PART B: SCIENTIFIC COUNCIL MEETING, 3-16 JUNE 2010

Contents

Back Row (left - right): Blair Greenan, Ivan Tretiakov, Ilya Skryabin, Temur Tairov, Mark Simpson, Rasmus Nygaard, Maris Plikshs, Heino Fock, Ole Jorgensen, Carsten Hvingel, Phil Large, Ricardo Alpoim, Romas Statkus, Bill Brodie, Rick Rideout, Brian Healey

Front Row: Vladimir Babyan, Alexander Pavlenko, Don Power, George Campanis, Mariano Koen-Alonso, Diana Gonzalez Troncoso, Fernando Gonzalez, Gary Maillet, Jean-Claude Mahé, Antonio Vázquez, Anna Akimova, Kathy Sosebee, Margaret Treble, Manfred Stein, Joanne Morgan, Eugene Colbourne, Karen Dwyer, Anthony Thompson, Dawn Maddock Parsons

Not Shown: Lisa Hendriksen, Garry Stenson, Ed Trippel, António Ávila de Melo, Tom Nishida, Barb Marshall, Lisa Pelzmann.

Gary Maillet - STACFEN Chair, Margaret Treble - STACPUB Chair, Carsten Hvingel - STACREC Chair (and Vice Chair of SC), Joanne Morgan - STACFIS Chair, Ricardo Alpoim - Chair of Scientific Council

REPORT OF SCIENTIFIC COUNCIL MEETING

3-16 JUNE 2010

Chair: Ricardo Alpoim Rapporteur: Anthony Thompson

I. PLENARY SESSIONS

The Scientific Council met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, during 3-16 June 2010, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), European Union (France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Russian Federation, and United States of America. The Executive Secretary, Vladimir Shibanov, 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 1125 hours on 3 June 2010. The provisional agenda was **adopted** with modification. The Scientific Council Coordinator, Anthony Thompson, was appointed the rapporteur.

Council was informed that two additional requests for advice had been received from Fisheries Commission since the Annual meeting. The first arose from the Fisheries Commission meeting on Shrimp in Div. 3M held in London, England, on 16 November 2009 and will be addressed under Agenda Item VII.1.d.vii. The second arose via a Fisheries Commission working group meeting on Greenland Halibut Management Strategy Evaluation (WGMSE) held in Brussels, Belgium, on 28-29 January 2010. Scientific Council convened by correspondence and provided its advice to Fisheries Commission (SCS Doc. 10/04) in advance of the WGMSE meeting held in Halifax, Canada on 2-4 May 2010. It is also noted that a request to provide advice on mesh size in the mid-water trawl fishery for redfish was deferred from 2009, and this will be addressed under Agenda Item VII.1.d.ix.

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

The WWF-Canada has been granted a 5-year observer status at NAFO and will be represented by Shelley Dwyer at this meeting of Scientific Council.

The proposal of Lisa Hendrickson as the Designated Expert for Northern Squid in SA 3 and 4 was approved by Scientific Council. Scientific Council has been without a Designated Expert for this stock since 2007 when Lisa Hendrickson resigned to assume other duties. The last full assessment of this stock was in 2006, owing to the lack of a Designated Expert in the intervening years. A full assessment of Northern Squid in SA 3 and 4 will be undertaken this year. There have been no other changes in Designated Experts since September 2009.

The opening session was adjourned at 1150 hours on 3 June 2010. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda. The Council considered **adopted** the STACFEN report on 10 June 2010, the STACPUB report on 11 June 2010, the STACREC report on 14 June 2010, and the STACFIS report on 16 June 2010.

The concluding session was called to order at 1025 hours on 16 June 2010.

The Council considered and **adopted** the report the Scientific Council Report of this meeting of 3-16 June 2010. The Chair noted that certain agenda items were deferred to the September 2010 meeting as noted in this report. The Chair received approval to leave the report in draft form for about two weeks to allow for minor editing and proof-reading on the usual strict understanding there would be no substantive changes.

The meeting was adjourned at 1335 hours on 16 June 2010.

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, and List of Representatives, Advisers and Experts, are given in Part E, 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 2009

Scientific Council Meeting, 4-18 June 2009

VII. Management Advice and Responses to Special Requests. 1. Fisheries Commission

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: There has been no improvement regarding the timeliness of the reporting of provisional commercial catches (landings) in 2009 to STATLANT 21A for the assessments to be undertaken at this June 2010 meeting of Scientific Council. It was noted that the reporting of discards is poor and there was again concern over the accuracy of some of the provisional catch reports.

Scientific Council Meeting, 21-25 September 2009

X. Other Matters. 1. Mesh size in the redfish fishery

Scientific Council reviewed a document (SCR Doc. 09/52) relevant to the Fisheries Commission request (Annex 1, Item 13) as well as a review of information from previous Council reports on issues of mesh size in redfish fisheries.

Scientific Council discussed the selectivity results presented in the research document and continued to be concerned that there appears to be little difference in the size-ranges of redfish retained by meshes of different sizes over the 90-130 mm mesh range. In addition, details on the configurations and hanging ratios of the cod-end mesh used in the research trials and those of commercial vessels were lacking. Scientific Council **recommended** that *further at-sea trials be conducted using square and diamond shaped meshes in the cod-end and that greater detail of the exact specifications of the research and commercial gears in use be documented.* Scientists from the Russian Federation recorded that they expect to be able to conduct such trails and to provide a report back to Scientific Council in 2010.

STATUS: The results of a preliminary study on "Some aspects of choosing the optimal mesh size in codends in beaked redfish fishery in Div. 3M of the NAFO Regulatory Area" (SCR Doc. 10/20). Further supporting analyses and studies, including information on bycatch in Div. 3M, will be presented to Scientific Council in September 2010.

It was noted that a cod-end containing redfish rapidly rises to the surface due to hydrostatic pressures and rather special conditions develop within the cod-end that results in the tension being taken off the meshes, thus allow them to open up and cause fish loss. It was therefore felt that the change of mesh size alone may not be a solution to the problem, and that some other gear modification may be more effective. Therefore, Scientific Council **recommended** that *the loss of redfish by mid-water and bottom trawls, during the later stages of hauling when the net comes to the surface, be referred to ICES for possible submission as a TOR to the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB) to investigate possible technical measures that could reduce the loss of redfish at the surface due to their developed buoyancy.*

STATUS: This was referred to the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB) to consider at their meeting on 31 May-4 June 2010. Owing to the need to synthesis recent information, a reply is anticipated around early September 2010.

III. FISHERIES ENVIRONMENT

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

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

STACFEN **recommended** that *consideration of support for one invited speaker to address emerging issues and concerns for the NAFO Convention Area during the June Meeting*.

STACFEN **recommended** that *Scientific Council to support a NAFO Co-Chair, keynote speakers, and an honorarium for consideration to the "ICES/NAFO Symposium on the Variability of the North Atlantic and its Marine Ecosystems during 2000-2009".*

IV. PUBLICATIONS

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

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

STACPUB **recommended** that *a sponge guide be published in the NAFO Studies Series in a waterproof format as well as an electronic format that would be available on the website*.

V. RESEARCH COORDINATION

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

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

STACREC **recommended** that *for 2011 the Secretariat draft a working paper describing all the catch related data available to Scientific Council (including weekly reporting, observer, VMS and discard data).*

In addition, STACREC **recommended** that *the Secretariat routinely send a reminder to Contracting Parties/countries by mid April and again by 2 May to those that have not submitted STATLANT 21A data and report to Scientific Council regarding the nature and extent of outstanding problems.* STACREC **recommended** that *DEs compile historical catch data in as finer scale (ideally by NAFO Division) and for as many years as possible.*

STACREC noted that in Scientific Council Reports references are made to STATLANT 21A data even though these data are updated for previous years when STATLANT 21B data become available. STACREC **recommended** that *reports and catch tables refer to STATLANT data as "STATLANT 21" data.*

STACREC noted that FAO 3-letter alpha codes are not available for most coral and sponges, either at the species or higher taxonomic levels, that occur in the NAFO area, The Secretariat advised that this is not a CWP issue and may require proposals to be submitted to FAO. STACREC **recommended** that *this issue be addressed by WGEAFM.*

The work of WGEAFM involves spatial analyses to identify and delineate areas with high concentration of VME-forming species (like corals and sponges). These analyses require unprocessed data (raw-data) e.g. from research surveys carried-out by different contracting parties combined in a single data set. There is no established practice for the sharing of raw data within NAFO.

STACREC **recommended** that *Scientific Council encourage research institutions from all Contracting Parties to share their survey data at the level of detail necessary for WGEAFM*. Equally important, STACREC **recommended** *Scientific Council to instruct WGEAFM that any data shared as part of its work towards addressing Scientific*

Council requests should neither be distributed outside WGEAFM nor used for purposes other than addressing WGEAFM ToRs without documented permission from the institution where the data originated and properly cited in all documents produced.

There is a need to established protocols for the sharing of aggregated and/or raw data among NAFO Contracting Parties and Scientific Committees.

STACREC **recommended** that *the NAFO Secretariat prepare a document for presentation at the next meeting of STACREC on (1) "Guidelines for data acquisition from Contracting Parties" and (2) a draft pro-forma MOU between NAFO and the data-owners (here taken to usually be the national research labs who collected the data) to cover data use agreements.*

To facilitate the compilation of overviews of research and data needs for NAFO stocks, STACREC **recommended** that *DEs compile this information for their stocks and forward to the Secretariat for inclusion in a future SCS document/working paper.*

VI. FISHERIES SCIENCE

The Council **adopted** the Report of the Standing Committee on Fisheries Science (STACFIS) as presented by the Chair, Joanne Morgan. 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.

In order to expedite the work of the Scientific Council, STACFIS **recommended** that *all Contracting Parties take measures to improve the accuracy of their reported nominal catches and present them as far in advance of future June Meeting as possible.*

STACFIS **recommended** that *catch estimate, including discards, from national sampling programs be provided.*

VII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. Fisheries Commission

The Fisheries Commission requests are given in Annex 1 of Appendix V.

The Scientific Council noted the Fisheries Commission requests for advice on northern shrimp (northern shrimp in Div. 3M and Div. 3LNO (Item 1)) was undertaken during the Scientific Council meeting on 21-29 October 2010. There are concerns regarding the downward trend of both these stocks and they need to be closely monitored. The Scientific Council provided updated scientific advice on northern shrimp stocks for 2010 and advice for 2011. Updated advice for 2011 will be provided at the Annual meeting in 2010 through an interim monitoring report.

a) Request for Advice on TACs and Other Management Measures for the year 2011

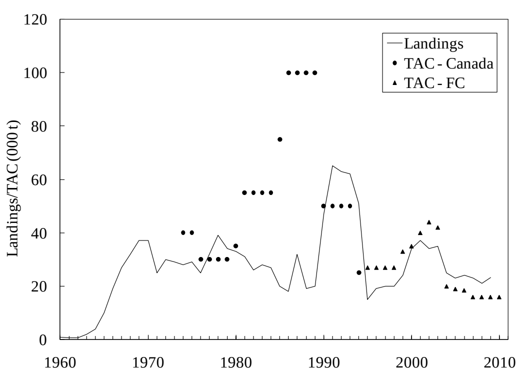
i) Greenland halibut in SA 2 and Div. 3KLMNO

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

Fishery and Catches: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by Fisheries Commission. Catches increased sharply in 1990 due to a developing fishery in the NAFO Regulatory Area in Div. 3LMNO and continued at high levels during 1991-94. The catch was only 15 000 to 20 000 t per year in 1995 to 1998 as a result of lower TACs under management measures introduced by the Fisheries Commission. The catch increased since 1998 and by 2001 was estimated to be 38 000 t, the highest since 1994. The estimated catch for 2002 was 34 000 t. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 t to 38 500 t. In 2003, a fifteen year rebuilding plan was implemented by Fisheries Commission for this stock (FC Doc. 03/13). The STACFIS estimate of catch for 2009 is 23 160 t. Since the inception of the FC rebuilding plan, estimated catches for 2004-2009 have exceeded the TACs considerably, with the catch over-run ranging from 22-45%.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	23	15[1]	nr	16
2008	21	15[1]	nr	16
2009	23	15[1]	<10.5[2]	16
2010			<8.8[2]	16

[1] Provisional.
[2] Scientific Council recommended that "fishing mortality should be reduced to a level not higher than $F_{0.1}$". Tabulated values correspond to the $F_{0.1}$ catch levels.
nr No recommendation - Evaluation of Rebuilding Plan

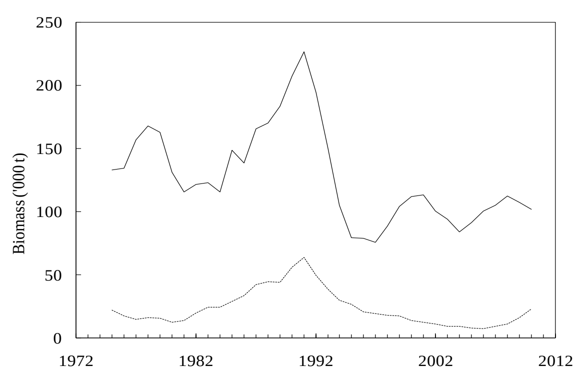


Data: Standardized estimates of CPUE were available from fisheries conducted by Canada, EU-Spain and EU-Portugal and unstandardized CPUE was available from Russia. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2+3KLMNO (1978-2009), EU in Div. 3M (1988-2009) and EU-Spain in Div. 3NO (1995-2009). Commercial catch-at-age data were available from 1975-2009.

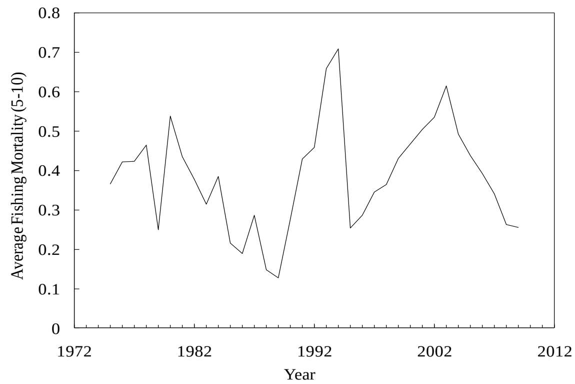
Assessment: A series of XSA analyses were conducted to examine sensitivities to the input data and also to re-examine whether XSA parameter settings used were still appropriate. Much of the investigations on data-sensitivity focused on how best to incorporate all available information from the EU Flemish Cap survey, considering that this survey was extended to 1 400 m depth in 2004.

Results reported below are from an Extended Survivors Analysis (XSA) tuned to the Canadian spring (Div. 3LNO; 1996-2009), and autumn (Div. 2J, 3K; 1996-2009) and the EU (Div. 3M; 0-700 m in 1995-2003; 0-1 400 m in 2004-2009) surveys was used to estimate the 5+ exploitable biomass, level of exploitation and recruitment to the stock. Natural mortality was assumed to be 0.2 for all ages.

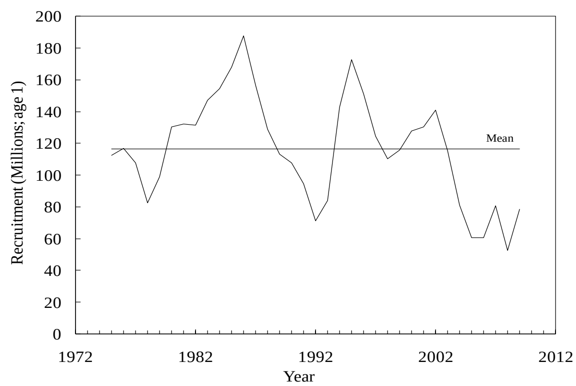
Biomass: The fishable biomass (age 5+; solid line) declined to low levels in 1995-1997 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2010, as weaker year-classes have recruited to the biomass. Estimates of 2010 survivors from the XSA are used to compute 2010 biomass assuming the 2010 stock weights are equal to the 2007-2009 average. The 2010 5+ biomass is estimated to be about 102 000 t. The 10+ biomass (dashed line) peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2010.



Fishing Mortality: High catches in 1991-1994 resulted in average fishing mortality over ages 5 to 10 (F_{5-10}) exceeding 0.70. F_{5-10} increased over 1995-2003 with increasing catch, but declined after 2003 under the FC rebuilding plan. F_{5-10} in 2009 is estimated to be 0.25. Note that although F_{5-10} decreased from 2008 to 2009, the total fishing mortality over all age groups increased, reflecting a slight change in commercial selectivity.



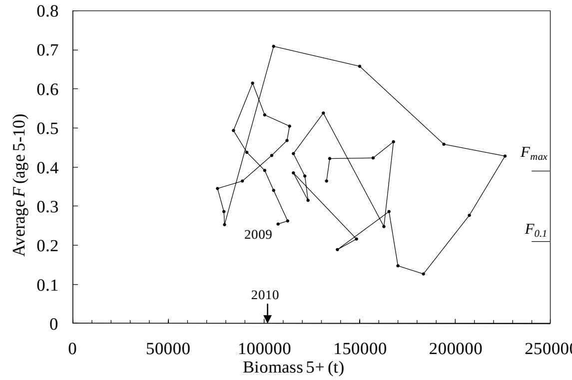
Recruitment: The current assessment indicates that all recent year-classes are well below average strength. These year-classes will recruit to the exploitable biomass in the next few years.



State of the Stock: Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2010, as weaker year-classes have recruited to the biomass. The level of recent estimates is higher than reported in previous assessments, as a result of including the new deep-water information from the EU survey, as well as a reduction in the amount of *F*-shrinkage required. The 10+ biomass peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2010. Average fishing mortality (over ages 5-10) has been decreasing since 2003. Recent recruitment has been far below average.

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

F_{max} is computed to be 0.39 and $F_{0.1}$ is 0.21, assuming weights at age and a partial recruitment equal to the average of each of these quantities over 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 (0.255) is near the $F_{0.1}$ level.



Projections and Evaluation of the Management Strategy:

In order to evaluate the population trends in the near term, stochastic projections from 2010 to 2014 were conducted assuming average exploitation pattern and weights-at-age from 2007 to 2009, and with natural mortality fixed at 0.2. Assuming the catch in 2010 remains at the 2009 level (23 150 t), the following projection scenarios were considered:

i) constant fishing mortality at $F_{0.1}$ (0.21)
ii) constant fishing mortality at F_{2009} (0.26)
iii) constant landings at 16 000 t, and
iv) constant landings at 23 150 t.

An additional projection was undertaken assuming that the catches in 2010 will match the TAC of 16 000 t and remain constant at this level in 2011-2013.

For each of the scenarios considered, projection results (see tables and figures below) of forecast yield up to 2013, exploitable (ages 5+) biomass, and ages 10+ biomass to 2014 are presented. Note that projected yield under $F_{0.1}$ is close to 16 000 t over 2011-2013. Thus under both the $F_{0.1}$ and 16 000 t constant catch options, total biomass is projected to increase by approximately 10%. In the case for which the 2010 catches are assumed to be 16 000 t in both 2010 and also in the projection period, total biomass is projected to increase by 20% by 2014.

Total biomass remains stable under yields corresponding to F_{2009} fishing mortality, but is projected to decrease by 15% if catches remain at 23 200 t through 2013. Fishing at F_{2009} for the period 2011-2013 would correspond to a reduction in catch from 17 500 t in 2011 to about 16 000 t in 2012 and 2013.

.Status Quo Catch in 2010; F0.1 over 2011-2013

	5+ Biomass (000 t)					Yield (000 t)				10+ Biomass (000t)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	93	86	87	88	93	23.2	12.1	11.8	11.9	20.1	26.9	31.7	34.3	34.6
p50	102	98	100	104	112	23.2	14.5	14.1	14.7	22.7	30.6	37.5	40.6	42.0
p95	113	113	116	128	139	23.2	17.8	16.9	18.2	25.9	35.3	43.7	48.0	49.6

Status Quo Catch in 2010; F_2009 over 2011-2013

	5+ Biomass (000 t)					Yield (000 t)				10+ Biomass (000t)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	87	84	83	84	23.2	14.9	14.0	13.5	19.9	26.5	30.5	31.3	30.7
p50	102	98	96	98	103	23.2	17.5	16.3	16.4	22.7	30.6	35.7	36.8	36.4
p95	112	113	111	120	129	23.2	20.7	19.2	20.2	25.7	35.4	42.0	43.4	43.1

Status Quo Catch in 2010; 16,000t over 2011-2013

	5+ Biomass (000 t)					Yield (000 t)				10+ Biomass (000t)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	85	81	79	87	23.2	16.0	16.0	16.0	19.9	26.4	30.3	29.6	28.0
p50	101	98	97	100	111	23.2	16.0	16.0	16.0	22.6	30.6	36.4	37.8	37.9
p95	112	111	113	124	140	23.2	16.0	16.0	16.0	25.8	35.3	43.5	47.6	49.3

Status Quo Catch over 2010-2013

	5+ Biomass (000 t)					Yield (000 t)				10+ Biomass (000t)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	86	74	63	62	23.2	23.2	23.2	23.2	20.0	26.6	26.5	21.6	15.1
p50	101	98	90	83	86	23.2	23.2	23.2	23.2	22.6	30.5	32.7	28.9	23.5
p95	112	112	106	108	116	23.2	23.2	23.2	23.2	25.7	35.3	40.0	38.3	34.1

16,000t in 2010-2013

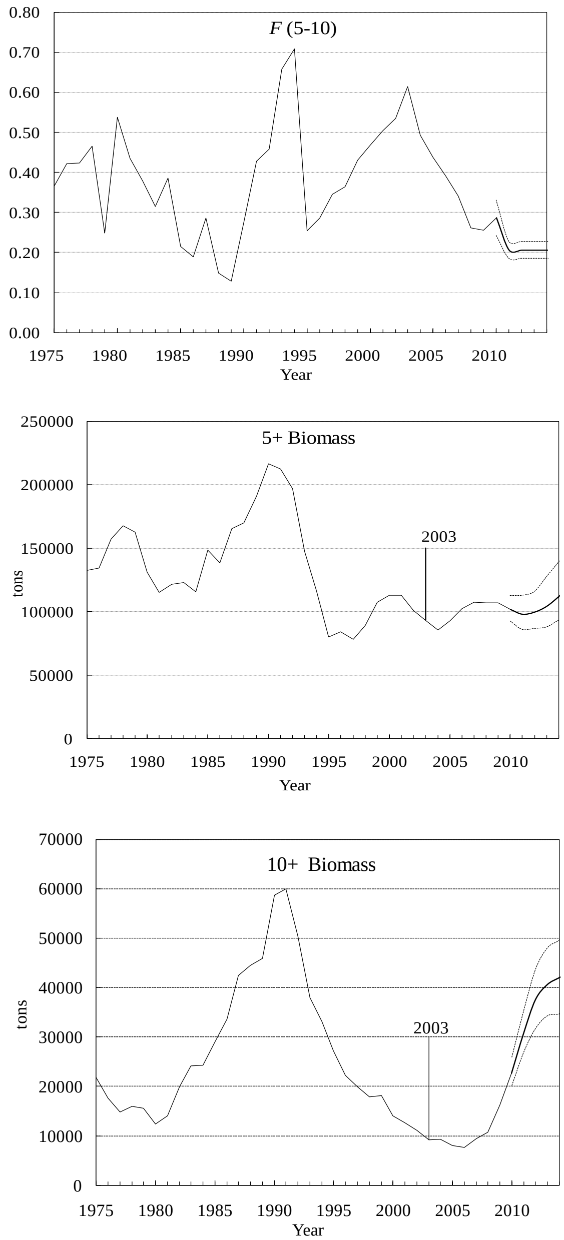
	5+ Biomass (000 t)					Yield (000 t)				10+ Biomass (000t)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	95	92	91	97	16.0	16.0	16.0	16.0	20.0	29.2	35.6	37.1	35.8
p50	102	107	107	109	120	16.0	16.0	16.0	16.0	22.7	33.8	42.3	45.6	45.9
p95	112	121	123	133	148	16.0	16.0	16.0	16.0	25.8	38.4	49.4	55.2	57.5

Growth rates of the exploitable (ages 5+), ages 10+ biomass, and ages 5-9 biomass relative to 2010, the terminal year of the current assessment are tabulated below. Differences in the rates of increase in each of these columns reflect changes in the age structure of the population, notably the improved status of the 10+ biomass in 2010 and subsequently through the projection period.

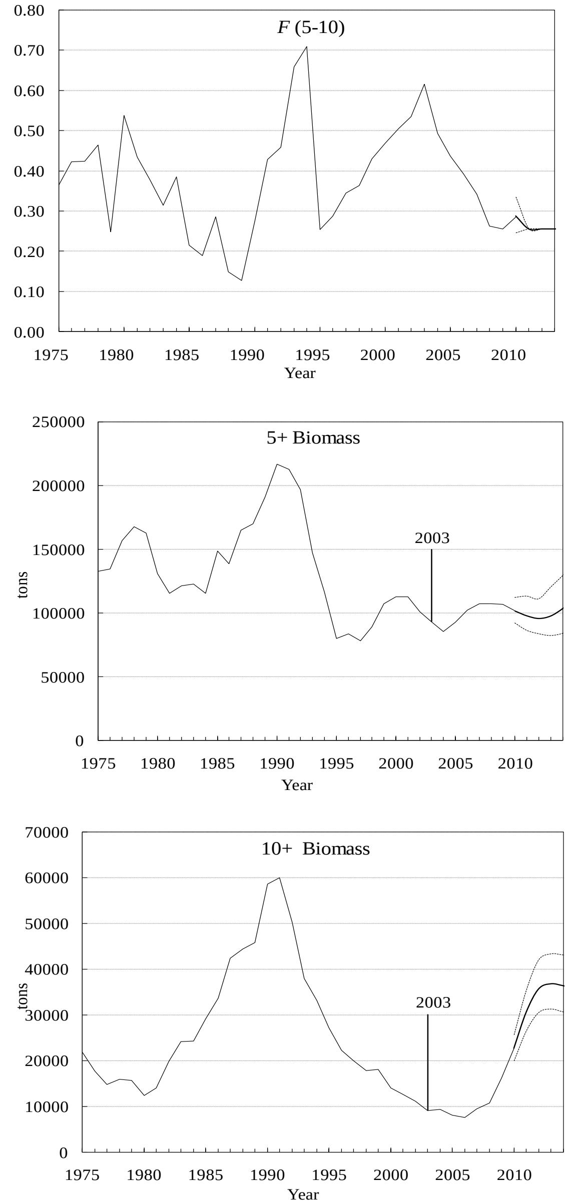
Projection Scenario	Biomass Change [B(2014)-B(2010)]/B(2010)		
	Ages 5+	Ages 10+	Ages 5-9
Status Quo Catch in 2010; F0.1 over 2011-2013	10%	85%	-11%
Status Quo Catch in 2010; F_2009 over 2011-2013	1%	60%	-16%
Status Quo Catch in 2010; 16,000t over 2011-2013	10%	67%	-7%
Status Quo Catch over 2010-2013	-15%	4%	-21%
16,000t in 2010-2013	18%	102%	-6%

The ratio of the exploitable (5 +) biomass at the end of the projection period to the target identified in the rebuilding plan was computed under each projection scenario. If catches are maintained at the current TAC level, total biomass is projected to be 80% of the 140 000 t, with five years remaining in the recovery plan. The potential of recovery to 140 000 t by 2014 is strongly dependent on future recruitment to the exploitable biomass, and recruitment has been very low in recent years.

Projection Scenario	B(2014) / 140Kt
Status Quo Catch in 2010; F0.1 over 2011-2013	0.80
Status Quo Catch in 2010; F_2009 over 2011-2013	0.74
Status Quo Catch in 2010; 16,000t over 2011-2013	0.79
Status Quo Catch over 2010-2013	0.61
16,000t in 2010-2013	0.86



A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2011-2014 assuming status quo catch (23 160 t) in 2010, and fixed catches corresponding to the $F_{0.1}$ level thereafter. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.



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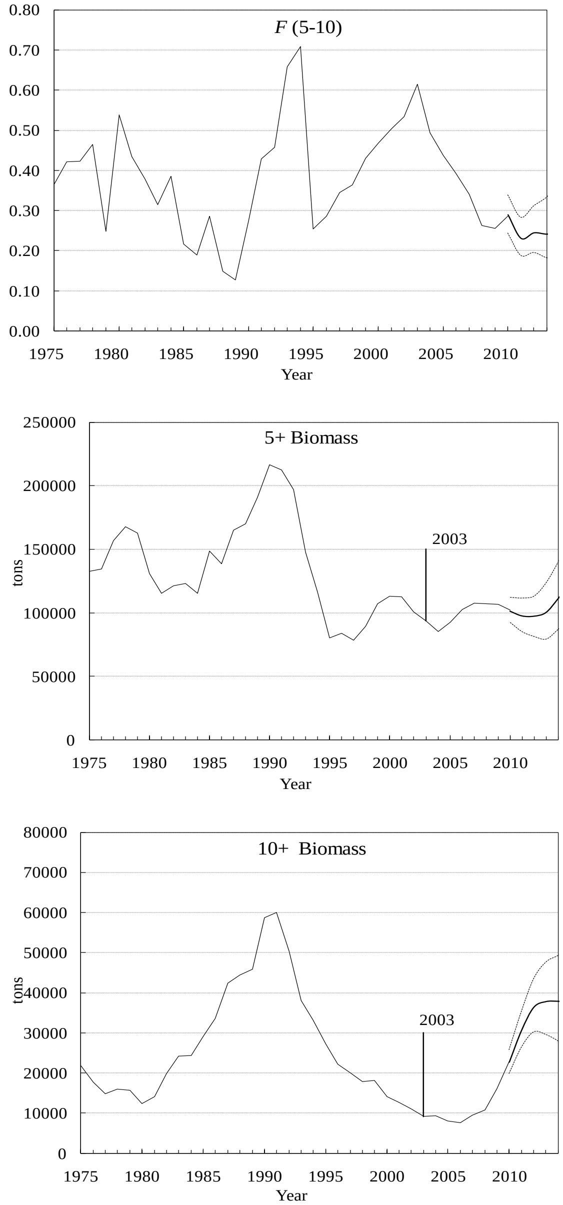
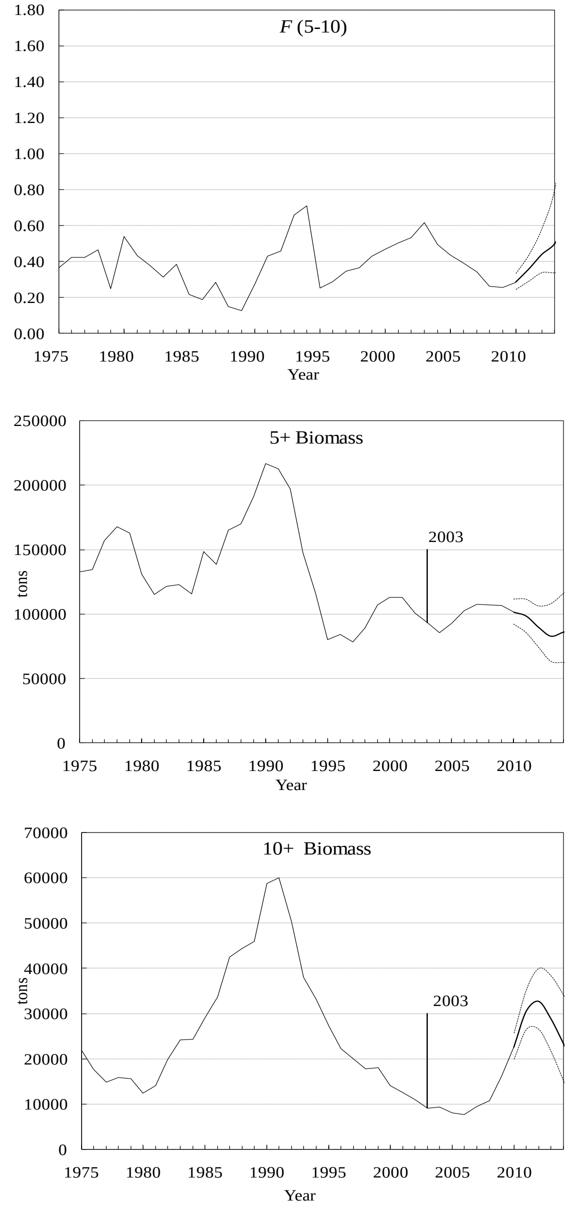


A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2011-2014 assuming status quo catch (23 160 t) in 2010, and fixed catches of 16 000 t thereafter. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.



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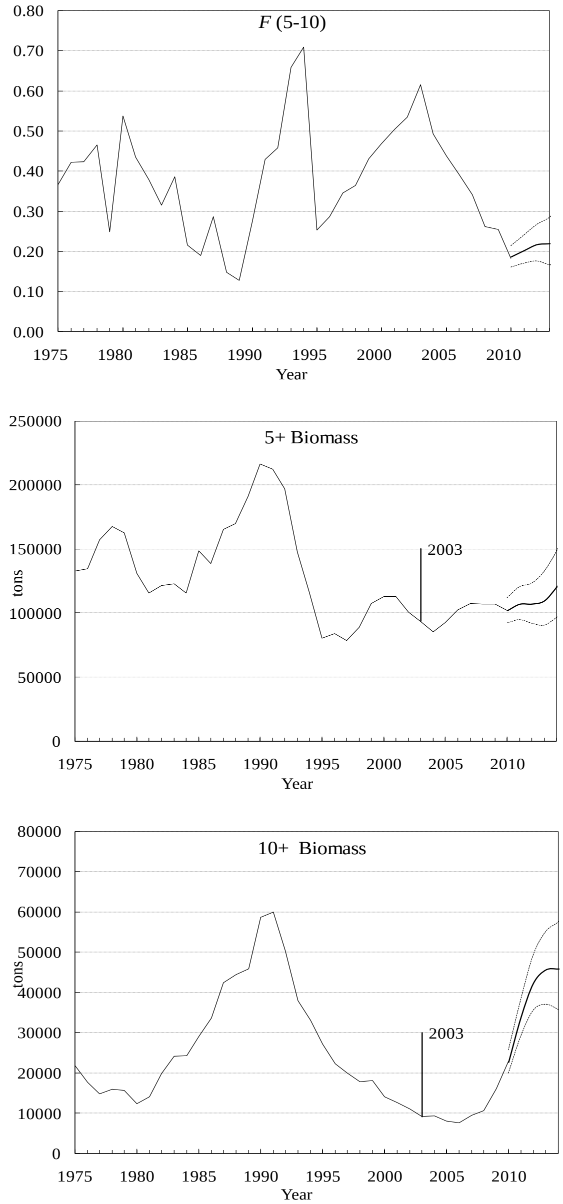


A stochastic projection for Greenland halibut in Subarea 2 and Div. 3KLMNO (from top): fishing mortality, ages 5+ biomass, and ages 10+ biomass in 2011-2014 assuming fixed 16 000 t catch over 2010-2013. The biomass levels of 2003 (year in which Fisheries Commission rebuilding plan developed) are highlighted.

Recommendation: Scientific Council noted that all year-classes which will recruit to the exploitable biomass in the short-term are weak. Projections at the $F_{0.1}$ level indicate about 10% growth in exploitable biomass over 2010-2014. Therefore, Scientific Council recommended that fishing mortality in 2011 be no higher than the $F_{0.1}$ level (median catch of 14 500 t in 2011).

Consideration should be given to reducing fishing mortality below the $F_{0.1}$ level to increase the probability of stock growth.

Special Comments: Scientific Council notes that XSA diagnostics continue to indicate serious problems in model fit. This assessment was accepted noting that careful attention will continue to be paid to model diagnostics in future assessments.

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.

Scientific Council noted that the prospects of rebuilding this stock have been compromised by catches that have exceeded the Rebuilding Plan TACs.

Scientific Council reviewed the issue of using CPUE indices in the assessment and confirmed its view that CPUE indices for this stock should not be interpreted to reflect stock size. However, further investigation of CPUE standardizations has been recommended.

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.

This stock will be next assessed during June 2011.

Sources of Information: SCR Doc. 09/12, 22, 10/8, 21, 23, 35, 40, 44; SCS Doc. 10/5, 6, 7, 10; FC Doc. 03/13

b) Request for Advice on TACs and Other Management Measures for the Years 2011 and 2012

The Fisheries Commission at its meeting of September 2009 reviewed the assessment schedule of the Scientific Council and with the concurrence of the Coastal State agreed to request advice for certain stocks on either a two-year or three-year rotational basis. In recent years, thorough assessments of certain stocks have been undertaken outside of the assessment cycle either at the request of Fisheries Commission or by the Scientific Council given recent stock developments.

Fisheries Commission, in their request, noted that Scientific Council had undertaken an assessment of northern shortfin squid in SA3+4 in 2008 for 2009, 2010, and 2011. This was not undertaken in 2008 owing to the lack of a Designated Expert. Now, with a Designated Expert in place, this stock was subject to a full assessment this year for 2011, 2012, and 2013.

The Fisheries Commission requested in 2009 that American plaice in Div. 3LNO be subject to a full assessment in 2010 in order to more accurately identify the status of this stock in relation to B_{lim}.

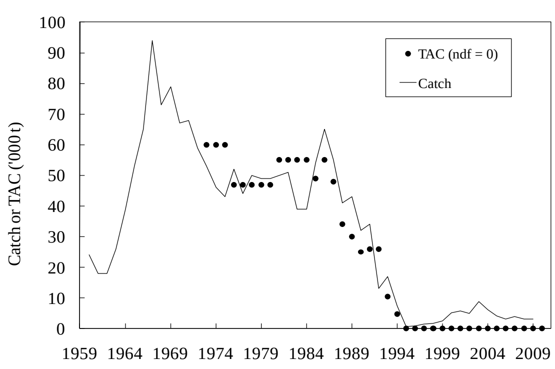
American plaice in Div. 3LNO

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. Total catch in 2009 was 3 515 t, mainly taken in the Regulatory Area.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	3.6	1.0	ndf	ndf
2008	2.5	1.9[1]	ndf	ndf
2009	3.5	1.4[1]	ndf	ndf
2010			ndf	ndf

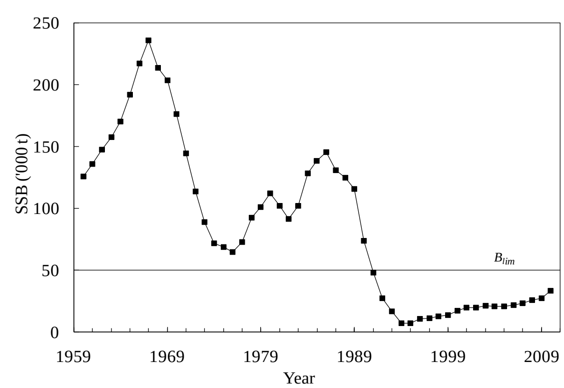
[1] Provisional
ndf No directed fishing.



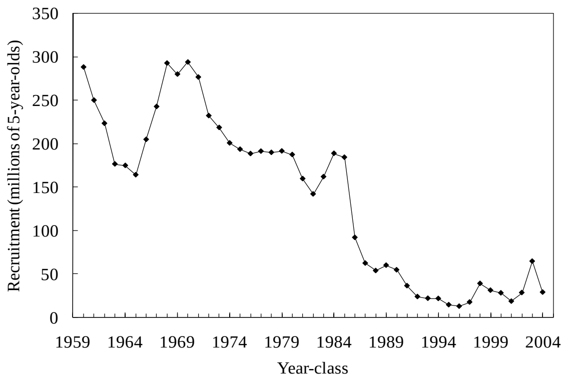
Data: Biomass and abundance data were available from several surveys. Age data from Canadian bycatch as well as length data from bycatch EU-Spain and EU-Portugal were available.

Assessment: An analytical assessment using the ADAPTive framework tuned to the Canadian spring, Canadian autumn and the EU-Spain Div. 3NO survey was used. Natural mortality (*M*) was assumed to be 0.2 on all ages except 0.53 on all ages from 1989 to 1996.

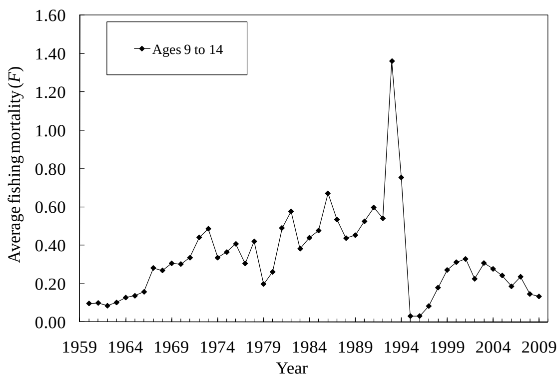
Biomass: Biomass and SSB are very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and is currently at 33 000 t. B_{lim} for this stock is 50 000 t.



Recruitment: Estimated recruitment at age 5 indicates that the strong 2003 year class is the largest since the 1986 year class but well below the long-term average.

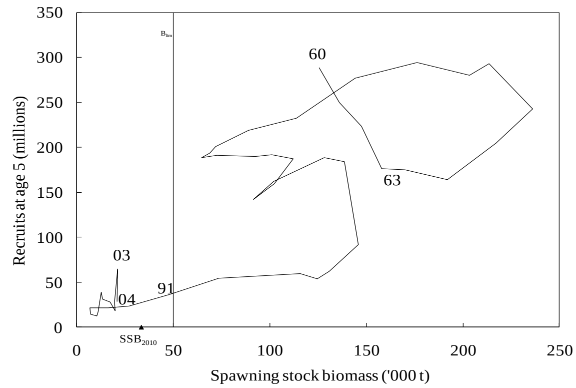


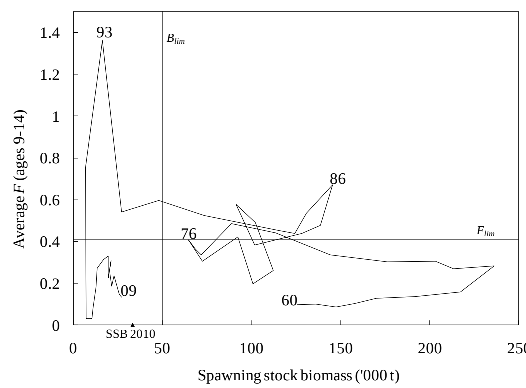
Fishing mortality: From 1995-2001, the average fishing mortality on ages 9 to 14 increased but since then has declined.



State of the Stock: The stock remains low compared to historic levels and although SSB is increasing, it is estimated to be below B_{lim}. Scientific Council notes that SSB was projected in the last assessment to surpass B_{lim} in 2010. However, in this assessment recent estimates of SSB were revised downward as a result of relatively low survey indices in 2009, as well as slight revisions to input data from previous years. In addition, stock weights and maturities now appear to be reduced compared to values used in the projections in the last assessment.

Reference Points: An examination of the stock recruit scatter shows that good recruitment, with the possible exception of the 2003 year class, has rarely been observed in this stock at SSB below 50 000 t and this is currently the best estimate of B_{lim}. In 2009 STACFIS adopted an F_{lim} of 0.4 consistent with stock history and dynamics for this stock. The stock is currently below B_{lim} and current fishing mortality is below F_{lim}.





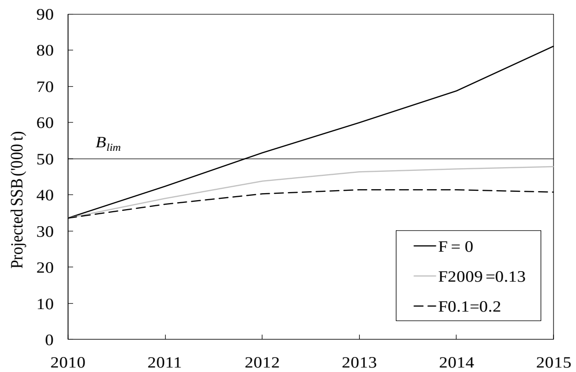
Short term considerations: Simulations were carried out to examine the trajectory of the stock under 3 scenarios of fishing mortality: F = 0, F = F_{2009} (0.13), and $F_{0.1}$ (0.2) (show below). Simulations were limited to a 5-year period. Recruitment was resampled from three sections of the estimated stock recruit scatter, depending on SSB.

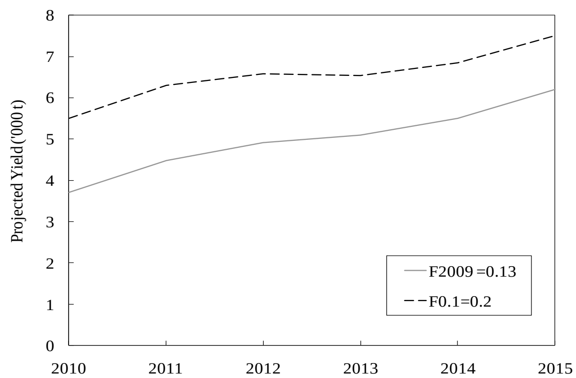
At F = 0 spawning stock biomass is estimated to increase and there is a 50% probability that SSB will surpass B_{lim} by 2012. Under $F_{current}$ and $F_{0.1}$ the population is estimated to grow more slowly and there is a less than 50% probability that SSB will reach B_{lim} by 2015.

	F=0		
	SSB ('000 t)		
	p5	p50	p95
2010	30	34	38
2011	37	42	48
2012	44	52	60
2013	50	60	70
2014	55	69	84
2015	61	81	112

	F_{2009} = 0.13					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2010	30	34	38	3.3	3.7	4.2
2011	34	39	44	3.9	4.5	5.1
2012	37	44	51	4.3	4.9	5.6
2013	39	46	56	4.5	5.1	6.0
2014	40	47	61	4.8	5.5	6.8
2015	40	48	71	5.2	6.2	8.7

	$F_{0.1}$ = 0.2					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2010	30	33	38	4.9	5.5	6.3
2011	33	37	43	5.6	6.3	7.2
2012	35	40	47	5.8	6.6	7.6
2013	35	41	49	5.7	6.5	7.5
2014	35	41	51	5.9	6.8	8.1
2015	34	41	53	6.4	7.5	9.3





Recommendation: There should be no directed fishing on American plaice in Div. 3LNO in 2011. Bycatches of American plaice should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directing for other species.

Special Comment: The next full assessment of this stock will be conducted in 2011.

Sources of Information: SCS Doc. 10/5, 6, 7; SCR Doc. 10/8, 15, 39

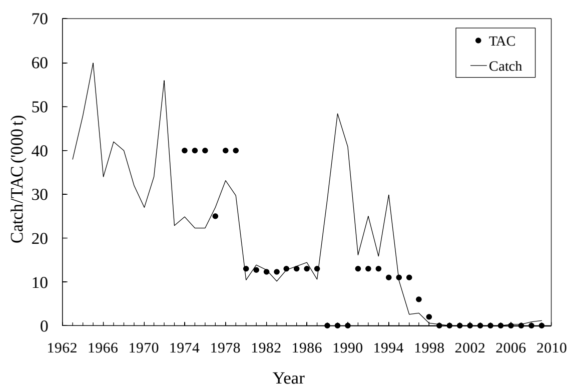
Cod in Div. 3M

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

Fishery and Catches: The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod has also been taken as bycatch in the directed redfish fishery by Portuguese trawlers. Estimated bycatch in shrimp fisheries is low. Large numbers of small fish were caught by the trawl fishery in the past, particularly during 1992-1994. Catches since 1996 were very small compared with previous years. Catches exceeded the TAC from 1988 to 1994, but were below the TAC from 1995 to 1998. In 1999 the direct fishery was closed and catches were estimated in that year as 353 t, most of them taken by non-Contracting Parties. Yearly bycatches between 2000 and 2005 were below 60 t, rising to 339 and 345 t in 2006 and 2007, respectively. In year 2008 and 2009 catches were increasing until 889 and 1161 t, respectively. The fishery has been reopened in 2010 with 5 500 t TAC.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	0.3	0.1	ndf	ndf
2008	0.9	0.4[1]	ndf	ndf
2009	1.2	1.2[1]	ndf	ndf
2010			4.1	5.5

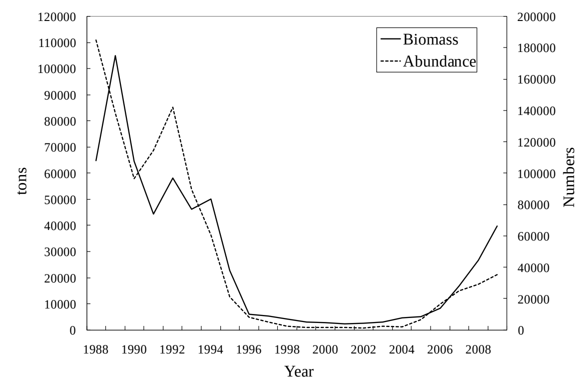
[1] Provisional.
ndf No directed fishing.



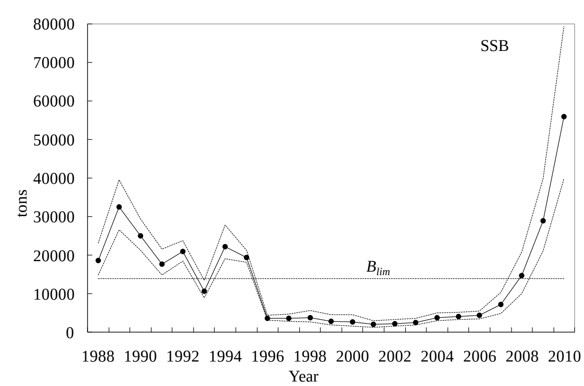
Data: Length and age compositions of the 2002-2005 commercial catches were not available. Length distributions were available for 2006-2009, although sampling levels were low. Abundance at age indices were available from the EU bottom trawl survey since 1988, covering the whole distribution area of the stock. Survey length-age keys were applied to the bycatch up to 2008. In 2009 an age-length key from EU-Portugal catches was available.

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

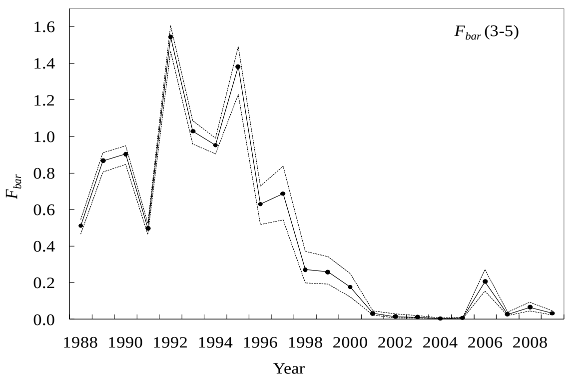
Total Biomass and Abundance: Model estimates in total biomass and abundance show an increasing trend in both values in recent years, being the increase in biomass higher than the one in abundance, although they are still well below the values of the first years of the assessment.



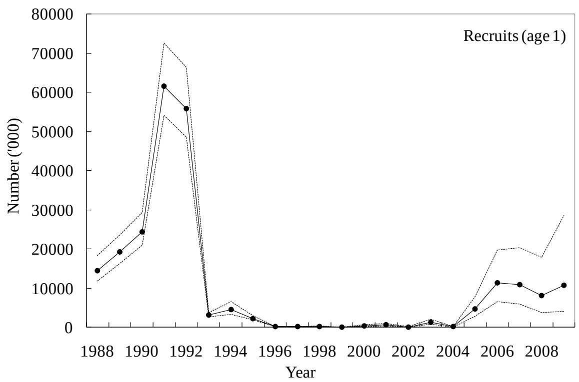
SSB: Spawning stock biomass shows yearly increases starting from 2004, with the biggest increase taking place during 2009 and 2010. The big increase in the last three years is largely due to four reasonably abundant year classes, those of 2004-2007, as well as to the larger weight at age and the younger age of maturity observed in recent years. Recent SSB may have lower reproductive potential than in the earlier time series.



Fishing mortality: Very low since 2001.

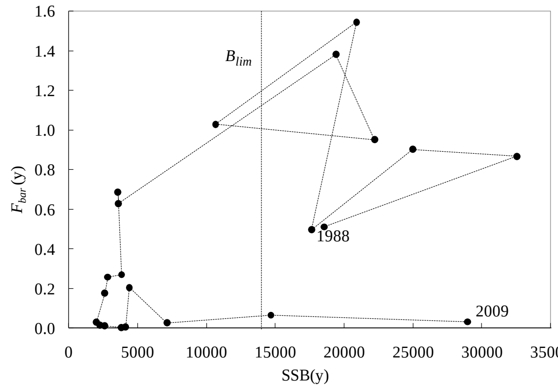


Recruitment: After recruitment failures during 1996-2004, values are higher in 2005-2009, although still below the levels of the late 80s and early 90s.



State of the Stock: There has been a significant spawning biomass increase, reaching levels much higher than the ones in the first years of the assessment (1988-1995), although total biomass and abundance remain still lower that in those years. As a result of changes noted in weight and maturity, it is unclear whether the meaning of spawning biomass as an indicator of stock status is the same as in the earlier period. Whereas recruitment has been better during 2005-2009, it is below levels in the beginning of the assessment period.

Reference Points: A spawning biomass of 14 000 t has been identified as B_{lim} for this stock. SSB is well above B_{lim} in 2010.

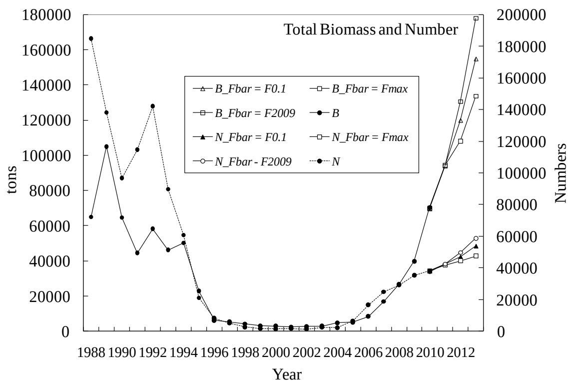


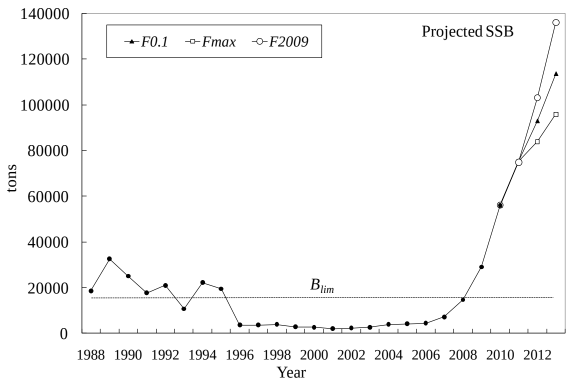
Stock Projections: Stochastic projections have been performed for 2011-2013 under three fishing mortality scenarios: (1) $F_{bar} = F_{0.1}$ (median = 0.130); (2) $F_{bar} = F_{max}$ (median = 0.230); (3) $F_{bar} = F_{2009}$ (median = 0.033). All scenarios assumed that the Yield for 2010 is the established TAC (5 500 t).

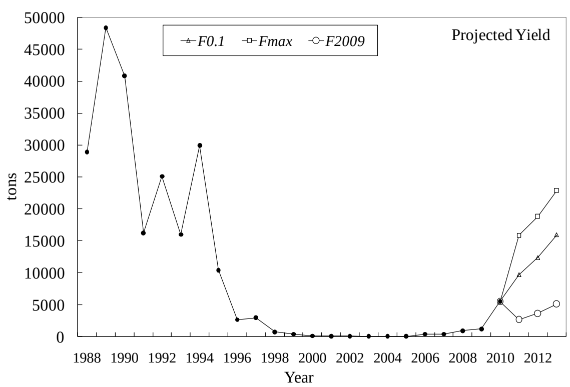
Under all scenarios, total biomass and SSB have a very high probability of reaching levels higher than all of the 1988-2010 estimates. However, this increase does not have a counterpart in terms of population abundances, which are projected to remain at levels below those of the late 80s. That is because the weights and maturities used in the projections were drawn from those of the last three years (much higher than those assumed in the earlier period). If these conditions do not persist, projection results will be overly optimistic.

Projected values for 2011-2013 are reliant on the relatively abundant four most recent cohorts rather than on healthy population abundances across all ages.

	Total Biomass		SSB		Yield	
	50%	5%-95%	50%	5%-95%	50%	5%-95%
			$F_{bar}=F_{0.1}$ (median=0.130)			
2010	70256	50220-99303	55883	39816-79366	5500	
2011	94226	64790-148921	75254	53724-104901	9696	4738-16734
2012	119863	74204-239329	92922	63973-143772	12357	6155-24424
2013	154829	78713-382444	113569	66583-260506	15913	7551-39985
			$F_{bar}=F_{max}$ (median=0.230)			
2010	69942	50151-99080	56279	39968-79068	5500	
2011	94178	65067-146667	75155	54076-104854	15848	7773-28595
2012	108048	65876-220560	83888	56792-131777	18825	9296-38370
2013	133604	63055-345060	95891	53584-232822	22876	10339-63157
			$F_{bar}=F_{2009}$ (median=0.033)			
2010	69628	49666-99058	56125	39600-79794	5500	
2011	93803	64542-147487	74895	53857-105221	2632	1329-4200
2012	130552	81677-247053	103096	71134-158937	3612	1956-6698
2013	177909	94840-396185	136085	83629-303361	5084	2624-11804







Recommendation: Considering the relatively low number of mature individuals currently in the stock, Scientific Council advises that a TAC lower than 10 000 t (approximate catch at $F_{0.1}$), appears not to be damaging the SSB that is currently well above $B_{lim.}$

Special Comments: The next full assessment of this stock will be in June 2011.

Sources of Information: SCR Doc. 10/23, 41; SCS Doc. 10/5, 6, 7.

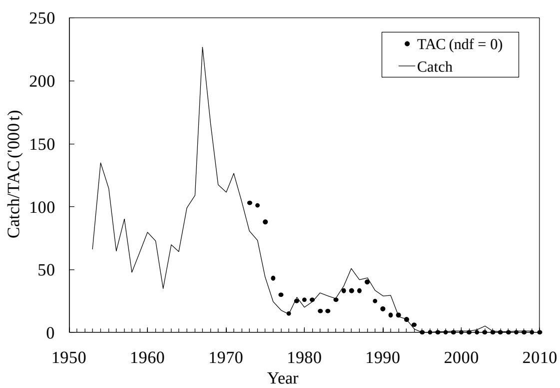
Cod in Div. 3NO

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: This stock has been under moratorium to directed fishing since February 1994. Since the moratorium catch increased from 170 t in 1995, peaked at about 4 800 t in 2003 then declined to 600 t in 2006. Since 2006 catches have increased steadily to 1 100 t in 2009.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	0.8	0.7	ndf	ndf
2008	0.9	0.7[1]	ndf	ndf
2009	1.1	0.6[1]	ndf	ndf
2010			ndf	ndf

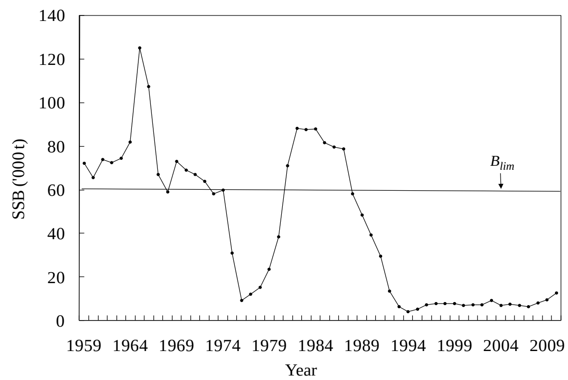
[1] Provisional.
ndf No directed fishing.



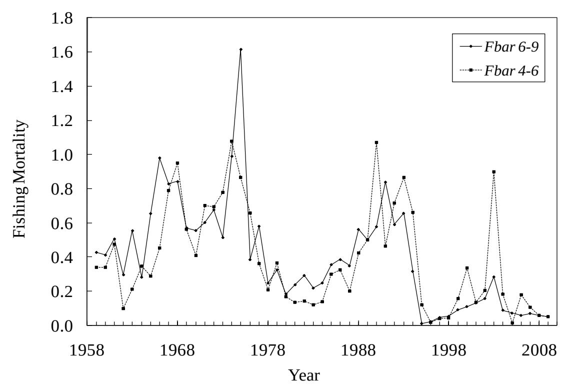
Data: Length and age composition were available from the 2007-2009 trawler fisheries to update catch at age. Canadian spring (1984-2009), autumn (1990-2009), and juvenile (1989-1994) surveys; and EU-Spain Div. 3NO May-June surveys provided abundance, biomass and size structure information.

Assessment: An analytical assessment was presented to estimate population numbers, biomass and SSB at 1 Jan in 2010.

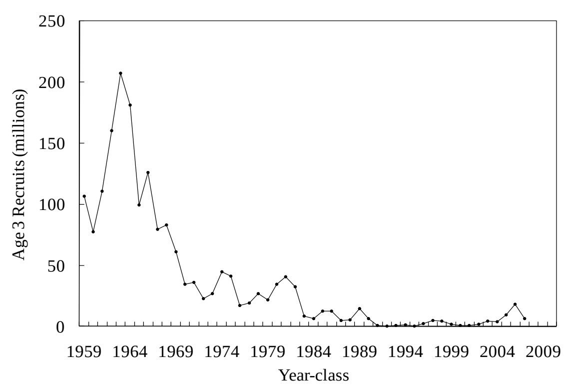
Biomass: The 2010 total biomass and spawning biomass remain low but are estimated to be at their highest levels since 1992.



Fishing Mortality: Has been declining since 2006. Estimates for ages 4-6 in 2008 and 2009 are less than 0.06 and are amongst the lowest estimated during the moratorium.

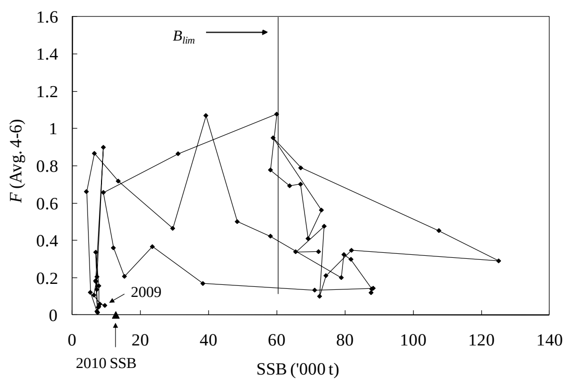


Recruitment: Remains low but has been improving in recent years with current estimates of the 2005-2007 year classes comparable to those from the mid- to late 1980s.



State of the Stock: Remains relatively low but has improved in recent years to levels just prior to the moratorium. Nevertheless, SSB is still well below B_{lim}.

Reference Points: The current best estimate of B_{lim} is 60 000 t. SSB in 2010 is estimated to be 12 700 t which is 21% of B_{lim}.



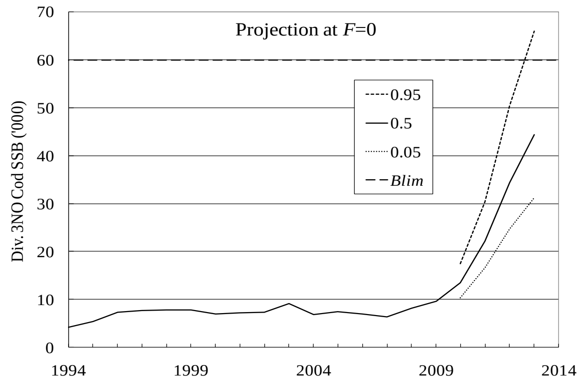
Short-term considerations: Simulations were carried out to examine the trajectory of the stock under two scenarios of fishing mortality: *F*=0, *F*=0.07 (the average *F* on ages 4-6 from 2007-2009). Simulations were limited to a 3-year period. Given the SSB is still estimated to be well below B_{lim}, recruitment (at age 3) was only re-sampled from 1994-2009 as this represents a reasonable expectation of what has occurred under low productivity conditions. At $F = 0$ spawning stock biomass is estimated to increase and there is an 88% probability that SSB will remain under B_{lim} by 2013. At $F = 0.07$ the population is estimated to grow more slowly. If the fishing mortality in 2010-2012 remains at the average estimated in 2007-2009 then yield is estimated to increase over the 3-year time period.

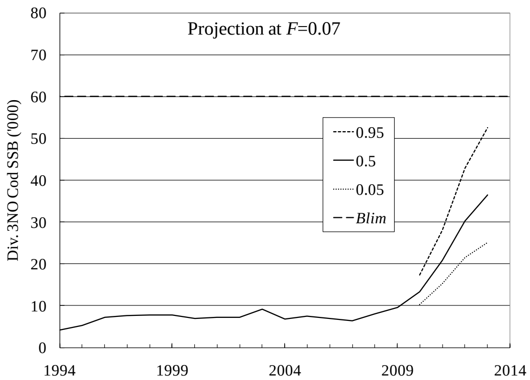
Stochastic Projection Results:

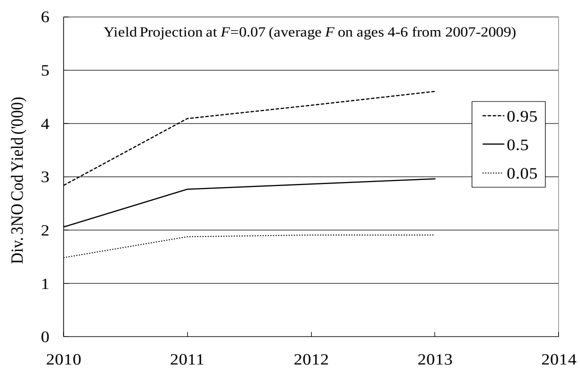
F=0	Beginning of Year SSB			
Percentile	2010	2011	2012	2013
0.95	17456	30414	50423	66023
0.75	14963	25056	39827	51819
0.5	13498	22181	34369	44368
0.25	12150	19752	30157	38374
0.05	10283	16572	24722	31190

F=0.07	Beginning of Year SSB			
Percentile	2010	2011	2012	2013
0.95	17358	27999	42894	52622
0.75	14853	23418	34660	42223
0.5	13388	20791	30294	36493
0.25	12028	18165	26116	31222
0.05	10261	15263	21474	25067

F=0.07	Yield			
Percentile	2010	2011	2012	2013
0.95	2843	4092	4343	4602
0.75	2356	3237	3382	3567
0.5	2054	2765	2862	2957
0.25	1768	2351	2419	2461
0.05	1478	1877	1904	1909







Recommendation: There should be no directed fishing for cod in Div. 3N and Div. 3O in 2011-2013. Bycatches of cod should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directed for other species.

Special Comments: The next assessment will be in 2013.

Sources of Information: SCR. Doc. 10/9, 42; SCS Doc. 10/5, 6, 7; 09/5, 12; 08/5, 6, 7.

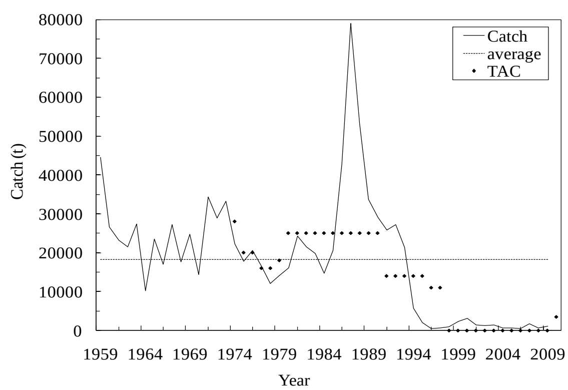
Redfish in Div. 3LN

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

Fishery and Catches: Reported catches oscillated around an average level of 21 000 t from 1965-1985, rise to an average about 40 000 t from 1986-1993, and drop to a low level observed from 1995 onwards within a range of 450-3 000 t. The estimated catch in 2009 was of 1051 t. From 1998-2009 a moratorium on direct fishing was in place. Since 1998 catches were taken as bycatch primarily in Greenland halibut fishery by EU-Portugal and EU-Spain.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	1.7	0.2[1]	ndf	0
2008	0.6	0.4[1]	ndf	0
2009	1.1	0.3[1]	3.5	0
2010			3.5	3.5

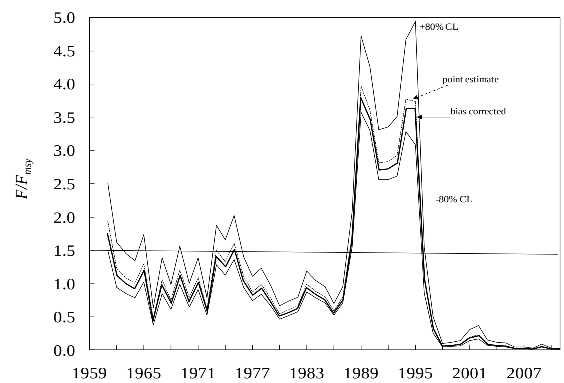
[1] Provisional.
ndf no directed fishing



Data: Catches from 1959-2009 (conditioned on a 1959-1994 CPUE series from STATLANT data), and data from most of the stratified-random bottom trawl surveys conducted by Canada and Russia and EU-Spain in various years and seasons in Div. 3L and Div. 3N, from 1978 onwards were available. Length frequencies were available for both commercial catch and surveys.

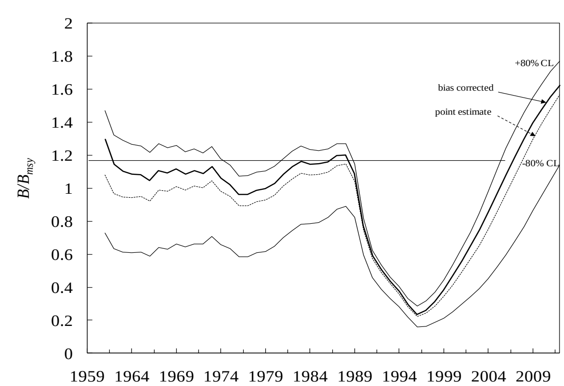
Assessment: An ASPIC model framework, was used to assess the status of the stock. This framework uses a non-equilibrium Schaeffer surplus production model to describe stock dynamics.

Fishing Mortality: The model results suggest a maximum sustainable yield (MSY) of 23 000 t that can be produced with a fishing mortality of 0.13. Between 1986 and 1992 catches higher than MSY pushed fishing mortality to well above F_{msy}. The quick decline of stock biomass was followed by a drop in relative fishing mortality that, since 1996, has been kept at low levels.



Recruitment: There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN. From commercial catch and Canadian survey length data there are signs of recruitment of above average year classes to the exploitable stock, from 4-5 years back in time.

Biomass: Relative biomass was at or slightly above B_{msy} for most of the former years up to 1987, supporting an average level of catches just below MSY. Between 1986 and 1992 catches higher than *MSY* determine the autumn of biomass from B_{msy} in 1987 to 24% B_{msy} in 1994, when a minimum stock size is recorded. Over the moratorium years biomass was allowed to increase and is now well above B_{msy}.



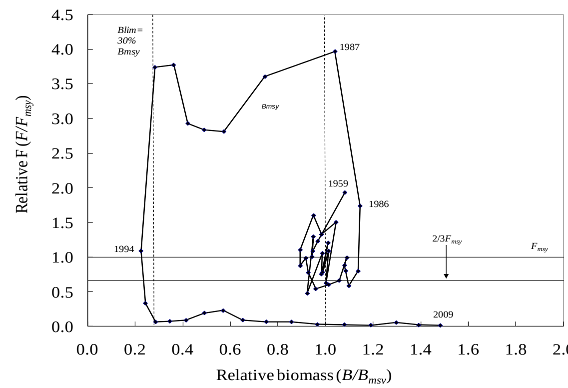
State of the Stock: The biomass of redfish in Div. 3LN is above B_{msy} , while fishing mortality is below F_{msy} .

Reference Points: The NAFO SC Study Group recommendations from the meeting in Lorient in 2004, as regards Limit Reference Points for stocks evaluated with surplus production models, considered F_{lim} at F_{msy} and F_{target} at 2/3 F_{msy}. The Study Group also considered that the biomass giving production of 50% *MSY* was a suitable B_{lim}. With the Schaeffer model used in the present ASPIC assessment this limit corresponds in this stock to (roughly) 30% B_{msy}. The stock was at (or below) B_{lim} between 1993 and 1996, prior to the implementation of the moratorium on this fishery in 1998.

Recommendation: Short term projections (50th percentile) of relative biomass, fishing mortality and catch, under $F_{statusquo}$ and a range of F_{msy} multipliers are presented below

	B/Bmsy			
Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
2010	1.608	**1.608**	1.608	1.608
2011	1.655	**1.655**	1.655	1.655
2012	1.707	**1.681**	1.651	1.591
2013	1.752	**1.705**	1.649	1.543
	F/Fmsy			
Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
2010	0.096	**0.096**	0.096	0.096
2011	0.030	**0.167**	0.333	0.667
2012	0.030	**0.167**	0.333	0.667
	Catch			
Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
2010	3500	**3500**	3500	3500
2011	1128	**6235**	12352	24237
2012	1163	**6343**	12360	23440

Redfish in Div. 3LN has been under moratorium from 1998 to 2009. A stepwise approach to direct fishery should start by a low exploitation regime in order to have a high probability that the stock biomass is kept within its present safe zone. Therefore Scientific Council recommended that an appropriate TAC for 2011-2012 could be around 1/6 of F_{msy} corresponding to a catch level of 6 000 t.



Special Comments: The status of the stock allows its exploitation, but the real response of the stock to a real direct fishery is still to be seen. Therefore any projection should be treated with caution.

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

The next assessment will be in 2012.

Sources of Information: SCR Doc. 10/25, 28, 29; SCS Doc. 10/5, 6, 7.

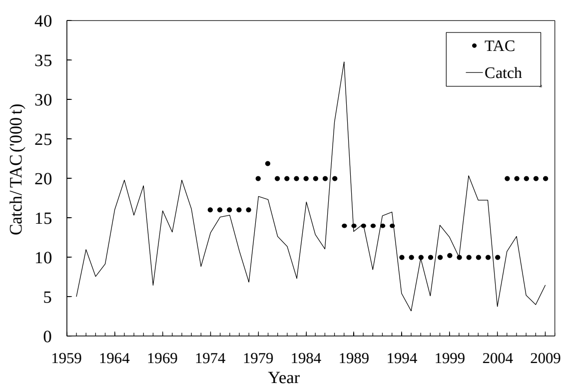
Redfish in Div. 3O

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*). 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. 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: The redfish fishery within the Canadian portion of Div. 3O has been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, while catch in the NRA portion of Div. 3O during that same time was regulated only by mesh size. A TAC was adopted by NAFO in September 2004. The TAC has been 20 000 t from 2005-2010 and applies to the entire area of Div. 3O. Nominal catches have ranged between 3 000 t and 35 000 t since 1960. Catches averaged 13 000 t up to 1986 and then increased to 27 000 t in 1987 and 35 000 t in 1988. Catches declined to 13 000 t in 1989, increased gradually to about 16 000 t in 1993 and declined further to about 3 000 t in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 20 000 t by 2001, and have generally declined since that time, with 2009 catches totaling 6 431 t.

