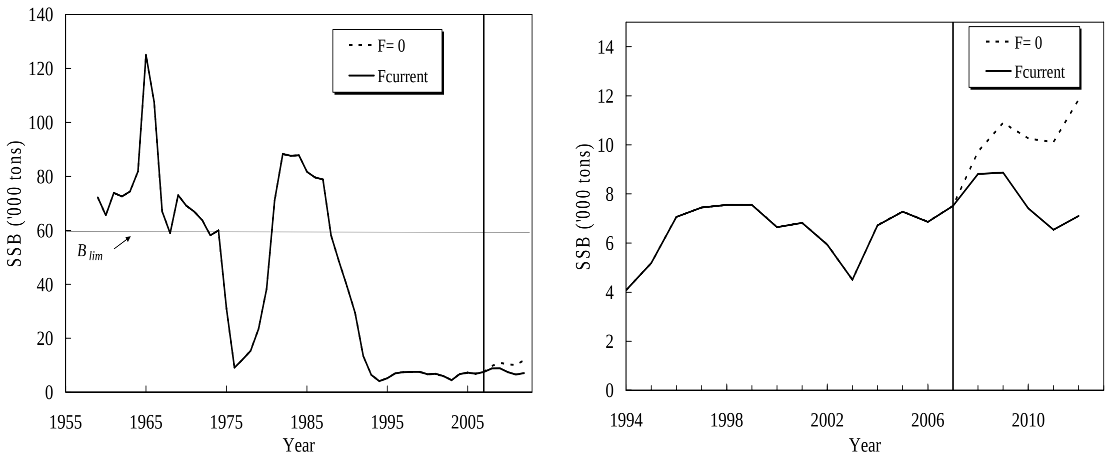


Fig. 9.8. Cod in Div. 3NO: deterministic projections under F = 0 (dashed line) and $F_{current}$. Panel at right highlight trends since 1994.

This stock will next be assessed in 2010.

10. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3L and 3N

(SCR Doc. 07/38; SCS Doc. 07/6, 8, 9)

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 and are often referred collectively to as "beaked redfish".

The average reported catch from Div. 3LN from 1959 to 1985 was about 22 000 tons ranging between 10 000 tons and 45 000 tons. Catches increased sharply from about 21 000 tons in 1985, peaked at an historical high of 79 000 tons in 1987 then declined steadily to about 450 tons in 1996. Catch increased to 900 tons in 1998, the first year under a moratorium on directed fishing, with a further increase to 3 100 tons in 2000. Catches declined again in 2001-2003 and were stable in 2004-2005 at 650 tons level. Catch recorded an historic low of 496 tons in 2006.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.9	1.8	1.5	0.9	1.0	1.3	0.7	0.7	0.2	
STACFIS	0.9	2.3	3.1	1.4	1.2	1.3	0.6	0.7	0.5	

ndf No directed fishing

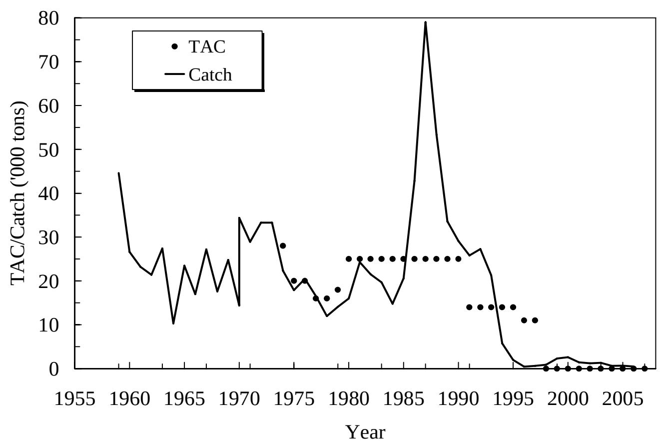


Fig. 10.1 Redfish in Div. 3LN: catches and TACs.

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 bycatch for those fleets in 2003 and 2005 and 2003-06 respectively. The overall mean length of the 1990-2006 catch was used to derive the anomalies of the mean length on the Div. 3LN beaked redfish commercial catch over this period. The proportion of small redfish in the catch (less than 20 cm) was calculated as well. Stability in the length structure of the catch/bycatch from 1990-2006 occurs at a mean length within the range of 27-32 cm with no clear trend in mean length anomalies detected over the period. Higher negative anomalies in 1991, 1992, 2003 and 2006 are associated with above average recruitment to the exploitable stock at ages 4-5.

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 3N and Nov-Dec 3L for most years). No survey was carried out in spring 2006 on Div. 3N. Russia also conducted a spring bottom trawl survey in Div. 3L (1983-1994) and Div. 3N (1983-1993).

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 bellow 732 m depth, most on Div. 3L. Until the autumn of 1995 the Canadians surveys were conducted with an Engels 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.*, 1998:76).

In general, the Canadian spring survey index for Div. 3L from 1992 to 1995 suggests the stock was at its lowest level relative to the time period prior to 1986 for surveys conducted in the first half of the year. A similar contrast occurs in the Canadian autumn survey index for Div. 3L from 1992 to 1995 relative to a time period prior to 1986 for surveys conducted in the second half of the year. Comparison of the winter/spring Canadian and spring Russian bottom trawl surveys in Div. 3L indicate a similar trend of decline in density estimates from 1984 to 1990 and stability at a low level till 1994. The situation is unclear for Div. 3N with both 1991-1993 summer/autumn Canadian and spring Russian surveys showing dramatic year to year changes of their indices but of opposite sign. However, when Div. 3L and Div. 3N biomass indices from either Canadian spring and autumn surveys are summed up to give a picture of the relative size of this redfish management unit as a whole (Fig. 10.2), both surveys suggest an increase in the size of the stock from 1996 onwards despite the wide inter annual fluctuations of the indices.

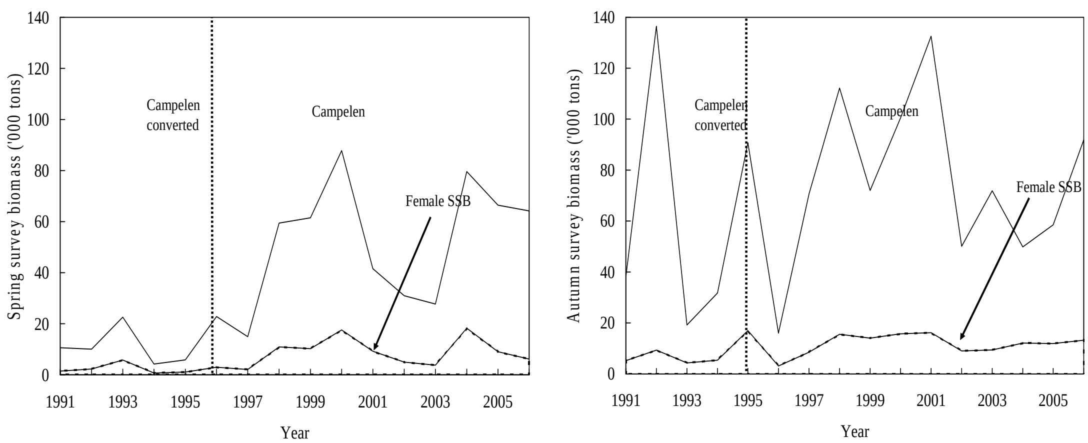


Fig. 10.2. Redfish in Div. 3LN: survey biomass and female spawning biomass , 1991-2006

The 1992 autumn indices for Div. 3N have an anomalously high magnitude (the highest for the two surveys and divisions) while staying between relatively low indices from the neighbouring years of 1991 and 1993. The 1992 mean weight per tow estimate for Div. 3N is associated with a large error, the highest for the two series and Divisions. The original 1992 autumn survey index for Div. 3N was not well sampled and therefore considered unrepresentative. The 1992 autumn survey indices for Div. 3L were used to generate a new 1992 index for Div. 3N, assuming that the relative size of the survey indices for Div. 3N compared to Div. 3L were constant between 1991 and 1992. The same assumption was used to generate a 2006 spring survey index for Div. 3N based on the 2006 spring survey index for Div. 3L, since no survey data are available for Div. 3N in the terminal year of the assessment.

In order to reduce the wide inter-annual variability of both surveys and detect trends within stock dynamics, the original biomass and female SSB annual values were replaced by 3-year moving averages. Each of the two moving average survey biomass series was standardized to the mean so that spring and autumn trends of the stock size could be easily compared (Fig. 10.3). Redfish survey biomass in Div. 3LN increased from well below the average in the first half of the 1990s, to well above average by the end of the 1990s. Subsequently, the survey biomass declined to just below average in 2002-2003 before increasing again over the most recent years.

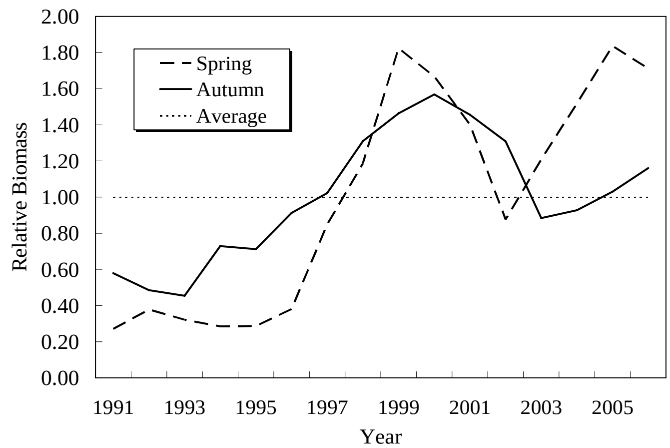


Fig. 10.3. Redfish in Div. 3LN: relative spring and autumn survey biomass, 1991-2006.

The overall 1991-2006 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. 10.4). 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 1990s. From 2001 onwards most of the length anomalies from either survey are close to the respective overall means. The relative small magnitudes of length residuals together with the lack of a clear pattern over time suggest stability on the length structure of the population in recent years. With the exception of the negative autumn survey anomalies of 1991 and 1992 which are associated with a pulse of recruitment from the late 1980's that correspond to mean lengths of 16.4 and 19.7 cm respectively there are no further signs of recruitment detected.

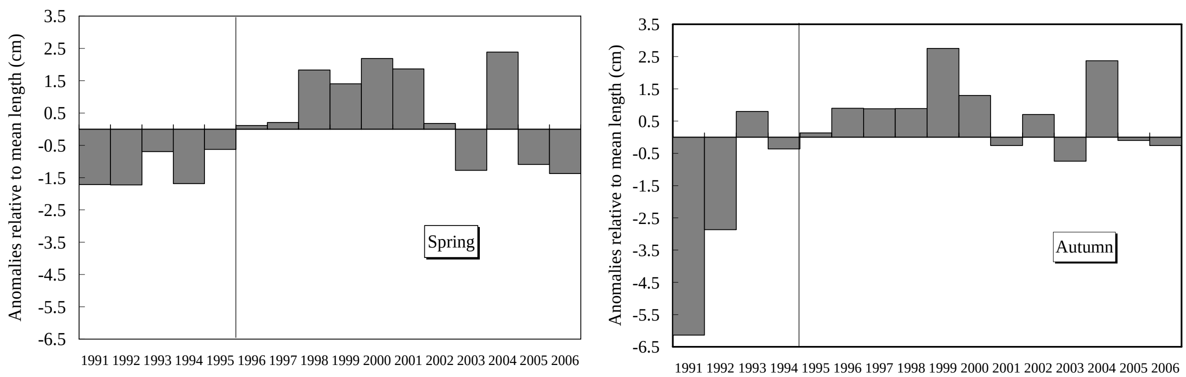


Fig. 10.4. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2006.

iii) *Recruitment*

There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN in the range of 12-14 cm for 1991 and 15-18 cm for 1992. There is no sign of any good year-classes since then.

c) Estimation of Stock Parameters

i) ***Relative exploitation***

Ratios of catch to spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy of fishing mortality. Spring survey series was chosen since is usually carried out on Div. 3L and Div. 3N during May till the beginning of June, and so can give an index of the average biomass at the middle of each year. The Div. 3LN STACFIS catch was used together with a spring survey biomass series smoothed by 3-year interval moving averages (Fig. 10.5).

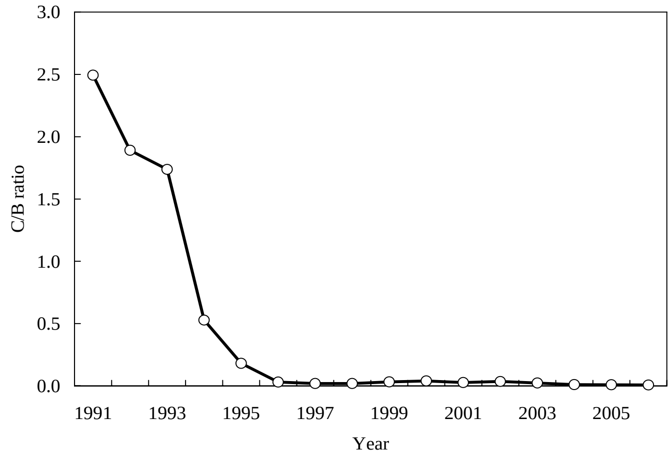


Fig. 10.5. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (moving average biomass, 1991-2006).

Catch/Biomass ratio declined continuously from 1991 to 1996, with a dramatic drop between 1993 and 1994. From 1996 onwards this proxy of fishing mortality is kept at a level close to zero.

ii) ***Size at maturity***

Maturity gives 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 non-equilibrium surplus production model (ASPIC; Prager, 1994, 2004 and 2007) was used to assess the status of the stock. The model incorporated catches from 1959-2006 (conditioned on a 1959-1994 CPUE series from STATLANT 21 data, used in the 1997 assessment), and spring and autumn survey biomass (1991-2006). All input series of biomass indices were given equal weight in the analysis. In this assessment the ASPIC version 5.16 fit the logistic form of the production model (Schaefer, 1954).

Different arrangements of each biomass index were used to explore the goodness of fit of the model under different data formulations. Due to the short time overlap between CPUE and surveys (4 years on 48 years of data) the assessment assumes that CPUE time series basically represent the abundance of the stock during the former period of the 1960s, 1970s and 1980s while surveys time series basically represent the abundance of the stock during the more recent period of the 1990s and 2000s. With such a short time overlap, the two pair-wise negative correlations found among STATLANT CPUE and the survey series, each based on just four pairs of observations, have been disqualified to halt the ASPIC assessment. Therefore only negative correlations between the model and any of the input series of biomass indices, or between the two surveys, were considered a violation of the fundamental assumption of ASPIC that all indices represent the abundance of the stock.

In order to reduce non explained variability and improve the fit of the ASPIC model to the available biomass indices two different categories of the data set formulations were considered: one based on the original annual values of each biomass index and the other where the annual values were smoothed by 3-year moving averages. Eleven ASPIC formulations were run in FIT mode corresponding to eleven possible arrangements of the three data series. An overview of the exploratory analysis lead to four main conclusions (1) The use of original autumn 1992 survey biomass jeopardize the ASPIC run with either option of data arrangement (observed annual data or moving averages) (2) Moving average formulations allow a better ASPIC fit than the one with the original annual data series (3) Moving average formulations with the STATLANT CPUE series ending in 1994 allow a better ASPIC fit than the one with the STATLANT CPUE series ending in 1991 to avoid overlap (and negative correlations) among CPUE and survey series (4) No significant improvement on ASPIC FIT is obtained by shortening the length of the STATLANT CPUE series at its beginning.

From the initial set of eleven ASPIC formulations a selection of four with better diagnostics was chosen for comparison of deterministic results. All runs give a similar picture of the stock as regards its carrying capacity and biomass level in the first year of the assessment, rate of stock biomass increase, maximum sustainable yield, fishing mortality on the last year of the assessment (2006) and biomass at the beginning of next year, and biomass and fishing mortality trajectories (relative to B_{msy} and F_{msy} respectively). Having better diagnostics than the formulation with non-modified annual values or the one with the STATLANT 21 CPUE series ending in 1991 (in order to have just one year overlap with the surveys data series and so avoid negative correlations among the series) the moving average formulation that incorporates both CPUE and spring and autumn survey series in their full extension was adopted to pursue with the assessment framework.

While recognizing ASPIC as a useful tool to carry out an analytic assessment of this stock, STACFIS didn’t accept this assessment based on two major concerns regarding the chosen input formulation:

Regardless of the wide inter-annual variability of the observed CPUE and survey data and poorer fit of the model, the original values of each biomass index provide very similar results namely as regards relative biomass and fishing mortality trajectories and should be used instead of moving averages;

From the early 1980s to the beginning of the 1990s, when catches were quickly raised from a previous average level of 21 000 tons (1965-1985) to a much higher average level of 41 500 tons (1986-1992), including a peak of 79 000 tons in 1987, available survey data from Canadian summer survey on Div. 3L (1978-1979, 1981, 1984-1985, 1990-1991 and 1993) and Russian trawl survey on Div. 3LN (1983-1993) suggests that stock size suffered a substantial reduction. However throughout this period stock dynamics from ASPIC basically rely on the CPUE series. In order to capture the full extent of this former stock decline ASPIC input should include the observed biomass indices from the two above mentioned survey series.

Therefore, 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 interim assessment of redfish in Div. 3LN at the June 2008 Scientific Council meeting.*

Interpretation of stock size indices remains difficult for this stock. Nonetheless, both CPUE and survey biomass indices available for the early 1990s are considerably lower than those from the 1980s, indicating a reduced stock size. The assemblage of Div. 3L and 3N Canadian spring and autumn survey indices suggests that stock was higher in the mid-2000s than in the early 1990s in terms of, biomass, female spawning biomass and abundance.

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. Stock length structure has been improving over the 1990s 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.

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.

This stock will next be assessed in 2010.

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3L, 3N and 3O

(SCS Doc. 07/6, 8, 9, 12; SCR Doc. 07/35, 56, 62)

a) Introduction

This fishery has been under moratorium since 1995. Total catch in 2006 was 2 828 tons, mainly taken in the Regulatory Area (Fig. 11.1). Catch increased from 1995 to 2003 and then decreased.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	nf	nf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	1.6	2.4	2.6	3.0	3.1	3.8	2.9	2.3[1]	0.9[1]	
STACFIS	1.6	2.6	5.2	5.7	4.9	6.9-10.6[2]	6.2	4.1	2.8	

[1] Provisional
[2] In 2003, STACFIS could not precisely estimate the catch
nf = No fishing
ndf = No directed fishing.

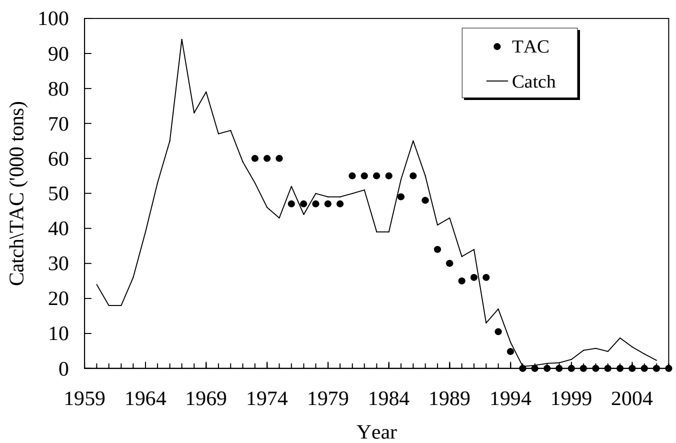


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs.

b) Input Data

i) *Commercial fishery data*

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

Catch-at-age. There was age sampling of the 2005 bycatch in the Canadian fishery and length sampling of bycatch in the Canadian, Spanish and Russian fisheries. There was no length sampling of bycatch from the Portuguese fishery in 2005 and no age sampling in the Canadian fishery in 2006. Catch-at-age in the Canadian bycatch was mainly age 7 to 11 with a peak at age 7 in 2005. In 2006, the Canadian catch of American plaice was only 94 tons, due to an almost complete halt to the Canadian yellowtail flounder fishery. Only one length frequency was taken and no otoliths were collected.

In 2005, the peak in length for the Spanish bycatch for Div. 3LNO was 39-40 cm. In the Russian fleet most of the by catch in Div. 3L was 20-60 cm fish and in Div. 3N the catch was predominated by fish 34-37 cm in length.

In 2006, the peak in length for the Portuguese trawler fleet in Div. 3L was between 26-30 cm, in Div. 3N two peaks in length at 36 cm and 50 cm dominated the catch and in Div. 3O in the 130 mm trawl catches there are two peaks in length at 36 and 54 cm; in the 280 mm trawl catches the dominant peaks are at 36 cm and between 48-52 cm. In the Spanish bycatch, most of the catch was between 33-42 cm in length in Divs. 3LNO. In the Russian bycatch in Div. 3L the bulk of the catch was made up of fish 20-60 cm in length, and in Div. 3O the catch was made up of fish 42-44 cm.

Total catch-at-age for 2005 and 2006 was produced by applying 2005 Canadian survey age-length keys to length frequencies collected each year by EU-Spain, EU-Portugal and Russia and adding it to the catch-at-age calculated for Canada. This total was adjusted to include catch for which there were no sampling data. Overall, ages 7-11 dominated both the 2005 and 2006 catches.

ii) ***Research survey data***

Canadian stratified-random bottom trawl surveys. Data from spring surveys in Div. 3L, 3N and 3O were available from 1985 to 2005. The spring survey from 2006 did not adequately cover many of the strata in Div. 3NO and therefore results were not comparable. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 2006, the depth range has been extended to at least 731 m in each survey.

In the spring survey 2005 the biomass (mean weight per tow) estimates for Div. 3LNO increased from the 2004 values and are showing an increasing trend overall since the mid-1990s. From 1996 to 1998 the estimate for Div. 3N biomass was approximately half of the estimate for Div. 3O while from 1999 to 2004 the estimates in the two divisions are similar. However, in 2005 the biomass estimate from Div. 3N is almost double the biomass estimate from Div. 3O. Biomass in Div. 3LNO combined was the highest it has been since 1996 but is still only 30% (Campelen estimates compared to Campelen equivalents) of that of the mid 1980s (Fig. 11.2).

Biomass continues to be distributed more to the south compared to historically, with less than 40% of the biomass distributed north of 45ºN in 2005, compared to more than 80% during the mid 1980s.

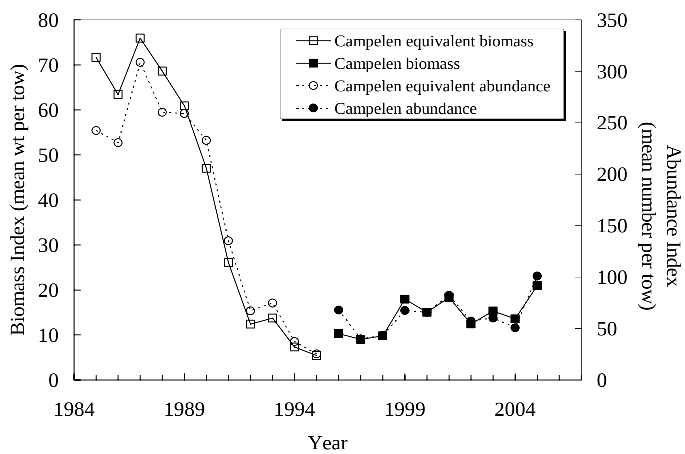


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys.

Abundance (mean number per tow) for Div. 3LNO declined during the late 1980s to early 1990s. Abundance has fluctuated since 1996 with perhaps a slight increase over the period (Fig. 11.2). As with the biomass estimate, mean number per tow has shown the greatest decline in Div. 3L. The proportion of fish that are ages 0 to 5 has been increasing and in recent years and has been amongst the highest in the time series. However, these ages are probably ‘under converted’ in the 1985 to 1995 data.

There is no conversion of the Canadian spring and autumn survey data series to Campelen equivalents prior to 1985. However, the index from the spring survey using Engel-equivalent data indicates that the biomass level in the mid-1980s was slightly lower than that in the late-1970s (Fig. 11.3).

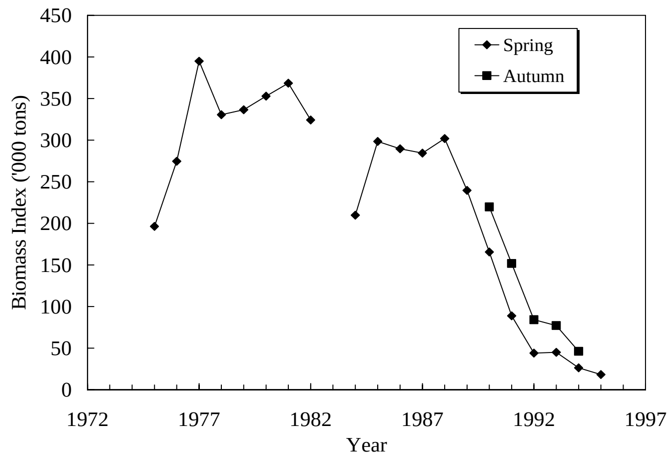


Fig 11.3. American plaice in Div. 3LNO: biomass index as swept area estimates from Canadian spring and autumn surveys using Engel and Engel equivalent units.

In 2004, coverage of strata from Div. 3L in the Canadian autumn survey was incomplete, and results were not used in the 2007 assessment. This point will be examined with respect to abundance at age by strata to evaluate the importance of the missing strata to the overall index and may be included in the next assessment.

From Canadian autumn surveys the biomass (mean weight per tow) index for Div. 3LNO in the autumn has shown a slight increasing trend since 1995 but remains well below the level of the early-1990s with the average of the 2006 estimate being 34% of the level of 1990 (Fig. 11.4). Mean weight-per-tow showed the largest decline in Div. 3L but has been fairly stable since the late 1990s. During 1995 to 1997, Div. 3N constituted on average 40% of the Div. 3NO total while the average since 2000 has been about 70% of the Div. 3NO total.