	Catch ('000 t)		TAC ('000 t)
Year	STACFIS	21A	Agreed
2007	5.2	7.5	20
2008	4.0	5.0[1]	20
2009	6.4	6.4[1]	20
2010			20

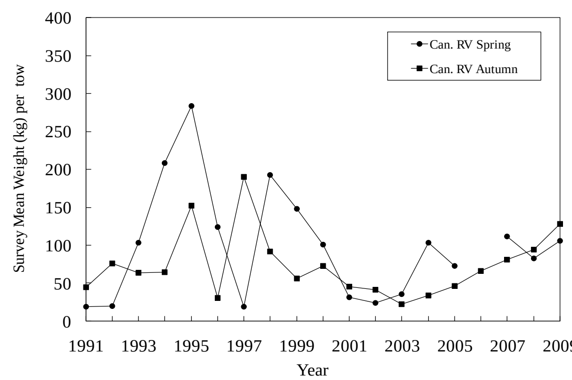
[1] Provisional



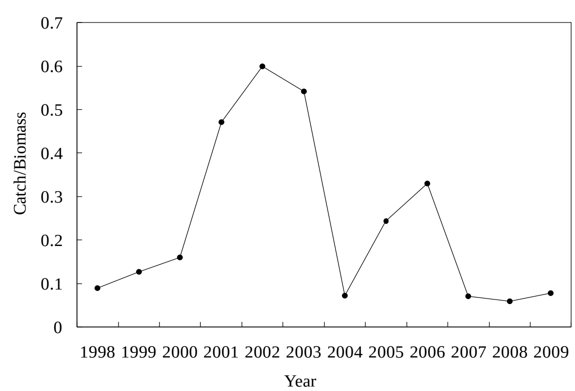
Input Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring and autumn surveys for 1991-2009. Length frequencies were available from Canada, Portugal and Spain in 2009.

Assessment: No analytical assessment was performed.

Biomass: While the Canadian spring survey estimates have been stable since 2004, the autumn survey estimates have increased continuously since 2003. Both indices are currently at or slightly above the series average.



Fishing Mortality: Catch/survey biomass index for Div. 3O redfish peaked in 2002 at 0.6 and has decreased since that time. Relative fishing mortality for 2007-2009 is approximately 0.1 and among the lowest values in the time series.



Recruitment: The 2001 year class appeared as a relatively large pulse at 17cm in the 2007 surveys and remains dominant at 19 cm in 2009. This represents the best sign of recruitment in the population since the 1988 year-class.

State of the Stock: Surveys indicate the stock has increased since the early 2000s.

Reference Points: There are presently no biological reference points for redfish in Div. 3O.

Recommendation: Catches have averaged about 13 000 t 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 2009, a period of 50 years, catches have surpassed 20 000 t 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 2011, 2012 and 2013.

Special Comments: Length frequencies suggest that the Div. 3O redfish fishery targets predominantly immature fish.

The next assessment will be in 2013.

Sources of Information: SCR Doc. 10/26; SCS Doc. 10/5, 6, 7, 10.

Thorny skate in Div. 3LNO

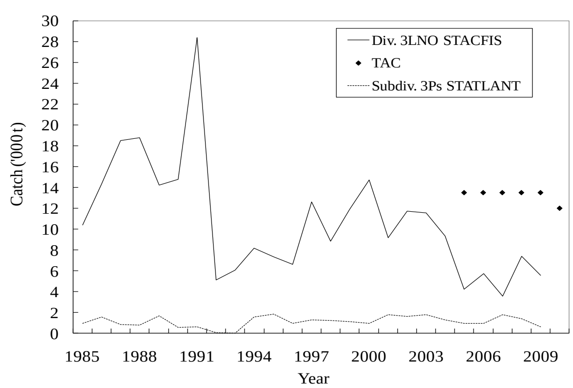
Background: Commercial catches of skates comprise a mix of skate species. However, thorny skate represents about 95% of the skates taken in the catches. Thus, the skate fishery on the Grand Banks can be considered as directed for thorny skate.

Fishery and Catches: Catches for NAFO Div. 3LNO increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this new fishery were EU-Spain, EU-Portugal, Russia, and Canada. Catches by all countries in Div. 3LNOPs over 1985-1991 averaged 18 066 t; with a peak of 29 048 t in 1991 (STATLANT 21A). From 1992-1995, catches of Thorny Skate declined to an average of 7 554 t, however there are substantial uncertainties concerning reported skate catches prior to 1996. Total catch, as estimated by STACFIS, in Div. 3LNOPs, averaged 9 000 t during the period 2000 to 2009. Average STACFIS catch in Div. 3LNO for 2005-2009 was 5 000 t.

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

	Catch ('000 t)			TAC ('000 t)[2]
	Div.3LNO		Subdiv.3Ps	Div. 3LNO
Year	STACFIS	21A	21A	
2007	3.6	6.2	1.8	13.5
2008	7.4	5.6[1]	1.4	13.5
2009	4.5	1.2[1]	0.7	13.5
2010				12

[1] Provisional
[2] TAC in 3Ps is 1.05 ('000 t)



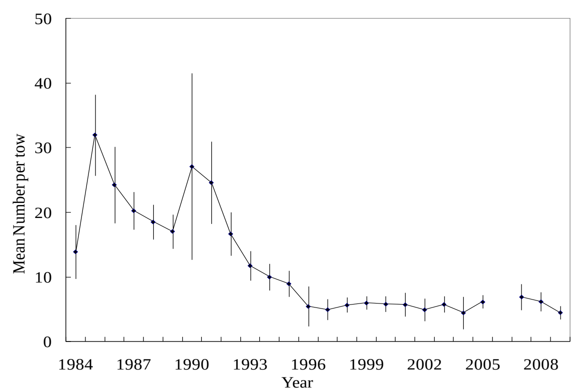
Data: Abundance and biomass indices were available from: annual Canadian spring (1971-1982; 1983-1995; 1996-2009) and autumn (1990-1994, 1995-2009) surveys.

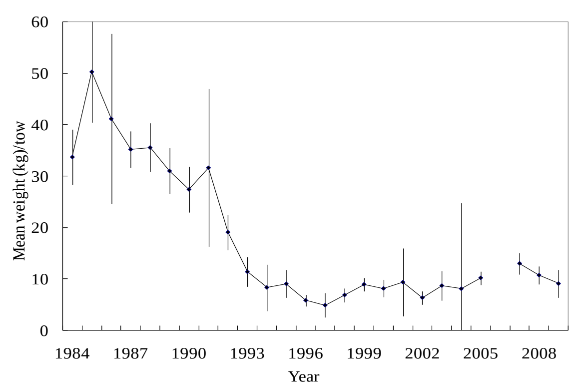
EU-Spain survey indices were available in the NAFO Regulatory Area of Div. 3NO (1997-2009). EU-Spain survey indices in the NRA of Div. 3L are available for 2006-2009 but are not considered due to the short time series.

Commercial length frequencies were available for EU-Spain (1985-1991, 1997-2009), EU-Portugal (2002-2004, 2006-2009), Canada (1994-2008), and Russia (1998-2009).

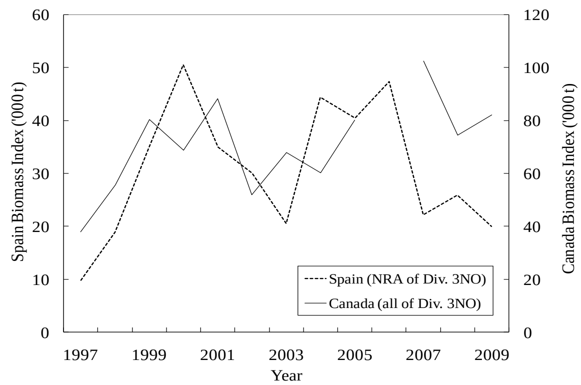
Assessment: No analytical assessment could be performed.

Biomass. The Canadian spring survey biomass indices fluctuated without trend prior to the mid-1980s then declined rapidly until the early-1990s. During the spring Campelen series, 1996 to 2009, the biomass has been stable at low levels. The pattern from the Canadian autumn survey, for comparable periods, was similar.

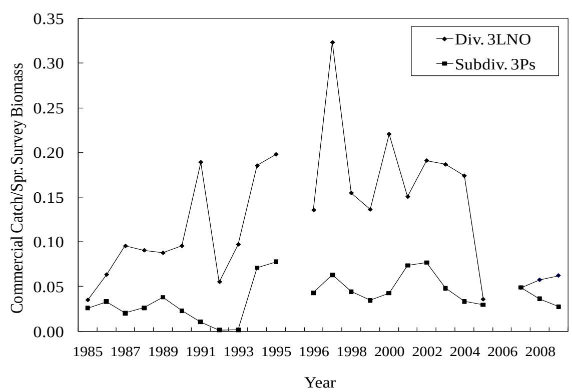




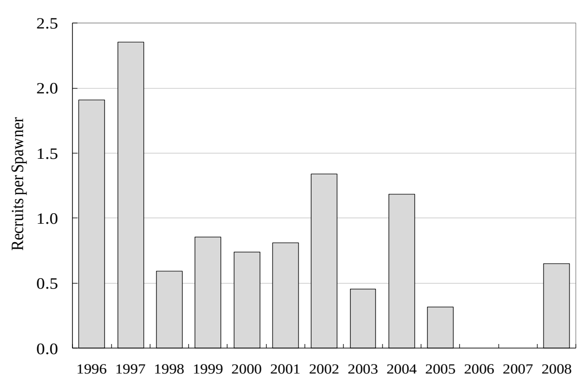
The Spanish survey was conducted in the NRA portion of Div. 3NO while the Canadian survey covered the entire extent of Div. 3NO. The biomass trajectory from the Spanish survey was very similar to that of the Canadian spring survey until recently. In recent years the EU-Spain index has remained lower than observed during 2004-2006.



Fishing Mortality. Catch/survey biomass index for Div. 3LNO peaked at 30% in 1997, then stabilized at approximately 17% during 1998-2004. In 2005, relative fishing mortality declined to 4%, and has remained around 5% since then.



Recruitment. Recruitment has been low since 1997.



State of the Stock: Although the state of the stock is unclear, the survey biomass has been relatively stable from 1996 to 2009 at low levels.

Recommendation: To promote recovery of thorny skate, Scientific Council recommended that catches in 2011 and 2012 should not exceed 5 000 t (the average catch during the past three years) in NAFO Div. 3LNO.

Reference Points: There are presently no biological reference points for thorny skate in Div. 3LNOPs.

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

The next assessment will be in 2012.

Sources of Information: SCS. Doc. 10/5, 6, 7; SCR Doc. 10/10, 24

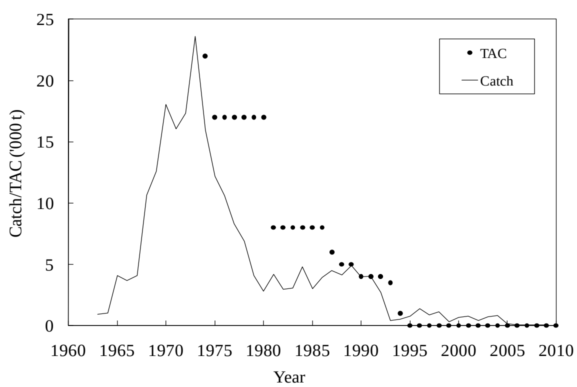
Witch flounder in Div. 2J3KL

Background: Historically, and in the most recent time period, the stock occurred mainly in Div. 3K, although in several years from 1991-2003 more of the stock occurred in Div. 3L**.** 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 t including unreported catches. The 2005 catch declined to 155 t and the 2006 catch was only 84 t. Since 2005, catches have averaged less than 100 t and in 2009 was 57 t.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	0.1	0.1	ndf	ndf
2008	0.1	0.1[1]	ndf	ndf
2009	0.1	0.1[1]	ndf	ndf
2010			ndf	ndf

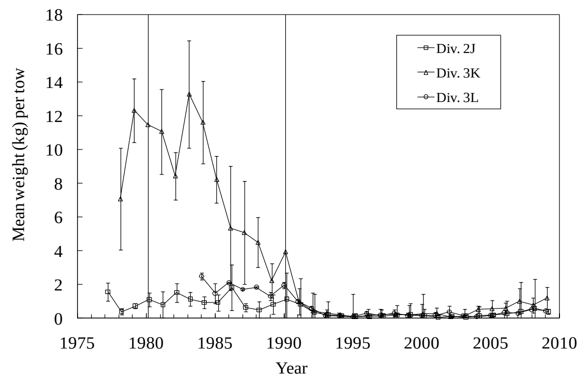
[1] Provisional
ndf No directed fishing.



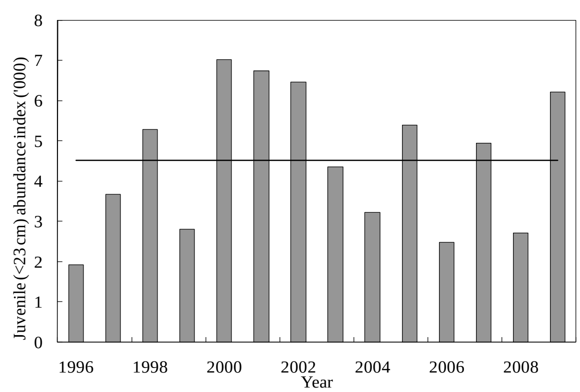
Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian autumn surveys during 1977-2009. Data from the EU-Spain survey in Div. 3L from 2006-2009 were available, but the time series was considered too short to be informative for this assessment. 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. However, a slightly increasing trend in the total stock survey biomass index has been observed since 2003.



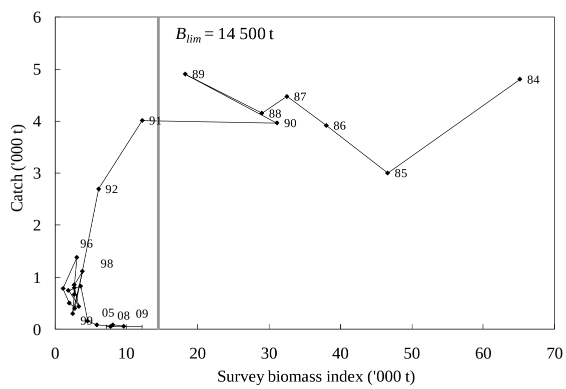
Recruitment: The 2000-2002 surveys had higher than average (1996-2009) numbers of small fish, suggesting stronger than average recruitment. Since then, the juvenile abundance index has been variable but has been higher than the average in 2005, 2007 and 2009.



State of the Stock: Recruitment was above the 1996-2009 average from 2000-2002. There has been an increase in the survey biomass index since 2003. Nevertheless, the overall stock remains at a very low level.

Recommendation: No directed fishing on witch flounder is recommended in the years 2011 to 2013 in Div. 2J, 3K and 3L 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 a previous assessment for this stock, a proxy for B_{lim} was calculated as 15% of the highest observed biomass estimate because no analytical assessment was available (B_{lim} = 9 800 t). Since this estimate is in the early part of the time series when the survey did not cover the entire stock area, B_{lim} was likely underestimated using this method. An analysis of the amount of biomass in index strata (those strata covered in 1984, the highest biomass estimate in the series) suggested that the biomass estimates in the early part of the time series may have been underestimated by about 48% -the average of the biomass outside of the index strata in 1996-2009. The estimates of total survey biomass from 1996-2009 show a strong positive correlation with the biomass estimates in the index strata. The proxy for B_{lim}, adjusted for less extensive coverage in the survey, is calculated to be 14 500 t (B_{lim} =15% of B_{1984}×1.48). In 2009, the biomass index remains below this reference point.



Special Comments: The next full assessment of this stock will be in 2013.

Sources of Information: SCR Docs. 10/15, 27; SCS Doc. 10/5, 6, 7.

Northern shortfin squid in SA 3+4

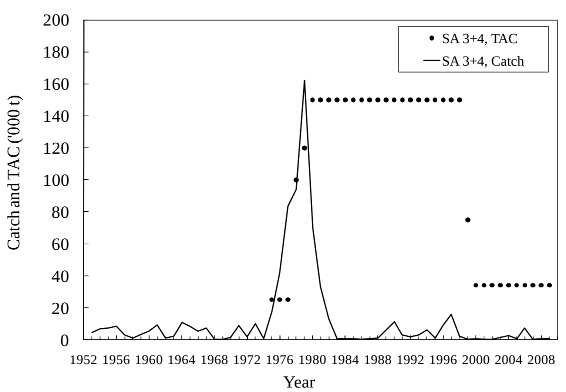
Background: Northern shortfin squid is an annual species (1-year life cycle) that is considered to comprise a unit stock throughout its range in the Northwest Atlantic Ocean, from Newfoundland to Florida, including Subareas 2-6.

Fishery and Catches: The fisheries in Subarea 3-4 consist of a Canadian inshore jig fishery in Subarea 3, and prior to 2000, an international bottom trawl fishery for silver hake, squid and argentine in Subarea 4. A TAC regulation was established in 1975. Occasionally, very low catches are taken in Subarea 2.

Catches remained below 11 000 t until the mid 1974, then increased markedly to a peak of 162 000 t in 1979, decreased again and has fluctuated between 100 and 15 000 t since 1983.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recommended	Agreed
2007	0.2	0.2[1]	19-34	34
2008	0.5	0.5[1]	19-34	34
2009	0.7	0.7[1]	19-34	34
2010			19-34	34

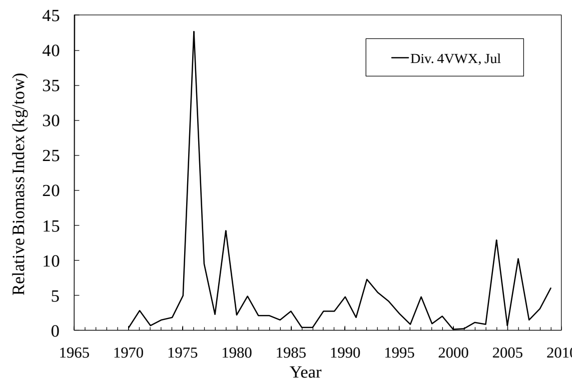
[1] Provisional.



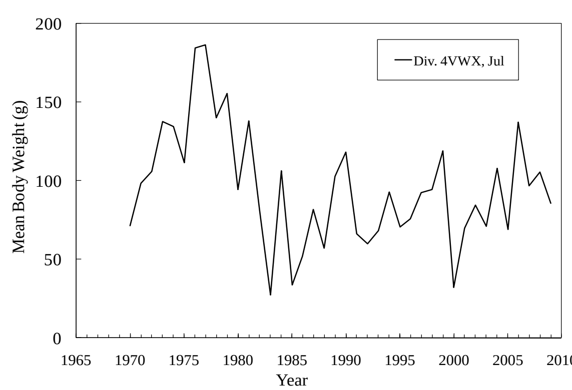
Data: Relative biomass and abundance indices were available from annual Canadian bottom trawl research surveys conducted in Subarea 4 in July on the Scotian Shelf (Div. 4VWX, 1970-2009) and in September in the southern Gulf of St. Lawrence (Div. 4T, 1971-2009). Minimum biomass and abundance indices were also available from the EU survey conducted on the Flemish Cap during July (Div. 3M, 1988-2009). The July survey indices are assumed to reflect relative biomass at the beginning of the fishing season. Of the three surveys that are conducted in Subareas 3+4, the Div. 4VWX surveys provide the best indices of relative biomass in Subareas 3+4 because of the timing of the survey and broad sampling coverage of *Illex* habitat.

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

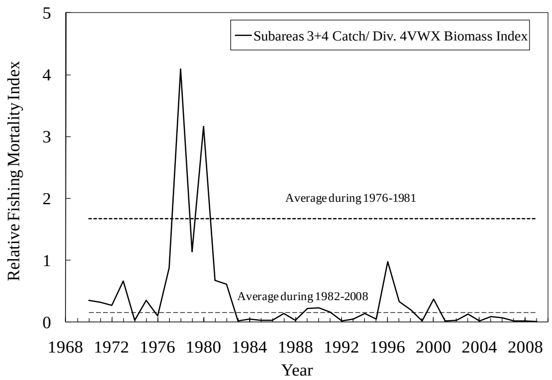
Biomass: Relative biomass indices from the Div. 4VWX surveys were highest during 1976-1981, averaging 12.6 kg/tow, indicating a period of high productivity. During 1982-2008, the average was much lower at 3.0 kg/tow indicating a low productivity period. In 2009, the relative biomass index from the Div. 4VWX July survey (6.0 kg/tow) was near the 1982-2008 average for the low productivity period.



Body Size: Annual mean body weights of squid from the Div. 4VWX surveys declined markedly during 1982-1983, following a period of much higher mean weights during 1976-1981. Squid size increased gradually thereafter, and in 1999, reached the largest size since 1981. Mean body weight declined to the second lowest level on record in 2000 (32 g), then increased gradually to 137 g in 2006. Thereafter, mean body weight declined to 86 g in 2009, a size near the 1982-2008 average (80 g).



Relative Fishing Mortality Indices: Relative fishing mortality indices were highest during 1978-1980 and averaged 1.67 during the period of highest catch (1976-1981). During 1982-2008, the indices were much lower and averaged 0.15. The indices have been below the 1982-2008 average since 2001 and declined to the lowest level on record (0.01) in 2009.



State of the Stock: In 2009, the relative biomass index and mean body weight of squid from the Div. 4VWX July survey were near their 1982-2008 averages for the low productivity period. In addition, the relative fishing mortality index was the lowest on record in 2009. These stock status indicators suggest that the Subareas 3+4 stock component remained in a state of low productivity during 2009 and that relative fishing mortality indices were also very low.

Recommendations: Based on available information, including an analysis of the upper range of yields that might be expected under the present low productivity regime (19 000-34 000 t), the Council advises that the TAC for 2011 to 2013 be set between 19 000 and 34 000 t.

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

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

Special Comments: Northern shortfin squid in Subareas 2-6 (and further south to Florida) are considered to comprise a unit stock and the current assessment only applies to the northern stock component.

The next assessment of the northern stock component will occur in 2013.

Sources of Information: SCR Doc. 98/59, 75, 01/22, 06/46, 10/31.

Northern shrimp in Div. 3LNO

Request item 1 on northern shrimp in Div. 3LNO from Fisheries Commission in 2009 was addressed by Scientific Council in October 2009 (NAFO Sc. Rep., 2009, p. 231) and will be updated by Scientific Council in September 2010.

c) Monitoring of Stocks for which Multi-year Advice was Provided in 2008 or 2009

i) Finfish

The Scientific Council previously provided multi-year advice for the following stocks:

In 2008: 3-year advice was provided for 2009, 2010 and 2011 for cod in Div. 3M, American plaice in Div. 3M, and witch flounder in Div. 3NO.

In 2009: 2-year advice was provided for 2010 and 2011 for American plaice in Div. 3LNO, yellowtail flounder in Div. 3LNO, redfish in Div. 3M, white hake in Div. 3NO and capelin in Div. 3NO.

Scientific Council undertook full assessment of cod in Div. 3M in 2008 and 2009 and, respectively, provided advice for 2009 and 2010. Scientific Council undertook a full assessment of American plaice in Div. 3LNO in 2009 and provided advice for 2010 and 2011. However, Scientific Council undertook full assessments for both these stocks in June 2010 and the advice is addressed in the summary sheets "Cod in Div. 3M" and "American plaice in Div. 3LNO" under agenda item VII.1.b.

The Scientific Council reviewed the status of the other six stocks (interim monitoring) at this June 2010 meeting, and found no significant change in any of these stocks to alter the multi-year advice previously provided. Accordingly, the Council reiterates this previous advice as follows:

Recommendation for American plaice in Div. 3M: Scientific Council recommended that there should be no directed fishery on American plaice in Div. 3M in 2009, 2010 and 2011. Bycatch should be kept at the lowest possible level. **Special Comments:** The apparent good recruitment of the 2006 year class remains to be confirmed in the next years. Because the value estimated by the XSA for the age 1 in 2007 is determined by one point from the EU-survey, the strength of the 2006 year class should be considered preliminary. The next Scientific Council full assessment of this stock will be in 2011.

Recommendation for capelin in Div. 3NO: Scientific Council recommended no directed fishery on capelin in Div. 3NO in 2010-2011. **Special Comments**: Scientific Council 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. The next assessment will be in 2011.

Recommendation for redfish in Div. 3M: Low fishing mortalities should be maintained so as to promote female spawning stock recovery. Scientific Council recommended that catch for all redfish in Div. 3M in 2010 and 2011 should not exceed 8 500 t which is in the range of catches in recent years. **Special Comments**: The next assessment will be in 2011.

Recommendation for white hake in Div. 3NO: Given the current level of recruitment, Scientific Council advises that catch of white hake in Div. 3NO, at the current TAC of 6000 t, is unrealistic. Catches in Div. 3NO for 2010 and 2011 should not exceed the 2006-2008 average annual catch level of 850 t. Catches in Subdiv. 3Ps for 2010 and 2011 should not exceed the 2006-2008 average annual catch level of 1 050 t. **Special Comments**: The next assessment of this stock will be in 2011.

Recommendation for witch flounder in Div. 3NO: No directed fishing on witch flounder in 2009, 2010 and 2011 in Div. 3N and 3O to allow for stock rebuilding. Bycatches in fisheries targeting other species should be kept at the lowest possible level. **Special Comments:** The next Scientific Council assessment of this stock will be in 2011.

Recommendation for yellowtail flounder in Div. 3LNO: Although biomass is well above B_{msy}, Scientific Council does not consider it prudent to fish above 85% F_{msy} because of the uncertainty in the estimation of F_{msy}. Scientific Council therefore recommended any TAC option up to 85% F_{msy} for 2010 and 2011. **Special Comment:** Scientific Council noted that the yellowtail flounder fishery takes cod and American plaice as bycatch. Hence, in establishing the TAC for yellowtail flounder, the impacts on Div. 3NO cod and Div. 3LNO American plaice of any increase in yellowtail flounder TAC should be considered. The next Scientific Council assessment of this stock will be in 2011.

d) Special Requests for Management Advice

i) The Precautionary Approach

The Fisheries Commission requested:

4. Noting the Precautionary Approach Framework as endorsed by Fisheries Commission, the Fisheries Commission requests that the Scientific Council provide the following information for the 2010 Annual Meeting of the Fisheries Commission for all stocks under its responsibility requiring advice for 2011:

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

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

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

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

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

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

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

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

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

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

ii) Evaluation of rebuilding and recovery plans

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

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

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

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

d) Provide, at its annual meeting in 2010, an overview of strategies to recover depleted fish stocks in the Northwest Atlantic, taking into account the proceedings of the NAFO co-sponsored "ICES PICES UNCOVER Symposium on Rebuilding Depleted Fish Stocks - Biology, Ecology, Social Science and Management Strategies" which is to take place November 3-6 2009 in Warnemünde, Germany. (Item 6)

This item was deferred to September 2010.

iii) Div. 3NO cod bycatch reduction measures

The Fisheries Commission requested: *Noting the FC Rebuilding Plan for 3NO cod adopted in September 2007, Fisheries Commission requests Scientific Council to advise, before September 2010, on possible measures the Commission may consider to ensure bycatch of cod is kept at the lowest possible level.* (Item 7)

In 2008 (*NAFO Sci. Coun. Rep.*, 2008, pages 34-35), Scientific Council provided advice on how seasonal and temporal changes to the yellowtail flounder fishery could substantially reduce the bycatch of Div. 3NO cod. In 2009, Scientific Council provided advice on gear modifications that affect the species-specific selectivity patterns (*NAFO Sci. Rep.*, 2009, pages 27-30) though the effectiveness of these are less clear and understood No single gear modification could be recommended to reduce Div. 3NO cod bycatch.

No additional advice was provided at this 2010 Scientific Council meeting.

iv) VME Fishery Impact Assessments

Fisheries Commission requested: *Recognizing the initiatives on vulnerable marine ecosystems (VME) through the work of the WGFMS, and with a view to completing fishery impact assessments at the earliest possible date, the Scientific Council is requested to provide the Fisheries Commission at its next annual meeting in 2010:*

a) guidance on the content of fishing plans/initial assessments for the purpose of evaluating significant adverse impacts on VMEs and identify viable risk evaluation methodologies for the standardized assessment of fishery impacts.

b) In light of the use of existing encounter protocols in tandem with the closed areas for corals and sponges:

i. assess new and developing methodologies that may inform the Fisheries Commission on any future review of the thresholds levels

ii. review and report on new commercial bycatch information as it becomes available, and.

iii. in light of i.) review the ability of the current encounter threshold values of 60 kg live coral and 800 kg sponge to detect new VME areas as opposed to cumulative catches of isolated individuals. (Item 8)

The Scientific Council responded:

For item 8a - *guidance on the content of fishing plans/initial assessments for the purpose of evaluating significant adverse impacts on VMEs and identify viable risk evaluation methodologies for the standardized assessment of fishery impacts.*

In general terms, fishing plans should include the following information:

Harvesting plan detailing type(s) of fishing expected to be conducted, vessels and gear types, fishing areas, target and potential bycatch species, fishing effort levels, dates of fishing, duration of fishing tows, soak time, etc;

Best available scientific and technical information on the current state of fishery resources and baseline information on the ecosystems, habitats and communities in the fishing area, including known or potential VMEs;

Identification, description and evaluation of the occurrence, scale and duration of likelihood of impacts, including cumulative impacts on VMEs;

Proposed mitigation plan including measures to prevent significant adverse impacts on VMEs;

Proposed monitoring plan of the effects of the fishing operations that includes recording/reporting that follows agreed NAFO template for exploratory fishery protocol for new fishing areas, or in existing fishing areas includes VME-indicator species in the bycatch reporting.

Although fishing plans should strive to fulfill this general content structure, properly addressing many of these elements requires scientific knowledge currently in development, both in terms of methods and basic data requirements. Practical definitions of what constitutes a significant adverse impact on VMEs, and robust methods to determine cumulative impacts are areas where no widely accepted international standards have been developed yet, although research efforts are ongoing to remedy this situation.

A critical aspect, necessary for properly developing fishing plans and which can certainly be addressed today, is the need for more and better data of commercial fisheries. Enhanced data collection and monitoring plans should be sufficiently detailed to conduct an assessment of the activity, when required, as well as to facilitate the identification of vulnerable marine ecosystems/species in the area fished. These data requirements would be especially desirable in the case of evaluating the impact of new fisheries on VMEs. Implementation of the fishing plan structure described above would likely place a considerable workload on observers on vessels engaged in these fisheries, however, this could be mitigated by the development of sub-sampling strategies.

Regarding the Exploratory Fishery Data Collection Form adopted by Fisheries Commission in 2009 and published in the 2010 NAFO Conservation and Enforcement Measures (FC Doc. 10/1), the Scientific Council **recommended** that:

a) Catches of the quantities of coral and sponges are requested to be recorded but this should be revised to live corals and sponges, in line with existing threshold regulations and recorded to species level when possible using the NAFO Coral Guide.

b) Zero catches of VME-indicator species (e.g. live coral and sponge) should be recorded.

c) Further, the distinction between actual and estimated weights needs to be clarified. Estimated weights presumably refer to weights raised from catch sub-samples (as opposed to guesstimates based on visual inspection). Given the threshold approach to monitoring presence/absence of VMEs, actual catch weights should be collected where possible.

d) Some gear types (e.g., bottom set longlines and gillnets) can take bycatches of corals and sponges. Therefore, general information on gear dimensions and amount of gear, irrespective of the specific gear type, are necessary parameters to record.

The coral guide for the NAFO region should allow consistency of reporting; corals should be identified and recorded to the lowest taxonomic level possible. A similar guide for the identification of sponges is currently being developed. Finally, there may be a need to clarify the time-line for reporting the contents of these forms to the NAFO Secretariat.

Risk assessment methods have not been discussed, but the method described in section 8.b.i can provide an initial avenue to explore these issues.

For item 8 b) - *In light of the use of existing encounter protocols in tandem with the closed areas for corals and sponges:*

i. assess new and developing methodologies that may inform the Fisheries Commission on any future review of the thresholds levels

Scaling-up of survey trawl catch quantities to commercial tows to produce threshold levels for corals and sponges have a number of problems. First, it assumes a linear relationship between the bycatch and tow distance/duration. Second, it assumes that the catchability is the same between research vessel trawls and commercial gear.

A new method involving simulation modeling on a GIS framework has been developed. This approach used research vessel survey data of sponge catches, as well as, fishing effort to simulate commercial fishery sponge bycatch. This model could be applied to coral or other bycatch. It will not address the issue of serious adverse impact of removals but it will allow impacts to be contextualized (e.g., as a proportion of total estimated biomass, or to estimate indirect effects). To apply this model to the NRA, an agreed upon set of gear descriptions and tow duration/lengths for each fishing fleet segment would need to be created. Further estimation of retention efficiencies of the different commercial gears and indirect effects of fishing will be needed to model effects of serious adverse impacts.

ii. review and report on new commercial bycatch information as it becomes available,

There were no new commercial bycatch data available. Scientific Council noted that lack of information on corals and sponges from commercial fisheries makes determination of encounter protocols much more difficult.

iii. in light of i) review the ability of the current encounter threshold values of 60 kg live coral and 800 kg sponge to detect new VME areas as opposed to cumulative catches of isolated individuals.

Scientific Council anticipates that the new methodology described in 8.b.i will allow for an evaluation of the current encounter thresholds in future, but this will require a discussion regarding the data input to use. Still, it will be difficult to evaluate the encounter threshold for live coral given the number of species present in the NRA and the large differences in their morphology and biomass. Given the identification of sea pens, small gorgonians, large gorgonians and black coral as components of VMEs, the same encounter threshold could cause significant adverse impacts to one group but not to another.

Further, encounter protocols are not gear specific, and different gears have different retention factors. Also, the fishing duration differs among fishing fleet segments. All of this information should be considered when developing a meaningful encounter threshold.

v) Seamount closures

Fisheries Commission requested: *Recognizing that areas closed to all bottom fishing activities for the protection of vulnerable marine ecosystems as defined in Article 15, including inter alia:*

- *Fogo Seamounts 1*
- *Fogo Seamounts 2*
- *Orphan Knoll*
- *Corner Seamounts*
- *Newfoundland Seamounts*
- *New England Seamounts*

and associated protocols for vessels conducting exploratory fishing in those areas, expire on December 31, 2010.

Mindful of the call for review of the above measures based on advice from the Scientific Council, Fisheries Commission requests that Scientific Council:

a) Review any new scientific information on the Fogo Seamounts 1, Fogo Seamounts 2, Orphan Knoll, Corner Seamounts, Newfoundland Seamounts and New England Seamounts which may support or refute the designation of these areas as vulnerable marine ecosystems.

b) Review any exploratory fishing activity on the seamounts in the context of significant adverse impact to vulnerable marine ecosystems and review current exploratory fishing data collection protocols operating in the seamount closure areas as defined in Article 15 for their usefulness in providing scientific information.

c) Review the potential for significant adverse impact of pelagic, long-line and other fishing gear types other than mobile bottom gear on seamount vulnerable marine ecosystems. (Item 9)

The Scientific Council responded:

For item 9a - *Review any new scientific information on the Fogo Seamounts 1, Fogo Seamounts 2, Orphan Knoll, Corner Seamounts, Newfoundland Seamounts and New England Seamounts which may support or refute the designation of these areas as vulnerable marine ecosystems.*

Scientific Council reviewed the limited information on Orphan Knoll, New England and Corner Rise seamounts that has been published since the seamount closures were put in place. After considering all the information that has accrued since the original decision to close the seamounts, as well as current understanding on the ecology of seamounts (structure and function) and the effects of human impacts on them, Scientific Council concludes that the available information supports the designation of these areas as vulnerable marine ecosystems.

For item 9 b - *Review any exploratory fishing activity on the seamounts in the context of significant adverse impact to vulnerable marine ecosystems and review current exploratory fishing data collection protocols operating in the seamount closure areas as defined in Article 15 for their usefulness in providing scientific information.*

To date, there have been no notifications to the NAFO Secretariat of exploratory fishing in the closed seamount areas, and Scientific Council is not aware of any current exploratory fishing data collection protocols that pertain only to seamounts. VMS data provided by the NAFO Secretariat indicated the presence of fishing vessels in the Corner Rise Seamount closed area during 2007 and 2009. Fishing has been reported to Scientific Council in NAFO Div. 6G in 2009 where Alfonsino (*Beryx splendens*) were reported as well as smaller catches of Black Cardinal Fish (*Epigonus telescopus*), Oilfish (*Ruvettus pretiosus*) and Smooth-hounds (*Mustelus mustelus*). This fishing was conducted using a midwater trawl gear. Fishing effort was 28 days. Length distributions for alfonsino for both sexes were reported with the smallest fish being 26 cm, but no other information was available to assess impacts. No coral/sponge bycatch was reported.

Item 8a reviews changes to exploratory fishing data collection protocols under the discussion of the fishing plans.

For item 9c - *Review the potential for significant adverse impact of pelagic, long-line and other fishing gear types other than mobile bottom gear on seamount vulnerable marine ecosystems.*

Evidence of fishing impacts by stationary gears (gillnets and longline) in deep-sea habitats, and subsequent coral bycatch, is well documented. The method of deployment of stationary gear (longlines, pots, and gillnets) is relatively consistent regardless of the area fished whether it is on the continental shelf, rise, slope or seamounts. Although fixed gears are stationary, spatial coverage can still be significant because the gear is linked. Crab pots can be deployed individually as seen in the Northwest Pacific, however, in the NL region, crab pots are linked together in ‘fleets’ with up to 50 pots per fleet. Coral bycatch occurs when the fleet is retrieved causing the crab pots to be dragged across the seafloor where the gear can ensnarl and entangle corals.

Benthic longlines are set as strings with a mainline consisting of hundreds of baited hooks, and can be anchored on one end or both. Impacts on sessile organisms occur as a longline string is retrieved. The mainline becomes taut creating a ‘clothes-line’ effect and anything in the path of the longline such as finger-shaped coral, will most likely be tipped, entangled, removed, or damaged during the retrieval process. This is particularly significant for large-fan corals that need to maintain an upright position (e.g. gorgonian corals). If the colony is damaged (e.g. branches severed) it may become more susceptible to parasitic organisms such as hydroids, or colonial sea anemones, which has been observed in Atlantic Canada.

Benthic gillnets have been shown to capture and damage corals as well. Benthic gillnets operate under the same principle as longlines, and can be comprised of fleets of many panels spread over many kilometers. Impacts on benthic sessile organisms occur when the gillnet panels are set close to or on the seafloor, and become entangled in large megafauna (corals and sponges). Gillnets are constructed of strong monofilament netting and is extremely durable. Once a gillnet becomes entangled, whether it be with the target species or not, the chances of release are low to nil.

For fixed gears in general, some mitigation can be achieved through the use of break-away ropes (a rope that breaks when the gear becomes snagged) but this does not eliminate the problem of the lost gear causing damage.

Concerns about the impact of pelagic or semi-pelagic fishing on and around seamounts include:

- Rapid depletion of indigenous populations of aggregations of deep-sea fish species vulnerable to fishing such as alfonsino (*Beryx* spp). It is known that pulse fishing for this species has occurred on seamounts in the NAFO area.

- The possibility of higher proportions of juvenile fish in catches.

- Occasional impact of fishing gear on benthic VMEs, particularly when fishing strategies involve fishing close to the sea bed on the summit and slopes of seamounts.

Despite their importance, the relationships between seamounts, pelagic fishing, pelagic species and benthic VMEs are not well understood. However, there is information that fishing has impacted on seamounts in the NAFO Regulatory Area. Twenty years (1976-1996) of significant effort in the area of the Corner Rise seamounts using both pelagic and bottom trawls is documented. Investigations of 5 seamounts in the Corner Rise complex using a remotely operated vehicle (ROV) documented pristine coral ecosystems, also found evidence of large-scale damage on the summits of Kükenthal peak and Yakutat Seamount.

Additionally, there may be an issue regarding real-time identification, monitoring and differentiation between pelagic and demersal fishing activity on seamounts.

Conclusion

There is a clear potential for fishing gears other than bottom trawling to produce significant adverse impacts on VME communities. Impacts are typically associated with 1) habitat destruction produced by the gear when in contact with the bottom, and 2) depletion of localized populations. Longlines, gillnets and traps, which are fixed gears, also move when they are being deployed and recovered. These manoeuvres can damage benthic structures and habitats. Given the slow growth/reproductive rates that characterize VME-forming species, these damages can accrue to constitute significant adverse impacts. In case of depletion/overfishing, localized populations are extremely sensitive to exploitation due to its life history characteristics/aggregating behaviour, and typically small population sizes. This type of impact is irrespective of the gear used, but is driven by the exploitation rates imposed, and it may apply to target and bycatch species.

vi) American plaice in Div. 3LNO

Noting the scientific advice provided in 2009 on American Plaice in Div. 3LNO, that the stock is estimated to increase and will likely surpass B_{lim} by 2010 under all fishing mortality scenarios considered (except for F_{lim}), Fisheries Commission requests the Scientific Council to conduct a full assessment in 2010, provide catch, biomass, and fishing mortality projections where possible, for as many years as the data will allow, at the following levels of fishing mortality: $F=0$; $F_{0.1}$; and F_{2009}, in addition to any projections that SC would find useful and provide a risk analysis as outlined in paragraph 5. (Item 12)

The Scientific Council responded:

The request for advice is addressed in the summary sheet "American Place in Div. 3LNO" under agenda item VII.1.b.

vii) Future management of Div. 3M shrimp

From the intersessional meeting of the NAFO Fisheries Commission in London, 16. November 2009:

The Fisheries Commission, at its intersessional meeting, noted that whereas the Scientific Council in its advice to the Fisheries Commission contained in Report of the Scientific Council Meeting, 21 - 29 October 2009 reiterated its September 2009 recommendation for 2010 and 2011 that the fishing mortality be set as close to zero as possible, the current Effort Allocation Scheme for 3M Shrimp Fishery allows for a high effort in the fishery.

Conscious of the efforts to reach agreed management measures based on the best available science, and challenges contained to reach consensus on the scope of possible adjustments of the current Effort Allocation Scheme or any specific quota allocation, the Fisheries Commission requests the Scientific Council to explore other possible mechanisms to assist in achieving the objective of sustainable management of the 3M shrimp, including but not limited to further seasonal or spatial closure of the fishery, gear modification, any additional requirements for scientific data reporting needed from the fisheries, or any other conservation or technical measure appropriate to achieving the objective.

The Fisheries Commission further requests the Scientific Council to explore the viability and usefulness of a second annual scientific survey in the spring season.

The Fisheries Commission requests the Scientific Council to consider these issues and report back to the Fisheries Commission at the Annual Meeting of NAFO in 2010. (Item 13)

The Scientific Council responded:

This request for advice is deferred to September 2010.

viii) Management Strategy Evaluations

Following the Fisheries Commission Working Group on Greenland Halibut Management Strategy Evaluation (WGMSE) in January 2010:

Scientific Council is requested to review and comment on the set of plausible operating models to be used in the evaluation of harvest control rules for Greenland halibut in Subarea 2 + Div. 3KLMNO by the FC WG. Two assessment methods are under consideration for conditioning operating models, SCAA and XSA. The operating models conditioned on SCAA should be reviewed by SC to determine their plausibility. A set of operating models conditioned on XSA have already been agreed by SC as plausible representations of the real system (NAFO SCR 09/37). If there are any changes or additions to these XSA-based operating models, SC should also review these.

All the operating models will be based on the same input data as the current base XSA model (CAV - current assessment view).

The use of SCAA in the MSE should be reviewed by the SC. The run referenced as "SCAA w. XSA data" in Figure 7 of SCR Doc 09/25 which used almost identical inputs to the current base XSA model, and the associated documents provide all specifications of the approach. For review purposes, these documents together with two further variants of the SCAA2 run will be provided. Both these variants will use exactly the same inputs to the current base XSA model, with one estimating the slope of selectivity at large age and the other setting this slope to be flat. Requests for possible further analyses regarding SCAA will be developed, if necessary, at the May meeting of the Working Group.

Recognizing the SC work schedule, SC is requested to conduct this review as soon as possible.

Scientific Council provided its advice to this request at its meeting held by correspondence in March-April 2010 (SCS Doc. 10/04).

ix) Mesh size in mid-water trawls for redfish

Fisheries Commission requests Scientific Council to examine the consequences resulting from a decrease in mesh size in the mid-water trawl fishery for redfish in Div. 3M, to 100 mm or lower. (Item 13 of 2009 FC request)

This request for advice is deferred to September 2010.

2. Coastal States

a) Request by Denmark (Greenland) for Advice on Management in 2011

i) Roundnose grenadier in SA 0+1

In the Scientific Council report of 2009 [*sic*. actually 2008], scientific advice on management of Roundnose grenadier in Subarea 0+1 was given as a 3-year advice (for 2009, 2010 and 2011). 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.* (Appendix V, Annex 3, Item 1)

The Scientific Council responded as follows:

The Scientific Council reviewed the status of this stock at this June 2010 meeting and noted that the Greenland survey in 2009 the biomass in Div. 1CD was estimated at 1 152 t. Despite the fact that the biomass has doubled compared to 2008 the biomass is still at the very low level seen since 1993, and there is no reason to consider that the status of the stock has changed. Therefore, Scientific Council has not changed its advice for 2011, that there should be no directed fishing for roundnose grenadier in SA 0+1 and that catches should be restricted to bycatches in fisheries targeting other species. The next Scientific Council assessment of this stock will be in 2011.

ii) Redfish and other finfish in SA 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 2008 given for 2009-2011. Denmark, on behalf of Greenland, requests the Scientific Council to *continue to monitor the status of Redfish (Sebastes* spp.*) and other finfish in Subarea 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.* (Appendix V, Annex 3, Item 2)

The Scientific Council responded as follows:

Redfish

Scientific Council reviewed the status of redfish stocks in SA 1 at this June 2010 meeting and noted that some increase has been seen in the indices in the Greenland deep-sea survey since 2008, and the EU-Germany survey since 2006. Recruitment has however been low since 2001. The Greenland groundfish/shrimp survey reveals the lowest biomass and abundance indices throughout its time series. With the extension of the indices including the 2009 survey, there is no basis for changes in the perception of the stocks. Both stocks are considered to be in a poor condition, and there is no reason to consider that the status of the resource has changed. Therefore, Scientific Council has not changed its advice for 2011, that there should be no directed fishery on demersal redfish in SA 1 in 2011 and that bycatches in the shrimp trawl fishery should be kept at the lowest possible level. The next Scientific Council assessment of these stocks will be in 2011.

Other finfish

Scientific Council reviewed the status of other finfish stocks as noted above at this June 2010 meeting and found there is no indication of change in the status of the stocks of American plaice, Atlantic wolffish and thorny skate in SA 1. These stocks remain depleted. Therefore, Scientific Council has not changed its advice for 2011, that there should be no directed fishery on American plaice, Atlantic wolffish and thorny skate in SA 1 in 2011 and that bycatches of these species in the shrimp fisheries should be kept at the lowest possible level.

The spotted wolffish stock has shown improvements since 2002 and is above or at average levels. There is not, however, a significant change in the state of the stock since the 2008 assessment. The Scientific Council is unable to advice on the catch level for spotted wolffish.

The next Scientific Council assessment of these finfish stocks will be in 2011.

iii) Greenland halibut in Div. 1A inshore

Advice for Greenland halibut in Subarea 1A inshore was in 2008 given for 2009-2010. Denmark, on behalf of Greenland, requests the Scientific Council to *provide advise on the scientific basis for the management of Greenland halibut in Subarea 1A inshore for 2011-2012.* (Appendix V, Annex 3, Item 4)

The Scientific Council responded as follows:

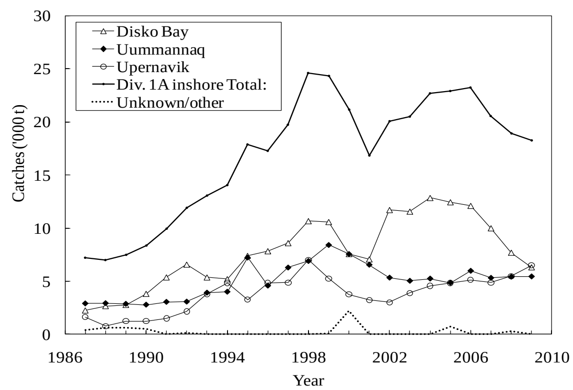
Greenland Halibut in Division 1A inshore

Background: The inshore stock is dependent on the spawning stock in Davis Strait and immigration of recruits from the offshore nursery grounds in Div. 1A and 1B. Only sporadic spawning seems to occur in the fjords, hence the stock is not considered self-sustainable. The fish remain in the fjords, and do not appear to contribute back to the offshore spawning stock. This connection between the offshore and inshore stocks implies that reproductive failure in the offshore spawning stock for any reason will have implications for the recruitment to the inshore stocks.

Fishery and Catches: Total landings in all areas combined have increased gradually since the late 1980s and peaked in the late 1990s at a level of 25 000 t. Landings then decreased to 16 900 t, but increased again during 2002-2005 reaching 23 000 t. Since 2006 landings have decreased again to a level of 18 300 t, and this decrease is caused exclusively by decreasing catches in the Disko Bay, where landings have decreased from above 12 000 t to just 6 321 t in 2009. Landings in the Uummanaq fjord has been at a level of 5 000 t since 2002 and in Upernvavik landings have increased since 2002 from 3 000 t to 6 498 t in 2009.

		Catch ('000 t)	TAC ('000 t)	
Area	Year	STACFIS	Recomm.	Agreed
Disko Bay	2007	10.4	ni[2]	
	2008	7.7	ni[2]	12.5
	2009	6.3	8.8	8.8
	2010		8.8	8.8
Uummannaq	2007	5.3	5.0	
	2008	5.4	5.0	5.0
	2009	5.5	5.0	5.0
	2010		5.0	5.0
Upernavik	2007	4.9	na[1]	
	2008	5.5	na[1]	5.0
	2009	6.5	na[1]	5.0
	2010		na[1]	6.0

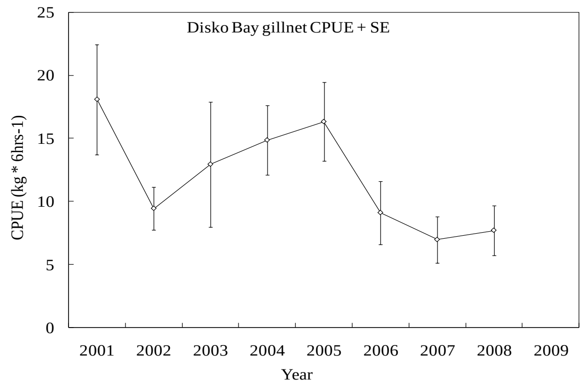
[1] No advice
[2] No increase in effort



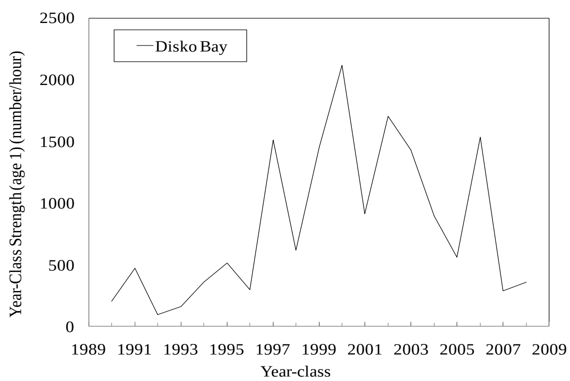
Data: Length frequencies from the commercial fishery were available for all three areas, except for the summer fishery in Uummannaq in 2009. Catch-at-age was available from 1988 to 2009 although with years missing especially for Upernavik. Catch and effort data provided from the Upernavik area allowed for a un-standardized CPUE index to be developed, although only covering fishery since 2007. Survey catch rate and length frequency data from the longline survey in Uummannaq was only available until 2007 and from the gillnet survey in Disko Bay until 2008. A biomass and abundance estimate and a recruitment index for age 1 was available from the shrimp/fish trawl survey in Disko Bay.

Assessment: No analytical assessment could be performed.

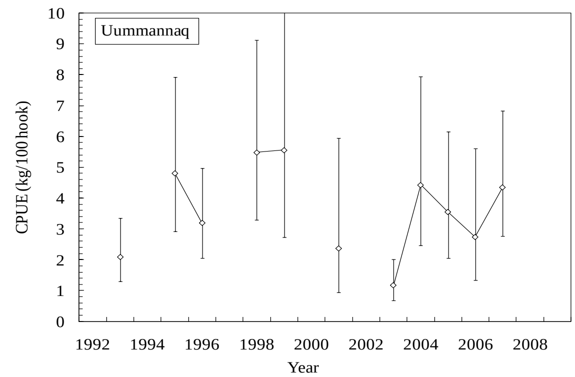
Disko Bay: From 2002 to 2006 catches were at a record high level above 12 000 t, but decreased in just 3 years to just 6 321 t in 2009. Mean length in the catches decreased from 2001 to 2007, but has increased since then and percentage of age-class 10 and younger has increased since 2002 to 90%. The gillnet survey (2001-2008) shows decreasing CPUE and NPUE from 2005 to 2007, but the 2008 estimates are at the same level as in 2007.



The abundance and biomass indices from the Greenland shrimp/fish trawl survey, declined significantly from 2004 to 2008, but seem to have stabilized in 2009. Recruitment indices in 2008 and 2009 of age 1 are below average, but since 2000 recruitment of age 1 has been well above average. The increase in mean length in the commercial catches seen since 2007 could be caused by year-classes from the high recruitment period entering the fishery.



Uummannaq: Landings have remained stable since 2002 and longline-survey abundance indices indicated a stable stock until 2007. Mean lengths in the summer fishery has decreased since 2004 and the winter fishery since 2007. Percentage of age 10 and younger in the catches has increased since 2002 to 80%.



Upernavik: Surveys have not been conducted since 2000 in the Upernavik area. Samplings from the commercial fishery have been sporadic from 2002 to 2007. However, with the extensions of the sampling in 2008 and 2009, mean length in the commercial landings seems to have been stable since 1999. Percentage of age 10 and younger is around 50 %. The un-standardized CPUE index from the commercial fishery is too short to determine trends.

State of the Stock: Except for Upernavik the age compositions in catches have been reduced to fewer and younger age groups compared to the early 1990s and the fishery has thus become more dependent on incoming year-classes.

Disko Bay: The CPUE and NPUE indices from the gillnet survey declined from 2005 to 2007 but stabilized in 2008. The abundance and biomass indices from the Greenland shrimp/fish trawl survey, declined from 2004 to 2008, but seem to have stabilized in 2009. Recruitment indices in 2008 and 2009 of age 1 are below average, but from 2000 to 2006 recruitment of age 1 was well above average. The increase in mean length in the commercial catches seen since 2007 could be caused by year-classes from the high recruitment period entering the fishery. However the decreasing catches and survey indices indicate a decreasing stock.

Uummannaq: Landings have remained stable since 2002. The survey indices indicate a stable stock until 2007. The steady decrease in mean length of the commercial catches since 2007 and the increase in percentage of age 10 and younger could indicate a decreasing stock but could also be caused by incoming year-classes.

Upernavik: Mean length in the commercial landings has been stable since 1999. Percentage of age 10 and younger in the catches is less than prior to 2001.

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

Disko Bay: Exploitable biomass has shown a decreasing trend since 2005 following some years with high catches and low recruitment. An extended period of higher recruitment is expected to enter the fishery in the coming years. However, until this is fully confirmed in the assessment, Scientific Council recommended that catches in 2011-12 should not exceed the mean catch level of the resent 2007-2009 period. Scientific Council therefore recommended that catches in 2011-12 should not exceed 8 000 t/yr.

Uummannaq: Based on the stable catches and CPUE indices Scientific Council found no reason to consider that the status of the stock has changed. Therefore Scientific Council recommended that catches for 2011-2012 should not exceed 5000 t/yr.

Upernavik: Given the short time-series of the CPUE index, the index could not be used for advice. No advice can be given for this area.

Reference Points: not determined.

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

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

Sources of Information: SCR Doc. 10/30, 43; SCS Doc. 10/12.

b) Request by Canada and Denmark (Greenland) for Advice on Management in 2011

The Scientific Council noted that the requests for advice on northern shrimp (northern shrimp in Div. 3M and Div. 3LNO) will be undertaken during Scientific Council meeting in October 2011.

Canada (Appendix V, Annex 2, Item 1a) and Denmark (on behalf of Greenland) (Appendix V, Annex 3, Item 3) as regards Greenland halibut in SA 1, requested Scientific Council to *provide advice on appropriate TAC levels for 2011, separately, for Greenland halibut in the offshore area of Divisions 0A+1AB and Divisions 0B+1C-F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.*

The Scientific Council responded as follows:

Greenland halibut in SA 0 + Div. 1A offshore and Div. 1B-1F

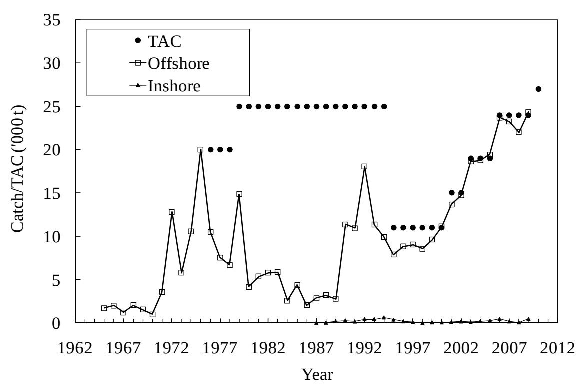
Background: The Greenland halibut stock in Subarea 0 + Div. 1A offshore and Div. 1B-1F is part of a common stock distributed in Davis Strait and southward to Subarea 3. Since 2002 advice has been given separately for the northern area (Div. 0A and Div. 1AB) and the southern area (Div. 0B and 1C-F).

Fishery and Catches: Due to an increase in offshore effort, catches increased from 3 000 t in 1989 to 18 000 t in 1992 and remained at about 10 000 t until 2000. Since then catches increased gradually to 24 800 t in 2009 primarily due to increased effort in Div. 0A and in Div. 1A.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21A	Recc.	Agreed
2007	23	23	24[2]	24
2008	22	15[1]	24[2]	24
2009	25	18[1]	24[2]	24
2010			27	

[1] Provisional

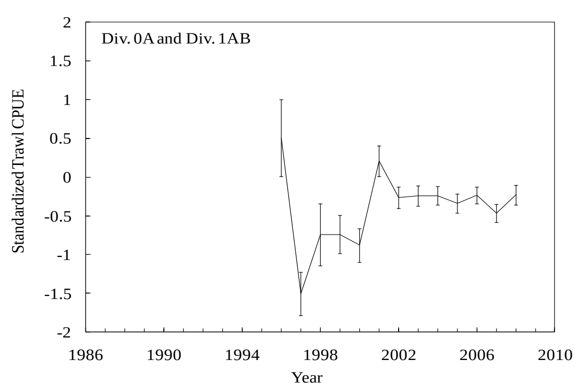
[2] Including 13 000 t allocated specifically to Div. 0A and 1AB since 2006.

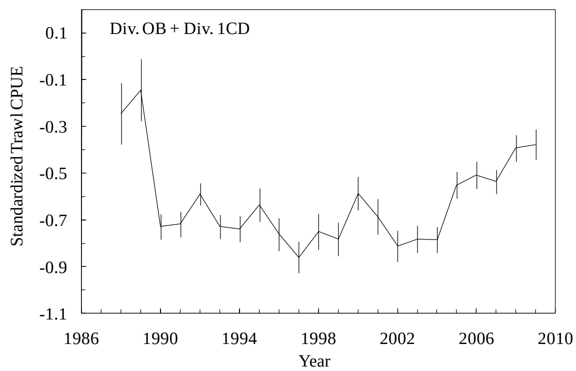


Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2009 were available from Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2009.

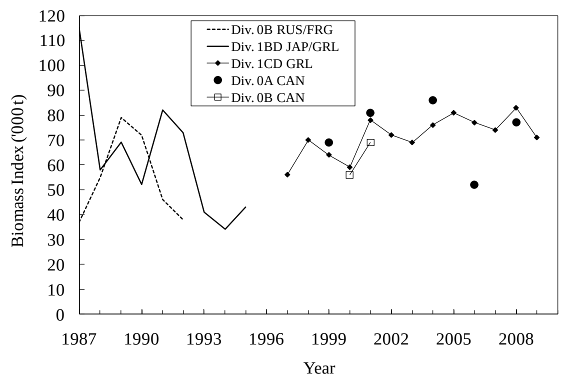
Assessment: No analytical assessment could be performed.

Commercial CPUE indices. Combined standardized catch rates in Div. 0A and Div. 1AB have been stable during 2002-2008. The combined Div. 0B and 1CD standardized catch rates have been stable during 2002 - 2004. Since then the standardized catch rates have increased gradually and were in 2009 at the highest level seen since 1989.

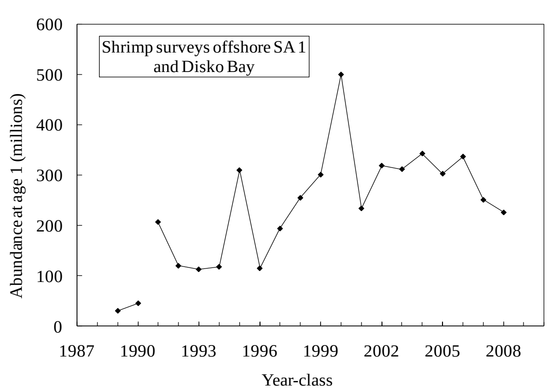




Biomass: The survey biomass in Div. 1CD increased gradually between 1997 and 2008, but decreased to 71 000 t in 2009 which is close to the average for the thirteen year time series. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has been gradually decreasing during 2004-2009 and was in 2009 slightly below the average for the time series (1991-2009).



Recruitment: The abundance of the 2000 year-class at age 1 in the entire area covered by the Greenland shrimp survey was the largest in the time series, while the 2002-2006 year-classes were well above average. The recruitment of the 2007 and 2008 year-class in the offshore nursery area (Div. 1A (South of 70°N) - Div. 1B) was below average.



Fishing Mortality: Level not known.

State of the Stock: Div 0A+1AB: Length compositions in the catches have been stable in recent years. Survey biomass in Div. 0A and CPUE indices in Div. 0A and 1AB have been stable in recent years.

Div. 0B+1C-F: Survey biomass in Div. 1CD has been stable and CPUE indices in Div. 0B and 1CD have shown an increasing trend in recent years and are at the level observed in the late 1980s.

Recommendation: Div 0A+1AB: Considering the relative stability in biomass and CPUE indices, for Greenland halibut in Div. 0A and 1AB Scientific Council advises that there is no basis to change advice for Div. 0A and Div. 1A off shore + Div. 1B for 2011 and the TAC should not exceed 13 000 t.

Div. 0B+1C-F: Taking into account the stability in biomass and the increasing trends in CPUE indices for Greenland halibut in Div. 0B and Div. 1CD Scientific Council advises that there is no basis to change advice for in Div. 0B and Div. 1C-F for 2011 and the TAC should not exceed 14 000 t.

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

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

Sources of Information: SCR Doc. 10/11, 30, 34; SCS Doc. 10/5, 8, 10, 12.

3. Scientific Advice from Council on its Own Accord

a) Oceanic (Pelagic) Redfish

Pelagic redfish (*Sebastes mentella*) in NAFO SA1 and SA2, and adjacent ICES areas V, VI and XIV, is not assessed by the NAFO Scientific Council. ICES receives a request from NEAFC each year to undertake an assessment and it is in the ICES North-Western Working Group (NWWG) that the assessment is made. NWWG met during 27 April - 4 May 2010 (ICES CM 2010/ACOM:07).

The "Workshop on Redfish Stock Structure" (WKREDS, 22-23 January 2009, Copenhagen, Denmark; ICES 2009) reviewed the stock structure of *Sebastes mentella* in the Irminger Sea and adjacent waters. ICES ACOM concluded, based on the outcome of the WKREDS meeting, that there are three biological stocks of *S. mentella* in the Irminger Sea and adjacent waters:

- a 'Deep Pelagic' stock (NAFO 1-2, ICES V, XII, XIV >500 m) - primarily pelagic habitats, and including demersal habitats west of the Faeroe Islands;

- a 'Shallow Pelagic' stock (NAFO 1-2, ICES V, XII, XIV <500 m) - extends to ICES I and II, but primarily pelagic habitats, and includes demersal habitats east of the Faeroe Islands;

- an 'Icelandic Slope' stock (ICES Va, XIV) - primarily demersal habitats.

Adult demersal *S. mentella* on the Greenland continental slopes (ICES XIV) is treated as a newly defined stock unit, however, stock structure is presently unknown and could be composed of various stock components (ICES Advice 2010, Book 2, p. 87).

Catch data as collated by NWWG for 2008 indicate, that for the deep pelagic stock of *S. mentella* catches of 30 000 t were entirely taken outside the NAFO Regulatory Area. For the shallow pelagic stock catches of 1 580 t were taken inside NAFO Subareas 1-2, whereas 428 t were taken outside NAFO Subareas. In 2009, NWWG data indicate no catches of pelagic redfish inside the NAFO Regulatory Area for either stock.

For the shallow pelagic stock, ICES advised on the basis of precautionary considerations that no directed fishery should be conducted and bycatch of this stock in non-directed fisheries should be kept as low as possible since the stock is at a very low state. A recovery plan should be developed (ICES Advice 2010, Book 2, p.70).

For the deep pelagic stock, ICES advised, that given the reduced abundance of this stock in recent years, a total catch limit of no greater than 20 000 t should be implemented in 2010, irrespective of whether a management plan has been developed by that time or not (ICES Advice 2010, Book 2, p. 79).

For the deep pelagic stock, ICES advised for the fisheries in 2011 on the basis of precautionary considerations that the fishery be reduced below the 2008 level to 20 000 t and that a management plan be developed and implemented. ICES suggests that catches of Deep Pelagic *S. mentella* are set at 20 000 t as a starting point for the adaptive part of the management plan (ICES advice 2010, Book 2, p.79).

In 2010 NAFO Scientific Council reviewed at its June meeting the ICES 2010 Advice to NEAFC for 2011 and supported the conclusion and advice. The Scientific Council recognizes that the catches in the NAFO area will be taken from the shallow pelagic stock, for which no directed fisheries has been advised.

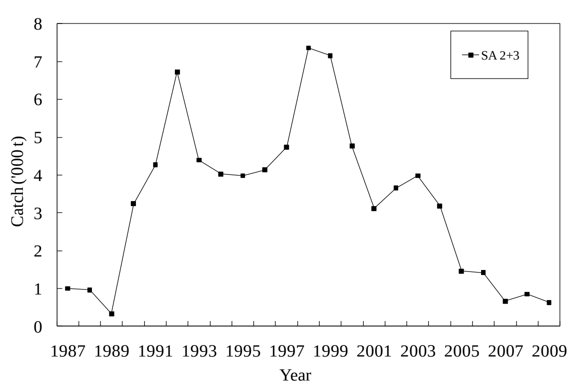
b) Roughhead grenadier in SA 2 + 3

Background: The stock structure of this species in the North Atlantic remains unclear. Roughhead grenadier is distributed throughout NAFO Subareas 0-3 in depths between 300 and 2 000 m. However, for assessment purposes, NAFO Scientific Council considers the population of Subareas 2 + 3 as a single stock.

Fishery and Catches: Roughhead grenadier is taken as by catch in the Greenland halibut fishery, mainly in NRA Divisions 3LMN. Most roughhead grenadier catches are taken by trawl and the only management regulation applicable to roughhead grenadier in the NRA is a general groundfish regulation requiring the use of a minimum 130 mm mesh size. A substantial part of the grenadier catches in Subarea 3 previously reported as roundnose grenadier has been roughhead grenadier. To correct the catch statistics STACFIS revised and approved roughhead grenadier catch statistics since 1987 for assessment purposes. Catches of roughhead grenadier increased sharply from 1989 (333 t) to 1992 (6725 t); since then until 1997 total catches have been about 4000 t. In 1998 and 1999 catches increased and were near the level of 7000 t. Since then, catches decreased to 3000-4000 t in 2001-2004 and to 700 t in 2007. A total catch of 847 t was estimated for 2008 and 629 in 2009. Most of the catches were taken in Div. 3LMN by Spain, Portugal and Russia fleets. In the catch series available, less than 2% of the yearly catch has been taken in Subarea 2.

	Catch ('000 t)	
Year	STATLANT 21A	STACFIS
2007	0.5	0.7
2008	0.4[1]	0.8
2009	0.7[1]	0.6
2010		

[1] Provisional

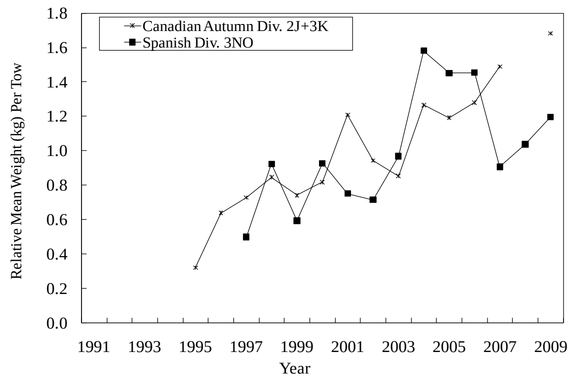


Data: Biomass indices were derived from: the Canadian stratified bottom trawl autumn surveys in Div. 2J and 3K since 1995, the Canadian stratified random bottom trawl spring surveys in Div. 3LNO since 1996 to 2006, the EU (Spain and Portugal) Flemish Cap survey in Div. 3M since 1991 and the Spanish Div. 3NO survey since 1997. Spanish Div. 3L survey are available for 2006-2009 but are not considered due to the short time series.

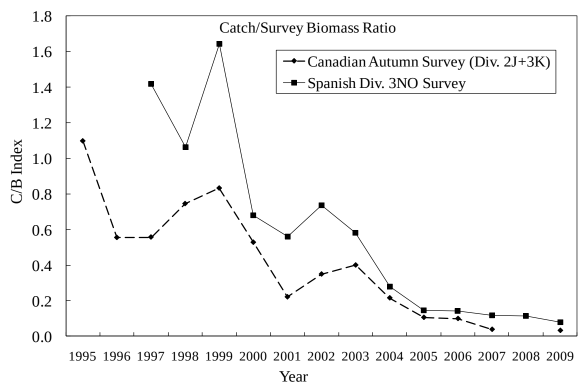
Catch-at-age data from the total catches in Div. 3LMNO are available since 1992. The period 2007-2009 were update based on the annual age length key (ALK) of Spanish commercial catches and Flemish Cap survey. Length frequencies from the EU-Spain, Russian and EU-Portugal trawl catches in Div 3LMNO are available since 1992, 1992 and 1996 respectively.

Assessment: Three different assessments were presented: Extended Survivors Analysis (XSA), a Stock-Production Model Incorporating Covariates (ASPIC) and a qualitative assessment based on survey and fishery information. XSA and ASPIC results were not accepted due to the low Fishing mortality estimated compared with the natural mortality level assumed in the case of the XSA and due to the lack of contrast in the data used in the ASPIC case. The qualitative assessment base on the Canadian autumn survey series (Div. 2J+3K) and the Spanish survey in Div. 3NO was considered as the best information to assess the stock status.

Biomass: Although the Canadian autumn 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 in resource status because their depth coverage is going down to 1 500 m. According with these surveys information the roughhead grenadier total biomass presents a general increased trend in the analyzed period and remains at the high level observed in the last years.



Fishing mortality: The catch / biomass (C/B) indices obtained using the Canadian autumn survey and the Spanish Div. 3NO survey biomass index show a clear decreasing trend from 1995 to 2009, due to an increasing trend in the survey biomass and a decrease in catches. In last year this ratio was at the lowest level of the time series with values of 0.03 for the Canadian autumn survey and 0.08 for the Spanish Div. 3NO survey. This low level is due to the fact that all surveys indices were at high 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 since 2005 in the Spanish 3NO and in the EU Flemish Cap surveys. The level of recruitment in recent years appears to be broadly similar to years other than 2004.

State of the Stock: Although the strong 2001 year class seems to be weaker than expected at older ages, the recent surveys biomass estimates still remain at high level.

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

Special Comments: It should be noted that the majority of the catches are constituted by immature fish.

The next full assessment will be held in 2013.

Sources of information: SCR Doc. 10/10, 21, 23, 32; SCS Doc. 10/5, 6, 7.

VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

1. Scientific Council, September 2010

Scientific Council noted that the Annual Meeting will be held 20-24 September 2010 at the World Trade and Convention Centre, Halifax, Nova Scotia, Canada.

2. Scientific Council, October 2010

The Scientific Council agreed that the dates and venue of the next Scientific Council /NIPAG meeting will be held from 20-27 October 2010 at the ICES Headquarters, Copenhagen, Denmark.

3. Scientific Council, June 2011

Scientific Council agreed that its June meeting will be held on 3-16 June 2011 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada, unless an invitation to host the meeting at another venue is received.

Scientific Council was informed at this June 2010 meeting, that The Director of the Institute of Sea Fisheries, Hamburg, EU-Germany, is extending an invitation to host the 2011 NAFO Scientific Council Meeting (3-16 June 2011) at the Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries, Institute of Sea Fisheries, Palmaille 9, 22767 Hamburg, Germany. Scientific Council extended their appreciation to the Director for the kind invitation and discussed the implications for selecting a new venue for the June 2011 meeting. Many participants noted advantages to holding the meeting in Europe. There are some logistical issues that need to be addressed. A decision has been deferred until the September 2010 meeting.

Scientific Council agreed that the June meeting 2011 should start on Friday 3 June to Thursday16 June.

4. Scientific Council, September 2011

Scientific Council noted that the Annual Meeting will be held on 19-23 September 2011. The meeting will be in Halifax, NS, Canada unless an invitation to host the meeting is extended by a Contracting Party.

5. Scientific Council, October 2011

The dates and venue of the Scientific Council/NIPAG meeting will be decided at the 2010 meeting. Provisional dates and venue are 19-26 October 2011. Invitations from Greenland and Norway are being considered as a venue for this meeting.

6. Scientific Council Working Groups

a) WGEAFM, December 2010

WGEAFM will meet at the NAFO Secretariat, Dartmouth, Canada, on 1-10 December 2010.

b) WGRP, March-April 2011

The next planned meeting of the working group on reproductive potential will take the form of a workshop to be held in March/April 2011.

7. ICES/NAFO Joint Groups

a) NIPAG, October 2010

The dates and venue of this NIPAG meeting will be 20-27 October 2010 at the ICES Headquarters, Copenhagen, Denmark.

b) WGDEC, March 2011

The **Working Group on Deep-water Ecology** will meet at ICES, Copenhagen, Denmark during March 2011.

c) WGHARP, August 2011

The next meeting of WGHARP is tentatively scheduled for the Russian Federation or the U.S. in August 2011.

d) NIPAG, October 2011

The dates and venue of this NIPAG meeting will be decided at the 2010 meeting. Provisional dates are 19-26 October 2011. Invitations from Greenland and Norway are being considered as a venue for this meeting.

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Topics for Future Special Sessions

a) Bayesian Methods Workshop, 2010

Scientific Council discussed "Bayesian methods" as a potential topic for a workshop in 2010. The Scientific Council Coordinator contacted various scientists that undertake assessments on NAFO stocks and found that 4-5 would like to attend a workshop on Bayesian methods. However, no experts came forward to develop and lead such a course. Owing to these difficulties, Scientific Council will no longer be holding this workshop. It is worth noting that ICES have held an introductory course on Bayesian inference in Fishery Science on 7-11 June 2010.

b) ICES/NAFO Hydrobiological Symposium, May 2011

The 2011 special session will be the ICES/NAFO symposium on “The Variability of the North Atlantic and its Marine Ecosystems during 2000-2009” that is due to be held on 10-12 May 2011. Steven Cadrin from the School of Marine Science, University of Massachusetts, USA, was proposed by the STACFEN Chair to represent Scientific Council as Co-Chair for this joint symposium. He has accepted this offer which was subsequently approved by the Scientific Council Executive Committee.