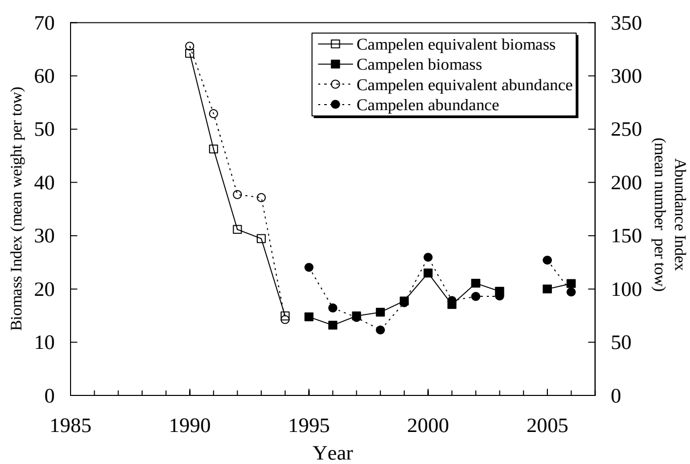


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys.

Abundance showed a substantial decline from 1990 to 1998 but has been somewhat higher since 1998 (Fig. 11.4). The largest decline was once again in Div. 3L. The age composition has been fairly stable over the 1990-2006 time period.

Spanish Div. 3NO Survey. Surveys have been conducted annually from 1995 to 2006 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 462 m (since 1998). In 2001, the trawl vessel (*C/V Playa de Menduiña*) and gear (Pedreira) were replaced by the *R/V Vizconde de Eza* using a Campelen trawl. Annual Canadian spring RV age length keys were applied to Spanish length frequency data (separate sexes, mean number per tow) except in 2006 where there were problems with the Canadian spring survey, and the combined 1997-2005 age length keys were applied to the 2006 data. The age composition for this survey was similar to the Canadian RV spring survey. The biomass and abundance values in 2006 were the highest in the time series from this survey (Fig. 11.5).

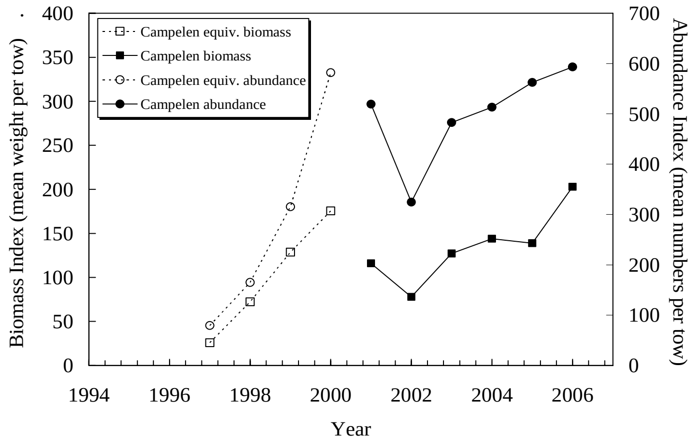


Fig. 11.5 American plaice in Div. 3LNO: biomass and abundance indices from the Spanish Div. 3NO survey.

iii) ***Biological studies***

Maturity. Age (A_{50}) and length (L_{50}) at 50% maturity were derived from spring research vessel data. For males, A_{50} were fairly stable for cohorts of the 1960s to mid 1970s. Male A_{50} then began a fairly steady decline to the 1991 cohort which had an A_{50} of just over 3 years. Male A_{50} has increased somewhat but is still below the 1960s and 1970s with an A_{50} of about 4 years compared to 6 years at the beginning of the time series. For females, estimates of A_{50} have shown a large, almost continuous decline, since the beginning of the time series. The A_{50} for recent cohorts is about 7 years compared to 11 years for cohorts at the beginning of the time series.

L_{50} has declined for both sexes but recovered in recent cohorts. The current L_{50} for males of about 20 cm is similar to the earliest cohorts estimated (1966). The L_{50} of most recent cohorts for females is in the range of 34-36 cm, somewhat lower than the 39 cm of the earliest cohorts.

Size-at-age. Mean weights-at-age were calculated for male and female American plaice for Div. 3LNO using spring survey data from 1990 to 2005 and mean lengths-at-age using data from 1985-2005. Means were calculated accounting for the length stratified sampling design. There is little indication of any trend over the time period in either mean length or weight-at-age, although a slight increase in size-at-age has been noted for some ages in recent years.

Mortality from surveys. Estimates of total mortality (*Z*) from the Campelen or equivalent, spring and autumn survey data were calculated for ages 1 to 16. Both surveys indicate an increase in mortality up to the mid-1990s and a decline afterwards. Mortality has shown some slight increase in the last few years in the spring survey, although the last estimate is lower in most ages.

c) Estimation of Parameters

Virtual population analysis (VPA) was conducted using the ADAPTive framework with catch-at-age and survey information up to 2006. STACFIS previously recommended that several exploratory analyses of the ADAPT model using alternative data sets and model formulation should be evaluated (*NAFO Sci. Coun. Rep.*, 2005, pg. 143).

Analyses with alternative data sets than that used in the previous assessment were reviewed, and STACFIS agreed to use the following data based on model fit:

- Canadian spring RV survey (1985-2005) (ages 5-14);
- Canadian autumn RV survey (1990-2003) (ages 5-14);
- Canadian autumn RV survey (2005-2006) (ages 5-14); and
- EU-Spain survey (1998-2006) (ages 5-14).

Both Canadian RV autumn 2004 and spring 2006 survey data points were removed from the model due to incomplete coverage in both surveys. Although the spring 2006 data are insufficient for inclusion in the model, additional analyses are required to determine whether or not the data from the 2004 Canadian autumn survey are comparable to other years in the time-series.

There was a plus group at age 15 in the catch-at-age and the ratio of *F* on the plus group to *F* on the last true age was set at 1.0. Natural mortality (*M*) was assumed to be 0.2 on all ages except 0.53 on all ages from 1989 to 1996 (*NAFO Sci. Coun. Rep*., 2001, pg. 141).

d) Assessment Results

The VPA analyses showed that population abundance and biomass declined fairly steadily from the mid- 1970s to 1995. Biomass and abundance have been relatively stable over the last number of years (Fig. 11.6). Average *F* on ages 9 to 14 showed an increasing trend from about 1965 to 1985. There was a large unexplained peak in *F* in 1993. F increased from 1995 to 2001 and has since declined (Fig. 11.7).

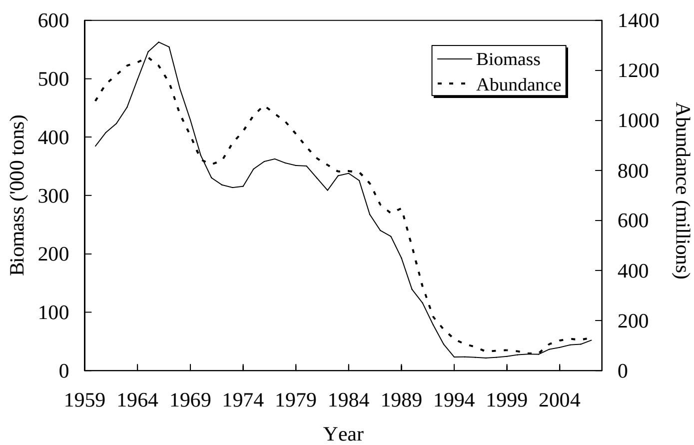


Fig. 11.6. American plaice in Div. 3LNO: population abundance and biomass from VPA

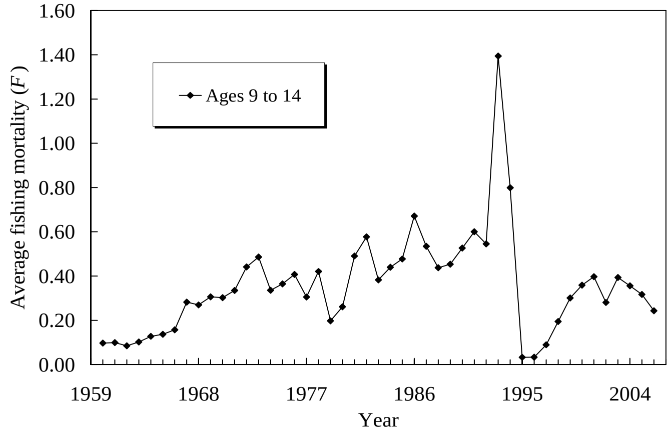


Fig. 11.7. American plaice in Div. 3LNO: average fishing mortality from VPA.

Spawning stock biomass has shown 2 peaks, one in the mid-1960s and another in the early- to mid-1980s. Since then it declined to a very low level (less than 10 000 tons) in 1994 and 1995 (Fig. 11.8). It has increased since then but still remains at a low level at about 36 000 tons. This is only 18% of the level in the mid-1960s and 26% of the level in the mid-1980s. Recruitment at age 5 has been steadily declining since the 1986 year-class and there has been no good recruitment since then (Fig. 11.8), except for a small increase due to the 1998 year-class.

Biomass: The biomass is very low compared to historic levels.

Spawning stock biomass: SSB declined to the lowest observed levels in 1994 and 1995. It has increased since then but remains very low at about 36 000 tons.

Recruitment: Estimated recruitment at age 5 indicates that all year-classes since those of the mid-1980s have been very weak.

Fishing mortality: Since 1995, the average fishing mortality on ages 9 to 14 increased but since 2003 has declined. However, considering the stock is under moratorium, average *F* remains high.

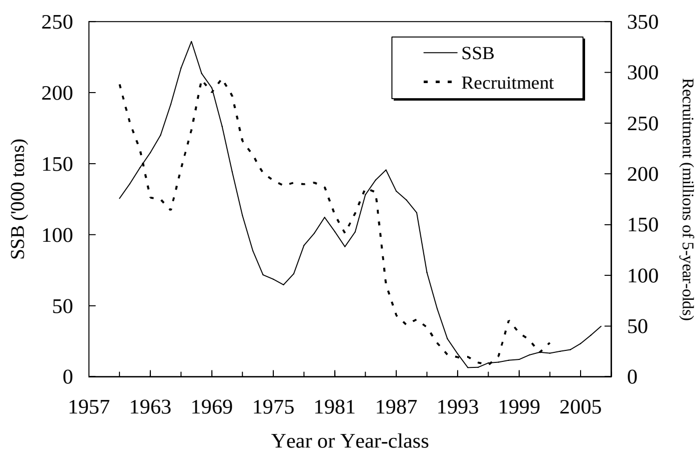


Fig. 11.8. American plaice in Div. 3LNO: spawning stock biomass and recruitment from VPA.

Retrospective patterns: A five year retrospective analysis was conducted by sequentially removing one year of data from the input data set (Fig. 11.9). STACFIS noted that the magnitude of the retrospective revisions in the current assessment has increased. This may be due in part to higher estimates of the 1998 cohort from the Spanish Div. 3NO survey at ages 5 and 6, relative to estimates of these cohorts in the Canadian surveys at these ages.

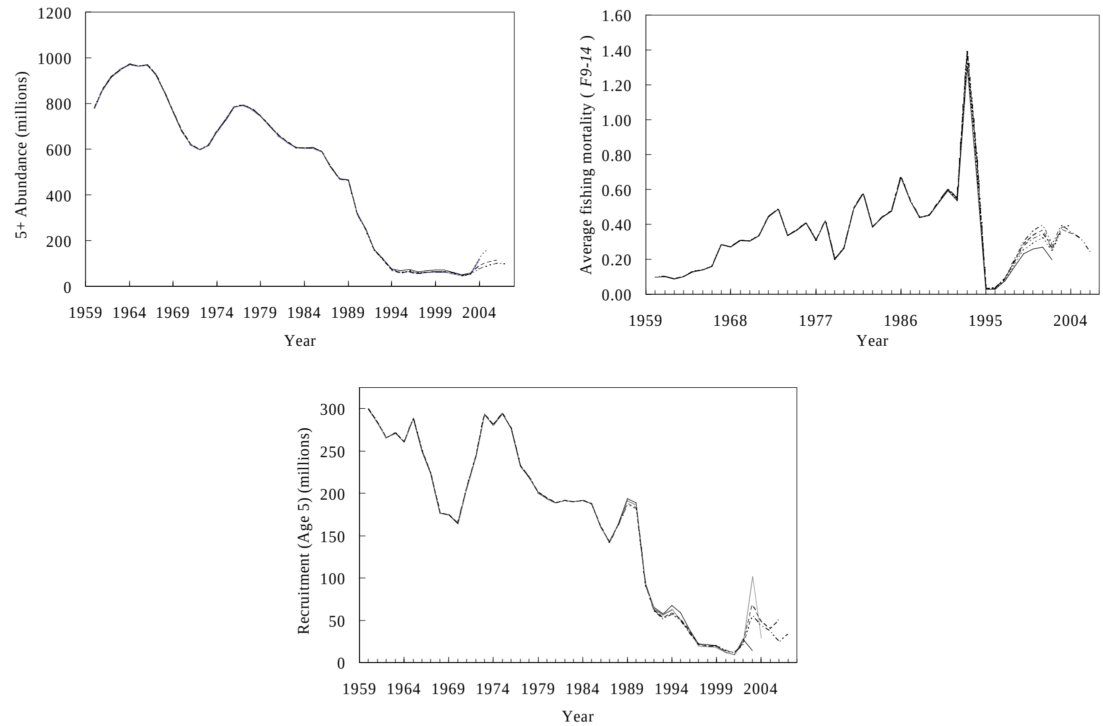


Fig 11.9 American plaice in Div. 3LNO: retrospective analysis of 5+ abundance, average *F* (ages 9-14) and recruitment (age 5).

e) Precautionary Reference Points

An examination of the stock recruit scatter shows that there has been no good recruitment observed at SSB below 50 000 tons (Fig. 11.10). 50 000 tons of SSB is the current best estimate of B_{lim} for this stock. The current estimate of biomass (36 000 tons) is well below B_{lim}.

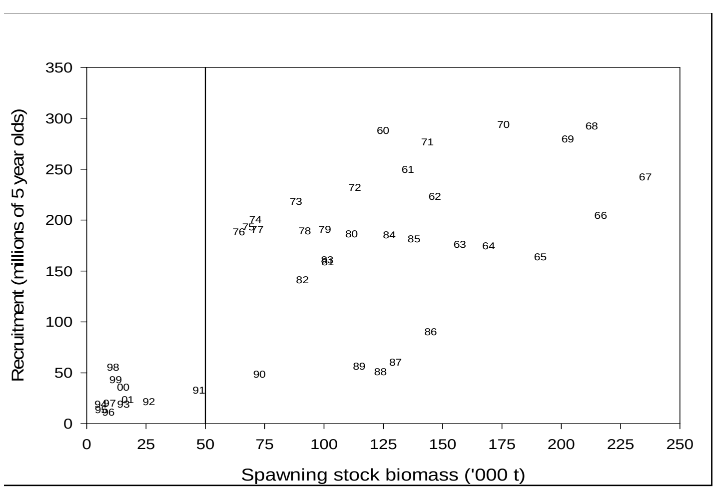


Fig. 11.10. American plaice in Div. 3LNO: stock recruit scatter.

SSB increased under low fishing mortality (*F*) from 1960 to 1967. Subsequently, SSB declined under rising *F* and some years of poor recruitment. SSB has been below B_{lim} since 1991. Since 1998, *F* has been at or above $F_{0.1}$ (Fig. 11.11).

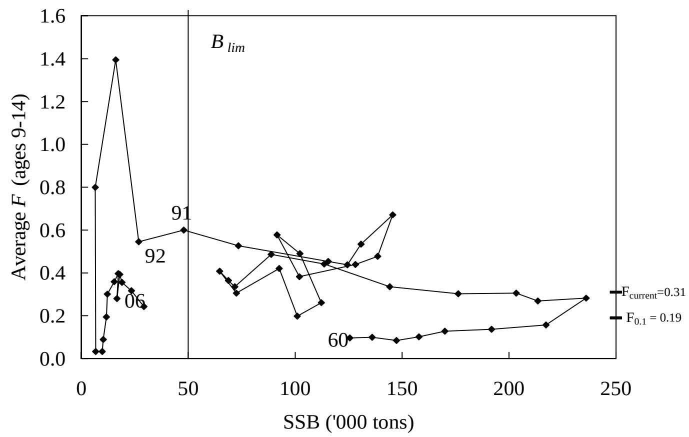


Fig. 11.11. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework.

f) Medium Term Considerations

Deterministic projections were carried out for 5 years to examine the trajectory of the spawning stock biomass under two scenarios of fishing mortality: $F = 0$, $F = F_{current}$. For these deterministic projections the results of the VPA were used. $F_{current}$ was set as the average *F* on ages 9-14 over the last 3 years and is 0.31. PR and weights were averaged over the last 3 years. Recruitment was the average R/S for the last 3 year-classes and was equal to 2.43. In addition the following values were used for 2008-12:

Age	5	6	7	8	9	10	11	12	13	14	15
M	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
PR	0.01	0.06	0.16	0.34	0.69	0.87	1.00	0.94	0.93	0.85	0.85
Stock Weight	0.15	0.26	0.38	0.48	0.58	0.70	0.86	0.99	1.21	1.50	1.93
Maturities	0.03	0.15	0.46	0.81	0.95	1.00	1.00	1.00.	1.00	1.00	1.00

M is natural mortality; PR is exploitation pattern

The stock is estimated to increase under both $F = F_{current}$ and $F = 0$, the increase in SSB at $F = 0$ is double that at current *F*. The increase under current conditions of *F* is only about 12 000 tons over the 5 year period and the stock does not exceed B_{lim}. The spawning stock reaches the B_{lim} of 50 000 tons by 2009 and 83 000 tons by 2012 with $F = 0$ (Fig. 11.12).

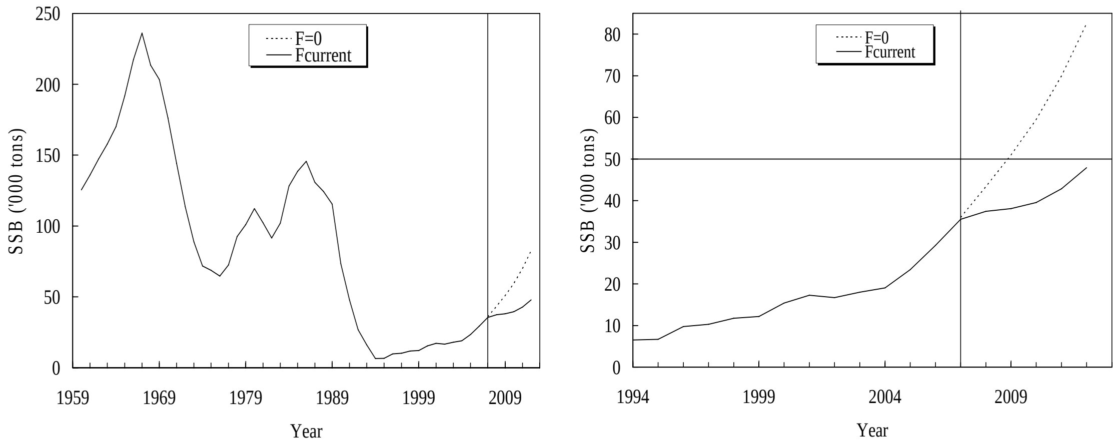


Fig. 11.12. American plaice in Div. 3LNO: projected spawning stock biomass at $F_{current}$ and F = 0.

g) Research Recommendations

Some progress was made on the recommendations from the 2005 assessment. Work will continue on the recommendation, including examining the value and timing of the period of high natural mortality.

$F_{lim} = F_{msy}$ was suggested as a possible reference point for this stock by the Limit Reference Point Study Group (SCS Doc. 04/12). However, STACFIS noted that an estimate of F_{msy} greatly depends on exploitation pattern (PR), stock recruitment model and natural mortality rate to be used in the computation. As the stock is under moratorium, the actual PR may not be appropriate as it differs considerably from the PR observed in the former period when the fishery was open. Natural mortality was previously estimated to have changed from the assumed 0.2 figure to a value of 0.53 over the period 1989 to 1996 (*NAFO Sci. Coun. Rep*., 2001, pg. 141). For the stock recruitment model, if a smoother is used, assumptions have to be made for recruitment when SSB values fall outside the observed data. Therefore, before adopting a F_{lim} value based on F_{msy}, STACFIS **recommended** that *investigation of the sensitivity of the estimation of* F_{msy} *to these parameters should be conducted.*

This stock will next be assessed in 2009.

12. Yellowtail flounder (*Limanda ferruginea*) in NAFO Divisions 3LNO

(SCR Doc. 07/36, 43, 51, 53)

Interim Monitoring Report

a) Introduction

Following the moratorium from 1994 to August 1998, catches have increased from 4 400 tons to 14 000 tons in 2005. In the 2006 fishery, the catch estimate of 930 tons was well below the TAC of 15 000 tons because of the absence of the Newfoundland based offshore Canadian fleet taking part in the fishery.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	4.0	6.0	10.0	13.0	13.0	14.5	14.5	15.0	15.0	15.5
STATLANT 21A	4.4	7.0	10.6	12.8	10.4	13.0	13.4	13.9[1]	0.9[1]	
STACFIS	4.0	7.0	11.0	14.1	10.8	13.5-14.1[2]	13.4	13.9	0.9	

[1] Provisional
[2] In 2003, STACFIS could not precisely estimate the catch

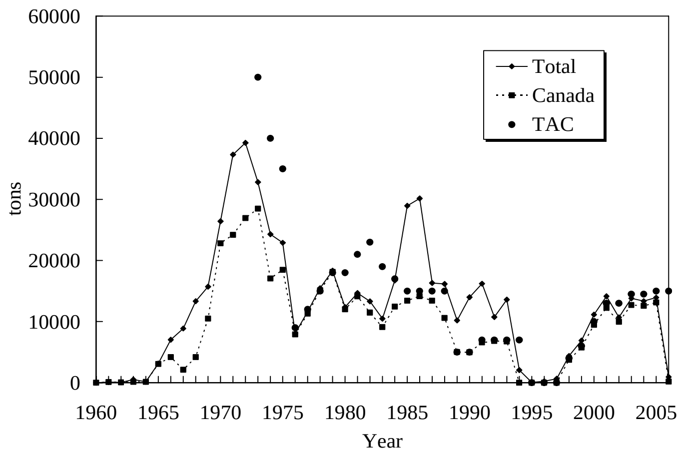


Fig. 12.1. Yellowtail flounder in Div. 3LNO: nominal catches and agreed TACs.

b) Data Overview

Surveys

Canadian stratified-random bottom trawl surveys. Data from the spring surveys in Div. 3LNO are available from 1984-2006. The 2006 survey biomass for Div. 3LNO increased from 2005, however there were wide confidence intervals around the 2006 survey estimate, and there were problems with survey coverage and timing. Therefore results may not be comparable to other years. Biomass continued to be well distributed in both the southern and northern areas of the bank.

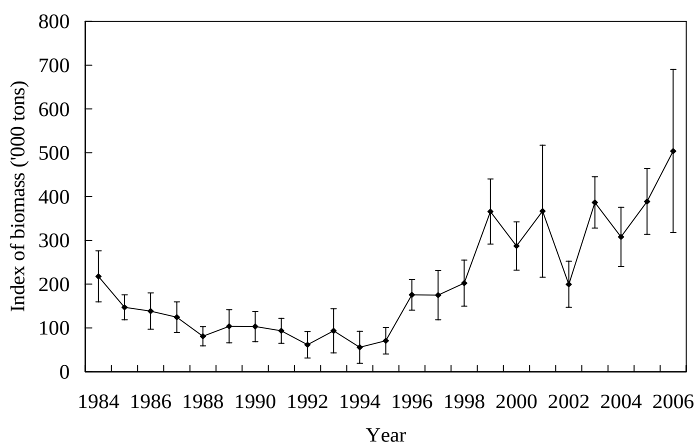


Fig. 12.2 Yellowtail flounder in Div. 3LNO: index of biomass from Canadian spring surveys. Error bars are approximate 95% confidence limits.

Data from the autumn surveys in Div 3LNO are available from 1990-2006. The recent trend in the index indicates a slight decrease from 2003-2006. The 2006 survey biomass for Div. 3LNO was 11% lower than the 2005 estimate. Biomass continued to be well distributed in both the southern and northern areas of the bank.

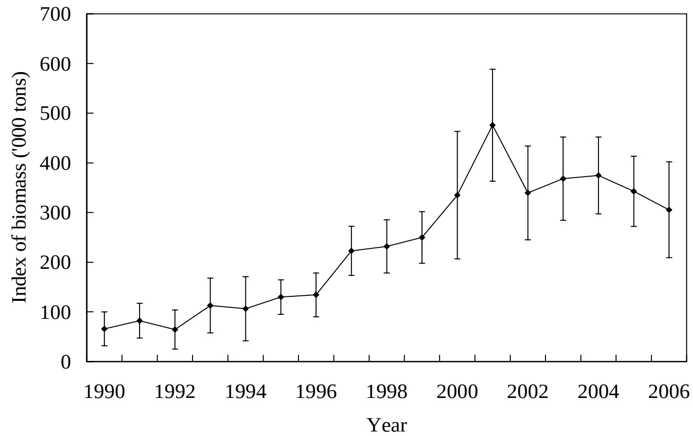


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from Canadian autumn surveys. Error bars are approximate 95% confidence limits.

Spanish Div. 3NO Surveys. Spring surveys have been conducted annually from 1995 to 2006 in the Regulatory area of Div 3NO. The biomass index increased from 1995 to 1999, then fluctuated without trend since 2000.