X. MEETING REPORTS

1. Report from WGHARP, August 2009

The Joint NAFO/ICES Working Group on Harp and Hooded Seals (WGHARP) met during 24-27 August 2009 at the ICES Directorate in Copenhagen, Denmark to consider recent research and to provide catch advice on the northeast Atlantic Ocean stocks of harp seals (*Pagophilus groenlandicus)*. In attendance were 10 scientists representing Canada, Denmark, Norway, Russia, and United States.

The WG reviewed data on catches, abundance estimates, and biological parameters of White Sea/Barents Sea and Greenland Sea harp seal stocks, and provided updated catch options in response to a 2008 request from Norway. The WG also received information on Northwest Atlantic harp seals, as well as Northwest Atlantic and Greenland Sea hooded seals *(Cystophora cristata)*. No requests were received from NAFO.

Northeast Atlantic harp seals

A survey of the White Sea/Barents Sea harp seal stock during March 2009 resulted in an estimate of 157 000 pups (SE = 17 000). This estimate is significantly lower than the estimates produced prior to 2004 (~300 000). The WG agreed that the survey appeared to have been carried out very well, although there were improvements in the reconnaissance efforts, evaluation of whelping, and survey timing (i.e. closely approximating the dates of surveys flown during 1998-2003). WG could not identify any obvious reasons for the change in pup production estimates since 2004 although a number of hypotheses exist including reduced adult recruitment due to past juvenile mortality, unobserved mortality of adults in recent years, or a shift in contemporary pupping to areas outside of the traditional areas. The high quality of the 2009 survey and the availability of recent data on reproductive parameters led the WG to conclude that the stock can now be classified as ‘Data Rich’. However, the precipitous decline in pup production after 2003 could not be accounted for by the existing NE model, and as a result the model greatly over-predicted pup production. Because of this, the NE model was considered inappropriate to provide catch options. The only alternative available was to provide sustainable catches option based upon the PBR approach (ICES 2006). Using this approach, the WG estimated that the TAC for the White Sea/Barents Sea harp seal stock should be 30 062 animals.

With respect to the Greenland Sea harp seal stock, new data were collected in 2009 on reproductive rates to supplement the Norwegian survey of pup production carried out during March-April 2007 (110 530 pups with a SE = 27 630). Because these new data are available, the WG considers the stock to be ‘Data Rich’ with abundance greater than N_{LIM}. Therefore, it was appropriate to use a population model to estimate abundance and evaluate catch options. Incorporating the recent survey estimates and reproductive data into the population model used previously produced a population estimate of 810 600 (std 185 030) animals for 2009, or 694 400 (std 165 680) age 1+ seals, and 116 600 (std 21 062) young of the year. Using this model, the WG suggests that a sustainable catch level would be either 49 801 (with a catch including 72.7% pups) or 30 865 (with only 1+ animals caught). Catches at this level will maintain the population at current levels over the next 10 years, while current catch levels (5 247 seals per year) will likely result in an increase in population size of 44% over the next 10 years. Catches 2x sustainable catches will result in the population declining 50-60% over the decade.

Northwest Atlantic harp and hooded seals

Catches

Harp seals - Although the Working Group did not receive any requests for advice on Northwest Atlantic populations of harp or hooded seals, it did review recent information on catches and research. A total of 354 867 harp seals were reported taken by commercial hunters in Canada during 2006. This exceeded the TAC (335 000) by 6%, although this assumes that 2 000 seals were taken in the Canadian Arctic which is double the level assumed to occur (Table 1). Catches were significantly reduced in 2007 (224 745, 83% of 270 000 TAC) due to the lack of ice in the southern Gulf and heavy ice off Newfoundland. Poor ice, offshore distribution and low prices also resulted in lower catches in 2008 with only 79% (217 850) of the TAC (275 000) taken. Catches in 2009 were extremely low, totalling only 72 407 seal (26% of the 280 000 TAC). This was primarily due to reduced effort owing to the low prices offered.

Data on catches in Greenland are usually available 1 to 2 years after the harvests. The most recent statistics (Table 1) indicate that Greenland harvests during 2005-2007 (82 800 - 92 200) were above the average for the past decade (~80 000). No new data are available on catches of harp seals in the Canadian Arctic. However, catches appear to be relatively low and a recent study indicates that current catches average less than 1 000 per year.

Given the reduced level of catches in Canada during the past two years, the high level of hunting in Greenland (including struck and loss) and the relative ages of seals taken in the two hunts, the current Greenland hunt may be having as great, or possibly even greater, impact on the population dynamics of Northwest Atlantic harp seals than the hunt in Canada.

Hooded seals - From 1998 - 2006, the Canadian total allowable catch for hooded seals (Newfoundland only) was set at 10 000 but was reduced to 8 200 for 2007-2009 as a result of new data on the status of the population and the adoption of the precautionary approach under Objective Based Fisheries Management (OBFM). The killing of bluebacks is prohibited in Canada. Catches of hooded seals (1+ only) have remained extremely low; since 2005, less than 50 hoods have been taken annually, with only 18 being reported in 2009. Catches in Greenland were between 1 000 and 2 000 between the mid 1950s and 1972. Since then catches have ranged from 3 000 - 10 000, being in the 6 000 - 7 000 range in most years. The most recent data indicates that 3,293 were taken in all of Greenland in 2007. With the exceptions of 1963-1982, when Canadian catches accounted for over 70% of the annual catches, Greenland accounted for over 65% of the hooded seals killed. In recent years, they have accounted for almost 100% of the catches.

Current research

Research on abundance, diet, reproductive rates, growth, condition and habitat use of both harp and hooded seals are continuing.

The results of the 2008 harp seal pup production surveys were not completed by the time of the meeting. However, it was reviewed at a meeting sponsored by Canada held in November 2009.

Estimates of recent diets, consumption and preliminary results of a model exploring the importance of harp seals and capelin on the population dynamics of Atlantic cod (*Gadus morhua*) were presented at a workshop on the impact of seals on Atlantic cod, held in Halifax, Canada in 2008. Changes in the population dynamics of Div. 2J3KL cod were explained by a model that incorporated fishing and capelin abundance; including harp seal predation did not improve the fit of the model.

Tables on (a) the reported catches of harp seals in the northwest Atlantic for 1952-2009, (b) the Canadian catches of hooded seals off Newfoundland and in the Gulf of St. Lawrence, Canada ("Gulf" and "Front"), 1946-2009, and (c) the catches of hooded seals in West and East Greenland 1954-2007, are provided in the 2009 WGHARP report (http://www.ices.dk/reports/ACOM/2009/WGHARP/WGHARP09.pdf).

2. Special Session in 2009: Symposium on "Rebuilding Depleted Fish Stocks", November 2009

The Symposium, Rebuilding Depleted Fish Stocks - Biology, Ecology, Social Sciences and Management Strategies, was held at the Yachthafenresidenz Hohe Düne in Warnemünde, Germany during 3-6 November 2009, and was co-convened by Cornelius Hammer (UNCOVER Project Leader and Director, Johann Heinrich von Thünen-Institut, Institute of Baltic Sea Fisheries, Rostock, Germany), Gordon Kruse (University of Alaska Fairbanks, Juneau, Alaska, USA), Olav Sigurd Kjesbu (Institute of Marine Research, Bergen, Norway), and Peter Shelton (Fisheries and Oceans Canada, Science Branch, St John's, NL, Canada). The Symposium was attended by more than 120 participants from 21 countries including Argentina, Canada, Estonia, Denmark, France, Germany, Iceland, Iran, Japan, Namibia, New Zealand, Norway, Poland, Russia, Scotland, Spain, Sweden, The Netherlands, Turkey, United Kingdom, and the United States of America. Participants also included representatives from the Baltic Fishermen's Association, European Union Commission, International Commission for the Conservation of Atlantic Tunas, Food and Agriculture Organization of the United Nations, International Council for the Exploration of the Sea, Organization for Economic Cooperation and Development, and the World Wildlife Fund for Nature. The Scientific Steering Committee for the Symposium comprised 12 individuals (and I was the one member representing NAFO). Selected papers from the Symposium will be published in a special issue of the ICES Journal of Marine Science subject to a full peer-review process. The Scientific Steering Committee and the four Symposium Co-Conveners will decide on the papers accepted for review. The Guest Editor, Niels Daan (The Netherlands) is responsible for the review process and is the final authority concerning the papers accepted for publication.

The Symposium Keynote Address was presented by Dr. Steven Murawski (Director of Scientific Programs and Chief Science Advisor for NOAA Fisheries, USA) and was entitled "Rebuilding Depleted Fish Stocks: The Good, the Bad, and the Mostly Ugly". Dr. Murawski summarized the current state of fish stock rebuilding plans worldwide, noting the plans could be categorized into those that were successful in meeting their objectives (the 'good'), those that were 'paper plans' despite assertions to the contrary (the 'bad'), and those that have been partially to completely unsuccessful despite significant management interventions (the 'ugly'). A fourth category consists of those plans for which categorization is presently too early (the 'incomplete'). Dr. Murawski elucidated the characteristics and attributes of 'good' and 'bad' rebuilding plans, and described the wide array of management measures used in these endeavors. He noted that even when 'good' rebuilding programs had been implemented (involving significant reductions in fishing mortality), some stocks had not responded - or responded more slowly than anticipated. In these cases, a variety of explanations have been offered for the absence or delay in recovery including dispensatory natural mortality rates, predator 'pits', climate effects, loss of evolutionary resilience, multispecies effects, and an inability to regain complex life-cycles determined by species co-evolution, migration patterns, and demography. It was noted that most 'good' plans have generally been those for single-species fisheries, and that a challenging problem is the differential pace of stock recovery among productive and relatively unproductive components of mixed species fisheries (where 'weak stock' recovery schemes may leave recovered or healthy components underfished due to bycatch concerns). He concluded his presentation by highlighting that recovery of 'overfished' stocks will require a more holistic, adaptive, and ecosystem-based approach to rebuilding that incorporates trophodynamics, habitat restoration, and climate effects - and one which is also sensitive to life history and the impacts of fisheries on stock resilience. He emphasized that a more consistent, effective, and politically-supported recovery paradigm was necessary if society was to meet its sustainability goals for fisheries.

The remainder of the Symposium considered recent scientific research and advances related to the status and recovery of overexploited and depleted fish stocks, focusing on sharing ideas and experiences (across disciplines and among stakeholders) related to biological and ecological evaluations of stock recovery and socioeconomic and management aspects of stock rebuilding. The entire Symposium was held in plenary (i.e., no concurrent sessions) and comprised five themes:

1. The Impact of Fisheries and Environmental Impacts on Stock Structure, Reproductive Potential and Recruitment Dynamics: Chaired by Toyomitsu Hori (Japan) and C. Tara Marshall (Scotland)

2. Trophic Controls on Stock Recovery: Chaired by Axel Temming (Germany) and Bjarte Bogstad (Norway)

3. Methods for Analyzing and Modelling Stock Recovery: Chaired by Ana Parma (Argentina) and Laurence Kell (Spain)

4. Social and Economic Aspects of Fisheries Management and Governance: Chaired by Denis Bailly (France) and Douglas Wilson (Denmark)

5. Management and Recovery Strategies: Chaired by Joseph Powers (USA) and Fritz Köster (Denmark)

Each Theme Session opened with a keynote address by an invited speaker, which was then followed by 9-11 contributed oral presentations. In total, 53 papers were orally presented in the five sessions. As well, a formal poster session comprising 28 posters was held on the evening of the third day of the Symposium (although the posters were on display during the entire Symposium).

The final day of the Symposium included a Panel Discussion, which involved a moderator (Ralf Röchert, Germany) and eight international experts representing science, the fishing industry, NGO conservation groups, and management authorities (Michael Anderson, Baltic Fishermen’s Association; Kevern Cochrane, FAO; Poul Degnbol, EC DG MARE; Gordon Kruse, University of Alaska Fairbanks; Philippe Moguedet, EC DG Research; Karoline Schacht, WWF Germany; and Peter Shelton, DFO Canada). The Panel Session was divided into five blocks (representing the five theme sessions), each opened with a brief summary by the corresponding Session Chairs of the principal findings of his/her theme session, followed by discussions and comments by the Panel members and by the audience.

For the final wrap-up, the Symposium Keynote Speaker, Dr. Steven Murawski, provided his observations on the key take-home messages from the Symposium. Among the points highlighted were:

1. There is currently available a rich knowledge of stock rebuilding experiences to draw upon.

2. Now is a critical time in the recovery debate, but more information is needed on socioeconomic considerations/impacts, and more interactions are needed with stakeholders. There is a need to clearly describe downside losses and upside benefits of recovery programs.

3. Stock recovery plans represent the most widespread wildlife planning experiments available anywhere. As such, it is imperative that these plans be documented, archived, and the experiences with these plans communicated to all.

4. We need to think carefully about stock recovery as the end points may not be well known. Hence, an adaptive approach may be essential.

5. Significant investments will be required in fishery science in the future. The current models to assess stocks were developed when fishing mortality rates were generally between F= 0.3-0.8. However, new assessment tools will be needed when stocks are managed at much lower rates (e.g., F=M). As well, given reduced exploitation rates in the future, there is likely to be a much greater need to move from recruitment surveys to the surveying of adults. Clearly, fishery science will need to more integrated in the future and explicitly incorporate habitat, environmental, and ecosystem aspects.

6. The human and economic costs of stock recovery to society need to be documented and communicated. Recognition of the considerable costs and resources involved in recovery efforts should help management to vigorously avoid stock collapses in the future.

7. Stock recovery invariably implies fewer fishermen in the future and significant transition costs. This should be understood and anticipated far in advance. It is also important that any resultant replacement activities of fisheries

(e.g., tourism; waterfront housing development; etc.) should not interrupt or impede stock recovery efforts by their resultant impacts.

8. While stock rebuilding may be possible, stock recovery may not. If fisheries-induced evolutionary changes have occurred, or if ecosystem and climate changes have significantly altered the productivity, demography, or dynamics of depleted fish stocks, restored stocks (in terms of biomass) may differ markedly (i.e., genetically, physiologically, and ecologically) from their status prior to depletion. In some cases, recovery to former biomass levels may not even be possible.

9. Uncertainties will always exist with respect to the stock rebuilding/stock recovery process. These uncertainties should not undermine the development and implementation of recovery plans. A precautionary and adaptive approach may be required to avoid delays in taking effective action, not only for stocks already in dire straits, but to keep those that are beginning to show signs of reduction from becoming depleted.

10. The current evidence is overwhelming that management can be effective in rebuilding of fisheries and restoring the economic and social benefits derived from sustainable fisheries.

The Symposium was closed at 1:00 PM on 6 November by Cornelius Hammer who thanked the Co-Conveners, the Session Chairs, the presenters, and all of the Symposium participants for their contributions. He also wished everyone a safe trip home, and indicated that the intended publication of Symposium papers in the ICES Journal of Marine Science was within a year.

The Symposium Program and other details are available at http://www.uncover.eu/index.php?id=180.

NAFO was a co-sponsor of this symposium and provided a financial contribution. Peter Shelton (Canada) represented NAFO as a co-convenor of this symposium and Fred Serchuk (USA) represented NAFO on the steering committee.

3. Working Group on EAFM, February 2010

The Scientific Council Working Group on Ecosystem Approaches to Fisheries Management (WGEAFM), met at the Institute of Marine Research, Vigo, Spain on 1-5 February 2010. The final report of this meeting is in draft form and could not be presented at this time. However, a summary was presented to highlight the main conclusions and to submit revised ToRs to Scientific Council that are consistent with a proposed roadmap towards an Ecosystem Approach to Fisheries (EAF) framework for NAFO developed at the meeting.

The goals of the meeting were to:

- To further advance our understanding on how the NAFO ecosystems work, how they are regulated, and how they respond to different types of perturbations.
- Use this knowledge to explore the concept of EAF, and to develop how it could be applied within NAFO.
- To address specific requests from Scientific Council.

The general ToRs for WGEAFM were approved by Scientific Council in June 2009 and were intended to guide the future work of WGEAFM in three thematic areas. In addition to these general ToRs, Scientific Council also included two Fisheries Commission Requests for Advice (Items 8 and 9) as specific ToRs for the group to address at this meeting. The ToRs and progress made were:

Theme 1: Take stock of past and planned WGEAFM related work

ToR 1. Update on identification and mapping of sensitive species and habitats in the NAFO area.

Analysis to improve/broaden previous work

The density-area method developed by WGEAFM (Kenchington *et al.*, 2009) and previously applied to identify locations of high concentrations of sponges (NAFO 2009) was used to identify locations of high concentrations of pennatulaceans (Murillo *et al*,. 2010). The analysis indicated that the general zones of high concentrations of seapens identified by WGEAFM using cumulative distribution analyses (NAFO, 2008a) were consistent with the results obtained with the new method; in addition, the new analysis allowed identifying 29 more individual tows that can be considered indicative of key locations (Murillo *et al*. 2010).

Update on ongoing survey/analysis

Several ongoing research activities are expected to generate data and produce analyses that will contribute towards achieving WGEAFM ToRs in the future. These activities included the ongoing NEREIDA cruises focused on the identification and delineation of VMEs and VME-defining species, the collection and identification of sponges in the 2009 Greenland demersal survey, and the activities being carried-out by the DFO Ecosystem Research Initiative (ERI) in the NL region (NEREUS program).

In 2009, the NEREIDA-related work involved surveys in the Flemish Cap, carried-out by the Spanish RV *Miguel de Oliver* and Canadian RV *Hudson*, and in the Scotian Shelf, by the Canadian RV Hudson. These surveys used an assortment of tools (e.g. multibeam acoustics, corers, ROVs) to collect detailed and precise information on the bathymetry, bottom structure, and benthic organisms. There are also plans to continue this work in 2010; detailed information on the planned survey to the Orphan Knoll by the RV *Hudson* was also presented.

Among ERI-NEREUS activities, preliminary results from the analysis of acoustic data collected during the 2008 Div. 2J3KLNO DFO autumn Multispecies Survey were introduced and discussed. These preliminary results were encouraging with respect to the possibility of improving assessment of pelagic species (e.g. capelin) by gathering acoustic data during regular bottom-trawl surveys. A first description of the results from a bottom-grab sampling program carried out during the DFO Div. 3LNO Spring survey was also presented. This work is beginning to provide a large scale picture of benthic communities in the Grand Bank that is expected to serve as baseline for detecting changes over time.

Theme 2: Status and functioning of NAFO marine ecosystems (empirical evidence)

ToR 2. Synthesis of current understanding of the dynamics of Large Marine Ecosystems (LMEs) in the NAFO area.

A summary of the current status of commercial stocks managed under NAFO was presented. Similarly, current status of marine mammal species in the NAFO area was described, with notes on a recent aerial survey that is generating the first point estimates of abundance for many cetacean species in the region. Analyses of the changes in the fish communities of the Newfoundland and Labrador (NL) Shelf, and the Flemish Cap ecosystems described and highlighted the major changes observed in these systems. In the case of the NL shelf, a preliminary analysis of common drivers in the trajectories of key fish species suggested that fisheries have been, and continue to be, important drivers in the NL ecosystem, but also indicated that environmental forcing is also important to explain the dynamics of these species. A summary of some results from the recent work done by the ICES Working Group on Holistic Assessment of Marine Ecosystems (WGHAME) was also presented and discussed (ICES, 2009). Overall, the results and analyses examined by WGEAFM support the concept that the dynamics and status of ecosystems as a whole are significantly affected/driven by large scale environmental processes (i.e. major system-wide trends, regime shifts), but where fishing can also have a powerful impact, and severe/rapid changes can occur when both driving forces act in conjunction.

ToR 3. Scope of Marine Protected Areas and VMEs in the context of habitat and spatial functioning.

Preliminary results from a GIS-based analysis aimed to delineate regional ecosystem sub-units in the Scotian Shelf were presented (SCR Doc. 10/06). This work follows a similar method to the one used in the Northeast continental shelf of the US and described in the first WGEAFM report (NAFO, 2008b). Using Georges Bank as study case, analyses on the efficacy of MPAs as management tool were presented and discussed. This work indicated that MPAs can be useful tools but they also can produce unintended consequences (e.g. effort displacement), and hence, their effects at the ecosystem level need to be closely monitored. Finally, some work done by ICES WGHAME on scale and resilience (ICES, 2009) was presented. This work suggests that ecosystem resilience can be scale-dependent, where large scale systems, considered as a whole, might be more resilient than sub-regional communities within them.

Theme 3: Practical application (synthesising the evidence and theory)

ToR 4. Systems level modelling and assessment approaches.

A brief description of the modelling work involved in ERI-NEREUS was provided. This work mainly involves bioenergetic-allometric models, but these range from single-species with forcing functions up to multispecies models. A summary of ongoing work towards developing Integrated Ecosystem Asssements (IEAs) in ICES and US were also provided. Although not identical, these approaches showed a high degree of similarity and were considered useful building blocks for WGEAFM. Equally useful was a summary on the options for implementing EBM currently under consideration for the Northeast Continental Shelf of the US. These elements were used for developing the roadmap for developing EAF for NAFO (see below)

ToR 5. Ecosystem indicators and how they can be used in management advice.

Although this ToR was only minimally addressed at the meeting, still a brief summary on the use of ecosystem indicators in ICES and US contexts was provided.

ToR 6. Methods for the long-term monitoring of VME status and functioning.

This ToR was addressed as part of ToR 7

Additional Items from Scientific Council and Fisheries Commission (placed in ToRs)

In addition to the long-term ToRs, WGEAFM also addressed some specific additional requests. These included one ToR directly requested by Scientific Council (ToR 7), and two ToRs based on Fisheries Commission requests to Scientific Council (ToRs 8 and 9). WGEAFM incorporated and addressed these last two ToRs at request of the Scientific Council chair.

ToR 7. Scientific Council addition: Monitoring methods for VMEs and historical link between fishing effort and VMEs.

A summary of possible methods for monitoring VMEs was presented, where different alternatives were identified and discussed. Comparisons between fishing footprint and locations of high concentrations of VME-indicator species were performed. Most of the significant catches of VME indicator species were recorded in RV tows carried out in areas within the footprint that have been only lightly fished or not fished at all.

ToR 8. Fisheries Commission request 8. Assessment of significant adverse impacts on VMEs, revision of bycatch data and assessment of thresholds in encounter protocols.

This Fisheries Commission request was addressed at the WGEAFM meeting; the result of this work was considered by SC when preparing its advice to Fisheries Commission.

ToR 9. Fisheries Commission request 9. Seamounts: new information, review of exploratory fishing and usefulness of the protocols, and evaluation of impacts on seamount VMEs by gears other than mobile-bottom.

This Fisheries Commission request was addressed at the WGEAFM meeting; the result of this work was considered by Scientific Council when preparing its advice to Fisheries Commission.

The advice by Scientific Council on the Fisheries Commission requests 8 and 9 is given under agenda items VII.1.d.iv and v.

Based on the information available, WGEAFM develop a roadmap for developing an EAF for NAFO. This roadmap identifies core features and guiding principles for the process of developing a NAFO EAF framework.

Summary of the Roadmap for Developing an Ecosystem Approach to Fisheries for NAFO

An EAF for NAFO should be: a) objective driven, b) focused on long-term ecosystem and stock sustainabilities, c) place-based, and d) addressing trade-offs among human activities explicitly.

At the core of EAF there is a need for developing Integrated Ecosystem Assessments (IEAs), where IEA can be defined as “a synthesis and quantitative analysis of information on relevant physical, chemical, ecological, and human processes in relation to specified ecosystem management objectives” (Levin *et al*., 2009).

When EAF implementation is considered, IEA can be linked to three practical sets of activities: a) definition of geographical management units, b) determination of ecosystem state and function, and c) development of management tools.

In this context, implementation requires the definition of regional ecosystem units which, in conjunction with jurisdictional and resource users information, will provide the background required to identify suitable ecosystem management units.

In terms of ecosystem state and function, it is considered that overall ecosystem productivity is limited and bounded by large scale forcers; therefore, ecosystem fishery production potential is dependent on ecosystem state. Achieving ecosystem sustainability would require state-dependent ecosystem fishery production to be allocated among target species considering species interactions both in terms of ecosystem goods (e.g. fisheries yields) and ecosystem services (e.g. the role of biodiversity as a “mechanism” for maintaining ecosystem resilience), noting that multispecies maximum sustainable yields are typically less than the summation of the corresponding single-species ones. This implies that trade-offs among fisheries need to be identified, as well as, clear objectives defined. Since all the above considerations may not fully capture species-specific biological and life history features, stock sustainability needs to be evaluated on the basis of single-species assessments. A three Tier hierarchical process was developed based on these premises, going from overall to single-species yields.

For the most part, the management toolbox is essentially the same (there are only so many things that can actually be controlled), but these tools will be use with a different set of objectives and priorities. Still, new tools and outputs will be required to address trade-offs and inform managers and stakeholders about them. Based on the results obtained, regulatory frameworks and/or mechanisms for management integration between coastal states and NRA will need to be examined by contracting parties.

Update of the ToRs for WGEAFM

Based on the EAF Roadmap, the long term ToRs for WGEAFM were redefined as follows:

<u>Theme 1: Spatial considerations</u>

ToR 1. Update on identification and mapping of sensitive species and habitats in the NAFO area.

ToR 2. Based on available biogeographic and ecological information, identify appropriate ecosystem-based management areas.

<u>Theme 2: Status, functioning and dynamics of NAFO marine ecosystems.</u>

ToR 3. Update on recent and relevant research related to status, functioning and dynamics of ecosystems in the NAFO area.

<u>Theme 3: Practical application of ecosystem knowledge to fisheries management</u>

ToR 4. Update on recent and relevant research related to the application of ecosystem knowledge for fisheries management in the NAFO area.

ToR 5. Methods for the long-term monitoring of VME status and functioning.

Theme 4: Specific requests

ToRs 6+. As generic ToRs, these are place-holders intended to be used when addressing expected additional requests from Scientific Council.

Next WGEAFM meeting date and venue

WGEAFM proposed to meet at the NAFO Secretariat, Dartmouth, on 1-10 December 2010, when they will focus on *Theme 1: Spatial Considerations* and *Theme 4: Specific requests*.

Scientific Council considerations with regards to WGEAFM activities

Scientific Council took notice of the progress made by WGEAFM. The information presented allowed Scientific Council to endorse the path described in the roadmap for EAF, and on that basis, approved the updated ToRs as well as the plan for a next meeting in December 1-10 2010 at the NAFO Secretariat.

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4. Working Group on Reproductive Potential, March 2010

Progress of the NAFO Working Group on Reproductive Potential was provided by E.A. Trippel (Chair). The Working Group is comprised of 21 members representing 10 countries (Canada, Denmark, Germany, Greece, Iceland, Norway, Russia, Spain, United Kingdom, and USA).

The 9th Meeting of the NAFO WG on Reproductive Potential was held at the Parthenon Hotel in Athens, Greece, March 15-19, 2010 to address the ToRs approved by Scientific Council in June 2008. There were 16 WG participants spanning 7 countries: Joanne Morgan (Canada), Olav Kjesbu (Norway), Rosario Dominguez (Spain), Loretta O'Brien, (USA), Yvan Lambert (Canada), Tara Marshall (UK), Rick Rideout (Canada), Jonna Tomkiewicz (Denmark), Hilario Murua (Spain), Peter Wright (UK), Alexandre Alonso-Fernández (Spain), Richard McBride (USA), Stylianos Somarakis (Greece), Fran Saborido-Rey (Spain) and Ed Trippel (Canada). A meeting of the EU

COST Research Network Action Fish Reproduction and Fisheries (FRESH) (Coordinator: Fran Saborido-Rey) was also held during this period. Mutual benefits of having the two groups meet together were achieved as both have complimentary science and management advice objectives. To facilitate this arrangement the meeting was co-chaired by Ed Trippel and Fran Saborido-Rey. Local arrangements were greatly appreciated for the meeting of 21participants (6 specific to FRESH) and were provided by Stylianos Somarakis and Katerina Anastasopoulou (Institute of Marine Biological Resources, Hellenic Centre for Marine Research, Crete Subdivision, Greece).

The objectives of the WG meeting were to address the proposed set of milestones and deliverables associated with each Term of Reference and document a list of proposed, ongoing and completed deliverables. The meeting was comprised of plenary and break-out group sessions, the former led by the Chairs and the latter by the ToR Co-Leaders. A larger than normal set of accomplishments has been achieved in the last year.

The joint meeting of FRESH and NAFO, permitted a broad spectrum of scientists to address the issues of relevance to NAFO Scientific Council. The synergy of work activities between these two scientific bodies has enhanced the progress made in this subject area. It was decided, due to the holding of the 9th meeting in March 2010, that it would be best to work intersessionally by correspondence during the summer and autumn of 2010 as a lead up to a workshop and symposium planned for early 2011 which are described below in the relevant ToR sections.

A brief summary of progress and future plans of each ToR are given below.

ToR 1: Explore and conduct evaluation of underlying assumptions of protocols used to estimate total realized egg production of selected marine species and stocks (Co-Leaders: Rick Rideout (DFO, Canada) and Rosario Dominguez (CSIC, Spain))

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

Establish Standard Operating Procedures:

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

- Evaluate histological techniques for assessment of atresia

Validation of Assumptions:

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

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

A number of primary publications have already been produced to address this ToR. Three extensive review papers targeted for the primary literature are planned and include the topic areas of (i) fish reproductive strategies (F. Sabordio-Rey), (ii) oocyte atresia (R. Rideout), and reproductive potential of indeterminate spawners (S. Somarakis). There is also an initiative underway tentatively titled: Handbook of Reproductive Ecology Studies for Fish Stock Assessment (co-editors R. Domínguez-Petit, H. Murua, F. Saborido-Rey, E. Trippel) that will involve >30 co-authors. This includes chapters in the following areas: (i) fish reproductive ecology, (ii) data collection and statistics for reproductive ecology studies, (iii) maturity, (iv) egg production, (v) sperm production, and (vi) elasmobranch reproductive potential.

The 4th Workshop on Gonadal Histology of Fishes was held in Cádiz, Spain, June 16-19, 2009 during which a number of deliverables to ToR 1 were presented with some achieving publication in the American Fisheries Society scientific journal Marine and Coastal Fisheries. Collectively, a solid year of achievements was made by this ToR that facilitates the present and future work activities of ToRs 2 and 3.

ToR 2: Explore and investigate the potential effects of changes in water temperature and food supply on reproductive success in selected marine species and stocks (Co-Leaders: Richard McBride (NMFS, USA) and Stylianos Somarakis (HCMR, Greece))

Environmental factors can modify the reproductive potential of fish stocks and thereby influence recruitment. Annual variations in water temperature and potential increases due to climatic warming will presumably act strongly to influence gonadal development and reproductive success. Prey resources also vary and influence fish condition which in turn affects reproductive output. In this ToR, using data on specific stocks and laboratory experiments, the influence of specific abiotic and biotic factors on gonadal development and spawning will be evaluated pending available data.

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

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

Two key review articles have been planned (i) effects of water temperature on reproduction and early life history traits of marine fishes and (ii) the potential effects of changes in food supply on reproductive success in selected marine species and stocks. Three other initiatives are also underway that are more specific in nature and include: (i) an examination of the effects of age, temperature and condition on timing and duration of spawning using research survey time series of specific cod and haddock stocks of the Northwest Atlantic and North Sea, (ii) an analysis of reproductive potential, growth and total egg production of cod in 3M and 3NO, and (iii) experimental research through a Canada/Spain scientific collaborative agreement to investigate the effects of water temperature on egg incubation of Greenland halibut.

Five products have been completed in the last year and reflect progress in the two key elements of ToR 2; water temperature and food supply, the latter more simply represented by condition factor.

ToR 3: Undertake appraisal of methods to improve fish stock assessments and fishery management advice that incorporate new biological data for highly exploited and closed fisheries (Co-Leaders: Joanne Morgan (DFO, Canada) and Loretta O'Brien (NMFS, USA))

The depressed and age-altered state of many marine fish stocks has led to reduced landings and in some instances fishery closures. New biological data associated with these altered states will be used to forecast recruitment and improve the accuracy of stock assessment advice. Building on information from previous WG ToRs, the intrinsic rate of population increase will be utilized to assess the timeframe for selected stocks to recover under various fishing and environmental conditions.

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

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

Egg production methods can estimate spawner biomass and/or stock numbers independently of commercial fisheries data. Improved information on stock reproductive potential is improving the accuracy of these methods. The daily egg production method is being explored to evaluate adult stock size for determinate spawning species in the Baltic and North Seas.

Ten initiatives are underway in ToR 3 that when completed will make a large contribution towards evaluating and implementing stock reproductive potential into scientific advice.

In addition, following a long-standing recommendation from Scientific Council, significant advancement has been made towards a “Workshop on Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species”. A description of the proposed activities of the Workshop is given below:

Outline of FRESH/NAFO Workshop - Spring 2011

Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species

Co-convenors: C.T. Marshall (Univ of Abdn, UK), M.J. Morgan (DFO, Canada), I. Mosquiera (Cefas, UK), L. O’Brien (NMFS, USA)

Background: Reproductive potential is central to the sustainability of fisheries. Variability in reproductive potential is often under-represented by conventional approaches to assessing stock status. Increased knowledge and improvements to databases allow new approaches to be developed. Consequently, there is increasing interest in implementing this knowledge into stock assessment.

Aim of the workshop: To review and recommend best practices for incorporating information about growth, maturation, condition and fecundity into assessment and advice for management of harvested marine species.

Venue for the workshop: University of Aberdeen

Timing of the workshop: 3 days in late March/early April

Format of the workshop The workshop will be organised into three sessions:

Theme 1: Estimating Stock Reproductive Potential Lead convenor: Tara Marshall (UK)

Presenting worked examples for stocks having a lot of detailed biological data; A range of stocks will be contrasted including long-lived, slow-growing stocks (Barents Sea cod) to short-lived, fast-maturing stocks (North Sea haddock). Discussion will address how to use this information for less data-rich stocks, through life history and hierarchical models. The analyses will yield insights into what new data should be collected routinely.

Theme 2: Implementing Estimates into Assessments Lead convenor: Loretta O’Brien (USA)

This session will focus on incorporating SRP estimates into an assessment model formulation. Model diagnostics (residuals, retrospective analyses) and time trends of various variables (e.g. SSB, recruitment) will be compared between model formulations with and without SRP estimates included in the estimation. Stock/Recruit relationships and biological reference points will be estimated and compared between model formulations and across stocks.

Theme 3: Are we doing it better, worse or just differently? Lead convenor: Joanne Morgan (Canada)

The focus of this session will be on examining whether or not we can improve our advice by incorporating SRP into assessments. The issue of the quality of biological data will be discussed. The impact of alternative estimates have on stock projections will be examined. The session will also discuss whether predictions of recruitment are improved and whether stock performance relative to reference points would be better with an alternative index of SRP.

Wrap-Up Discussion: Where do we go from here?

Recommendations for best practices will be summarised with a view to preparing a publication describing state of the art including needs for future research. Participants will discuss best practices in relation to what is feasible for their own stocks. No publication outlet has yet been decided, though a potential publication outlet is the NAFO Scientific Council Studies.

NAFO Scientific Council noted that significant progress has been made by the NAFO WG on Reproductive Potential in the past 12 months and this excellent progress has been in part due to the synergy developed between the WG and the EU sponsored COST Activity Fish Reproduction and Fisheries.

Scientific Council was pleased that a workshop on '*Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species*' is planned for the spring of 2011. Council noted the importance of this workshop to the improvement of scientific advice and **recommended** that *Designated Experts attend the workshop.*

5. WGDEC, March 2010

The ICES/NAFO Joint Working Group on Deep-water Ecology (WGDEC) met on 22-26 March 2010 at ICES HQ, Copenhagen, Denmark. Ellen Kenchington represented NAFO Scientific Council at this meeting with support from Vladimir Vinnichenko and Pablo Duran. The report below is taken from the working group's Executive Summary. Details relevant to Scientific Council advice to Fisheries Commission requests are included in the responses made by Scientific Council.

Chapter 1 lists the Terms of Reference that the WGDEC attempted to address in 2010. As is usually the case, the ToRs represent a great intellectual as well as time challenge to WGDEC members. As indicated in Chapter 2, the start of the WGDEC meeting saw members accepting leadership and supporting roles in addressing particular ToRs. It has been mentioned that several of the ToRs are not always clear of exactly what is being asked for and what deliverable is expected. In future, WGDEC needs to do a better job in asking clarifying questions well before the start of the annual gathering. Chapter 3 saw an ongoing effort to update maps of the North Atlantic. New information has been obtained for the Northwest Atlantic (e.g. Canada and the USA) in particular for corals and sponges in Hudson Strait, the Gulf of St Lawrence and the Newfoundland-Labrador Shelves/Slopes, Canada, and for Hatton Bank, Beothuk Knoll and the NAFO Regulatory Area, and for Rockall Bank and the Hebridean slopes and the Cantabrian Sea. Data collection is ongoing and it is expected that more updates will be available for 2011. These data will form the basis of an ICES WGDEC coral and deep-water sponge ARCGIS database that will be developed over the next year. The importance of individual sponges as microhabitat for invertebrate species has been widely demonstrated and includes a wide range of ecological interaction including both facultative and obligate commensalisms. The general co-occurrence of temperate sponge grounds with demersal fish assemblages has been less well documented. In response to this request, in Chapter 4 Kenchington *et al*. (2010) examined the association of 34 demersal fish taxa with *Geodia*-dominated sponge grounds using data collected from 104 research vessel survey trawls of 500 to 1500 m depth along the continental slopes of the Grand Banks and Flemish Cap. In December 2006, the United Nations General Assembly ("UNGA") adopted Resolution 61/105 which, in its Paragraphs 76 to 95, calls on member states and Regional Fisheries Management Organization to take steps to protect vulnerable marine ecosystems in the high seas from the adverse impacts of fisheries. Many of the ecosystems supported by cold-water corals, sponges and other communities have been highlighted as Vulnerable Marine Ecosystems (VME) that are susceptible to Significant Adverse Impacts (SAI). In Chapter 5, WGDEC attempted to review the science used in assessing VME's and the "Encounter Clause". This chapter proved to be the most challenging and controversial for several WGDEC members. While the science currently used for threshold weights indicating the possible location of a VME and the encounter clause and move on rule was reviewed by WGDEC, parts of the earlier drafts also took on a verdict on evils of bottom-trawling mentality. While the damage to VME's caused by bottom trawling was reviewed and discussed, an opinion on the good or evil of bottom fishing methods was not asked for in the ToR. Chapter 6 concluded that it is currently impossible to give precise estimates for total amounts and percentage of VMEs impacted by human activity because the data on coral and sponge distribution is highly patchy and far from complete. Recent advances in predictive habitat modelling may allow comparisons of potential habitat with current distribution to assist in addressing this problem, but the output from such models is not yet available to WGDEC. Consequently there is no direct means of quantifying the impact of human activities on the VMEs over the past decade. It is, however, possible to assess the likelihood that VMEs have been impacted from information on patterns in fishing activity in areas where VME's are known to be present. Lack of knowledge limits the possibilities for assessing the recovery potential of damaged cold-water coral and sponge habitats. The recovery rate of these biotic habitats depends mainly on the rate of colonization and growth. There is a great variation in these factors between species. Growth rates for deep-water sponges are poorly known. Chapter 7 observed that the data collected under the observer programme needs to address the mentioned criteria and such data should contribute to the impact assessments for the likelihood of significant adverse impacts in a given area. As there is little information on describing sponge species occurring at depths greater than 1500 m, Chapter 8 simply suggested that this be a continuing ToR when such data are received and can be reviewed and discussed. Chapter 9 was not fully addressed as it was felt that it would be best and more thoroughly addressed at a later date. Chapter 10 discussed ocean acidification, a rising global scientific priority. Over the last century, anthropogenic carbon dioxide (CO_2) from the burning of fossil fuels has greatly increased. As anthropogenic CO_2 is absorbed by seawater, the concentration of carbonate ions has increased as well, resulting in a decreased pH of seawater. This 'ocean acidification' (OA) has become an emerging scientific issue that has become a priority among many of the world's nations. This issue has emerged as a scientific priority because of the potential negative effect that it may have on marine ecosystems and the many economic and non-economic services they provide. In order to monitor natural fluctuations and anthropogenic changes in carbonate chemistry and assess the biological response to such changes, a robust ocean acidification observation network must be constructed by enhancing the monitoring capabilities of existing systems, increasing the temporal and spatial coverage of time-series measurements, and continuing current sampling efforts but expanding these efforts to open-ocean and coastal regions. Chapter 11 was not fully addressed as it was felt that it would be best and more thoroughly addressed at a later date. In 2008, ICES recommended to OSPAR and NEAFC that they work together and coordinate the respective protected areas in order to reduce confusion among stakeholders and a better chance of coherent management of human activities in these areas. This approach is still recommended and was discussed in detail in Chapter 12.

6. Report of FC WG MSE (Jan and May 2010) and FC WG FMS (May 2010)

António Vazquez (SC representative at WG MSE) and Bill Brodie (SC representative at WG FMS) informed the Scientific Council of the work done on these Fisheries Commission working groups. Scientific Council appreciated the update and thanks both for their commitment and contribution.

7. Meetings Attended by the Secretariat

a) Coordinating Working Party on Fishery Statistics (CWP, February 2010)

The 23rd Session of the CWP was held in Hobart, Tasmania, Australia, 22-23 February 2010. It was attended by representatives of ten fisheries bodies. Nine member organizations were absent. The meeting was attended by Ricardo Federizon, Fisheries Commission Coordinator at the NAFO Secretariat, who presented the results of the CWP meeting.

Among the topics, which may be relevant to the Scientific Council, discussed at the 23rd session were:

Fishing gear classification - In 2009, the ICES/FAO Working Group on Technology and Fish Behaviour (WGFTFB) informed CWP that it has made effort since 2005 in updating the technical contents of FAO Fish Tech Paper No. 222 Rev1 Definition and Classification of fishing gear categories. The original publication of this technical paper served as the basis of the CWP International Standard Statistical Classification of Fishing Gear (ISSCFG) adopted in 1980. The ISSCFG belongs to the CWP and its modification requires the adoption by the CWP itself. It was agreed that when the WGFTFB completed its revision of technical gear classification, it would submit a proposal to the CWP for its consideration.

Definition of bycatch - FAO informed that it proposed the definition of bycatch for consideration of the Expert Consultation on International Guidelines by Bycatch Management and Reduction of Discard, held in Rome, Italy 30 November - 3 December 2009. The proposal was not adopted. The meeting noted that the terms "bycatch" are currently used in many different ways, e.g. "catch not retained", "all catch other than target", "unintended catch especially undersized fish", etc. The compilation of the current utilization of terms was considered to be the useful initial step. There were differences in view whether this should be included in the CWP Handbook.

Statistical Data and Metadata eXchange (SDMX)_- Eurostat explained that this is its initiative to have a more efficient process for exchange of data by defining standard formats. It is currently under implementation with regards the flag States submission of STATLANT 27 through a "gentleman's agreement" with 27 EU member states. It was point out that the Eurostat initiative in the STATLANT 27 submission process will have consequences on the way NAFO receives the STATLANT 21 submissions because several EU member states also report

STATLANT 21. Eurostat assured it will keep NAFO in the loop with regards to SDMX with a view of a more efficient process of STATLANT 21 submissions from EU member states.

Global Standards on Automated Data Transmission - VMS - It was recognized that although the vessel transmitted information such as VMS data is primarily collected for MCS purpose, they also have a high potential to provide useful source of information for scientific and statistical purposes. NAFO, for instance have used VMS data for scientific purposes. The meeting keep reviewing the progress in the utilization of such data. It was noted that the term “VMS” is defined strictly in relation to compliance at some organizations. It was suggested to utilize more general term of “Vessel Transmitted Information” for the future.

Revision of the CWP Handbook - 3 types of revision: i) those requiring only minor or simple updates in which FAO would take the responsibility for reviewing and revising; ii) those with some text available but requiring substantial expansion and/or rewriting; iii) topics no text existing. Concerning categories i and ii, IATTC agreed to lead on the revision of catch and landings and logbooks components, ICES/FAO on fishery fleet and gears components, Eurostat on socio-economic component. CCAMLR and NAFO agreed to coordinate the preparation on the new ecosystem monitoring and fisheries impact on ecosystem. The meeting agreed to collaborate with the designated coordinators of those components with the aim to finalize the updated draft at the next session which will be in July 2011, San Diego, California, USA.

Also, STATLANT 21 issues specific to NAFO concerning its reliability and the manner of reporting were presented by the NAFO representative at the meeting. It was clarified that NAFO is not constraint to institute changes towards improvement. However, the CWP expects to be informed on the changes.

b) Fishery Resources Monitoring System (FIRMS, February 2010)

The 6th Session of the FIRMS Steering Committee was held in Hobart, Tasmania, Australia, 24-26 February 2010. It was attended by representatives of eight fisheries bodies. Five member organizations were absent. The meeting was attended by Ricardo Federizon, Fisheries Commission Coordinator at the NAFO Secretariat.

Among the topics, which may be relevant to the Scientific Council, discussed at the 23rd session were:

Marine Resource Inventory Module --- NAFO reported on the Scientific Council classification matrix used for reporting status and trends.

Fisheries Module - NAFO indicated that it can contribute to the Fisheries Module by providing information on management regime, management methods, monitoring system, as well as the fisheries profile. The partnership agreement between NAFO and FIRMS need not be revised as this is already covered by the original agreement.

Categories of Fishery Measures - The participants agreed on two general categories: 1) Compliance Measures, e.g. port state controls, VMS, at-sea inspections; and 2) Conservation and Management Measures, e.g. quotas and catch limits, closed areas and seasons. Examples in both categories can either be binding or non-binding.

c) Fish Stocks Agreement Meeting (UN, March 2010)

The meeting of the *9th Round of Informal Consultations of States Parties to the UN Fish Stocks Agreement was held at the* UN HQ in New York on 16-17 March 2010 and was attended by the NAFO Executive Secretary Vladimir Shibanov. Details of the meeting and the summary report of the outcomes of the meeting can be found at http://www.iisd.ca/oceans/fsaic9/.

d) Deep-sea Fisheries Guidelines Workshop (FAO, May 2010)

The "Workshop on the Implementation of the FAO Guidelines for the Management of Deep-sea Fisheries in the High Seas" was organized by FAO, Rome, and hosted by the Department of Fisheries, Korea at the Lotte Hotel, Busan, Korea, on 10-12 May 2010. The meeting was attended by the SC Coordinator Anthony Thompson. The workshop was attended by some 30 invited experts with experience in RFMOs, Government administration and research, university research, conservation, and industry. The meeting was divided into three major sessions: Management and conservation in areas where a competent RFMO/A is in existence, Protection of Vulnerable Marine Ecosystems (VMEs), and Management and conservation where there are no competent RFMO/As. Each session was lead by a consultant who presented summary papers to stimulate discussion. In general, presentations focused on strengths and weakness in the implementation of the Deep-sea Fisheries (DSF) Guidelines, highlighted problem areas, and outlined support mechanisms to help address identified issues. Comments and discussion from the floor were both interesting and lively, and represented a cross-section of views that reflected the participants' interests and experiences. There was considerable overlap among sessions and it became clear that clear divisions were impossible. The output of this meeting will be used to assist FAO in developing appropriate future support to implement the DSF Guidelines.

The FAO DSF Guidelines was developed to assist states and RFMO/As in sustainably managing fisheries and in implementing UNGA Res. 61/105, paragraphs 76-95, concerning responsible fisheries in the marine ecosystem. The DSF Guidelines were developed over 2-3 years following discussions at expert and technical consultations, and exist as a document that has assumed some degree of independence from the UNGA Resolution on which it was based. RFMOs, like NAFO, discuss, interpret, and consider the above documentation and then develop and publish specific management regulations for member Contracting Parties to follow. Thus, there are often three documents covering the protection of VMEs in the high seas by which the performance of individual RFMOs can be assessed, with the RFMOs own regulations being the most binding on Contracting Parties with fishing interests, and the UNGA Resolution perhaps has the greatest wider accountability via the Secretary General's report to the General Assembly on progress made by States and relevant organizations. The FAO DSF Guidelines has played an important role in interpretation and implementation of the UNGA Res. 61/105 within NAFO, and in particularly as guidance to NAFO Scientific Council.

Selected discussion points of relevance to NAFO were:

- The meanings of vulnerable, significant, assessment and resource. It was noted that these are critical terms in the DSF Guidelines and that their meaning and/or quantification need further clarification in order that they be consistently applied.
- Data collection was likewise discussed at length, especially with regard to common standards and to confidentiality. The sensitivities were well appreciated, but it was also noted that a greater degree of data sharing, if it could be achieved, could provide synergistic benefits across the various parties engaged in the fisheries and their management.
- Further definitions of VME indicator species and if these are to include the roaming but uncommon larger fish species sometimes caught as bycatch.
- Capacity building issues were repeatedly noted, though tended to be different according to specific circumstances. In the existing often older RFMOs, where traditional fisheries management has been a focus over the past few decades, it was noticed that increased support for the participation of more ecologists was desirable.
- The requirements for studies on the move-away protocols, the meaning of encounter thresholds, and the effectiveness of the encounter provisions in protecting VMEs. Of further note here were the apparent differences among RFMOs in the reporting of VME encounters according to the presence and type of onboard observer.
- There was considerable discussion centering around the requirements for gear/area specific "impact assessments" in existing and new fishing areas under the DSF Guidelines as being fundamental to "the assessment of significant adverse impact" required by the UNGA Res. 61/105.

e) Fish Stocks Agreement Meeting (UN, May 2010)

The meeting of the *Resumed Review Conference of the UN Fish Stocks Agreement* was held at the UN HQ in New York on 24-28 May 2010 and was attended by the NAFO Executive Secretary Vladimir Shibanov. Details of the meeting and the summary report of the outcomes of the meeting can be found at http://www.iisd.ca/oceans/rfsaic/.

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. General Plan of Work Annual Meeting, September 2010

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

2. Structure of Scientific Council

This June 2010 meeting of Scientific Council started on a Thursday and finished on a Wednesday; one day earlier than the June 2008-2009 meetings. Another helpful change this year was the agreement of the STACFIS catches by lunch time on the first day of the meeting, and this allowed for improvements in the planning of the timing of the assessments and their presentations. The meeting of Scientific Council on the first Friday afternoon and Monday, and the holding of STACFEN on the first Friday morning and STACREC and STACPUB on the first Saturday, allowed for the designated experts to concentrate more on their assessments early in the meeting. Having noted this, discussions on vulnerable marine ecosystems early in the meeting took longer than expected and STACFIS had to make up for around two lost days by extending their meeting time. Next year it is planned to have agreed STACFIS catches before the start of the June SC meeting.

Owing to the above, it was decided to start the June 2011 meeting on Friday 3 June with the opening of Scientific Council, followed by a brief STACFIS planning session and then the full STACFEN meeting. STACREC and STACPUB will be undertaken on the first Saturday. Additionally, there will be an extra day following the last weekend in the June 2011 meeting that should assist Scientific Council in the timely deliberations of its business.

3. *Ad hoc* Fisheries Commission requests

It was again noted that *ad hoc* requests from Fisheries Commission, often with tight deadlines, imposes a significant workload on Scientific Council. A recent example is an inter-sessional request for advice on management strategy evaluation on operating models that was made on 26 February 2010 and required a response by 2 May 2010. Other examples come from the *ad hoc* requests made during the annual meeting.

This concern has been noted earlier, and in September 2000 Scientific Council recorded - “During the course of the current meeting, concern was expressed by members of the Scientific Council regarding performing "on the spot" technical analyses in response to *ad hoc* requests from the Fisheries Commission. During the Annual Meetings a smaller complement of scientific expertise within the Scientific Council is in attendance, and this quite often presents considerable difficulty in the Council's ability to provide the best possible advice on many technical requests when the required experts are unavailable. The Council Chairman was asked to continue discussions with the Fisheries Commission Chairman on this matter.” (*NAFO Sci. Coun. Rep*., 2000: 191). In 2007, Scientific Council recommended that for the Annual Meeting the Fisheries Commission submits, whenever possible, its questions for Scientific Council well in advance of the meeting. Scientific Council asks that the Secretariat includes this recommendation in the circulation of the Annual Meeting agenda. The Scientific Council Chair will continue dialogue with the Fisheries Commission Chair to ensure that *ad hoc* requests are made in a timely manner.

4. Timing of Shrimp Advice

Scientific Council noted the difficulties in the timing of the provision of the shrimp advice (*NAFO Sci. Coun. Rep*, 2009, p. 239) and this was raised at the intersessional Fisheries Commission meeting of 16 November 2009. Scientific Council has not, as yet, proposed a new schedule. Fisheries Commission suggested that CPs may raise this issue at subsequent meetings of Fisheries Commission (FC Doc. 09/24).

5. Other Matters

No items were raised.

XII. OTHER MATTERS

1. Designated Experts

Council noted that a Designated Expert for northern short-finned squid in SA 3+4 was identified and welcomed the return of Lisa Hendrickson (USA) to her former position that has been vacant since 2007.

2. Update on the Redrafting of the CEM

The Editorial Drafting Group (EDG) of the NAFO CEM has received the comments from Scientific Council regarding references contained within the NAFO CEM to the Council. The EDG will provide a report to their recommendations to STACTIC at the 2010 Annual meeting.

3. Stock Assessment Spreadsheets

It is requested that the stock assessment spreadsheets be submitted to the Secretariat as soon after this June meeting as possible.

4. Meeting Highlights for NAFO Website

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

5. Merit Awards

a) Scientific Merit Award

In June 2008, Scientific Council considered two classes of award. One award recognizes outgoing Chairs for their leadership in accepting these roles. A second award recognizes an outstanding scientific contribution to the Council. Decisions on the latter award would be made by the Chair and Scientific Council Coordinator supported by nominations from Council members.

Based on a request for nominations submitted to Council members in September 2009, Scientific Council awarded the second "Outstanding Scientific Contribution" award to Manfred Stein (Germany) at the June 2010 meeting in recognition of his outstanding scientific contributions to improve our understanding of ocean climate conditions and hydrographic variability with links to commercially-important fish and invertebrate stocks in the North Atlantic. Manfred has had a long and distinguished career in marine sciences participating and publishing reports on numerous climate and hydrographic studies throughout the North Atlantic that has spanned over 30 years. Since then he continued to contribute to NAFO in many capacities serving as Chair of the Environmental Subcommittee from 1985-1994, Chair of the Standing Committee of Fisheries Environment (STACFEN) during 1995-2001 (Interim Chair in 2009) and the Standing Committee on Publications (STACPUB) during 2002-2009. Manfred has also contributed to numerous NAFO and ICES Symposia in a variety of capacities over many years since his career began. Manfred has completed numerous oceanographic and fisheries surveys under less than ideal working conditions in the unforgiving North Atlantic aboard a variety of scientific research vessels. His commitment to attend NAFO Scientific Council meetings and report to a variety of Standing Committees is unsurpassed in his dedication and attention to detail. His efforts and long-time contributions to the study of environmental information and effects on fisheries over many decades within the NAFO community will surely be missed.

On behalf of the Scientific Council and the Secretariat, we extend our best wishes to Manfred and sincerely thank him for his many contributions to this Council over the years.

b) Chair's Merit Award

Scientific Council acknowledges the dedication and hard work of retiring Chairs with a merit award. There were no retiring Chairs at this meeting of Scientific Council, but it was noted that Manfred Stein had vacated both the

STACPUB Chair and STACFEN Chair last September but was unable to collect his award. It was therefore, with great pleasure, that the Chair of Scientific Council bestowed two merit awards on Manfred for his services to STACPUB as Chair (2002-2009) and to STACFEN as interim Chair (2009).

8. Other Business

a) Budget

The budget for the current year 2010 was presented to Scientific Council. It was noted that the special session in 2010 that was to take the form of a workshop on new assessment methods will not be held this year and therefore the budget for this will not be required. Other budget items remain as requested by Scientific Council and as approved by General Council.

The 2011 budget was discussed by Scientific Council and will be presented to STACFAD in September 2010 for consideration.

Scientific Council has benefited from the representation of a Scientific Council member on STACFAD over the recent years. The Scientific Council Chair and Scientific Council Coordinator will present the budget to STACFAD in September.

b) Capacity-building in Ocean Affairs and the Law of the Sea

The NAFO Executive Secretary presented an outline of the eleventh meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea that will be held at United Nations Headquarters in New York from 21 to 25 June 2010. Pursuant to paragraph 193 of General Assembly resolution 64/71 of 4 December 2009, in its deliberations on the report of the Secretary-General on oceans and the law of the sea, the Consultative Process at its eleventh meeting will focus its discussions on capacity-building in ocean affairs and the law of the sea, including marine science. The Executive Secretary will represent NAFO at this meeting. Further details can be found at http://www.un.org/Depts/los/consultative_process/consultative_process.htm

c) TXOTX

The completion of the Technical eXperts Overseeing Third country eXpertise (TXOTX) project questionnaire was discussed by Scientific Council in September 2009. It was noted that the Scientific Council Coordinator, several Designated Experts of STACFIS and several members of the standing committees and working groups have already completed sections relevant to their duties within NAFO. These submissions were not reviewed by Scientific Council in plenary and the current Chair would complete sections 1 and 5 and send on the entire completed questionnaire by mid-October. The response has been good and TXOTX have expressed gratitude for the time spent by NAFO Scientific Council members in completing their sections of the questionnaire. It is expected that TXOTX will report back to Scientific Council on the benefits they received and outline the benefits of this exercise to NAFO.

Phil Large (EU) reported that TXOTX Work packages 3 (Review across regions) and 4 (Synopsis) are progressing and it is the intention to provide outcomes relevant to NAFO for comment before presentation of overall outcomes at the final TXOTX Workshop in early 2011. Representatives from all participating RFMOs, countries and stakeholders will be invited.

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 16 June 2010, 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 3-16 June 2010 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 1335 hours on 16 June 2010.

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

Chair: Gary Maillet Rapporteur: Eugene Colbourne

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 4 and 10 June 2010, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Greenland), European Union (France, Germany, Portugal, Estonia, Latvia, Lithuania and Spain), Russian Federation, USA and Japan.

1. Opening and Appointment of Rapporteur

The Chair opened the meeting by welcoming participants to this June 2010 Meeting of STACFEN.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 10/04, 05, 12, 13, 16, 17, 19, 37, 38, SCS Doc.10/06, 08, 10, 11, and 12.

Eugene Colbourne (Canada) was appointed rapporteur.

2. Review of Recommendations

STACFEN made two recommendations in June 2009.

STACFEN noted that in recent years good year-classes have been observed in a number of populations in the northwest Atlantic. STACFEN therefore **recommended** that *the appearance of good year-classes be explored in relation to environmental conditions*.

STATUS: No progress.

NAFO usually convenes a symposium on environmental issues every 10 years, and as the last one was held in 2002, E. B. Colbourne (Canada, DFO) suggested that the forthcoming ICES Symposium could take the place of the next NAFO symposium. STACFEN therefore **recommended** that *Scientific Council to support participation and possible co-sponsorship of the "ICES/NAFO Symposium on the Variability of the North Atlantic and its Marine Ecosystems during 2000-2009"*.

STATUS: There was considerable work undertaken by the STACFEN Chair to act on this recommendation. NAFO Scientific Council has selected Steve Cadrin, USA, as Co-convenor (Co-Chair) and an application for support will be discussed by Scientific Council at this June 2010 meeting.

3. Climate and Environmental Conditions in 2009

The highlights of the climate and environmental conditions in the NAFO Convention Area for 2009 are:

- The North Atlantic Oscillation index for 2009 was near the long-term mean and as a consequence, outflow of arctic air masses to the Northwest Atlantic during the winter (December-February) return to more like normal conditions. This resulted in a slight increase in air temperatures coherent throughout the Northwest Atlantic relative to 2008.

- Although annual mean air temperatures in 2009 cooled relative to 2006, they remained above normal over most of the NAFO Convention Area from West Greenland to the Grand Banks, the Gulf of St. Lawrence and the Scotian Shelf. Air temperatures over the Gulf of Maine were slightly below normal. Remarkable positive anomalies were observed over the western Arctic over Baffin Bay and Davis Strait with anomalies greater than +4°C.

- Sea-ice extent and duration around Greenland was near normal in 2009. Sea ice coverage increased in 2009 on the Newfoundland and Labrador Shelves, and the Gulf of St. Lawrence, but remained below historical means. Sea ice extent and duration were normal on the Scotian Shelf but ice volume was substantially greater than the long term mean.

- Oceanographic conditions off West Greenland during the summer 2009 were characterised by below normal presence of cold-lower salinity Polar Water and above normal presence of warm-higher salinity Irminger Water.

- In the Labrador Sea, the autumn-winter of 2007–2008 had the largest cumulative heat loss from the ocean to the atmosphere of the seven years examined, with magnitude about 50% above the 2002–2007 mean. This indicates that an anomalously high level of atmospheric cooling led to the enhanced production of Labrador Sea Water in 2008. Subsequently, in 2009 surface fluxes were close to the 2002-2007 mean.

- In 2009, convection in the central Labrador Sea was limited to the upper 800 m of the water column. This is in strong contrast to the 2008 winter conditions during which convection penetrated to 1600 m related to the coldest winter (January–March) surface air temperatures in 16 years.

- The environmental composite index which integrate a number of meteorological and physical oceanographic time series, continued to decline in 2009 from record high levels observed during the mid-2000s, but remains slightly above the long-term 40-year mean across the Newfoundland and Labrador Shelves. A similar composite index on the Scotian Shelf and Gulf of Maine was up slightly in 2009.

- The upper layer baroclinic transport of the shelf-slope component of the Labrador Current off southern Labrador and Flemish Pass increased significantly in 2009.

- The cross sectional area of <0°C (CIL) water mass, while slightly below normal on the eastern Newfoundland Shelf for the 15th consecutive year, in contrast to above normal conditions on the southern Labrador Shelf, the most extensive since 1994.

- Averaged spring bottom temperatures were near normal in Div. 3LNO (+0.4 SD) and in Subdiv 3Ps (-0.2 SD) in 2009. Averaged autumn bottom temperatures were above normal by 1.4 SD (0.6°C) in Div. 3K, by 1.5 SD (0.5°C) in 2J and about normal in Div. 3LNO.

- The stratification of the upper 50 m throughout the waters of eastern Canada was near normal values.

- Overall, 2009 was an average year for ocean temperature across the Scotian Shelf and Gulf of Maine with the exception of deep basins in Cabot Strait and Emerald Basin where temperatures were substantially below normal indicating a greater influence of Labrador Slope Water.

- Overall, 2009 was remarkably normal using the meteorological and oceanographic composite indexes developed for the Scotian and Newfoundland and Labrador Shelves.

- The intensity of the spring bloom was similar to previous years but the initiation of the production was delayed and the duration was substantially reduced in NAFO Subarea 2.

- Satellite composite imagery during early spring 2009 indicated no spatially extensive surface blooms were observed across the Grand Banks with most of the production confined to the offshore waters and into the southern part of the Labrador Sea which propagated through early summer.

- The link between temperature and phytoplankton abundance suggests increasing production with continued warming of northern waters but potential impacts on other key oceanographic processes (nutrients, stratification, mixing) remain unclear.

- The timing and intensity of phytoplankton blooms across the Scotian Shelf and Gulf of Maine were comparable in recent years.

- Annual integrated production levels were below normal across Subarea 2 while above normal in Subareas 3-5.

4. Invited Speaker

Due to a variety of circumstances, it was not possible to host an invited speaker to address STACFEN. Manfred Stein has kindly provided a listing of invited speakers to the Environmental Subcommittee back to 1994 which eventually became STACFEN in later years (see appendix at the end of the report for listing). An invited speaker has been a long-standing tradition to address NAFO STACFEN and many excellent keynote speakers have addressed STACFEN on a variety of topics. The main topics in the past have focused attention on response of biological communities to environmental variability and emerging ocean climate patterns within the NRA. STACFEN **recommended** that *consideration of support for one invited speaker to address emerging issues and concerns for the NAFO Convention Area during the June Meeting*.

5. Review of Integrated Science Data Management Report

A review of the Integrated Science Data Management (ISDM formerly MEDS) Report for 2009 was presented in **SCR Doc. 10/14**. ISDM is the Regional Environmental Data Center for NAFO and is required to provide an annual inventory of environmental data collected in the NAFO regulatory area to the NAFO Standing Committee on Fisheries Environment (STACFEN). In order for ISDM to carry out its responsibility of reporting to the Scientific Council, the Designated National Representatives selected by STACFEN are requested to provide ISDM with all marine environmental data collected in the Northwest Atlantic for the preceding years. Provision of a meaningful report to the Council for its meeting in June 2010 required the submission to ISDM of a completed oceanographic inventory form for data collected in 2009, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2009. The data of highest priority are those from the standard sections and stations, as described in NAFO SCR Doc. No. 88/1, Serial N1432, 9p. Inventories and maps of physical oceanographic observations such as ocean profiles, surface thermosalinographs, drifting buoys, currents, waves, tides and water level measurements for the calendar year 2009 are included. This report will also provide an update on other ISDM activities during 2009. Data that have been formatted and archived at ISDM are available to all members on request. Requests can be made by telephone (613) 990-0243, by e-mail to isdm-gdsi@dfo-mpo.gc.ca, by completing an on-line order form on the ISDM web site at www.meds-sdmm.dfo-mpo.gc.ca/meds/Contact_US/Request_e.asp or by writing to Services, Integrated Science Data Management (ISDM), Dept. of Fisheries and Oceans, 12th Floor, 200 Kent St., Ottawa, Ont. Canada K1A 0E6.

6. Ocean Climate and Physical, Biological and Chemical Oceanographic Studies

Subareas 0 and 1. A review of meteorological, sea ice and hydrographic conditions in West Greenland in 2009 was presented in SCR Doc. 10/04 and SCS Doc. 10-12. In winter 2008/2009, the North Atlantic Oscillation (NAO) index was positive describing anomalous westerlies over the North Atlantic Ocean. Often this results in colder conditions over the West Greenland region, but the air temperature was higher than normal, especially over the Baffin Bay. The extension of multi-year-ice (“Storis”) was about normal. The general settings in the region have traditionally been presented with offset in the hydrography observed over the Fylla Bank. Here, time series of mid-June temperatures on top of Fylla Bank show above average conditions in 2009 with noticeable high salinities. In general, the surface and subsurface temperatures and salinities were higher than normal suggesting lower presence of Polar Water than normal. The presence of Irminger Water in the West Greenland waters was above normal in 2009. Pure Irminger Water (waters of Atlantic origin) could be traced north to the Sisimiut section with the exception of the Fylla Bank section where only modified Irminger Waters were found. This suggests that the pure Irminger Water seen north of Fylla Bank has passed Fylla Bank earlier - for example as a result of a decreasing strength of the Irminger Water inflow during spring/summer compared to wintertime. Nevertheless, the mean (400–600 m) salinity and temperature west of Fylla Bank was both above normal. For the same depth interval at Maniitsoq and Sisimiut, the salinities were the highest observed yet with highest and 5th highest temperature respectively. In the Disko Bay off Ilulissat, the bottom temperature and salinity was the highest observed – however only observed since 1980.

A review of meteorological, sea ice and hydrographic conditions around Greenland in 2009 was presented in SCR Doc. 10/05 and SCS Doc. 10/08. The pattern of sea level atmospheric pressure over the North Atlantic during winter 2008/2009 indicated one distinct negative pressure anomaly cell, located over Greenland and the Labrador Sea, and another negative anomaly cell located over Europe and Northern Africa. A strong positive anomaly cells covered Scandinavia and Western Russia, and a slightly weaker positive anomaly cell stretched from the Azores area to the west of the British Isles. As a consequence of this pattern, the NAO index for the winter 2008/2009 was weak and slightly negative (-0.08). Warmer-than-normal conditions were observed around Greenland during 2009 that results in the positive anomaly of the annual temperature of +0.8 K at Nuuk. Based on satellite derived ice charts, it is shown that winter sea ice conditions were less favorable during 2009 off West Greenland than during 2008. However, the maximum of ice extension in 2009 was less than the year before. The anomaly of the mean water temperature in the upper 200 m at Fyllas Bank Station 4 increased in comparison with the previous year and reached

+1.1K in autumn 2009. Calibration salinity samples from the deep water station Cape Desolation 3 off southwest Greenland reveal harmonic oscillation signals which are most expressed at the 1500m depth level ($r^2 = 0.88$). At 3000m depth, in the domain of the Denmark Strait Overflow water mass, the harmonic signal is weaker, and it explains 48% of variation in the calibration data.

Subareas 1 and 2. A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2009 was presented in SCR Doc. 10/17. The Labrador Sea experienced very warm winter surface air temperatures in 2009; temperatures ranged from approximately 8°C above normal in the northern region near Davis Strait to about 2-4°C above normal in the southern Labrador Sea. This is in strong contrast to the 2008 winter conditions during which the central Labrador Sea experienced the coldest winter (January–March) surface air temperatures in 16 years and the ocean responded with deep convection to 1600 m. In 2009, convection was limited to the upper 800 m of the water column. Maximum sea ice extent was near the long-term mean for this region, however, sea ice concentration was lower than normal in the region of the northern Labrador Sea. The cooling and densification of the upper levels of the west-central Labrador Sea observed in the 2008 winter interrupted a recent warming trend at intermediate depth levels, however, the milder air temperatures during the winter of 2009 limited convection and the warming trend has resumed in 1000-1500 m layer. Monthly mean sea surface temperatures were slightly warmer than normal (approximately 1ºC) for all of 2009.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador (NL) Region during 2009 was presented in SCR Doc. 10/16 and SCS Doc. 10/10. The NAO index for 2009 was about normal (+0.1 SD) and as a consequence, outflow of arctic air masses to the Northwest Atlantic during the winter (Dec.-Feb.) return to normal conditions. This resulted in a slight increase in air temperatures throughout the Northwest Atlantic from West Greenland to Baffin Island to Labrador and Newfoundland relative to 2008. Sea-ice extent and duration on the NL Shelf increased in 2009 but remained below average for the 15th consecutive year, although it was the most extensive since 1994 during the spring. Local water temperatures on the NL Shelf continued a slight cooling trend but remained above normal in some areas in 2009. Salinities, which were lower than normal throughout most of the 1990s, have experienced a general increasing trend during the past 8 years. At Station 27, the depth-averaged annual water temperature decreased from the record high observed in 2006 to about 0.4 SD above normal in 2009. Annual surface temperatures at Station 27 also decreased from the 64-year record of 1.7°C (3 SD) above normal in 2006 to about 0.4°C (0.7 SD) above normal in 2009. Bottom temperatures at Station 27 were slightly below normal in 2009 the first time since 1995. The area of the Cold-Intermediate-Layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland Shelf was below normal (0.4 SD) for the 15th consecutive year while off southern Labrador it was above normal by 0.6 SD, the largest since 1994. Bottom temperatures on the Grand Banks (Div. 3LNO) during the spring were above normal by <1 SD. During the autumn bottom temperatures in Div. 2J and 3K were above normal by up to 1.5 SD while in Div. 3LNO they were about normal. A total of 112 environmental time series were analyzed and 54 were within ±0.5 SD and are not considered significantly different from normal, 72 indicated warmer temperatures, saltier water with less CIL and sea-ice, but only 42 of these were considered significantly different than normal. A composite climate index derived from selected annual and seasonal time series ranked 34th in 60 years of observations, which represents a decreasing trend since the record high in 2006.

An investigation of the oceanographic and lower trophic level biology in the region of Orphan Knoll, a NAFO closed area was presented in SCR Doc. 10/19. Physical properties indicate that mid-depth waters above Orphan Knoll are in a boundary region between outflow from the Labrador Sea (subpolar gyre) and northward flow of the North Atlantic Current (subtropical gyre). Near-bottom current measurements provide evidence for anti-cyclonic (clockwise) circulation around the knoll. A west-east gradient in nutrients was observed and is likely related to water mass differences between Orphan Basin and the region east of Orphan Knoll. The saturation state of seawater on the Orphan Knoll sediment surfaces is less than 1.2 and, therefore, organisms with shells and skeletons composed of aragonite and calcite with high magnesium content (more soluble than aragonite) may be affected by ocean acidification. The saturation state of seawater with respect to $CaCO_3$ and the ecosystem response need to be monitored closely. Chlorophyll, small phytoplankton and bacteria in the Orphan Basin-Orphan Knoll region in the spring of 2008 and 2009 showed strong spatial and inter-annual variability, reflecting the complex physical dynamics and growth conditions in the region. Bacterial abundance appeared to be elevated on the summit of the knoll compared to surrounding waters at the same depth, but the persistence of this feature is not known. Zooplankton abundance was significantly greater in the region in 2009 relative to the preceding year, but no enhancement relative to the surrounding region was observed over Orphan Knoll. Overall, we have little evidence at this point that Orphan Knoll enhances the lower trophic level biology in the water column above the knoll; however, near-bottom anti-cyclonic circulation could have important implications for the benthic community which will be surveyed in July 2010.

Subarea 4. A description of environmental information collected on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas during 2009 was presented in SCR Doc. 10/12. A review of the 2009 physical oceanographic conditions on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas indicates that near normal conditions prevailed. The climate index, a composite of 18 selected, normalized time series, averaged +0.3 (±0.8) SD, i.e. essentially normal; 11 variables were within 0.5 standard deviations of their normal values, 5 more than 0.5 SD above and 2 more than 0.5 SD below normal. Spatial variability was less systematic than in 2008. In 2009, temperatures at Cabot Strait (200-300 m), bottom temperatures in areas Div. 4Vn and 4X, at 250 m in Emerald Basin, at 200 m in Georges Basin and on Georges Bank were below normal. Sea surface temperatures at Halifax and Emerald Basin were also below normal; all other areas featured above normal temperatures.

Subareas 4- 6. The United States Research Report listed several ongoing oceanographic, plankton and benthic studies conducted by the Northeast Fisheries Science Center (NEFSC) in NAFO Subareas 4 through 6 presented in SCS Doc. 10-11). A total of 1 627 CTD (conductivity, temperature, depth) profiles were collected and processed on Northeast Fisheries Science Center (NEFSC) cruises during 2009. Of these, 1 613 were obtained in NAFO Subareas 4, 5, and 6. These data are archived in an oracle database. Cruise reports, annual hydrographic summaries, and data are accessible at: http://www.nefsc.noaa.gov/epd/ocean/MainPage/index.html. CTD data from 4 cruises conducted in 2009 remain to be processed. When these data are processed they will be added to the oracle database and cruise reports will be accessible at the same website. During 2009, zooplankton community distribution and abundance were monitored using 665 bongo net tows taken on six surveys. Each zooplankton 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 13 transects across the Gulf of Maine from Cape Sable, NS to Boston, and 14 transects across the Mid-Atlantic Bight from New York to the Gulf Stream. The relationship between hydrography and the distribution of the invasive colonial tunicate *Didemnum vexillum* on Georges Bank was investigated in 2009. The survey focused on areas not yet colonized by the tunicate on both sides of the U.S.-Canadian border and both inside and outside of areas closed to bottom fishing in the U.S., and areas in the U.S. of unknown habitat type and status. *D. vexillum* did not occur in areas of strong tidal temperature fluctuations and substrate coverage by this tunicate was highest inside Closed Area II, presumably for lack of disturbance by trawling.