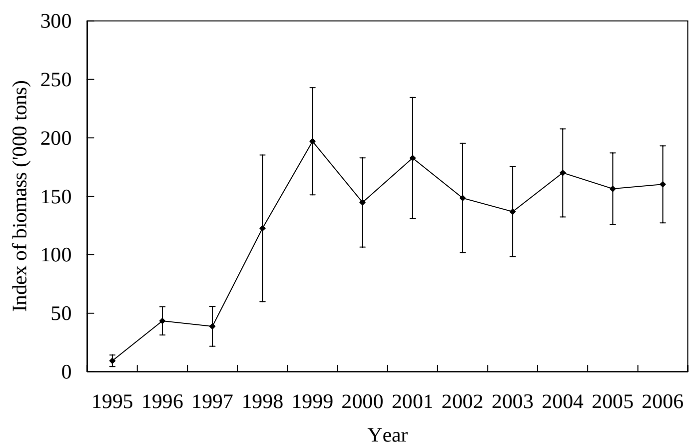


Fig. 12.4.Yellowtail flounder in Div. 3LNO: index of biomass from the Spanish spring surveys in the NRA in Div. 3NO. Error bars are approximate 95% confidence limits.

c) Exploration of ASPIC model

In the 2006 review of the stock assessment of NAFO Div. 3LNO yellowtail flounder, STACFIS recommended that further exploration of the ASPIC surplus production model including sensitivity analysis on various input indices be presented 2007.

Since 2000, the formulation of the standard model has been a logistic form of a non-equilibrium surplus production model (ASPIC) using nominal catch conditioned with the Campelen spring survey series. The model is then tuned with the following survey data: the Canadian Yankee spring surveys, the Canadian Campelen autumn surveys, the Russian spring surveys and the Spanish spring surveys. The standard model also uses a penalty term on the objective function to constrain the starting biomass.

A sensitivity analysis of the standard model formulation and an analysis of alternate model formulations were carried out to examine their performance and effect on parameter estimates. The sensitivity analyses suggests that the penalty term in the model should be dropped in favour of constraining the *B1* ratio (B_t/B_{msy}) at 2.0. The standard model shows a poor fit with the Russian survey time series, however, the model is now robust enough to exclude the Russian time series. An alternate formulation of the standard model which excludes the Russian time series and the 1990-1994 converted Canadian autumn estimates and replaces it with the 1985-1994 converted juvenile groundfish survey series appended to the 1995-2005 Campelen autumn series showed promising results and should be investigated further. The sensitivity analysis methods described in the analysis should be part of the full assessment of the yellowtail flounder stock.

d) Conclusion

Based on overall indices for the current year, there is nothing to indicate a change in status of this stock.

e) Research recommendations

Based on the results of the sensitivity analysis and the alternate model formulation in the input data used in the ASPIC surplus production model for yellowtail flounder in Div. 3LNO, STACFIS **recommended** that:

1) a sensitivity analysis of parameter estimates for the surplus production model (ASPIC) be routinely completed;

2) further investigations be conducted on the effect of excluding the Russian spring time series, 1971-1991 from the standard formulation, as well as including the Canadian juvenile time series (1985-1994);

3) 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;

4) 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;

5) in future assessments, the risk of the stock being below B_{lim} *= 30%* B_{msy} *be expressed.*

This stock will next be assessed in 2008.

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3N and 3O

(SCS Doc. 07/6, 8, 9)

Interim Monitoring Report

a) Introduction

Reported catches in the period 1972-84 ranged from a low of about 2 400 tons in 1980 and 1981 to a high of about 9 200 tons in 1972 (Fig. 13.1). With increased bycatch from other fisheries, catches rose rapidly to 8 800 and 9 100 tons in 1985 and 1986, respectively. This increased effort was concentrated mainly in the Regulatory Area of Div. 3N. From 1987 to 1993 catches ranged between about 4 500 and 7 500 tons and then declined in 1994 to less than 1 200 tons when no directed fishing on the stock was agreed. Since then, catches have averaged about 600 tons and in 2006 was about 480 tons.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.6	0.9	0.7	0.5	0.7	0.9	0.6	0.3[2]	0.5[2]	
STACFIS	0.6	0.8	0.5	0.7	0.4	0.85-2.24[1]	0.6	0.3	0.5	

[1] In 2003, STACFIS could not precisely estimate the catch
[2] Provisional
ndf = no directed fishery.

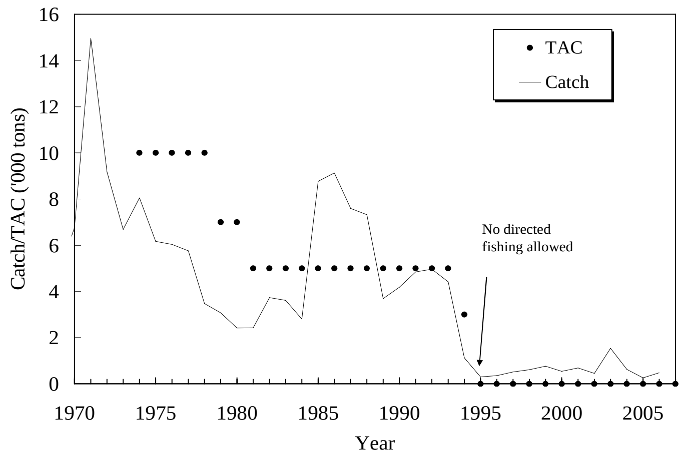


Fig. 13.1. Witch flounder in Div. 3N and 3O: catches and TAC.

b) Data Overview

i) *Research survey data*

Mean weight (kg) per tow. For Div. 3N, mean weights (kg) per tow in the Canadian spring survey ranged from as high as 0.96 kg per tow in 1984 to a low of 0.07 kg per tow in 1996 and have been variable since then with the 2005 value higher than recent years, but with wide 95% confidence limits. Mean weights (kg) per tow in the autumn survey in Div. 3N ranged from 1.22 kg per tow in 1992 to a low of 0.07 kg per tow in 1996. Estimates have been variable throughout the series but show a slightly increasing trend to 2005 although error bars are wide. In 2006, the estimate decreased to 0.46 kg per tow. Trends in the autumn survey are complicated by variable coverage of the deeper strata from year to year. In Div. 3O, the spring survey estimates are variable, but show a decreasing trend from 9.67 kg per tow in 1985 to 0.83 kg per tow in 1998. Since then mean weights per tow have remained variable but increased slightly in 2003 (6 kg per tow) and then decreased to 2 kg per tow in 2005. The autumn survey in Div. 3O increased from 2001 to 2004 and has remained about 6 kg per tow since then. Although the combined index in Div. 3NO spring surveys (Fig. 13.2) appeared higher in 2003 than in recent years, it was driven by one large set. The mean weight per tow estimate in 2004 was 3.2 kg per tow with wide confidence limits. In 2005 the index decreased to 1.4 kg per tow. The Canadian spring survey was incomplete in 2006 and estimates are not available.

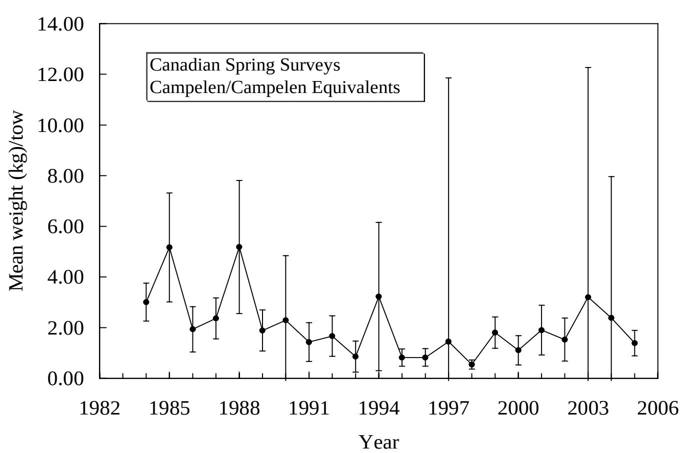


Fig. 13.2. Witch flounder in Div. 3NO: mean weights (kg) per tow from Canadian spring surveys (95% confidence limits are given. Note that the full range of confidence limits is not displayed where they extend below zero). Estimates were not available in 2006 due to inadequate survey coverage.

Length Frequency data: The frequencies taken in the Canadian surveys ranged from 8-65 cm with modal length around 40 cm. Smaller fish were evident in the Canadian research vessel frequencies from 1995-2000 and in 2002, which may be contributing to the apparent improvement in the stock from 2000 to 2003, but this peak was not evident in the 2001, or the 2003-06 surveys (autumn only in 2006).

c) Conclusion

Based on available information for the current year, there is nothing to indicate a change in the status of the stock.

This stock will next be assessed in 2008.

14. Capelin (*Mallotus villosus*) in Div. 3N and 3O

(SCR Doc. 07/12)

a) Introduction

The fishery for capelin started in 1971 and total catch was maximal in mid-1970s with the highest catch of 132 000 tons in 1975. The directed fishery was closed in 1992 and the closure has continued through 2007 (Fig. 14.1). No catches have been reported for this stock since 1993.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	ndf	na	na	na	na	na	na	na	na	na
Catch[1]	0	0	0	0	0	0	0	0	0	0[1]

[1] No catch reported or estimated for this stock,
ndf = no directed fishing
na = no advice possible.

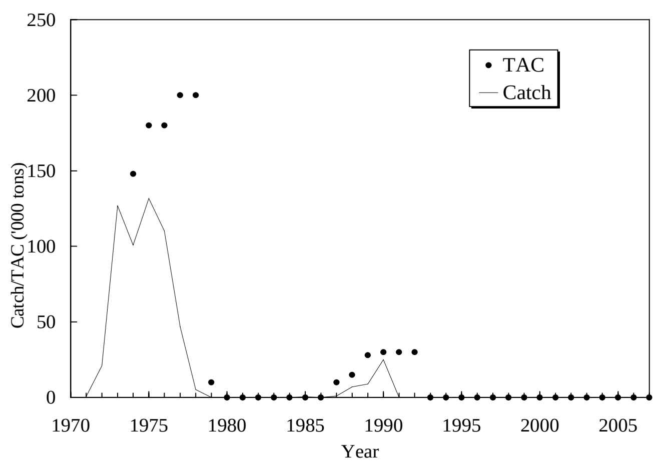


Fig. 14.1. Capelin in Div. 3NO: catches and TACs.

b) 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 several times has advised to conduct investigations of capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this advice was not followed. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random spring bottom trawl surveys.

In 1996-2006, when Campelen was used as sampling gear, survey biomass of capelin in Div. 3NO varied from 3.9 to 58 100 tons (Fig. 14.2) at the average value for this period 24 000 tons. In 2005, survey biomass of capelin in Div. 3NO was 3 900 tons, that corresponded to the lowest level of the stock since 1996, in 2006 survey biomass slightly increased and was 9 600 tons.

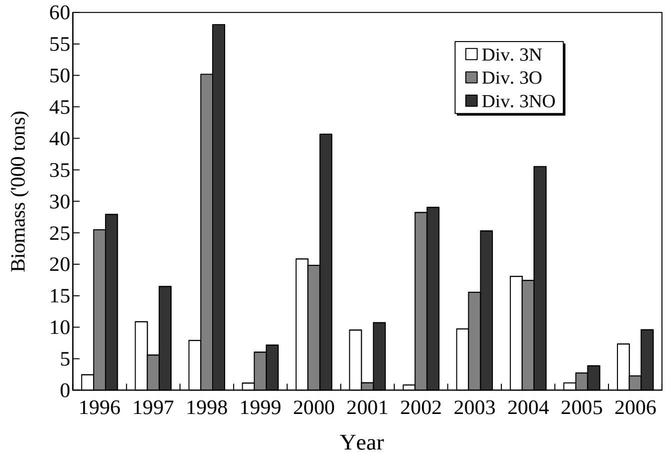


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates in 1996-2006.

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 1990-2006. 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 as in 2005 (NAFO Sci. Coun. Rep., 2005, pg. 149). According to data from 1996-2006, mean catch had a linear significant relationship (R^2 = 0.94, F = 133.43, df = 9, p = 0.0000) with indices of survey.

The confidence intervals around the average catch index were obtained by bootstrapping of standardized catch values. According to data from 1996-2006, the mean catch varied between 0.06 and 0.76 with 0.33 as the average for these years. In 2005 and 2006, this parameter was 0.06 and 0.19, respectively (Fig. 14.3).

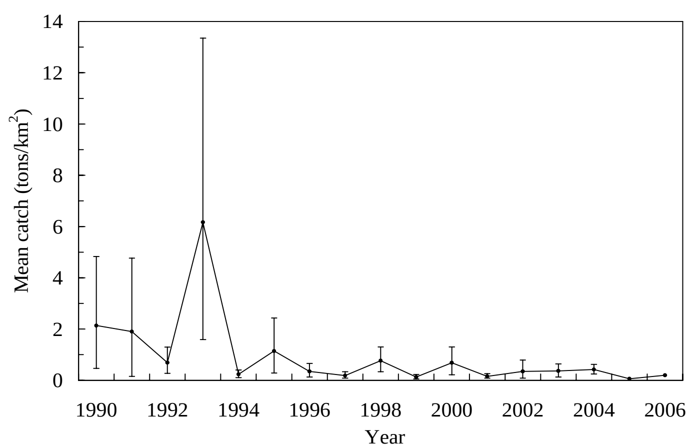


Fig. 14.3. Capelin in Div. 3NO: mean catch (tons/km^2) in 1990-2006.

The estimate of 2006 corresponds to a low level of stock size that was observed in 1997, 1999 and 2001. Fisheries were conducted in the years when this value was equal or higher than 2 tons/km^2.

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 a low level relative to that of the late 1980s.

e) Precautionary Reference Points

STACFIS is not in a position to determine biological reference points for capelin in Div. 3NO at this time.

f) Research Recommendations

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.*

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 assessed in 2009.

15. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3O

(SCR Doc. 07/07, 55, 02/79, 05/11; SCS Doc. 07/6, 8, 9)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3O; the deep-sea redfish (*Sebastes mentella*) and the Acadian redfish (*Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics. Within Canada's fishery zone redfish in Div. 3O have been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, whereas catch was only regulated by mesh size in the NRA of Div. 3O. In September 2004, the Fisheries Commission adopted TAC regulation for redfish in Div. 3O, implementing a level of 20 000 tons per year for 2005-2007. This TAC applies to the entire area of Div. 3O.

Nominal catches have ranged between 3 000 tons and 35 000 tons since 1960 (Fig. 15.1). Up to 1986 catches averaged 13 000 tons, increased to 27 000 tons in 1987 with a further increase to 35 000 tons in 1988, exceeding TACs by 7 000 tons and 21 000 tons, respectively. Catches declined to 13 000 tons in 1989, increased gradually to about 16 000 tons in 1993 and declined further to about 3 000 tons in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 14 000 tons by 1998, declined to 10 000 tons by 2000 then doubled to 20 000 tons in 2001. From 2002-2003 catches averaged 17 200 tons then declined dramatically to about 3 800 tons in 2004. In 2005 and 2006 catches were higher at about 11 000 tons and 13 000 tons respectively.

The large catches in 1987 and 1988 were due mainly to increased activity in the NRA by Non-Contracting Parties (NCPs), primarily Panama and at that time South Korea. There hasn't been any activity in the NRA by NCPs since 1994. Estimates of under-reported catches have ranged from 200 tons to 23 500 tons. There have also been estimates of over-reported catch in the recent period since 2000. Over this time period, over-reported catch has ranged from 1 800 tons (2001) to 4 300 tons (2003). Although most fleets directing for redfish in the NRA reduced their catch from 2003 to 2004, the decline was primarily accounted for by the Russian fleet which reduced its activity of because of problems with catches of small redfish (<21 cm). Canada has had limited interest in a fishery in Div. 3O because of small sizes of redfish encountered in areas suitable for trawling.

In general, the fishery has occurred primarily from May to October since 1990. The prominent means of capture is the bottom otter trawl which generally accounts for greater than 90% of the catch. The catch by mid-water trawls is predominantly by Russia. Canadian, Portuguese and Spanish fleets utilize bottom trawling.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC[1]	10	10	10	10	10	10	10	20	20	20
TAC	10	10	10	10	10	10	10	20	20	20
STATLANT 21A	13.3	12.6	12.8	22	19.4	21.5	6.4	11.9[2]	12.9[2]	
STACFIS	14	12.6	10	20.3	17.2	17.2	3.8	10.7	12.6	

[1] 1998-2004 only applied within Canadian fishery jurisdiction
[2] Provisional.

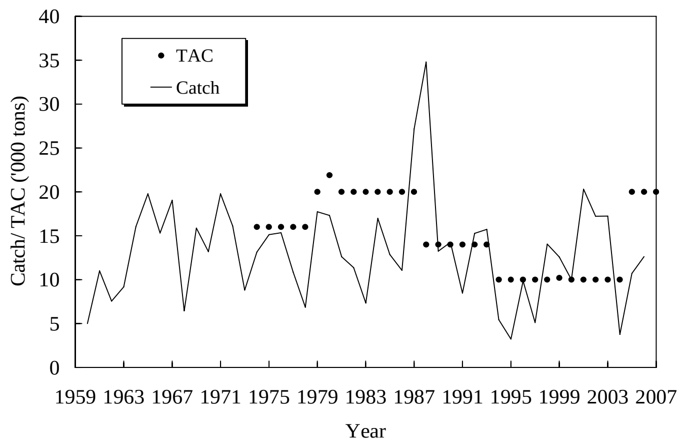


Fig. 15.1. Redfish in Div. 3O: catches and TACs (from 1974 to 2004 applied to Canadian fisheries jurisdiction; from 2005 for entire Div. 3O area).

b) Input Data

i) *Commercial fishery data*

A catch rate database with effort measured in days fished was standardized using a multiplicative model for the Canadian fleet and for NRA fleets.

Catch rate indices (Fig. 15.2) show much within year variability. The index for NRA fleets averaged about 17 tons per day over 1987-1992. The index declined to its lowest level in the series at 8 tons per day in 1996 then increased to 15 tons per day in 1998 then remained stable to 2003. Catch rate was lower in 2004 and 2005, averaging about 13 tons per day.

For the Canadian index, there were only short periods of sustained directed effort prior to 1996. During a period of sustained activity from 1976-81 catch rates were stable and comparable to catch rates at the beginning of the series. The next onset of a sustained directed fishery began in 1996 which showed a general increase to 2003 and has remained at that level to 2006. The index in recent years is at the same level it was in the late 1970s as well as the early 1960s.

The catch rate index of the Canadian fleet may at best be simply reflecting fishing success rather than stock trends. Canada has not accounted for a major portion of the reported catches from Div. 3O and has only fished within its 200-mile fisheries jurisdiction. The interpretation of commercial catch rates as an indicator of stock abundance in Div. 3O remains difficult. Redfish tend to form patchy aggregations at times very dense. In Div. 3O there is a limited amount of fishable area in deeper waters along the steep slope of the southwest Grand Bank where larger fish tend to be located.

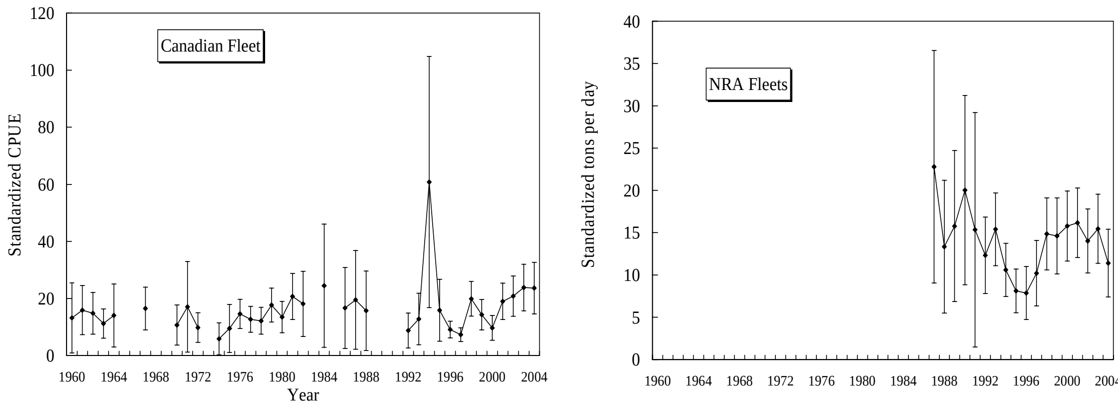


Fig. 15.2. Redfish in Div. 3O: standardized CPUE by fleet.

Sampling of the redfish fisheries was conducted by Canada, Spain, Portugal, and Russia from the 2006 trawl fishery. The Portuguese fleet fished between 121 m and 750 m while the Russian fleet fished from 120 m-600 m. Logbook information from the Canadian fleets indicated most of the catch was taken at depths >300 m (range 184 m-604 m). Annual catch at length suggested fish between 21-29 cm generally dominated the catches. Lengths between 20-24 cm (range 11- 39 cm) dominated the Portuguese catch. The Spanish catch was dominated by 20-31 cm fish (range 17-38 cm) while the dominant size range in the Russian catch was 21-31 cm (range 15-44 cm), which was sampled for total length.

ii) ***Research survey data***

Stratified-random surveys have been conducted by Canada in Div. 3O in spring and autumn from 1991 to 2005. In 2006, only autumn indices were available due to inadequate survey coverage in the spring survey. The surveys cover to depths of 732 m (400 fathoms) in spring and to 1 464 m (800 fathoms) in autumn. Until the autumn of 1995 these surveys were conducted with an Engels 145 high lift otter trawl. Starting in the autumn 1995 survey, a Campelen 1800 survey trawl was used. The Engel data were converted into Campelen equivalent units.

Biomass Indices:

Results of bottom trawl surveys for redfish in Div. 3O indicated a considerable amount of variability. This occurred between seasons and years. Although it is difficult to interpret year to year changes in the estimates, in general, the spring survey index (Fig. 15.3) suggests the stock may have increased from an average of 19 kg/tow in 1991-92 to an average of 205 kg/tow between 1994 and 1996 and subsequently declined to an average of 31 kg/tow between 2002 and 2003. The index shows a large increase in 2004 to 103 kg/tow that was influenced by one large set in a stratum that represented 40% of the biomass index. The 2005 value decreased once more to 73 kg per tow. The autumn surveys, while more stable in the early 1990s, generally supports the pattern of the spring survey index to 2002. However, the autumn index suggests stability to 2004, and then a more gradual increase to 2006 to 66 kg per tow. Research vessel surveys do not appear to adequately sample fish greater than 25 cm which up to 1997 have generally comprised the main portion of the fishery.

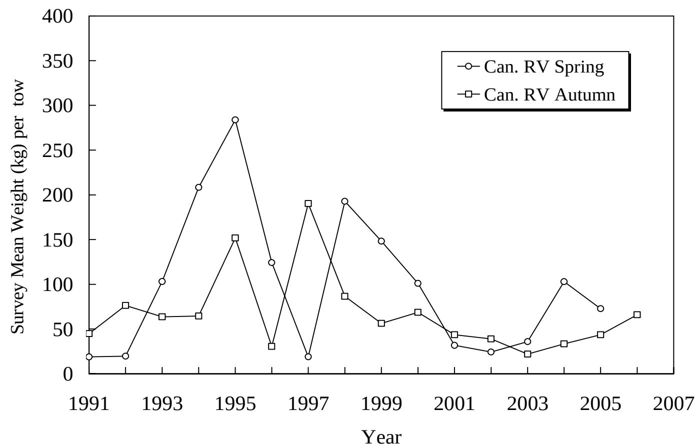


Fig. 15.3. Redfish in Div. 3O: survey biomass indices from Canadian surveys in Div. 3O in Campelen equivalent units for surveys prior to autumn 1995.

Recruitment:

Size distribution from the Canadian spring and autumn surveys in terms of mean number per tow at length indicates a bimodal distribution in 1991 corresponding to the 1988 and 1984 year-classes respectively. The 1984 year-class progressed at about one cm per year up to 1994 and cannot be traced any further. The 1988 year-class remains dominant at 22-23 cm from 2001-2006 surveys (Fig. 15.4). Recruitment pulses detected in both surveys in 1999 were greatly diminished by 2002. There are new pulses detected in surveys between 2003 and 2006 surveys but it is too early to determine what their relative contribution will be to the population. The 1988 year-class was the last good recruitment to the population.

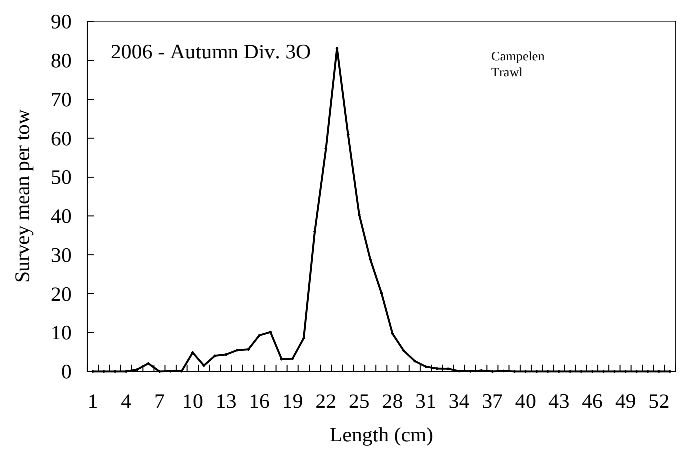


Fig. 15.4 Redfish in Div. 3O: Size distribution (stratified mean per tow) from Canadian autumn surveys for 2006.

c) Estimation of Stock Parameters

i) *Fishing mortality*

A fishing mortality proxy was derived from catch to biomass ratios. As most of the catch of the 1990s was taken in the last three quarters of the year, the catch in year *n* was divided by the average of the Canadian spring (year = *n*) and autumn (year = *n*-1) survey biomass estimates to better represent the relative biomass at the time of the year before the catch was taken. Survey catchability (q) for redfish is not known but assumed less than one. Prior to 1998 the catch was composed of fish greater than 25 cm which are not well represented in the survey catch. From 1998 to 2006, the fishery size composition more resembled the survey size composition. Accordingly, catch/biomass ratios were only calculated for the surveys from 1998-2006. The results (Fig. 15.5) suggest that relative fishing mortality increased steadily from 1998 to 2002 remained high in 2003 but declined substantially in 2004. In 2005, relative fishing mortality increased once more and was around the series average. The 2006 estimate of fishing mortality was calculated using only the autumn survey biomass.