7. Interdisciplinary Studies

An important role of STACFEN, in addition to providing climate and environmental summaries for the NAFO Convention Area, is to determine the response of fish and invertebrate stocks to the changes in the physical and biological oceanographic environment. It is felt that a greater emphasis should be placed on these activities within STACFEN and therefore STACFEN **recommended** that *further studies be directed toward integration of environmental information with changes in the distribution and abundance of resource populations.*

The following studies were considered at the June 2010 Meeting:

An investigation of other potential climate indices such as the Arctic Oscillation (AO) index to evaluate the large-scale physical forcing conditions in northern temperate and polar regions was presented in SCR Doc. 10/38. The AO is a natural pattern of climate variability. It consists of opposing patterns of atmospheric pressure between the polar regions and middle latitudes. The positive phase of the AO exists when pressures are lower than normal over the Arctic, and higher than normal in middle latitude. In the negative phase, the opposite is true; pressures are higher than normal over the Arctic and lower than normal in middle latitudes. The long-term mean of AO index indicates a significant positive trend ($r^2=0.34$, $p < 0.001$). The negative and positive phases of the AO set up opposing temperature patterns. A record negative AO index during winter 2009/2010 led to warmer than usual air temperatures over the Arctic Ocean and cooler than normal temperatures over central Eurasia, the United States and southwestern Canada.

The analysis of common trends in fishery and environmental time series was presented in SCR Doc. 10/37. Dynamic factor analysis (DFA) is based on structural time series models that examine terms of a trend, seasonal effects, a cycle, explanatory variables and noise, all of which are allowed to be stochastic. DFA was used to assess the existence of common trends and the influence of external drivers on the trends in biomass of key species of the NL system. The species examined included cod, Greenland halibut, American plaice, redfish and yellowtail flounder. The NAO index, Station 27 sea surface temperature (ST27-SST), a composite environmental index (CEI) and an *ad hoc* fishery index (FI) were considered as candidate explanatory variables. Common trends were observed in the biomass trajectories of 5 key fish species. Negative common trends were found from the early-mid 1980s to the mid 1990s, while positive common trends characterized the period from the mid 1990s to 2008. Fishing pressure appears as a consistent and significant driver both in the early as well as the more recent period. The NAO index, ST27-SST and the CEI also appear as significant drivers, but their effect is less consistent than the one observed for fishing. The CEI appears as a driver in the northern region (2J3KL), while ST27-SST, and to a lesser extent NAO, appear more relevant in the Grand Bank region (3LNO).

Remote sensing data using the Sea-viewing Wide Field-field-of-view Sensor (SeaWiFS) and Moderate Resolution Imaging Spectrodiometer (MODIS) to analyze the spatial and temporal variability of phytoplankton abundance was presented in SCR Doc. 10/13. In 2009, the production cycle was delayed (2-4 weeks) and the duration was reduced compared to previous years on the Labrador Shelf (NAFO Subarea 2). The composite satellite imagery during the spring bloom indicated reduced surface blooms throughout the Grand Banks and northeast Shelf (Subarea 3). During the latter part of the production cycle in 2009 (late April through June) intense blooms were detected over a widespread area of the northeast Newfoundland Shelf and southern part of the Labrador Sea. Phytoplankton biomass levels on the Scotian Shelf and Gulf of Maine (Subarea 4, 5) were comparable to recent years throughout the production cycle. A linear relationship between sea surface temperature and phytoplankton abundance was observed in northern waters which may lead to higher productivity with a continued warming trend. The utility of dynamic factor analysis (DFA) was explored to identify common trends in 16 SeaWiFS statistical sub-regions throughout the northwest Atlantic and to evaluate the predictive ability of large-scale physical forcing.

8. Update of the On-Line Annual Ocean Climate and Environmental Status Summary

In 2003 STACFEN began production of an annual climate status report to describe environmental conditions during the previous year. This web-based annual summary for the NAFO area includes an overview that summarizes the overall general climate changes for the previous year and a regional overview that provided climate indices from each of the Subareas. An update of the on-line annual ocean climate status summary for the NAFO Convention Area will be posted shortly. Eugene Colbourne is continuing to take the lead together with the physical and biological oceanographers to produce the on-line annual climate status summary. This information will include contributions received from Subareas 0-1, West Greenland (M. Stein, A. Akimova, and M. Ribergaard), Subareas 2-3, Grand Banks and Labrador Sea / Shelf (E. Colbourne, I. Yashayaev, B. Greenan, G. Maillet, P. Pepin), Subareas 4-5, Scotian Shelf and Gulf of Maine (B. Petrie, Glen Harrison), and Subareas 5-6, Georges Bank and Gulf of Maine (US Representative). The Chair and E. B. Colbourne agreed to working in conjunction with the NAFO Secretariat on an update of the online annual ocean climate status summary for the NAFO Convention Area for 2009.

9. Environmental Indices (Implementation in the Assessment Process)

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

SCR Doc. 10/37 and SCR Doc. 10/12 presented a different method for moving forward beyond the descriptive and simple linear correlation approaches that have been used in the past to evaluate environmental indices and their linkage to natural resource populations. The dynamic factor analysis method outlined in SCR Doc. 10/37 is a relatively new method in fishery science and a small number of publications currently exist. STACFEN is encouraged to further evaluate the utility of this approach to detect common patterns in a multivariate set of time series and relationships between those time series and explanatory variables. This type of analysis can naturally been expanded to investigate the relationships between environmental variables and multiple trophic levels including zooplankton and commercially-important invertebrate and fish stocks.

10. Recommendations Based on Environmental Conditions

STACFEN made no formal recommendations during this 2010 meeting in regard to new environmental indices but the committee is again encouraged to provide ideas for additional indices for future use and any additional species that could be evaluated in relation to the environment.

11. National Representatives

The Committee was informed of one change in the National Representative responsible for hydrographic data submissions. Currently, the National Representatives 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), Vacant (Portugal), M. J. Garcia (Spain), B. F. Pristehepa (Russia), L. J. Rickards (United Kingdom), and K. J. Schnebele (USA). The National Representative from Portugal will be updated shortly.

12. Other Matters

a) ICES/NAFO Hydrobiological Symposium

The proposed joint ICES/NAFO Symposium on the "*Variability of the North Atlantic and its Marine Ecosystems during 2000-2009.*" was further discussed. The North Atlantic ecosystem has significantly changed during the past decade. These climate-driven changes need to be understood at a fundamental level to anticipate future changes and to enable effective ecosystem based management of ocean resources. The details regarding the timing (May 10-12, 2011) and format of the Symposium was provided by Anna Akimova. The key challenge of the symposium is to summarize and understand the hydrobiological variability during the decade of 2000-2009 in relation to longer time variability or change, and quantify the interactions between the variability of climate/physics, plankton, fish, mammals and seabirds in North Atlantic marine ecosystems. STACFEN **recommended** that *Scientific Council to support a NAFO Co-Chair, keynote speakers, and an honorarium for consideration to the "ICES/NAFO Symposium on the Variability of the North Atlantic and its Marine Ecosystems during 2000-2009"*.

13. Adjournment

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

Annex I - Invited Speakers at NAFO Environmental Meetings

The following is a list of the invited speakers during Environmental Subcommittee (ENSUB) and Standing Committee on Fisheries Environment (STACFEN) June meetings.

1994 Invited lecture (Dr. S. Goddard, MUN, St. John's, NFLD: "Production of Antifreeze Proteins in Cod"); first Invited lecture; Chair: M. Stein

1995 Invited lecture (Dr. Andrew Thomas, ACRSO, Bedford, NS, Canada: "A general overview of the marine remote sensing field"); first meeting of STACFEN, which in 1994 replaced the ENSUB under STACFIS; Chair: M. Stein

1996 Invited lecture (Dr. Mojib Latif, MPI, Hamburg, Germany: "A mechanism for decadal climate variability" was cancelled. Dr. Latif was unable to attend due to health reasons); Chair: M. Stein

1997 Invited lecture (Dr. J. Fischer, MUN, St. John's, NFLD: "Niche space occupied by common fish species off Newfoundland"); Chair: M. Stein

1998 Invited lecture (D. Mountain, NEFS/NOAA, USA: "Review of historical and recent environmental conditions in Subareas 5 and 6"); Chair: M. Stein

1999 Invited lecture (Dr. R. R. Dickson, CEFAS, Lowestoft, UK: "Aspects of the physical and biological response to NAO variability"); Chair: M. Stein

2000 Invited lecture (W. Melle, IMR, Norway: "Climate-fish-plankton interactions"); Chair: M. Stein

2001 Invited lecture (G. Wegner, ISH, Hamburg, Germany: "The EU Concerted Action on Stock Assessment and Prediction: Aim, Procedure, Results"); Chair: M. Stein

2002 Mini-symposium on Hydrographic Variability in NAFO Waters 1991-2000; Chair: E. Colbourne

2003 Invited Lecture (T. Platt Bedford Institute of Oceanography Dartmouth, Nova Scotia: "Climate, Weather and the Pelagic Ecosystem"); chair: E. Colbourne

2004 Invited speaker (Ken Frank, Bedford Institute of Oceanography Dartmouth, Nova Scotia: "Assessment of the State of a Large Marine Ecosystem – the Eastern Scotian Shelf"); Chair: E. Colbourne

2005 Invited speaker – (Dr. Mariano Koen-Alonso, Northwest Atlantic Fisheries Centre in St. John's, Canada: "Multi-species bioenergetic-allometric models and ecosystem-based management: a synoptic (personal, and probably biased) view of the lessons learned and the road ahead"); Chair: E. Colbourne

2006 Invited speaker- (Dr. Philip C. Reid, Director, Sir Alister Hardy Foundation for Ocean Science, Plymouth, UK: "Climate impacts on North Atlantic ecosystems: the relevance of plankton monitoring to NAFO"); Chair: E. Colbourne

2007 Invited speaker – (Dr. Andrew Kenny, CEFAS, Lowestoft, U.K.: "Integrated Assessment of the North Sea Ecosystem"); Chair: E. Colbourne

2008 Invited speaker – (Dr. Rodolphe Devillers, MUN, St. John's, NFLD: "GEOCOD: Integrating Environmental Information and Fisheries Data"); Chair: G. Maillet

2009 Invited speaker – (Dr. Erica Head, BIO; Dartmouth, NS: "Spatial and temporal variability in plankton abundance and composition in the NW Atlantic, as indicated by observations from BIO cruises on the L3 (AR7W) line in the Labrador Sea and from Continuous Plankton Recorder sampling in the southern Labrador Sea and on the Newfoundland and Scotian shelves"); Interim Chair: M. Stein

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

Chair: Margaret Treble Rapporteur: Manfred Stein

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 5 and 11 June 2010, to consider publication-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Russian Federation and the 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 1515 hours by welcoming the participants.

2. Appointment of Rapporteur

Manfred Stein (EU-Germany) was appointed rapporteur.

3. Adoption of Agenda

The Agenda as given in the Provisional Agenda (GFS/10-122, dated 01 April 2010) was adopted with the addition of items 5c, 6b and 6c.

4. Review of Recommendations in 2009

Recommendations from June

STACPUB had **recommended** that *a coral guide be published in the NAFO Studies Series in a waterproof format as well as an electronic format that would be available to on the website*.

STATUS: A booklet with waterproof pages containing the coral guide has been prepared by the Secretariat. The electronic version of the coral guide was mounted to the NAFO website as NAFO Scientific Council Studies 42.

5. Review of Publications

a) Annual Summary

i) Journal of Northwest Atlantic Fishery Science (JNAFS)

STACPUB was informed that: A total of 11 papers were accepted for Volume 42, The Role of Marine Mammals in the Ecosystem in the 21st Century volume, and all are now online. Only two of the submitted papers were not published; one was rejected and the other required a substantial re-write and was not re-submitted. The last article was uploaded on 27 May 2010 and the paper copy is planned to be printed in early June 2010. There are no plans to produce a hardcover print version since Vol. 41 had low orders.

A total of 6 papers have been submitted for publication in Volume 43, of which two have been accepted and are online, one has been accepted and is at the proof stage, and the others are in the review process. The paper copy is planned to be printed in January 2011.

ii) NAFO coral and sponge identification guides

STACPUB was informed that: A coral guide was printed in 2009 on waterproof paper and coil bound. It has a total of 34 pages and there were 200 copies made in 2009 and circulated with the CEM in December. A further 30 copies printed in 2010 for more specific distribution mainly following requests from research laboratories. This publication is used to identify corals in the NAFO Area. A translation into Russian was also published by PINRO in 2010.

STACPUB **recommended** that *a sponge guide be published in the NAFO Studies Series in a waterproof format as well as an electronic format that would be available on the website.*

iii) Digital Objects Identifier system (DOIs)

STACPUB was informed that: DOI submissions for recently published JNAFS articles are complete to date and are now being assigned to past volumes. To date Volume 13 and onwards have been completed with plans to input volumes 1-12 as time permits. This will make it easier to find JNAFS articles on-line and will hopefully encourage authors to cite JNAFS articles more often.

iv) Aquatic Science and Fisheries Abstracts (ASFA)

STACPUB was informed that: The NAFO Secretariat is an "ASFA Input Centre" and submits metadata for its publications to be included in the ASFA database that is disseminated to libraries and institutions worldwide. As of June 2010, all ASFA entries are up to date, partially thanks to an auto-indexing initiative by the publisher ProQuest. This initiative halves the time taken to enter records by using software to assign category and descriptor fields, though it still takes around 10-15 minutes per record. The NAFO Secretariat is one of three test centres performing an evaluation of the auto-indexing software. The SC Coordinator will be attending an ASFA board meeting in Morocco in July 2010 to discuss this and other ASFA related issues.

v) NAFO Scientific Council Studies

STACPUB was informed that: The Coral Identification Guide was produced as Studies Issue No. 42 and is available from NAFO's webpages.

All past volumes of the Studies series have been uploaded and are now available on the public NAFO website.

vi) NAFO Scientific Council Reports

STACPUB was informed that: A total of 75 printed copies of the NAFO Scientific Council Reports 2009 (Redbook) volume (325 pages) were produced in May 2009. The Redbook contained reports of the June, September, and November 2009 Scientific Council meetings, along with a list of NAFO publications relevant to the meetings and contact details for participants. Also included, were the NAFO shrimp stocks assessed at the NAFO/ICES *Pandalus* Assessment Group (NIPAG) meeting. This book was distributed to participants of Scientific Council meeting of June 2010.

The website publication of Reports of all Scientific Council Meetings held in 2009 was prepared as meeting reports were finalized. 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 2009.

vii) Progress report of Index and Lists of Titles

STACPUB was informed that: The provisional index and lists of titles of 70 research documents (SCR Docs) and 24 summary documents (SCS Docs) that were presented at the Scientific Council Meetings during 2009 were compiled and presented in SCS Doc. 10/09 for this June 2010 Meeting. This document will no longer be produced after this year due to the search feature for the web documents that will be presented by the Secretariat during this meeting.

viii) Historical document digitizing

STACPUB was informed that: In 2009 the NAFO Secretariat began a project to digitize historical documents. A student was hired over the summer and began to scan meeting documents, starting in 1979. During the 200 hours he worked approximately 950 documents were scanned and meta-data about these documents entered. In 2010 the Secretariat began to check these documents for quality and upload them to the web. To date the 1979 and 1980 meeting documents (SCR, SCS, FC and GC) have been completed and work has begun on 1981.

It was also decided to digitize previous volumes of the Meeting Proceedings and Scientific Council Reports. This project has been completed back to 1995/96.

This year the Secretariat has plans and a budget, to continue to scan and check further meeting documentation and eventually all NAFO publications. These documents will be uploaded periodically as work is completed and time permits.

ix) Progress report of meeting documentation CD

STACPUB was informed that: Approximately 300 copies of the Meeting Documentation CD 2009 were produced. The CD contains:

- GC/FC Proceedings 08-09
- GC/FC Report Sep 09
- SC Reports 2009
- NAFO Convention
- NCEM 2010
- Rules of Procedure
- Annual Report 2009

The CD will be placed in the back of both the 2009 Scientific Council Reports and the 2009/10 Meeting Proceedings for General Council and Fisheries Commission. The CD was also distributed to a mailing list consisting of Libraries and Institutes.

b) Guidelines for SCR Documents

STACPUB discussed the treatment of SCR documents at the Working Group level. STACPUB indicated the importance to incorporate historic SCR documents in the electronic archives of NAFO and it was felt that there should be standards maintained in these kinds of scientific documents. STACPUB agreed to implement the following guidelines for SCR documents:

SCR Documents are produced to support plenary, standing committee and working group meetings of Scientific Council. They should be scientific in nature and content and as far as possible. SCR Documents should be clearly written following normal scientific language with figures, tables and literature being appropriately referenced. They should include an abstract not exceeding 250 words[1] and the statement "NOT TO BE CITED WITHOUT PRIOR REFERENCE TO THE AUTHOR(S)". SCR Documents represent the work of the authors and not necessarily the views of the meeting in which it was presented. SCR Documents are placed on the public pages of the NAFO website and are considered as internal NAFO reports.

SCR Documents must be presented in person by the author or their designate, discussed at the appropriate meeting and changes requested by the Chair incorporated. SCR Documents are not formally reviewed. Acceptance of SCR Documents is undertaken by the Chair. The Chair may refer the matter to the Scientific Council Executive Committee for their decision or advice as appropriate.

Content of Paper

The paper should be in English. The sequence should generally follow: Title, Abstract, Text, References, Tables and Figures. Authors can decide if they would like Tables and Figures throughout the text or following the text.

Title

The paper should start with the title, followed by the name(s), address(es) and emails of the author(s) including professional affiliation, and any related footnotes.

[1] *NAFO Sci. Coun. Rep*., 1999. p. 33

Abstract

An informative concise abstract should be provided not exceeding 250 words.

Text

In general, the text should be organized into Introduction, Materials and Methods, Results, Discussion, and Acknowledgements.

Introduction should be limited to the purpose and rationale of the study.

Materials and Methods should describe in sufficient detail the materials and methods used, so as to enable other scientists to evaluate or replicate the work.

Results should answer the questions evolving from the purpose of the study in a comprehensive manner and in an orderly and coherent sequence, with supporting tables and figures.

Discussion should explain the main contributions from the study, with appropriate interpretation of the results focusing on the problem or hypothesis. Comparisons with other studies should be included here.

Acknowledgements should be limited to the names of individuals who provided significant scientific and technical support, including reviewers, during the preparation of the paper, and the names of agencies which provided financial support.

References

The references cited in the text should be listed alphabetically. References should be mainly restricted to significant published literature. Unpublished documents and data, papers in preparation, and papers awaiting acceptance to other journals, may be cited with full contact addresses as unpublished or personal communications.

Tables and Figures

Tables and Figures must be numbered consecutively and have concise and descriptive captions. Figures should normally be submitted in black and white. Colour plots and photographs are acceptable only if colour is essential to the content. SCR Documents are printed in black and white but coloured figures are included in the pdfs on the website.

c) Document Search Feature for the Web

The Secretariat identified that the current search feature on the JNAFS website was beginning to be unwieldy. It was decided that a new, sleeker search function was required for this site. In addition, the historical meeting documents are beginning to be scanned and placed on the public website and it was felt that a search feature would be a good addition to this area.

The NAFO Secretariat developed a search feature for the JNAFS site and in future this development will also be used for the historical documents section. The JNAFS beta-search can be found at: http://www.nafo.int/search. There are still some quality control issues which should be addressed before this becomes publicly accessible.

6. Other Matters

a) Application to Thomson Web of Knowledge

An application was made on 15 May 2007 for JNAFS to be evaluated by Thomson Scientific for inclusion in their Web of Knowledge and given a citation index. The Secretariat was informed on 1 June 2010 that the application was unsuccessful. A previous application was also unsuccessful.

b) Webstats

The www.nafo.int continues to attract interest. The stats are fairly evenly distributed with a drop on the weekend days. The 2 large dips reveal holes in the database. Considerable time has been put in to removing the number of artificial hits made by crawlers. As well, NAFO uses frames to display its web-pages and this causes a bit of confusion in getting clean web statistics, By looking at the detailed numbers though it is obvious that some of the main page hits are the Media pages, the IUU list, the SC publications page, the CEM and the map, as well as hits on the general pages such as the Convention and the history.

The NAFO website team is beginning to look at ways to improve the site and earlier this year a survey was emailed to all NAFO contacts seeking feedback. To date there have been quite a few responses and the comments will be taken into consideration later this year when the website is updated.

As would be expected Volume 41, the Reproductive Potential Symposium volume and papers within this volume, received quite a lot of interest. Volumes 40 and 42 were also among the top hits as well. The general front pages were viewed many times and individual papers from Vol. 35 remain in the top 100.

c) General Editors Report JNAFS

JNAFS continues to publish high-quality research articles of relevance to the NAFO Convention Area. There is a dedicated core of Associate Editors that assist authors in ensuring that publications maintain the quality required for JNAFS. There is a continuing trend that submissions of regular articles are declining, especially from work undertaken within the NAFO Area. JNAFS does accept studies from other areas, but this is usually because of their relevance and applicability to work within the NAFO Area. It was the intention to produce one regular issue each year, supplemented by symposium issues according to the symposium special meeting schedule. It was therefore disappointing that too few articles were received in 2008 to have an "annual" Volume 40 and this had to be combined with 2009 to produce the seven published articles. Volumes 41 and 42 are symposium issues, and volume 43 is now filling up with regular articles.

It seems likely that JNAFS will continue at its present capacity for the coming years.

7. Adjournment

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 1830 hours on 11 June 2010.

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

Chair: Carsten Hvingel Rapporteur: Phil Large

The Committee met at Alderney Landing, at 2 Ochterloney Street, Dartmouth, Nova Scotia, during 5-14 June 2010 to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, Denmark (Greenland), European Union (France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, Russian Federation, and United States of America. The Scientific Council Coordinator was in attendance.

1. Opening

The Chair opened the meeting at 0900 hours on 5 June 2010, welcomed all the participants and thanked the Secretariat for providing support for the meeting. The Chair proposed some minor adjustments to the agenda, which was then adopted.

2. Appointment of Rapporteur

Phil Large was appointed as rapporteur.

3. Review of Previous Recommendations

Sampling of commercial fisheries

In 2009 STACREC noted that sampling of commercial fisheries has become sporadic for some stocks, creating difficulties in producing representative catch-at-age. Given the importance of commercial sampling to the assessments, STACREC **recommended** that *Contracting Parties make greater efforts to ensure that sampling of commercial fisheries is representative for all stocks, whether taken in directed fisheries or as bycatch*.

It was agreed that further work was required to address this recommendation and that this may require reviewing procedures applied in other RFMOs e.g. CCAMLR. STACREC again **recommended** that *Contracting Parties make greater efforts to ensure that sampling of commercial fisheries is representative for all stocks, whether taken in directed fisheries or as bycatch.*

4. Fishery Statistics

a) Catch Data Used by STACFIS

i) Process for compilation of catch data

The compilation of comprehensive and accurate catch data is fundamental to the work of NAFO. The catch figures are fundamental to providing the best scientific advice and are the most important input data to the stock assessments. Catch figures scale the estimates of stock size and reference points and thus directly affect scientific advice.

Large resources are allocated by NAFO and Contracting Parties to acquire reliable catch data e.g. via onboard observers, control at sea, landing control and VMS. In spite of this effort and the overall importance of these data in the work of NAFO, meeting the deadline of 1 May for the submission of STATLANT 21A data to the Secretariat continues to be a problem: some countries do not submit on time and data quality issues persist for some stocks.

Following discussion of a wide range of issues including:

- the recording and accessibility of data compilation procedures used by Scientific Council;
- the accessibility of data at the NAFO Division level;
- the maintenance of stock-specific catch compilation records by DEs;
- the need to make greater use of observer records of catches;
- the need to make greater use of VMS for effort and catch estimation;
- the need for uncertainty about catch estimates to be quantified;
- the need for explicit information on discards.

STACREC **recommended** that for 2011 *the Secretariat draft a working paper describing all the catch related data available to Scientific Council (including weekly reporting, observer, VMS and discard data).*

In addition, STACREC **recommended** that *the Secretariat routinely send a reminder to Contracting Parties/countries by mid April and again by 2 May to those that have not submitted STATLANT 21A data and report to Scientific Council regarding the nature and extent of outstanding problems*. STACREC **recommended** that *DEs compile historical catch data in as finer scale (ideally by NAFO Division) and for as many years as possible.*

ii) The use of "catch" in Scientific Council reports

STACREC noted that there is an increasing use in scientific reports (particularly at ICES) of "landings" and "landings per-unit effort" (LPUE) in instances when discard data are not available and the use of "catch" and "catch per-unit-effort" (CPUE) only when discard data are included (even if zero). However, it is noted that there may be a potential conflict with the STATLANT guidelines that are based on the CWP Handbook of Fishery Statistical Standards where the term "Nominal Catches" refers to landings converted to live weight.

iii) STATLANT figures in reports and catch tables

STACREC noted that in Scientific Council Reports references are made to STATLANT 21A data even though these data are updated for previous years when STATLANT 21B data become available. STACREC **recommended** that *reports and catch tables refer to STATLANT data as "STATLANT 21" data.*

b) Progress Report on Secretariat Activities in 2009/2010

i) STATLANT 21A and 21B

In accordance with Rule 4.4 of the Rules of Procedure of the Scientific Council, as amended by Scientific Council in June 2006, the deadline dates for this year's submission of STATLANT 21A data and 21B data for the preceding year are 1 May and 31 August, respectively. The Secretariat produced a compilation of the countries that have submitted to STATLANT and made this available to the meeting (Table 1 and SCS Doc. 10/23).

Table 1. Dates of receipt of STATLANT 21A and 21B reports for 2007-2009 up to 3 June 2010.

Country/Component	STATLANT 21A (deadline, 1 May)			STATLANT 21B (deadline, 31 August)		
	2007	2008	2009	2007	2008	2009
CAN-CA	22 Feb 08	30 Mar 09	31 Mar 10	3 Jul 08	31 Aug 09	
CAN-M						
- CAN-SF	7 Nov 08	15 May 09	14 May 10	10 Nov 08		21 May 10
- CAN-G	26 May 08	10 Jun 09	2 Jun 10	4 Nov 08	6 Oct 09	
CAN-N	21 May 08	29 May 09	29 Apr 10	29 Aug 08	31 Aug 09	
CAN-Q	Dec 07	27 Apr 09		7 Nov 08		
CUB	30 Apr 08					
E/EST**	8 Apr 08	4 May 09	30 Apr 10	8 Apr 08	4 Sep 09	
E/DNK	21 May 08	25 May 09	24 May 10	21 May 08	25 May 09	24 May 10
E/FRA-M						
E/DEU	23 Apr 08	27 Apr 09	27 Apr 10	28 Aug 08	21 Aug 09	
E/NLD						
E/LVA**	8 Apr 08	1 Apr 09	2 Jun 10	28 Jul 08	3 Aug 09	
E/LTU**	24 Apr 08	10 Jun 09				
E/POL**		2 Jun 09 (n.f.)				
E/PRT	29 Apr 08	29 Apr 09	11 May 10	4 Sep 08	31 Aug 09	
E/ESP	4 Jun08	2 Jun 09	3 Jun 10	4 Jun 08	2 Jun 09	3 Jun 10
E/GBR	21 May 08 (n.f.)	2 Jun 09	2 Jun 10	-	1 Sep 09	
FRO	30 May 08	16 Jul 09	1 Jun 10	30 May 08	16 Jul 09	1 Jun 10
GRL						
ISL	30 May 08 (n.f.)	11 May 09		-		
JPN	25 Apr 08	1 May 09		25 Apr 08	10 Aug 09	
KOR						
NOR	30 Apr 08	4 Jun 09	15 Apr 10	3 Oct 08		
RUS	20 May 08	18 May 09	3 Jun 10		9 Jul 09	
USA		26 May 10				
FRA-SP	10 Sep 08	11 May 09	2 Jun 10	11 May 09	11 May 09	
UKR						

The Secretariat gave a presentation on a new interface for submitting queries for STATLANT 21A data. If required a similar interface can be developed to query STATLANT 21B data (including effort data).

ii) Codes for invertebrates

STACREC noted that FAO 3-letter alpha codes are not available for most coral and sponges, either at the species or higher taxonomic levels, that occur in the NAFO area, The Secretariat advised that this is not a CWP issue and may require proposals to be submitted to FAO. STACREC **recommended** that *this issue be addressed by WGEAFM.*

5. Research Activities

a) Biological Sampling

i) Report on activities in 2009/2010

STACREC reviewed the list of Biological Sampling Data for 2009 (SCS Doc. 10/13) 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 2010 Meeting.

ii) Report by National Representatives on commercial sampling conducted

Canada-Newfoundland (SCS Doc. 10/10**):** Information was obtained from the various fisheries taking place in all areas from Subareas 0, 2, 3 and portions of Subarea 4. Information was included on fisheries and associated sampling for the following stocks/species: 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. 3KLMNO), 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).

EU-Portugal (SCS Doc 10/7): Data on catch rates were obtained from trawl catches for Greenland halibut (Div. 3LMNO), redfish (Div. 3MO), skates (Div. 3LNO) and roughhead grenadier (Div. 3N). Data on length composition of the catch were obtained for Greenland halibut (Div. 3LMNO), redfish *S. mentella* (Div. 3LMNO), American plaice (Div. 3LMNO), roughhead grenadier (Div. 3LMNO) and thorny skate (Div. 3LMNO). Cod (Div. 3MNO). Spinytail skate (Div. 3LMN). Witch flounder (Div. 3LO). Atlantic halibut (Div. 3NO). Redfish *S. marinus* (Div. 3M), haddock (Div. 3M), yellowtail flounder (Div. 3N) and white hake (Div. 3O).

EU-Spain (SCS Doc. 10/06)**:** All effort and catch information in the Spanish Research Report are based on information from NAFO observers on board. In 2009 information from 1459 days was available while total effort of the Spanish fleet in NAFO Regulatory Area (Div. 3LMNO and 6G) was 1470 days (99% coverage). Spanish fleet has, at least, four different fisheries in NAFO Subarea 3 characterized by different mesh size, target species, depth and fishing area. The Spanish fleet effort in NAFO area is mainly directed to Greenland halibut (mostly in Div. 3LM), alternating with the skate fishery in the second half of the year (Div. 3NO), shrimp fishery (Div. 3LM), and in less degree redfish (Div. 3O and Div. 3M).

In addition to NAFO observers, IEO scientific observers were on board 241 fishing days that it means 16.5 % of the Spanish total effort. All length, age and biological information presented are based on sampling carried out by IEO observers: in 2009, 233 samples were taken, with 30 418 individuals of different species examined. Data on catch, length and age composition of the Spanish trawl catches were obtained for Greenland halibut and roughhead grenadier. Catches length composition were obtained for cod, redfish, American plaice, witch flounder, yellowtail flounder, skates and *Beryx splendens*.

Denmark/Greenland (SCS Doc. 10/12): Denmark/Greenland. Length frequencies were available from the Greenland trawl fishery in Div. 1A and Div. 1D and CPUE data were available from the Greenland trawl fishery in Div. 1A and 1CD. (SCR Doc. 10/34). Length and age compositions were available from the inshore long line and gillnet fishery in inshore in Div. 1A.

EU-Estonia: No submission.

EU-Germany (SCS Doc. 10/08): Demersal fishing effort decreased in Div. 1D inside the Greenland EEZ from 2230 hours in 2007 to 1891 hours in 2008 and 1781 h in 2009. The fishery was directed towards Greenland halibut (*Reinhardtius hippoglossoides*). Reported landings amounted to 1493 t of Greenland halibut. The bycatch of roundnose grenadiers was < 1 t in 2008 and 2009 compared to 2.2 t (2006) to about 4 t (2007). Wolffish and skates were not reported as bycatch (presumably less than 1 ton). In 2009, catches in the German commercial cod fisheries in Div. 1F dropped from 2415 t in 2008 to 370 t. Size distributions and CPUEs are presented.

EU-Latvia (SCS Doc. 10/16): Latvian fishery in NAFO area in 2009 was conducted by one vessel. Catches: redfish in Div. 1F – 79 t, Div. 3M – 58.6 t, Pandalid shrimp in Div. 3M -1198.5 t and in Div. 3L – 334 t.

All Latvian length/weight sampling of catches and discards by species in 2009 from TBS trawl catches for Pandalid shrimps in the Div. 3M and Div. 3L was carried out by NAFO/scientific observers. The observers are employed by the Latvian Institute of Food Safety, Animal Health and Environment "BIOR", and they are specially trained to collect also the basic scientific data. From bottom trawl Pandalid shrimp fishery in Div. 3L and 3M the total number of 33 samples were taken with 3576 northern prawn and 839 discarded redfish measurements. Estimates of discard total amounts from NAFO observer's data on Latvian Pandalid shrimps directed fishery by species is available. In 2009 EU-Latvia did not conducted redfish sampling in Div. 1F and 3M.

EU-Lithuania No submission.

Russia (SCS Doc. 10/05): In 2009 Russian fishing vessels operated in SA 1 and SA 3. The fishery was mainly directed on Greenland halibut in Div. 1A, 1CD, 3LMN and deep-water redfish in Div. 3MNO. Data on catch, sex, maturity, age, individual weight and length composition obtained from Russian trawl catches for Greenland halibut (Divs. 1AD, Div. 3LN) and redfish (Div.3LN) were available. Data on catch and length composition on roughhead grenadier (Div. 3LN), American plaice (Div. 3L), threebeard rockling (Div. 3LN), thorny skate (Div. 3L), witch flounder (Div. 3LN), black dogfish (Div. 3LN), northern wolfish (Div. 3LN), roughnose grenadier (Div. 3LN), blue hake (Div. 3LN), and common grenadier (Div. 3LN) were also presented.

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

Designated Experts were reminded to provide available data from commercial fisheries to the Secretariat for inclusion on the member's pages.

b) Biological Surveys

i) Review of survey activities in 2009 (by National Representatives and Designated Experts)

Canada (SCS Doc. 10/10) 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 2009 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2J3KLMNO. The spring survey was conducted from April to late June, and consisted of tows, (297 in Div. 3LNO) with the Campelen 1800 trawl, by the research vessels *Alfred Needler* and *Teleost*. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to December, and consisted of 586 tows with the Campelen 1800 trawl. Three research vessels were used: *Teleost* and *Alfred Needler,* and this survey continued a time series begun in 1977. Additional surveys during 2009, directed at various species using a variety of designs and fishing gears, were described in detail in SCS Doc. 10/10 and in other documents. Oceanographic surveys were discussed in detail in STACFEN.

EU-Spain (SCS Doc. 10/6): The Spanish bottom trawl survey in NAFO Regulatory area Div. 3NO was conducted from 31 May to 18 June 2009 on board R/V *Vizconde de Eza* using Campelen gear with a stratified design. A total of 111 hauls were carried out to a depth between 41 and 1 424 m, two of those which were null. The results of the Spanish 3NO bottom trawl survey, including biomass indices with their errors and length distributions, as well as the calculated biomass based on conversion of length frequencies for Greenland halibut, American plaice, Atlantic cod, Yellowtail flounder, Thorny skate, White hake and Roughhead grenadier are presented as Scientific Council Research documents. A total of 95 hydrographic profile samplings were made. Material for histological maturity, fecundity and growth studies of Cod, American place and Greenland halibut were taken.

In 2009, the bottom trawl survey in Flemish Pass (Div. 3L) was carry out on board R/V *Vizconde de Eza* using the usual survey gear (Campelen 1800) from July 25th to August 12th. The area surveyed was Flemish Pass to depths up 800 fathoms (1463 m) following the same procedure as in previous years. The number of hauls was 103 and 5 of them were nulls. Survey results including abundance indices and length distributions of the main commercial species are presented as Scientific Council Research (SCR) documents. Samples for histological (Greenland halibut, American plaice) and ageing (Greenland halibut, American plaice, roughhead grenadier and cod) studies were taken. Ninety five hydrographic profile samplings were made in a depth range of 106-1366 m.

In 2007 the Spanish administration obtained a license from Canadian Authorities to carry out a research survey inside of the Canadian waters in 3L Division. In 2009 this survey was made by the R/V *Vizconde de Eza*, covering 14 strata in the north of Div. 3L, using a Campelen survey gear up to 1420 meters depth and following the same procedures as in 3NO survey. The original plan could not be completed and only 37 valid fishing operations, instead of the 44 initially planned, were carried out. Due to the low number of hauls these results should be considered with caution.

EU–Spain and Portugal (SCS Doc. 10/6, 7): The EU bottom trawl survey in Flemish Cap (Div. 3M) was carried out on board R/V *Vizconde de Eza* using the usual survey gear (Lofoten) from June 21th to July 23th 2009. The area surveyed was Flemish Cap Bank to depths up to 800 fathoms (1 460 m) following the same procedure as in previous years. The number of hauls was 184 and six of them were nulls. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, roughhead grenadier and Greenland halibut are presented as Scientific Council Research documents. Samples for histological assessment of sexual maturity of cod, redfish, Greenland halibut and Roughhead grenadier were taken. Oceanography studies continued to take place.

EU Spain, United Kingdom, Canada and Russia (SCS Doc. 10/6): NEREIDA Project: The main objective of NEREIDA project is focused on the implementation of the Ecosystem Approach to the fisheries management in order to identify Vulnerable Marine Ecosystems (VMEs), paying special attention to the cold water corals and sponges. Geographically, the study area covers between the 200 miles of the Canadian EEZ and the 700-2000 m isobaths in High Seas of the Atlantic Northwestern. Three different surveys were made in 2009 between June and August on board R/V *Miguel de Oliver*. Different geological, ecological and biological samples and studies were carried during the surveys.

Denmark/Greenland (SCR Doc. 10/12): Denmark/Greenland: The West Greenland standard oceanographic stations were surveyed in 2009 as in previous years. Further, a number of oceanographic stations were taken in four different fjord systems at Southwest Greenland (SCR Doc. 10/04).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2009. In July-August 271 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.10/30).

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 1997-2009 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 2009 68 valid hauls were made. During the survey about 2100 Greenland halibut were tagged with floy-tags. (SCR Doc. 10/11).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2006 the longline survey was conducted in Uummannaq and Disko Bay (SCR 08/39) (no longline survey since 2006).

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2008 a total of 30 gillnet settings were made along 4 transect. Each gillnet was composed of four panels with different mesh size (46, 55, 60 and 70 mm stretch meshes). No gillnet survey in 2009.

EU-Germany (SCS Doc. 10/8): Since 1982, annual groundfish surveys were conducted as fourth quarter stratified random surveys covering the shelf areas and the continental slope off West Greenland (Divisions 1B-1F) outside the 3-mile limit to the 400 m isobath. In October-November 2009, 34 valid hauls were carried while covering 80 % 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 wolfish (*Anarhichas lupus*), and thorny skate (*Amblyraja radiata*) are documented in Appendix IV, section III.A for respective SA1 stocks.

USA (SCS Doc 10/11): Highlights of the report include information on three stocks: Cape Cod-Gulf of Maine yellowtail flounder, Atlantic halibut, and Subarea 5 Northern Shrimp. An extensive description of the research into determination of the relationship of hydrography to the distribution of the invasive colonial tunicate *Didemnum vexillum* is given. Finally, a section detailing the calibration of the R/V *Albatross IV* to the new FSV *Henry B. Bigelow* with a link to the NEFSC Reference Document was presented.

ii) Surveys planned for 2010 and early 2011

International Nereida Survey on VMEs in the NRA

During the three summer 2010 surveys multibeam data and high resolution seismic mapping along with ground truth samples (rock dredge and box corer) will continue from 46º 30’ N in a southward direction to the tail of the Grand Bank. An extension to the sampling scheme stretching into Canadian waters is planned in order to give a complete coverage of the canyons in surveyed areas.

DFO RV Hudson Survey July 2010

A research mission is planned for July 7-27, 2010 on board the Canadian Coast Guard Vessel, *Hudson*. This mission is a collaborative effort between the Canadian Department of Fisheries and Oceans (DFO), Memorial University of Newfoundland, the University of Quebec at Montreal, and international NEREIDA project, led by Spain. The purpose of the mission is to increase our understanding of the deep-sea benthos in biologically important and unexplored areas in the NRA by:

- Deploying and retrieving current meters from a location within the Gully MPA, which could improve understanding of micro-habitat selection processes of coral;
- Collecting coral specimens in an effort to better understand their reproductive biology and genetic connectivity (All locations);
- Visually assessing the impact of trawling on deep-sea vulnerable marine ecosystems (e.g. coral, sponge and related organisms) in relation to recently dedicated closure areas on Flemish Cap;
- Collecting rock, sediment and dead coral samples to better understand the current and past geological processes of the location being studied (Flemish Cap, Orphan Knoll, Tobin’s Point);
- Exploring previously described “mound” features of unknown origin on Orphan Knoll;
- Describing the biology and geology at strategically placed mooring locations around the periphery of Orphan Knoll – this information should help resolve some lingering questions concerning current and water mass movement around the knoll;
- Retrieving 2 moorings at specific locations around Orphan Knoll;
- Collect data on ground fish distribution and abundance by running specially designed fish transects at Tobin’s Point;
- Collecting CTD data from deployment locations in Flemish Cap, Orphan Knoll and Tobin’s Point.

The mission will utilize the remotely operated vehicle ROPOS (www.ropos.com), and at each location extensive video surveys will be conducted to extend our understanding of the bathymetric distribution of corals, sponges and associated organisms in relation to habitat (i.e., depth, slope, substrate (class; grain size, carbon content)) to depths of 3000 m. Nearly every dive will involve:

- An initial multibeam by ROPOS at the start location of the transect (1 hr);
- Collection and real-time biological/geological analysis of forward and downward facing HD video;
- Specimen and geological sample collection;
- Water sampling and analysis;

- Waypoints for collection when necessary;
- Digital still imagery of pertinent specimens and collected biological/geological samples;
- Push-core collections at specified locations along each transect, and;
- Upon retrieval of ROPOS, deployment of CTD.

Other surveys

An inventory of biological surveys planned for 2009 and early 2010, 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 2010 Meeting.

c) Stock Assessment Spreadsheets – Update

STACREC discussed the compilation of the stock assessment spreadsheets and concluded that this was an important exercise and the Designated Experts should be encouraged to continue this practice and submit spreadsheets to the Secretariat.

d) Other Research Activities

No new activities were reported.

6. Cooperation with other Organizations

a) Coordinating Working Party on Fishery Statistics (CWP)

At the CWP in February 2010 in Hobart, the NAFO Secretariat raised the issue of 3-letter alpha codes for invertebrates (see 4.b.ii above).

7. Review of SCR and SCS Documents

The following papers were available to STACREC:

SCR Doc. 10/2. V.V. Paramov. Infestation of beaked redfish *Sebastes mentella by* copepod *Sphyrion lumpi* in the different regions of fishing in the opened part of North Atlantic.

SCR Doc. 10/3. V.V. Paramov. Pigmented patches of beaked redfish *Sebastes mentella* in the different regions of fishing in the opened part of North Atlantic.

STACREC decided not to address these documents as they were not presented, but was otherwise not sure how to deal with such submissions and agreed to defer this question to STACPUB for further clarification.

8. Other Matters

a) Tagging Activities

STACREC noted that information on tagging activities in the Northwest Atlantic has been published by the Secretariat in SCS Doc. 10/14.

b) Manual of Groundfish Surveys

It was reported to STACREC that no further progress had been made.

c) Sponge Guide

STACREC noted that a first draft of a Guide to Sponges in the NAFO Convention Area will be available towards the end of 2010.

d) Other Business

i) Data sharing

STACREC noted that NAFO WGEAFM had encountered problems accessing research data for VME indicator species from some Contracting Parties. The lack of full access to raw data for all WGEAFM members has caused some delays in their work and may eventually prevent WGEAFM from fully and effectively addressing its ToRs in the future.

The work of WGEAFM involves spatial analyses to identify and delineate areas with high concentration of VME-forming species (like corals and sponges). These analyses require unprocessed data (raw-data) e.g. from research surveys carried-out by different contracting parties combined in a single data set. There is no established practice for the sharing of raw data within NAFO.

STACREC **recommended** that *Scientific Council encourage research institutions from all Contracting Parties to share their survey data at the level of detail necessary for WGEAFM*. Equally important, STACREC **recommended** *Scientific Council to instruct WGEAFM that any data shared as part of its work towards addressing Scientific Council requests should neither be distributed outside WGEAFM nor used for purposes other than addressing WGEAFM ToRs without documented permission from the institution where the data originated and properly cited in all documents produced.*

There is a need to established protocols for the sharing of aggregated and/or raw data among NAFO Contracting Parties and Scientific Committees.

STACREC **recommended** that *the NAFO Secretariat prepare a document for presentation at the next meeting of STACREC on (1) "Guidelines for data acquisition from Contracting Parties" and (2) a draft pro-forma MOU between NAFO and the data-owners (here taken to usually be the national research labs who collected the data) to cover data use agreements.*

STACREC further noted the ongoing initiatives to record more detailed data (particularly on VME indicator species such as corals and sponge) from the fishery operations in the NRA, and that the work of SC would benefit from having access to such data as they become available to the Secretariat.

ii) Research and data needs

To facilitate the compilation of overviews of research and data needs for NAFO stocks, STACREC **recommended** that *DEs compile this information for their stocks and forward to the Secretariat for inclusion in a future SCS document/working paper.*

9. Adjournment

The Chair thanked the participants for their valuable contributions to the Committee. Special thanks were extended to the rapporteur and to the 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 adjourned the meeting at 1100 hours on 14 June.

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

Chair: Joanne Morgan Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, from 3 to 16 June 2010, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain fish stocks. Representatives attended from Canada, Denmark (in respect of the Faroe Islands and Greenland), the European Union (France, Germany, Latvia, Lithuania, Portugal, Spain and United Kingdom), Japan, the Russian Federation, and the United States of America. Various members of the Committee, notably the designated stock experts, were significant in the preparation of the report considered by the Committee.

The Chairman, Joanne Morgan (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 with minor changes. STACFIS was informed by Scientific Council about changes in Designated Experts for certain stocks and noted that an assessment expert had been designated for Northern shortfin squid in SA 3+4.

STACFIS noted the request to conduct a full assessment of American in Div. 3LNO in 2009 (Annex 1.12). STACFIS also noted that with a designated expert available for Northern shortfin squid in SA 3+4 there would be a full assessment of this stock in 2010.

II. GENERAL REVIEW

1. Review of Recommendations in 2007 and 2009

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: Once again timely and reliable catch estimates were a problem.

Greenland halibut (*Reinhardtius hippoglossoides*) in SA 0, Div. 1A offshore and Div. 1B-F

STACFIS **recommended** that *catch rates in the gillnet fisheries in Div. 0A and 0B should be made available before the assessment in 2010.*

STATUS: No progress

Demersal redfish (*Sebastes* spp.) in SA 1

STACFIS reiterated the **recommendation** that *the species composition and quantity of redfish discarded in the shrimp fishery in Subarea 1 be further investigated.*

STATUS: No progress

Other finfish in SA 1

STACFIS reiterated the **recommendation** that *the species composition and quantity of other finfish discarded in the shrimp fishery in Subarea 1 be further investigated.*

STATUS: no further progress since the study reported in SCR Doc. 07/88.

STACFIS reiterated the **recommendation** that *the distribution of these species in relation to the main shrimp-fishing grounds in SA1 be investigated, in order to further discover means of reducing the amount of discarded bycatch.*

STATUS: no progress.

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

Seeing that the biomass of Div. 3M cod is increasing and the distribution of redfish fishery appears to be changing, STACFIS **recommended** that *cod bycatch should be more thoroughly investigated and the levels of commercial sampling increase.*

STATUS: No progress. However, with the opening of the fishery the cod fishery will now be directed and sampling of this fishery will occur.

STACFIS noted that the short term development of this stock will be dependent on recent year-classes and therefore it **recommended** that *the stock be fully assessed in 2010.*

STATUS: The stock was assessed in 2010.

Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 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 reported.

American plaice (*Hippoglossoides platessoides*) in Div. 3M

Average F in recent years has been very low relative to 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 or stock production models) be attempted in the next full assessment of Div. 3M American plaice.*

STATUS: the next full assessment of this stock will be in 2011 and this recommendation will be explored at that time.

Because ages below 3 are not well selected in the EU survey series STACFIS also reiterates its **recommendation** that *exploratory runs of the XSA should be done with the input data starting at age 3 or 4*.

STATUS: this will be explored in the next full assessment, planned for 2011.

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

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 progress.

Capelin (*Mallotus villosus*) in Div. 3NO

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

STATUS: Acoustic data have been collected during the Canadian autumn survey during 2008 and 2009. These data are partially processed.

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

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 model to this stock.*

STATUS: A surplus production model was attempted again in this assessment. However, results were not tabled as model fit was extremely poor, perhaps due to poor contrast in the input data, and indices were poorly correlated.

White hake (*Urophycis tenuis*) in Div. 3NO and Subdiv. 3Ps

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

STATUS: Tissue samples have been collected and genetic studies are ongoing.

STACFIS **recommended** that *the collection of information on commercial catches of white hake be continued and now include sampling for age, sex and maturity to determine if this is a recruitment fishery*.

STATUS: Commercial catches now include sampling for age, sex and maturity whenever possible.

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: Otoliths are being collected but have yet to be aged.

Roughhead grenadier (*Macrourus berglax*) in SA 2+3

STACFIS **recommended** to *explore the use the production models in this stock*.

STATUS: Several runs were carried out to investigate the sensitivity of the model to various input specifications. All of the attempted runs show a poor fit of the model due to the lack of contrast in the data used.

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

In 2007, STACFIS noted that slightly increasing trends in survey biomass and mean weight (kg) per tow indices for the stock area as a whole were not seen in abundance indices, suggesting increasing trends are due to growth and not recruitment. To further investigate recruitment status, STACFIS **recommended** that *length frequency data from the survey be examined*.

STATUS: Length frequencies from the survey were presented.

Greenland halibut (*Reinhardtius hippoglossoides*) in SA 2 + Div. 3KLMNO

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

STATUS: ICES/NAFO Workshop on Age Reading of Greenland Halibut (WKARGH) will be held in Vigo, Spain, 14-17 February 2011. Age determination methods applied to Greenland Halibut have not been validated and several publications suggest that current methods underestimate age of older specimens. There is a need to evaluate available information on otolith growth patterns, age determination issues and the current situation of age estimation of Greenland Halibut. Since the last workshop (St. John’s, 2006) several institutions have conducted tagging programs, ageing structure comparisons, and other work in order to validate seasonal zones in otoliths and progress on this work will be presented at this workshop.

Previous survey experiments have noted that the depth distribution of Greenland halibut extends beyond 1 500 m, the maximum depth of the survey information currently available to assess this stock. Considering that very few age 10+ fish are captured in either commercial fisheries or in trawl surveys, STACFIS reiterated its **recommendation** that *exploratory deep-water surveys for Greenland halibut in Subarea 2 and Divisions 3KLMNO be conducted using gears other than bottom trawls to complement existing survey data.*

STATUS: No progress.

Tagging experiments could provide information on movement, growth rates and validate the current aging methods. STACFIS **recommended** that *tagging experiments of Greenland halibut in Subarea 2 and Divisions 3KLMNO be conducted.*

STATUS: No progress.

Recognizing that the available survey series, taken individually or in combination, do not cover the entire range of this stock, STACFIS **recommended** that *a synoptic survey of Greenland halibut in Subarea 2 and Divisions 3KLMNO be conducted over a series of years, to the maximum depth possible.*

STATUS: No progress.

STACFIS **recommended** that *the choice of assessment model be investigated in further assessment workshops that would first quantitatively analyze the impacts of data characteristics and model structure and formulation on the estimation of state variables of interest, and secondly evaluate qualitatively the relative merits of model assumptions once their effects were known.*

STATUS: The tuning indices and *F* shrinkage were explored further in this assessment, resulting in a change in input data used and *F* shrinkage applied. In addition a preliminary exploration of a Statistical catch-at-age model was presented.

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 precision of the indices.*

STATUS: No progress.

2. General Review of Catches and Fishing Activity

As in previous years STACFIS conducted a general review of catches in the NAFO SA 0–4 in 2009. STACFIS noted that an *ad hoc* working group had deliberated on catch estimates before the meeting, thereby enabling finfish catch estimates by stock, Division and Contracting Party to be available soon after the meeting commenced. This working group considered various sources of information including reported catches available to 1 June 2010 as compiled from STATLANT 21 reports. Despite the fact that catch figures are fundamental to providing the best scientific advice, meeting the deadline of 1 May for the submission of STATLANT 21A data to the Secretariat continues to be a problem and the accuracy of officially reported provisional statistics remains questionable.

In order to expedite the work of the Scientific Council, STACFIS **recommended** that *all Contracting Parties take measures to improve the accuracy of their reported nominal catches and present them as far in advance of future June Meeting as possible.*

STACFIS **recommended** that *catch estimate, including discards, from national sampling programs be provided.*

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. It is noted that the STATLANT 21A totals do not include all countries in many cases as not all countries had submitted data prior to the June SC meeting. For most stocks the table below includes STATLANT data available to 4 June 2010. A series of these tabulations from 2001–2009 will be found in the introductory catch table within the report for each stock. A summary for 2009 is as follows:

Stocks	21A[1]	STACFIS
STOCKS OFF GREENLAND AND IN DAVIS STRAIT		
Greenland halibut in SA 0, Div. 1A offshore. & Div. 1B–F	17 800	25 000
Greenland halibut in Div. 1A inshore.		18 270
Roundnose grenadier in SA 0+1	+	+
Demersal redfish in SA 1	20	160
Other finfish in SA 1	10[1]	1 140
STOCKS ON THE FLEMISH CAP		
Cod in Div. 3M	1 175	1 161
Redfish in Div. 3M	7 625	11 317
American plaice in Div. 3M	46	70
STOCKS ON THE GRAND BANKS		
Cod in Div. 3NO	581	1 083
Redfish in Div. 3LN	251	1 051
American plaice in Div. 3LNO	1 376	3 5
Yellowtail flounder in Div. 3LNO	5 575	6 187
Witch flounder in Div. 3NO	102	375
Capelin in Div. 3NO	0	0
Redfish in Div. 3O	6 488	6 431
Thorny skate in Div. 3LNOPs (Div. 3LNO portion)	1 225	4 465
White hake in Div. 3NOPs (Div. 3NO portion)	418	425
WIDELY DISTRIBUTED STOCKS		
Roughhead grenadier in SA 2+3	665	629
Witch flounder in Div. 2J+3KL	54	57
Greenland halibut in SA 2 & Div. 3K–O	14 614	23 160
Short-finned squid in SA 3+4	674	727

[1] Greenland has not submitted STATLANT 21A data since 2007.

III. STOCK ASSESSMENTS

A. STOCKS OFF GREENLAND AND IN DAVIS STRAIT: SA0 AND SA1

Environmental Overview

Hydrographic conditions in this region depend on a balance of atmospheric forcing, advection and ice melt. Winter heat loss to the atmosphere in the central Labrador Sea is offset by warm water carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried south by the east Baffin Island Current. Within the 1 500 m depth range over much of the Labrador Sea temperatures have become steadily higher and salinity also higher over the past number of years compared with the early 1990s. The low temperature and salinity values in the inshore region of southwest Greenland reflect the inflow of Polar Water carried by the East Greenland Current. Water of Atlantic origin with temperatures >3^{o}C and salinities >34.5 is normally found at the surface offshore off the shelf break in this area.

The general conditions in the West Greenland region have traditionally been presented with offset in the hydrography observed over the Fylla Bank. Oceanographic conditions during summer 2009 were characterised by lower amounts of cold-lower salinity Polar Water and above normal presence of warm-higher salinity Irminger Water. In general, the surface and subsurface temperatures and salinities were higher than normal suggesting reduced contributions of Polar Water and higher proportions of Irminger Water.

The Labrador Sea experienced very warm winter surface air temperatures in 2009; temperatures ranged from approximately 8°C above normal in the northern region near Davis Strait to about 2-4°C above normal in the southern Labrador Sea. In 2009, convection was limited to the upper 800 m of the water column, a significant reduction compared to 2008 with convection penetrating to 1600 m. Maximum sea ice extent was near the long-term mean for this region, however, sea ice concentration was lower that normal in the region of the northern Labrador Sea. Monthly mean sea surface temperatures were slightly warmer than normal (approximately 1ºC) for all of 2009.

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

(SCR Doc. 10/11, 30, 34; SCS Doc. 10/5, 8, 10, 12)

a) Introduction

During the period 1982-1989 nominal catches of Greenland halibut in Subarea 0 and Div. 1A offshore + Div.1B-1F fluctuated between 300 and 4 500 t. Catches increased from 3 000 t in 1989 to 13 500 t in 1990. Catches remained at that level in 1991 but increased again in 1992 to 18 500 t. During 1993-2000 catches have fluctuated between 8 300 and 11 800 t. Catches increased to 13 800 t in 2001 and increased further to 19 700 t in 2005. In 2006 catches increased to 24 200 t, remained at that level in 2007 but decreased slightly to 22 400 t in 2008. Catches increased again in 2009 to 24 800 t (Fig. 1.1).

Between 1979 and 1994 a TAC was set at 25 000 t for SA 0+1, including Div. 1A inshore. In 1994 it was decided to make separate assessments for the inshore area in Div. 1A and for SA 0 + Div. 1A offshore + Div.1B-1F.

From 1995-2000 the advised TAC for SA 0 + Div. 1A offshore + Div.1B-1F was 11 000 t. In 2000 there was set an additional TAC of 4 000 t for Div. 0A+1A for 2001. This TAC was increased to 8 000 t for 2003 for Div. 0A+1AB. Total advised TAC for 2004 and 2005 remained at 19 000 t. In 2006 the advised TAC in Div. 0A+1AB was increased with further 5 000 t to 13 000 t. Total advised TAC remained at that level – 24 000 t - in 2008 and 2009. In 2010 TAC was increased with 3 000 t allocated to Div. 0B+1C-F. Hence the total TAC is 27 000 t for 2010.

In Subarea 0 catches peaked in 1992 at 12 800 t, declined to 4 700 t in 1994 and remained at that level until 1999. Catches increase to 5 400 t in 2000 and increased further to 8 100 t in 2001, primarily due to an increase in effort in Div. 0A. Catches remained at that level in 2002 but increased again in 2003 to 9 200 t and remained at that level in 2004-2005. Catches increased to 12 200 t in 2006 due to increased effort in Div. 0A. Catches decreased slightly to 11 500 t in 2007 and further to 10 400 t in 2008. Catches increased again in 2009 to 12 400 t.

Catches in Div. 0A increased gradually from a level around 300 t in the late 1990s and 2000 to 4 100 t in 2003, declined to 3 800 t in 2004 but was back at the 2003 level in 2005. In 2006 catches increased to 6 600 t, due to increased effort. Catches decreased slightly in 2007 to 6 200 t and further to 5 300 t in 2008. Catches increased again in 2009 to 6 600 t.

Catches in Div. 1A offshore and Div. 1B-1F fluctuated between 1 800 and 2 500 t during the period 1987-1991. Then catches fluctuated between 3 900 and 5 900 t until 2001. Catches increased gradually from 5 700 t in 2001 to 9 500 t in 2003, primarily due to increased effort in Div. 1A. Catches remained at that level in 2004 and 2005. In 2006 catches increased to 12 000 t due to increased effort in Div. 1A. Catches were at the same level during 2007 – 2009 (12 400 t in 2009).

Prior to 2001 catches offshore in Div. 1A and in Div. 1B were low but they increased gradually from 100 t in 2000 to 4 000 t in 2003 and remained at that level in 2004-2005. Catches in that area increased further in 2006 to 6 200 t and remained at that level in 2007-2008. Catches increased slightly to 6 700 t in 2009.

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	15	15	19	19	19	24	24	24	24	27
TAC	15	15	19	19	19	24	24	24	24	
SA0	8	7	9	10	10	12	11	11		
SA1[1]	6	7	10	10	10	12	12	12		
Total STATLANT 21A	13	16[2]	20[3]	19[4]	20[4]	24[4]	23[4]	15	18	
Total STACFIS	14	15	19	19	20	24	23	22	25	

[1] Excluding inshore catches in Div.1A
[2] Including 708 t reported by error from Div 0A
[3] Including 1 366 t reported by error from Div. 1A
[4] Excluding 2 000 -4 300 t reported by error from Div. 1D

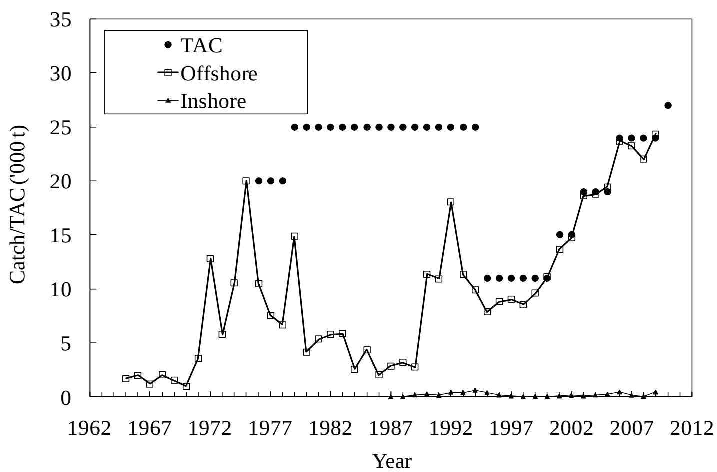


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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 2009, 1 515 t were taken by gillnet, 102 t by longline, 4 006 t by trawl and 185 t were taken by longline in inshore Cumberland Sound.

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 2009, trawlers caught 4 364 t and 2 229 t were taken by gillnetters. The longline fishery in the area, which took about 1/3 of the catches in 2003, has apparently ceased.

The fishery in Div. 1A offshore + Div. 1B-1F. Traditionally the fishery in SA 1 has taken place in Div. 1D and to a minor extent Div. 1C. Catches have mainly been taken by trawlers from Japan, Greenland, Norway, Russia, Faroe Islands and EU (mainly Germany). These countries, except Japan, were also engaged in the fishery in the area in 2009. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 t in 2004 and there has not been any gillnet fishery in the area since then. An offshore longline fishery in Div. 1CD took place during 1994-2002. Since then longline fishery has only taken place irregularly and with small catches, about 20 t in the recent three years. Inshore catches in Div. 1B-Div. 1F amounted to 251 t, which were mainly taken by gillnets.

Throughout the years there have been a certain amount of research fishing offshore in Div. 1A but the catches have always been less than 200 t per year. Catches increased gradually from about 100 t in 2000 to about 6 200 t in 2006-2009. All catches in recent years were taken by trawlers from Greenland, Russia and Faroe Islands.

b) Input Data

i) Commercial fishery data

Information on length distribution was available from gillnet and trawl fishery in Div. 0A and single and twin trawl fishery in Div. 0B. The bulk of the catches in the gillnet fishery in Div. 0A were between 50 and 80 cm with a mode around 63 cm as in recent years. The length distributions in the trawl fishery in Div. 0A showed a mode of 47 cm where it use to be around 48 cm. The length distributions in the single and twin trawl fishery in Div. 0B were very similar with modes around 48-50 cm, for both types of gear, as seen in recent years.

Information on length distribution of catches was available from trawlers from Russia and Greenland fishing in Div. 1A and from Greenland, Russian and Norwegian trawlers fishing in Div. 1D.

The length distribution in the Russian and Greenland fishery in Div. 1A showed modes at 44-48 cm and 51 cm, respectively. In Div. 1D the mode was around 49-54 cm in the fishery by all countries. The mode in the trawl fishery in Div. 1D has been at 47-51 cm in the last decade.

Age distributions were available from the Russian fishery in Div. 1A and 1D. A combined Div. 1A-1D age distribution showed a dominance of age 8.

Standardized catch rates from Div. 0A showed a minor increase between 2007 and 2008 but has generally been stable since 2002. There were no CPUE data from Div. 0A in 2009.

Standardized catch rates from Div. 1AB increased from 2002 to 2006 but have declined during 2007-2008 and the catch rates were in 2008 back at the 2004 level. The catch rates increased again in 2009 to the 2006 level.

The combined Div. 0A+1AB standardized catch rates before 2001 is based on catches < 300 t from research fisheries. Since 2002 standardized catch rates have been stable (Fig. 1.2). The series was not updated in due to lack of data from 2009 from Div. 0A

The standardized catch rates from Div. 0B decreased gradually from 1995 to 2002, but increased again until 2005. Catch rates have declined slightly during 2006 and 2007, but increased in 2008 and further in 2009 to the highest level seen in the time series which dates back to 1990.

Standardized catch rates in Div. 1CD declined gradually from 1989-1996, increased between 1997 and 2000 but declined slightly again until 2002. Since then standardized catch rates have increased gradually and were in 2009 were the highest seen since 1989.

The combined Div. 0B+1CD standardized catch rates has been stable in the period 1990-2001, declined somewhat in 2002, remained at that level in 2003 and 2004. Since then standardized catch rates have increased gradually and in 2009 were at the highest level seen since 1989. Catch rates in 1988 and 1989 are from one 4000 GT vessel fishing alone in the area (Fig. 1.2).

It is not known how the technical development of fishing gear, etc. has influenced the catch rates. There are indications that the coding of gear type in the log books is not always reliable, which also can influence the estimation of the catch rates. Further, 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, the catch rates should be interpreted with caution.

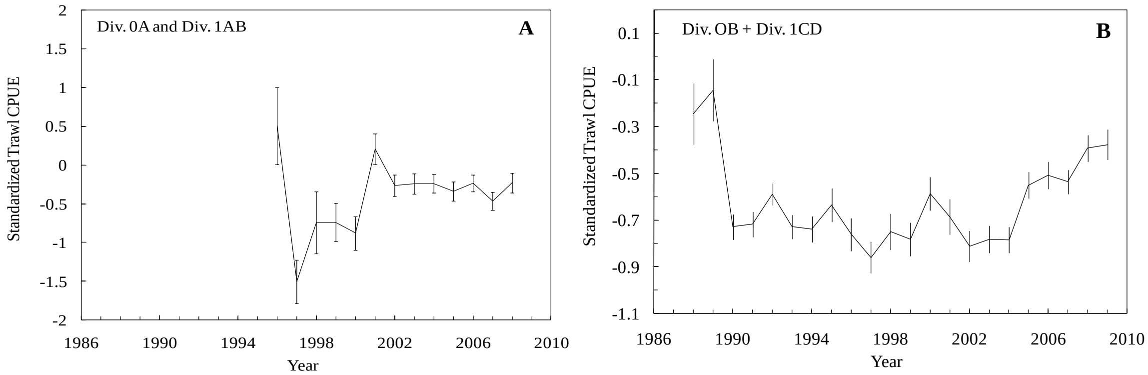


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): **A**: Combined standardized trawler CPUE from Div. 0A and Div. 1AB with ± S.E (Not updated in 2009). **B**: Combined standardized trawler CPUE from Div. 0B and Div. 1CD.

ii) Research survey data

Japan-Greenland and Greenland Deep-sea surveys. During the period 1987-95 bottom trawl surveys were conducted in Subarea 1 jointly by Japan and Greenland (the survey area was re-stratified and the biomass estimates were recalculated in 1997). In 1997 Greenland initiated a new survey series covering Div. 1CD. The survey is conducted as a stratified-random bottom trawl survey covering depths between 400 and 1 500 m. The trawlable biomass in Div. 1CD has shown an increasing trend since 1997 and the biomass was estimated to be 83 000 t in 2008 which was the highest in the time series. The biomass decreased to 71 000 t in 2009, close to average for the time series (Fig. 1.3). The abundance increased between 1997 and 2001 and has been stable since 2002 but decreased in 2009 to a level slightly below the average for the time series.

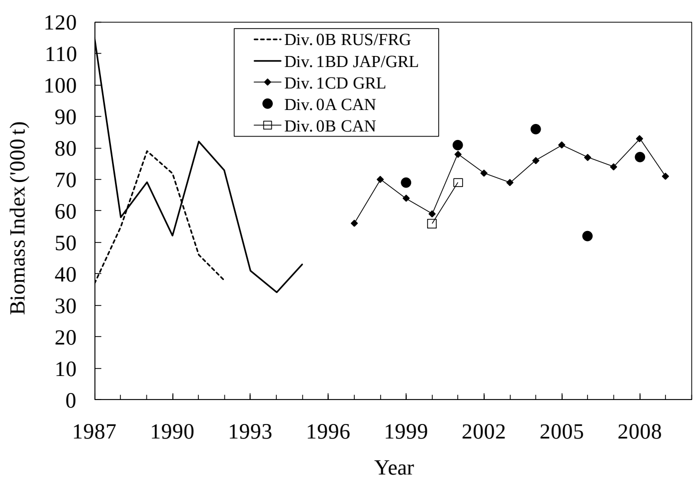


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from bottom trawl surveys. Note, incomplete coverage of the 2006 survey in Div. 0A.

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 biomass has increased gradually from 68 700 t to 86 200 t in 2004. The biomass decreased to 52 271 t in 2006 (Fig. 1.3). However, the survey coverage was not complete and two of the four strata missed fell within the depths 1 001-1 500 m and accounted for 11 000 – 13 000 t of biomass in previous surveys. Biomass was in 2008 estimated to be 77 182 t. Mean biomass per tow was 1.67 t/ km^2, higher than in 2006 and 1999 but lower than was observed in 2001 and 2004. The overall length distribution ranged from 6 cm to 99 cm with a relatively flat top on the distribution (the mode stretched between 33 cm and 39 cm) and is most similar to that seen in 2006 and 1999. There was no survey in 2009.

Greenland shrimp survey. Since 1988 annual surveys have been conducted with a shrimp trawl off West Greenland between 59°N and 72°30'N from the 3-mile boundary to the 600 m depth contour line. The biomass in the offshore area peaked in 2004 (31 100 t). The biomass decreased gradually to 19 000 t in 2007, increased slightly in 2008 but decreased again in 2009 to 17 000, which is about 1 000 t below the average of the time series. The survey gear was changed in 2005, but the 2005-2009 figures are adjusted for that. The biomass and abundance time series 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, increased in 2003 to 319 million and has stayed at that level until 2007, but declined to 251 million in 2008 and further to 226 million in 2009. The reduction in recruitment in the total survey area between 2008 and 2009 was caused by a reduction in recruitment in the inshore Disko Bay, while the reduction between 2008 and 2009 was caused by a reduction of recruitment in Div. 1A north of 70°N. (Fig.1.4). The figures were recalculated in 2007, based on the new strata, but it did not change the over all trends in the recruitment.

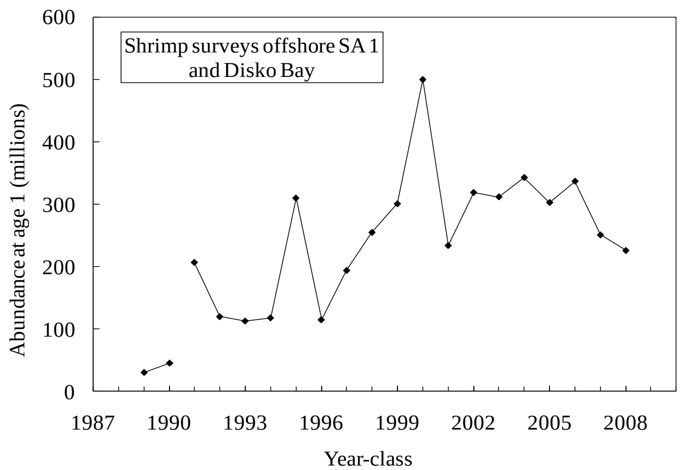


Fig. 1.4. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1).

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1A(South of 70°N)-1B has declined since the relatively large 1991 year-class, but the recruitment has been above the level in the 1980s. The recruitment increased again with the 1995-year class, which was the largest on record. The 1996 year-class seemed to be small but the recruitment has increased gradually until the 2000 year-class. Since then the recruitment has been around or a little above average. The 2007 year class was below average (412 per hr) and the recruitment of the 2008 year-class was estimated as 420 age-one caught per hour, also some what below the average for the time series (551 no per hr).

c) Estimation of Parameters

An Extended Survivors Analysis (XSA) stock assessment model fitted to the stock data from SA 0+1 was presented in 2003. The analysis was considered to be provisional due to problems with the catch-at-age data and the short time series, but the outcome was considered to reflect the dynamics of the stock. The XSA has not been updated in recent years due to lack of catch-at-age data.

A Greenland halibut age determination workshop concluded that the current aging methods underage old fish. About one third of the catches in SA0 come from gillnet 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 ASPIC was attempted again in 2009, but results were not tabled as the outcome of the analysis did not improve significantly. The ASPIC fails primarily because of lack of contrast in the input data and short time series.

d) Assessment Results

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

Fishery and Catches: Due to an increase in offshore effort, catches increased from 3 000 t in 1989 to 18 000 t in 1992 and remained at about 10 000 t until 2000. Since then catches increased gradually to 24 800 t in 2009 primarily due to increased effort in Div. 0A and in Div. 1A.

Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2009 were available from Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2009.

Assessment: No analytical assessment could be performed.

Commercial CPUE indices. Combined standardized catch rates in Div. 0A and Div. 1AB have been stable during 2002-2008. The combined Div. 0B and 1CD standardized catch rates have been stable during 2002 - 2004. Since then the standardized catch rates have increased gradually and were in 2009 at the highest level seen since 1989.

Biomass: The survey biomass in Div. 1CD increased gradually between 1997 and 2008, but decreased to 71 000 t in 2009 which is close to the average for the thirteen year time series. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has been gradually decreasing during 2004-2009 and was in 2009 slightly below the average for the time series (1991-2009).

Recruitment: The abundance of the 2000 year-class at age 1 in the entire area covered by the Greenland shrimp survey was the largest in the time series, while the 2002-2006 year-classes were well above average. The recruitment of the 2007 and 2008 year-class in the offshore nursery area (Div. 1A (South of 70°N) - Div. 1B) was below average.

Fishing Mortality: Level not known.

State of the Stock: Div. 0A+1AB: Length compositions in the catches have been stable in recent years. Survey biomass in Div. 0A and CPUE indices in Div. 0A and 1AB have been stable in recent years.

Div. 0B+1C-F: Survey biomass in Div. 1CD has been stable and CPUE indices in Div. 0B and 1CD have shown an increasing trend in recent years and are at the level observed in the late 1980s.

e) Precautionary Reference Points

Age-based or production models were not available for estimation of precautionary reference points. 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 *catch rates in the gillnet fisheries in Div. 0A and 0B and trawl fishery from Div. 0A from 2009 and 2010 should be made available before the assessment in 2011.*

The next assessment will be in 2011.