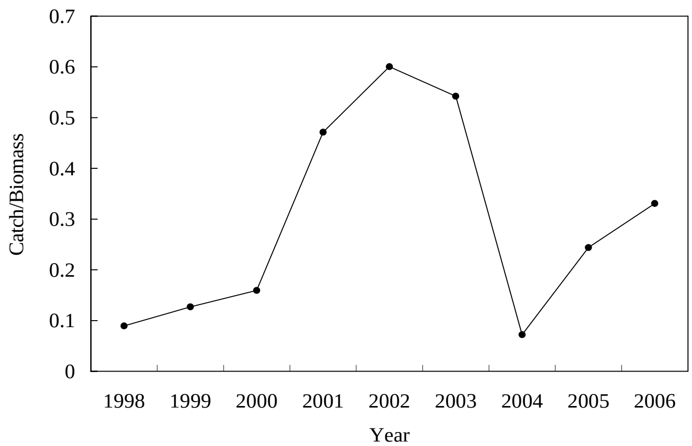


Fig. 15.5.Redfish in Div. 3O: catch/survey biomass ratios for Div. 3O. The 2006 value was calculated using only the autumn biomass estimate.

ii) ***Size at maturity***

A size at maturity analysis presented in 2002 based on an analysis of Canadian survey data for redfish suggested L_{50} is about 28 cm for females and 21 cm for males (*NAFO Sci. Coun. Rep.*, 2001:37) . Those results were obtained from an analysis of *S. fasciatus* and *S. mentella* combined. Information presented in 2005 estimated size at maturity for S. fasciatus with the species identified by meristic characters. The data suggest for *S. fasciatus* L_{50} for males is 21 cm and for females is 20 cm (*NAFO Sci. Coun. Rep*., 2005:153). STACFIS noted these results were unusual in that typically L_{50} values are larger for females than males. As well, the L_{50} for female *S. fasciatus* and *S. mentella* were higher in the neighboring stock area of Div. 3M at 26.5 and 30.1 cm respectively (Saborido-Rey, 1994). L_{50} for female *S. fasciatus* in Div. 3O was calculated at 25 cm for 2006.

d) Assessment Results

It is not possible to determine current fishing mortality rate or absolute size of the stock. It is difficult to accept that the Canadian CPUE series is representative of the trends in the stock. Surveys indicate general trends over the time period. The Canadian spring and autumn survey estimates have remained relatively stable since 2001 but at a much lower level than the mid-1990s. Given the stable biomass indices the increase in catches from 2001-2003 which averaged about 18 000 tons, suggests that fishing mortality increased during this time period. The reduction in catch to about 4 000 tons in 2004 suggests a reduction in fishing mortality. With increased catches in 2005 and 2006 fishing mortality is estimated to have increased. What is of particular concern is the poor recruitment since the relatively strong 1988 year-class. Given that the bulk of the catches in recent years are comprised of fish less than 27 cm, these fisheries may be targeting predominantly immature fish, particularly if the catches comprise a greater proportion of *S. mentella*.

e) Reference Points

At present it is not possible to determine limit or other reference points for either fishing mortality or biomass for redfish in Div. 3O.

f) Research Recommendations

STACFIS noted that although previous attempts at applying surplus production models to this stock were unsuccessful, additional data may improve model fits. STACFIS **recommended** that *additional work be undertaken to explore the application of surplus production models to this stock.*

References

Saborido-Rey, F., 1994. El género *Sebastes* Cuvier, 1829 (Pisce, Scorpaenidae) en el Atlántico Norte: identificación de espécies y poblaciones mediante métodos morfométricos; crescimiento y reproducción de las poblaciones en Flemish Cap. Universidad Autónoma de Madrid, Facultad de Biología, Departamento de Zoología, Madrid. Phd Thesis, xi, 276 pp.

This stock will next be assessed in 2010.

16. Thorny Skate (*Amblyraja radiata*) in Div. 3L, 3N, 3O and Subdiv. 3Ps

(SCR Doc. 07/33; SCS Doc. 07/06, 08, 09, 12)

Interim Monitoring Report

a) Introduction

Commercial catches of skates comprise a mix of skate species. However, thorny skate makes up about 95% of the skates taken in the Canadian catches and 96% of EU-Spain skate catches in Div. 3NO. Thus, the skate fishery on the Grand Banks can be considered as a directed fishery for thorny skate.

Nominal catches increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this fishery are EU-Spain, Canada, Russia and EU-Portugal. Some thorny skate continue to be taken as a bycatch in other fisheries. Reported catches peaked at about 31 500 tons in 1991 (STATLANT 21A). During 1985 to 1991, catches averaged 22 300 tons, lower during 1992-1995 (8 600 tons) although there are substantial uncertainties in the catch levels prior to 1996. Catch levels from 1995 to 2004 as estimated by STACFIS averaged 12 000 tons but were reduced to an average of 6 300 tons in 2005-2006 (Fig. 16.1).

This species came under quota regulation in September 2004, when the Fisheries Commission set a TAC of 13 500 tons for 2005-2007 in Div. 3LNO and Canada set a TAC of 1 050 tons for Subdiv. 3Ps. Recent nominal catches and TAC (‘000 tons) are as follows:

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Div. 3LNO										
Recommended TAC								11.0	11.0	11.0
TAC								13.5	13.5	13.5
STATLANT 21A	9.5	11.9	18.3	14.9	11.8	14.3	11.5	3.3	5.0	
STACFIS (incl. discards)	9.0	9.8	14.1	11.2	10.6	14.3	9.7	4.7	5.8	
Subdiv. 3Ps										
TAC								1.05	1.05	1.05
STATLANT 21A	1.3	1.1	1.0	1.8	1.7	1.8	1.1	0.7	1.1	
STACFIS (incl. discards)	1.5	1.3	1.1	2.0	1.6	2.0	1.2	0.9	1.1	
Div. 3LNOPs										
STATLANT 21A	10.8	13.0	19.3	16.7	13.5	16.1	12.6	4.0	6.1	
STACFIS (incl. discards)	10.5	11.1	15.2	13.2	12.2	16.3	10.9	5.6	6.9	

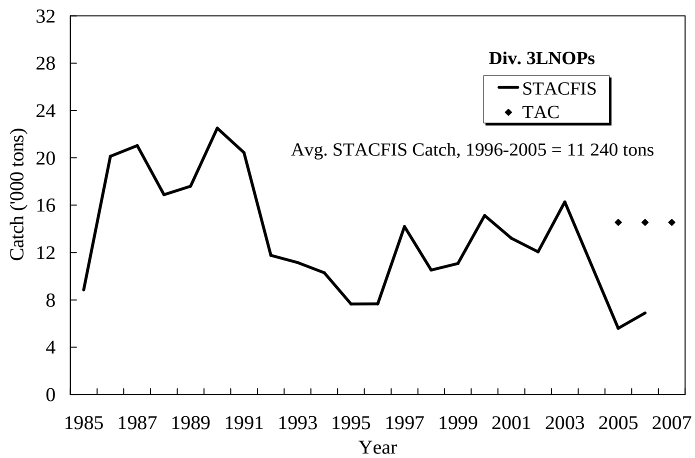


Fig. 16.1.Thorny skate in Div. 3LNO and Subdiv. 3Ps: catches, 1985-2006 and TAC for Div. 3LNO plus Subdiv. 3Ps. The estimates include discards.

b) Data Overview

i) ***Research surveys***

Insufficient Canadian spring survey sets were completed in Subdiv. 3Ps in 2006 and only shallow strata were surveyed in Div. 3NO in 2006 (to 77 m in Div. 3N, to 103 m in Div 3O). A significant portion of the stock biomass was missed, thus, Canadian survey indices are not presented for 2006 (Fig. 16.2).

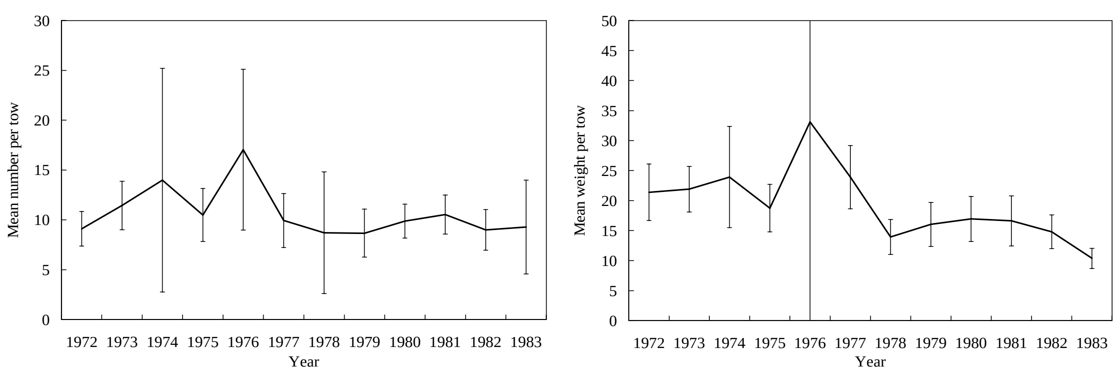


Fig.16.2a. Thorny skate in Div. 3LNOPs: estimates of Yankee 41 otter trawl mean numbers and mean weights per tow from Canadian spring surveys.

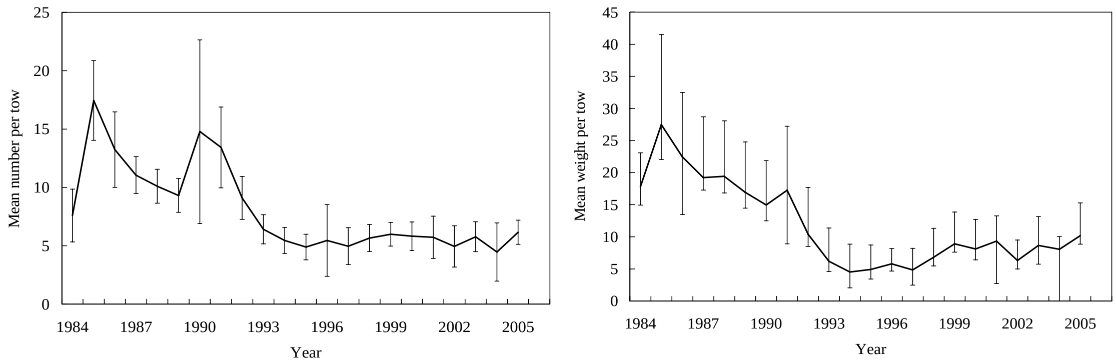


Fig.16.2b Thorny skate in Div. 3LNOPs: estimates of Campelen equivalent mean numbers and mean weights per tow from Canadian spring surveys. 2006 points are excluded due to insufficient survey coverage

The Spanish Div. 3NO survey was conducted in the NRA portion of Div. 3NO to a depth of 1 400 m, while the Canadian spring survey covered all of Div. 3NO (except in 2006). The biomass trajectory from the Spanish survey was very similar to that of the Canadian spring survey (Fig. 16.3).

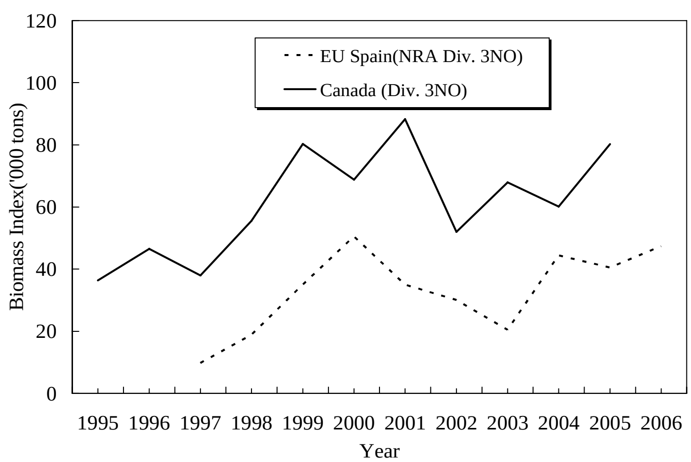


Fig.16.3. Thorny skate in Div. 3NO: estimates of biomass from Spanish Div. 3NO survey compared to Canadian spring surveys.

The results of the 2006 the Spanish Div. 3NO survey did not alter the perception of stock status by STACFIS.

c) Conclusion

With the addition of indices for the current year, there is nothing to indicate a significant change in the status of the stock.

This stock will next be assessed in 2008.

17. White hake (*Urophycis tenuis*) in Div. 3N, 3O and Subdiv. 3Ps

(SCR Doc. 05/60, 07/21, 37, 52; SCS Doc. 07/06, 08, 09, 12)

a) Introduction

The advice requested by Fisheries Commission is for Div. 3NO although the stock area is specified as Div. 3NO plus Subdiv. 3Ps. Previous studies indicated that white hake constitute a single unit within Div. 3NOPs and that fish younger than 1 year, 2+ juveniles, and mature adults distribute at different locations within Div. 3NO and Subdiv. 3Ps. This movement of fish of different stages between areas must be considered when assessing the status of white hake in Div. 3NO. Therefore, an assessment of Div. 3NOPs white hake is conducted with information on Div. 3NO alone included.

From 1970-2006, white hake catches in Div. 3NO fluctuated, averaging approximately 2 000 tons, exceeding 5 000 tons in three years during that period. Catches peaked in 1985 at approximately 8 100 tons then declined, averaging 2 090 tons from 1988 to 1994 (Fig. 17.1). With the restriction of fishing by other countries to areas outside Canada's 200-mile limit in 1992, non-Canadian landings fell to zero. Average catch was at its lowest in 1995-2001 (464 tons) but increased to 6 752 tons in 2002 and 4 841 tons in 2003 following the recruitment of the large 1999 year-class. Catches declined to an average of 1 102 tons in 2004-2006.

Catches in Subdiv. 3Ps were less variable, averaging 1 114 tons in 1985-93, then decreasing to an average of 668 tons in 1994-2003. Subsequently, catches increased to an average of 1 338 tons in 2004-2006.

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, Russia in 2003 in Div. 3NO in the NRA resulting in the 2003-2004 peak. There were no directed fisheries by EU-Spain in 2004 or by EU-Spain, EU-Portugal or Russia in 2005-2006. In 2003-2004, 14% of the total catches of white hake in Div. 3NO and Subdiv. 3Ps were taken by Canada but increased to 93% in 2006, mainly due to an absence of a directed fishery for white hake by other countries in 2005-2006.

Recent nominal catches and TACs ('000 tons) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Div. 3NO										
TAC								8.5	8.5	8.5
STATLANT 21A	0.2	0.4	0.6	0.6	4.8	6.2	1.9	0.9[1]	1.2[1]	
STACFIS	0.2	0.4	0.6	0.7	6.8	4.8	1.3	0.9	1.1	
Subdiv. 3Ps										
STATLANT 21A	0.6	0.6	1.1	0.9	0.9	1.1	1.3	1.5[1]	1.3[1]	

[1] Provisional

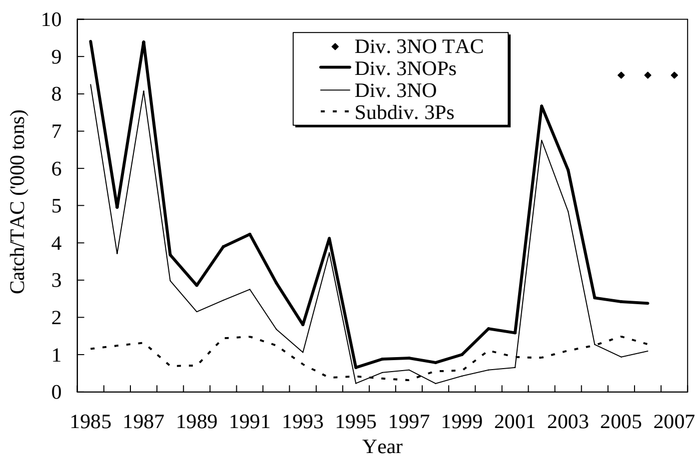


Fig. 17.1. White hake in NAFO Div. 3NO and Subdiv. 3Ps: total catches and TACs.

b) Input Data

i) *Commercial fishery data*

Length composition. Length frequencies are available for Canada (1994-2006), EU-Spain (2002, 2004), EU-Portugal (2003-2004, 2006), and Russia (2000-2006). In the Canadian fishery in 2004-2006, peak lengths caught by longlines in Div. 3O and Subdiv. 3Ps were 58-70 cm, comprising >80% mature fish; gillnets in Div. 3O and Subdiv. 3Ps were 68-78 cm, comprising >95% mature fish; and 2002-2006 trawls from Div. 3O and Subdiv. 3Ps with peak lengths of 57-77 cm, percent of mature fish varying between 1% and 43%. Sizes reported by EU-Spain and EU-Portugal were mainly in the 35-60 cm range, proportion mature ranging between 25% and 65%. Russia reported a much wider range of sizes, mainly from 25-75 cm, 26-63% mature. Smaller fish, peaking at 27-36 cm were reported as bycatch in Russian trawl fisheries in 2006.

ii) *Research survey data*

Canadian stratified-random bottom trawl surveys. Data from spring surveys in Div. 3N, 3O and Subdiv. 3Ps were available from 1975 to 2005. In the 2006 Canadian spring survey, most of Subdiv. 3Ps was not surveyed and only shallow strata in Div. 3NO (to a depth of 77 m in Div. 3N, to 103 m in Div. 3O) were surveyed and thus the survey estimates in the most recent year are not included in this analysis. Data from autumn surveys in Div. 3NO were available from 1990 to 2006. Surveys prior to 1991 generally went to a maximum depth of 366 m. After 1991, the range of depths surveyed was extended to at least 731 m. Given that 80% of the biomass distributes at depths <350 m, white hake occur mostly within the area surveyed over time. As well, estimates based on sets from strata that have been surveyed throughout the years, compared to estimates that include deep water and inshore strata, yield very similar results for white hake. Canadian spring and autumn surveys were conducted using a Yankee 41.5 bottom trawl prior to 1984, using an Engel 145 bottom trawl from 1984 to spring 1995, and a Campelen 1880 trawl thereafter. There are no survey catch rate conversion factors for white hake among gears and thus are presented as separate series.

The spring index for Div. 3NOPs declined in the early 1980s, peaking in the late 1980s and again in 2000 (Fig. 17.2a). In particular, the very large 1999 year-class resulted in a large peak in the autumn of 1999 and spring of 2000 (Fig. 17.2a, b). The indices have since declined to levels similar to 1996-1998. Values for 2006 are not presented because Canadian spring survey coverage was inadequate in Div. 3NO and Subdiv. 3Ps. From 2002 to 2005, the population was stable at a lower level similar to what was observed in 1996-1998.

The Div. 3NO indices (spring and autumn) show a different pattern than the spring Div. 3NOPs series because white hake distribute differently by stage among Divisions (Fig. 17.2a, b). Juveniles older than one year occur mainly in Subdiv. 3Ps while young of the year (YOY), one year olds and mature adults concentrate in Div. 3NO. Thus, both the spring and autumn Div. 3NO indices reflect changes in mature adults and juveniles younger than age 2 (based on modal analyses) but not changes in the entire population. The only information available for Canadian surveys in 2006 is from the autumn in Div. 3NO. However, the 2006 autumn Div. 3NO value is similar in magnitude to the previous year.

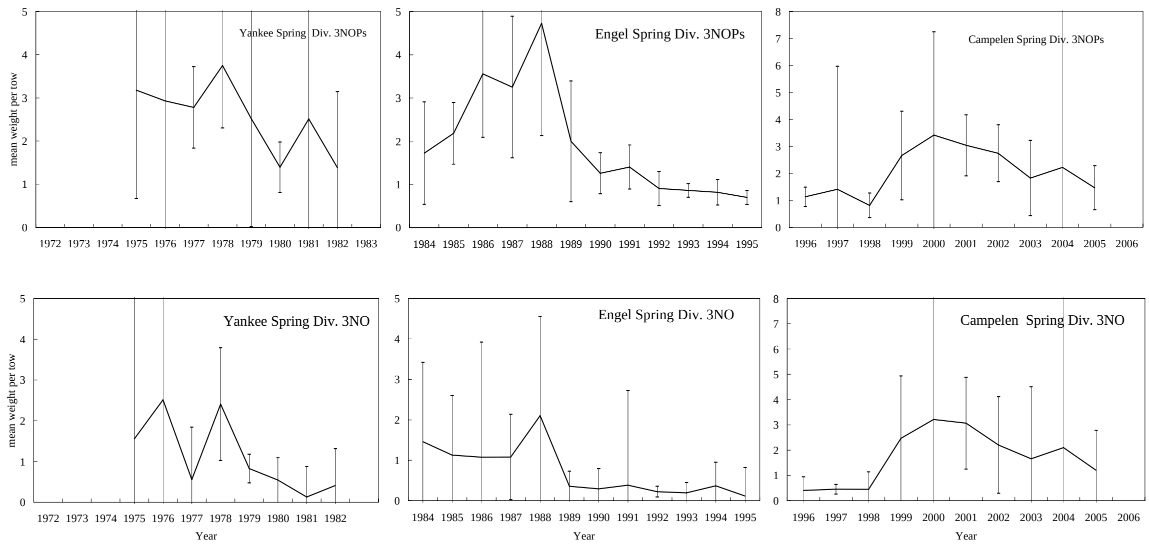


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: mean weight per tow from Canadian spring surveys, 1975-2005. The 2006 points are not shown since survey coverage in that year was incomplete. The Yankee, Engel and Campelen time series are not standardized and thus are presented on separate panels. Error bars represent ± S.D.

The large peak observed in the autumn of 1999 is observed in the spring of 2000 in Div. 3NO. This time shift of several months corresponds to the growth of a large year-class of white hake, located mainly in Div. 3O. The 2006 value (comprising mainly adults and one year olds) was similar in magnitude to 2005 (Fig. 17b).

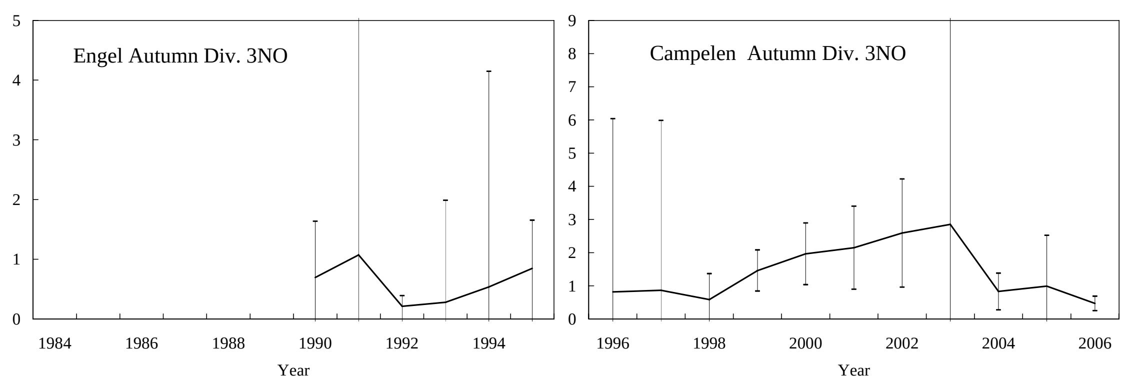


Fig. 17.2b White hake in Div. 3NO: mean weight per tow from Canadian autumn surveys, 1990-2006. The Engel and Campelen time series are not standardized and thus are presented on separate panels. Error bars represent ± S.D.

Spanish 3NO stratified-random bottom trawl surveys. Biomass indices in the NAFO Regulatory Area of Div. 3NO were available for white hake from 2001 to 2006. Spanish surveys were conducted with Campelen gear (similar to that used in Canadian surveys) in the spring to a depth of 1 400 m. Spanish biomass indices were highest in 2001, then declined to 2003 and have been relatively stable since. The trend is similar to the Canadian spring survey index (Fig. 17.3).

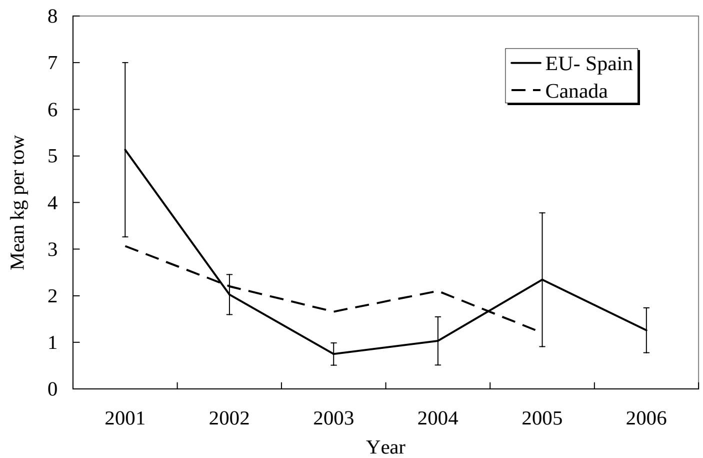


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from Spanish 3NO surveys in 2001-2006 compared to Canadian spring survey indices in all of Div. 3NO. Error bars represent ± S.D.

Survey Size Distribution. Research surveys conducted in spring by Canada and EU-Spain track progression of the large 1999 year-class through 2000-2006 (Fig. 17.4). Note that various years are on different scales so the modes in latter years can be seen. A large mode of white hake with an average length of 22 cm was observed in 2000. In both surveys, average length of the mode increased through time; 43 cm in 2002, 48 cm in 2003, 54 cm in 2004, 58 cm in 2005 and 61 cm in 2006. In 2004 and 2005, there was also a mode of small white hake although the 2005 mode was not observed in the EU-Spanish survey.