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

(SCR Doc. 10/30, 43 SCS Doc. 10/12)

a) Introduction

The inshore fishery for Greenland halibut developed in the beginning of the twentieth century, but has increased dramatically during the past 20 years. The winter fishery is performed from the seaice, and the catch is transported back to the factory on dogsledges. A longline is driven in a horisontal direction under the ice by means of a steel plate with a rock underneath that works as a glider. The summer fishery is traditionally performed from small open boats using longlines but in the recent 10-15 years, larger vessels (30-40 ft) have entered the fishery and gillnets have been introduced. The fishery is concentrated in the Disko Bay, the Uummannaq Fjord and Upernavik area, all located in division 1A. There is little migration between the subareas and a separate TAC is set for each area. The stocks do not contribute to the spawning in Davis Strait, and no significant spawning has been observed in the areas, hence the stocks are dependent on recruitment from offshore spawning areas.

Disko Bay landings increased from about 2 000 t in the mid 1980s and peaked in 2004 with more than 12 000 t. However, since 2006 landings have decreased sharply and in 2009 only 6 321 t was landed. (Fig 2.1)

Uummannaq Fjord landings increased from a stable level of 3 000 t in the mid 1980s and peaked in 1999 at a level of more than 8 000 t. Landings then decreased and have since 2002 fluctuated between 5 000 and 6 000 t. In 2009 5 451 t was landed (Fig 2.2).

Upernavik area landings increased from the mid 1980's and peaked in 1998 at a level of 7 000 t. This was followed by a period of decreasing catches, but since 2002 catches have increased substantially and in 2009 catches were at 6 498 t (Fig 2.3.).

Total catches in SA1 inshore peaked at the end 1990s at about 25 000 t. This was followed by two years in a row of decreasing catches to below 17 000 t, upon which catches increased again to a level of 23 000 t in 2005. Since 2006, however catches have decreased substantially to a level of 18 000 t in 2009. Unlike the decrease seen in the late 1990s, the recent decrease in SA1 inshore is caused exclusively by decreasing catches in the Disko Bay area, where catches have been halved in just 3 years.

Recent landings and advice ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recomm TAC	7.9	7.9	7.9	na	ni	ni	ni	ni	8.8	8.8
Disko Bay TAC								12.5	8.8	8.8
Disko Bay catch	7.1	11.7	11.6	12.9	12.5	12.1	10.0	7.78	6.3	
Recomm TAC	6.0	6.0	6.0	na	5.0	5.0	5.0	5.0	5.0	5.0
Uummannaq TAC								5.0	5.0	5.0
Uummannaq catch	6.6	5.4	5.0	5.2	4.9	6.0	5.3	5.4	5.5	
Recomm TAC	4.3	4.3	4.3	na	na	na	na	na	na	na
Upernavik TAC								5.0	5.0	6.0
Upernavik catch	3.2	3.0	3.9	4.6	4.8	5.1	4.9	5.5	6.5	
SA 1 inshore Unknown	2.2				0.8			0.3		
STATLANT 21A	16.5	17.6	20.6	25.2	21.6	24.2	21.3			
STACFIS	16.9	20.1	20.5	22.7	22.9	23.2	20.6	18.9	18.3	

na no advice.
ni no increase in effort.

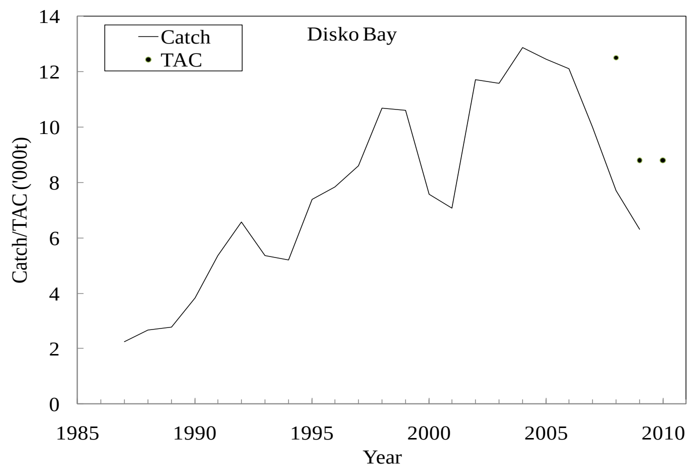


Fig 2.1. Greenland halibut in Disko Bay (Division. 1A): nominal catches and TAC. No TAC set prior to 2008.

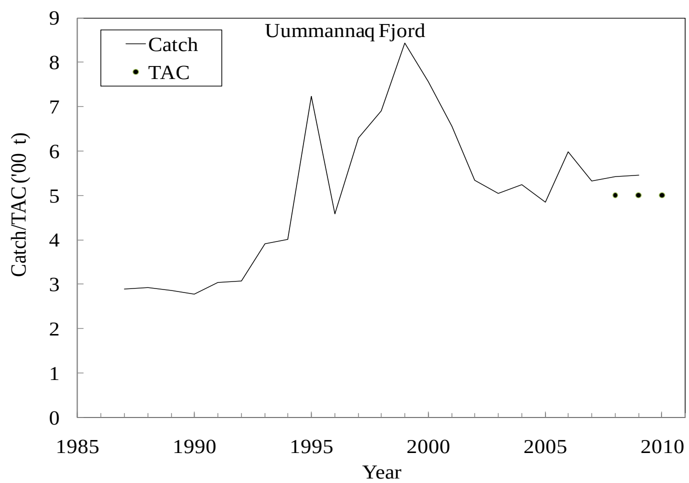


Fig 2.2. Greenland halibut in Uummannaq fjord (Division 1A): nominal catches and TAC. No TAC set prior to 2008.

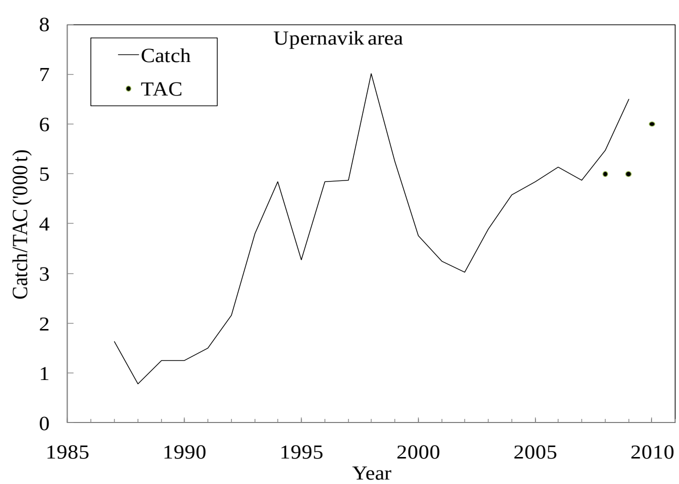


Fig 2.3. Greenland halibut in Upernavik area (Division 1A): nominal catches and TAC. No TAC set prior to 2008.

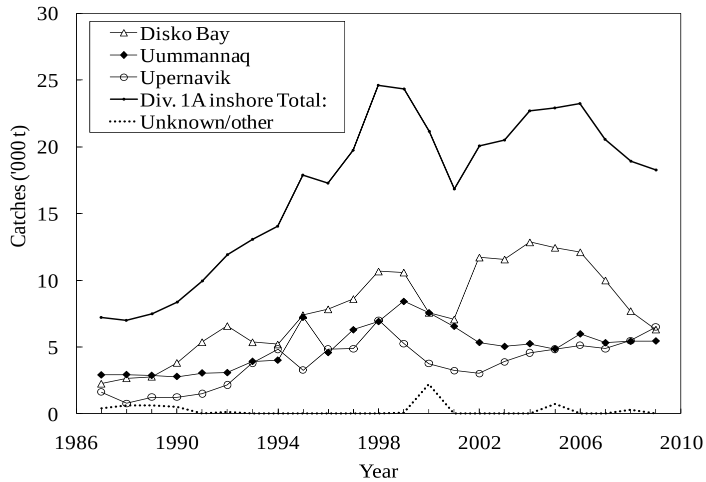


Fig. 2.4. SA1 inshore catches of Greenland halibut since 1987.

b) Data Overview

Commercial fishery data

Data quality provided by industry has improved in recent years. Especially data provided from the Upernavik area is now at a high quality, allowing for a un-standardized CPUE index to be developed. The CPUE index, however, only covers the relatively short time series from 2007 to May 2010. The un-standardized index reveals a decreasing trend in CPUE (kg/ hook) since 2008 (Fig 2.5.). Mean length of landed fish sampled on fish factories, is given in Fig 2.5-2.7. In Disko Bay mean length decreased from 2001 to 2007, but has increased since then (Fig 2.6.). In the Uummannaq Fjord mean length has decreased in the summer fishery since 2004 and the winter fishery since 2007. In the Upernavik area mean length has remained stable since 1999. Percentage of age-class 10 and younger has increased in the Disko Bay since 2002 to 90% (Fig 2.9.). In the Uummannaq fjord percentage of age 10 and younger has increased since 2006 to 80% and is at the same high level as in the 1990s (Fig 2.10). In Upernavik the percentage of age-class 10 and younger is at a lower level than the end 1990s (Fig 2.11.)

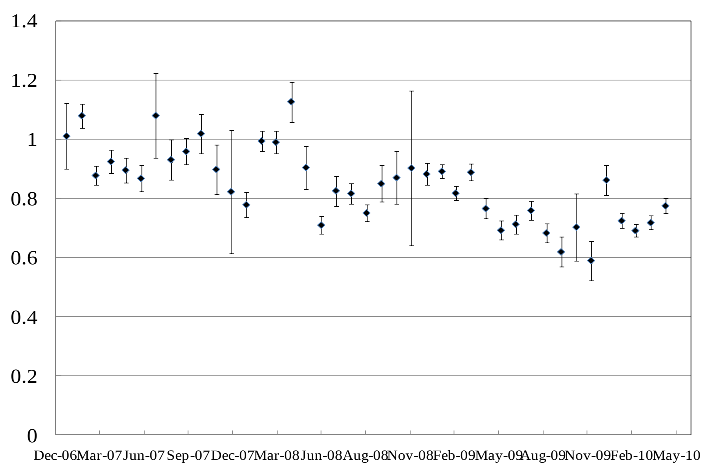


Fig 2.5 Upernavik un-standardized longline CPUE index per month since 2007.

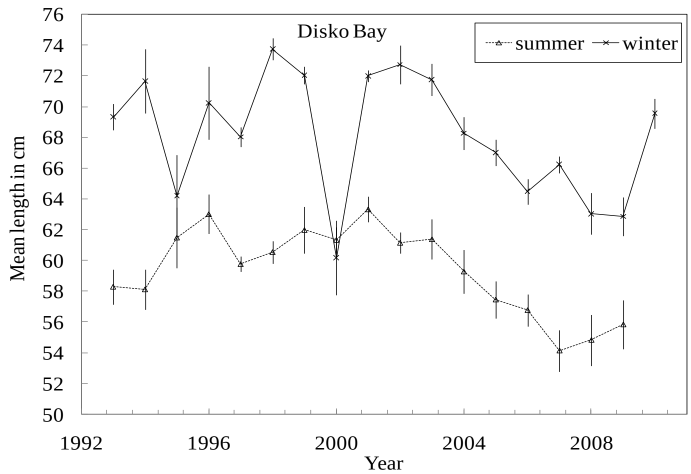


Fig 2.6 Mean length of Greenland halibut in commercial longline catches from Disko Bay +95% Cl.

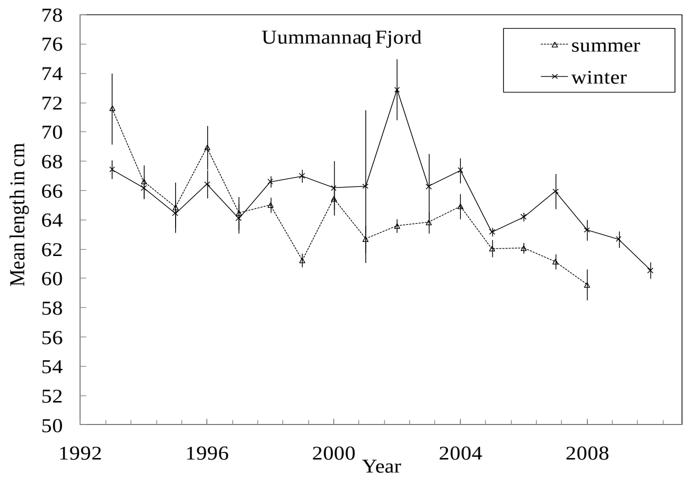


Fig 2.7 Mean length of Greenland halibut in commercial longline catches from Uummannaq +95% Cl.

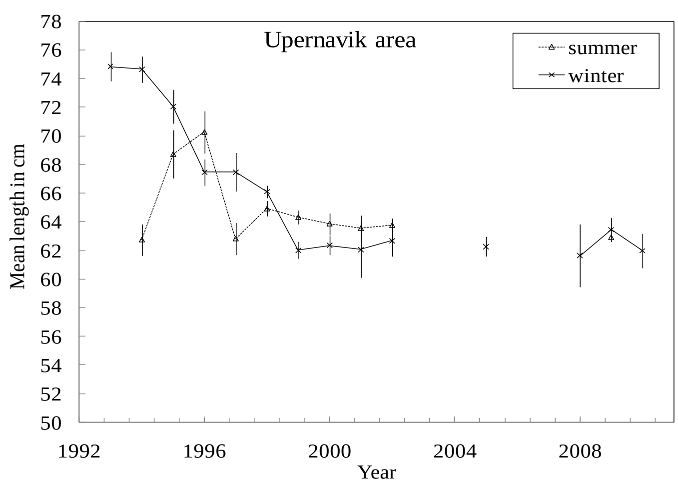


Fig 2.8 Mean length of Greenland halibut in commercial longline catches from Upernavik +95% Cl.

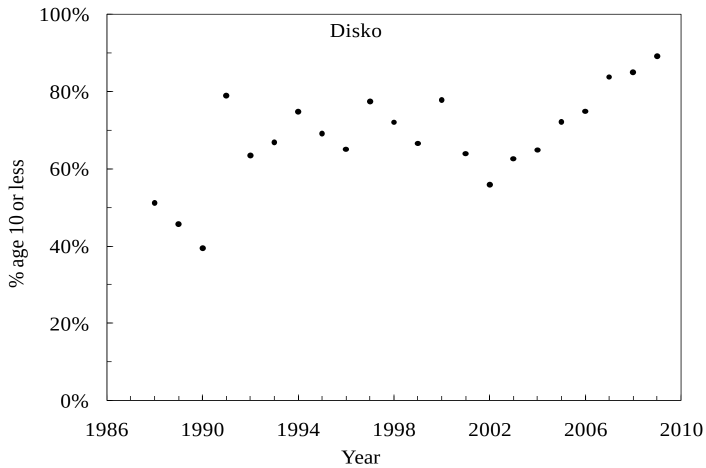


Fig 2.9 Disko Bay development in percentage of *age 10 and younger* expressed in commercial landings by year.

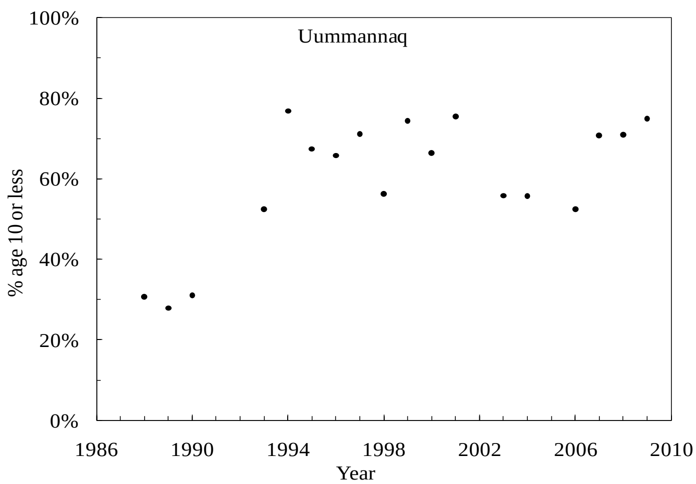


Fig 2.10 Uummannaq development in percentage of *age 10 and younger* in commercial landings by year.

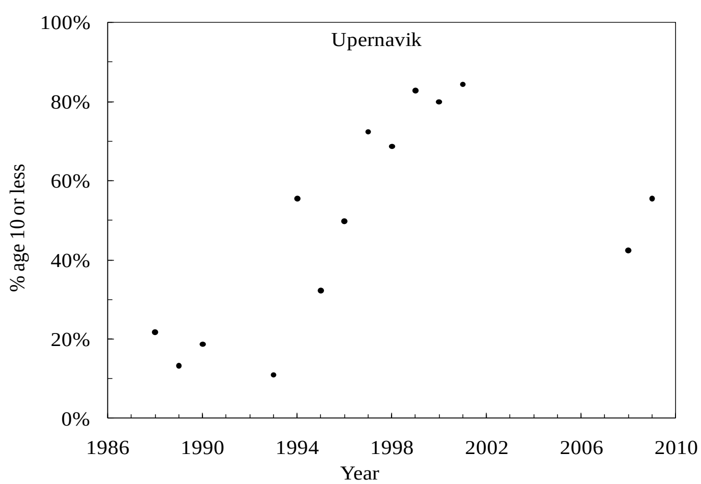


Fig 2.11 Upernavik development in percentage of *age 10 and younger* in commercial landings by year.

Research survey data

Disko Bay: A longline survey has been conducted since 1993 but the survey was changed to a gillnet survey in 2001. This survey was not conducted in 2009. Both CPUE and NPUE decreased substantially since 2005 but have stabilized from 2007 to 2008 (Fig 2.12). Since 1991 the Greenland shrimp/fish trawl survey has also included Disko Bay. The trawl survey indices of biomass and abundance decreased sharply from 2004 to 2008 (Fig 2.13). However, the 2009 estimate is at the same level as in 2008 and the decrease seems to have stopped. Recruitment indices from the shrimp/fish trawl survey in 2008 and 2009 of age 1 are below average, but since 2000 recruitment of age 1 to 3 has been well above average (Fig 2.14.).

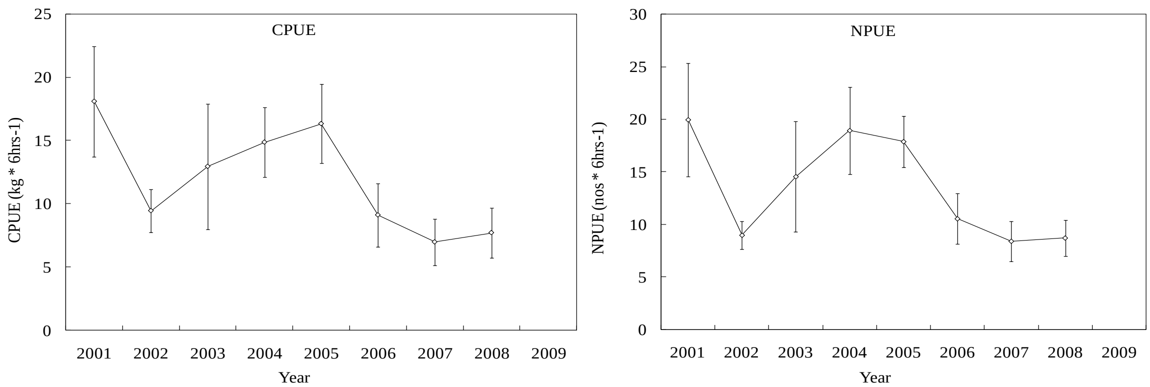


Fig 2.12. Disko Bay gillnet survey CPUE and NPUE + 95% CI indicated.

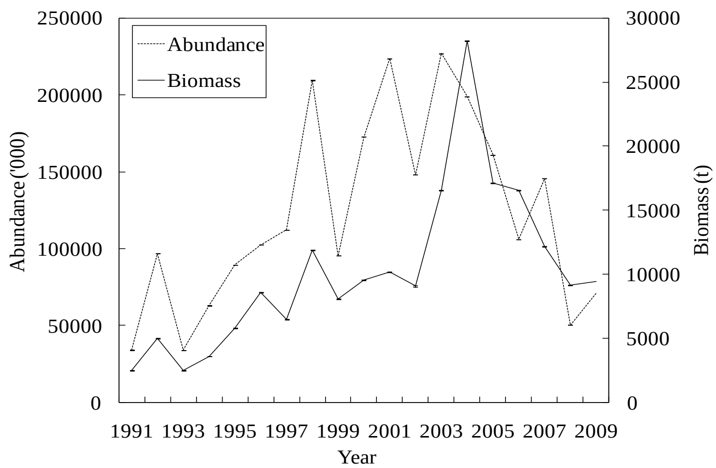


Fig 2.13. The Greenland shrimp/fish trawl survey in Disko Bay: Abundance ('000) and Biomass (t) indices for Greenland halibut.

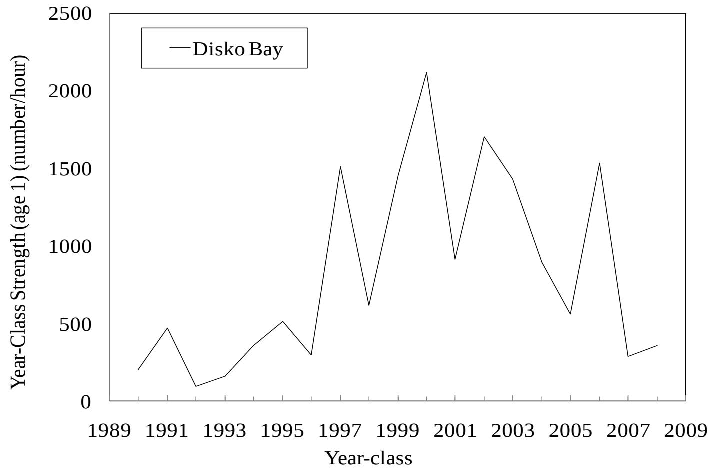


Fig 2.14. Year-class strength from the shrimp/fish trawl survey in Disko Bay.

The Uummannaq fjord has been covered by a long line survey since 1993. No survey was conducted in 2008 or 2009. The survey CPUE index was, however, stable during the 2004 to 2007 period (Fig 2.15).

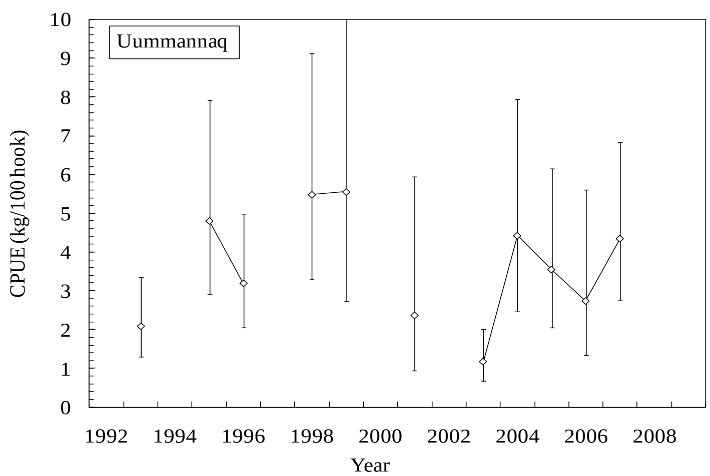


Fig 2.15. Uummannaq fjord longline survey CPUE + 95% CI.

The Upernavik area has previously been covered by a longline survey, but no survey has been conducted since 2001. A longline survey in this area is scheduled in 2010.

c) Assessment Results

Fishery and Catches: Total landings in all areas combined have increased gradually since the late 1980s and peaked in the late 1990s at a level of 25 000 t. Landings then decreased to 16 900 t, but increased again during 2002-2005 reaching 23 000 t. Since 2006 landings have decreased again to a level of 18 300 t, and this decrease is caused exclusively by decreasing catches in the Disko Bay, where landings have decreased from above 12 000 t to just 6 321 t in 2009. Landings in the Uummanaq fjord has been at a level of 5 000 t since 2002 and in Upernvavik landings have increased since 2002 from 3 000 t to 6 498 t in 2009.

Data: Length frequencies from the commercial fishery were available for all three areas, except for the summer fishery in Uummannaq in 2009. Catch-at-age was available from 1988 to 2009 although with years missing especially for Upernavik. Catch and effort data provided from the Upernavik area allowed for an unstandardized CPUE index to be developed, although only covering fishery since 2007. Survey catch rate and length frequency data from the longline survey in Uummannaq was only available until 2007 and from the gillnet survey in Disko Bay until 2008. A biomass and abundance estimate and a recruitment index for age 1 was available from the shrimp/fish trawl survey in Disko Bay.

Assessment: No analytical assessment could be performed.

Disko Bay: From 2002 to 2006 catches were at a record high level above 12 000 t, but decreased in just 3 years to just 6 321 t in 2009. Mean length in the catches decreased from 2001 to 2007, but has increased since then and percentage of age-class 10 and younger has increased since 2002 to 90%. The gillnet survey (2001-2008) shows decreasing CPUE and NPUE from 2005 to 2007, but the 2008 estimates are at the same level as in 2007. The abundance and biomass indices from the Greenland shrimp/fish trawl survey, declined significantly from 2004 to 2008, but seem to have stabilized in 2009. Recruitment indices in 2008 and 2009 of age 1 are below average, but since 2000 recruitment of age 1 has been well above average. The increase in mean length in the commercial catches seen since 2007 could be caused by year-classes from the high recruitment period entering the fishery.

Uummannaq: Landings have remained stable since 2002 and longline-survey abundance indices indicated a stable stock until 2007. Mean lengths in the summer fishery has decreased since 2004 and the winter fishery since 2007. Percentage of age 10 and younger in the catches has increased since 2002 to 80%.

***Upernavik*:** Surveys have not been conducted since 2000 in the Upernavik area. Samplings from the commercial fishery have been sporadic from 2002 to 2007. However, with the extensions of the sampling in 2008 and 2009, mean length in the commercial landings seems to have been stable since 1999. Percentage of age 10 and younger is around 50 %. The un-standardized CPUE index from the commercial fishery is too short to determine trends.

State of the Stock: Except for Upernavik the age compositions in catches have been reduced to fewer and younger age groups compared to the early 1990s and the fishery has thus become more dependent on incoming year-classes.

Disko Bay: The CPUE and NPUE indices from the gillnet survey declined from 2005 to 2007 but stabilized in 2008. The abundance and biomass indices from the Greenland shrimp/fish trawl survey, declined from 2004 to 2008, but seem to have stabilized in 2009. Recruitment indices in 2008 and 2009 of age 1 are below average, but from 2000 to 2006 recruitment of age 1 was well above average. The increase in mean length in the commercial catches seen since 2007 could be caused by year-classes from the high recruitment period entering the fishery. However the decreasing catches and survey indices indicate a decreasing stock.

Uummannaq: Landings have remained stable since 2002. The survey indices indicate a stable stock until 2007. The steady decrease in mean length of the commercial catches since 2007 and the increase in percentage of age 10 and younger could indicate a decreasing stock but could also be caused by incoming year-classes.

Upernavik: Mean length in the commercial landings has been stable since 1999. Percentage of age 10 and younger in the catches is less than prior to 2001.

Reference Points: could not be determined.

The next full assessment is planned for 2012.

3. Roundnose Grenadier (*Coryphaenoides rupestris*) in SA 0+1

Interim Monitoring Report (SCR Doc. 10/11 SCS Doc. 10/8)

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 < 5 t was estimated for 2009 as in 2008. Catches of roundnose grenadier have been reported from inshore areas and Div. 1A where roundnose grenadier is known not to occur. These catches must be roughhead grenadier and are therefore excluded from totals for roundnose grenadier, but it is also likely that catches from the offshore areas south of Div 0A-1A reported as roundnose grenadier may include roughhead grenadier.

Recent catches and TAC's ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Agreed TAC	3.4	4.2	4.2	4.2	4.2	4.2				
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.06	0.03	0.04	0.02	0.01	0.02	0.01	0.00	0.00	
STACFIS	0.06	0.03	0.04	0.02	0.01	0.02	0.03	0.00	0.00	

ndf No directed fishing.
No TAC set for 2007-2010.

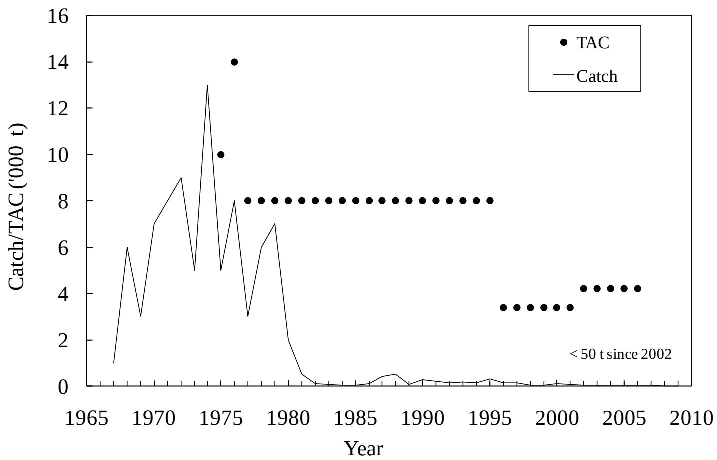


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2010

b) Data Overview

Research survey data

There has not been any survey that covers the entire area or the entire period which makes direct comparison between survey series difficult. In the period 1987-1995 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. The survey area was restratified and the biomasses recalculated in 1997. Russia has in the period 1986-1992 conducted surveys covering Div. 0B and Div. 1CD at depths down to 1 250 m until 1988 and down to 1 500 from then on. The surveys took place in October-November. During 1997-2008 Greenland has conducted a survey in September - November covering Div. 1CD at depth between 400 and 1500 m. Canada conducted surveys in Div. 0A in 1999, 2001, 2004, 2006 and 2008 and Div. 0B in 2000 and 2001 at depths down to 1500 m. Roundnose grenadier has very seldom been observed in Div. 0A.

In the Greenland survey in 2009 the biomass in Div. 1CD was estimated at 1 151 t compared to 546 t in 2008. The biomass is the largest observed since 2002, but the biomass is still at the very low level observed since 1993. Almost all the biomass was found in Div 1D. 800-1400 m. The fish were generally small, between 4 and 8 cm pre anal fin length.

The Canadian surveys in Div. 0B in 2000 and 2001 also showed very low biomasses, 1 660 and 1 256 t, respectively.

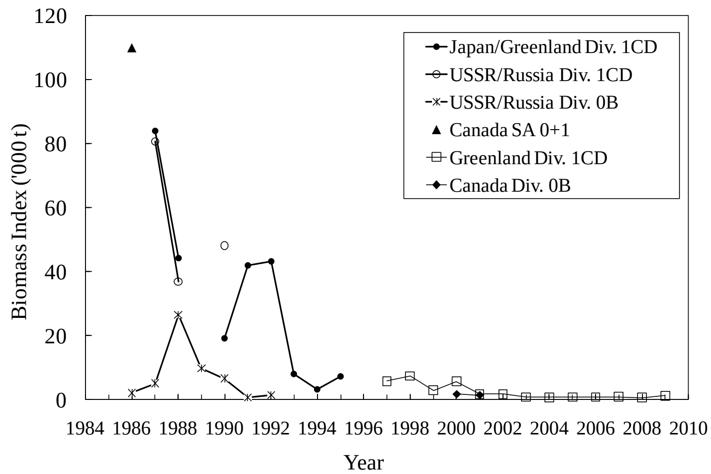


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/ Greenland, Canadian and Greenland surveys in Div. 0B and Div.1CD.

c) Precautionary Reference Points

STACFIS is not in a position to determine biological reference points for roundnose grenadier in SA 0+1 at this time. Previously STACFIS has considered a survey estimate of 111 000 t from 1986 as $B_{virgin.}$ However, given that roundnose grenadier is a long living species and that fishery stopped around 1979, it is uncertain whether the stock could be considered as virgin in 1986. Although the biomass estimates from the 80s and early 90s are not directly comparable with recent estimates these are far below what was seen previously. The survey time series from the 80s and the early 90s are, however, too short to be used for estimation of reference points.

d) Conclusion

In the Greenland survey in 2009 the biomass in Div. 1CD was estimated at 1 152 t. Despite the fact that the biomass has doubled compared to 2008 the biomass is still at the very low level seen since 1993, and there is no reason to consider that the status of the stock has changed.

The next full assessment of this stock will take place in 2011.

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

Interim Monitoring Report (SCR Doc. 07/88; 10/11, 30; SCS Doc. 10/12)

a) Introduction

There are two redfish species of commercial importance in SA 1, golden redfish (*Sebastes marinus*) and deep-sea redfish (*Sebastes mentella*). 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 SA 1 has been less than 1 000 t since 1987 and less than 500 t since 2001 and only 160 t were reported for 2009 (142 t in SCS Doc 10/12 and 18 t in STATLANT 21A). Recent and historical catch figures do not include the weight of substantial numbers of small redfish discarded by the trawl fisheries directed to shrimp. A study conducted in 2006 and 2007 indicated that Redfish caught in the Greenland shrimp fishery amounted to ~0.6% of the shrimp catch and was composed mainly of small redfish between 6 and 13 cm (SCR Doc. 07/88). A minor amount of mainly Golden redfish are taken inshore by smaller vessels.

Recent catches ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TAC	19	19	8	1	1	1	1	1	1	1
STATLANT 21A	0.1	0.1	0	0.3	0.2	0.4	0.3	0[1]	0.02[1]	
STACFIS Catch	0.3	0.5	0.5	0.3	0.2	0.4	0.3	0.03	0.16	

[1] Greenland has not submitted STATLANT 21A data since 2007.

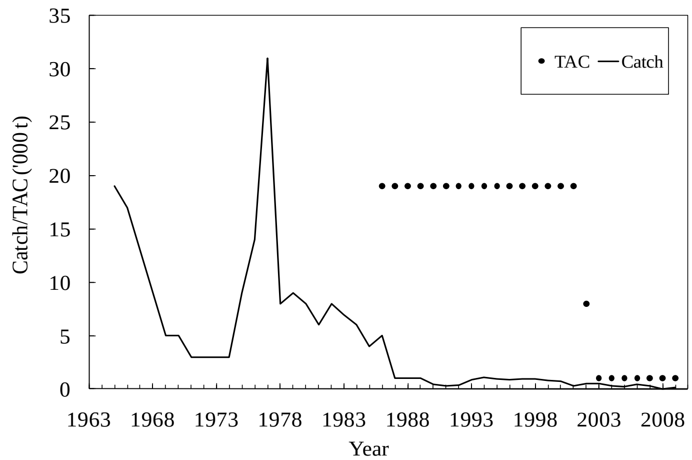


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

b) Data Overview

Research survey data

The EU-Germany groundfish survey (0-400m), the Greenland-Japan/Greenland deep-sea survey (400-1500 m) and the Greenland groundfish/shrimp survey (50-600 m) were all conducted in 2009. The Greenland deep-sea survey have showed an increase in deep-sea redfish biomass and abundance indices in the recent two years, while both the EU-Germany groundfish survey and the Greenland groundfish/shrimp survey shows decreases in biomass and abundance indices. The increase in biomass index of deep-sea redfish in the Greenland deep-sea survey was caused by a better coverage of relevant depths and is to a large extent caused by a few large catches.

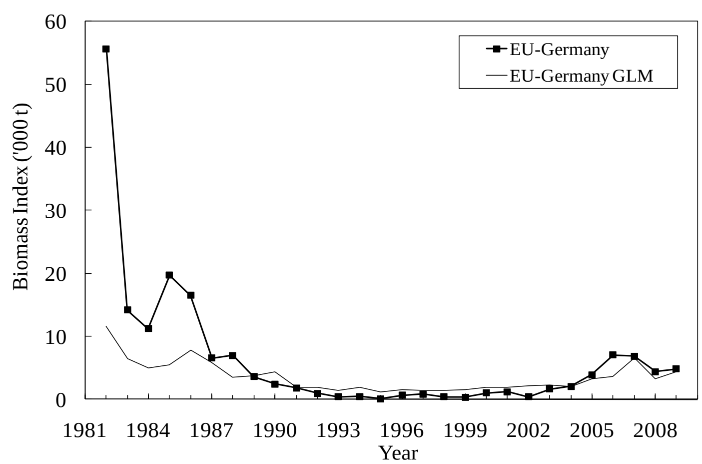


Fig. 4.2. Golden redfish in NAFO Subarea 1: survey biomass index.

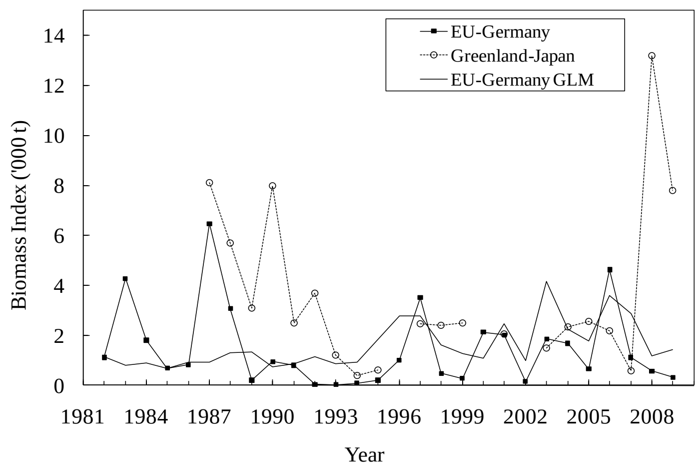


Fig. 4.3. Deep-sea redfish in Subarea 1: survey biomass indices.

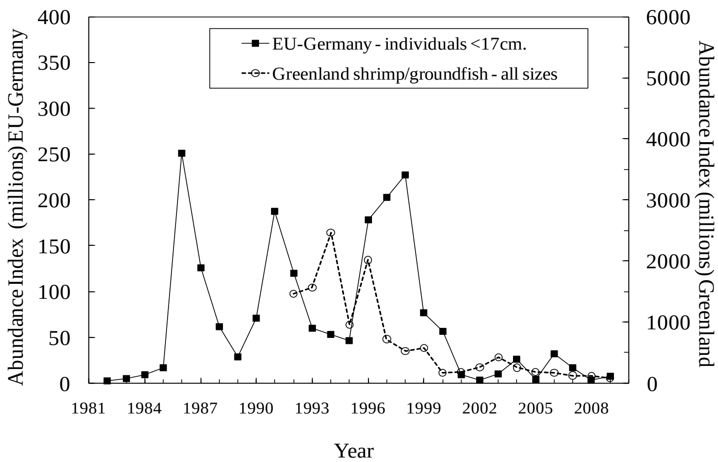


Fig. 4.4. Deep-sea redfish and golden redfish combined in SA 1: Survey abundance indices for EU-Germany survey (juvenile individuals <17cm) and the Greenland groundfish/shrimp survey.

c) Conclusion

Some increase has been seen in the indices in the Greenland deep-sea survey since 2008, and the EU-Germany survey since 2006. Recruitment has however been low since 2001. The Greenland groundfish/shrimp survey reveals the lowest biomass and abundance indices throughout its time series. With the extension of the indices including the 2009 survey, there is no basis for changes in the perception of the stocks. Both stocks are considered to be in a poor condition.

STACFIS reiterated the **recommendation** that *the species composition and quantity of redfish discarded in the shrimp fishery in SA 1 be further investigated.*

This stock will next be assessed in 2011

5. Other Finfish in SA 1

Interim Monitoring Report (SCR Doc. 10/30; SCS Doc. 10/12)

a) Introduction

Other finfish in SA 1 includes American plaice (*Hippoglossoides platessoides*), Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*) and thorny skate (*Amblyraja radiata*). Catch statistics for both wolffish species are combined, since no species-specific data are available. In recent years, no catch data was available for American plaice and thorny skate.

Recent nominal catches (t) for wolffish are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
STATLANT 21A	39	87	306	313	515	764	880	4[1]	10[1]	
STACFIS	82	118	393	313	515	764	880	1152	1140	

[1] Greenland has not submitted STATLANT 21A data since 2007.

b) Data Overview

Research survey data

The Greenland groundfish/shrimp survey and the EU- German survey were conducted in 2009. Stocks of American plaice, Atlantic wolffish and Thorny skate all show decreasing and below average biomass in both the EU-Germain survey and the Greenland Groundfish/shrimp survey. Biomass indices for Spotted wolffish increased between 2002 and 2008 to a level above average. The stock shows no sign of dominating year classes (SCR Doc 10/30). Abundance estimates for Spotted wolffish have however decreased substantially since 2005 in the Greenland groundfish/shrimp survey.

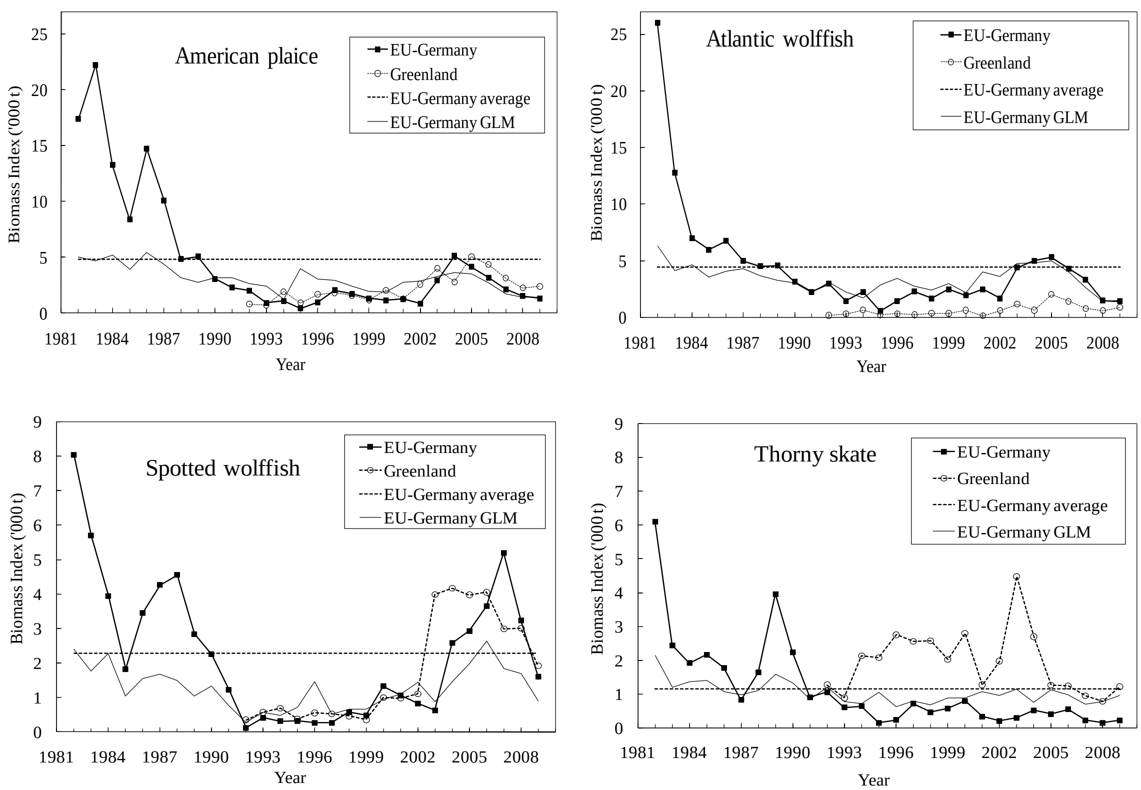


Fig. 5.1. Other finfish in SA 1: survey biomass indices.

c) Conclusion

With the extension of the indices including the 2009 survey results there is no indication of change in the stocks of Americal plaice, Atlantic wolffish and Thorny skate in SA 1. These stocks remain depleted. The Spotted wolffish stock has been above or near average levels since 2002. There is not, however, a significant change in the state of the stock since the most recent full assessment.

d) Research Recommendations

STACFIS reiterated the **recommendation** that *the species composition and quantity of other finfish discarded in the shrimp fishery in SA 1 be further investigated.*

STACFIS reiterated the **recommendation** that *the distribution of these species in relation to the main shrimp-fishing grounds in SA1 be investigated, in order to further discover means of reducing the amount of discarded bycatch.*

These stocks will next be assessed in 2011.

B. STOCKS ON THE FLEMISH CAP: SA 3 AND DIV. 3M

Environmental Overview

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

In 2009, surface temperatures on Flemish Cap were slightly below normal. The near-bottom temperatures remained above well above normal values. On the Flemish Cap, surface salinities were slightly lower than normal. The Cold-Intermediate-Layer (CIL) area increased on the Flemish Cap during summer, with positive anomalies (colder conditions) the first time in almost a decade. The baroclinic transport in the offshore branch of the Labrador Current through the Flemish Pass increased significantly in 2009 compared to the previous year. A composite index derived from the temperature and salinity indices for the Flemish Cap section sampled during the summer was slightly below normal in 2009. Annual integrated phytoplankton biomass was favorable and well above normal throughout Subarea 3.

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

(SCR Doc. 10/23, 41; SCS Doc. 10/5, 6, 7)

a) Introduction

i) Description of the fishery and catches

The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod has also been taken as bycatch in the directed redfish fishery by Portuguese trawlers. Estimated bycatch in shrimp fisheries is low. Large numbers of small fish were caught by the trawl fishery in the past, particularly during 1992-1994. Catches since 1996 were very small compared with previous years.

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

Catches exceeded the TAC from 1988 to 1994, but were below the TAC from 1995 to 1998. In 1999 the direct fishery was closed and catches were estimated in that year as 353 t, most of them taken by non-Contracting Parties based on Canadian Surveillance reports. Those fleets were not observed since 2000, and the current reduced catches are mainly obtained as bycatch of the redfish fishery. Yearly bycatches between 2000 and 2005 were below 60 t, rising to 339 and 345 t in 2006 and 2007, respectively. In year 2008 and 2009 catches were increasing until 889 and 1161 t, respectively. The fishery has been reopened in 2010 with a TAC of 5 500 t.

Recent TACs and catches ('000 t) are as follow:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	5.5
STATLANT 21A	0.1	0.0	0.0	0.0	0.0	0.1	0.1[1]	0.4[1]	1.2[1]	
STACFIS	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.9	1.2	

[1] Provisional
ndf No directed fishery

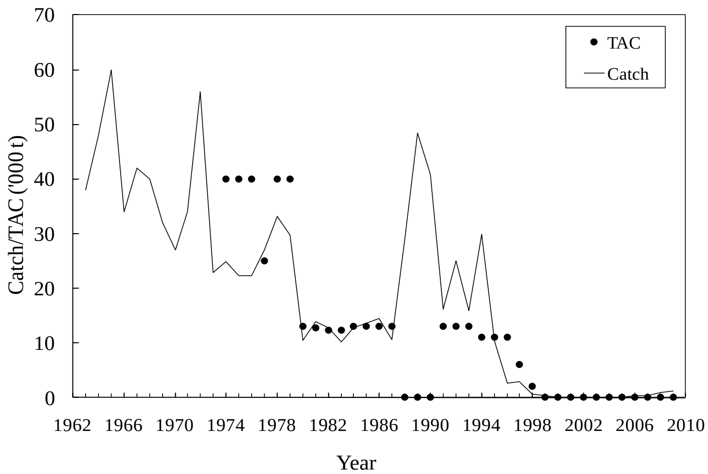


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch line includes estimates of misreported catches since 1988. No direct fishery is plotted as 0 TAC.

b) Input Data

i) Commercial fishery data

Length and age compositions from the 2002 to 2005 commercial catches were not available. That information is available for the 1973 to 2001 period and for years 2006 to 2009, although sampling levels in this last period were low. In 2009 length distribution for Portugal are available, which has an unique mode at 60 cm. Length to age conversions up to 2008 were performed using age-length keys from the EU Flemish Cap survey, since they were the only ones available. In 2009 an age-length key from EU-Portugal catches was available. In 2009 age 4 was the most abundant in the catch.

ii) Research survey data

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

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

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

Stratified-random bottom trawl surveys have been conducted by the EU since 1988 covering the whole distribution of the stock. Since 2003 the survey has used a new vessel and in order to make the series comparable fishing trials were performed with both vessels in 2003 and 2004.

The EU Flemish Cap survey indices also showed a decline in trawlable biomass going from a peak value of 114 000 t in 1989 to 27 000 t in 1992. This was followed by an increase to 61 000 t in 1993, then a decrease to around 10 000 t for the 1995 to 1997 period and then a steady decrease until the lowest observed level of 1 600 t in 2003. Biomass increased in 2004 and 2005 to around 5 000 t. The indices since 2006 show a strong increase in biomass, especially in 2009, with values starting in 13 000 t in 2006 and reaching 75 000 t in 2009. The growth of the strong 2005 year class has contributed to the increase in biomass.

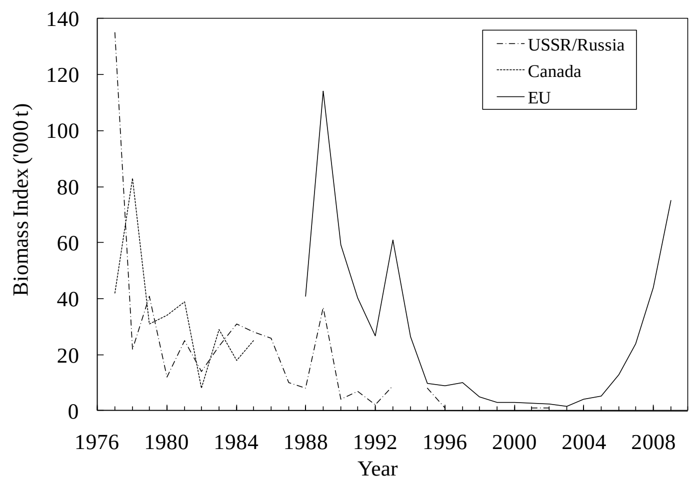


Fig. 6.2. Cod in Div. 3M: total biomass estimates from surveys.

There is also a general increase in abundance, but it is less strong, reflecting the fact that stock weight at age has generally increased in recent years. Abundance at age indices were available from the Flemish Cap survey. After a consistent series of above average recruitments (age 1) during 1988-1995, the EU Flemish Cap survey indicates poor recruitments during 1996-2004, even obtaining observed zero values in 2002 and 2004. Since 2005 above average recruitments have again been observed. In particular, the age 1 index in 2006 is the fourth largest in the EU series.

iii) Biological data

Mean weight at age in the stock, derived from the EU Flemish Cap survey data, shows a strong increasing trend since the late 1990s. In 2009 youngest and oldest ages increased theirs mean weight-at-age with respect to 2008, while the ages 3-4 decreased them, but still remain higher than at the beginning of the series.

In 2008 assessment new annual maturity ogives were provided for years 2000-2006. There are no major differences between the new maturity ogives provided in 2008 and the ones used until 2007. In years 2007 to 2009 maturity ogives were not available yet, so 2006 maturity ogive was used for those years. There has been a continuous decline of the A_{50} (age at which 50% of fish are mature) through the years, going from above 5 years of age in the late 1980's to just above 3 years of age since about year 2000 (see Fig. 9 of SCR Doc. 10/41).

c) Estimation of Parameters

In 2008 and 2009 a VPA-type Bayesian model was used for the assessment of this stock. The input data for the model are:

Catch data: catch numbers and mean weight at age for 1988-2009, except for 2002-2005, for which only total catch is available.

Tuning: numbers at age from the EU Flemish Cap survey data for 1988-2009

Ages: from 1 to 8+ in both cases

Catchability analysis: dependent on stock size for ages 1 to 2

Priors: over survivors at age at the end of the final assessment year, over survivors from the last true age at the end of every year, over fishing mortalities at age and total catch weight for years without catch numbers at age, over numbers at age of the survey and over the natural mortality. Prior distributions were set as last year assessment.

d) Assessment Results

Total Biomass and Abundance: Model estimates in total biomass and abundance show an increasing trend in both values, being the increase in biomass higher than the one in abundance, although they are still well below the values of the first years of the assessment (Fig. 6.3).

Spawning stock biomass: Model estimates of SSB (Fig. 6.4) indicate yearly increases starting from 2004, with the biggest increase taking place during 2009 and 2010. Whereas SSB at the beginning of 2008 is estimated to be 14 691 t with 90% probability interval of (10 070, 20 872 t), SSB at the start of 2010 is 55 992 t with 90 % probability interval of (39 872, 79 316 t), that is, well above B_{lim}, which is 14 000 t, and above the second highest value of the series, that was in 1989 with 32 545 t. The big increase in the last three years is largely due to four reasonably abundant year classes, those of 2004-2007, and to their early maturity.

Very substantial contributors to the rise in SSB are the larger weight at age and the younger age of maturity observed in recent years. Recent SSB may have lower reproductive potential than in the earlier time series. As an example, if SSB in 2009 had been computed using the weight at age and maturity at age values average from 1988 to 1995, its estimated value would have been 16 847 t, much lower than the current estimate of 55 992 t. As a result of these changes, it is unclear whether the meaning of SSB as an indicator of stock status in recent years is the same as in the earlier period.

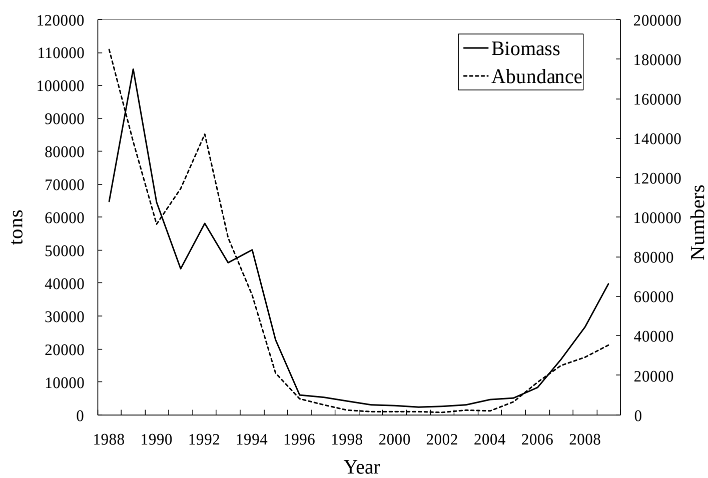


Fig. 6.3. Cod in Div. 3M: Biomass and Abundance estimates for years 1988 to 2009.

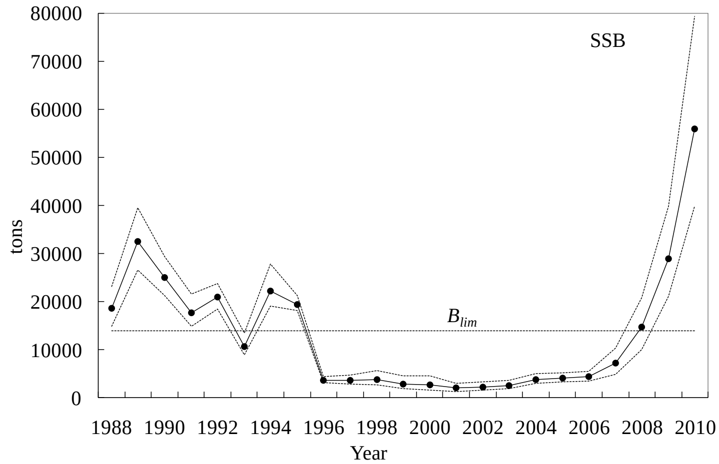


Fig. 6.4. Cod in Div. 3M: SSB estimates and 90% probability intervals for years 1988 to 2010. The horizontal dashed line is the B_{lim} level of 14 000 t.

Recruitment: After a series of recruitment failures between 1996 and 2004, recruitment values in 2005-2009 are higher, although still below the levels of the late 1980s and early 1990s (Fig. 6.5). There is considerable uncertainty associated with the four most recent values, as indicated by the wide 90% probability limits.

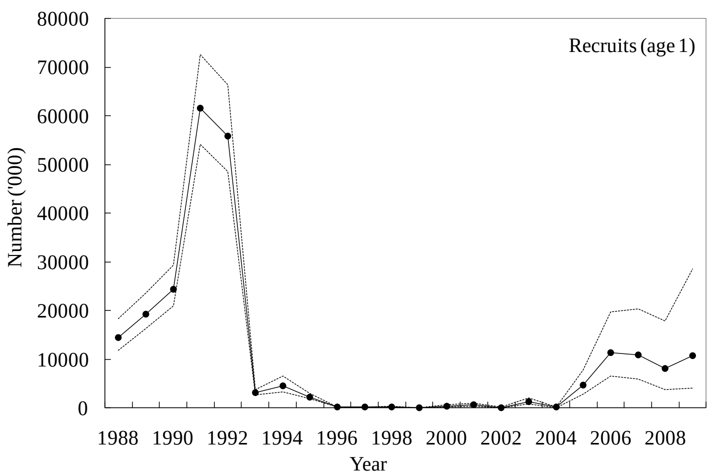


Fig. 6.5. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2009.

Fishing mortality: F_{bar} (ages 3-5) is estimated to have been at very low levels since 2001 (Fig. 6.6). An increase is observed in 2006, which is mainly due to high fishing mortality rates at ages 3 and 4. In 2009 the F_{bar} level remains very low.

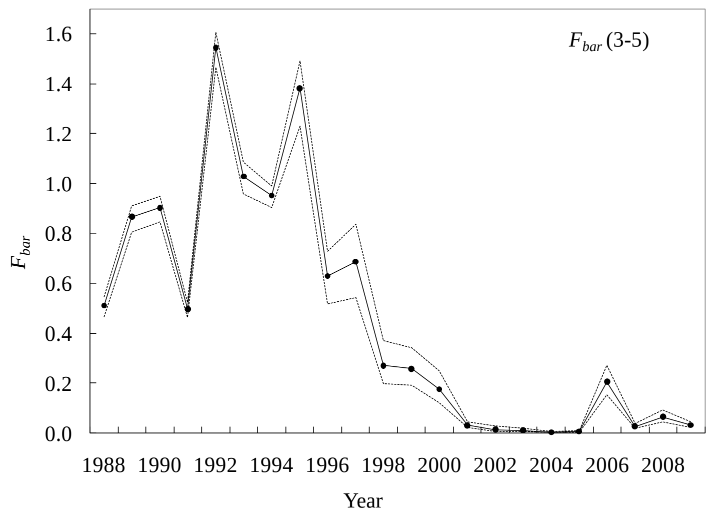


Fig. 6.6. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2009.

e) Retrospective analysis

A six-year retrospective analysis of the Bayesian model was conducted by eliminating successive years of catch and survey data. Fig. 6.7 to 6.9 present the retrospective estimates of age 1 recruitment, SSB and F_{bar} at ages 3-5.

Retrospective analisys show a overstimation of R in recent years (Fig. 6.8), while the SSB and fishing mortality in recent years do not show a clear retrospective pattern (Fig. 6.7 and 6.9).

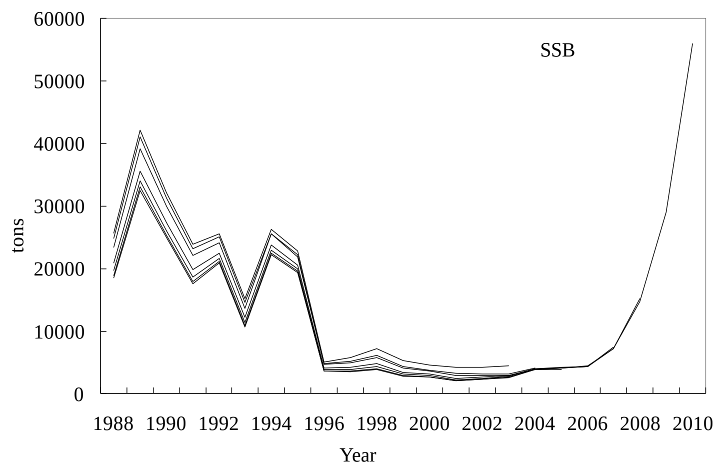


Fig. 6.7. Cod in Div. 3M: Retrospective results for SSB.

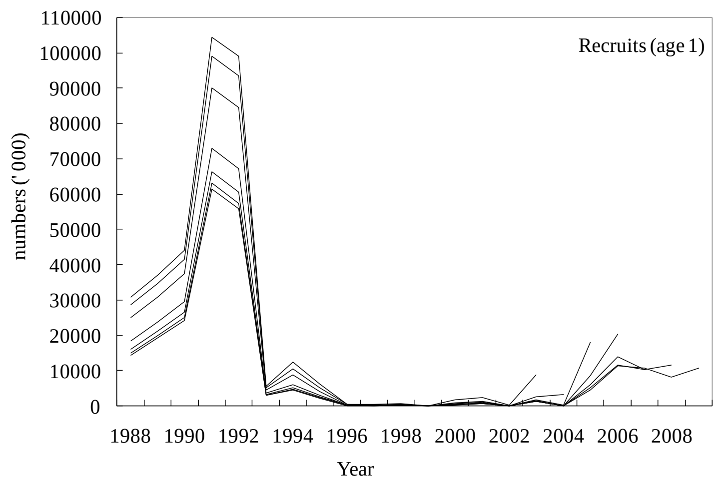


Fig. 6.8. Cod in Div. 3M: Retrospective results for recruitment.

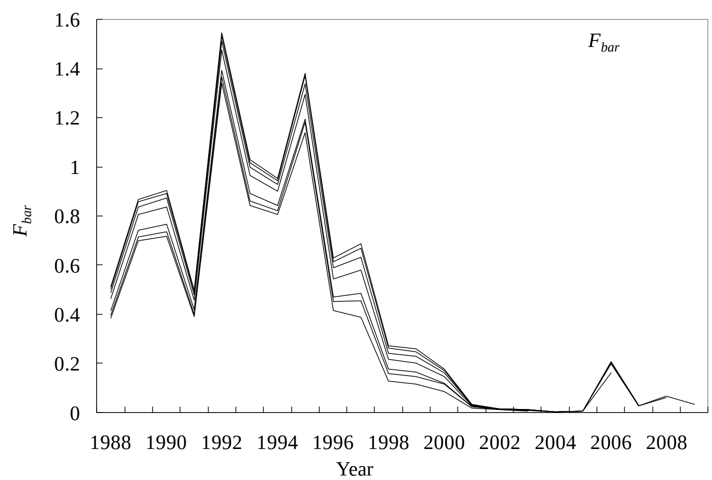


Fig. 6.9. Cod in Div. 3M: Retrospective results for F_{bar}..

f) State of the Stock

There has been a significant spawning biomass increase, reaching levels much higher than the ones in the first years of the assessment (1988-1995), although total biomass and abundance remain still lower that in those years. As a result of changes noted in weight and maturity, it is unclear whether the meaning of spawning biomass as an indicator of stock status is the same as in the earlier period. Whereas recruitment has been better during 2005-2009, it is below levels in the earlier period.

g) Reference Points

B_{lim} was estimated at 14 000 t from the results of the earlier XSA model. As the Bayesian model now used for the assessment of the stock gave in 2008 very similar answers to XSA for the common period, the validity of the current B_{lim} value would not seem to be in question. Fig. 6.10 shows a stock-recruitment plot, with 14 000 t indicated by the dashed vertical line. The value still appears as a reasonable choice for B_{lim}: only low recruitments have been observed with SSB below this level whereas both high and low recruitments have been observed at higher SSB values. SSB is well above B_{lim} in 2010. Fig. 6.11 shows a stock-F_{bar} plot.

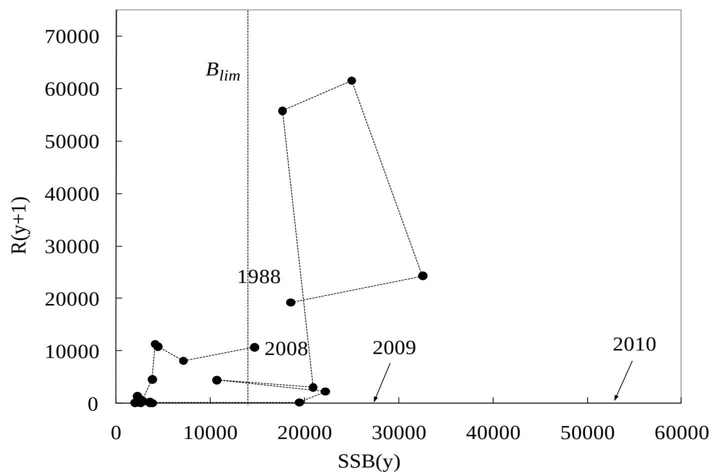


Fig. 6.10. Cod in Div. 3M: Stock-Recruitment (posterior medians) plot

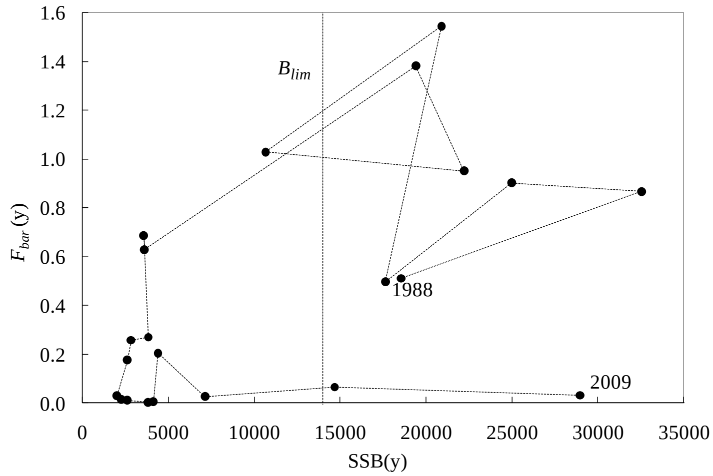


Fig. 6.11. Cod in Div. 3M: Stock-F_{bar}(3-5) (posterior medians) plot

Fig. 6.12 shows the Bayesian yield per recruit with respect to F_{bar}, in which we can see the estimated values for $F_{0.1}$, F_{max} and F_{2009}.

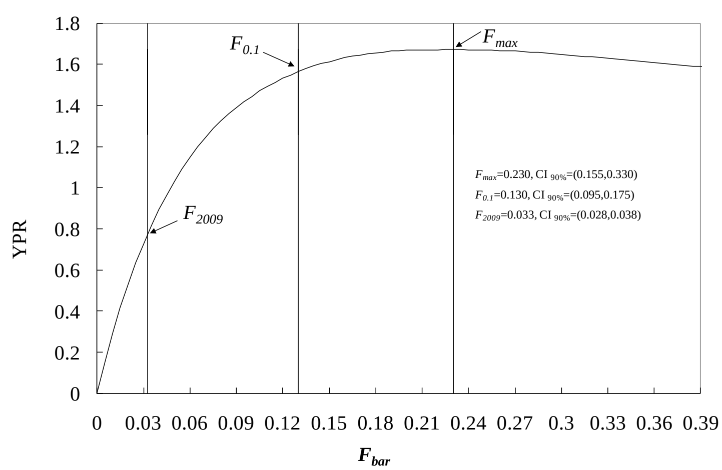


Fig. 6.12. Cod in Div. 3M: Bayesian Yield per recruit

h) Stock Projections

Stochastic projections of the stock dynamics over a 3 year period (2011-2013) have been performed. The variability in the input data is taken from the results of the Bayesian assessment. Input data for the projections are as follows:

Numbers aged 2 to 8+ in 2010: estimates from this assessment.

Recruitments for 2010-2013: Recruits per spawner were estimated for each of the assessment years. As the last 3 years have a much higher value than the average, recruits per spawner were drawn randomly from the values in all of the assessment years.

Maturity ogive: Drawn randomly from the maturity ogives (with their associated uncertainty) of years 2004-2006 (2007-2009 were not used since no data were available to estimate an ogive for those years).

Weight-at-age in stock and weight-at-age in catch: Drawn randomly from the values in 2007-2009.

PR at age for 2010-2012: The recent years fishery were only bycatch and it is unlikely to have the same PR as the direct fishery, so an average of the PRs estimated for 1988-1998, the period in which the fishery was open, was chosen.

F_{bar}*(ages 3-5)*: Three scenarios were considered. All scenarios assumed that the Yield for 2010 is the established TAC (5500 t):

(Scenario 1) $F_{bar}=F_{0.1}$ (median value = 0.130). Results are in Fig 6.13, 6.14, 6.15.

(Scenario 2) $F_{bar}=F_{max}$ (median value = 0.230). Results are in Fig 6.16, 6.17, 6.18.

(Scenario 3) $F_{bar}=F_{2009}$. (median value = 0.033). Results are in Fig 6.19, 6.20, 6.21.

Fig. 6.22 to 6.24 summary the projection results under all the Scenarios in just one figure. These results indicate that fishing at any of the considered values of F_{bar}, total biomass and SSB during the next 3 years have a very high probability of reaching levels higher than all of the 1988-2010 estimates (Fig. 6.13, 6.14, 6.16, 6.17, 6.19, 6.20, 6.22 and 6.23), although the increase in SSB is higher than in total biomass. However, similarly to what was indicated in the presentation of the assessment results, the huge increase predicted for SSB does not have a counterpart in terms of population abundances, which are projected to remain at levels below those of the late 1980s (Fig. 6.22). This mismatch is largely due to the fact that weight-at-age and maturity-at-age values used for the projection period are much higher than those assumed to have applied at the end of the 1980s. If these conditions do not persist, projection results will be overly optimistic. The removals associated with these F_{bar} levels are lower than those in the period before 1995 (Fig. 6.15, 6.18, 6.21 and 6.24).

All the results of the projections are summarized in the following table:

	Total Biomass			SSB			Yield		
	5%	50%	95%	5%	50%	95%	5%	50%	95%
				$F_{bar}=F_{0.1}$ (median=0.130)					
2010	50220	70256	99303	39816	55883	79366		5500	
2011	64790	94226	148921	53724	75254	104901	4738	9696	16734
2012	74204	119863	239329	63973	92922	143772	6155	12357	24424
2013	78713	154829	382444	66583	113569	260506	7551	15913	39985
				$F_{bar}=F_{max}$ (median=0.230)					
2010	50151	69942	99080	39968	56279	79068		5500	
2011	65067	94178	146667	54076	75155	104854	7773	15848	28595
2012	65876	108048	220560	56792	83888	131777	9296	18825	38370
2013	63055	133604	345060	53584	95891	232822	10339	22876	63157
				$F_{bar}=F_{2009}$ (median=0.033)					
2010	49666	69628	99058	39600	56125	79794		5500	
2011	64542	93803	147487	53857	74895	105221	1329	2632	4200
2012	81677	130552	247053	71134	103096	158937	1956	3612	6698
2013	94840	177909	396185	83629	136085	303361	2624	5084	11804

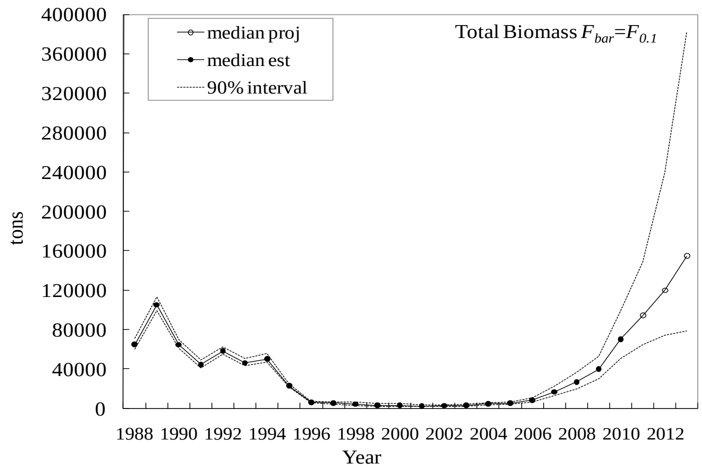


Fig. 6.13. Cod in Div. 3M: Projected Total Biomass under Scenario 1 for F_{bar} (medians and 90% probability intervals).

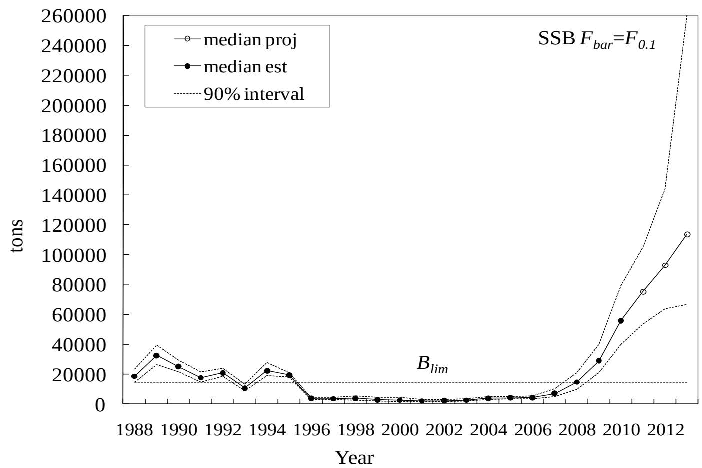


Fig. 6.14. Cod in Div. 3M: Projected SSB under Scenario 1 for F_{bar} (medians and 90% probability intervals).

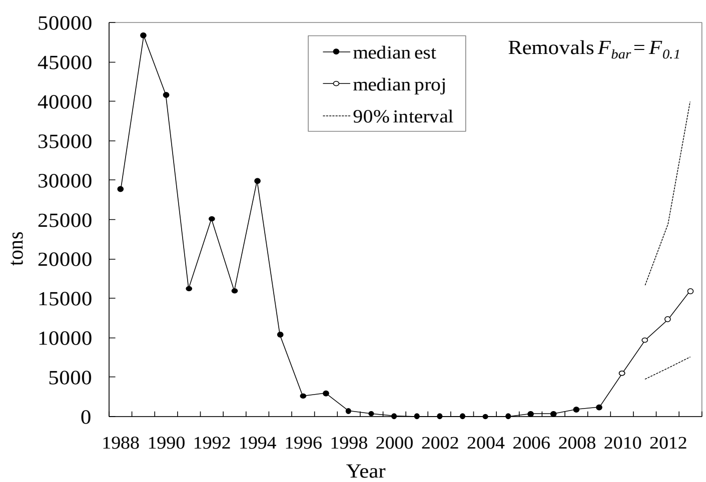


Fig. 6.15. Cod in Div. 3M: Projected removals under Scenario 1 for F_{bar} (medians and 90% probability intervals).

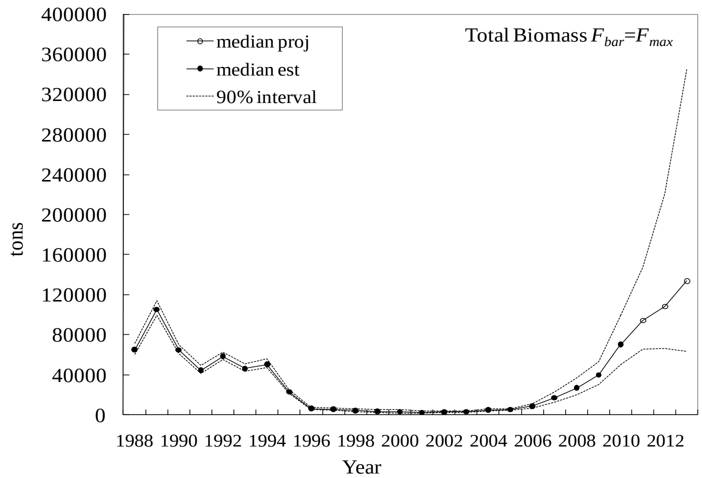


Fig. 6.16. Cod in Div. 3M: Projected Total Biomass under Scenario 2 for F_{bar} (medians and 90% probability intervals).