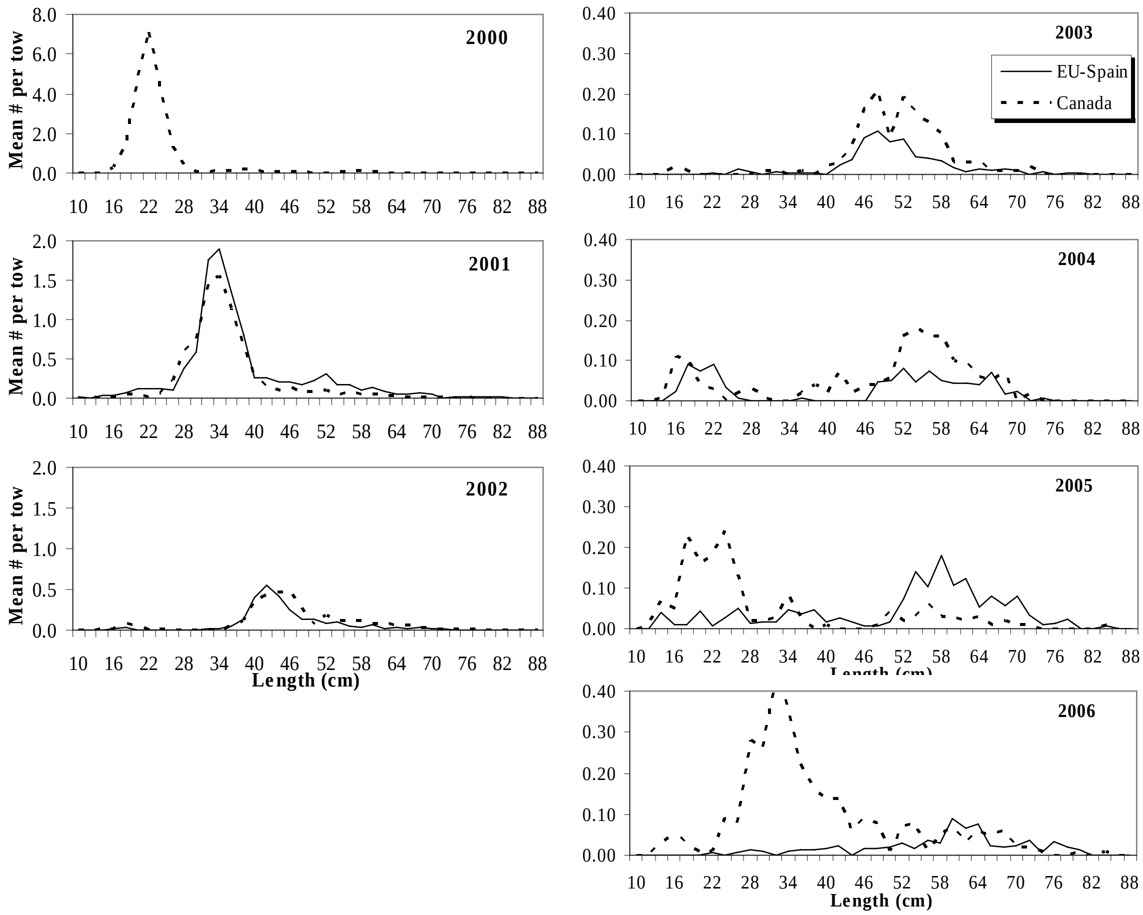


Fig. 17.4. White hake in Div. 3NO: Abundance at length from Canadian Campelen and Spanish Campelen spring surveys in 2000-2006.

iii) *Biological studies*

Distribution. White hake in Div. 3NO and Subdiv. 3Ps are confined largely to an area associated with the warmest bottom temperatures (4-8ºC) along the southwest fringe of the Grand Banks, edge of the Laurentian Channel and southwest coast of Newfoundland.

White hake distribute at different locations during various parts of their life cycle. Fish <25 cm in length (1st year fish) occur almost exclusively on the Grand Bank in shallow water (nursery ground). Juveniles (2+ years) are widely spread and a high proportion of white hake in the Laurentian Channel portion of Subdiv. 3Ps are juveniles. Mature adults concentrate on the southwest slope of the Bank (spawning grounds) in both Subdiv. 3Ps and Div. 3NO.

Maturity. Maturity at size was estimated for each sex separately, using Canadian spring survey data from 1997-2004. Length (L_{50}) at 50% maturity is different between the sexes; with fifty percent of males maturing at 39 cm, and fifty percent of females maturing at 57 cm. However, L_{50} was very similar for each sex between Div. 3NO and Subdiv. 3Ps (Fig. 17.5).

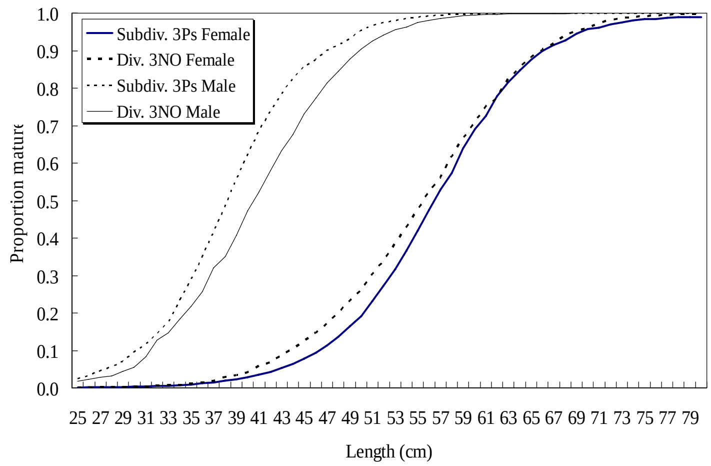


Fig. 17.5. White hake in Div. 3NO and Subdiv. 3Ps: ogives calculated for each sex from Canadian spring surveys and averaged over 1997-2004.

Life stages. Canadian spring survey trends in abundance for 1996-2006 were staged as one year olds, age 2+ juveniles (IMM), and mature adults (SSA) (Fig. 17.6). Recruitment was very high in 1999. Year-classes since then have been extremely low, as compared to the 1999 year-class. A peak is observed in 2005, but is much smaller than the 2000 peak (Fig. 17.6b).

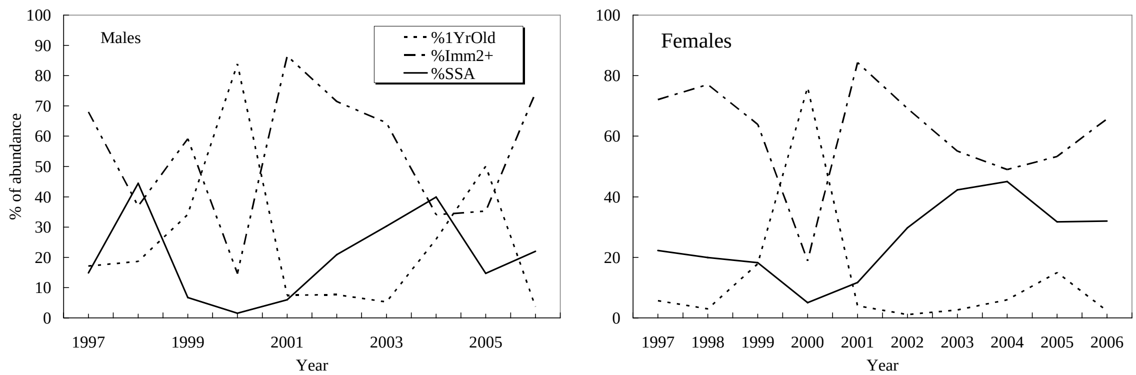


Fig. 17.6a.White hake in Div. 3NO and Subdiv. 3Ps: proportion of stages in terms of abundance by sex from Canadian Campelen spring survey data in 1997-2006.

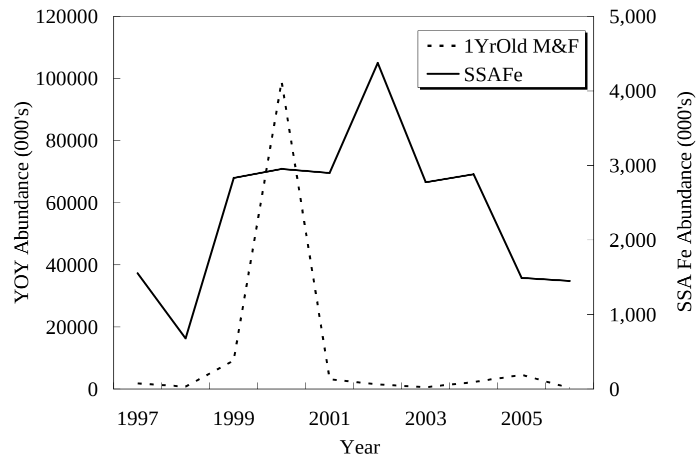


Fig. 17.6b White hake in Div. 3NO and Subdiv. 3Ps: staged trends in abundance of female spawners (SSA Fe) and recruits (one-year-old males plus females) from Canadian Campelen spring survey data in 1997-2006.

iv) ***Recruitment***

Recruits per spawner varied between 0.4 and 35 recruits for each adult female in 1997-2004 (Fig. 17.7). Two significant values were observed in this time series: 13.5 in 1998 and 35 in 1999. The largest value in recent years is 1.6 in 2004.

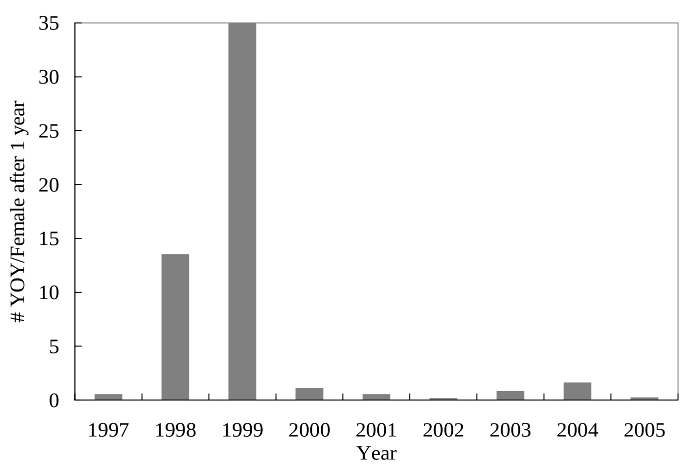


Fig. 17.7. White hake in Div. 3NO and Subdiv. 3Ps: recruit per spawner from Canadian Campelen spring surveys in 1997-2004. Females are from year-1.

A particle tracking study in the vicinity of where white hake release their eggs into the water column suggests that variation in ocean current strength and direction, location of release of the eggs, depth of the particles (eggs, larvae and young juveniles) in the water column can affect location where the young fish settle. In years when a larger proportion of juveniles settle on the shallow part of the Grand Banks (nursery area), rather than being carried out beyond the shelf edge, can lead to greater survival of young fish. In particular, interannual variability in strength of the Labrador Current may have profound impacts on the destination of the eggs and larvae and pelagic juveniles at the time of settlement. Reduced flow of the Labrador current in 1999 may have led to the observed settlement of large numbers juveniles onto the shallow Grand Bank, and subsequent large year-class.

b) Assessment Results

Biomass. The biomass of this stock increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has substantially decreased until 2003 and has been stable since.

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

Relative F (catch/Canadian spring survey biomass). Using STACFIS agreed commercial catch and Canadian spring survey biomass index, estimates of relative F were calculated for white hake in Div. 3NO and Div. 3NOPs. Relative *F* fluctuated in the 1980s then declined in the 1990s (Fig. 17.8). The index increased in 2002-2003, declined in 2004 then increased again in 2005. Canadian survey data were not available for 2006.

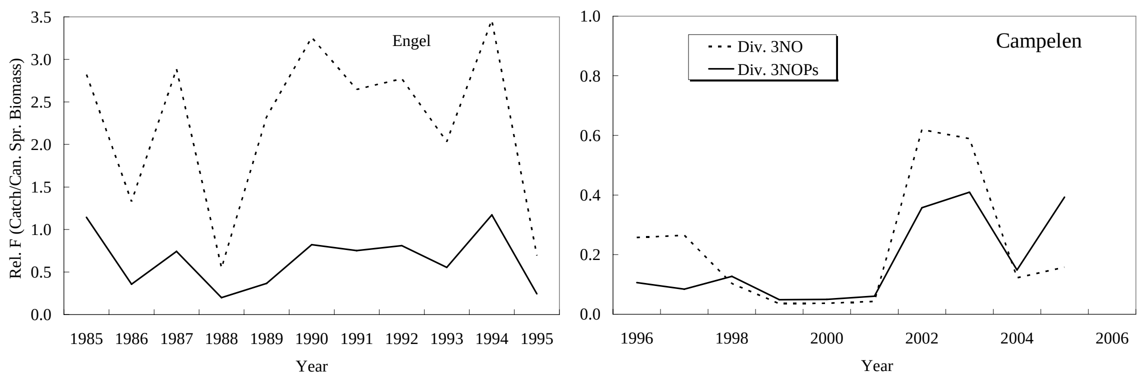


Fig. 17.8.White hake in Div. 3NO and Subdiv. 3Ps: estimates of relative *F* from STACFIS agreed commercial catches and Canadian spring surveys.

State of the stock. Following the dominance of 1999 fish in 2000, a progression of this year-class is observed through subsequent years leading to increased catches in the white hake fishery in 2002-2003, when fish reached harvestable sizes, followed by a reduction in catches since. Both catches and survey biomass indices were much reduced in 2004-2005 relative to 2000-2001.

c) Reference Points

Reference Points with respect to a Precautionary Approach for this species have not been determined.

d) Research Recommendations

STACFIS **recommended** that *the genetic analyses in 2003 of Div. 3NO versus Subdiv. 3Ps samples be continued; in order to help determine whether Div. 3NOPs white hakes comprise a single breeding population.*

STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2005+); thereby allowing age-based analyses of this population.*

This stock will next be assessed 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 -1-2ºC 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 3-4ºC and salinities in the range of 34-34.75. On average bottom temperatures remain <0ºC over most of the northern Grand Banks but increase to 1-4ºC 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 (1-3ºC) except for the shallow inshore regions where they are mainly <0ºC. In the deeper waters of the Flemish Pass and across the Flemish Cap bottom temperatures generally range from 3-4ºC. Throughout most of the year the cold relatively fresh water overlying the shelf is separated from the warmer higher density water of the continental slope region by a strong temperature and density front. This winter-formed water mass is generally referred to as the cold intermediate layer (CIL) and is considered a robust index of ocean climate conditions. In general, shelf water masses undergo seasonal modification in its properties due to the seasonal cycles of air-sea heat flux, wind forced mixing and ice formation and melt leading to intense vertical and horizontal gradients particularly along the frontal boundaries separating the shelf and slope water masses. Temperature and salinity conditions over the Scotian Shelf are largely determined by advection of water from southern Newfoundland and the Gulf of St. Lawrence as well as offshore slope waters. In the northeast regions of the Scotian Shelf the bottom tends be covered by relatively cold waters (1-4ºC) whereas the basins in the central and southwestern regions have bottom temperatures that typically are 8-10ºC.

Ocean temperatures on the Newfoundland and Labrador Shelf during 2006 remained above normal, reaching a 61-year record high at Station 27 off eastern Newfoundland, thus continuing the warming trend experienced during the past several years. The cross-sectional area of <0ºC (CIL) shelf water during the summer of 2006 remained below the long-term mean along all sections from Labrador to Southern Newfoundland. In some areas the CIL was below normal for the twelveth consecutive year and off eastern Newfoundland it was the third lowest (warmest) since 1948. Further south, on the Scotian Shelf ocean temperatures increased over 2005 values to above normal conditions over most areas making 2006 the warmest year in 37 years. Sydney Bight and Misaine Bank had typical temperature anomalies of 1.3 and 0.7ºC; Emerald Basin, Lurcher Shoals, Georges Basin and eastern Georges Bank all showed positive anomalies ranging from 0.1-1.4ºC at most depths. The temperatures from the July groundfish survey increased substantially from the record cold values in 2004. The overall anomaly for the combined areas of 4Vns, 4W and 4X was 0.7ºC, the third warmest in 37 years. Upper layer salinities throughout the waters of eastern Canada increased to the highest observed in over a decade during 2002 and remained above normal in 2003 to 2006, however there were considerable local variability. The water column stratification, which may have important implication for marine production increased to above normal conditions during 2006 in most areas.

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

(SCR Doc. 05/46, 07/10, 11, 18, 25, 34, 37; SCS Doc. 07/06, 08, 09, 12)

a) Introduction

i) *Description of the fisheries*

It has been recognized that a substantial part of the recent grenadier catches in Subarea 3, previously reported as roundnose grenadier correspond to roughhead grenadier. The misreporting has not yet been resolved in the official statistics before 1996, but the species are reported correctly since 1997. However, the STACFIS revised roughhead grenadier catches since 1987 were presented in SCR Doc. 98/28. From 1993 to 1997 the level of the catches was around 4 000 tons. The highest level of observed catches (7 231 tons) was reached in 1998. From then until 2004 catches were around 3 000 tons. In 2005 and 2006, catches declined further to 1 500 tons. Roughhead grenadier is taken as bycatch in the Greenland halibut fishery, mainly in Div. 3LMN Regulatory Area (Fig. 18.1).

The revised recent catches ('000 tons) are as follows:

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
STATLANT 21A	7.2	7.1	8.9	2.0	1.7	1.8	1.7	1.3	0.3[1]	
STACFIS	7.4	7.2	4.8	3.1	3.7	4.2-3.8[2]	3.2	1.5	1.4	

[1] Provisional,
[2] STACFIS could not precisely estimate the catch in 2003

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

b) Input Data

i) *Commercial fishery data*

Length frequencies from the Spanish, Russian and Portuguese trawl catches in Div. 3LMNO are available since 1992, 1992 and 1996 respectively. In the commercial fishery catches females attain larger lengths than males. Catch-at-age data from the total catches (applying the annual age-length key (ALK) of Spanish commercial catches) in Div. 3LMNO are available since 1992. In 2006, most of catches are composed of ages between 5 and 14, with a mode at age 9.

ii) *Research survey data*

Canadian autumn surveys. Stratified random bottom trawl surveys have been conducted, usually in October-November, in Div. 2J and 3KL since 1978, while Div. 2G and 2H have only been covered occasionally. Since 1990 the survey also covered Div. 3NO. Until 1995 an Engel trawl was used, which was then changed to a Campelen 1800. Surveys depth goes to 1 500 m in Div. 2J and 3K and to 730 m in Div. 3LNO, the latter having been extended to 1 463 m after 1995. In 2002 in Div. 3M a total of 26 hauls were made at depths between 732-1 463 m. Between 2004 and 2006, operational difficulties led to incomplete coverage of the survey in NAFO Divisions 3LMNO.

The estimates from 1995 onwards are not directly comparable with the previous time series because of the change in the survey gear. Taking into account the incomplete coverage of some strata in Div. 2GH and 3LMNO from 1995-2006, only the indices of Division 2J and 3K are comparable from 1995 onwards. From 1995, the biomass of this survey in Div. 2J and 3K shows an increasing trend, reaching its maximum in 2004 with a value of 14 800 tons and remaining at this level in 2005 and 2006 (Fig. 18.2).

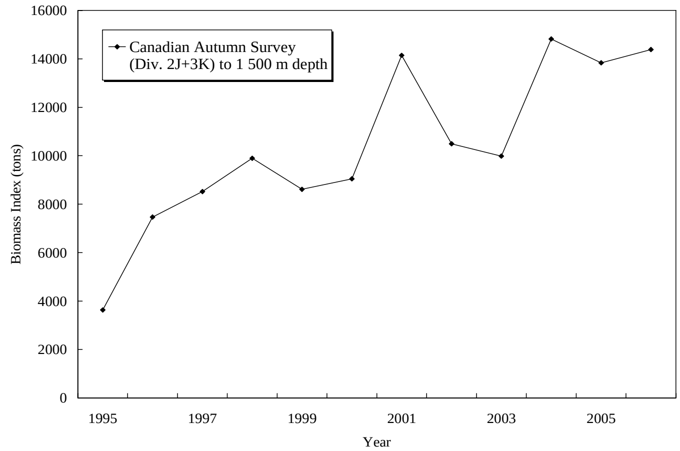


Fig. 18.2. Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian autumn (Div. 2J3K) survey.

Canadian spring surveys. Stratified random bottom trawl surveys have been conducted in Div. 3L, 3N and 3O in spring since 1991 to a maximum depth of 731 m. Until 1996 an Engel trawl was used, which then changed to a Campelen 1 800.

In this survey, a direct comparison of the biomass levels through the whole time series is not possible due to the change in the survey gear in 1995. Fig. 18.3 shows the biomass estimate from this survey from 1996 until 2005. Operational difficulties in 2006 resulted in incomplete coverage of the survey in Div. 3NO and the estimate for this year is not directly comparable with those earlier in the time series. From 1996 to 2004, the biomass level does not present a clear trend and is around 3 000 tons. In 2005, the biomass index increased to 12 000 tons. In all years biomass is largely concentrated in Div. 3L. Biomass estimates from the spring survey series are considerably lower than the ones obtained in the autumn series, as the spring surveys cover only the southern divisions and the shallower depths, where according to other information this species is less abundant. For the same reason, the 2005 high value may not be reflective of population status.

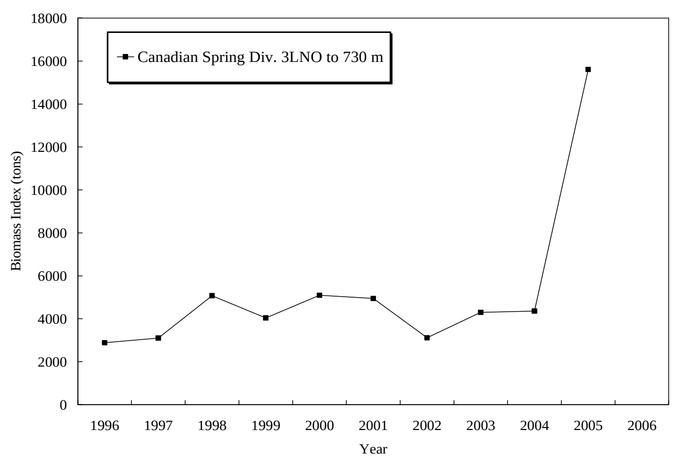


Fig. 18.3 Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

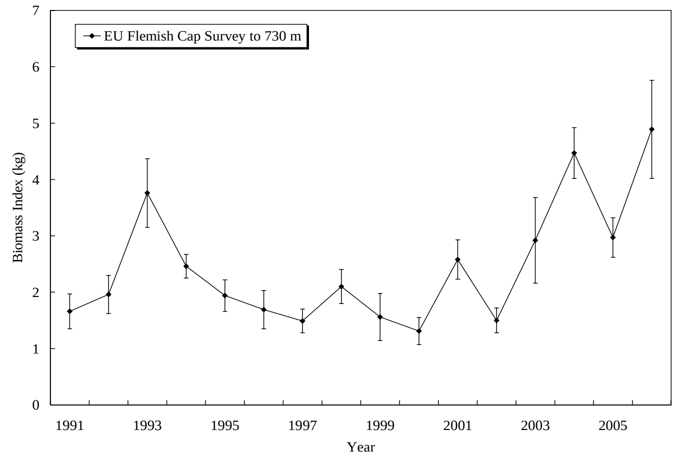


Fig. 18.4. Roughhead grenadier in Subareas 2+3: biomass indices (+/- SE) from the EU Flemish Cap (Div. M) survey.

EU (Spain and Portugal) Flemish Cap survey. EU conducts a stratified bottom trawl survey in Div. 3M since 1988, which goes to 730 m of depth. Since 1991, the survey was conducted with the R/V Cornide de Saavedra. In 2003 this vessel was replaced by the R/V Vizconde de Eza. The former series of Cornide de Saavedra was transformed to the new R/V Vizconde de Eza (SCR Doc. 05/29). The roughhead grenadier biomass index as well as the age composition from this survey series are presented in SCR Doc. 07/25. Figure 18.4 shows the biomass trend of this series. A biomass peak of 3.76 kg per tow was observed in 1993. From then until 2002, the biomass index was more or less stable at values in between 1 and 2 kg per tow. From 2002 onwards, the biomass index shows an increasing trend, reaching a historical maximum of 4.89 kg in 2006.

Spanish Div. 3NO survey. EU-Spain conducts a stratified random spring bottom trawl survey in the NAFO Regulatory Area of Division 3NO since 1995. In 2001 the vessel and trawl gear were replaced. The transformed entire series of mean catches, biomass, length and age distributions for roughhead grenadier were presented in SCR Doc. 07/34 and SCR Doc. 07/37. From 1997 to 2002 the biomass indices of this survey did not show a clear trend. However, since then the biomass index has increased and in 2004 it reached a historical maximum (12.09 kg). In 2005 and 2006 the biomass level was similar to the 2004 level (Fig. 18.5).

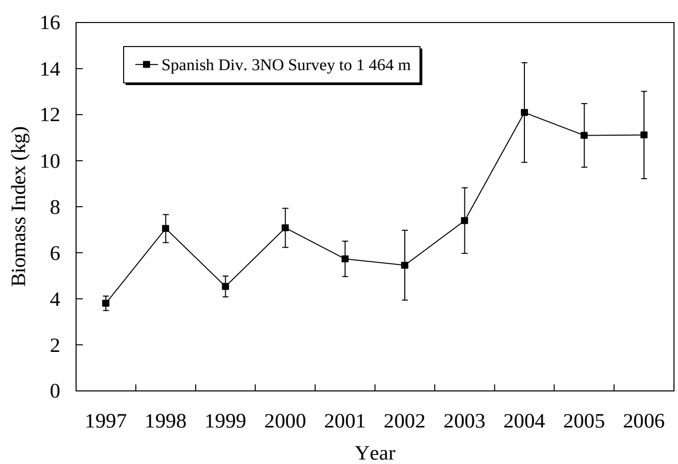


Fig. 18.5. Roughhead grenadier in Subareas 2+3: biomass indices (+/- SE) from the Spanish Div. 3NO survey.

iii) *Recruitment*

Figure 18.6 presents the abundance series (MNPT) for ages 2, 3, 4 and 5 of the EU Flemish Cap survey and the Spanish Div. 3NO survey from 1994 to 2006. A strong upcoming 2001 year-class can be clearly seen in 2003 (age 2) and 2004 (age 3) in both series. This year-class signal can be tracked in the Spanish Div. 3NO series but is not so clear in the 2005 and 2006 EU Flemish Cap survey series.

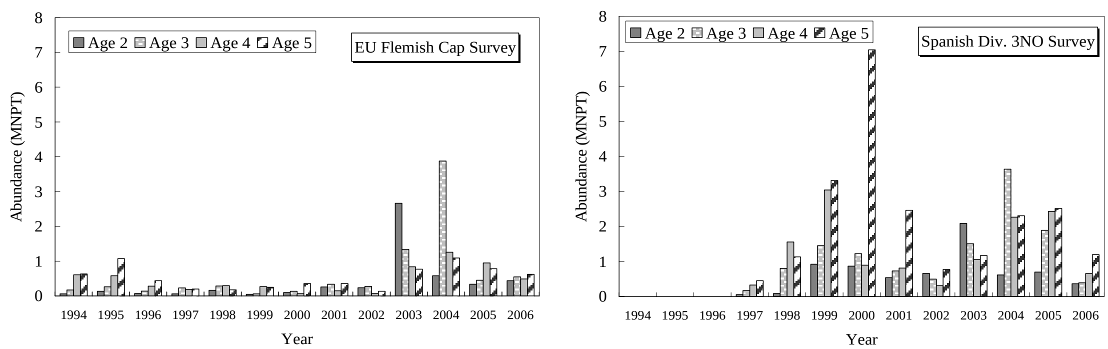


Fig. 18.6. Roughhead grenadier in Subareas 2+3: Spanish Div. 3NO survey and EU Flemish Cap survey abundance at ages 2, 3, 4 and 5.

iv) *Biological studies*

SCR Doc. 07/25 provides information on age and length structure in Div. 3M based on results from the EU Flemish Cap survey series. Age and length composition of the catches show clear differences between sexes. The proportion of males in the catches decreases progressively as length increases and there are sexual differences in growth. Male growth rates declines when reaching a pre-anal fin length of 18 cm, at around 9 years of age, while female growth rate does not slow down until reaching 34-35 cm, at around 20 years old.

SCR Doc. 07/11 provides information on distribution and length in Div. 3KLMNO based on Russian data. A trend towards decreasing catches and to a distribution at lesser depths from the northern areas towards southern ones was noted. A general length increase with depth was noted in Div. 3K and 3M . In Div. 3L and 3N, length showed a downward trend or did not vary substantially with depth.

Size composition from Russian Div. 3LMNO commercial catches from 1996 to 2006 was presented using length of the body from the tip of the snout to the base of the first anal fin ray converted from the total length.

c) Assessment Results

An analytical XSA assessment of the NAFO roughhead grenadier Subareas 2 and 3 was presented but it was not accepted due to the uncertainty in the results.

Biomass: Although the Canadian fall survey series (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 is resource status because their depth coverage is going down to 1 500 m. According with these surveys information the roughhead grenadier total biomass indices indicate a general increasing trend from 1995 onwards, both surveys reaching its maximum in 2004 and remaining at this level in 2005 and 2006.

Fishing Mortality: The *Z* estimate from the catch curve based upon commercial catch at age data (1992-2006) was 0.356 for ages 8 to 20, similar to the *Z* of the 2005 assessment and smaller than 0.39, the value estimated at the 2003 assessment. The value estimated from the catch curve of the EU Flemish Cap survey (1994-2006) was 0.474 for the same ages and 0.426 for the catch curve of the Spanish survey in Div. 3NO data (1997-2006). However, the value based on the Flemish Cap survey is likely to be an overestimation since this survey covers only the shallowest distribution of the resource.

The catch / biomass (C/B) indices obtained using the Canadian autumn survey and the Spanish Div. 3NO survey biomass index in the period 1995-2006 show a clear decreasing trend from 1995 to 2004, due to an increasing trend in the survey biomass and a decrease in catches (Fig. 18.7). In 2005 and 2006 this ratio was stable at the lowest level of the time series with values of 0.10 for the Canadian fall survey and 0.14 for the Spanish Div. 3NO survey. This low level is due to the fact that all surveys indices were in 2005 and 2006 at their maximum biomass level and catches were at their minimum level.

Recruitment: The strong 2001 year-class can be tracked in 2003 and 2004 at ages 2 and 3 but was weaker than expected in 2005 and 2006 at ages 4 and 5.

State of the Stock: Current fishing mortality is the lowest of the series and although the strong 2001 year-class seems to be weaker than expected, the assessment results showed that the current estimates of biomass are the highest of the available time series.

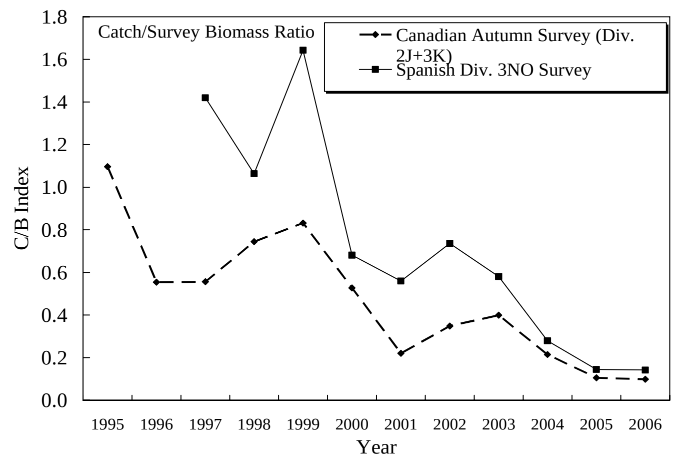


Fig. 18.7. Roughhead grenadier in Subareas 2+3: catch/biomass index based upon Canadian Autumn survey and Spanish Div. 3NO survey.

d) Reference Points

STACFIS is not in a position to provide reference points at this time.

e) Research Recommendations

STACFIS **recommended** 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.*

This stock will next be assessed in 2010.

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

(SCR Doc. 07/27; SCS Doc. 07/6, 8, 9)

a) Catches

The fishery for witch flounder in this area began in the early 1960s and increased steadily from about 1 000 tons in 1963 to a peak of over 24 000 tons in 1973 (Fig. 19.1). Catches declined rapidly to 2 800 tons by 1980 and subsequently fluctuated between 3 000 and 4 500 tons to 1991. The catch in 1992 declined to about 2 700 tons, the lowest since 1964; and further declined to around 400 tons by 1993. Until the late 1980s, the fishery was conducted by Poland, USSR and Canada mainly in Div. 3K. Since then, the regulated fishery had been mainly Canadian although EU (Portugal and Spain) has taken increased catches in the Regulatory Area of Div. 3L since the mid-

1980s. Although a moratorium on directed fishing was implemented in 1995, the catches in 1995 and 1996 were estimated to be about 780 and 1 370 tons, respectively. However, it is believed that these catches could be overestimated by 15-20% because of misreported Greenland halibut. The catches in 1997 and 1998 were estimated to be about 850 and 1 100 tons, respectively, most of which was reported from the Regulatory Area of Div. 3L. From 1999 to 2004 catches were estimated to be between 300 and 800 tons, and in 2005 and 2006 catch declined to 155 tons and 84 tons respectively.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.4	0.4	0.5	0.6	0.7	0.5	0.3	0.2[1]	0.1[1]	
STACFIS	1.1	0.3	0.7	0.8	0.4	0.7	0.8	0.2	0.1	

ndf no directed fishing
1 Provisional

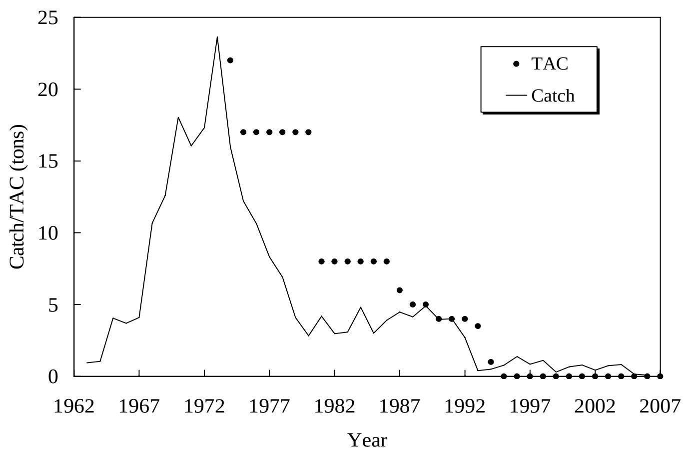


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) Input Data

i) *Research survey data*

Mean weight (kg) per tow. Research vessel surveys have been conducted in autumn by Canada since 1978 in Div. 2J and 3K and since 1984 in Div. 3L. Mean weights (kg) per tow for witch flounder in Div. 2J+3KL were estimated from the Canadian autumn surveys. For Div. 2J, mean weights (kg) per tow ranged from as high as 1.82 kg per tow in 1986 to a low of 0.05 kg per tow in 2003 and increased slightly over 2004 to 2006 to 0.28 kg per tow (Fig. 19.2). In Div. 3K, during 1979-85, there was a period of relative stability where most survey sets averaged 7-13 kg. Since that time estimates have declined considerably to less than 0.09 kg per tow in 1995. Values increased slightly after 1995 ranging from 0.17 to 0.28 kg per tow between 1996 and 2001, but declined in 2002 to 0.09 kg per tow, the lowest value in the series and remained low at 0.13 kg per tow in 2003. In 2004 the estimate increased slightly to 0.52 kg per tow and remained around 0.6 kg per tow in 2005 and 2006. For Div. 3L, mean weights per tow varied generally between 2.5 and 1.31 kg per tow from 1984 to 1990 but declined rapidly since then to a low of 0.08 kg per tow in 1995. Values have remained under 0.4 kg per tow since then, and in 2006, mean weight (kg) per tow is estimated to be 0.33. Increases in biomass indices for the whole stock area were not observed in abundance indices, suggesting the slight increasing trends in biomass are the result of growth and not recruitment.

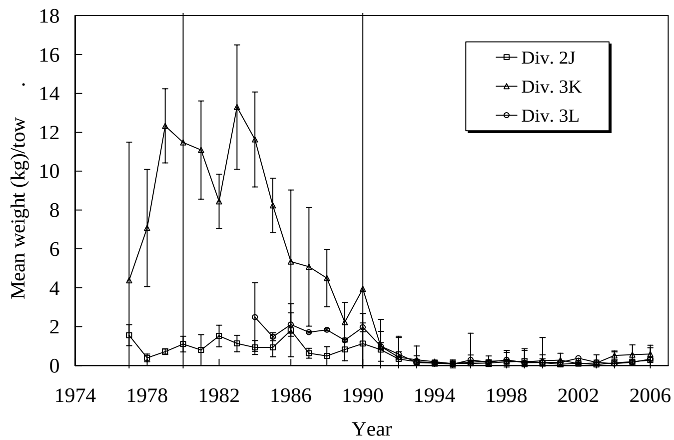


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow from Canadian autumn surveys.

Distribution. Survey distribution data from the late 1970s and early 1980s indicated that witch flounder were widely distributed throughout the shelf area in deeper channels around the fishing banks primarily in Div. 3K. By the mid-1980s, however, they were rapidly disappearing and by the early 1990s had virtually disappeared from the area entirely except for some very small catches along the slope and more to the southern area. They now appear to be located only along the deep continental slope area, both inside and outside the Canadian 200-mile fishery zone (Fig. 19.3).

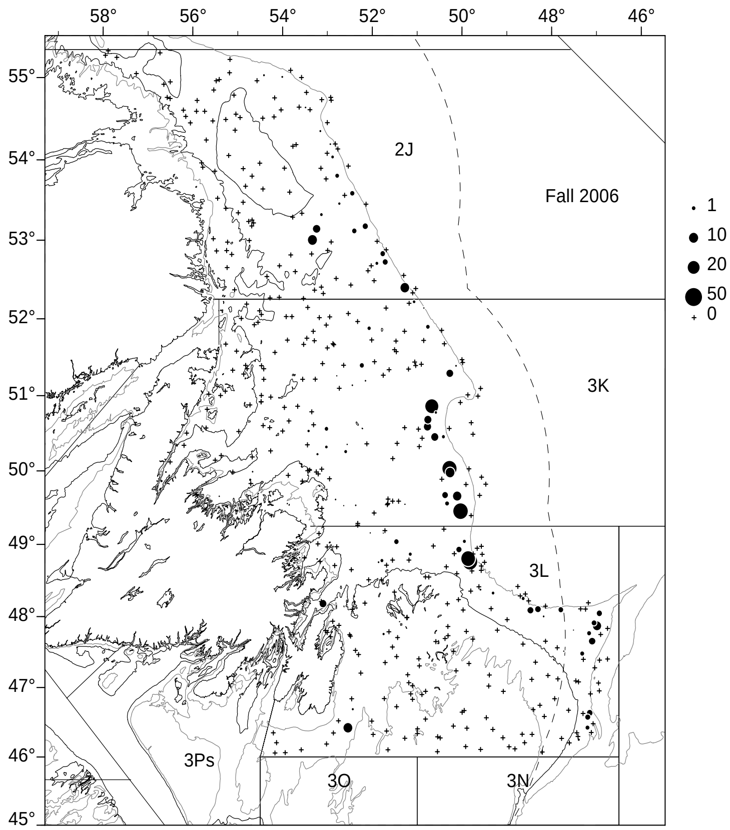


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per set from Canadian surveys during autumn 2006.

c) Assessment Results

Based on the most recent data, STACFIS considers that the overall stock remains at a very low level.

d) Reference Points

In the absence of an analytical assessment for this stock, Blim was calculated as 15% of the highest observed biomass estimate (B_{lim} = 9 800 tons; Fig. 19.4). Since the highest observed biomass estimates are in the early part of the time series when the survey did not cover the entire stock area, Blim may be underestimated using this method. Nevertheless, the stock has been below this limit reference point since 1992.

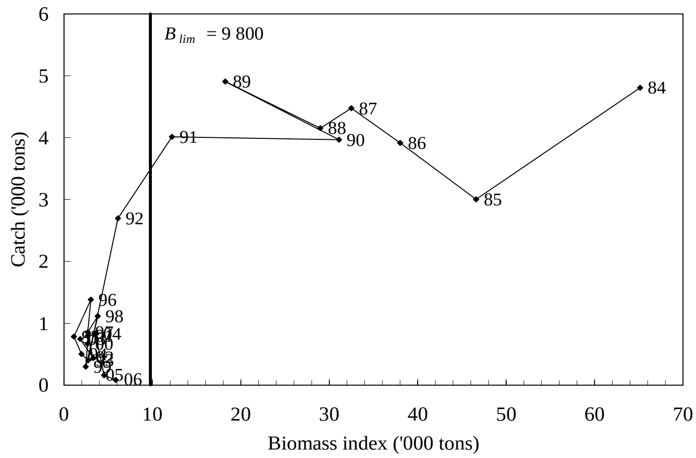


Fig. 19.4. Witch flounder in Div. 2J, 3K and 3L: Catch ('000 tons) and biomass index ('000 tons) from Canadian autumn surveys.

e) Research Recommendation

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.*

In stock will next be assessed in 2010.

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

(SCR Doc. 07/10, 18, 23, 31, 35, 45, 50, 53, 54, 58, 59; SCS Doc. 07/,6, 8, 9,12; FC Doc 03/13)

a) Introduction

Catches increased from low levels in the early 1960s to over 36 000 tons in 1969, and ranged from less than 20 000 tons to 39 000 tons until 1990 (Fig. 20.1). In 1990, an extensive fishery developed in the deep water (to at least 1 500 m) in the NAFO Regulatory Area (NRA), around the boundary of Div. 3L and 3M and by 1991 extended into Div. 3N. The total catch estimated by STACFIS for 1990-94 was in the range of 47 000 to 63 000 tons annually, although estimates in some years were as high as 75 000 tons. Beginning in 1995, TACs for the resource were established by the Fisheries Commission, and the catch declined to just over 15 000 tons in 1995, a reduction of about 75% compared to the average annual catch of the previous 5 years. The catch from 1996-98 was around 20 000 tons per year. Subsequently catches increased and by 2001 had reached 38 000 tons before declining to 34 000 tons in 2002. The total catch for 2003 was believed to be within the range of 32 000 tons to 38 500 tons; for assessment purposes, STACFIS used a catch of 35 000 tons.

In 2003, Scientific Council noted that the outlook for this stock was considerably more pessimistic than in recent years, and that catches were generally increasing despite declines in all survey indices. In 2003 the Fisheries Commission implemented a fifteen year rebuilding plan for this stock, and established TACs of 20 000, 19 000, 18 500 and 16 000 tons, respectively for the years 2004 to 2007. Subsequent TAC levels shall not be set at levels beyond 15% less or greater than the TAC of the preceding year until the Fisheries Commission rebuilding target of 140 000 tons of age 5+ biomass has been achieved. During the first three years of the rebuilding plan, estimated catches for 2004 – 2006 have been 25 500 tons, 23 250 tons, and 23 500 tons, respectively. These catches exceed the rebuilding plan TACs by 27%, 22%, and 27%, respectively.

Prior to the 1990s Canada was the main participant in the fishery followed by USSR/Russia, Denmark (Faroe Islands), Poland and EU-Germany (GDR before 1989) fishing primarily in Subarea 2 and Division 3K. Since then the major participants in the fishery are EU-Spain, Canada, EU-Portugal, Russia and Japan. All except Canada fish the NRA mainly in Divisions 3LM and to a lesser degree in Divisions 3NO.

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

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Recommended TAC	nr	30	30	40	40	36	16	nr*	nr*	nr*
TAC	27	33	35	40	44	42	20[1]	19[1]	18.5[1]	16[1]
STATLANT 21A	20	23	32	29	29	27	16	17.9[2]	4.3[2]	
STACFIS	20	24	34	38	34	32-38[3]	25	23	24	

nr – no recommendation.
* Evaluation of rebuilding plan.
1 Fisheries Commission rebuilding plan (FC Doc. 03/13)
2 Provisional.
3 In 2003, STACFIS could not precisely estimate the catch.

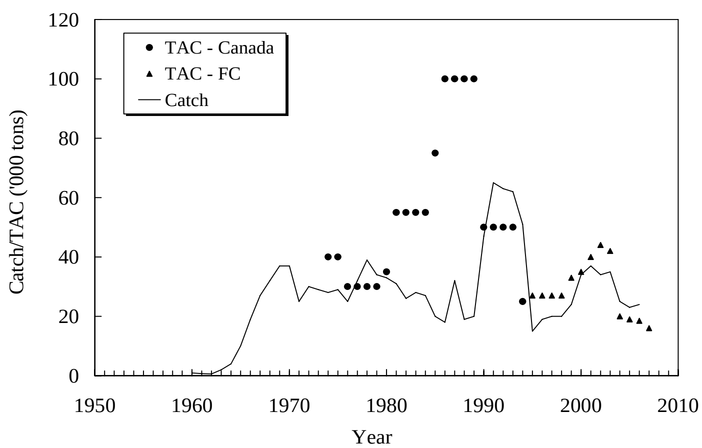


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) Input Data

i) *Commercial fishery data*

Catch and effort. Analyses of otter trawl catch rates (Fig. 20.2) from Canadian vessels operating inside of the Canadian 200 mile limit, using hours fished as the measure of effort, indicated a declining trend since about the mid-1980s, stabilizing at a low level during the mid-1990s. The standardized catch rate increased from 1997-2001 then declined in 2002 and remained stable to 2005 at the low levels of the mid-1990s. The 2006 estimate of standardized CPUE indicates a sizeable increase compared to recent years.

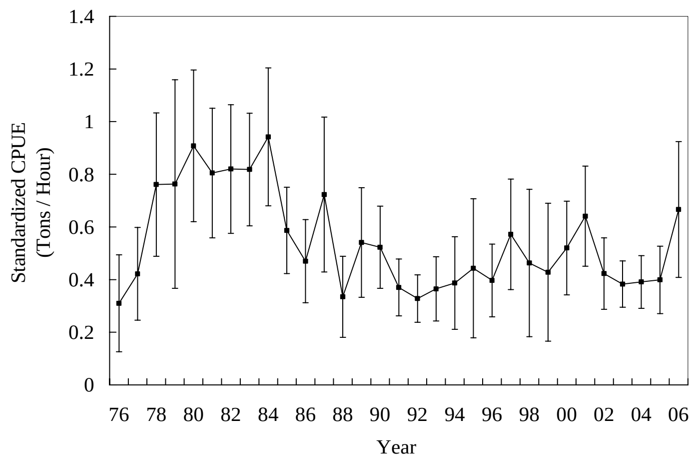


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) based on hours fished from the Canadian otter trawl fishery in Div. 2HJ+3KL.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN from 1988-2006 (Fig. 20.3) declined sharply from 1988 to 1991, and remained around this low level until 1994. CPUE gradually increased until 1999-2000, declined in 2001 and with the exception of 2004, have increased since that time.

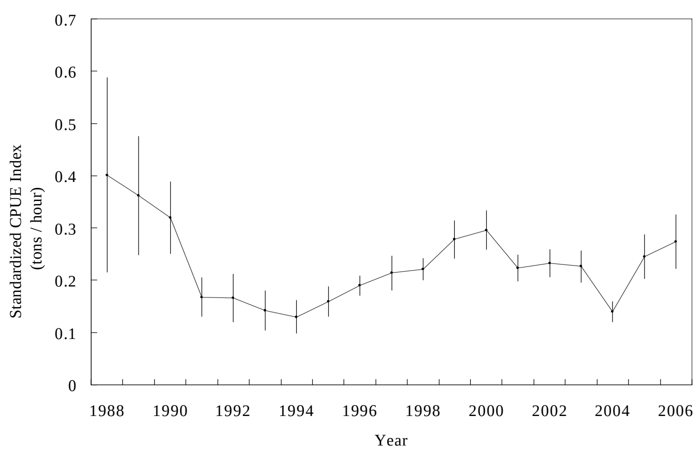


Fig. 20.3 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (±2 S.E.) from EU-Portugal trawlers with scientific observers in Div. 3LMN.

Catch-rates of Spanish otter trawlers fishing in the NRA of Div. 3LMNO from 1992-2006 (Fig. 20.4) have shown cyclical trends, yet increased substantially since 2004. A spatial analysis of catch and effort trends of the Spanish fleet 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.

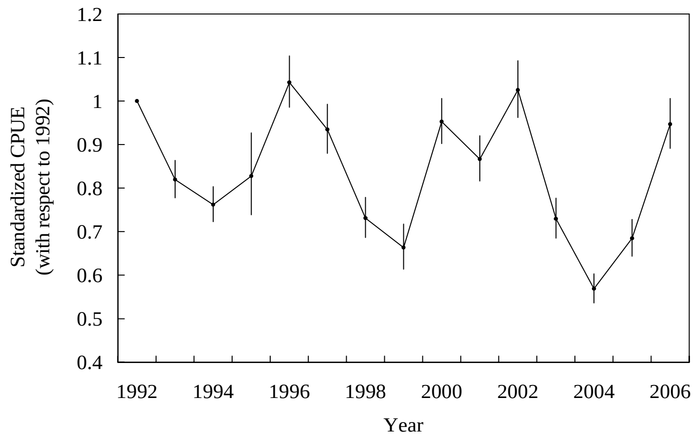


Fig. 20.4 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE (with approximate 95% CIs) from EU-Spain trawlers with scientific observers in Div. 3LMNO.

A comparison of each of the standardized CPUE series demonstrates that trends in standardized catch rates from each fleet have not been consistent over time (Fig 20.5). However, recent increases in CPUE have been detected in all fleets.

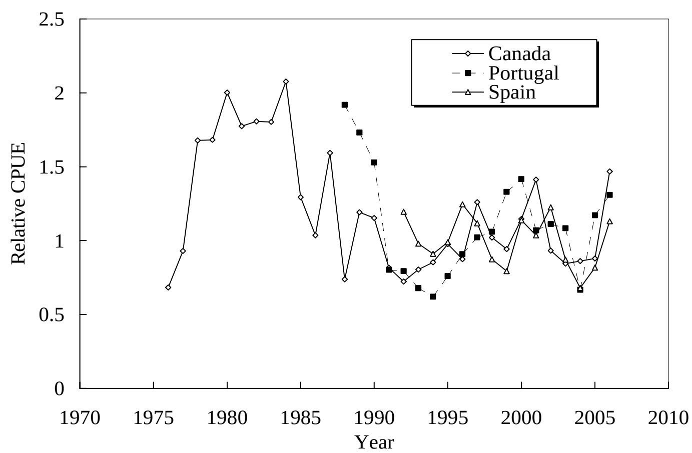


Fig. 20.5 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each series of standardized CPUE estimates is scaled to the 1992-2006 average).

STACFIS previously recognized that trends in commercial catch per unit effort for Greenland halibut in Subarea 2 and Div. 3KLMNO should not be used as indices of the trends in the stock (*NAFO Sci. Coun. Rep*., 2004:149). It is possible that by concentration of effort, commercial catch rates may remain stable or even increase as the stock declines.

Catch-at-age and mean weights-at-age. The methods used for constructing the catch-at-age and mean weights-at-age (kg) from 1975-2000 fisheries are described in detail in SCR Doc. 00/24.

The catch-at-age data for Canadian fisheries in 2006 were presented. Length samples for the 2006 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 2006 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 11% to the landed weight, much lower than the long-term average contribution of 24% to the annual catch biomass. Mean weights-at-age exhibit variable patterns in the earliest period likely due to poor sampling. Mean weights-at-age for age groups 5-9 during the recent period were relatively stable. For older fish they were variable and show a declining trend since 1998.

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. 20.6; 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 four 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-composition of the 2006 survey showed relatively few recruits and increased numbers of older individuals. In 2005 mean numbers declined and mean weight per tow increased.