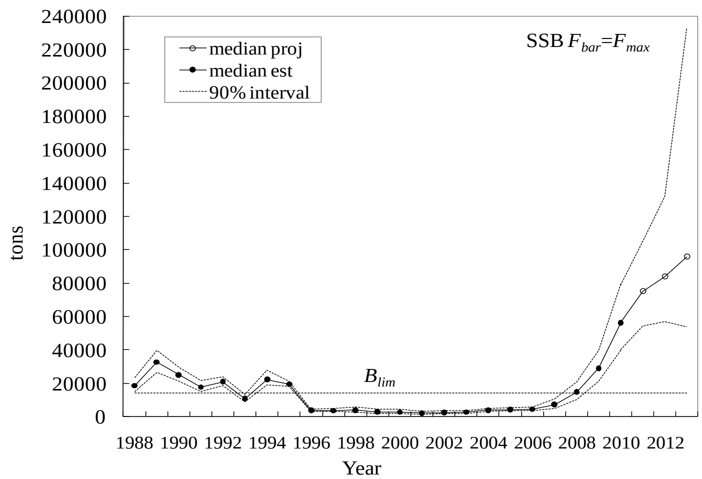


Fig. 6.17. Cod in Div. 3M: Projected SSB under Scenario 2 for F_{bar} (medians and 90% probability intervals).

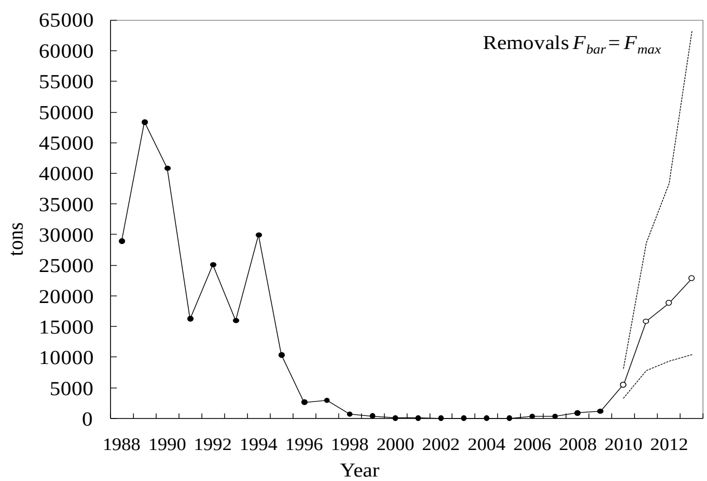


Fig. 6.18. Cod in Div. 3M: Projected removals under Scenario 2 for F_{bar} (medians and 90% probability intervals).

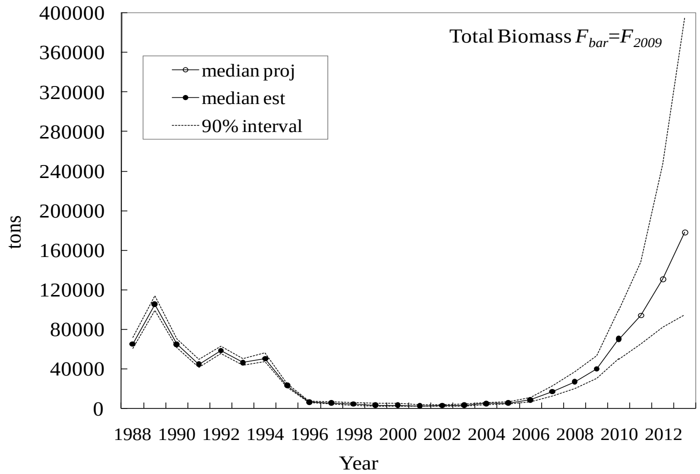


Fig. 6.19. Cod in Div. 3M: Projected Total Biomass under Scenario 3 for F_{bar} (medians and 90% probability intervals).

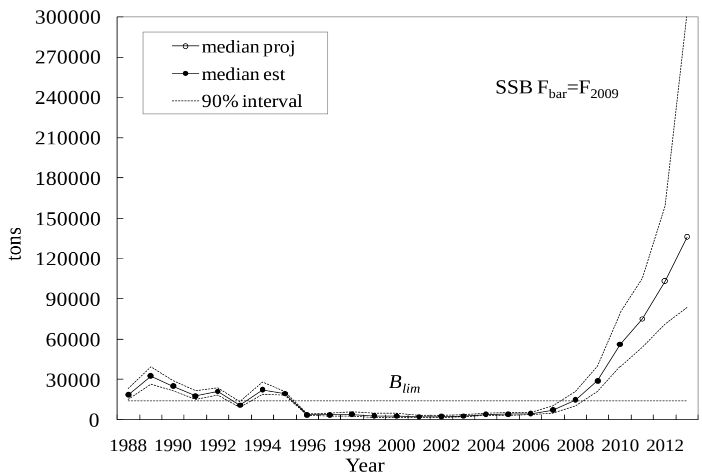


Fig. 6.20. Cod in Div. 3M: Projected SSB under Scenario 3 for F_{bar} (medians and 90% probability intervals).

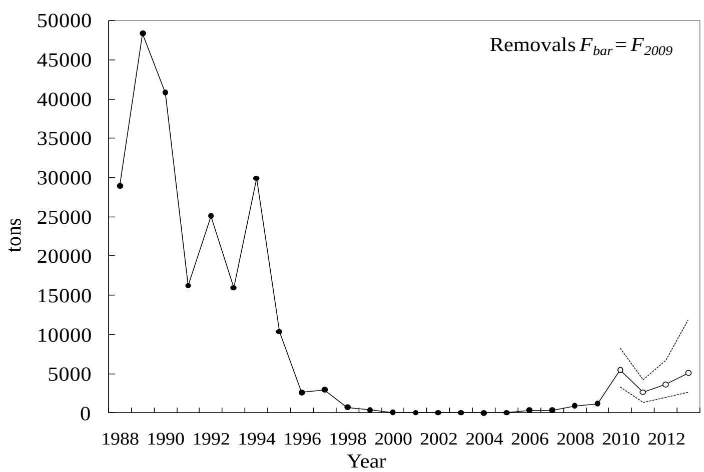


Fig. 6.21. Cod in Div. 3M: Projected removals under Scenario 3 for F_{bar} (medians and 90% probability intervals).

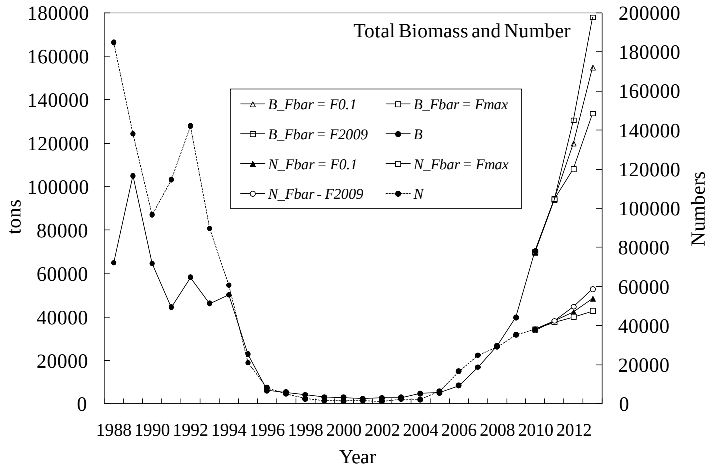


Fig. 6.22. Cod in Div. 3M: Projected Total Biomass and Abundance under all the Scenarios. "B" means Biomass, "N" means Abundance

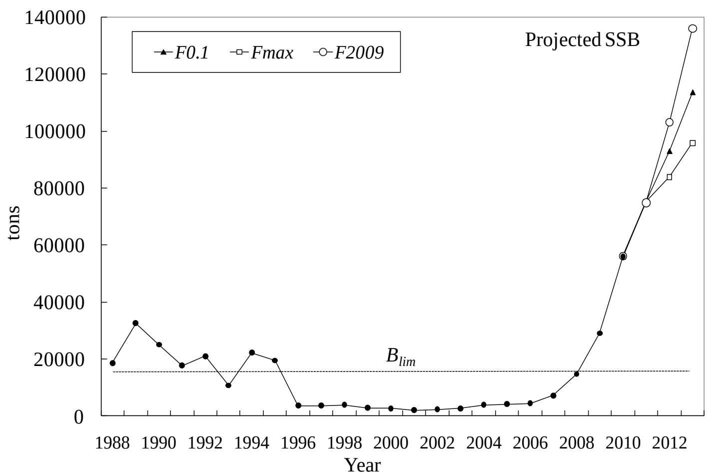


Fig. 6.23. Cod in Div. 3M: Projected SSB under all the Scenarios.

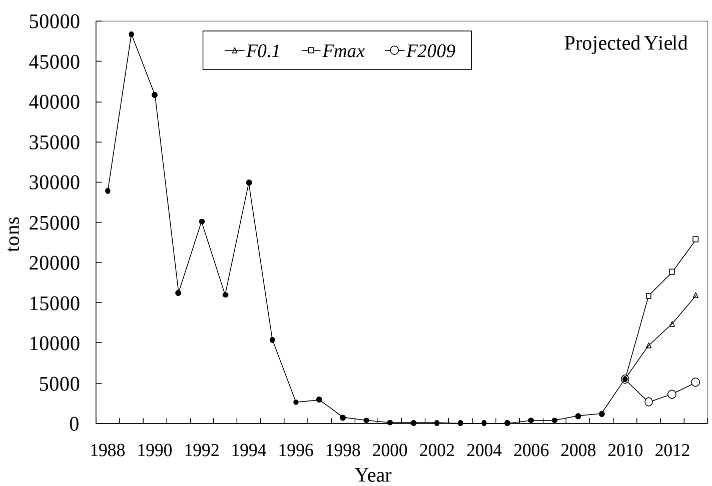


Fig. 6.24. Cod in Div. 3M: Projected removals under all the Scenarios.

The projected values for the period 2011-2013 are reliant on relatively abundant recent cohorts, rather than on healthy population abundances across all ages, making the stock much more fragile than suggested by SSB values alone.

i) Research Recommendations

Taking into account that the stock is changing rapidly and this could lead to considerable change in the maturity ogive, STACFIS **recommended** that *the maturity ogives be updated to include data for the years 2007-2009.*

The next full assessment for this stock will be in 2011.

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

Interim Monitoring Report (SCR Doc. 10/ 23; SCS Doc. 10/5, 6, 7)

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 and long recruitment process to the bottom. Redfish species are long lived with slow growth.

i) Description of the fishery

The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-99, when a minimum catch around 1 000 t 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 an abrupt decline of fishing effort.

There was a relative increase of the catch on 2000-2002 to a level above 3 000 t but in 2003 the overall catch didn't reach 2 000 t. In 2004, catch raised again near 3 000 t and Portugal consolidated its major role in the fishery.

A golden redfish fishery occurred on the Flemish Cap bank from September 2005 onwards on shallower depths above 300 m, basically pursued by Portuguese bottom trawl and Russia pelagic trawl. This new reality implied a revision of catch estimates, in order to split recent commercial catch from the major fleets on Div. 3M (Portugal, Russia and Spain) into golden and beaked redfish catches. In order to estimate a proxy of the beaked redfish catch by fleet, a 2005-2008 review of the logbooks from the monitored vessels has been carried out last year by the national sampling programmes of Portugal, Spain and Russia. This exercise has been updated at present for 2009. The estimated level of beaked redfish catch remained stable on 2008-2009, though with a slight increase from 3 200 t to 3 800 t.

The redfish bycatch in the Div. 3M shrimp fishery (once an important part of fishing mortality on the earlier ages, from 1993 until 2003) declined since 2004, but remains unknown for 2006-2009.

Recent TACs, catches and bycatch ('000 t) are as follows (Fig. 7.1):

	2001	2002	2003	2004	2005	2006	2007	2008	2009[1]	2010
Recommended TAC	5	5	5	5	5	5	5	5	5	8.5
TAC	5	5	5	5	5	5	5	8.5	8.5	10.0
STATLANT 21A	34	3.0	2.0	3.1	6.4	6.3	5.6	6.8	7.6	
STACFIS Total catch	3.2	2.9	1.9	2.9	6.6	7.2	6.7	8.5	11.3	
STACFIS Catch[2]	3.2	2.9	1.9	2.9	4.8	6.3	5.5	3.2	3.8	

[1] Provisional.
[2] Estimated beaked redfish catch.

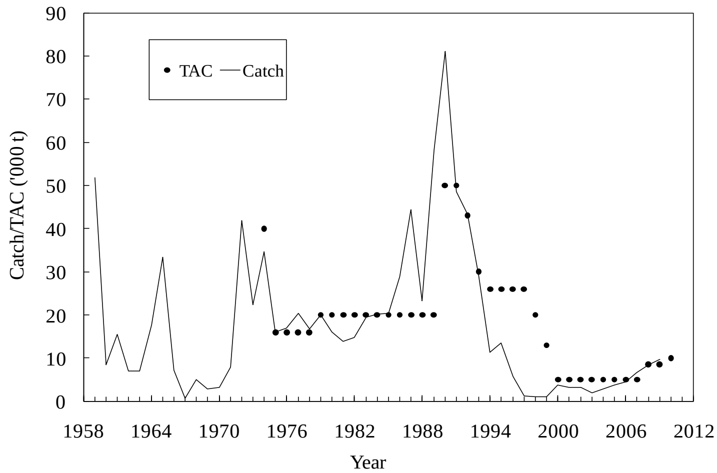


Fig. 7.1 Redfish in Div. 3M: catches and TACs.

b) Data Overview

Research surveys

From the EU bottom trawl survey on Flemish Cap (1988-2009) total beaked redfish biomass and abundance declined from 2006 onwards but continue to stay well above their observed level until the early 2000s. Female spawning survey biomass continues to grow: in 2005-2009 the increasing portion of young maturing females from the good 1999, 2000, 2001 and 2002 year classes, together with the increasing biomass of these cohorts are supporting the observed increase of the SSB survey index (Fig. 7.2).

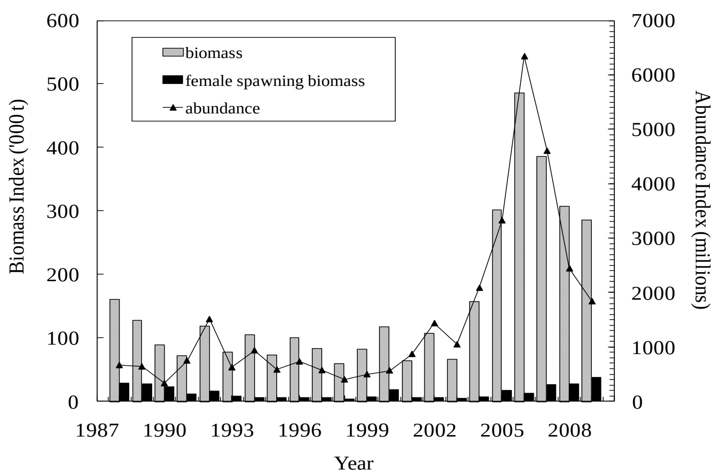


Fig. 7.2. Beaked redfish in Div. 3M: survey biomass, female spawning biomass and abundance from EU surveys (1988-2009).

c) Conclusions

The perception of the stock status given by the EU survey has been maintained in 2009.

The next full assessment of the stock is planned for 2011.

d) Current and Future Studies

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

STACFIS **recommended** that *an update of the recent Div. 3M golden redfish fishery information be compiled on an annual/fleet basis, including estimated catch and size distribution of the golden redfish catches.*

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

Interim Monitoring Report

a) Introduction

A total catch of 70 t was estimated for 2009 (Fig. 8.1).

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
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	0.1	0.1	0.1	0.1	0.1	0.1[1]	0.1[1]	
STACFIS	0.1	0.1	0.1	0.1	0.05	0.05	0.1	0.1	0.1	

ndf No directed fishing.
[1]Provisional

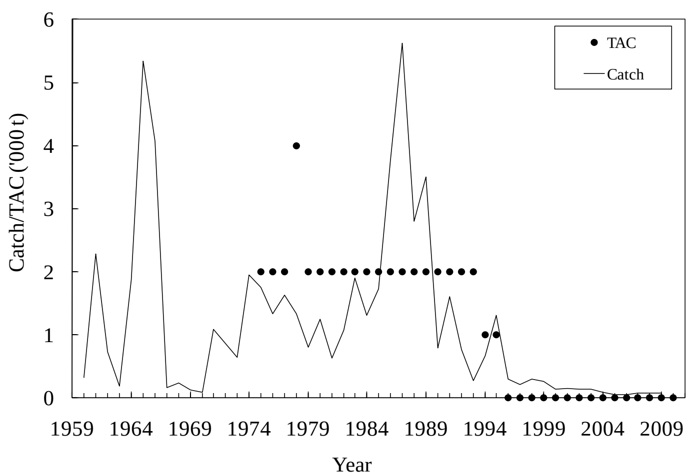


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs (ndf is plotted as 0 TAC).

b) Data Overview

The EU bottom trawl survey on Flemish Cap was conducted during 2009. The survey estimates remained at low levels as previous years (Fig. 8.2 and 8.3).

Recruitment from 1991 to 2005 was very weak. The 2007-2009 surveys show the 2006-2008 year-classes to be stronger than cohorts seen since the early 1990s (SCR Doc. 10/23).

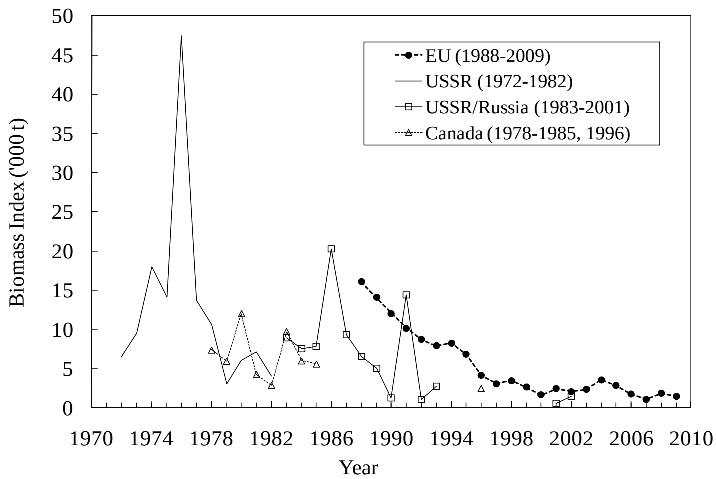


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys.

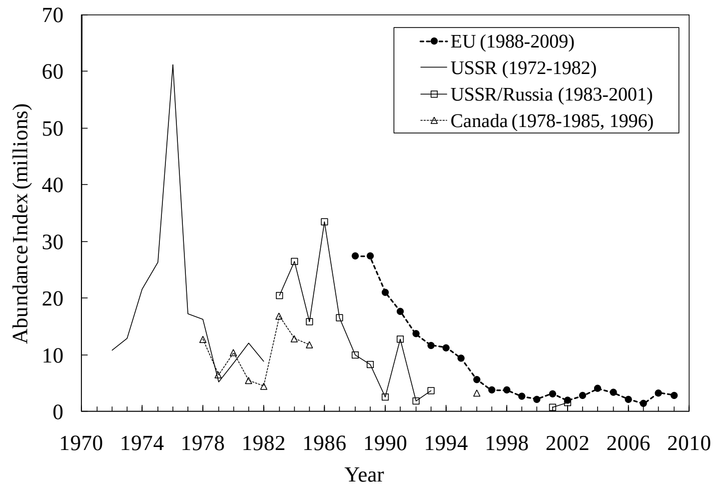


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys.

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 (50% of age 5 and 100% of age 6 plus) in 2010. Level of catches and fishing mortality since 1992 appear to be relatively low and survey data indicate that the stock biomass and the SSB remained at a very low level. Although there are signs of improved recruitment, there is no major change to the perception of the stock status.

The next full assessment is expected to be in 2011.

d) Research Recommendations

Average *F* in recent years has been very low relative to *M*. Therefore STACFIS reiterates its **recommendation** that *the utility of the XSA must be re-evaluated and the use of alternative methods (eg. Survey-based models or stock production models) be attempted in the next full assessment of Div. 3M American plaice*.

Because ages below 3 are not well selected in the EU survey series STACFIS also reiterates its **recommendation** that *exploratory runs of the XSA should be done with the input data starting at age 3 or 4.*

C. STOCKS ON THE GRAND BANK: SA 3 AND DIV. 3LNO

Environmental Overview

The water masses characteristic of the Grand Banks are typical Cold-Intermediate-Layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0°C during spring and through to autumn. The winter-formed CIL water mass is a reliable index of ocean climate conditions in this area. Bottom temperatures increase to 1-4°C in southern regions of Div. 3NO due to atmospheric forcing and along the slopes of the banks below 200 m depth due to the presence of Labrador Slope Water. On the southern slopes of the Grand Banks in Div. 3O bottom temperatures may reach 4-8°C due to the influence of warm slope water from the south. The general circulation in this region consists of the relatively strong offshore Labrador Current at the shelf break and a considerably weaker branch near the coast in the Avalon Channel. Currents over the banks are very weak and the variability often exceeds the mean flow. The proportion of bottom habitat on the Grand Banks covered by <0°C water has decreased from near 50% during the first half of the 1990s to <15% during 2004 and 2006.

The annual surface temperatures at Station 27 remained above the long-term in 2009, a trend observed since 2002. Bottom temperatures at Station 27 were slightly below normal while vertically averaged temperatures were only slightly above normal in 2009. Annual surface salinities at Station 27 were above normal in 2009. The cross sectional area of <0°C (CIL) water mass, was slightly below normal on the eastern Newfoundland Shelf for the 15th consecutive year. Averaged spring bottom temperatures were near normal in Div. 3LNO and in Subdiv 3Ps. Averaged autumn bottom temperatures were above normal in Div. 3K and about normal in Div. 3LNO. The environmental composite index which integrate a number of meteorological and physical oceanographic time series, continued to decline in 2009 from record high levels observed during the mid-2000s, but remains slightly above the long-term 40-year mean across the Newfoundland and Labrador Shelves.

9. Cod (*Gadus morhua*) in NAFO Div. 3NO

(SCR. Doc. 10/09, 42; SCS Doc. 10/05, 06, 07; 09/05, 09, 12; 08/05, 06, 07)

a) 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.

b) Fishery and Catches

Nominal catches increased during the late 1950s and early 1960s, reaching a peak of about 227 000 t in 1967. During the period from 1979 to 1991, catches ranged from 20 000 to 50 000 t. The continued reduction in recommended TAC levels contributed to the decline in catches to a level of about 10 000 t in 1993 (Fig. 9.1).

This stock has been under moratorium to directed fishing since February 1994. Since the moratorium catch increased from 170 t in 1995, peaked at about 4 800 t in 2003 then declined to 600 t in 2006. Since 2006 catches have increased steadily to 1 100 t in 2009.

Recent nominal catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	ndf	Ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	1.1	1.2	1.6	0.9	0.6	0.3	0.7	0.7[1]	0.6[1]	
STACFIS	1.3	2.2	4.3-5.5[2]	0.9	0.7	0.6	0.8	0.9	1.1	

[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

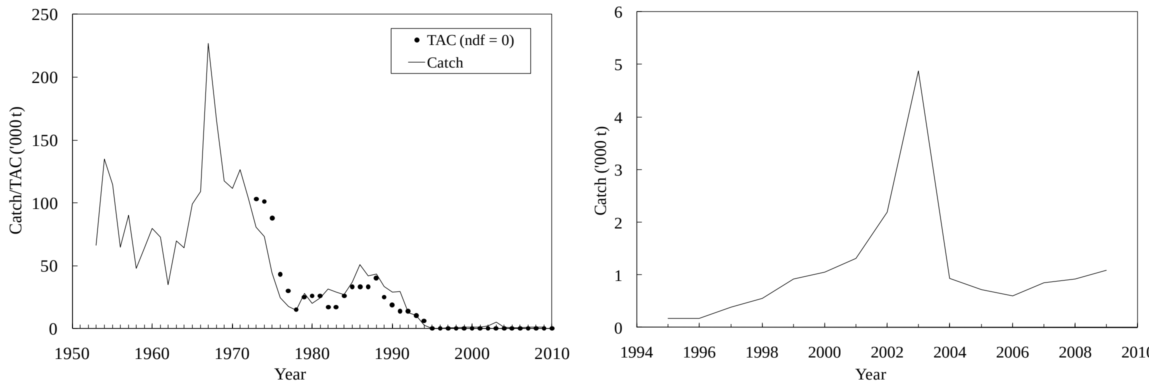


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing. No directed fishery is plotted as 0 TAC.

c) Input Data

Length and age composition were available from the 2007-2009 trawler fisheries to update catch at age. Canadian spring (1984-2009), autumn (1990-2009), and juvenile (1989-1994) surveys; and EU-Spain Div. 3NO May-June surveys provided abundance, biomass and size structure information.

i) Commercial fishery data

Catch-at-age. To develop catch at age over the 2007-2009 period various sources of information were available. Length and age sampling was available for Canada for 2007-2009. Sampling was not conducted on the longline fleets which have accounted for 20%-40% of the Canadian landings over this period. Length sampling was available for 2007-2008 from Russia, 2007-2009 from EU-Portugal and 2007-2009 from EU-Spain. The catch-at-age for these fleets was constructed by applying Canadian survey age length keys to the available length sampling. The catch from 2007-2009 was dominated by ages 3-6.

ii) Research survey data

Canadian spring surveys (SCR Doc. 10/42). Stratified-random surveys have been conducted in Div. 3N during the 1971-2009 period, with the exception of 1983, and in Div. 3O during 1973-2009 with the exception of 1974 and 1983. Coverage in the 2006 survey was too limited to be used as an index of this stock. The index values from 1984 to 1996 were converted into Campelen equivalent units.

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 surveys indicated increased catches of cod then the index declined to its lowest level in 1995. Except for a brief period of improvement from 1999 to 2001 the index remained low to 2004. There was a substantial increase in abundance in 2007 that has persisted to 2009, the highest in the index since before the moratorium (Fig. 9.2). The increase is the result of improved recruitment from the 2005-2007 year classes.

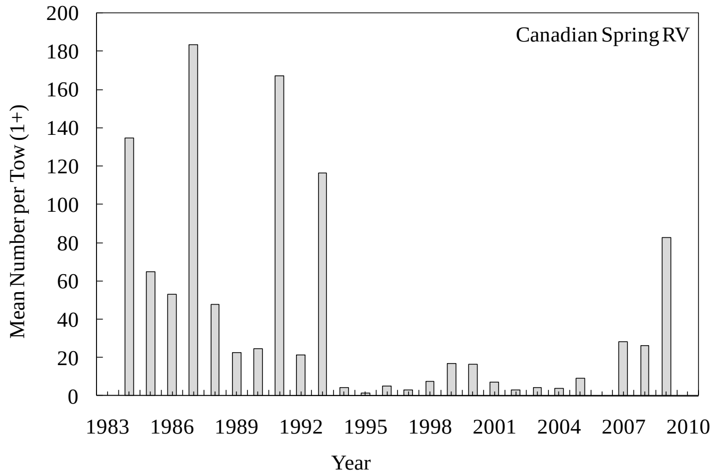


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian Spring surveys for the period including converted data.

Canadian autumn surveys (SCR Doc. 10/42). Additional stratified-random surveys have been conducted by Canada during autumn since 1990. The survey results from 1990-1994 were also converted into Campelen equivalent values. The index values from 1990 to 1992 were the largest in the time series (Fig 9.3). The trend since 1993 is similar to the spring series.

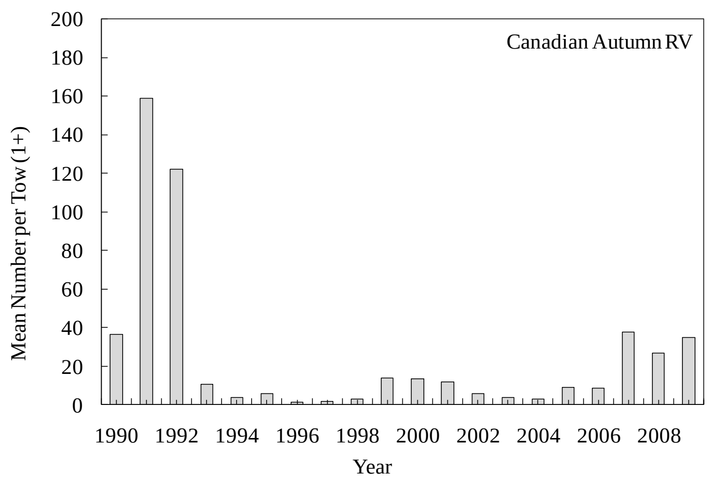


Fig. 9.3. Cod in Div. 3NO: mean number per tow from Canadian Autumn surveys for the period including converted data.

Canadian juvenile surveys (SCR Doc. 10/42). 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. 9.4).

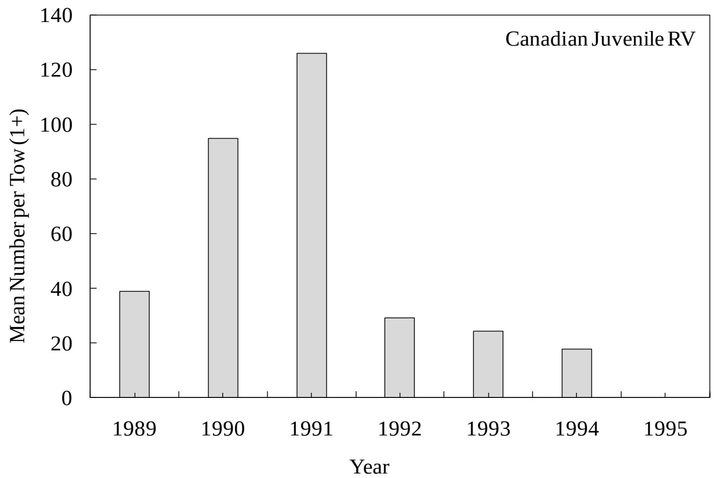


Fig. 9.4. Cod in Div. 3NO: mean number per tow from Canadian Juvenile surveys.

EU-Spain Div. 3NO surveys (SCR Doc. 10/09). Stratified-random surveys were conducted by EU-Spain in the NRA area of Div. 3NO in May/June from 1995-2009. 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 was relatively low and stable from 1997-2005 with the exception of large increases in 1998 and 2001 (Fig. 9.5). These large increases were influenced by a few large sets in those years. Since 2005 there has been a steady increase to the highest estimate in the series in 2009.

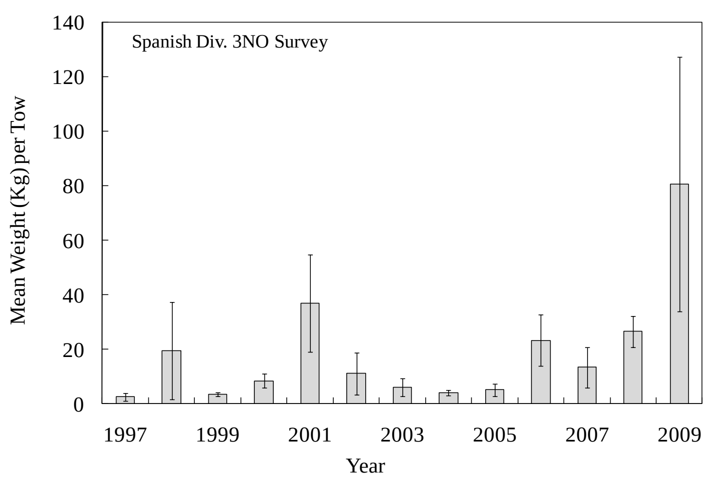


Fig. 9.5. Cod in Div. 3NO: mean weight per tow (± 1 s.d.) from EU-Spain Div. 3NO surveys.

iii) Biological studies

Length-at-age. Mean length-at-age was calculated for cod in Div. 3NO using Canadian spring survey data from 1975 to 2009 except for 1983 (no survey) and 2006 when survey coverage was too poor to be considered representative. Although there is variation in length-at-age there is little indication of any long-term trend.

Recently at least two year-classes (2005 and 2006) have appeared to be stronger than cohorts seen since the early 1990s. Mean length-at-age for cohorts measured in the spring survey since the introduction of the Campelen trawl were compared to those for the 2005 and 2006 cohorts at ages 2 to 4. The 2005 cohort was substantially smaller at age than other cohorts during the time period (Fig. 9.6). However, the 2006 cohort (at age 2 and 3) was similar in length-at-age to other cohorts from 1995 to 2009.

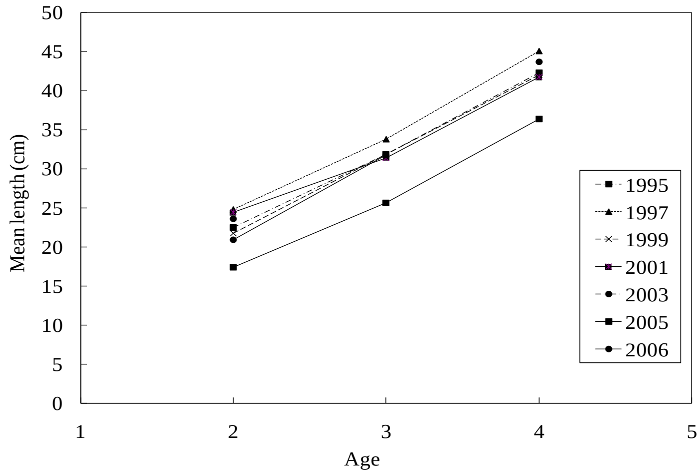


Fig. 9.6. Cod in Div. 3NO: mean length-at-age for year classes since 1995 from Canadian Div. 3NO spring surveys.

Maturity-at-age. Annual proportion mature is modeled by cohort. The estimated age at 50% maturity (A50) ranged between 5.6 and 7.4 years for cohorts produced from the 1950's to 1980's. Age at 50% maturity declined during 1980-1990 from approximately 6.8 to 4.9. For subsequent cohorts, although variable, A50 have generally been lower than those estimated for cohorts produced from the 1950's to the early 1980s, and was lowest for the 1998 and 1999 cohorts. The A50 for the most recent estimable cohorts (2002-2004) ranged from 4.9 to 5.8, similar to values in the late 1980s.

d) Estimation of Parameters

Sequential population analysis (SPA)

STACFIS reviewed cohort consistency plots and correlation analyses for each of the survey indices for this stock that were continued into 2009. The results indicate generally good tracking for the Canadian surveys but less so for the EU-Spain survey which has used Canadian age-length keys as the basis for aging information. STACFIS was also informed that age-length keys are being developed from fish sampled during the EU-Spain surveys back to 1997 and an index-at-age should be available for the next assessment of this stock. Previous explorations of including this index in an SPA in 2006 resulted in a poorer fitting model. Therefore, it was decided not to include the EU-Spain index for this assessment.

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 at ages 3-12 in 2010. The SPA formulation also estimated numbers at age 12 from 1994-2009 and survey catchabilities at ages 2-10 for each survey for a total of 53 parameters to be estimated. 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.

The mean square error of the model fit was 0.646 based on an estimation of 53 parameters. Overall the Canadian spring and autumn surveys show little pattern in the residuals, although there are some year effects. There is a trend in the residuals of the Canadian juvenile survey.

For the survivors estimated in 2010, the relative error in the parameter estimates decreased with age from a high of 58% at age 3 to 32% at age 12. Relative bias was a high of 18% at age 3 decreasing to 5% at age 12.

e) Assessment Results

The SPA results calibrated with the three Canadian survey indices indicate that the spawning stock was at an extremely low level in 1994 and remained stable at a low level to 2007. SSB has increased to its highest level since 1992 and is estimated to be 12 700 t in 2010 (Fig. 9.7). Similar trends occurred in total biomass, estimated to be about 30 000 t in 2010.

Recruitment has been improving in recent years with current estimates of the 2005-2007 year classes comparable to those from the mid - late 1980s (Fig. 9.7). However, it remains well below historic values.

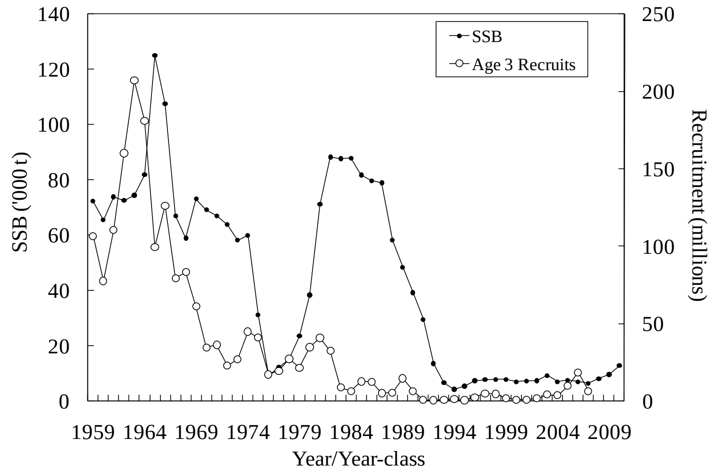


Fig. 9.7. Cod in Div. 3NO: time trend of spawner stock biomass (SSB) and corresponding recruitment from the SPA.

Prior to 1990, fishing mortality was usually highest on older ages (6-9). Since then, *F* has generally been highest on younger ages (4-6) (Fig. 9.8). The fishing mortality on these age groups was low in the early years of the moratorium but increased then peaked at 0.9 in 2003 and has been declining since 2006. Current estimates over ages 4-6 for 2008 and 2009 are less than 0.06 and are amongst the lowest estimated during the moratorium.

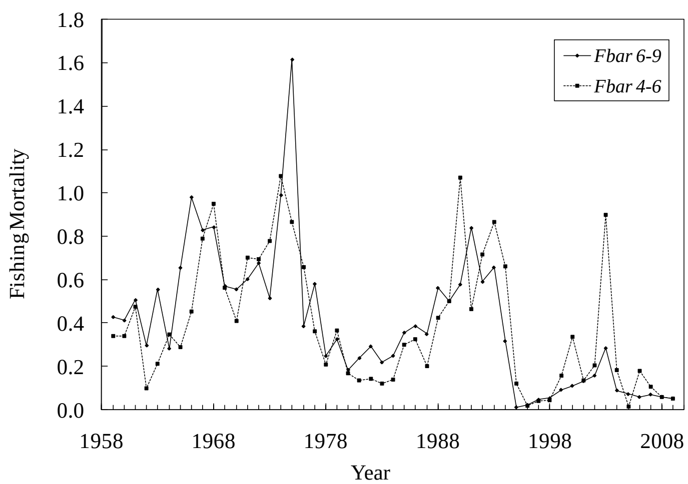


Fig. 9.8. Cod in Div. 3NO: time trend of average fishing mortalities from the SPA.

f) Retrospective Analysis

A retrospective analysis was conducted to investigate whether there were systematic trends in the estimates of population size. A 5-year period was chosen to evaluate, whereby a complete year of data was removed in succession from the model but the formulation remained the same. The retrospective analysis indicated recruitment and SSB tended to be underestimated in previous years, whereas mean *F* (ages 4-6) tended to be overestimated (Fig. 9.9).

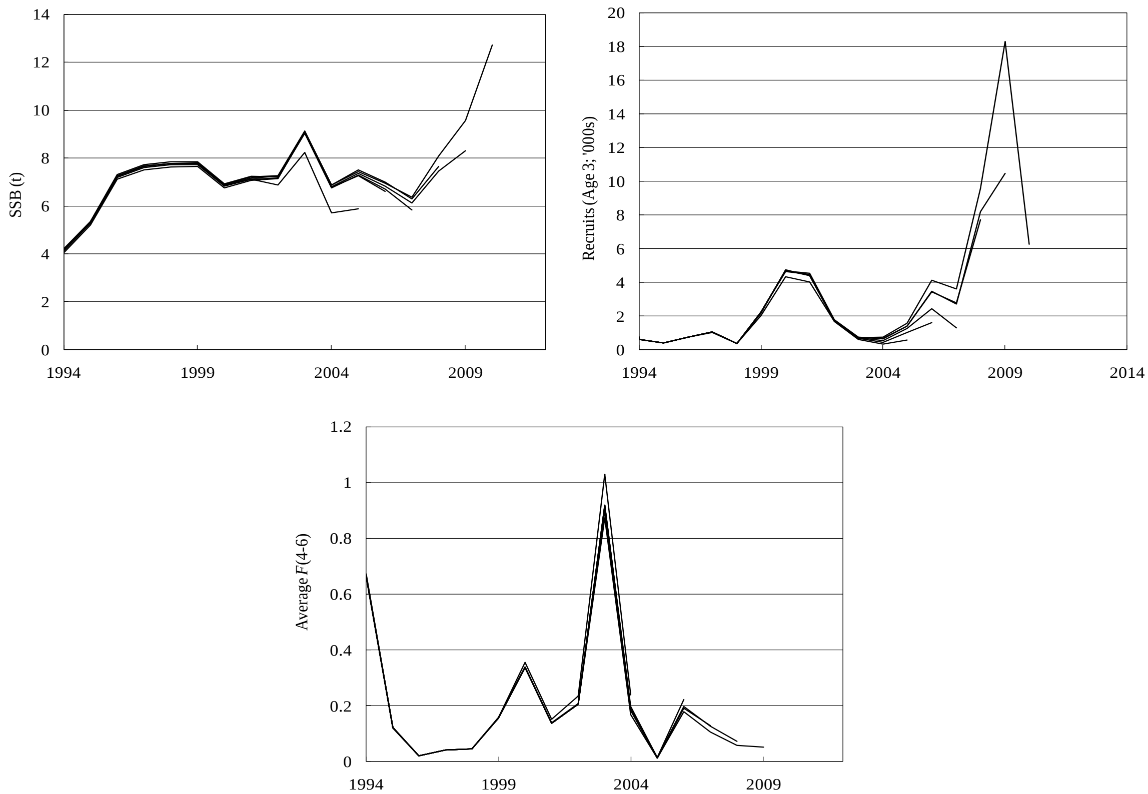


Fig. 9.9. Cod in Div. 3NO: Five-year retrospective analysis of SSB, age 3 recruitment and average *F* on ages 4-6.

g) Assessment Summary

Biomass: The 2010 total biomass and spawning biomass remain low but are estimated to be at their highest levels since 1992.

Fishing Mortality: Has been declining since 2006. Estimates for ages 4-6 in 2008 and 2009 are less than 0.06 and are amongst the lowest estimated during the moratorium.

Recruitment: Remains low but has been improving in recent years with current estimates of the 2005-2007 year classes comparable to those from the mid- late 1980s.

State of the Stock: Remains relatively low but has improved in recent years to levels just prior to the moratorium. Nevertheless, SSB is still well below B_{lim}.

h) Reference Points

The current best estimate of B_{lim} is 60 000 t. (Fig. 9.10). SSB in 2010 is estimated to be 12 700 t which is 21% of B_{lim}.

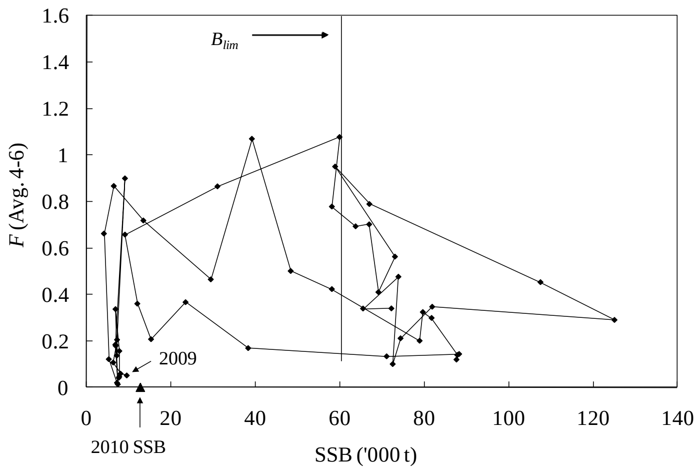


Fig. 9.10. Cod in Div. 3NO: stock trajectory 1959-2009.

i) Short-Term Considerations – Stochastic Projections

Simulations were carried out to examine the trajectory of the stock under two scenarios of fishing mortality: *F*=0, *F*=0.07 (the average *F* on ages 4-6 from 2007-2009). For these simulations the results of the SPA and the covariance of these population estimates were used. The following inputs were the basis of these projections:

Age	Estimate of 2010 population numbers ('000)	Relative error on population estimate	Weight-at-age mid-year (avg. 2007-2009)	Weight-at-age beginning of year (avg. 2007-2009)	Maturity-at-age (avg. 2007-2009)	PR rescaled relative to ages 4-6 (avg. 2007-2009)
3	6257.6	0.584	0.47	0.36	0.02	0.36
4	14752.1	0.419	0.90	0.66	0.12	0.67
5	6264.0	0.346	1.43	1.22	0.35	1.27
6	1686.3	0.342	2.21	1.76	0.73	1.05
7	1368.8	0.323	2.83	2.49	0.92	1.22
8	390.2	0.311	3.71	3.10	0.99	0.81
9	128.2	0.312	5.18	4.32	1.00	0.40
10	50.0	0.322	6.95	6.15	1.00	0.90
11	55.8	0.308	6.85	6.63	1.00	0.53
12	159.4	0.324	9.08	7.84	1.00	0.82

Simulations were limited to a 3-year period. Given the SSB is still estimated to be well below B_{lim}, recruitment (at age 3) was only re-sampled from 1994-2009 as this represents a reasonable expectation of what has occurred under low productivity conditions.

At *F*=0 spawning stock biomass is estimated to increase and there is an 88% probability that SSB will remain under B_{lim} by 2013 (see table below, Fig. 9.11). At *F*=0.07 the population is estimated to grow more slowly. If the fishing mortality in 2010-2012 remains at the average estimated in 2007-2009 then yield is estimated to increase over the 3-year time period.

Stochastic Projection Results

F=0	Beginning of Year SSB			
Percentile	2010	2011	2012	2013
0.95	17456	30414	50423	66023
0.75	14963	25056	39827	51819
0.5	13498	22181	34369	44368
0.25	12150	19752	30157	38374
0.05	10283	16572	24722	31190

F=0.07	Beginning of Year SSB			
Percentile	2010	2011	2012	2013
0.95	17358	27999	42894	52622
0.75	14853	23418	34660	42223
0.5	13388	20791	30294	36493
0.25	12028	18165	26116	31222
0.05	10261	15263	21474	25067

F=0.07	Yield			
Percentile	2010	2011	2012	2013
0.95	2843	4092	4343	4602
0.75	2356	3237	3382	3567
0.5	2054	2765	2862	2957
0.25	1768	2351	2419	2461
0.05	1478	1877	1904	1909

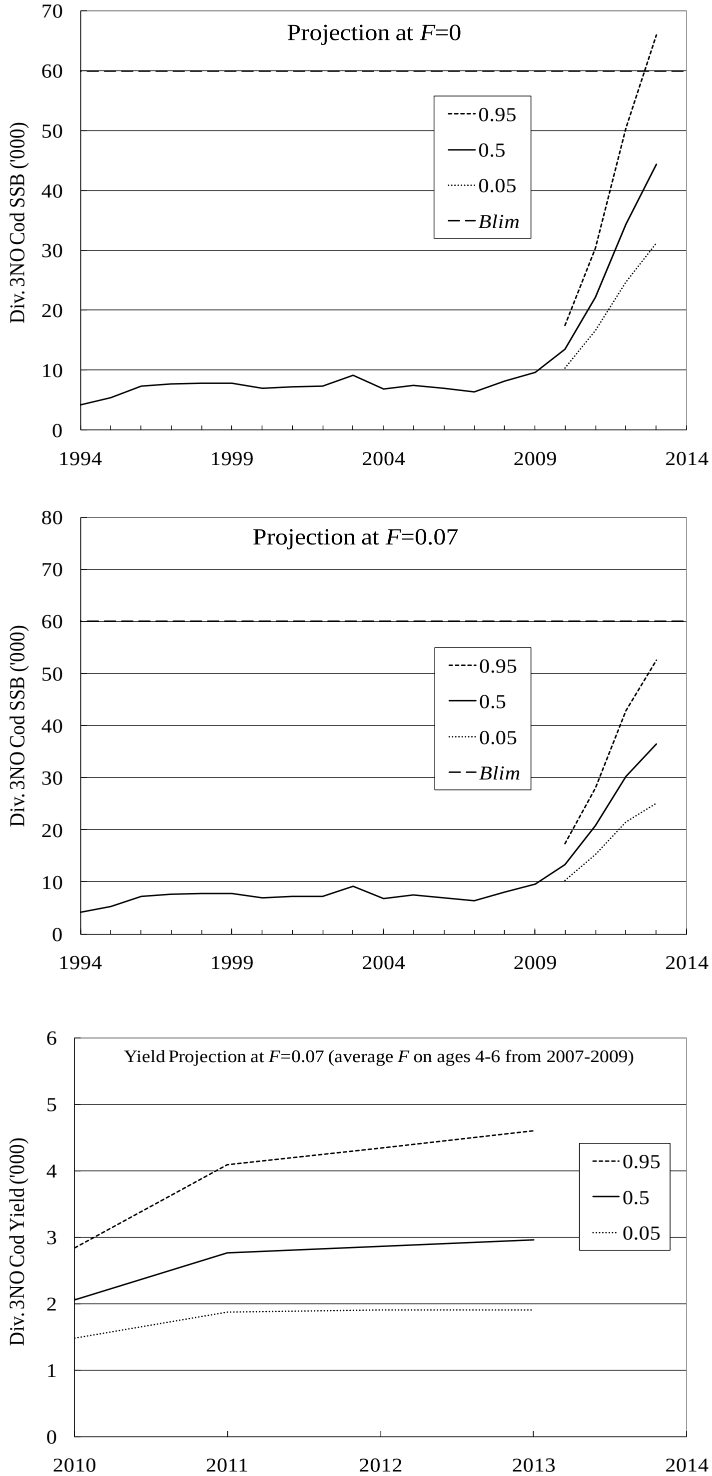


Fig 9.11. Cod in Div. 3NO: Stochastic projections at *F*=0 and *F*=0.07 (the average *F* on ages 4-6 from 2007-2009).

The next assessment of this stock will be in 2013.

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

(SCR Doc. 10/25, 28, 29; SCS Doc. 10/5, 6, 7)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3LN; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics.

Reported catches from Div. 3LN declined from 45 000 to 10 000 t on the first years of catch records (1959-1964) and oscillated afterwards (1965-1985) around an average level 21 000 t. Catches increased sharply to a 79 000 t high in 1987 and autumn steadily to 450 t, a minimum reached in 1996. From 1998 until 2009 a moratorium on direct fishing was in place. Catch increased to 3 141 t in 2000, declined gradually and stabilized at 650 t level in 2004-2005. Catch returned to the historic low level in 2006 with 496 t, recorded an unexpected three times fold increase in 2007 with 1664 t, drop in 2008 to 600 t but increase again in 2009 to 1051 t (Fig. 10.1).

Recent nominal catches and TACs ('000 t) for redfish are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009[1]	2010
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	3.5
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	3.5
STATLANT	0.9	1.0	1.3	0.7	0.7	0.2	0.2	0.4	0.3	
STACFIS	1.4	1.2	1.3	0.6	0.7	0.5	1.7	0.6	1.1	

[1] Provisonal
ndf No directed fishing.

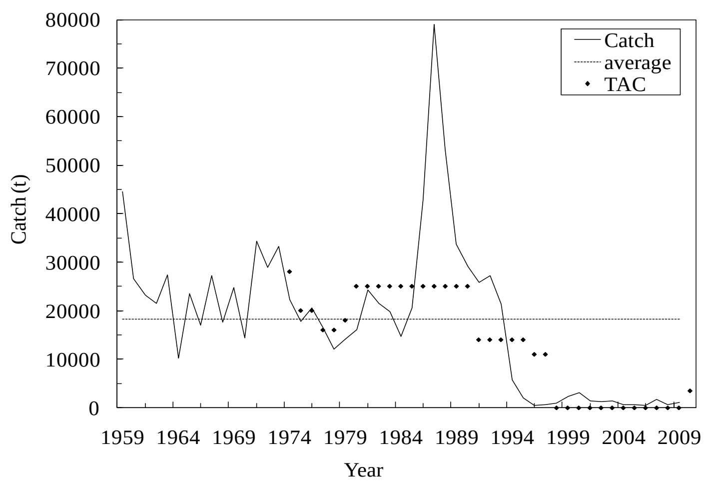


Fig. 10.1. Redfish in Div. 3LN: catches and TACs (No directed fishing is plotted as zero TAC)

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 several years. Above average mean lengths, an apparent stable length structure of the catch with no clear trends towards smaller or larger length groups and proportions in numbers of small redfish usually below 1%, are observed on most of the years of the 1990-2005 interval. However, well below average mean lengths occurred on 2006, 2008 and 2009, coupled with high proportions of small redfish in the catch. Under a very low exploitation regime, such sudden drop on the mean lengths of the redfish bycatch in Div. 3LN on the most recent years would probably reflect the recruitment of above average year classes to the exploitable stock, from 4-5 years back in time.

ii) Research survey data

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/Nov.-Dec. 3L for most years). No survey was carried out in spring 2006 on Div. 3N.

The design of the Canadian surveys was based on a stratification scheme down to 732 m for Div. 3LN. From 1996 onwards the stratification scheme has been updated to include depths down to 1 464 m (800 fathoms) but only the autumn surveys have swept strata below 732 m depth, most 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.

Since 1983 Russian bottom trawl surveys in NAFO Div. 3LMNO turn to stratified-random, following the Canadian stratification for Sub area 3. On 1984 standard tows were set to half hour at 3.5 knots, with a standard gear. From 1984 till 1990, vessels conducting this survey were of the same tonnage class with the exception of 1985, when a vessel of smaller tonnage class was employed. This smaller category was later employed on the 1991 and 1993 surveys. On 1992 and 1994 Russian survey was carried out only in Div. 3L. On 1995 the Russian bottom trawl series in NAFO Sub area 3 was discontinued.

In 1995 EU-Spain started a new stratified-random bottom trawl spring (May-June) survey on NAFO Regulatory Area of Div. 3NO. Despite changes on the depth contour of the survey, all strata in the NRA till 732m were covered every year following the standard stratification. From 1998 onwards the Spanish survey was extended to 1464 m and in 2004 expanded to the Regulatory Area of Div. 3L. From 1995 till 2000 the survey was carried out by the Spanish stern trawler C/V *Playa de Menduiña* using a Pedreira bottom trawl net. In 2001 the R/V *Vizconde de Eza* , trawling with a Campelen net, replaced the commercial stern trawler. In order to maintain the data series obtained since 1995, comparative fishing trials were conducted in spring 2001 to develop conversion factors between the two fishing vessel and gear combinations. Former Div. 3NO redfish survey indices from C/V *Playa de Menduíña* have now been transformed to R/V *Vizconde de Eza* units, and so, for the first time, the Div. 3N Spanish spring survey series (1995-2009) is included in the present assessment framework.

In order to turn the survey series comparable and facilitate the detection of trends within stock dynamics, the available survey biomass series and the female SSB survey series were standardized and so presented on Fig. 10.2. From the first half of the 1980s to the first half of the 1990s Canadian survey data in Div. 3L and Russian bottom trawl surveys in Div. 3LN suggests that stock size suffered a substantial reduction. Redfish survey bottom biomass in Div. 3LN remained well below average level until 1998 and start a discrete and discontinuous increase afterwards. A pronounced increase of the remaining biomass indices has been observed over the most recent years since 2006. Considering all available bottom trawl survey series occurring in Div. 3L and Div. 3N from 1978 until 2009, 100% of the biomass indices were above the average of their own series on 1978-1985, only 25% on 1986-2005, and 85% on 2006-2009. Both 1991-2009 spring and autumn standardized female SSB series for Div. 3LN combined showed very similar patterns to correspondent survey biomass series over the years, with all observations above average since 2006.

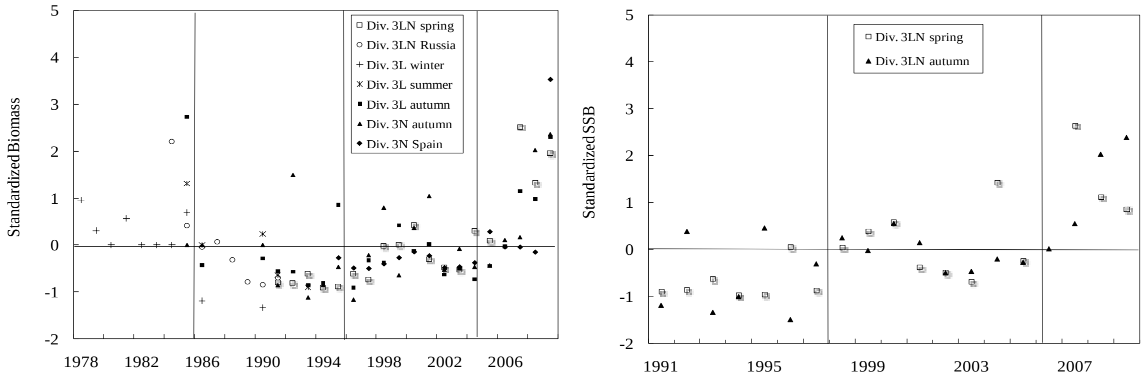


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2009, left panel) and female spawning biomass (1991-2009, right panel). Each series standardized to zero mean and unit standard deviation.

During the first half of the 1990's on both survey series the mean lengths were below or slightly above average. Mean lengths on most of the years between 1996 and 2004 were well above the mean, reflecting a shift on the stock length structure to larger individuals probably justified by a higher survival of the year classes through this interval. However since 2005 mean lengths generally autumn to below-well below average, just as observed on the bycatch from the commercial fisheries (Fig. 10.3). This most recent pattern on surveys and by catch at length seems to confirm the occurrence of one or more recent pulses on recruitment, the first to be detected on this stock since 1991-1992.

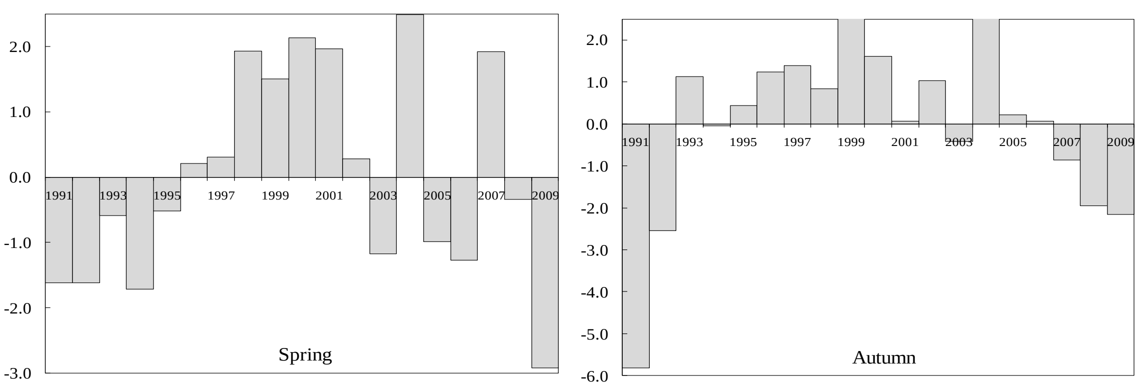


Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2009

iii) Recruitment

There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN in the range of 12-14 cm for 1991 and 15-18cm for 1992. From commercial catch and Canadian survey length data there are signs of recruitment of above average year classes to the exploitable stock, from 4-5 years back in time.

c) Assessment Results

An ASPIC model framework (Prager, 1994), was used to assess the status of the stock. This framework uses a non-equilibrium Schaeffer surplus production model to describe stock dynamics. The input data were:

Statlant CPUE	Statlant cpue for Div. 3LN,$_{1959\text{-}1994}$ & catch for Div. 3LN $_{1959\text{-}2009}$
3LN spring survey	Canadian spring survey biomass for Div. 3LN, $_{1991\text{-}2005,\ 2007\text{-}2009}$
3N autumn survey	Canadian autumn survey biomass for Div. 3N, $_{1991,\ 1993\text{-}2009}$
3LN Russian survey	Russian spring survey biomass for Div. 3LN , $_{1984\text{-}1991}$ (Power and Vaskov,1992)
3L winter survey	Canadian winter survey biomass for Div. 3L, $_{1985\text{-}1986}$ and 1990
3L summer survey	Canadian summer survey biomass for Div. 3L, $_{1978\text{-}1979,\ 1981, 1984\text{-}1985,\ 1990\text{-}1991}$ and 1993
3L autumn survey	Canadian autumn survey biomass for Div. 3L, $_{1985\text{-}1986,\ 1990\text{-}1994,\ 1996\text{-}2009}$

The 2009 Spanish spring biomass index for Div. 3N has an enormously high magnitude, corresponding to more than a ten times fold increase from the previous year. This jump has no parallel on the increases also observed from 2008 to 2009 on both Canadian spring and autumn surveys on Div. 3N and can only be compared to the isolated highs observed in autumn 1992 for Div. 3N and 1995 for Div. 3L, that have been considered outliers of the respective survey biomass series and excluded from the ASPIC framework. Three input options, corresponding to three possible arrangements related with the Spanish survey (ending in 2009, or in 2008, or the exclusion of this survey from the assessment), were used to test the goodness of fit of the model to the available survey data. An overview of the exploratory analysis under a traffic light rating frame, lead to the conclusion that so far the model will perform better without the Spanish survey on Div. 3N.

Different starting values for key parameters, different random number seeds, different estimates of the 2009 catch and different magnitudes of last year surveys were used to test the robustness of the $ASPIC_{fit}$ 2010 formulation. The catch and seed related options arrived to the same or very similar solutions, showing that the ASPIC results given by the chosen formulation are insensitive to either small changes on last year catch or first value/default inputs chosen to initialize the assessment. However the assessment from the different hypothesis considered regarding the 2009 surveys show that the model is sensitive to the biomass indices available for the terminal year.

A 2010-2007 $ASPIC_{fit}$ retrospective analysis was carried out in order to check for bias on relative biomass and fishing mortality. Going back in time the assessments present an over bias on biomass, intrinsic rate of stock biomass increase (and F_{msy}), and *MSY*, and present an under bias on fishing mortality, carrying capacity of stock biomass (and B_{msy}) and surplus production. These retrospective patterns are the model response to the general increase of the current survey series, recorded over the most recent years. The observed retrospective patterns don't change the perception of the stock history. Moreover, correlations among input data and between model and input data increase, and the diagnostic fit improves as more data are added.

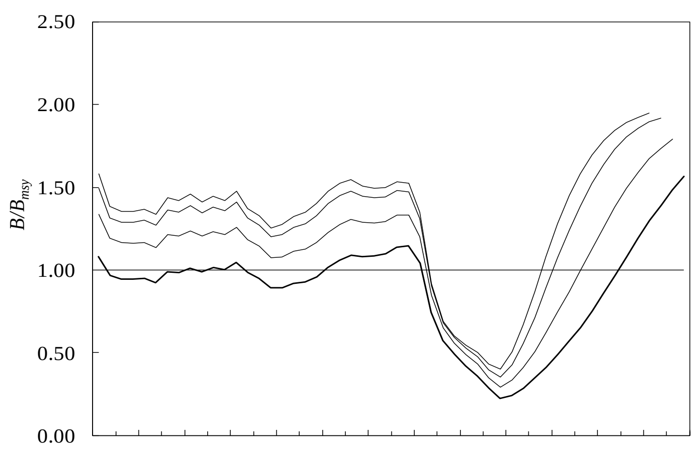


Fig. 10.4a. Redfish in Div. 3LN: Retrospective B/B_{msy} from $ASPIC_{fit}$ 2010-2007

The ASPIC 2010 input formulation runs on both deterministic (FIT) and bootstrap (BOT) mode with 1000 trials. Correlation among the majority of possible combinations of surveys is high but the model has a relative poor fit to most input series due to the usual wide inter annual variability of redfish abundance indices. Patterns on residuals between observed and model generated values also seem to be more randomly distributed than on previous assessments. As a result, relative biomass and fishing mortality bias corrected trajectories are very close to their deterministic ones.

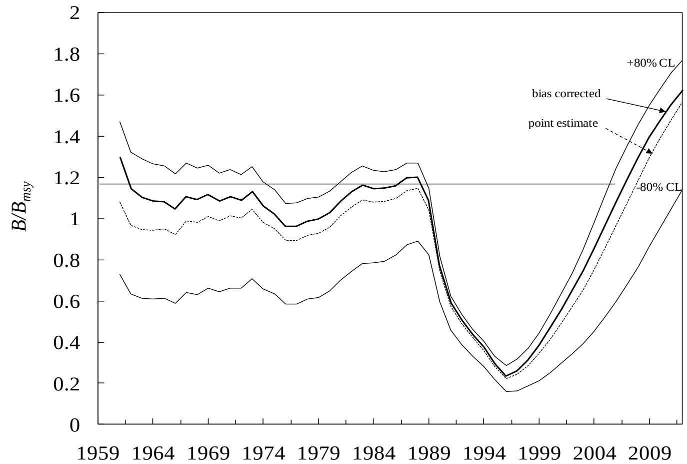


Fig. 10.4b. Redfish in Div. 3LN: B/B_{msy} 1959-2010 trajectories (point estimate and bias corrected with approximate 80% CL's)

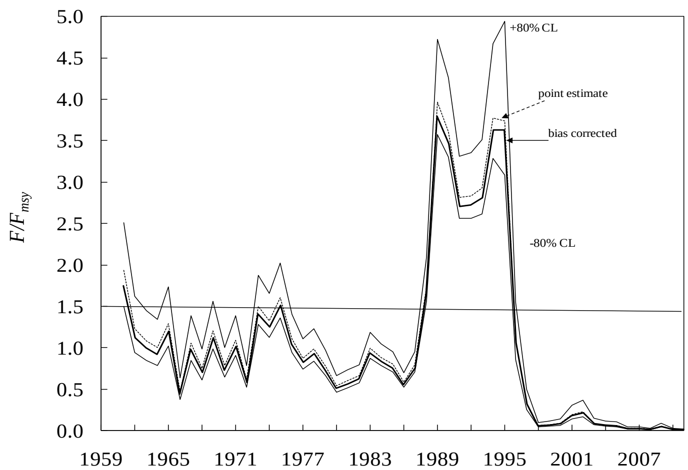


Fig. 10.4c. Redfish in Div. 3LN: F/F_{msy} 1959-2010 trajectories (point estimate and bias corrected with approximate 80% CL)

The model results suggest a maximum sustainable yield (*MSY*) of 23 000 t that can be produced with a fishing mortality of 0.13 when stock biomass is at B_{msy} level. The magnitude of *MSY* matches the average level of catches taken from this stock over more than two decades (21 000 t, 1965-1985) along with an apparent stability of the stock. Relative biomass was at or slightly above B_{msy} for most of the former years up to 1987, supporting an average level of catches just below MSY. Between 1986 and 1992 catches were higher than *MSY* (26000-79000 ton), pushing fishing mortality to well above F_{msy}. Eight years of heavy over-fishing determine the autumn of biomass from B_{msy} in 1987 to 24% B_{msy} in 1994, when a minimum stock size is recorded. The quick decline of stock biomass through the second half of the 1980s – first half of the 1990's was followed by a drop on catch and fishing mortality. Since 1996 both were kept at low to very low levels. Over the moratorium years biomass was allowed to increase and is now well above B_{msy} .

Table 10.1 Summary of the ASPIC 2010 results from bootstrapped analysis

Param. name	Point estimate	Bias corrected	Estimated bias in pt estimate	Estimated relative bias	Bias-corrected approximate confidence limits 80% lower	80% upper	50% lower	50% upper	Inter-quartile range	Relative IQ range
B1/K	0.541	0.651	0.111	20.43%	0.358	0.739	0.415	0.599	0.183	0.338
K	386900	371430	-15470	-4.00%	330700	487600	364300	459100	94780	0.245
MSY	22580	23031	451	2.00%	20460	24260	21360	23320	1954	0.087
Ye(2010)	15450	13331	-2119	-13.72%	8811	22850	12970	20370	7402	0.479
Bmsy	193500	185763	-7737	-4.00%	165400	243800	182200	229500	47390	0.245
Fmsy	0.117	0.127	0.011	9.07%	0.092	0.140	0.100	0.125	0.025	0.215
B./Bmsy	1.562	1.608	0.046	2.92%	1.170	1.790	1.322	1.659	0.337	0.216
F./Fmsy	0.031	0.030	-0.00063	-2.07%	0.025	0.044	0.028	0.037	0.009	0.300

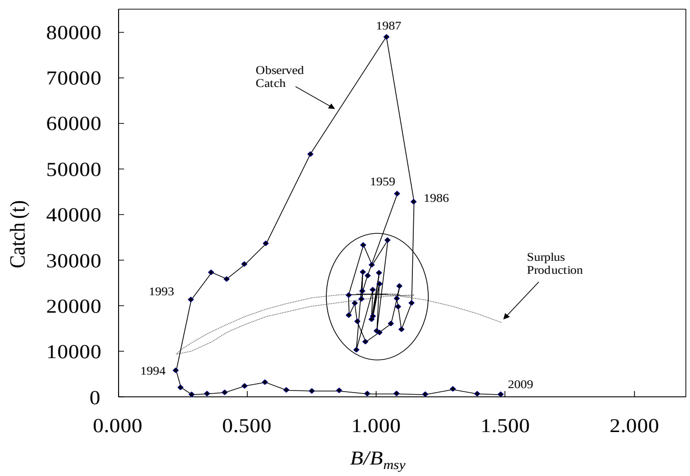


Fig. 10.4d. Redfish in Div. 3LN: Catch versus Surplus Production from $ASPIC_{fit}$ 2010

Catch versus surplus production trajectories show that from 1960 until 1985 catches form a cluster of points around dome of the surplus production curve. On 1986-1987 catches rise well above the surplus production and, though declining continuously since then, were still above equilibrium yield in 1993. Estimated catch has been well below surplus production levels since 1994.

Fishery and catches. Reported catches oscillated around an average level of 21 000 t from 1965-1985, rise to an average about 40 000 t from 1986-1993, and drop to a low level observed from 1995 onwards within a range of 450-3000 t. The estimated catch in 2009 was of 1051 t. From 1998-2009 a moratorium on direct fishing was in place. Since 1998 catches were taken as bycatch primarily in Greenland halibut fisheries by EU-Portugal and EU-Spain.

Data. Catches from 1959-2009 (conditioned on a 1959-94 CPUE series from STATLANT data), and data from most of the stratified-random bottom trawl surveys conducted by Canada and Russia and EU-Spain in various years and seasons in Div. 3L and Div. 3N, from 1978 onwards were available. Length frequencies were available for both commercial catch and surveys.

Assessment. An ASPIC model framework, was used to assess the status of the stock. This framework uses a non-equilibrium Schaeffer surplus production model to describe stock dynamics.

Biomass. Relative biomass was at or slightly above B_{msy} for most of the former years up to 1987, supporting an average level of catches just below MSY. Between 1986 and 1992 catches higher than MSY resulted in a decrease in biomass from B_{msy} in 1987 to 24% B_{msy} in 1994, when a minimum stock size is recorded. Over the moratorium years biomass was allowed to increase and is now well above B_{msy}.

Fishing mortality. The model results suggest a maximum sustainable yield (MSY) of 23 000 t that can be produced with a fishing mortality of 0.13. Between 1986 and 1992 catches higher than MSY pushed fishing mortality to well above F_{msy}. The quick decline of stock biomass was followed by a drop in relative fishing mortality that, since 1996, has been kept at low levels.

Recruitment. There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN. From commercial catch and Canadian survey length data there are signs of recruitment of above average year classes to the exploitable stock, from 4-5 years back in time.

State of stock. The biomass of redfish in Div. 3LN is above B_{msy}, while fishing mortality is below F_{msy}.

d) Reference Points

The ASPIC bias corrected results were put under the precautionary framework. The trajectory presented shows a stock around B_{msy} with an exploitation around F_{msy} through 25 years on a row (1960-1985), rapidly declining afterwards to below B_{msy} when fishing mortality rises to well above F_{msy} (1986-1987), reproaching and surpassing B_{msy} when fishing mortality dropped (1993-1995) and is kept well below F_{msy}.

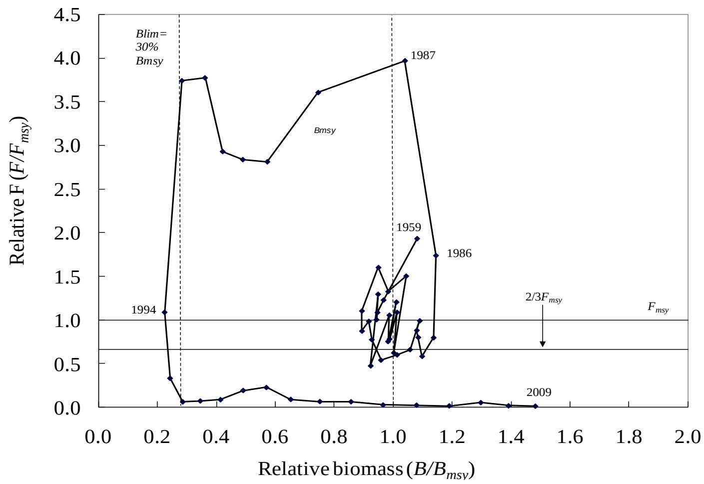


Fig. 10.5. Redfish in Div. 3LN: stock trajectory under a precautionary framework for $ASPIC_{bot}$ 2010.

The NAFO SC Study Group recommendations from the meeting in Lorient in 2004 (SCS Doc. 04/12), as regards Limit Reference Points for stocks evaluated with surplus production models, considered F_{lim} at F_{msy} and F_{target} at 2/3 F_{msy}. The Study Group also considered that the biomass giving production of 50% *MSY* was a suitable B_{lim}. With the Schaeffer model used in the present ASPIC assessment this limit corresponds in this stock to (roughly) 30% B_{msy}. The stock was at (or below) B_{lim} between 1993 and 1996, prior to the implementation of the moratorium on this fishery in 1998.

e) Projections

Due to the retrospective bias nature of this assessment, conditioned by increasing trends on surveys (every next assessment will revise downwards recent relative biomass and upwards surplus production) only short term stochastic projections were carried out as follows, assuming a catch for 2010 at the 2010 TAC of 3 500 t:

Table 10.2. Short term projections for redfish in Div. 3LN. The 10th, 50th, and 90th percentiles of projected B/B_{msy}, F/F_{msy} and catch (t)are shown, for projected F values of $F_{statusquo}$, 1/6 F_{msy}, 1/3 F_{msy} and 2/3 F_{msy}.