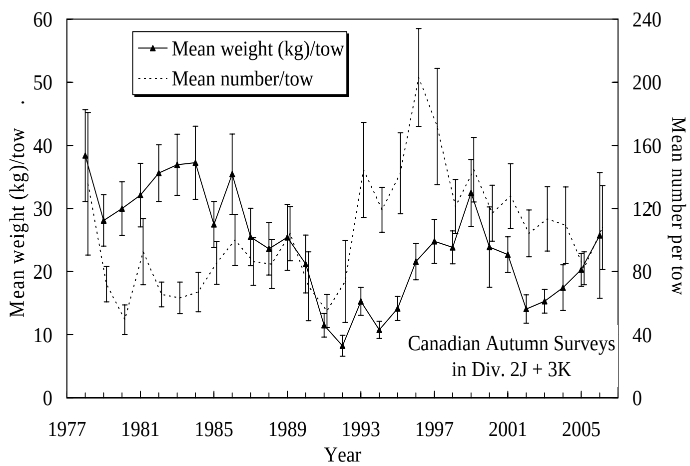


Fig. 20.6 Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

During the late 1970s and early 1980s large Greenland halibut (greater than 70 cm) contributed almost 20% to the estimated biomass. However, after 1984 this size category declined and by 1988 virtually no Greenland halibut in this size range contributed to the index. Since then, the contribution to the index from this size group has been extremely low, often zero.

The Canadian autumn survey in Div. 3L has generally shown trends that are consistent with those from Div. 2J+3K. In 2004, there were substantial coverage deficiencies in Div. 3L and results from this survey are not comparable to other years in the time series. Autumn surveys within Div. 3NO have varying deep-water coverage. Canadian autumn surveys in Div. 3M indicated a decline from 1998 to 2002, which is the lowest value in the series (Fig. 20.7). The 2003 value increased to about the 2001 level. Div. 3M was not surveyed in the autumn of 2004 or 2005; the 2006 estimates of abundance and biomass are relatively low.

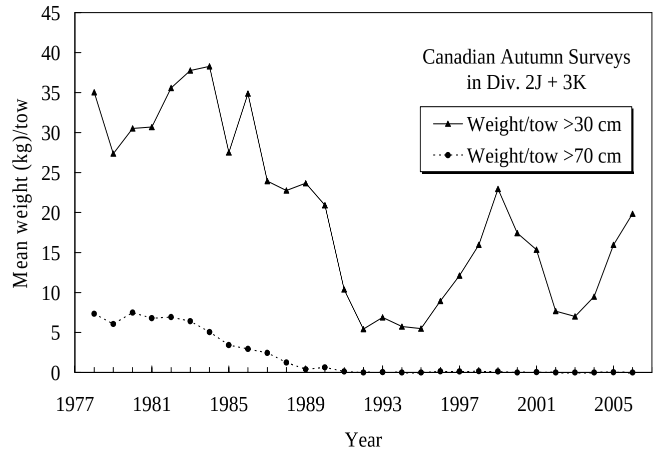


Fig. 20.7 Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 3M.

STACFIS previously noted (*NAFO Sci. Coun. Rep.*, 1993:103) an apparent redistribution of the resource in the early 1990s. Thus, the declining trend in the Canadian autumn surveys in Div. 2J and 3K from the mid-1980s to the early 1990s may be more a reflection of Greenland halibut emigrating from the survey area to the deep waters of the Flemish Pass as opposed to a severe decline in the stock. Here they have been exploited by what has become the main component of the commercial fishery. Since the mid-1990s, survey indices both in the Regulatory Area and in Div. 2J and 3K 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 surveys in Div. 3LNO and 3M. The biomass index (mean weight (kg) per tow) from the Canadian spring surveys in Div. 3LNO using the Campelen trawl increased from 1996 to 1998. The index declined from 1998-2002 and has been more or less stable since (Fig. 20.8). Div. 3NO were not adequately surveyed in the spring of 2006.

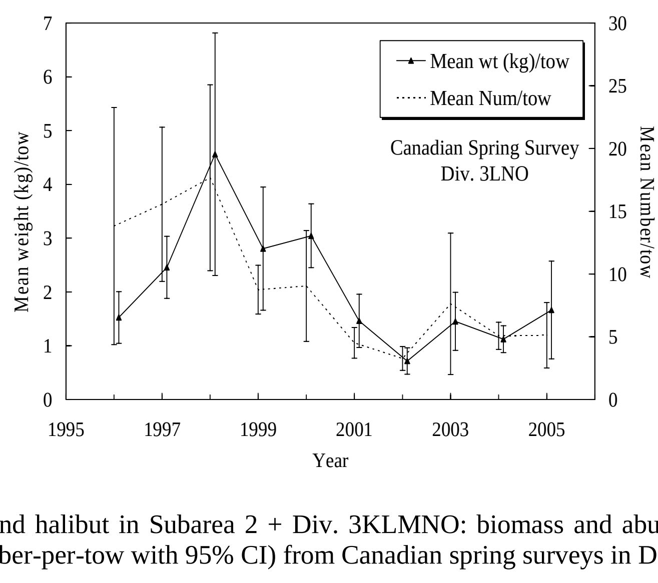


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M. Surveys conducted by the EU in Div. 3M during summer indicate that the Greenland halibut biomass index (mean weight (kg) per tow) on Flemish Cap in depths to 730 m, increased in the 1988 to 1998 period (Fig. 20.9) to a maximum value in 1998. The biomass index declined consistently over 1998-2002. The 2002- 2006 results have been relatively stable, with the exception of an anomalously low value in 2003.

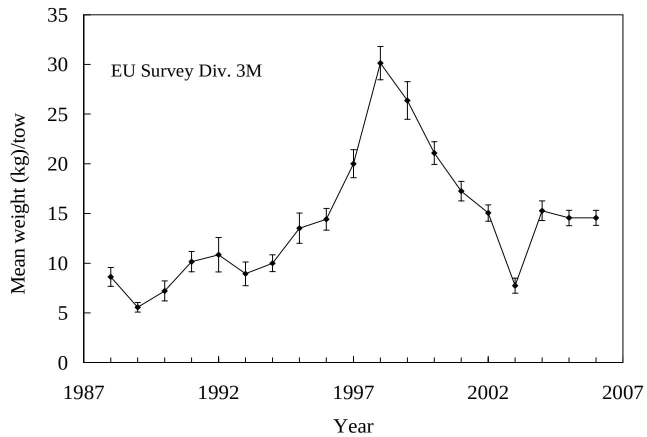


Fig. 20.9.Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (mean catch per tow ± 1 S.E.) from EU summer surveys in Div. 3M.

EU-Spain stratified-random surveys in Div. 3NO Regulatory Area. 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 2006 (Fig. 20.10).

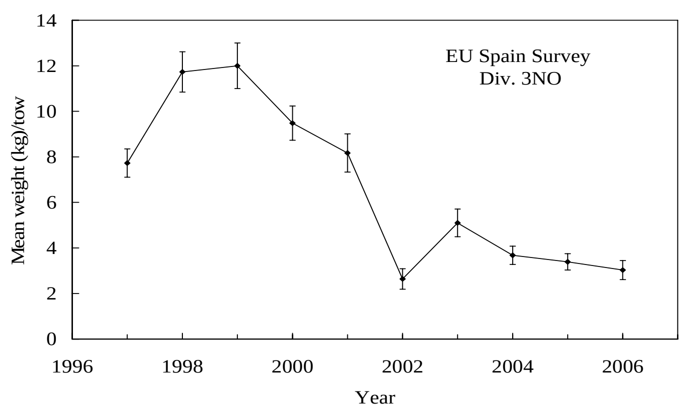


Fig. 20.10.Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in Div. 3NO.

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 were 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, despite these concerns, STACFIS **agreed** that VPA analyses for 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. 20.6) is showing an increasing trend. At the same time, the Spanish Div. 3NO (Fig 20.9) and EU Flemish Cap biomass indices (Fig. 20.10) – surveys adjacent to the region with the highest fishing effort - have not shown any increase in biomass in the recent period. The increase in Div. 2J+3K is, however, consistent with an increasing trend in commercial CPUE (Fig. 20.5). Further, STACFIS noted an increase in the 2006 biomass from the deepwater portion of the EU Flemish Cap survey (added to the survey design in 2004).

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.

iii) *Biological Studies*

Estimates of maturity in Div. 2J+3K were updated, and examined for trends over time. Maturation estimates from survey data are compared to those derived from commercial sampling. The results indicate that the old age at maturity estimated from the survey data is not an artifact of very few old fish in the sample. Average A_{50} estimated from the survey data over the time period is 10 years for males and 12.7 years for females. For males the average L_{50} over the time period is 62 cm while for females it is 78 cm. For both males and females there is an indication of maturation at a smaller size and younger age for more recent cohorts. Estimates of maturity at length by year were similar to those estimated by cohort for both males and females. This indicates that ageing error is not a factor in estimating that Greenland halibut mature at an old age and a large size in Div. 2J+3K. There may be retrospective pattern in estimates for some cohorts, which appear to be a function of rapid increases in the sampled proportions of maturity.

c) Estimation of Parameters

Survey and catch data were used to estimate numbers at age using the 2006 agreed XSA formuation. Model diagnostics indicated that the model structure and assumptions were reasonable, so the XSA formulation was not altered. The XSA model specifications are given below:

Catch data from 1975 to 2006, ages 1 to 14+

Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1995	2006	1	12
Canadian autumn survey (Div. 2J3K)	1996	2006	1	13
Canadian spring survey (Div. 3LNO)	1996	2005	1	8

Natural Mortality is assumed 0.2 for all years, ages.
Tapered time weighting not applied
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 11
Terminal year survivor estimates shrunk towards the mean F of the final 5 years
Oldest age survivor estimates shrunk towards the mean F of ages 10 – 12
S.E. of the mean to which the estimates are shrunk = .500
Minimum standard error for population estimates from each cohort age = .500
Individual fleet weighting not applied

d) Assessment Results

Biomass (Fig. 20.11): The fishable biomass (age 5+) declined to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. However, relatively high catches and fishing mortality since then accompanied by poorer recruitment has caused it to decline again, and the 2004 to 2007 estimates are amongst the lowest in the series. Estimates of 2007 survivors from the XSA are used to compute 2007 biomass assuming the 2007 stock weights are equal to the 2004-2006 average. The 2007 5+ biomass is estimated to be about 73 000 tons. The 10+ biomass peaked in 1991 and has since declined.

Fishing Mortality (Fig. 20.12): High catches in 1991-94 resulted in average fishing mortality over ages 5 to 10 (F_{5-10}) exceeding 0.50. F_{5-10} declined to about 0.25 in 1995 with the substantial reduction in catch. F_{5-10} increased since then and has remained high in spite of the Fisheries Commission Rebuilding Plan. F_{5-10} in 2006 is estimated to be 0.59.

Recruitment (Fig. 20.13): The current assessment indicates that all recent year-classes are of below average strength. The estimated abundance of the 2003 - 2005 year-classes are the lowest values in the time series.

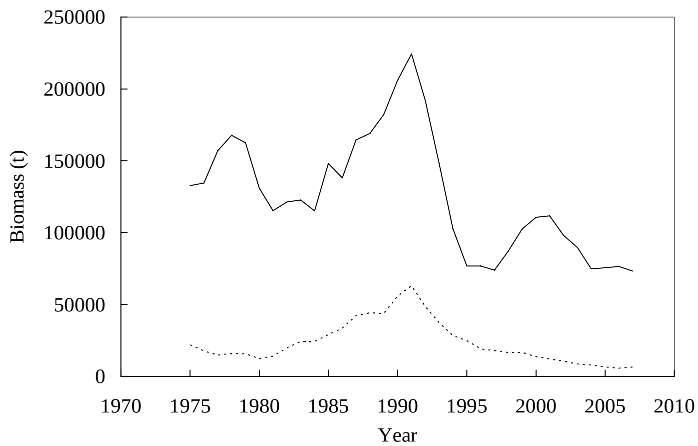


Fig. 20.11. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated exploitable (5+ biomass in tons; solid line) and 10+ biomass (tons; dashed line) from XSA analysis.

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

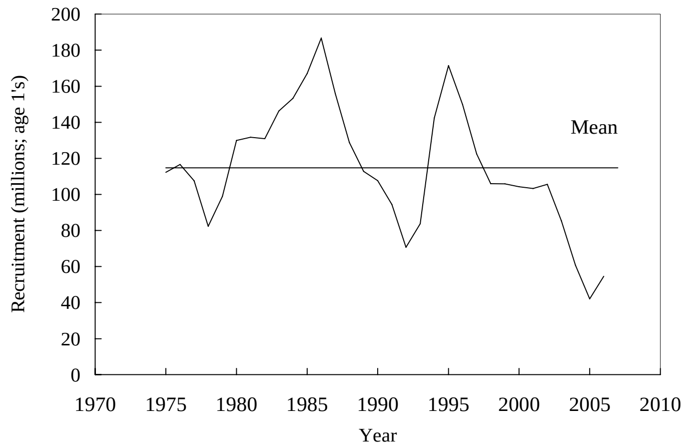


Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA analysis.

e) Retrospective Analysis

A five-year retrospective analysis of the XSA was conducted by eliminating successive years of catch and survey data. Fig- 20.14 - 20.16 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. 20.14), and the fishing mortality in recent years has been over-estimated (Fig. 20.15). Note that the relative difference between the magnitude of the 1993-1995 cohorts and those of 1998-2001 has decreased considerably as data were added to the model (Fig. 20.16).

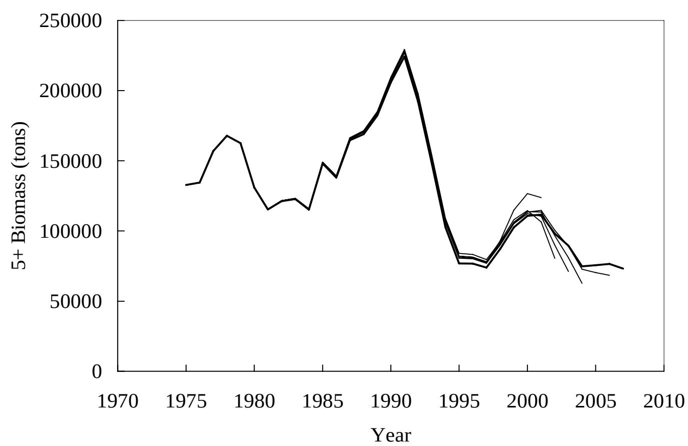


Fig. 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; 5+ biomass.

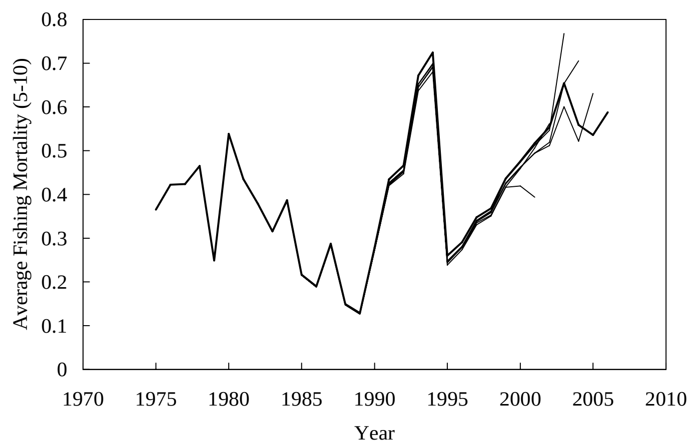


Fig. 20.15. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

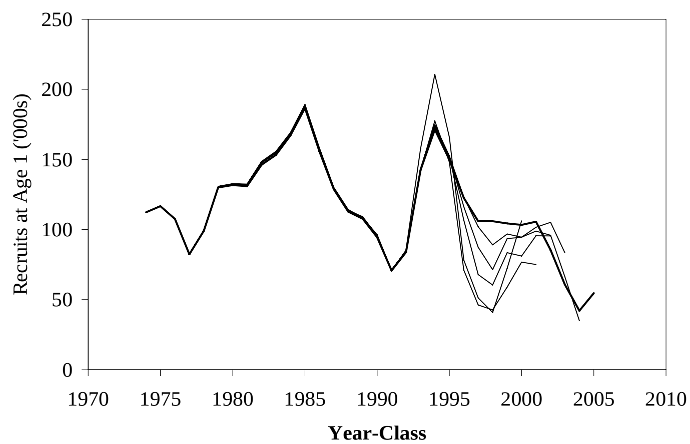


Fig. 20.16. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

f) Reference Points

i) *Precautionary approach reference points*

Precautionary approach reference points have not previously been defined for this stock. Several of the standard approaches typically available for age-disaggregated assessments are not applicable for this stock given the difficulties in determining the spawner biomass (or appropriate proxy). Limit reference points could not be determined for this stock at this time.

ii) *Yield per recruit reference points*

F_{max} is computed to be 0.25 and $F_{0.1}$ is 0.14 based upon average weights and partial recruitment for the past 3 years. A plot of these reference levels of fishing mortality in relation to stock trajectory (Fig. 20.18) indicates that the current average fishing mortality is more than twice the F_{max} level. STACFIS also noted that the average fishing mortality has been below F_{max} for only five years of the time series, and below $F_{0.1}$ only once. Under the Fisheries Commission Rebuilding Plan, fishing mortality has remained high while the exploitable biomass is relatively low.

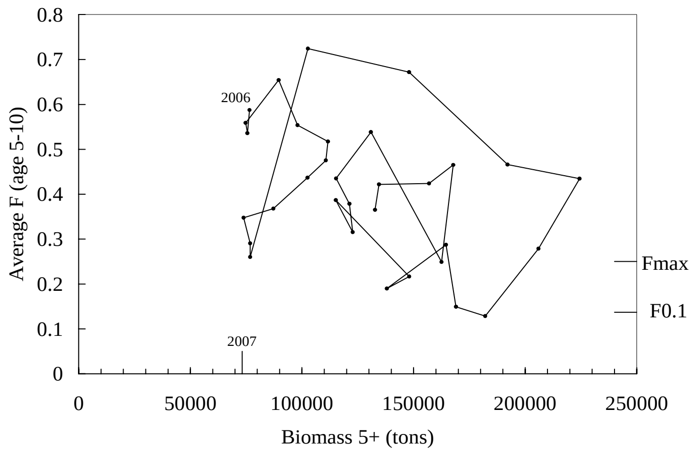


Fig. 20.17.Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory with relation to yield per recruit reference points. The 2007 estimate of biomass (73 000 tons) is indicated on the biomass axis.

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. Further, as the projection period lengthens, an increasing proportion of the age composition is comprised 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.

The Fisheries Commission has implemented a 15-year rebuilding plan for this resource by instituting an exploitable biomass target (ages 5+) of 140 000 tons. As an initial step, the Fisheries Commission established TACs of 20 000, 19 000, 18 500, and 16 000 tons for 2004-2007, respectively. In order to evaluate the population trends under the established TACs, five-year deterministic and stochastic projections to 2012 were conducted assuming average exploitation pattern and weights-at-age from 2004 to 2006, and with natural mortality fixed at 0.2.

The rebuilding plan TACs for 2004 - 2006 were exceeded by 27%, 22%, and 27% respectively. As such, all projections carried out assume that 20, 000 tons will be removed during 2007 (16, 000 TAC + 25%). No rebuilding plan TACs have been set beyond 2007; during the years 2008 – 2011, four scenarios are evaluated:

i) constant fishing mortality at the $F_{0.1}$ level (=0.138)

ii) constant fishing mortality at F_{2006} (=0.588)

iii) constant landings at 16 000 tons (denoted Rebuilding Plan I), and

iv) annual landings reduced by 15%, the maximum possible reduction under the Fisheries Commission Rebuilding Plan, from the 2007 TAC level. Specifically, removals in 2008 are assumed to be 13 600 tons, and are reduced by 15% in each additional year. (Denoted Rebuilding Plan II).

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 2007 and corresponding CVs are computed from the XSA output. Deterministic projections were conducted assuming a recruitment value fixed at the 1999-2004 geometric mean of the age 1 XSA estimates. For the stochastic projections, recruitment was bootstrapped from the 1975-2004 age 1 numbers from the XSA; more recent recruitment levels were not included as these estimates are less certain. STACFIS noted that assumed recruitment levels have almost no impact on the medium term projections. Scaled selection pattern and corresponding CVs are derived from the 2004 to 2006 average from the XSA. Weights at age in the stock and in the catch and corresponding CVs are computed from the 2004-2006 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.

Greenland Halibut in Subareas 2 + 3KLMNO
Input data for stochastic projections

Name	Value	Uncertainty (CV)	Name	Value	Uncertainty (CV)
Population at age in 2007			Selection pattern	(2004-2006	
N1	Bootstrap (1975-2004)		sH1	0.000	0.000
N2	44699	0.62	sH2	0.000	0.000
N3	28196	0.26	sH3	0.000	0.000
N4	33357	0.21	sH4	0.020	0.579
N5	38162	0.17	sH5	0.113	0.556
N6	36757	0.15	sH6	0.445	0.204
N7	23496	0.13	sH7	1.514	0.038
N8	7183	0.14	sH8	1.739	0.177
N9	1871	0.20	sH9	1.249	0.099
N10	1021	0.21	sH10	0.941	0.198
N11	610	0.21	sH11	0.961	0.430
N12	370	0.22	sH12	0.893	0.451
N13	145	0.25	sH13	0.876	0.382
N14	189	0.29	sH14	0.876	0.382
Weight in the catch	(2004-2006)		Weight in the stock	(2004-2006	
WH1	0.000	0.00	WS1	0.000	0.00
WH2	0.000	0.00	WS2	0.000	0.00
WH3	0.187	0.33	WS3	0.000	0.00
WH4	0.272	0.10	WS4	0.000	0.00
WH5	0.392	0.04	WS5	0.392	0.04
WH6	0.568	0.06	WS6	0.568	0.06
WH7	0.824	0.03	WS7	0.824	0.03
WH8	1.178	0.07	WS8	1.178	0.07
WH9	1.605	0.06	WS9	1.605	0.06
WH10	2.066	0.08	WS10	2.066	0.08
WH11	2.611	0.07	WS11	2.611	0.07
WH12	3.380	0.06	WS12	3.380	0.06
WH13	4.131	0.08	WS13	4.131	0.08
WH14	5.208	0.10	WS14	5.208	0.10
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. 20.19), fishing yield, and average fishing mortality (Fig. 20.20) are presented. Results indicate that the exploitable biomass will continue to decline if current levels of fishing mortality are maintained. If catches over 2008-2011 are constant at 16 000 tons (Rebuilding Plan I), exploitable biomass remains stable with minimal recovery. Exploitable biomass is projected to increase rapidly if fishing mortality is reduced to the $F_{0.1}$ level, or if the catches in 2008 and onward are decreased by 15% annually (Rebuilding Plan II).

Table 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: Results of Deterministic projections under various catch levels and fishing mortality options. Rebuilding Plan I indicates a fixed annual catch of 16 000 tons; Rebuilding Plan II indicates a 15% annual reduction in catches from the 2007 TAC level (16 000 tons).

	F0.1					Fcurrent			
Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)	Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)
2007			20000	0.445	2007			20000	0.445
2008	69883	6154	8057	0.138	2008	69883	6154	26102	0.588
2009	77374	9280	10191	0.138	2009	54735	5784	21224	0.588
2010	84088	17155	10749	0.138	2010	45453	5698	16440	0.588
2011	96257	30306	10612	0.138	2011	47541	5298	13653	0.588
2012	109528	41109			2012	53864	4594		

	Rebuilding Plan I					Rebuilding Plan II			
Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)	Year	5+ Biomass (t)	10+ Biomass (t)	Yield (t)	Fbar (5-10)
2007			20000	0.445	2007			20000	0.445
2008	69883	6154	16000	0.305	2008	69883	6154	13600	0.250
2009	67411	7783	16000	0.283	2009	70422	8242	11560	0.181
2010	65963	11600	16000	0.303	2010	74773	13973	9826	0.145
2011	70396	16226	16000	0.346	2011	87444	24014	8352	0.120
2012	75610	17952			2012	103032	34433		

Table 20.3 provides growth rates of the exploitable and 10+ biomass in relation to those in 2003, when the rebuilding plan was implemented, and in 2007, the terminal year from the current assessment. Table 20.4 presents the ratio of the exploitable (5 +) biomass at the end of the projection period in relation to the target identified in the rebuilding plan. Severe declines in the biomass are evident if current levels of fishing mortality are maintained. If catch levels are reduced by 15% annually (Rebuilding Plan II) or 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. Maintaining a fixed catch of 16 000 tons annually, the projected biomass remains below the level when the rebuilding plan was implemented. Note that potential success of the rebuilding plan is much greater under $F_{0.1}$ or 15% annual reductions in catch (2012 exploitable biomass approximately three-quarters of the rebuilding target) than that under current levels of F or fixed catches of 16 000 tons.

Table 20.3.Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass growth (%) under various projections. Biomass at the end of the projection period (2012) is compared to the biomass at the beginning of the projection (2007; 73 000 tons) and the biomass in 2003, when the rebuilding plan was instituted (89 500 tons).

F0.1		
	Biomass (t)	
	5+	10+
2012 relative to 2007	50%	529%
2012 relative to 2003	22%	377%
B(2012) / 140 Kt	0.78	

Fcurrent		
	Biomass (t)	
	5+	10+
2012 relative to 2007	-26%	-30%
2012 relative to 2003	-40%	-47%
B(2012) / 140 Kt	0.38	

Rebuilding Plan I		
	Biomass (t)	
	5+	10+
2012 relative to 2007	3%	175%
2012 relative to 2003	-16%	108%
B(2012) / 140 Kt	0.54	

Rebuilding Plan II		
	Biomass (t)	
	5+	10+
2012 relative to 2007	41%	427%
2012 relative to 2003	15%	300%
B(2012) / 140 Kt	0.74	

Table 20.4 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 tons.