Fsatutsquo	percentiles			**1/6 Fmsy**	percentiles		
Year	10	50	90	Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy				BIOMASS RELATIVE TO Bmsy			
2010	1.170	**1.608**	1.790	2010	1.170	**1.608**	1.790
2011	1.251	**1.655**	1.819	2011	1.251	**1.655**	1.819
2012	1.337	**1.707**	1.855	2012	1.311	**1.681**	1.828
2013	1.418	**1.752**	1.882	2013	1.366	**1.705**	1.833
FISHING MORTALITY RELATIVE TO Fmsy				FISHING MORTALITY RELATIVE TO Fmsy			
2010	0.083	**0.096**	0.135	2010	0.083	**0.096**	0.135
2011	0.025	**0.030**	0.044	2011	0.142	**0.167**	0.245
2012	0.025	**0.030**	0.044	2012	0.142	**0.167**	0.245
YIELDS FOR 2011 AND 2012				YIELDS FOR 2011 AND 2012			
2010	3500	**3500**	3500	2010	3500	**3500**	3500
2011	1092	**1128**	1208	2011	6038	**6235**	6669
2012	1110	**1163**	1283	2012	6064	**6343**	6973

1/3 Fmsy	percentiles			**2/3 Fmsy**	percentiles		
Year	10	**50**	90	Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy				BIOMASS RELATIVE TO Bmsy			
2010	1.17	**1.608**	1.79	2010	1.170	**1.608**	1.790
2011	1.25	**1.655**	1.82	2011	1.251	**1.655**	1.819
2012	1.28	**1.651**	1.80	2012	1.229	**1.591**	1.731
2013	1.31	**1.649**	1.78	2013	1.208	**1.543**	1.666
FISHING MORTALITY RELATIVE TO Fmsy				FISHING MORTALITY RELATIVE TO Fmsy			
2010	0.083	**0.096**	0.135	2010	0.083	**0.096**	0.135
2011	0.284	**0.333**	0.490	2011	0.567	**0.667**	0.980
2012	0.284	**0.333**	0.490	2012	0.567	**0.667**	0.980
YIELDS FOR 2011 AND 2012				YIELDS FOR 2011 AND 2012			
2010	3500	**3500**	3500	2010	3500	**3500**	3500
2011	11970	**12352**	13190	2011	23520	**24237**	25810
2012	11840	**12360**	13510	2012	22560	**23440**	25450

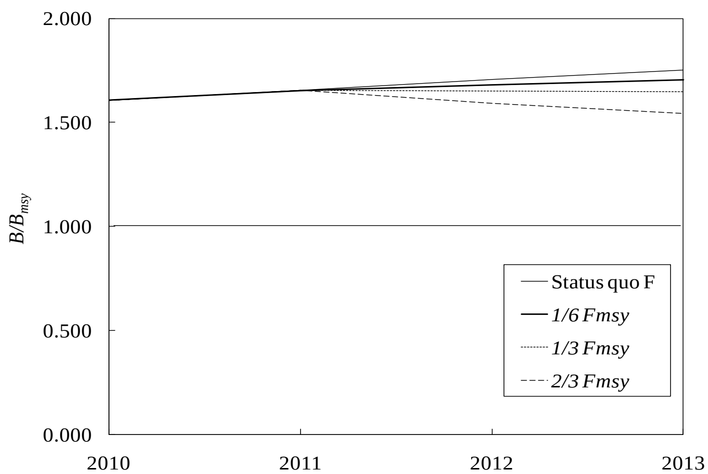


Fig. 10.6a. Redfish in Div. 3LN: 2010-2013 bias corrected B/B_{msy} projections

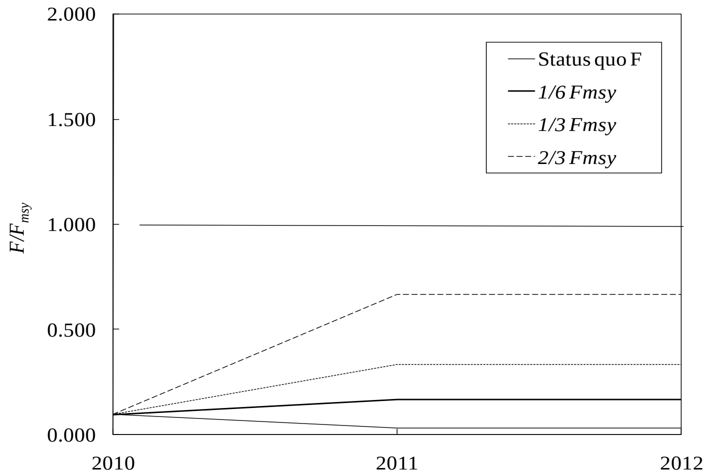


Fig. 10.6b. Redfish in Div. 3LN: 2010-2013 bias corrected F/F_{msy} projections

The status of the stock allows its exploitation, but the real response of the stock to a real direct fishery is still to be seen. Therefore any projection should be treated with caution.

The next full assessment of this stock will be in 2012.

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO

(SCS Doc. 10/5, 6, 7; SCR Doc. 10/8, 15, 39)

a) Introduction

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. Total catch in 2009 was 3 515 t, mainly taken in the Regulatory Area (Fig. 11.1).

Recent nominal catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	3.5	3.2	3.7	2.7	2.4	0.9	1.0	1.9[1]	1.4[1]	
STACFIS	5.7	4.9	6.9-10.6[2]	6.2	4.1	2.8	3.6	2.5	3.5	

[1] Provisonal
[2] In 2003, STACFIS could not precisely estimate catch
ndf No directed fishing

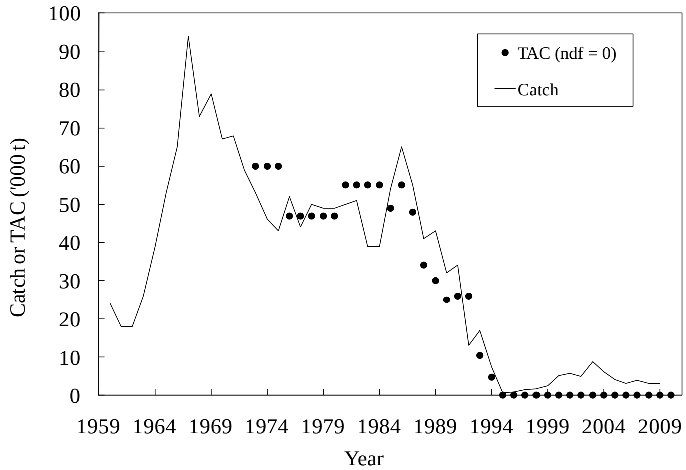


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

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 2009 bycatch in the Canadian fishery and length sampling of bycatch in the Canadian, EU-Spain, EU-Portugal and Russian (only one length frequency) fisheries. Sampling of the Canadian catch was considerably lower than it was in 2007-2008. Catch-at-age in the Canadian bycatch ranged from ages 5 to 20 and catch was comprised mainly of fish aged 7 to 11, with the peak being the 2000 year class.

In 2009 there was a large peak at 30 cm in the American plaice bycatch of the Spanish Greenland halibut fishery. The Spanish bycatch in the skate fishery was dominated by fish that were between 34 and 37 cm, with a smaller mode at 57 cm. The bycatch in the EU-Portugal fishery consisted mainly of fish between 30 and 42 cm, but with smaller peaks at 38 and 42 cm. There were more large fish (> 50 cm) in the bycatch of the EU-Spain fleet than in the EU-Portugal catch.

Total catch-at-age for 2009 was produced by applying Canadian survey age-length keys to length frequencies collected each year by countries with adequate sampling 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 6 - 11 dominated the 2009 catch.

The mean fish weight in the Canadian 2009 catch (0.802 kg/fish) was the highest in the recent period, but similar to the 2005 and 2007 levels of about 0.75 kg. These mean weights at age were also slightly higher for the Canadian catch in 2009 than the mean weights at age for Spain or Portugal.

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 2009. Surveys prior to 1991 generally had a maximum depth of 366 m. From 1991 to 2009, the depth range has been extended to at least 731 m in each survey. The spring survey from 2006 did not adequately cover many of the strata in Divisions 3NO and therefore results were not comparable.

In the 2009 spring survey, the biomass (mean weight per tow) estimate for Divisions 3LNO declined by almost 50% compared to the 2008 value. Prior to 2004, the estimate of biomass for Div. 3N was either less or approximately equal to the estimate of Div. 3O. From 2005 onwards the biomass estimate from Div. 3N has been about double the biomass estimate from Div. 3O. In 2008, biomass in Div. 3LNO combined was the highest since 1996 but in 2009 this declined to levels of the late 1990s and is currently only 17% (Campelen estimates compared to Campelen equivalents) of that of the mid 1980s (Fig. 11.2).

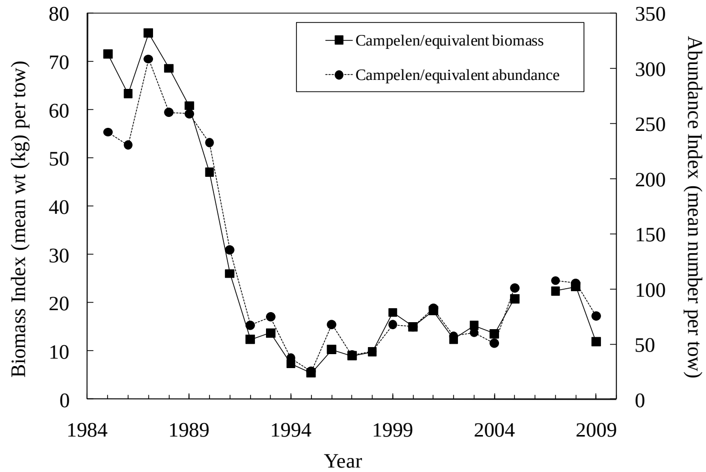


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys.

Abundance (mean number per tow) for Div. 3LNO declined during the late 1980s-early 1990s. Abundance has fluctuated since 1996 with a slight increase over the period until 2009, when it declined by about 30% from the previous year (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 1 to 5 has been increasing and in recent years remain amongst the highest in the time series. However, these ages are probably 'under converted' to varying degrees 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).

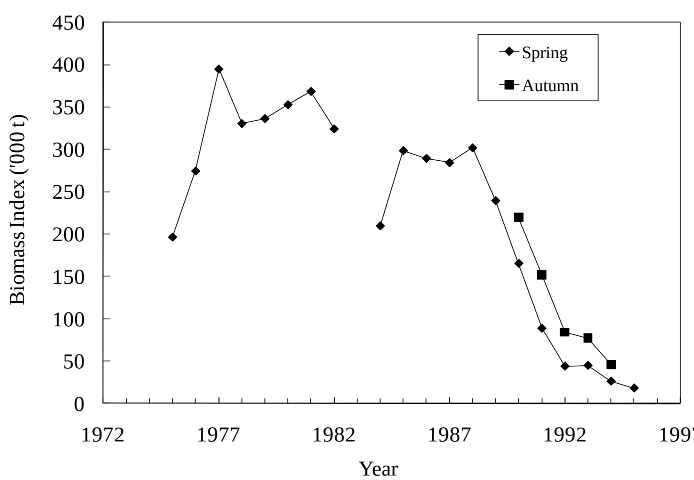


Fig 11.3. American plaice in Div. 3LNO: biomass index as swept area estimates from Canadian spring and autumn surveys using Engel and Engel equivalent units.

In 2004, coverage of strata from Div. 3L in the Canadian **autumn survey** was incomplete, and results were not used in the 2009-10 assessments.

From Canadian **autumn surveys** the biomass (mean weight per tow) index for Div. 3LNO in the autumn has shown an increasing trend since 1995 but remains well below the level of the early-1990s (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 between 60-70% of the Div. 3NO total.

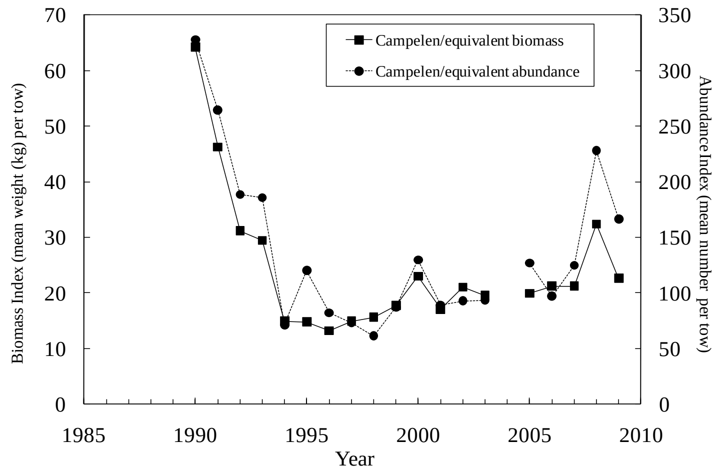


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys.

Abundance showed a substantial decline from 1990 to 1998, mainly in Div. 3L, but has been increasing since 1998 (Fig. 11.4). The value in 2009 dropped by almost 30% from the high value of 2008. The proportion of fish aged 0-5 years has been increasing slightly since 1998.

EU-Spain Div. 3NO Survey. From 1998-2009, surveys have been conducted annually by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 462 m. In 2001, the trawl vessel (CV *Playa de Menduiña*) and gear (*Pedreira*) were replaced by the RV *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) to get numbers at age 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 surveys. The biomass and abundance indices for the time series have been variable since 2005, with a decrease to 2009 (Fig. 11.5).

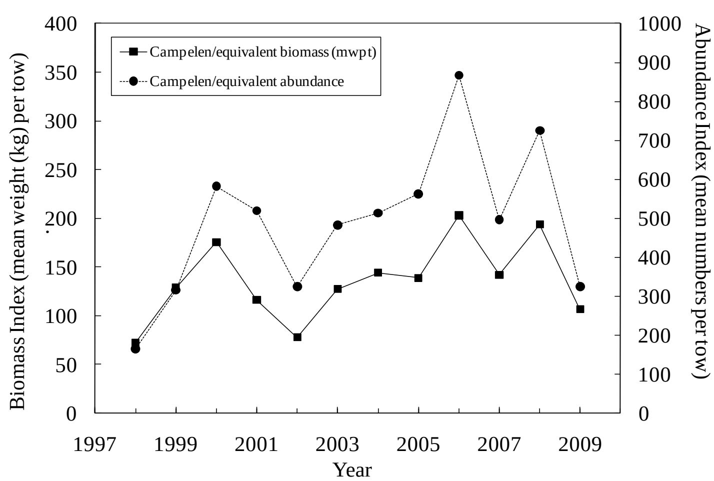


Fig. 11.5 American plaice in Div. 3LNO: biomass and abundance indices from the EU-Spain Div. 3NO survey.

iii) Biological studies

Maturity. Age (A_{50}) and length (L_{50}) at 50% maturity estimates were produced by cohort from spring research vessel data. For males, A_{50} were fairly stable for cohorts of the 1960s to mid 1970s, with perhaps a slight increase over that time period. 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. For females the A_{50} for recent cohorts is about 8 years compared to 11 years for cohorts at the beginning of the time series. Additional data on the recent cohorts resulted in a decrease in their estimated proportion mature.

L_{50} declined for both sexes but recovered in recent cohorts. The current L_{50} for males of about 20 cm is 2 to 3 cm lower than the earliest cohorts estimated. The L_{50} of most recent cohorts for females is in the range of 34-35 cm, somewhat lower than the 39 cm of the earliest cohorts.

Size-at-age. Mean weights-at-age and mean lengths-at-age were calculated for male and female American plaice for Div. 3LNO using spring survey data from 1990 to 2009, except for 2006 when survey coverage was too poor to be considered representative. Means were calculated accounting for the length stratified sampling design. Although there is variation in both length and weight-at-age there is little indication of any long-term trend for either males or females.

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. The spring survey indicates an increase in mortality up to the mid 1990s for most ages. This trend is also in the autumn data but is not as evident. Mortality declined after the mid 1990s in both surveys. This was followed by an increase in the early 2000s. In both surveys, estimates are lower in the mid 2000s for most ages. In the autumn survey, the last two estimates of *Z*, and in the spring survey the last estimate of *Z*, were higher for most ages. For many ages, these most recent estimates of *Z* were at or near the level of those from the early 1990s.

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

c) Estimation of Parameters

An analytical assessment using the ADAPTive framework tuned to the Canadian spring, Canadian autumn and the EU-Spain Div. 3NO survey was used. The virtual population analysis (VPA) was conducted based on the 2009 formulation with catch-at-age and survey information from the following:

- Catch at age (1960-2009) (ages 5-15+) (note: catch at age for 2008 was revised since last assessment);
- Canadian spring RV survey (1985-2009) (no 2006 value) (ages 5-14);
- Canadian autumn RV survey (1990-2009) (no 2004 value) (ages 5-14); and
- EU-Spain Div. 3NO survey (1998-2009) (ages 5-14). .

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 over all years. Natural mortality (*M*) was assumed to be 0.2 on all ages except 0.53 on all ages from 1989 to 1996.

d) Assessment Results

The model provides a good fit to the data with a mean square of the residuals of 0.28. Relative errors on the population estimates ranged from 0.15 to 0.32. The relative errors on the catchabilities (*q*) were all less than 0.2. The VPA analyses showed that population abundance and biomass declined fairly steadily from the mid- 1970s to 1995. Biomass and abundance have been increasing 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).

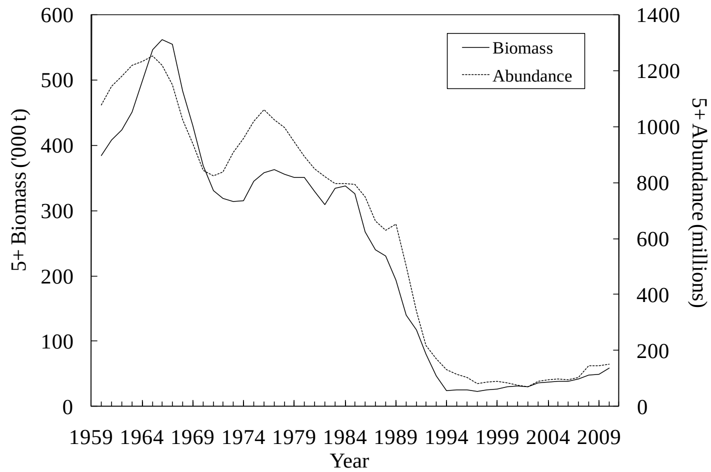


Fig. 11.6. American plaice in Div. 3LNO: population abundance and biomass from VPA

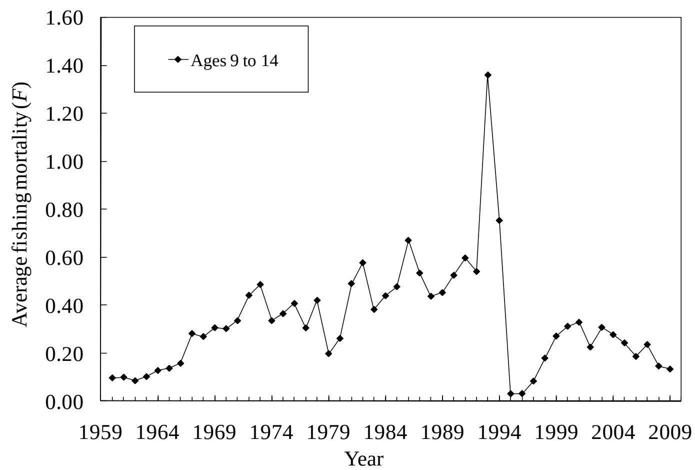


Fig. 11.7. American plaice in Div. 3LNO: average fishing mortality from VPA.

Spawning stock biomass has shown 2 peaks, one in the mid 1960s and another in the early to mid 1980s. It declined to a very low level (less than 10 000 t) in 1994 and 1995 (Fig. 11.8). Since then the SSB has been increasing, reaching about 33 000 t in the current year. Recruitment has been generally poor for the past two decades; however, the 2003 year class is the largest since the 1986 year class (Fig. 11.9).

Biomass: The biomass is very low compared to historic levels.

Spawning stock biomass: SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and is currently at 33 000 t. B_{lim} for this stock is 50 000 t.

Recruitment: Estimated recruitment at age 5 indicates that the strong 2003 year class is the largest since the 1986 year class but well below the long-term average.

Fishing mortality: From 1995-2001, the average fishing mortality on ages 9 to 14 increased but since then has declined.

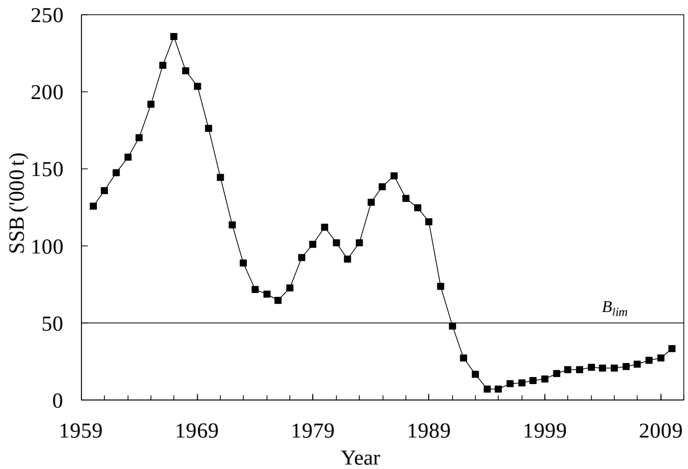


Fig. 11.8. American plaice in Div. 3LNO: spawning stock biomass from VPA.

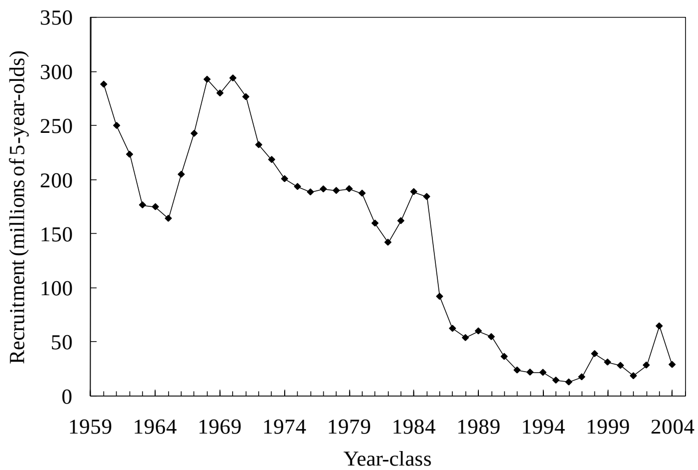


Fig. 11.9. American plaice in Div. 3LNO: recruits (at age 5) from VPA.

Retrospective patterns: A five year retrospective analysis was conducted by sequentially removing one year of data from the input data set (Fig. 11.10). There is a retrospective pattern present that seems to be larger than has been present in recent years.

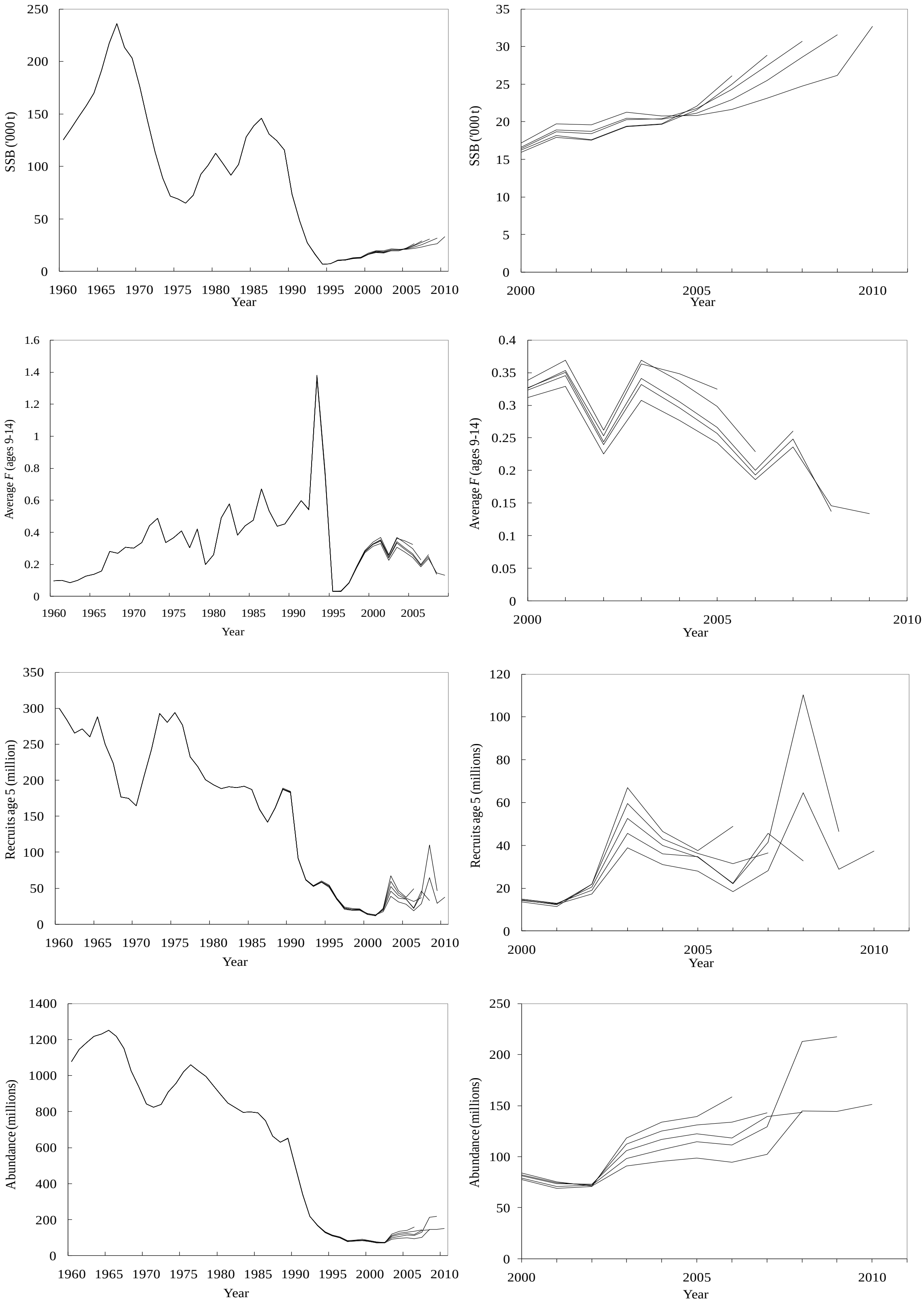


Fig 11.10. American plaice in Div. 3LNO: retrospective analysis of SSB, average *F* (ages 9-14), recruitment (age 5) and 5+ population numbers.

The perception of the stock is different from the current assessment compared to last year's assessment, with the estimate of SSB in 2009 (41 000 t) being revised downward by 37%. The major reason for this change is that the tuning indices used in the VPA showed a decline in 2009. Additionally, the 2008 catch at age was revised and numbers at age from the Canadian autumn survey in 2008 were added. In the autumn 2008 and 2009 surveys, the 1998 cohort did not appear as strong as it did previously at younger ages. Calculated stock weights have also decreased. Finally the maturity ogives (calculated by cohort) had a retrospective pattern (the proportion mature for most of the youngest ages in the most recent year is lower than the year before) from 2010 to 2009, causing the estimate to be further estimated downward.

State of the Stock: The stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below B_{lim}. STACFIS notes that SSB was projected in the last assessment to surpass B_{lim} in 2010. However, in this assessment recent estimates of SSB were revised downward as a result of relatively low survey indices in 2009, as well as slight revisions to input data from previous years. In addition, stock weights and maturities now appear to be reduced compared to values used in the projections in the last assessment.

e) Precautionary Reference Points

An examination of the stock recruit scatter shows that good recruitment has rarely been observed in this stock at SSB below 50 000 t, with the possible exception of the 2003 year class, and this is currently the best estimate of B_{lim} (Fig. 11.11). In 2009 STACFIS adopted an F_{lim} of 0.4 consistent with stock history and dynamics for this stock. The stock is currently below B_{lim} and current fishing mortality is below F_{lim} (Fig. 11.12).

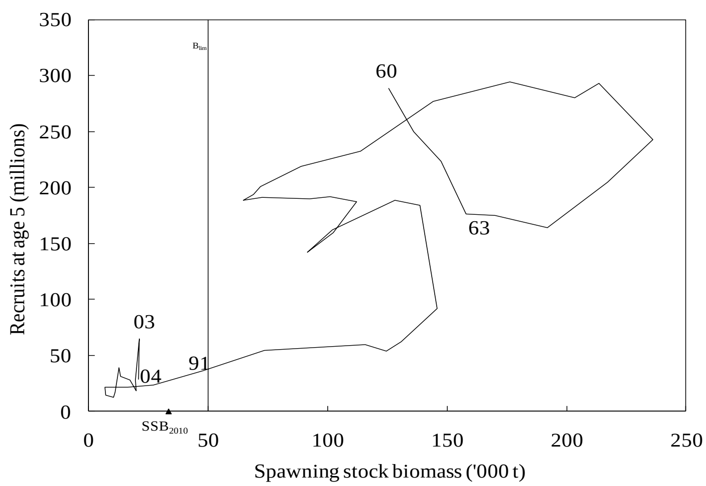


Fig. 11.11. American plaice in Div. 3LNO: stock recruit scatter. The vertical line is B_{lim}.

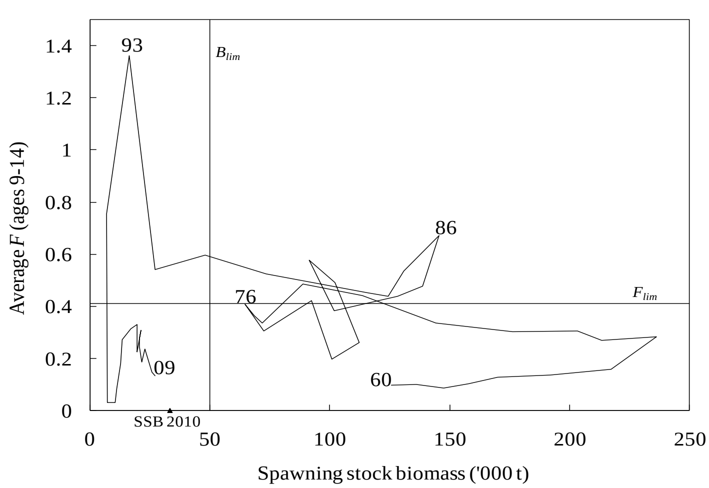


Fig. 11.12. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework.

f) Short Term Considerations

Simulations were carried out to examine the trajectory of the stock under 3 scenarios of fishing mortality: $F = 0$, $F = F_{2009}$ (0.13), and $F_{0.1}$ (0.2). F_{max} is difficult to determine for this stock and highly labile so estimates were not provided under this scenario. For these simulations the results of the VPA and the covariance of these population estimates were used. The following assumptions were made:

Age	Estimate of 2010 population numbers('000)	CV on population estimate	Weight-at-age mid-year(avg. 2007-2009)	Weight-at-age beginning of year(avg. 2007-2009)	Maturity-at-age(avg. 2007-2009)	Rescaled PR relative to ages 9-14(avg. 2007-2009)
5			0.197	0.169	0.023	0.021
6	23373	0.318	0.278	0.230	0.064	0.054
7	42528	0.227	0.376	0.326	0.232	0.168
8	14869	0.189	0.485	0.443	0.489	0.371
9	7321	0.181	0.579	0.548	0.775	0.415
10	8664	0.166	0.721	0.662	0.934	0.450
11	7281	0.160	0.870	0.801	0.986	0.685
12	6678	0.150	1.163	1.044	0.997	1.339
13	1602	0.167	1.313	1.253	1	1.388
14	481	0.202	1.474	1.385	1	1.723
15	1074	0.197	1.795	1.653	1	1.723

Simulations were limited to a 5-year period. Recruitment was resampled from three sections of the estimated stock recruit scatter, depending on SSB. The three sections were 50 000 t of SSB and below (only low recruitment), greater than 50 000 t to 155 000 t (low and high recruitment), and greater than 155 000 t (only high recruitment). The simulations contained a plus group at age 15. At $F = 0$ spawning stock biomass is estimated to increase and there is a 50% probability that SSB will surpass B_{lim} by 2012. Under $F_{current}$ and $F_{0.1}$ the population is estimated to grow more slowly and there is a less than 50% probability that SSB will read B_{lim} by 2015 (Table 13.1 and Fig. 11.13). Yield is estimated to increase over the 5-year time period under $F_{current}$ and $F_{0.1}$.

Table 11.1. American plaice in Div. 3LNO: Results of stochastic projections under various fishing mortality options. Labels p5, p50 and p95 refer to 5th, 50th and 95th percentiles of each quantity.

	F=0		
	SSB ('000 t)		
	p5	p50	p95
2010	30	34	38
2011	37	42	48
2012	44	52	60
2013	50	60	70
2014	55	69	84
2015	61	81	112

	$F_{2009} = 0.13$					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2010	30	34	38	3.3	3.7	4.2
2011	34	39	44	3.9	4.5	5.1
2012	37	44	51	4.3	4.9	5.6
2013	39	46	56	4.5	5.1	6.0
2014	40	47	61	4.8	5.5	6.8
2015	40	48	71	5.2	6.2	8.7

	$F_{0.1} = 0.2$					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2010	30	33	38	4.9	5.5	6.3
2011	33	37	43	5.6	6.3	7.2
2012	35	40	47	5.8	6.6	7.6
2013	35	41	49	5.7	6.5	7.5
2014	35	41	51	5.9	6.8	8.1
2015	34	41	53	6.4	7.5	9.3

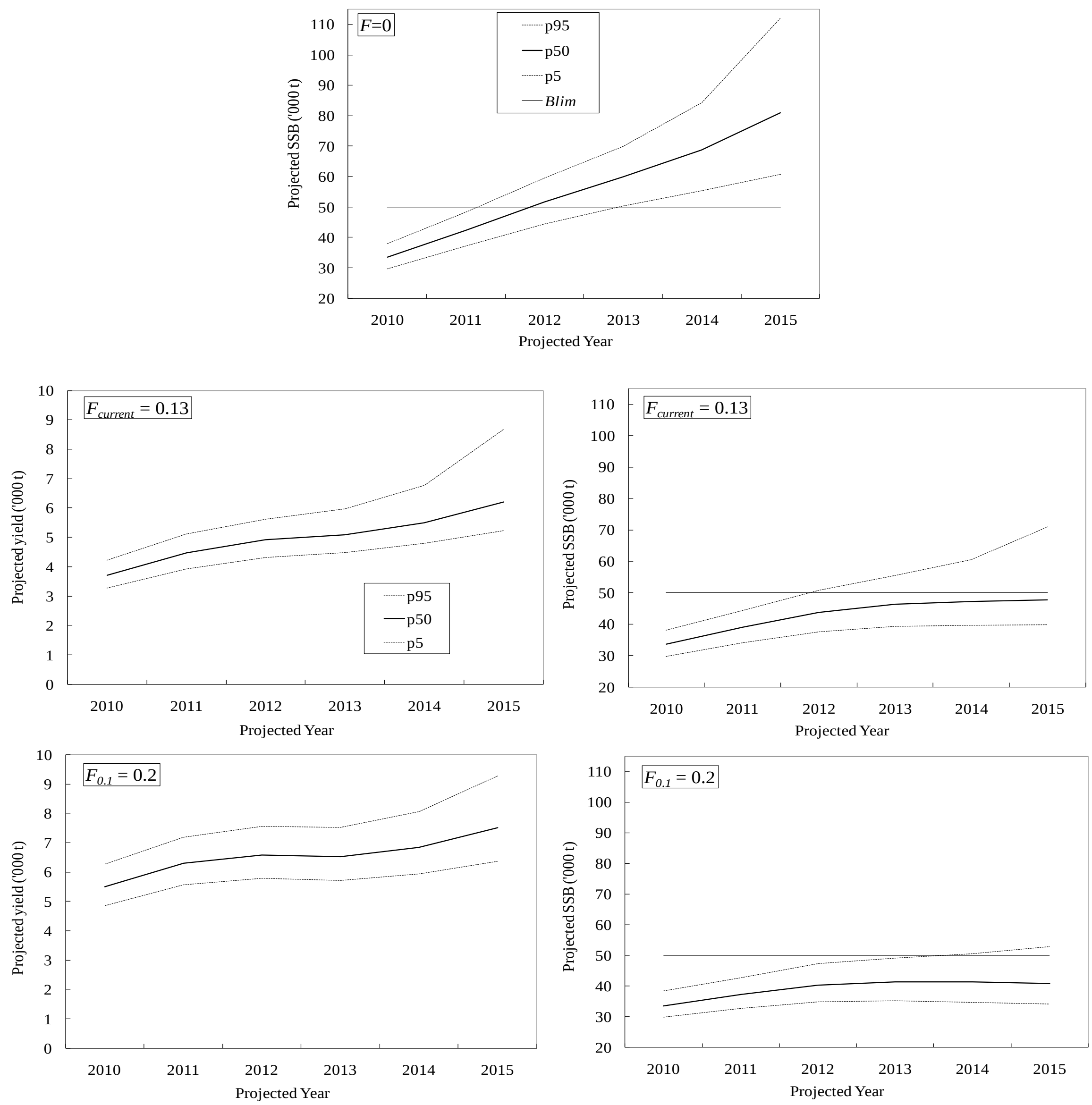


Fig. 11.13. American plaice in Div. 3LNO: median spawning stock biomass and yield from projections along with various percentiles at F=0, F_{2009} and $F_{0.1}$.

The next full assessment of this stock is expected to be in 2011.

12. Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO

Interim Monitoring Report (SCS Docs. 10/05, 06, 07)

a) Introduction

Since the fishery re-opened in 1998, catches increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches from 2001 to 2008 ranged from 11 000 to 14 000 t, except in 2006 and 2007, when catches were well below the TACs due to corporate restructuring and a labour dispute in the Canadian fishing industry. In 2009, there was a reduction in effort in the Canadian fishery due to market conditions, and only 6 200 t of the 17 000 t TAC was taken.

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	13.0	13.0	14.5	14.5	15.0	15.0	15.5	15.5	< 85% F_{msy} [3]	< 85% F_{msy} [3]
TAC	13.0	13.0	14.5	14.5	15.0	15.0	15.5	15.5	17	17
STATLANT 21A	12.8	10.4	13.0	13.1	13.9	0.6	4.4	11.3[1]	5.5[1]	
STACFIS	14.1	10.8	13.5-14.1[2]	13.4	13.9	0.9	4.6	11.4	6.2	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.
[3] SC recommended any TAC up to 85% F_{msy} in 2009 to 2011.

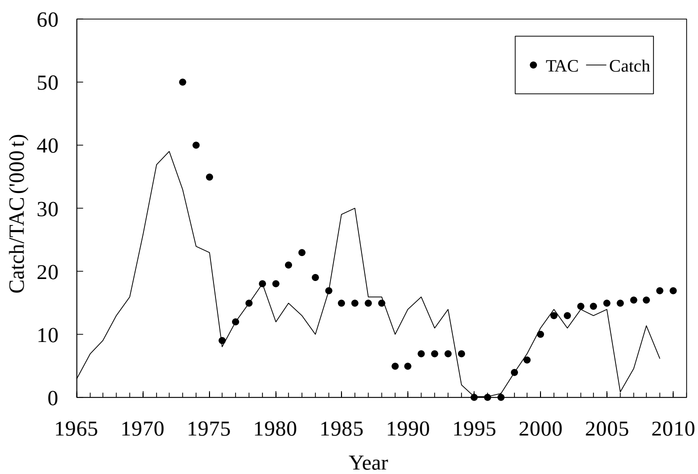


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

b) Data Overview

i) Research survey data

Canadian stratified-random spring surveys. Problems with the Canadian survey vessel resulted in incomplete coverage, particularly in Div. 3N, in the 2006 spring survey, and survey results in that year may not be comparable with those in other years. The index of trawlable biomass in 2008 was the highest in the series, but declined in 2009. Since 1999, the index of trawlable biomass has been variable, but remains well above the level of the late 1980s and early 1990s.

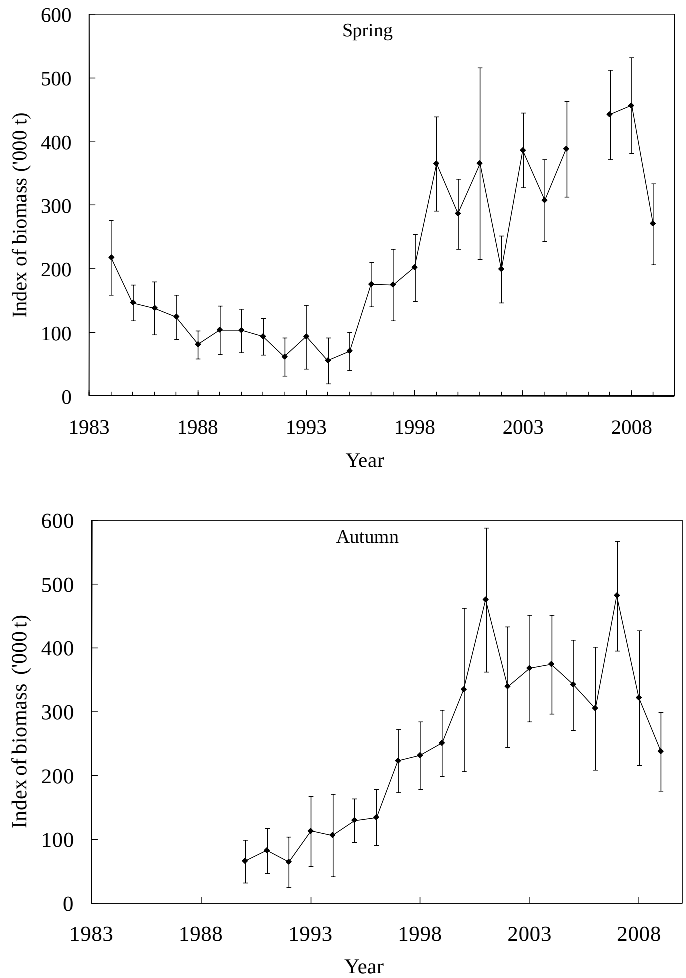


Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx 95% confidence intervals, from Canadian spring and autumn surveys.

Canadian stratified-random autumn surveys. The index of trawlable biomass for Div. 3LNO increased steadily from the early-1990s (Fig. 12.2). Following a decline in 2002 from a peak value in 2001, biomass in 2002-2006 remained relatively stable, and then increased to the series high in 2007. The biomass index decreased in 2008, and in 2009 declined further, to about the level of the late 1990s, but was still well above values in the early part of the time series.

EU-Spain stratified-random spring surveys in the NAFO Regulatory Area of Div. 3NO. Beginning in 1995, Spain has conducted stratified-random surveys for groundfish in the NAFO Regulatory Area (NRA) of Div. 3NO. These surveys cover a depth range of approximately 45 to 1 464 m. In 2001, extensive comparative fishing was conducted between the old vessel, C/V *Playa de Menduiňa* (using Pedreira trawl) with the new vessel, R/V *Vizconde de Eza*, using a Campelen 1800 shrimp trawl as the new survey trawl.

The biomass of yellowtail flounder increased sharply up to 1999, in general agreement with the Canadian series in Div. 3LNO, and has been relatively stable from 2000-2009 (Fig. 12.3).

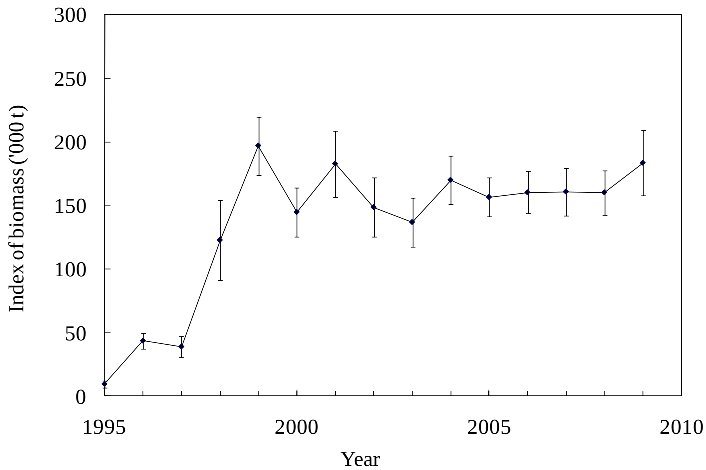


Fig.12.3 Yellowtail flounder in Div. 3LNO: index of biomass from the Spanish spring surveys in the Regulatory Area of Div. 3NO. Data are in Campelen equivalents ±1SD.

Stock distribution. In all surveys, yellowtail flounder were most abundant in Div. 3N, in strata on the Southeast Shoal and those immediately to the west (360, 361, 375 & 376), which straddle the Canadian 200 mile limit. Yellowtail flounder appear to be more abundant in the Regulatory Area of Div. 3N in the 1999-2009 surveys than from 1984-1995, and the stock has continued to occupy the northern portion of its range in Div. 3L, similar to the mid-1980s when overall stock size was also relatively large. The vast majority of the stock was still found in waters shallower than 93 m in both seasons.

Recruitment. Total numbers of juveniles (<22 cm) from spring and autumn surveys by Canada and spring surveys by Spain are given in Fig. 12.4. High catches of juveniles in the autumn of 2004 and 2005 were not evident in either the Canadian or Spanish spring series. Although no clear trend in recruitment is evident, the number of small fish was below the 1996-2009 average in all three surveys in 2008 and 2009.

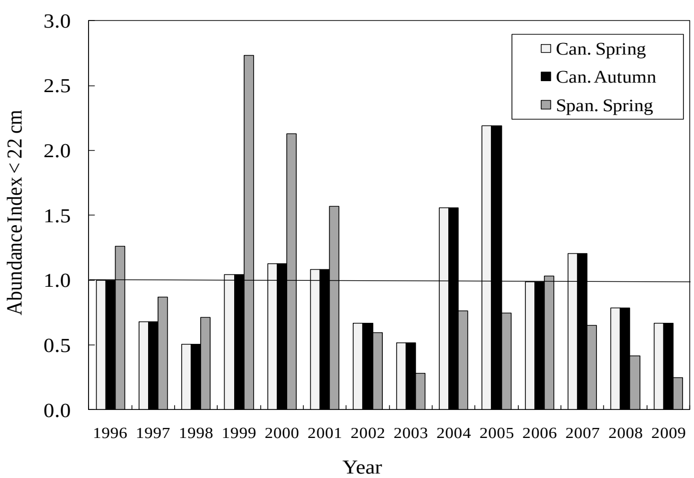


Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile abundance indices from spring and autumn surveys by Canada (Can.) and spring surveys by Spain (Span.). Each series is scaled to its means.

c) Conclusion

Although the Canadian spring and autumn survey indices declined in 2009, this may be within the variation of the series. Overall, there is nothing to indicate a change in the status of the stock.

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

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

Interim Monitoring Report (SCS Docs. 10/5, 6, 7)

a) Introduction

Reported catches in the period 1972 84 ranged from a low of about 2 400 t in 1980 and 1981 to a high of about 9 200 t in 1972 (Fig. 13.1). With increased bycatch in other fisheries, catches rose rapidly to 8 800 and 9 100 t in 1985 and 1986. The increased effort was concentrated mainly in the NAFO Regulatory Area (NRA) of Div. 3N. From 1987 to 1993 catches ranged between about 3 700 and 7 500 t and then declined in 1994 to less than 1200 t when it was agreed there would be no directed fishing on the stock. Since then, catches have averaged about 500 t; in 2009 the catch was 375 t, taken mainly in the NRA of Div. 3O.

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.7	0.7	0.9	0.6	0.3	0.2	0.2	0.2[2]	0.1[2]	
STACFIS	0.7	0.4	0.9-2.2[1]	0.6	0.3	0.5	0.2	0.3	0.4	

[1] In 2003, STACFIS could not precisely estimate the catch.
[2] Provisional
ndf No directed fishery

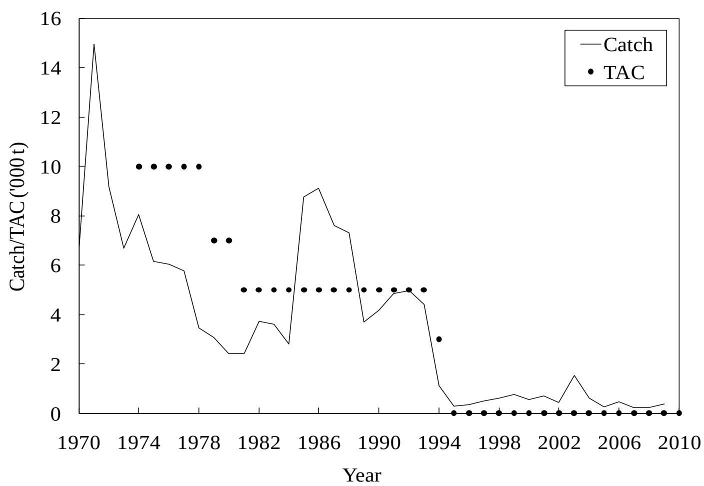


Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as 0 TAC.

b) Data Overview

i) Research survey data

Canadian spring RV survey mean weight per tow. For Div. 3N, mean weights per tow in the Canadian spring survey ranged from as high as 0.96 kg in 1984 to a low of 0.07 kg in 1996 and have been variable since then with the 2009 value about 0.81 kg. In Div. 3O, the spring survey estimates also have been variable, but show a decreasing trend from 9.67 kg in 1985 to 0.83 kg in 1998. Since then, although the trend remained variable, there was a general increase in mean weights per tow to 2003 (6 kg) but a subsequent decreasing trend to 2.8 kg in 2009. The combined Div. 3NO estimates of mean weight per tow have increased slightly from the mid-1990s, remaining stable since 2003 (Fig. 13.2). The high value in 2003 was largely influenced by one large set; the 2006 survey estimate is biased due to substantial coverage deficiencies and is therefore not included.

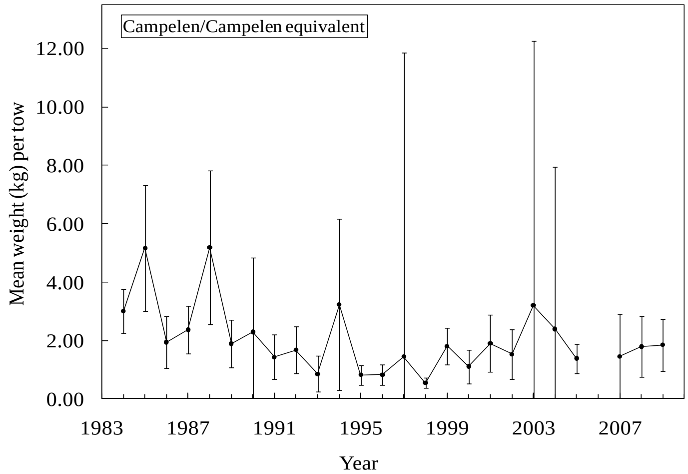


Fig. 13.2. Witch flounder in Div. 3NO: mean weights per tow from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units.

Canadian autumn RV survey mean weight per tow. Trends in the autumn survey are complicated by variable coverage of the deeper strata from year to year. Mean weights per tow in the autumn survey in Div. 3N ranged from 0.07 kg in 1996 to the high value observed in 2009 (5.2 kg/tow). The autumn survey index in Div. 3O increased from 2001 to 2004 but had decreased to about 2.3 kg per tow in 2007. However, similar to the large increase in Div. 3N, there has been a large increase in mean weight per tow in Div. 3O since then, and in 2009 is 9.0 kg/tow. With the exception of a low value of 1.4 kg/tow in 2007, the combined index in Div. 3NO autumn survey (Fig. 13.3) has shown a general increasing trend since 1996, reaching the highest value in the time series in 2009, at 7.2 kg/tow.

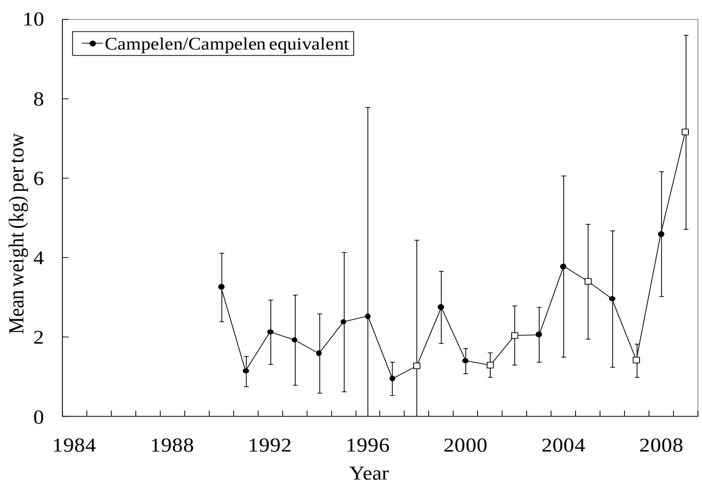


Fig. 13.3. Witch flounder in Div. 3NO: mean weights per tow from Canadian autumn surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols refer to years in which more than 50% of the deep water (> 730 m) strata were covered by the survey.

EU-Spain Div. 3NO RV survey biomass. Surveys have been conducted annually from 1995 to 2009 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1462 m (since 1998). In 2001, the research vessel (R/V *Playa de Menduiña*) and survey gear (Pedreira) were replaced by the R/V *Vizconde de Eza* using a Campelen trawl (NAFO SCR Doc. 05/25). Data for witch flounder in Div. 3NO prior to 2001 have not been converted and therefore data from the two time series cannot be compared. In the Pedreira gear time series, the biomass increased from 1995-2000 but declined in 2001; in the Campelen gear time series, the biomass index has been variable but has been generally decreasing since 2004 (Fig. 13.4).

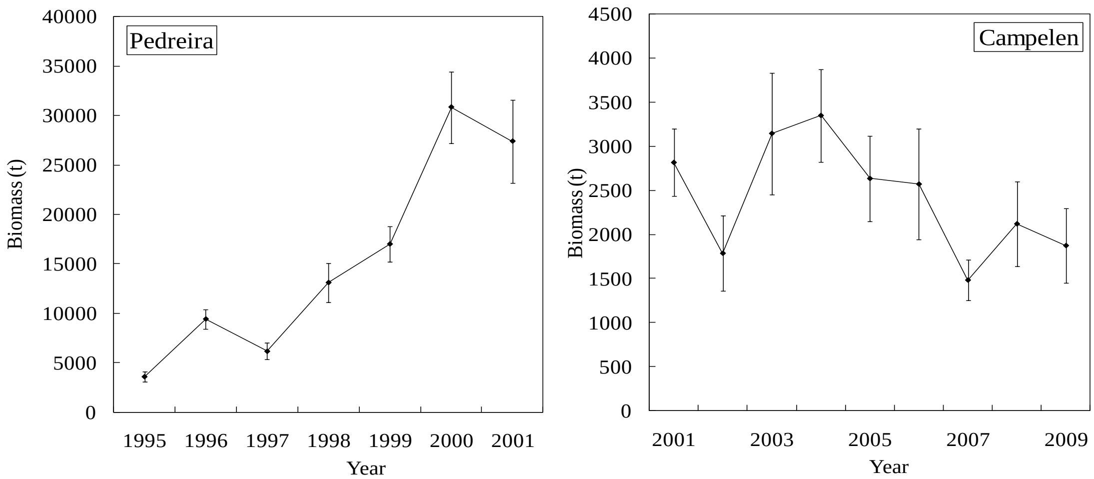


Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from Spanish Div. 3NO surveys (±1 standard deviation). Data from 1995-2001 is in Pedreira units; data from 2001-2009 are Campelen units. Both values are present for 2001.

c) Conclusion

Overall, there is nothing to indicate a change in the status of the stock.

The next full assessment of this stock is planned for 2011.

14. Capelin (*Mallotus villosus*) in Div. 3NO

Interim Monitoring Report

a) Introduction

The fishery for capelin started in 1971 and total catch was maximal in mid-1970s with the highest catch of 132 000 t in 1975. The directed fishery was closed in 1992 and the closure has continued through 2009 (Fig. 14.1). No catches have been reported for this stock since 1993.

Nominal catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A[1]	0	0	0	0	0	0	0	0	0	
STACFIS[1]	0	0	0	0	0	0	0	0	0	

[1] No catch reported or estimated for this stock
ndf = no directed fishing.

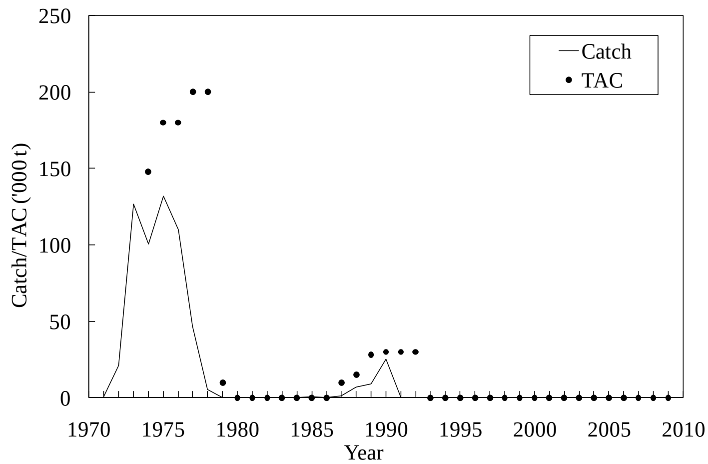


Fig. 14.1. Capelin in Div. 3NO: catches and TACs. No directed fishery plotted as 0 TAC.

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 repeated since 1995. In recent years, STACFIS has repeatedly recommended investigation of the capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this recommendation has not been acted upon. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random spring trawl surveys. In 1996-2009, when a Campelen trawl was used as a sampling gear, survey biomass of capelin in Div. 3NO varied from 3900 to 114 652 t (Fig.14.2), the average value for this period is 31 337 t. In 2005, survey biomass of capelin in Div. 3NO was 3900 t, the lowest level since 1996; in 2006 and in 2007 survey biomass increased and was 9600 and 29 300 t respectively. In 2008 the biomass index sharply increased to 114 600 t which is the highest in 1996-2008 period. In 2009 biomass significant decreased compared to 2008 and was 30 606 t.

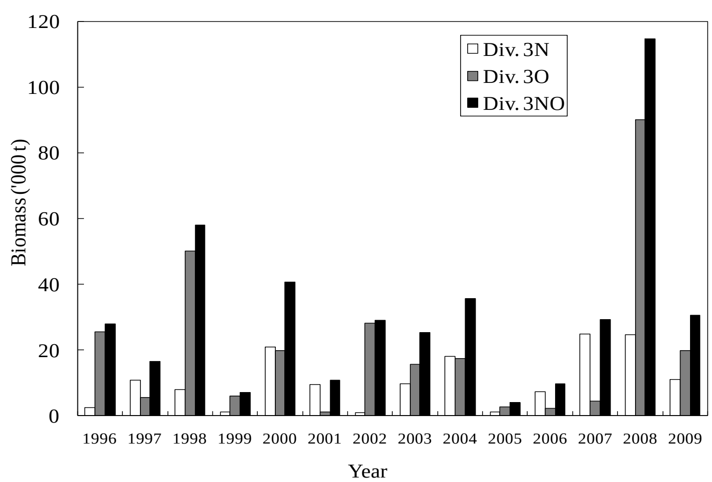


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates in 1996-2009.

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 1990-2009. However, if the proportions of zero and non-zero catches change, the index may not be comparable between years.

Survey catches were standardized to 1 km^2 for combining Engel and Campelen trawl data. Sets which did not contain capelin were not included in account. The confidence intervals around the average catch index were obtained by bootstrapping of standardized catch values. According to data from 1996-2008, the mean catch varied between 0.06 and 1.56. In 2007 and 2008, this parameter was 0.41 and 1.56, respectively (Fig. 14.3), thus reaching in 2008 its highest value in the period. In 2009 mean catch decreased to 0.51. Years when the stock supported a fishery had values for this index of 2 or more.

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

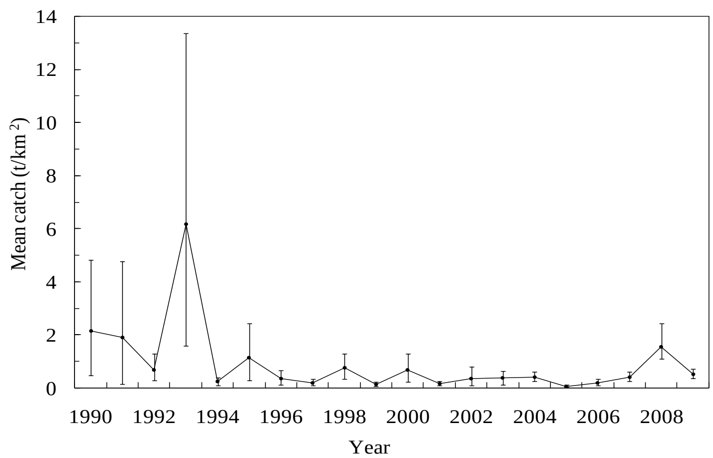


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km^2) in 1990-2009.

d) Assessment Results

It is not clear how the data reflects the real stock distribution and stock status. Nevertheless, STACFIS considered that the stock is still at low level relative to that of the late 1980s.

The next full assessment will be in 2011.

e) Research Recommendations

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

15. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3O

(SCR Doc. 10/26; SCS Doc. 10/5, 6, 7, 10)

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 fasciatu*s). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics. 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

The redfish fishery within the Canadian portion of Div. 3O has been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, while catch in the NRA portion of Div. 3O during that same time was regulated only by mesh size. A TAC was adopted by NAFO in September 2004. The TAC has been 20 000 t from 2005-2010 and applies to the entire area of Div. 3O. Nominal catches have ranged between 3 000 t and 35 000 t since 1960 (Fig. 15.1). Catches averaged 13 000 t up to 1986 and then increased to 27 000 t in 1987 and 35 000 t in 1988. Catches declined to 13 000 t in 1989, increased gradually to about 16 000 t in 1993 and declined further to about 3 000 t in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 20 000 t by 2001, and have generally declined since that time, with 2009 catches totaling 6 431 t.

The large redfish catches in 1987 and 1988 were due mainly to increased activity in the NRA by non-Contracting parties (NCPs). There has been no activity in the NRA by NCPs since 1994. From 1983-1996 estimates of under-reported catch ranged from 200 t to 23 500 t. There have also been estimates of over-reported catch in the recent period since 2000, with a maximum value of 4 300 t in 2003.

The redfish fishery in Div. 3O occurs primarily in the last three quarters of the year. Canadian, Portuguese and Spanish fleets utilize bottom trawling, making this the prominent means of capture and accounting for greater than 90% of the catch. The catch by midwater trawls is predominantly by Russia.

Nominal catches and TACs (‘000 t) for redfish in the recent period are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC					NR	NR	NR	NR	NR	NR
TAC[1]	10	10	10	10	20	20	20	20	20	20
STATLANT 21A	22.5	19.4	21.5	6.4	11.9	11.0	7.5	5.0[2]	6.4[2]	
STACFIS	20.3	17.2	17.2	3.8	10.7	12.6	5.2	4.0	6.4	

[1] 2000-2004 only applied within Canadian EEZ.
[2] Provisional.
NR = No recommendation

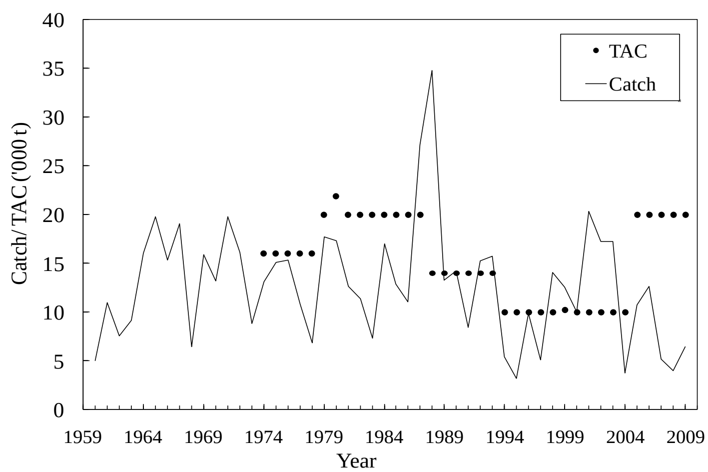


Fig. 15.1. Redfish in Div. 3O: catches and TACs (from 1974 to 2004 applied to Canadian fisheries jurisdiction; from 2005 for entire Div. 3O area).

b) Input Data

Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring and autumn surveys for 1991-2009. Length frequencies were available from Canada, Portugal and Spain in 2009.

i) Commercial fishery data

A standardized catch rate series was produced for Canadian fleets fishing within the Canadian Exclusive Economic Zone and for NRA fleets. However, there are large uncertainties associated with the catch used in the calculation of CPUE. Also, it is questionable whether catch rate indices are indicative of stock trends. Redfish tend to form patchy aggregations that are at times very dense and 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.

Sampling of the redfish fisheries was conducted by Canada, Spain, and Portugal from the 2009 trawl fishery. Fleets generally fished between 275 and 550 m. Length frequencies were similar among participating countries with an overall size range of 13-40 cm and a modal length of 18-19 cm.

ii) Research survey data

Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring and autumn stratified-random surveys during 1991-2009. 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. Thereafter 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. 15.2) has remained stable since 2004 and at a level above the low points of 2001-2003. The autumn surveys, while more stable in the early 1990s, generally support the pattern of the spring survey index but with a gradual and steady increase from 2003 to 2009.

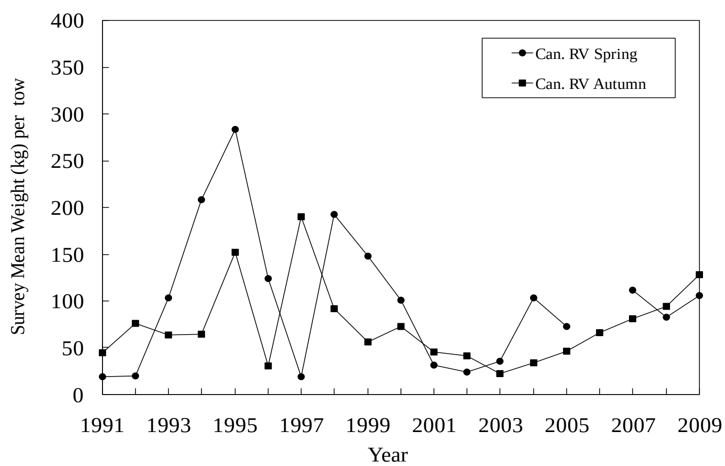


Fig. 15.2. Redfish in Div. 3O: survey biomass indices from Canadian surveys in Div. 3O in Campelen equivalent units for surveys prior to autumn 1995.

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 a 1988 and 1984 year-class 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 but progresses slowly between 22-25 cm from 2001-2007 surveys then decreases substantially. Recruitment pulses detected in both surveys in 1999 were greatly diminished by 2002. There was a new relatively large pulse at 17cm in the 2007 surveys corresponding to a 2001 year class. This year class remains dominant at 19 cm in 2009 (Fig. 15.3). Although their presence was detected at smaller sizes in previous surveys, the sudden increase in density at 17cm is unusual. Nevertheless, this represents the best sign of recruitment in the population since the 1988 year-class.

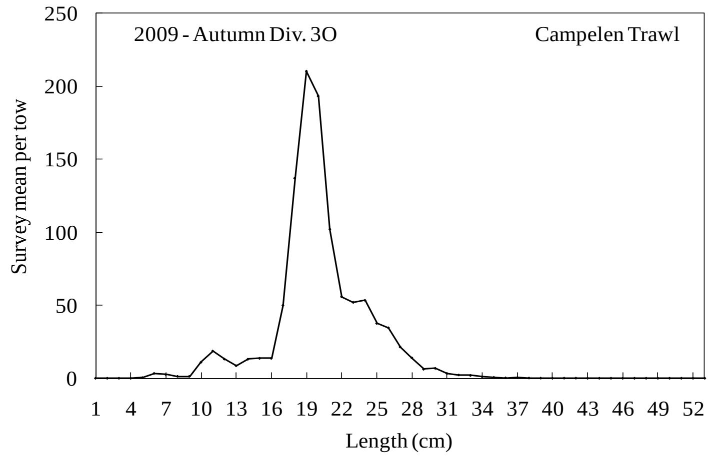


Fig. 15.3. Redfish in Div. 3O: Size distribution (stratified mean per tow) from Canadian autumn surveys for 2009.

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. 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 2009, the fishery size composition more resembled the survey size composition. Accordingly, catch/biomass ratios were only calculated for the surveys from 1998-2009. The results (Fig. 15.4) 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. The values for 2007-2009 were among the lowest in the time series.

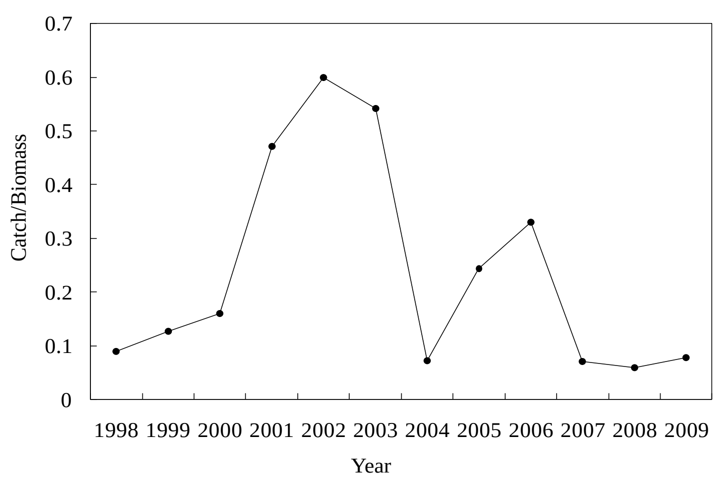


Fig. 15.4. Redfish in Div. 3O: catch/survey biomass ratios for Div. 3O. The 2006 value was calculated using only the autumn biomass estimate.

ii) Size at maturity

No new maturity at length data were available. However, based on previous analyses of size at maturity for this stock and current catches at length it is clear that the fishery is based predominantly on immature fish.

d) Assessment Results

Assessment Results: No analytical assessment was performed.

Biomass: While the Canadian spring survey estimates have been stable since 2004, the autumn survey estimates have increased continuously since 2003. Both indices are currently at or slightly above the series average.

Fishing Mortality: Catch/survey biomass index for Div. 3O redfish peaked in 2002 at 0.6 and has decreased since that time. Relative fishing mortality for 2007-2009 is approximately 0.1 and among the lowest values in the time series.

Recruitment: The 2001 year class appeared as a relatively large pulse at 17cm in the 2007 surveys and remains dominant at 19 cm in 2009. This represents the best sign of recruitment in the population since the 1988 year-class.

State of the Stock: Surveys indicate the stock has increased since the early 2000s.

Reference Points: There are presently no biological reference points for redfish in Div. 3O.

e) 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 model to this stock.*

The next full assessment will be in 2013.

16. Thorny Skate (*Amblyraja radiata*) in Div. 3LNO and Subdiv. 3Ps

(SCR Doc. 10/ 10, 24; SCS Doc. 10/ 05, 06, 07)

a) Introduction

Thorny skate on the Grand Banks was first assessed by Canada, for the stock unit 3LNOPs. Subsequent Canadian assessments also provided advice for Div. 3LNOPs. However, Subdivision 3Ps is presently managed as a separate unit by Canada, and Div. 3LNO is managed by NAFO.

Catch History. Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skate species taken in the Canadian and EU-Spain catches. Thus, the skate fishery on the Grand Banks can be considered a fishery for thorny skate. In 2005, NAFO Fisheries Commission established a TAC of 13 500 t for thorny skate in Div. 3LNO. In Subdivision 3Ps Canada has established a TAC of 1 050 t.

Catches for NAFO Div. 3LNO increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this new fishery were EU-Spain, EU-Portugal, Russia, and Canada. Catches by all countries in Div. 3LNOPs over 1985-1991 averaged 18 066 t; with a peak of 29 048 t in 1991 (STATLANT 21A). From 1992-1995, catches of thorny skate declined to an average of 7 554 t, however there are substantial uncertainties concerning reported skate catches prior to 1996. Total catch, as estimated by STACFIS, in Div. 3LNOPs, averaged 9 000 t (Fig. 16.1) during the period 2000 to 2009. Average STACFIS catch in Div. 3LNO for 2005-2009 was 5000t.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Div. 3LNO:										
TAC					13.5	13.5	13.5	13.5	13.5	12.0
STATLANT 21A	14.9	11.8	14.3	11.8	3.5	5.5	6.2	5.6[1]	1.2[1]	
STACFIS	9.2	11.8	11.6	9.3	4.2	5.8	3.6	7.4	4.5	
Subdiv. 3Ps:										
TAC					1.05	1.05	1.05	1.05	1.05	1.05
STATLANT 21A	1.8	1.6	1.8	1.3	1.0	1.0	1.8	1.4[1]	0.7[1]	

[1] Provisional

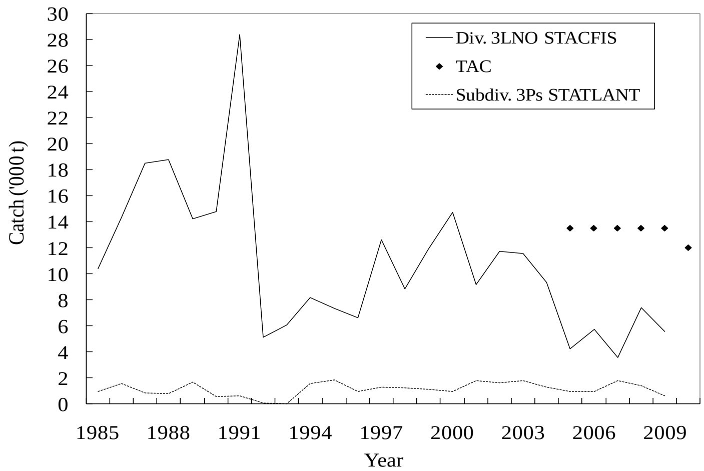


Fig. 16.1. Thorny skate catch in Div. 3LNO and Subdiv. 3Ps, 1996-2009, and TAC.

b) Input Data

i) Commercial fishery data

Thorny skates from either commercial or research survey catches are currently not aged.

Commercial length frequencies were available for EU-Spain (1985-1991, 1997-2009), EU-Portugal (2002-2004, 2006-2009), Canada (1994-2008), and Russia (1998-2009).

In 2008-2009, commercial length distributions from EU-Spain, EU-Portugal, and Russia in skate-directed trawl fisheries (280 mm mesh) of Div. 3LNO in the NRA indicated that the range of sizes caught did not vary between EU-Spain and Russia, and were similar to those reported in previous years. One exception was the distribution of skates caught by EU-Portugal in Div. 3NO in 2009: a 25-45 cm range with a mode of 42 cm was significantly smaller than those of EU-Spain and Russia (27-93 cm; with a mode of 66 cm). In other trawl fisheries (130-135 mm mesh) of Div. 3LNO in 2008-2009, length distributions of skate bycatch also did not vary between EU-Spain and Russia. In 2008, the size range of skate bycatch reported by EU-Portugal was similar to that of Russian trawlers (28-104 cm with a mode of 58 cm); although Russia also reported a small catch of 12-18 cm young-of-the-year skates. However, EU-Portugal caught an abbreviated range of smaller skates in 2009: a 24–64 cm range with a mode of 46 cm; while EU-Spain caught 26-86 cm skates with a 67-cm mode. In 2009, sampling by Russia was limited to only 59 skates, and Canada did not measure skate lengths in Div. 3LNO to compare with those of previous years.

No standardized commercial catch per unit effort (CPUE) exists for thorny skate.

ii) Research survey data

Canadian spring surveys. Stratified-random research surveys have been conducted by Canada in Div. 3L, 3N, 3O, and Subdiv. 3Ps in spring; using a Yankee-41.5 otter trawl in 1972-1982, an Engel-145 otter trawl in 1983-1995, and a Campelen-1800 shrimp trawl in 1996-2009. Maximum depth surveyed was 366 m before 1991, and ~750 m since then. Subdivision 3Ps was not surveyed in 2006; nor was the deeper portion (>103 m) of Div. 3NO in that year, due to mechanical difficulties on Canadian research vessels.