Scenario	Projected Biomass Relative to 140 000t
F0.1	0.78
F2006	0.38
Rebuilding Plan I	0.54
Rebuilding Plan II	0.74

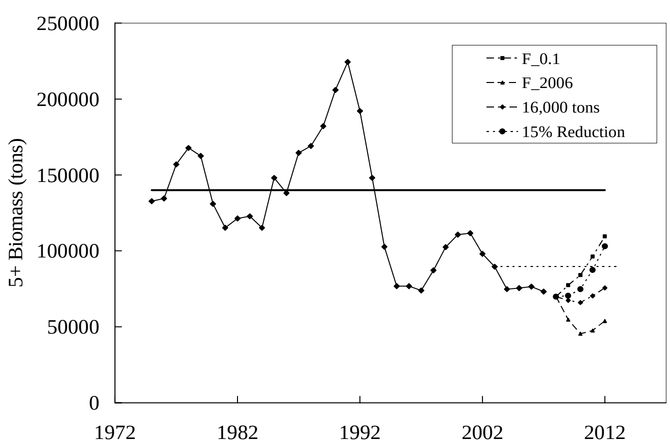


Fig. 20.18. Greenland halibut in Subarea 2 + Div. 3KLMNO: Deterministic projection of 5+ biomass to 2012 (see text for description of projection scenarios). The solid horizontal line represents the rebuilding plan target biomass of 140 000 tons; the dashed horizontal line is the level of the exploitable biomass in 2003, when the Fisheries Commission Rebuilding Pan was implemented.

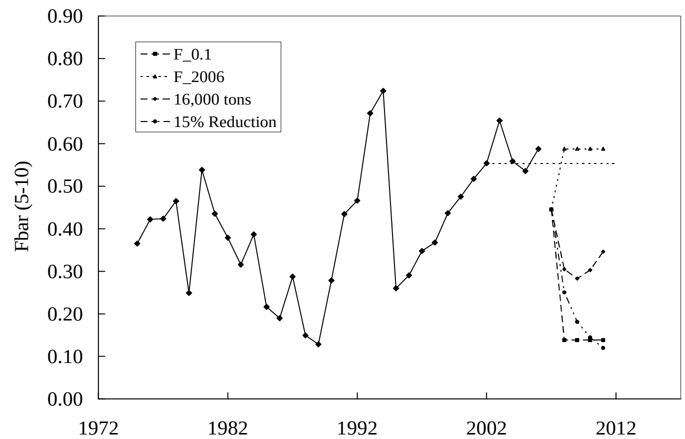


Fig. 20.19.Geenland halibut in Subarea 2 + Div. 3KLMNO: Deterministic projection of average fishing mortality to 2011 (see text for description of projection scenarios). The horizontal dashed line indicates the level of fishing mortality when the rebuilding plan was implemented.

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 20.21 - 20.24, 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, it is assumed that 20 000 will be removed during 2007 (16 000 tons TAC + 25%).

In addition, probability profiles of the biomass in 2012, the end of projection period (Fig. 20.25) are compared to the 2003 level, when the rebuilding plan was implemented, and also to 140 000 tons, the target level identified in the rebuilding plan. These illustrate the risk of the projected exploitable biomass in 2012 being below a reference level. Only the scenarios under $F_{0.1}$ or 15% annual reduction provide a high (>90%) probability that the exploitable biomass will have recovered to the 2003 level by 2012. Even under the most optimistic scenario, there is a low (<10%) probability that the 2012 biomass will have reached the 140 000 tons target.

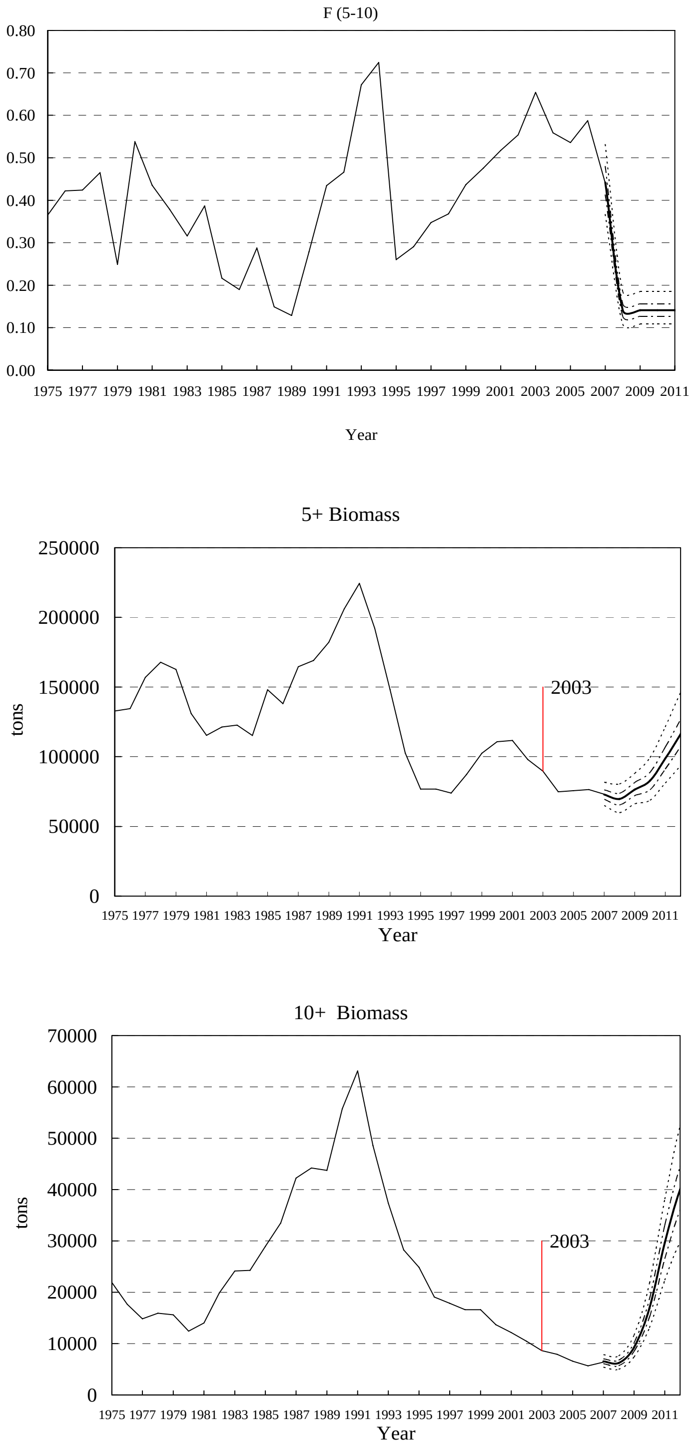


Fig. 20.20. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2008-2012 assuming catches correspond to the $F_{0.1}$ level. The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

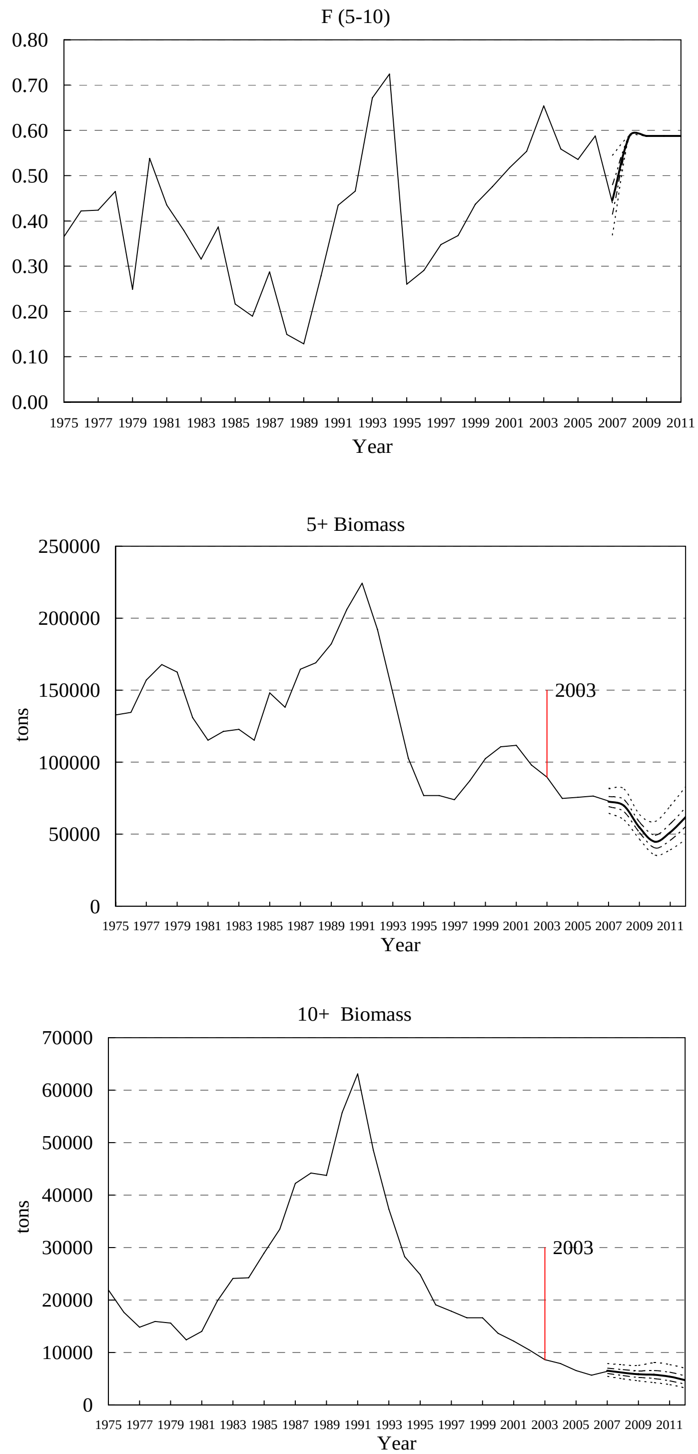


Fig. 20.21. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2008-2012 assuming catches correspond to the F_{2006} level. The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

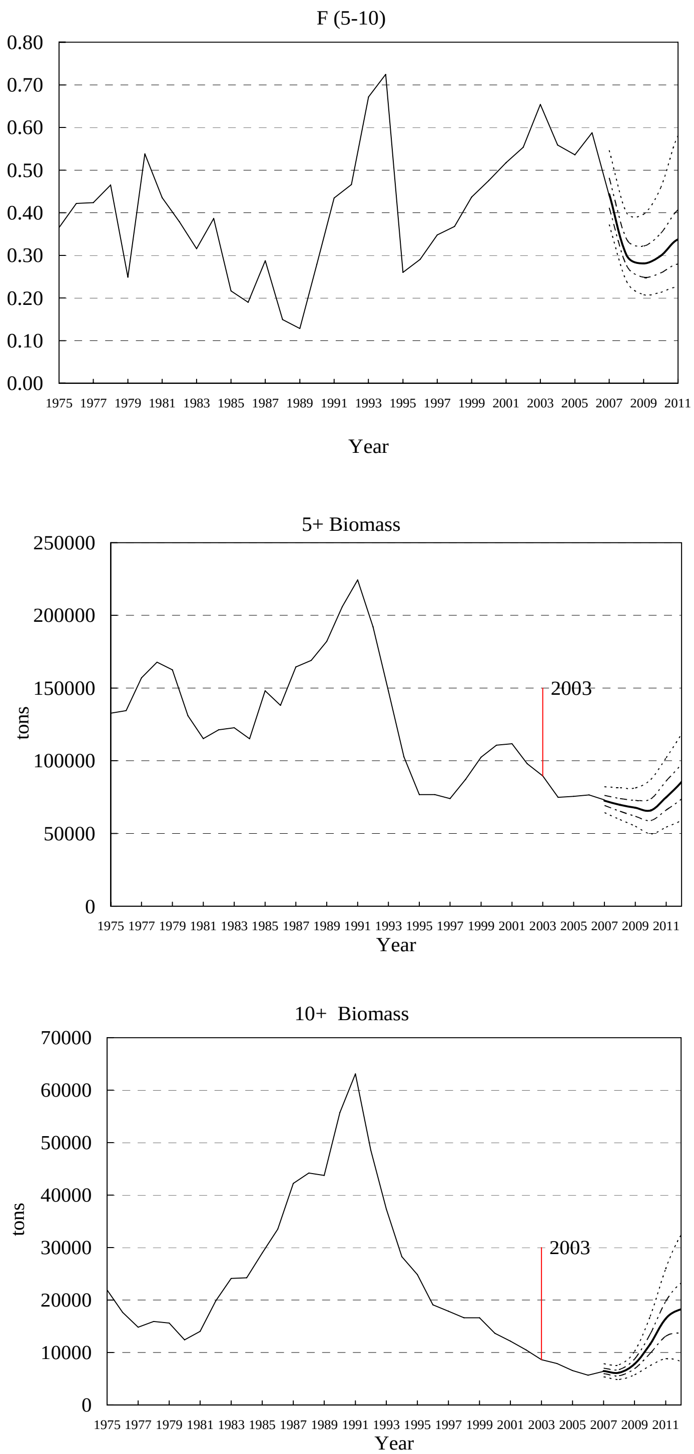


Fig. 20.22. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2008-2012 under Rebuilding Plan I (catches from 2008 onward are fixed at 16 000 tons). The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

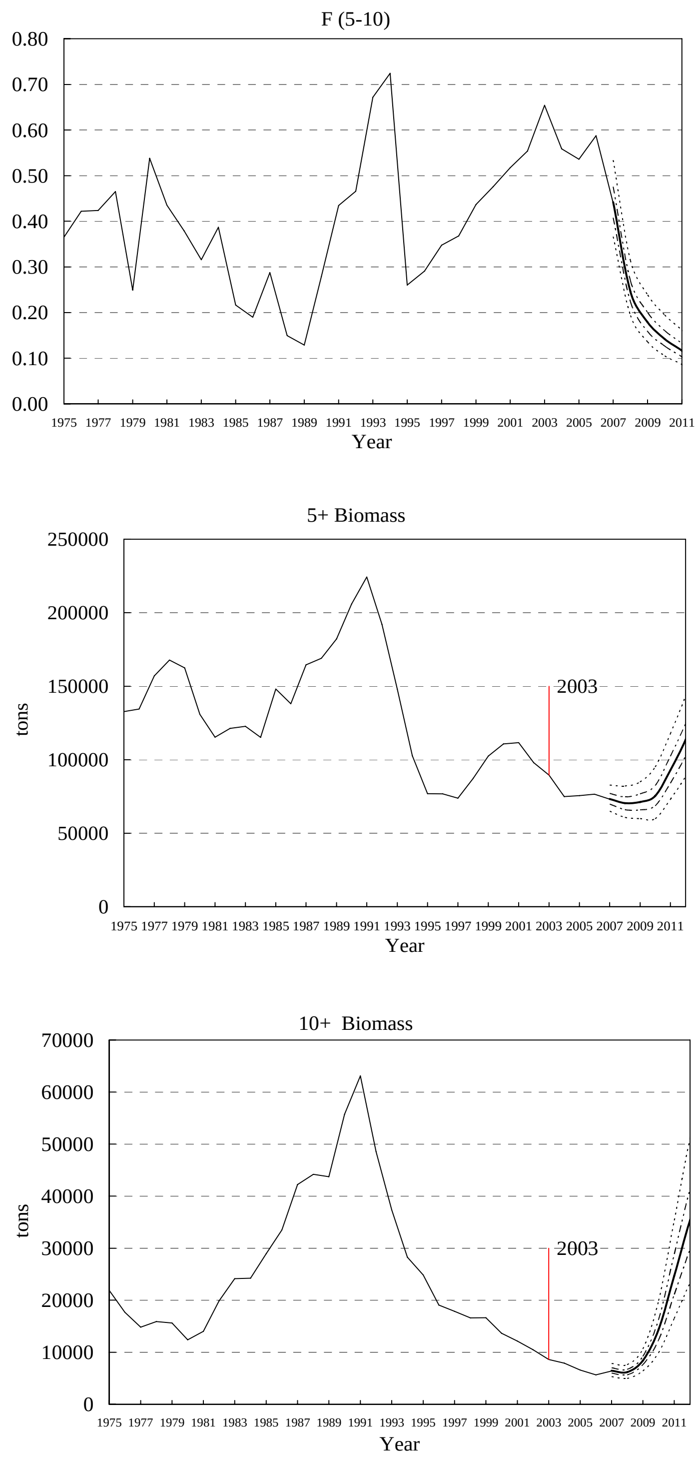


Fig. 20.23. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2008-2012 under Rebuilding Plan II (assuming catches from 2008 onward are reduced by 15% annually from the 2007 TAC level). The biomass levels of 2003 (year in which rebuilding plan developed) are highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

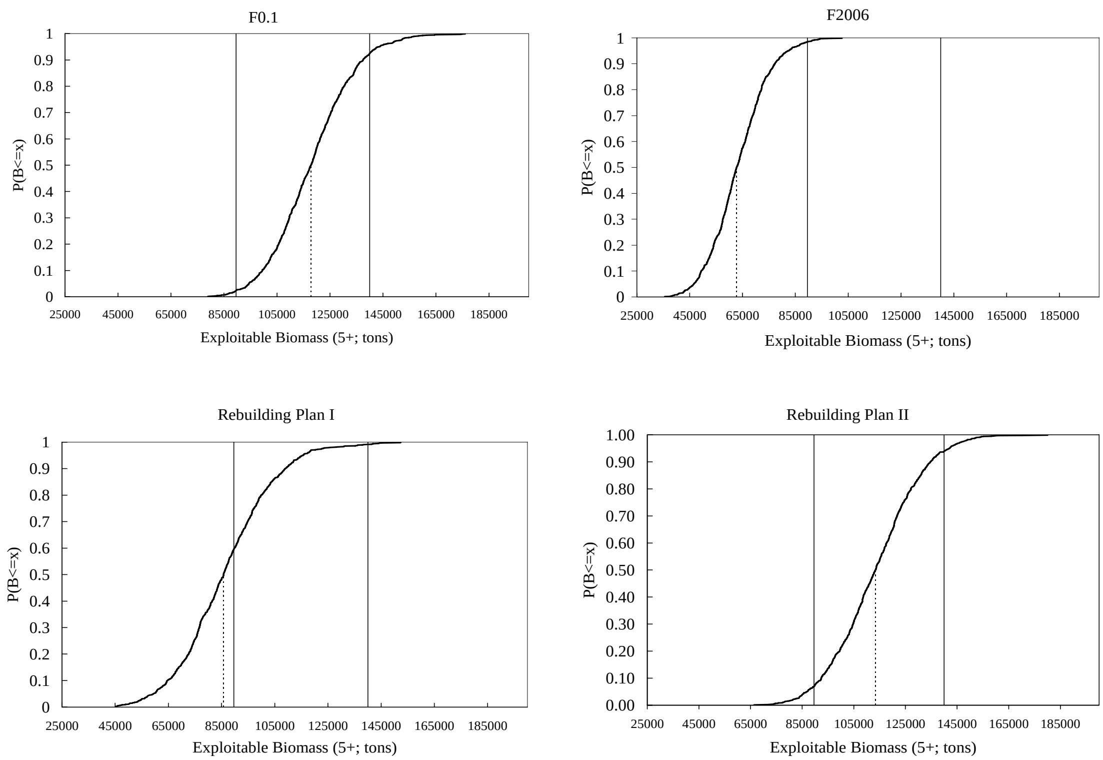


Fig. 20.24. Greenland halibut in Subarea 2 + Div. 3KLMNO: Probability profile of exploitable biomass in 2012 for each of the four projection scenarios. Solid vertical lines demarcate the biomass level in 2003 (89 500 tons) and the rebuilding plan target (140 000 tons). The dashed vertical line indicates the median value of the projected exploitable biomass in 2012 under each scenario.

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 Doc.*, 2000 V:06, 25 p.

h) Research Recommendations

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

STACFIS **recommended** that *research continue on age determination for Greenland halibut in Subarea 2 and Div. 3KLMNO to improve accuracy and precision.*

There is concern that the application of maturity ogives to the exploitable 5+ biomass at age will not adequately reflect changes in the population spawning stock biomass (SSB), and its use as a predictor of recruitment is unclear. STACFIS **recommended** that *stock-recruit relationships using an index of SSB derived from estimates of maturity at age and exploitable 5+ biomass at age be explored.*

Previous survey experiments have noted that the depth distribution of Greenland halibut extends beyond 1500 m, 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 1500 m. 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 compliment existing survey data.*

This stock will next be assessed in 2008.

21. Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4

Interim Monitoring Report

a) Introduction

The Subareas 3+4 catch in 2006 (6 850 tons) was substantially higher than the catch in 2005 (600 tons) and was also the highest since 1997 (Fig. 21.1). Most of the catch in 2006 (99%) was from Div. 3KL.

Recent catches and TACs ('000 tons) 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	0.61	<0.11	
STATLANT 21A SA 5+6										
STACFIS SA 3+4	1.9	0.3	0.4	<0.1	0.2	1.1	2.3	0.6	6.9	
STACFIS SA 5+6	23.6	7.4	9.0	3.9	2.8	6.4	25.2	12.0	13.9	
STACFIS Total SA 3-6	25.5	7.7	9.4	4.0	3.0	7.5	27.5	12.6	20.8	

[1] Provisional

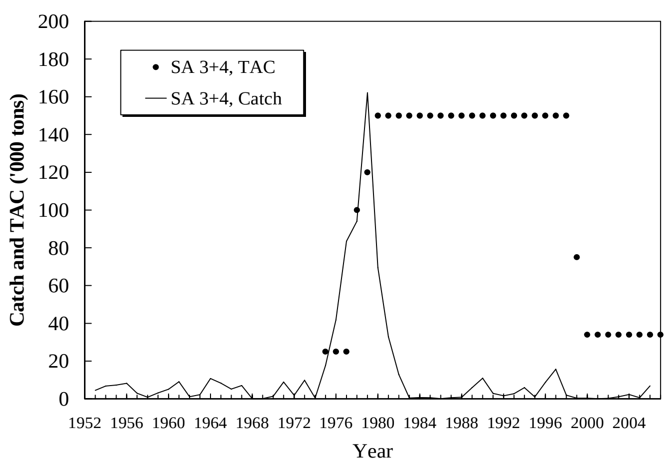


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

b) Data Overview

During 2006, indices of relative abundance (74.4 squid per tow) and biomass (10.2 kg per tow) were the fourth highest on record in the Div. 4VWX July survey. The values of the index in 2004 and 2006 were the highest two observed since the onset of the low productivity period beginning in 1982 (Fig. 21.2).

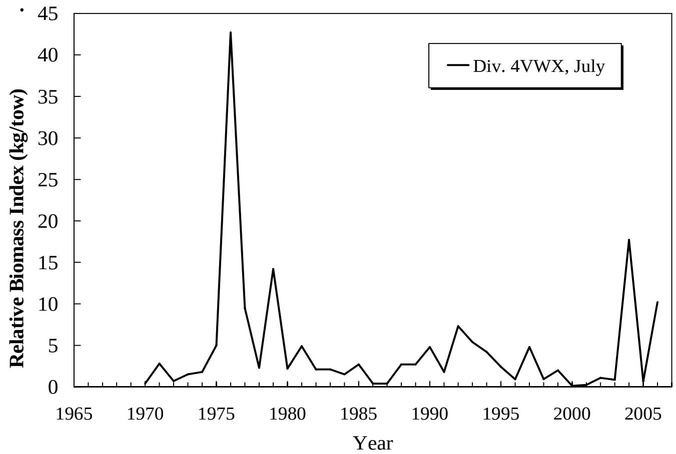


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices from the July survey in Div. 4VWX.

During 2006, the mean weight of squid from the Div. 4VWX survey (137 g) was the highest amongst the range observed during the low productivity period (Fig. 21.3).

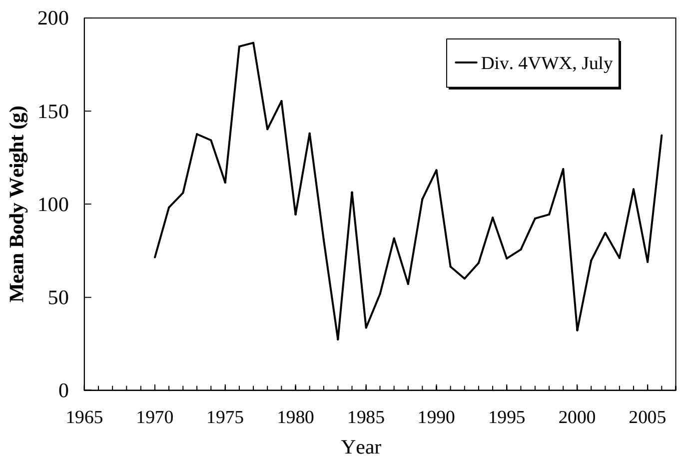


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX

c) Conclusion

In summary, the survey biomass index of squid caught in the 2006 July Div. 4VWX survey was the second highest since the onset of the 1982 low productivity period and mean body weight was the highest observed. Although this suggests an improved stock status in 2006, it is difficult to ascertain whether there has been a change in stock productivity since 2003 because the 2005 survey biomass index was much lower than the 2004 and 2006 indices.

This stock will next be assessed in 2008.

IV. OTHER MATTERS

1. Other Business

a) Designated Experts

The Chair noted the necessity to seek an acting replacement intersessionally for the Designated Expert for cod in Div. 3M. The selection of Carmen Fernandez was formally endorsed by the Committee at this meeting and the Chair noted the Secretariat will include her on the annual nomination list of Designated Experts that requires confirmation from the national institutes.

The Chair also noted that there is currently a vacancy in the role of Designated Expert for Northern Shortfinned squid (*Illex illecebrosus*) in Subareas 3+4. Candidates with expertise in squid biology and dynamics had already been approached prior to this meeting without a successful result. Alternative candidates will be sought prior to the September meeting.

2. Acknowledgements

The Chair noted this meeting will be the last for Dr. Steve Walsh, current Designated Expert for yellowtail flounder in Div. 3LNO, as he is set to retire in September 2007 after a career that has spanned three decades. Dr. Walsh was acknowledged for his contribution to the assessments of various flatfish species, particularly yellowtail flounder and American plaice, as well as for his research on fishing gear technology and survey catchability.

The Chair thanked the participants for their valuable contributions. He particularly acknowledged the hard work and dedication of the Designated Experts and recognized their contribution to the entire meeting. Special thanks were extended to the Secretariat for their excellent support to the meeting. The meeting was adjourned noting that the report will be reviewed and that minor editorial changes will be made by the Chair.