Indices for Div. 3LNOPs in 1972-1982 (Yankee series) fluctuated without trend (Fig. 16.2a).

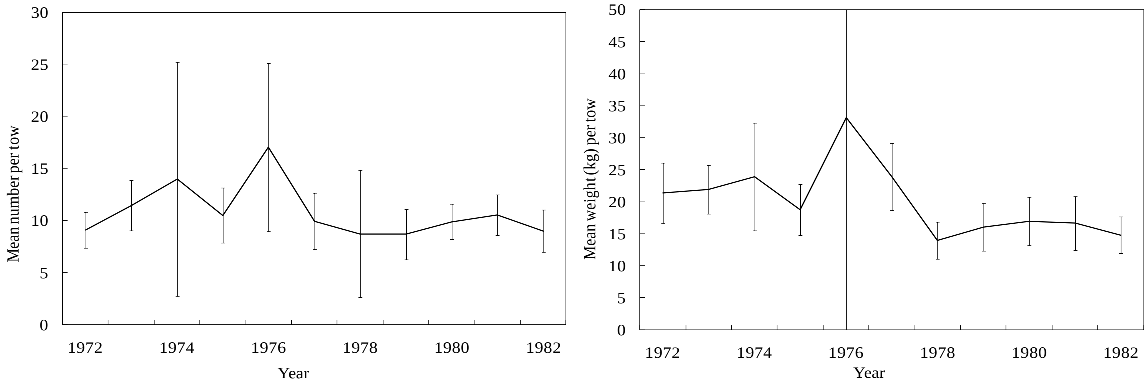


Fig. 16.2a. Thorny skate in Div. 3LNOPs, 1972-1982: estimates of mean numbers and mean weights per tow (unconverted) from Canadian spring surveys.

Standardized mean number and mean weight per tow from Canadian spring research surveys are presented in Fig. 16.2b for Div. 3LNOPs. In 2005, STACFIS recommended adoption of a multiplicative model for conversion of Thorny Skate Engel trawl data (1984-1995) to Campelen equivalents to derive a standardized time series for thorny skate in Div. 3LNOPs. Catch rates of thorny skate in Div. 3LNOPs indicated a declining trend over 1985-1995. Since 1996, indices have been relatively stable at historically low levels (Fig. 16.2b).

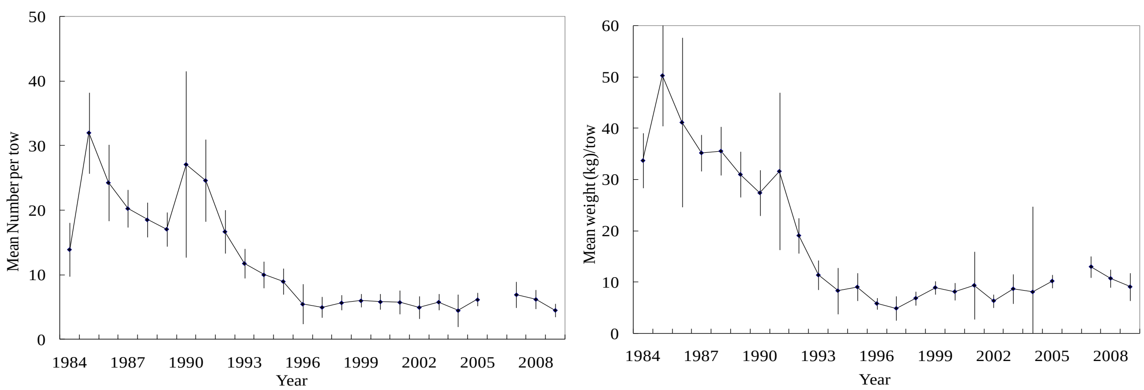


Fig. 16.2b. Thorny skate in Div. 3LNOPs, 1984-2009: estimates of Campelen-equivalent mean numbers (left panel) and mean weights (right panel) per tow from Canadian spring surveys. Survey in 2006 was incomplete.

Canadian autumn surveys. Stratified-random autumn surveys have been conducted by Canada in Div. 3L, 3N, and 3O; using an Engel-145 otter trawl in 1990-1994, and a Campelen-1800 shrimp trawl in 1995-2009 to depths of ~1 450 m.

Autumn survey catch rates, similar to spring estimates, declined over the early 1990s. Catch rates have been stable since 1995 (Fig. 16.2c). Autumn estimates of abundance and biomass are on average higher than spring estimates. This is expected, because thorny skates are found at depths exceeding the maximum depths surveyed in spring (~750 m), and are more deeply distributed during winter/spring.

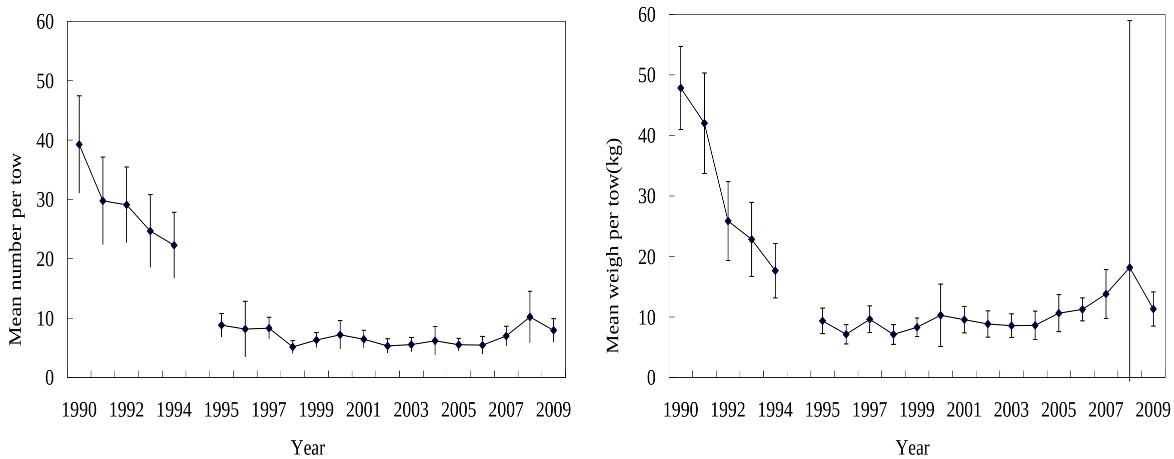


Fig. 16.2c. Thorny skate in Div. 3LNO, 1990-2009: estimates of mean numbers and mean weights per tow (unconverted) from Canadian autumn surveys. Note that Engel data in 1990-1994 and Campelen data in 1995-2009 are not directly comparable.

EU-Spain surveys. EU-Spain 3NO survey biomass indices in Div. 3NO were available for 1997-2009. EU-Spain surveys were limited to the NRA of Div. 3NO; while Canadian surveys covered the entire Div. 3NO area. The biomass trajectory from the EU-Spain surveys was very similar to that of Canadian spring surveys in most years (Fig. 16.3). In recent years the EU-Spain 3NO index has remained lower than that observed during 2004-2006. EU-Spain survey indices in the NRA of Div. 3L are available for 2006-2009 but are not considered due to the short time series.

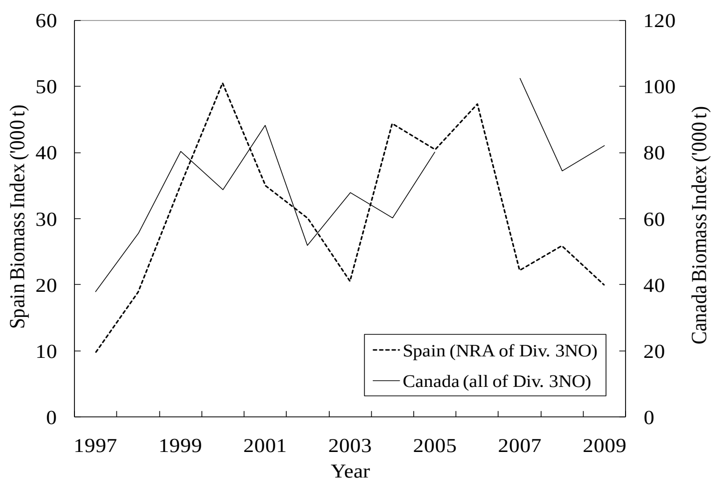


Fig. 16.3. Thorny Skate in Div. 3NO, 1997-2009: biomass estimates from Spanish spring surveys compared to Canadian Campelen spring surveys. Note that the EU-Spain survey occurs only in the NRA of Div. 3NO. The Canadian survey in 2006 was incomplete.

iii) Biological studies

Based on Canadian Campelen spring surveys in Div. 3LNOPs, various life stages of thorny skate underwent different changes in abundance over time. In 1996-2009, the abundance of Thorny skate recruits (5-20 cm TL) appeared to be relatively stable, estimates of male and female immature skates fluctuated along decreasing trends, and estimates of mature skates fluctuated along an increasing trend.

A relationship between mature female abundance and thorny skate recruits was used to estimate recruitment. This index declined from 1.9 and 2.4 in 1996 and 1997 (respectively) to an average of 0.8 since 1998; with the lowest value of 0.3 occurring in 2005 (Fig. 16.4). Thorny skates have low fecundity and long reproductive cycles. These characteristics result in low intrinsic rates of increase, and suggest low resilience to fishing mortality.

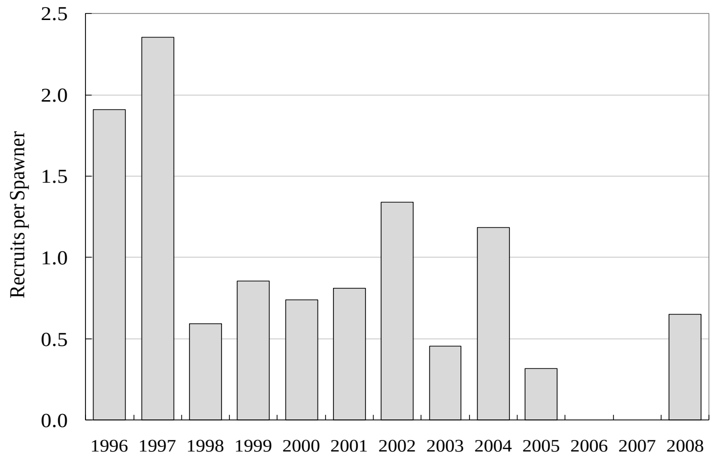


Fig. 16.4. Recruits per spawner expressed as number of male and female recruits (in year [*y*] produced per adult female in year [*y*-1]) from Canadian Campelen spring surveys in Div. 3LNOPs, 1996-2008. Survey in 2006 was incomplete.

c) Assessment Results

Assessment Results: No analytical assessment was performed.

Biomass: The Canadian spring survey biomass indices fluctuated without trend prior to the mid-1980s then declined rapidly until the early-1990s. During the spring Campelen series, 1996 to 2009, the biomass has been stable at low levels. The pattern from the Canadian autumn survey, for comparable periods, was similar.

Fishing Mortality: Catch/survey biomass index for Div. 3LNO peaked at 30% in 1997, then stabilized at approximately 17% during 1998-2004 (Fig. 16.5). In 2005, relative fishing mortality declined to 4%, and has remained around 5% since then.

Recruitment: Recruitment has been low since 1997.

Reference Points: There are presently no biological reference points for thorny skate in Div. 3LNOPs.

State of the Stock: Although the state of the stock is unclear, the survey biomass has been relatively stable from 1996 to 2009 at low levels. Average STACFIS catch in Div. 3LNO for 2005-2009 was 5 000t.

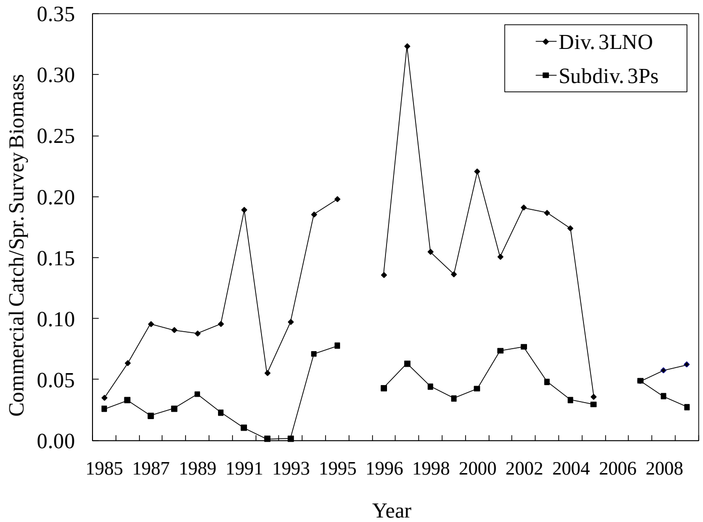


Fig. 16.5. Fishing Mortality Index (catch/spring survey biomass) for Div. 3LNO and Subdiv. 3Ps in 1996-2009. Commercial catch estimates are STACFIS-agreed numbers; biomass indices are from Canadian Campelen spring research surveys. Survey in 2006 was incomplete.

d) Recommendations

STACFIS **recommended** that *further work be conducted on development of a quantitative stock model*.

17. White Hake (*Urophycis tenuis*) in Div. 3NO and Subdiv. 3Ps

Interim Monitoring Report (SCR Doc. 10/10; SCS Doc. 10/5, 6, 7)

a) Introduction

The advice requested by Fisheries Commission is for NAFO Div. 3NO. 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. 3NO white hake is conducted with information on Subdiv. 3Ps included.

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, and Russia in 2003, in the NRA of Div. 3NO; 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 2005-2009. In 2003-2004, 14% of the total catch of white hake in Div. 3NO and Subdiv. 3Ps were taken by Canada, but increased to 93% by 2006; primarily due to the absence of a directed fishery for white hake by other countries. A TAC for white hake was implemented by Fisheries Commission in 2005.

In 1970-2009, white hake commercial catches in Div. 3NO fluctuated; averaging approximately 2 000 t, and exceeding 5 000 t in only three years during that period. Catches peaked in 1985 at approximately 8 100 t then declined; averaging 2 090 t in 1988-1994 (Fig. 17.1). Average catch was at its lowest in 1995-2001 (464 t), but increased to 6 752 t in 2002 and 4 841 t in 2003; following recruitment of the large 1999 year-class. NAFO-reported catches (STATLANT 21A) from 2005-2008 averaged 944 t, and totaled 414 t in 2009.

Commercial catches of white hake in NAFO Subdiv. 3Ps were less variable; averaging 1 114 t in 1985-93, and then decreasing to an average of 668 t in 1994-2003 (Fig. 17.1). Subsequently, catches increased to an average of 1 138 t in 2004-2008, and totaled 365 t in 2009.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Div. 3NO:										
TAC	-	-	-	-	8.5	8.5	8.5	8.5	8.5	6.0
STATLANT 21A	0.6	5.4	6.2	1.9	1.0	1.2	0.7	0.9[1]	0.4[1]	
STACFIS	0.7	6.8	4.8	1.3	0.9	1.1	0.6	0.9[1]	0.4[1]	
Subdiv. 3Ps:										
STATLANT 21A	0.9	0.9	1.1	1.4	1.6	1.5	1.3	0.7[1]	0.4[1]	

[1]Provisional

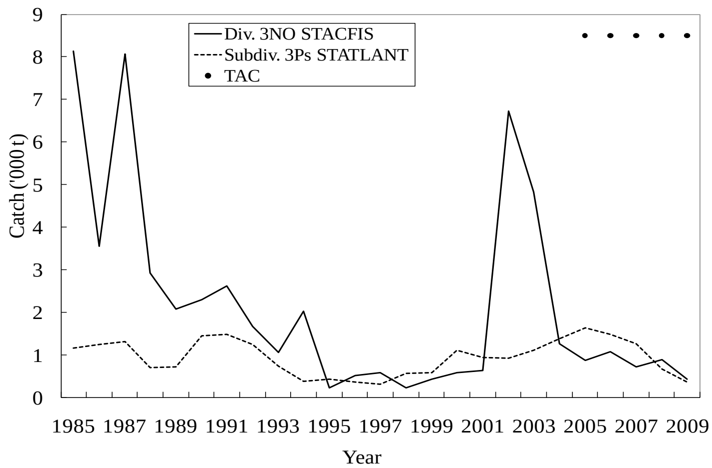


Fig. 17.1. White hake in Div. 3NO: total catch of white hake in NAFO Div. 3NO (STACFIS) and Subdivision 3Ps (STATLANT21A). The Total Allowable Catch (TAC) is indicated on the graph.

b) Input Data

Research survey data

Canadian stratified-random bottom trawl surveys. Data from spring research surveys in NAFO Div. 3N, 3O, and Subdiv. 3Ps were available from 1972 to 2009. 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; thus the survey estimate for 2006 was not included. Data from autumn surveys in NAFO Div. 3NO were available from 1990 to 2009. Canadian spring surveys were conducted using a Yankee 41.5 bottom trawl prior to 1984, an Engel 145 bottom trawl from 1984 to 1995, and a Campelen 1800 trawl thereafter. Canadian autumn surveys in Div. 3NO were conducted with an Engel 145 trawl from 1990 to 1994, and a Campelen 1800 trawl from 1995-2009. There are no survey catch rate conversion factors between trawls for white hake; thus each gear type is presented as a separate time series.

Abundance and biomass indices of white hake from the Canadian spring research surveys in Div. 3NOPs are presented in Fig. 17.2a. In 2003-2009, the population remained at a low level; similar to that previously observed in the Campelen time series for 1996-1998. The dominant feature of the white hake abundance time series was the peak abundance observed over 2000-2001. This peak in abundance was also reflected in the very large 1999 year-class in Canadian autumn research surveys of Div. 3NO (Fig. 17.2b). Autumn indices have since declined to levels similar to those of 1996-1998. Autumn survey catch rates in Div. 3NO remained at levels comparable to those observed from 1995 to 1998 in the Campelen time series.

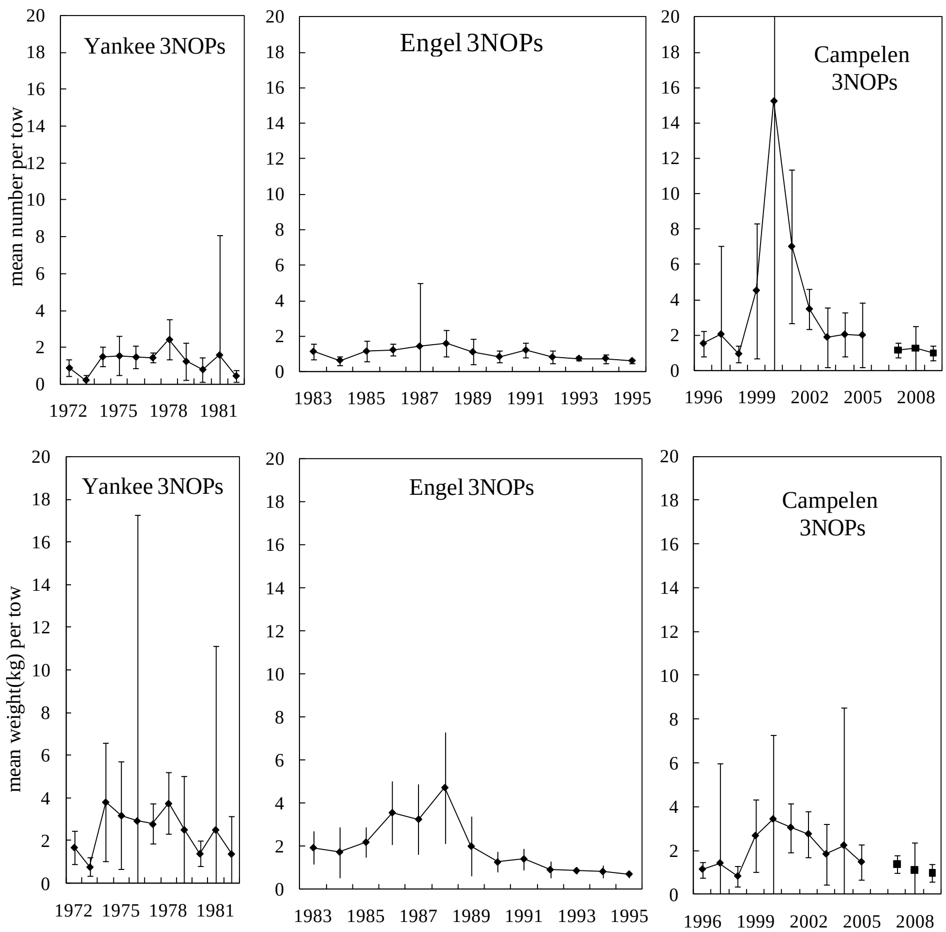


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: mean number and mean weight per tow from Canadian spring research surveys, 1972-2009. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. The Yankee, Engel, and Campelen time series are not standardized, and are thus presented on separate panels.

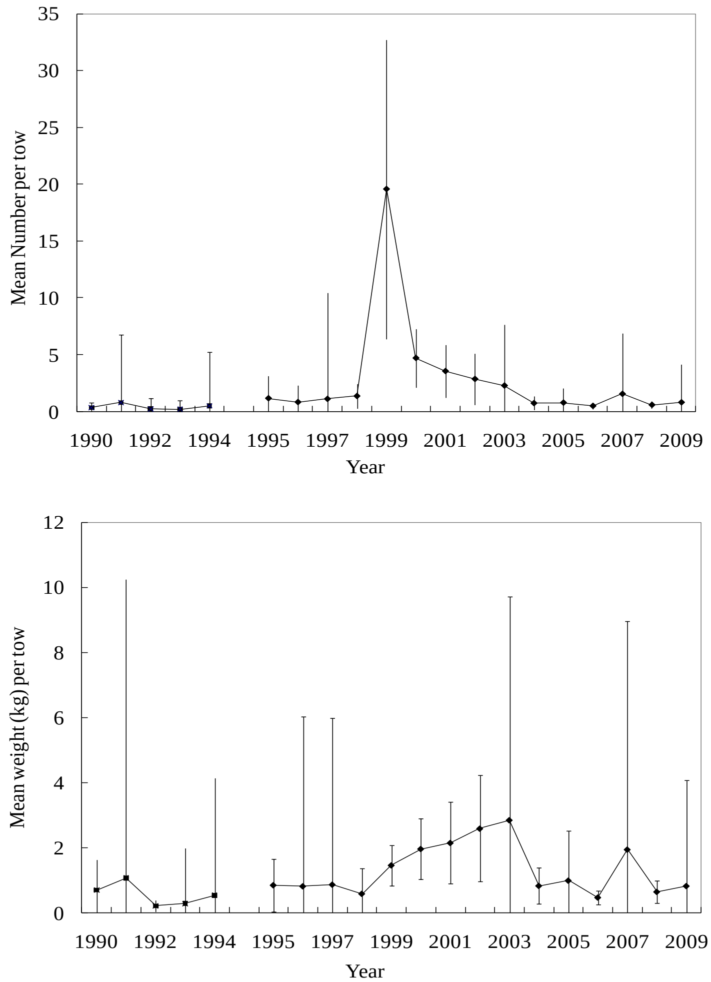


Fig. 17.2b. White hake in Div. 3NO: mean number per tow (upper panel) and mean weight per tow (lower panel) from Canadian autumn research surveys, 1990-2009. The Engel (■) and Campelen (♦) time series are not standardized.

EU-Spain stratified-random bottom trawl surveys in the NRA. EU-Spain biomass indices in the NAFO Regulatory Area of Div. 3NO were available for white hake from 2001 to 2009 (Fig. 17.3). Spanish surveys were conducted with Campelen gear (similar to that used in Canadian surveys) in the spring to a depth of 1 400 m. The EU-Spain biomass index was highest in 2001, then declined to 2003, peaked slightly in 2005, and then declined to its lowest level in 2008. In 2009, the Spanish index increased slightly relative to 2008. The overall trend is similar to that of the Canadian spring survey index (Fig. 17.3).

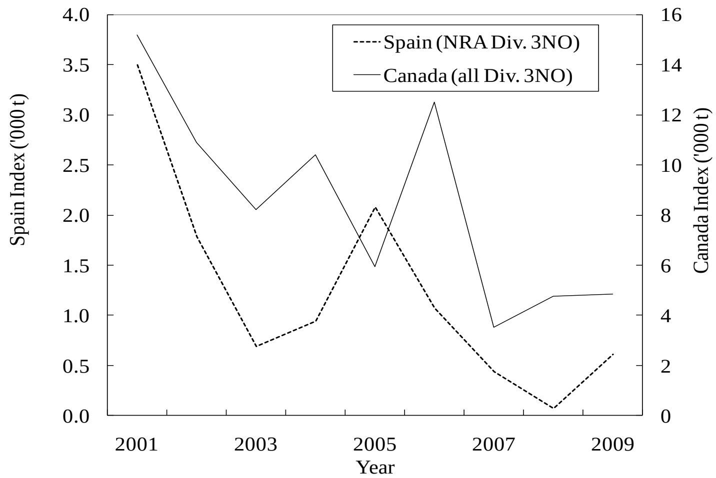


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from Spanish Campelen spring surveys in 2001-2009; as compared to Canadian spring survey indices in all of Div. 3NO.

Recruitment. In Canadian spring research surveys, the number of white hake less than 27 cm in length is assumed to be an index of recruitment at age 1. Recruits per spawner varied between 0.07 and 48.7 from 1997-2008 (Fig. 17.4). Two significant values were observed in this time series: 13.2 in 1998 and 48.7 in 1999. The largest value in recent years was 1.6 recruits per spawner in 2004. The 1999 year-class was large; but no large year class has been observed since then.

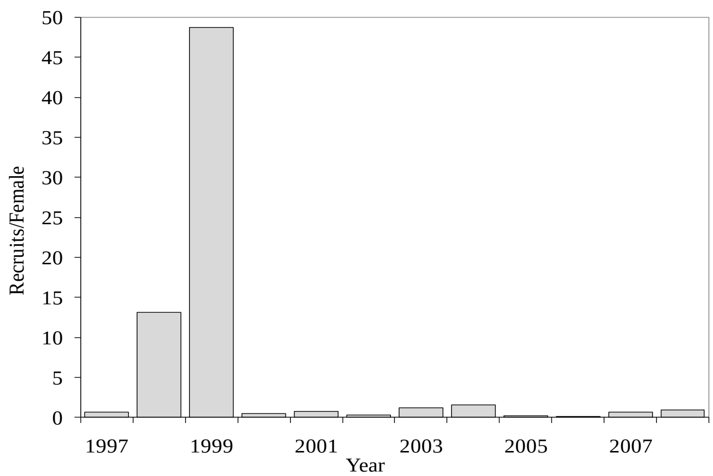


Fig. 17.4. White hake recruits per spawner from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2009. Recruits in year (y+1) are compared to the number of females in year(y).

c) Assessment Results

Based on current information there is no change in status of this stock.

The next full assessment of this stock is planned for 2011.

d) Research Recommendations

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

STACFIS **recommended** that *the collection of information on commercial catches of white hake be continued and now include sampling for age, sex and maturity to determine if this is a recruitment fishery.*

STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2009+); thereby allowing age-based analyses of this population.*

STACFIS **recommended** that *survey conversion factors between the Engel and Campelen gear be investigated for this stock.*

D. WIDELY DISTRIBUTED STOCKS: SA 2, SA 3 AND SA 4

Environmental Overview

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1-2°C and salinities of 32-33.5. Labrador Slope Water flows southward along the shelf edge and into the Flemish Pass region, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3°-4°C and salinities in the range of 34-34.75. On average bottom temperatures remain <0°C over most of the northern Grand Banks but increase to 1-4°C in southern regions and along the slopes of the banks below 200 m. North of the Grand Bank, in Div. 3K, bottom temperatures are generally warmer (1-3°C) except for the shallow inshore regions where they are mainly <0°C. In the deeper waters of the Flemish Pass and across the Flemish Cap bottom temperatures generally range from 3-4°C. Throughout most of the year the cold, relatively fresh water overlying the shelf is separated from the warmer higher-density water of the continental slope region by a strong temperature and density front. This winter-formed water mass is generally referred to as the cold intermediate layer (CIL) and is considered a robust index of ocean climate conditions. In general, shelf water masses undergo seasonal modification in their properties due to the seasonal cycles of air-sea heat flux, wind-forced mixing and ice formation and melt, leading to intense vertical and horizontal gradients particularly along the frontal boundaries separating the shelf and slope water masses. Temperature and salinity conditions over the Scotian Shelf are largely determined by advection of water from southern Newfoundland and the Gulf of St. Lawrence as well as offshore slope waters. In the northeast regions of the Scotian Shelf the bottom tends to be covered by relatively cold waters (1-4°C) whereas the basins in the central and southwestern regions have bottom temperatures that typically are 8-10°C.

Ocean temperatures on the Newfoundland and Labrador Shelf continued a slight cooling trend but remained above normal in some areas in 2009. Salinities, which were lower than normal throughout most of the 1990s, have experienced a general increasing trend during the past 8 years. At Station 27, the depth-averaged annual water temperature decreased from the record high observed in 2006 to slightly above normal in 2009. Annual surface temperatures at Station 27 also decreased from the 64-year record of 1.7°C above normal in 2006 to about 0.4°C above normal in 2009. Bottom temperatures at Station 27 were slightly below normal in 2009 the first time since 1995. The area of the Cold-Intermediate-Layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland Shelf was below normal for the 15th consecutive year while off southern Labrador it was above normal, the largest since 1994. Bottom temperatures on the Grand Banks (3LNO) during the spring were above normal. During the autumn bottom temperatures in Div. 2J and 3K were above normal while in Div. 3LNO they were about normal. A composite climate index derived from selected annual and seasonal time series across the NAFO Convention Area ranked 34th in 60 years of observations, which represents a decreasing trend since the record high in 2006.

A review of the 2009 physical oceanographic conditions on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas indicates that near normal conditions prevailed in 2009. The climate index, a composite of 18 selected, normalized time series, were within the long-term mean. Spatial variability was less systematic than in 2008. In 2009, temperatures at Cabot Strait (200-300 m), bottom temperatures in areas Div. 4Vn and 4X, at 250 m in Emerald Basin, at 200 m in Georges Basin and on Georges Bank were below normal. Sea surface temperatures at Halifax and Emerald Basin were also below normal; all other areas featured above normal temperatures. The volume of the Cold Intermediate Layer (CIL), defined as waters with temperatures <4°C, was estimated from the full depth CTD profiles for the region from Cabot Strait to Cape Sable. In 2009, the observed volume of 4950 km^3 was slightly less than the long-term mean value of 5100 km^3 in 2008.

18. Roughhead Grenadier (*Macrourus berglax*) in SA 2+3

(SCR Doc. 10/10, 21, 23, 32; SCS Doc. 10/5, 6 and 7)

a) Introduction

The stock structure of this species in the North Atlantic remains unclear because there is little information on the number of different populations that may exist and their relationship. Roughhead grenadier is distributed throughout NAFO Subareas 0 to 3 in depths between 300 and 2 000 m. However, for assessment purposes, NAFO Scientific Council considers the population of Subareas 2 and 3 as a single stock.

i) Description of the fisheries and catches

Roughhead grenadier is becoming an important commercial fish in the waters managed by the Northwest Atlantic Fishery Organization (NAFO), especially in the NAFO Regulatory Area (NRA). Roughhead grenadier is taken as bycatch in the Greenland halibut fishery, mainly in NRA Divisions 3LMN. Most roughhead grenadier catches are taken by trawl and the only management regulation applicable to roughhead grenadier in the NRA is a general groundfish regulation requiring the use of a minimum 130 mm mesh size.

A substantial part of the grenadier catches in Subarea 3 previously reported as roundnose grenadier has been roughhead grenadier. To correct the catch statistics STACFIS revised and approved roughhead grenadier catch statistics since 1987 for assessment purposes. The misreporting has not yet been resolved in the official statistics before 1996, but the species are considered to be reported correctly since 1997. Catches of roughhead grenadier increased sharply from 1989 (333 t) to 1992 (6725 t); since then until 1997 total catches have been about 4000 t. In 1998 and 1999 catches increased and were near the level of 7000 t. Since then, catches decreased to 3000–4000 t in 2001–2004 and to 700 t in 2007. A total catch of 847 t was estimated for 2008 and 629 in 2009 (Fig. 18.1). Most of the catches were taken in Div. 3LMN by Spain, Portugal and Russia fleets. In the catch series available, less than 2% of the yearly catch has been taken in Subarea 2.

Recent catches ('000 t) are as follow:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
STATLANT 21A	2.0	1.7	1.8	1.7	1.3	0.6	0.5	0.4[1]	0.7[1]	
STACFIS	3.1	3.7	4.2-3.8[2]	3.2	1.5	1.4	0.7	0.8	0.6	

[1] Provisional.
[2] In 2003, STACFIS could not precisely estimate the catch.

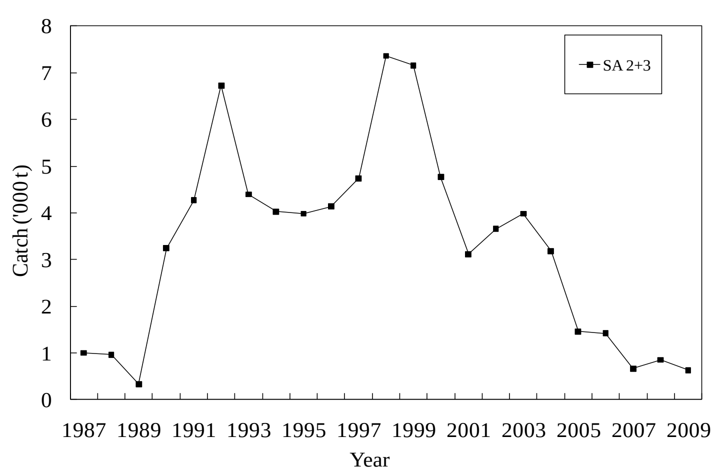


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

b) Input Data

i) Commercial fishery data

Length frequencies from the EU-Spain, Russian and EU-Portugal trawl catches in Div. 3LMNO are available since 1992, 1992 and 1996 respectively. Due to the growth differences between sexes, length and age data have been analyzed by sex. The EU-Spain and EU-Portugal lengths frequencies were presented as pre anal fin length (AFL), while the Russian ones as total lengths. The roughhead length compositions from the Russian catches have been converted to AFL. Catch-at-age data from the total catches in Div. 3LMNO are available since 1992. The period 2007-2009 were update based on the annual age-length key (ALK) of Spanish commercial catches and Flemish Cap survey. In the commercial fishery catches, females attain larger lengths and ages than males. In the period 2008-2009, most of catches are composed of ages between 5 and 11, with a mode at age 7. Catches age distribution in the period 2008-2009 were based on younger ages than in the previous period (2004-2007).

ii) Research survey 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 to 2006, the EU (Spain and Portugal) Flemish Cap survey in Div. 3M since 1991 and the EU Spanish Div. 3NO survey since 1997. EU Spanish Div. 3L surveys are available for 2006-2009 but are not considered due to the short time series.

Canadian autumn surveys. Stratified random bottom trawl surveys have been conducted in Div. 2J and 3KL since 1978, while Divisions 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 1500 m in Div. 2J and 3K and to 730 m in Div. 3LNO, the latter having been extended to 1463 m after 1995. In 2002 in Div. 3M a total of 26 hauls were made at depths between 732 – 1463 m. In 2004 and 2006, operational difficulties led to incomplete coverage of the survey in NAFO Div. 3LMNO and in 2008 in Div. 2J3K (SCR Doc. 10/21). The estimate for these divisions and years are not directly comparable with the time series.

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 Div. 2J and 3K are comparable from 1995 onwards. From 1995, the biomass of this survey in Div. 2J and 3K shows a continuous increasing trend, reaching its maximum in 2009 (Fig. 18.2).

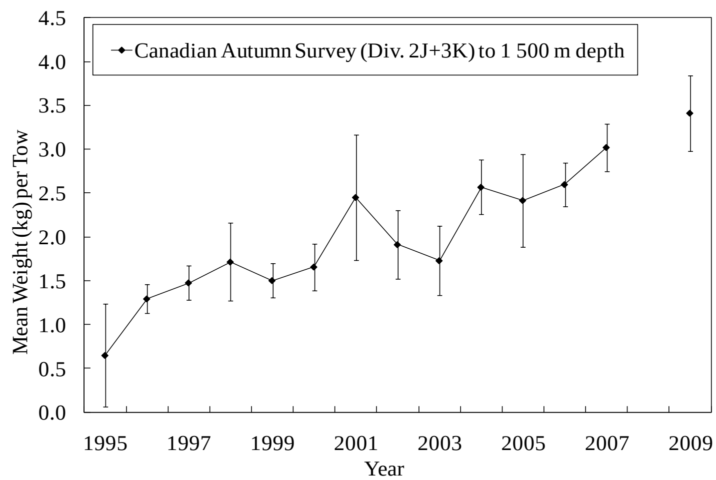


Fig. 18.2. Roughhead grenadier in Subareas 2+3: biomass indices ($^{+}/_{-}$ SE) from the Canadian autumn (Div. 2J3K) survey.

Canadian spring surveys. Stratified random bottom trawl surveys have been conducted in Div. 3L, 3N and 3O in spring since 1978. Until 1996 an Engel trawl was used, which then changed to a Campelen 1800. The depth range of the surveys goes to 731 metres.

In this survey, a direct comparison of the biomass levels through the whole time series is not possible due to the change in the survey gear in 1995. Figure 18.3 shows the biomass 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. Data from this survey since 2007 were not available for analyses at this meeting. From 1996 to 2004, the biomass level does not present a clear trend. In 2005, the biomass index had a big increase. 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.

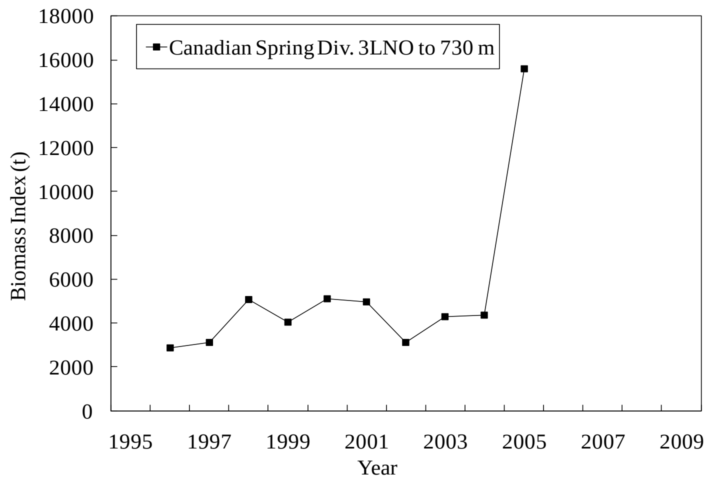


Fig. 18.3 Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

EU (Spain and Portugal) Flemish Cap survey. EU conducts a stratified random bottom trawl survey in Div. 3M from 1988. The survey was manly conducted with the R/V *Cornide de Saavedra* since 1988. The vessel changed in 2003 to the R/V *Vizconde de Eza* and previous data were converted. The survey, originally covering depths to 730 m, was extended to 1400 m depth in 2004. Indices of biomass are presented for the full depth range over 2004 to 2009 and 0-730 m from 1991-2009 (Fig 18.4). The roughhead grenadier age composition from this survey series was presented. The 730 m. biomass indices present a peak 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 in 2006. Since 2007 the indices have been very variable with a general decreased trend, reaching their historical minimum in 2009. The 1400 indices show a clear decreased trend since the beginning of the series.

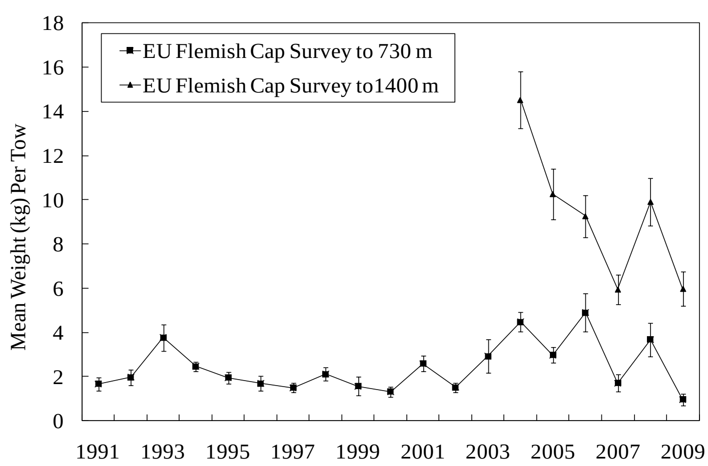


Fig. 18.4. Roughhead grenadier in Subareas 2+3: biomass indices (+/- SE) from the EU Flemish Cap (Div. 3M) survey.

EU-Spain Div. 3NO survey. EU-Spain conducts a stratified random spring bottom trawl survey in the NAFO Regulatory Area Div. 3NO since 1995, which goes to 1 464 m of depth since 1997. 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 available. 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 the period 2004-2006 reached the maximum level. In 2007 decreased to the 2003 level. In 2008 and 2009 the indices showed a slight increase (Fig. 18.5).

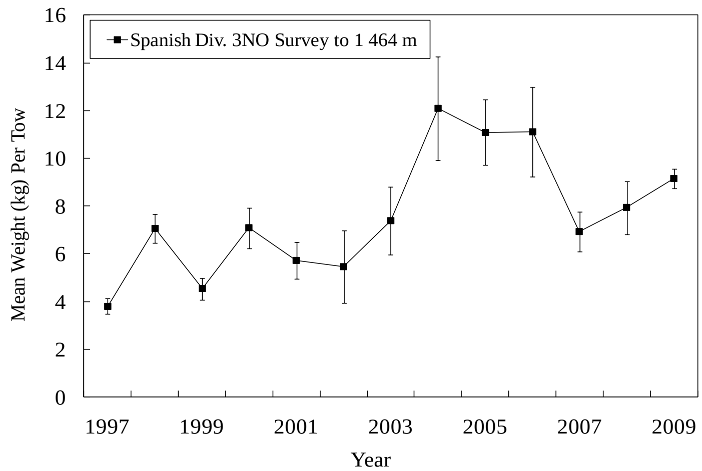


Fig. 18.5. Roughhead grenadier in Subareas 2+3: biomass indices (+/- SE) from the Spanish Div. 3NO survey.

Summary of research surveys data trends. There is not available a survey indices covering the total distribution, in depth and area, of this stock. The Canadian autumn survey series (Div. 2J+3K) and the Spanish Div. 3NO are considered the best survey indicators of stock biomass as they are the longest series extending 1500 meters. Both indices shows a general increase trend since the beginning of the series but the increase of Spanish Div. 3NO indices in the most recent period is less accentuated than the Canadian autumn survey (Fig. 18.6).

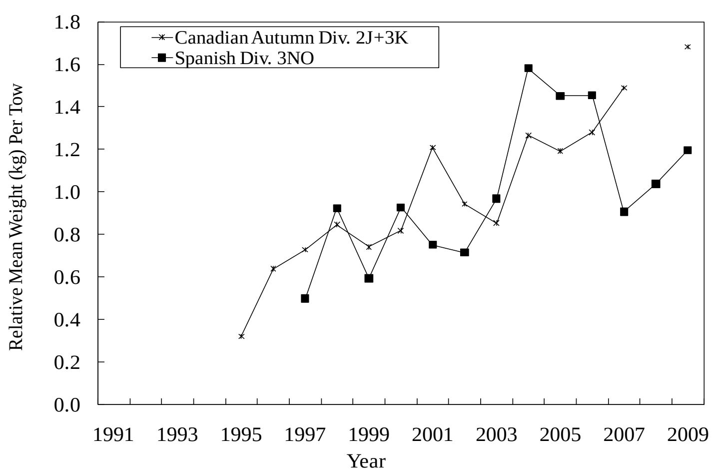


Fig. 18.6. Roughhead grenadier in Subareas 2+3: relative biomass indices from Canadian autumn survey and Spanish Div. 3NO survey. Each series is scaled to their mean.

iii) Recruitment

Figure 18.7 presents the abundance series (Mean Number Per Tow) for age 3 of the EU Flemish Cap survey and the Spanish Div. 3NO survey from 1994 to 2009. A strong 2001 year class can be clearly seen in 2004 in both series, although at older ages this year class appears weaker.

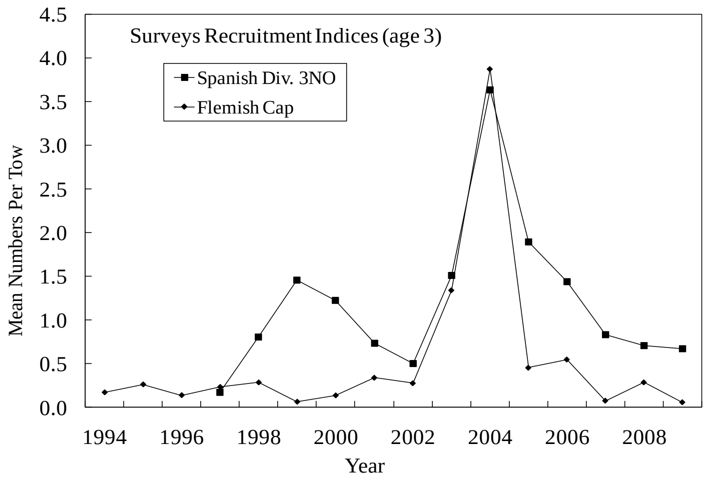


Fig. 18.7. Roughhead grenadier in Subareas 2+3: Spanish Div. 3NO survey and EU Flemish Cap survey abundance (Mean Numbers Per Tow) at ages 3.

iv) Biological studies

Age and length structure information in Div. 3M based on results from the EU Flemish Cap survey series was provides. Age and length compositions of the catches show clear differences between sexes. The proportion of males in the catches decreases progressively as length or age increases.

c) Assessment Results

Three different assessments were presented: Extended Survivors Analysis (XSA), a Stock-Production Model Incorporating Covariates (ASPIC) and a qualitative assessment based on survey and fishery information. XSA and ASPIC results were not accepted due to the low fishing mortality estimated compared with the natural mortality level assumed in the case of the XSA and due to the lack of contrast in the data used in the ASPIC case. Although all these problem both models results present a very similar trend in the fishing mortality and biomass values and are comparable to the qualitative assessment base on the Canadian fall survey series (Div. 2J+3K) and the Spanish survey in Divisions 3NO that was considered as the best information to assess the stock status.

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 in resource status because their depth coverage is going down to 1 500 meters. According with these surveys information the roughhead grenadier total biomass presents a general increased trend in the analysed period and remains at the high level observed in the last years.

Fishing Mortality: The catch / biomass (C/B) indices obtained using the Canadian autumn survey and the Spanish Div. 3NO survey biomass index show a clear decreasing trend from 1995 to 2009, due to an increasing trend in the survey biomass and a decrease in catches (Fig. 18.8). In last year this ratio was at the lowest level of the time series with values of 0.03 for the Canadian autumn survey and 0.08 for the Spanish Div. 3NO survey. This low level is due to the fact that all surveys indices were at high biomass level and catches were at their minimum level.

The Z estimate from the catch curve based upon commercial catch at age data (1992-2009) was 0.356 for ages 8 to 20 (R2=0.99) and 0.169 for ages 6 to 13 (R2=68). The value estimate from the catch curve of the EU Flemish Cap survey (1994-2009) was 0.456 and 0.412 for the catch curve of the EU Spanish 3NO survey data (1997-2009) for ages 8 to 20 and 0.202 and 0.242 for ages 6 to 13. The differences between the Z values estimated based upon catches, Spanish 3NO survey and the Flemish Cap survey can be explained due to different depth coverage of sampling. The level of *Z* is similar to the level calculated with the same method in the last assessments.

Recruitment: The strong 2001 year class can be tracked in 2003 and 2004 at ages 2 and 3 but was weaker than expected since 2005 in the Spanish 3NO and in the EU Flemish Cap surveys. The level of recruitment in recent years appears to be broadly similar to years other than 2004.

State of the Stock: Although the strong 2001 year class seems to be weaker than expected at older ages, the recent surveys biomass estimates still remain at high level.

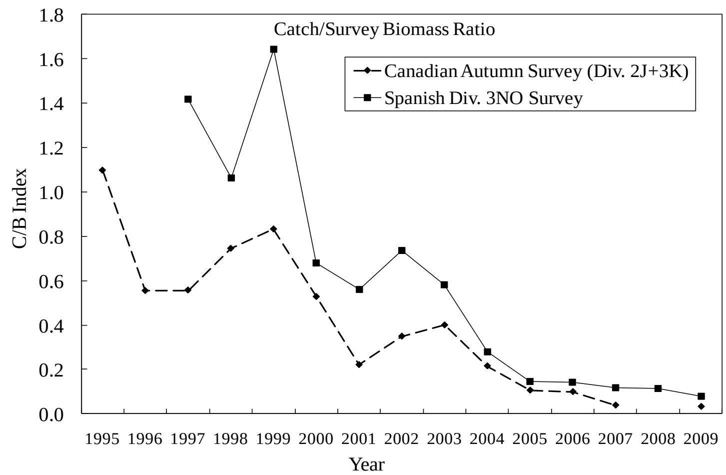


Fig. 18.8. Roughhead grenadier in Subareas 2+3: catch/biomass index based upon Canadian autumn survey and Spanish Div. 3NO survey.

d) Reference Points

STACFIS is not in a position to provide reference points at this time.

e) Recommendations

STACFIS recommended in 2009 to explore the use of production models in this stock. A non-equilibrium surplus production model incorporating covariates (ASPIC) was applied to nominal catch for roughhead grenadier in NAFO Subarea 2 and 3 from 1992-2009 and survey biomass indices. Several runs were carried out to investigate the sensitivity of the model to various input specifications. All of the tried runs show a poor fit of the model due to the lack of contrast in the data used.

STACFIS **recommended** that *further investigation on recruitment indices for roughhead grenadier in Subareas 2 and 3 will be carried out.*

Next full assessment will be in 2013.

19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL

(SCR Doc. 10/15, 10/27; SCS Doc. 10/5, 6, 7)

a) Fishery and Catches

The fishery for witch flounder in this area began in the early 1960s and increased steadily from about 1 000 t in 1963 to a peak of over 24 000 t in 1973 (Fig. 19.1). Catches declined rapidly to 2 800 t by 1980 and subsequently fluctuated between 3 000 and 4 500 t to 1991. The catch in 1992 declined to about 2 700 t, the lowest since 1964; and further declined to around 400 t by 1993. Until the late 1980s, the fishery was conducted by Poland, USSR and Canada mainly in Div. 3K. Since then, the regulated fishery had been mainly Canadian although EU (Portugal and Spain) has taken increased catches in the Regulatory Area of Div. 3L since the mid-1980s. Although a moratorium on directed fishing was implemented in 1995, the catches in 1995 and 1996 were estimated to be about 780 and 1 370 t, respectively. However, it is believed that these catches could be overestimated by 15-20% because of misreported Greenland halibut.

The catches during 1995-2004 ranged between 300 and 1 400 t including unreported catches. The 2005 catch declined to 155 t and the 2006 catch was only 84 t. Since 2005, catch averaged less than 100 t and in 2009 was 57 t.

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.6	0.5	0.5	0.3	0.2	0.1	0.1	0.1[1]	0.1[1]	
STACFIS	0.8	0.4	0.7	0.8	0.2	0.1	0.1	0.1	0.1	

[1] Provisional.
ndf no directed fishing.

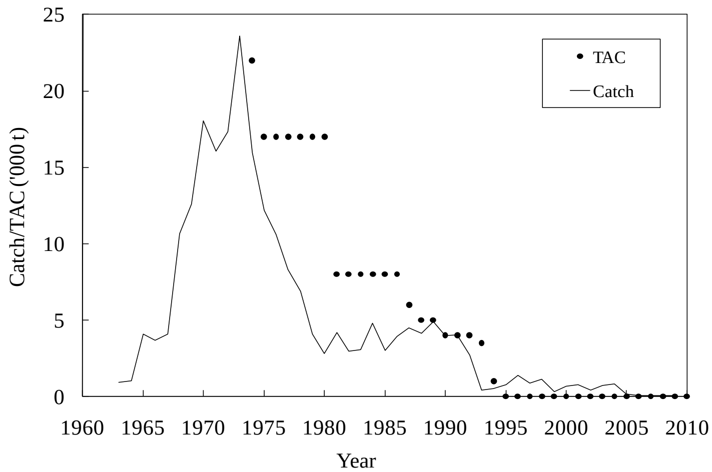


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC. No directed fishing is plotted as 0 TAC.

b) Data

Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian autumn surveys during 1977-2009. Data from the EU-Spain survey in Div. 3L from 2006-2009 were available, but the time series was considered too short to be informative for this assessment. Age based data have not been available since 1993 and none are anticipated in the near future.

i) Research survey data

Canadian stratified-random autumn surveys. Research vessel surveys have been conducted in autumn by Canada since 1978 in Div. 2J and 3K and since 1984 in Div. 3L. For Div. 2J, mean weights (kg) per tow ranged from as high as 1.82 kg in 1986 to a low of 0.05 kg in 2003. Since then values have increased each year to 0.59 kg in 2008, then declined slightly in 2009 (Fig. 19.2). In Div. 3K, during 1979-85, there was a period of relative stability where most survey sets averaged 7-13 kg. Estimates then declined considerably to less than 0.09 kg per tow in 1995. Values remained low from 1996 to 2003, ranging from 0.09 to 0.28 kg per tow. In 2004, the estimate increased slightly to 0.52 kg per tow and there has been a general increasing trend since then. The 2009 mean weight per tow was 1.19 kg. For Div. 3L, mean weights per tow varied generally between 2.5 and 1.31 kg from 1984 to 1990 but declined rapidly to a low of 0.08 kg in 1995. Estimates have varied at levels less than about 0.5 kg per tow since then.

In 1996, research vessel survey coverage was expanded to include more of the stock area, and biomass estimates prior to that are likely underestimated. Survey coverage in Div. 3L was incomplete in 2004 and 2005, and in 2008 there were substantial survey coverage deficiencies in 2J, 3K and 3L (SCR 09/012). Results in these years may, therefore, not be comparable to other years.

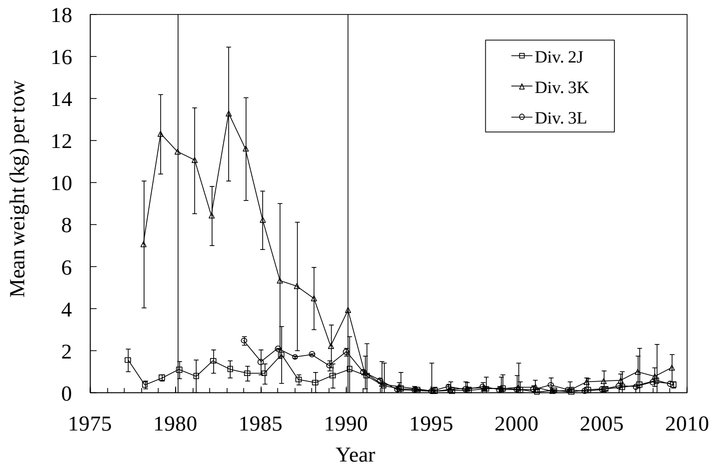


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow from Canadian autumn surveys.

Stock 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).

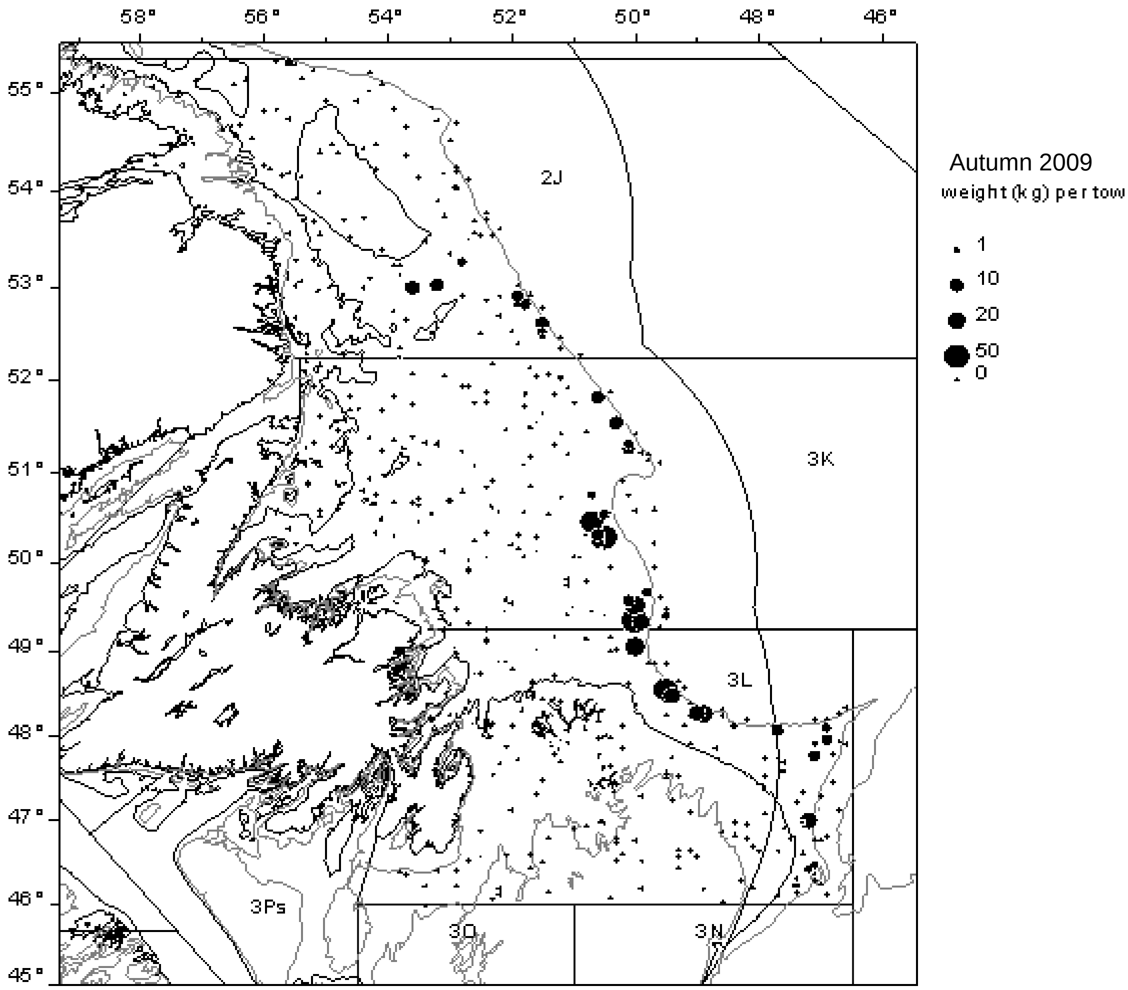


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per set from the Canadian survey during autumn 2009.

c) Assessment Results

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. However, a slightly increasing trend in the total stock survey biomass index has been observed since 2003.

Recruitment: Population numbers of juvenile witch flounder (<23 cm) from Canadian autumn surveys from 1996-2009 are given in Fig. 19.4. The 2000-2002 surveys had higher than average (1996-2009) numbers of small fish, suggesting stronger than average recruitment. Since then, the juvenile abundance index has been variable but has been higher than the average in 2005, 2007 and 2009.

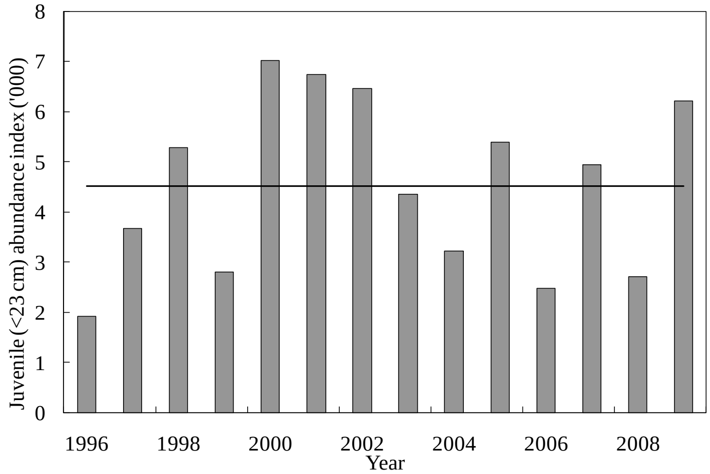


Fig. 19.4. Index of juvenile (<23 cm) abundance in Div. 2J, 3K, and 3L witch flounder from Canadian autumn surveys 1996-2009.

d) State of the Stock

Recruitment was above the 1996-2009 average from 2000-2002. There has been an increase in the survey biomass index since 2003. Nevertheless, the overall stock remains at a very low level.

e) Reference Points

In a previous assessment for this stock, a proxy for B_{lim} was calculated as 15% of the highest observed survey biomass estimate because no analytical assessment was available (B_{lim} = 9 800 t). Since this estimate is in the early part of the time series when the survey did not cover the entire stock area, B_{lim} was likely underestimated using this method. An analysis of the amount of biomass in index strata (those strata covered in 1984, the highest biomass estimate in the series) suggested that the survey biomass estimates in the early part of the time series may have been underestimated by about 48% -the average of the biomass outside of the index strata in 1996-2009. The estimates of total survey biomass from 1996-2009 show a strong positive correlation with the biomass estimates in the index strata (Fig. 19.5). The proxy for B_{lim}, adjusted for less extensive coverage in the survey, is calculated to be 14 500 t (B_{lim}=15% of B_{1984}*1.48). In 2009, the biomass index remains below this reference point (Fig. 19.6 and 19.7).

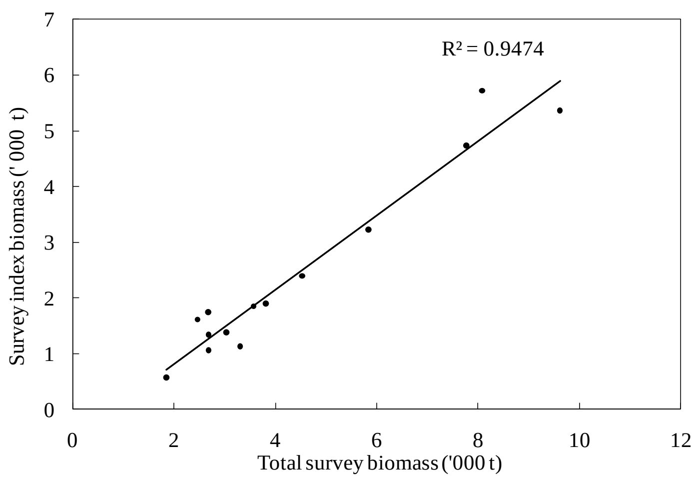


Fig. 19.5. Correlation of the total survey biomass index ('000 t) and biomass in index strata ('000 t) for witch flounder in Div. 2J+3KL from Canadian autumn surveys.

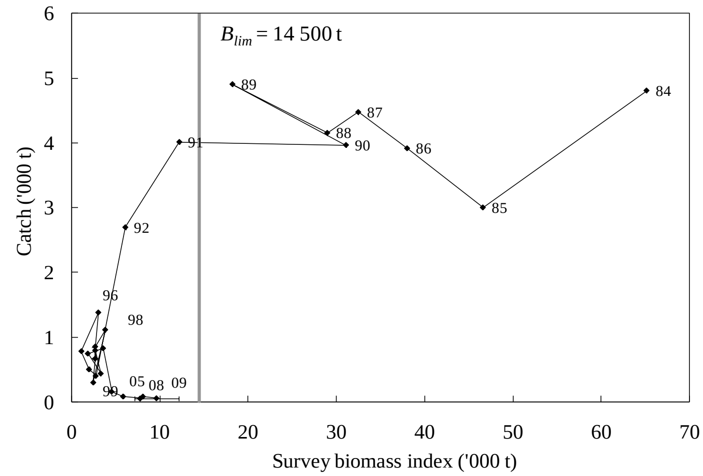


Fig. 19.6. Witch flounder in Div. 2J+3KL: Catch ('000 t) and survey biomass index ('000 t) from Canadian autumn surveys.

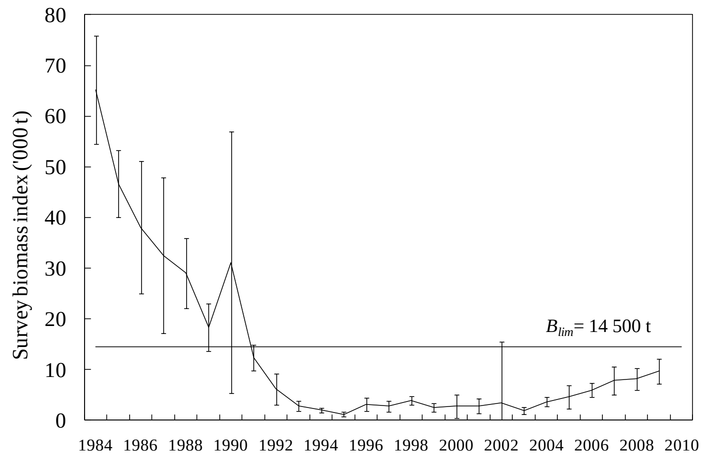


Fig. 19.7. Witch flounder in Div. 2J+3KL: Biomass index ('000 t) from Canadian autumn surveys.

The next full assessment of this stock will be in 2013.

20. Greenland Halibut (*Reinhardtius hippoglossoides*) in SA 2 + Div. 3KLMNO

(SCR Doc. 09/12, 22; 10/8, 21, 23, 35, 40, 44; SCS Doc. 10/5, 6, 7, 10; FC Doc 03/13)

a) Introduction

Fishery and Catches: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by Fisheries Commission. Catches increased sharply in 1990 due to a developing fishery in the NAFO Regulatory Area in Div. 3LMNO and continued at high levels during 1991-94. The catch was only 15 000 to 20 000 t per year in 1995 to 1998 as a result of lower TACs under management measures introduced by the Fisheries Commission. The catch increased since 1998 and by 2001 was estimated to be 38 000 t, the highest since 1994. The estimated catch for 2002 was 34 000 t. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 t to 38 500 t. In 2003, a fifteen year rebuilding plan was implemented by Fisheries Commission for this stock (FC Doc. 03/13). The STACFIS estimate of catch for 2009 is 23 160 t. Since the inception of the FC rebuilding plan, estimated catches for 2004 – 2009 have exceeded the TACs considerably, with the catch over-run ranging from 22%-45%.

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	40	40	36	16	nr*	nr*	nr*	nr*	<10.5*,3	<8.8*,3
TAC	40	44	42	20	19	18.5	16	16	16	16
STATLANT 21A	34	31	31	17	18	18	15[1]	15[1]	15[1]	
STACFIS	38	34	32-38[2]	25	23	24	21	21	23	

nr – no recommendation
* evaluation of rebuilding plan
[1] Provisional
[2] In 2003, STACFIS could not precisely estimate the catch
[3] Scientific Council recommended that "fishing mortality should be reduced to a level not higher than $F_{0.1}$". Tabulated values correspond to the $F_{0.1}$ catch levels.

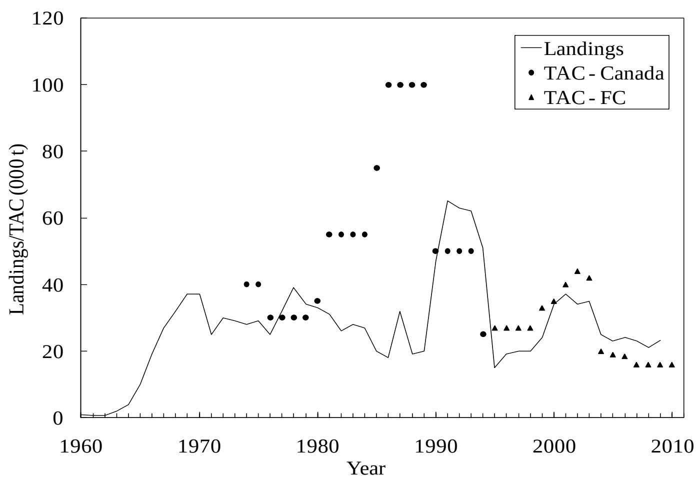


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) Input Data

Standardized estimates of CPUE were available from fisheries conducted by Canada, EU- Spain and EU-Portugal, and unstandardized CPUE was available from Russia. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2+3KLMNO (1978-2009), EU in Div. 3M (1988-2009) and EU-Spain in Div. 3NO (1995-2009). Commercial catch-at-age data were available from 1975-2009.

i) Commercial fishery data

Catch and effort. Analyses of otter trawl catch rates from Canadian vessels operating inside of the Canadian 200 mile limit indicated a general decline from the mid-1980s to the mid-1990s. The 2007 – 2009 estimates of standardized CPUE for Canadian otter-trawlers indicate a sizeable increase compared to previous years, and the 2008 and 2009 values exceed all others in the time-series. At present, most of the Canadian landings come from Divs. 2J3K (SCR Doc. 10/35).

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN over 1988-2009 (SCS Doc. 10/07) declined sharply in 1991 from initial levels. Consistent increases were estimated over the mid-1990's until 2000. The standardized CPUE has increased substantially since 2004, and the 2009 estimate is the largest in the time-series. In recent years, most of the EU-Portugal catches have been in Divs. 3LM.

Spatial analysis of catch and effort trends of the Spanish fleet (SCR Doc. 09/22) 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 within Div. 3LM. The standardized CPUE for the Spanish fleet has also increased considerably after 2005.

Unstandardized catch rates from the Russian fleet over 1998-2009 (SCS Doc. 10/05) indicate similar patterns as in the other fleets.

A comparison of the available standardized CPUE estimates from the Canadian, Spanish and Portuguese fleets indicates consistency in the timing and relative magnitude of the increases described above (Fig 20.2).

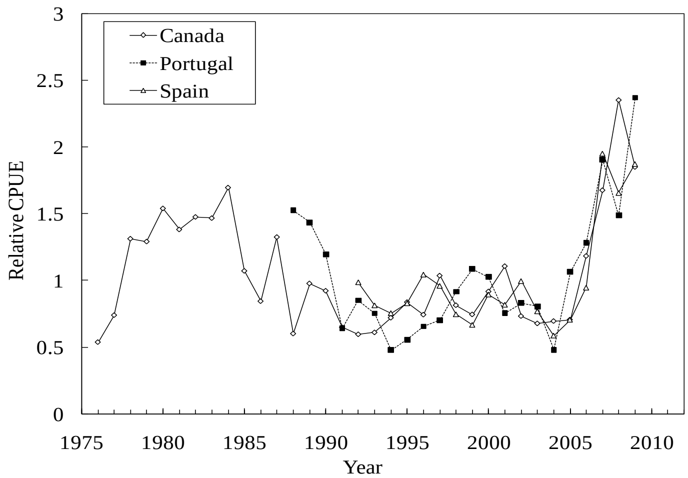


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, EU-Portugal and EU-Spain trawlers. (Each standardized CPUE series is scaled to its 1992-2009 average.)

STACFIS previously recognized that trends in commercial catch per unit effort for Greenland Halibut in Subarea 2 and Divisions 3KLMNO should not be used as indices of the trends in the stock (*NAFO Sci. Coun. Rep.*, 2004, p. 149). It is possible that by concentration of effort and/or concentration of Greenland Halibut, commercial catch rates may remain stable or even increase as the stock declines.

Catch-at-age and mean weights-at-age. The catch-at-age data for Canadian fisheries in 2009 were presented. Length samples for the 2009 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 the total 2009 catch-at-age, consistent with 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 about 9% to the total annual landings, less than half of the long-term average. Mean weights-at-age exhibit variable patterns in the earliest period likely due to poor sampling. Mean weights-at-age for age groups 5-7 during the recent period have increased slightly. For older fish (ages 8+) they were variable but generally indicate a declining trend over the past decade.

ii) Research survey data

STACFIS reiterated that most research vessel survey series providing information on the abundance of Greenland halibut are deficient in various ways and to varying degrees. Variation in divisional and depth coverage creates problems in comparing results of different years (SCR 09/12). 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, and are described below.

Canadian stratified-random autumn surveys in Div. 2J and 3KLMNO. The Canadian autumn survey index provides the longest time-series of abundance and biomass indices (Fig. 20.3; mean weight (kg) and numbers per tow) for this resource. Biomass declined from relatively high estimates of the early 1980s to reach an all-time low in 1992. The index increased substantially due to the abundant 1993-1995 year-classes, but this increase was not sustained, and the index decreased by almost 60% from 1999-2002. The index continually increased over the next five years. Mean numbers per tow were stable through the 1980s, but increased substantially in the mid-1990s, again due to the presence of the 1993-1995 year-classes. After this, abundance declined to the late 1990s and had been relatively stable except for the decline in 2005. The age-composition of the 2005-2007 surveys have shown relatively few recruits and unexpectedly high numbers of older individuals of cohorts which were estimated to be below average from survey information at younger ages. The 2008 survey was not fully completed as many deep water areas important to Greenland Halibut indices were not surveyed, and estimates are not directly comparable with previous years. The 2009 biomass index has declined by approximately 30% from the 2007 level (SCR Doc. 10/21). The 2009 abundance index is comparable to recent values but is heavily influenced by age 1 fish, captured over much of Div. 2J3K.

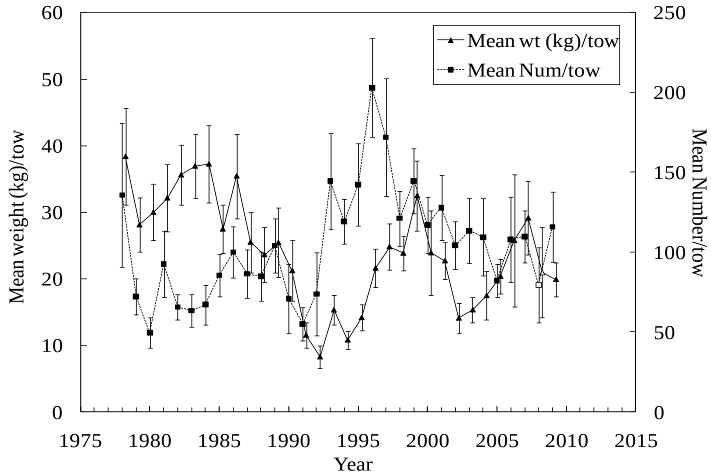


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

Fig. 20.4 characterizes a significant increase in fish that are 30-70 cm which was not preceded by any evidence of recruitment in the <30 cm length class. The 2007 biomass per tow result for the 30-70 cm grouping is more than 2.5 times the 2002-2004 average. In 2009, the biomass index in this size group declined considerably (40%) compared to the 2007 level. The increases since 2002 are consistent with indications of improvement in the commercial CPUE (since 2004) from various fleets throughout the stock area.

During the late 1970s and early 1980s large Greenland halibut (greater than 70 cm) contributed almost 20% to the estimated biomass (Fig. 20.4). However, after 1984 this size category declined and by 1988 virtually no Greenland halibut in this size range contributed to the index. Since then, the contribution to the index from this size group has been extremely low, often zero.

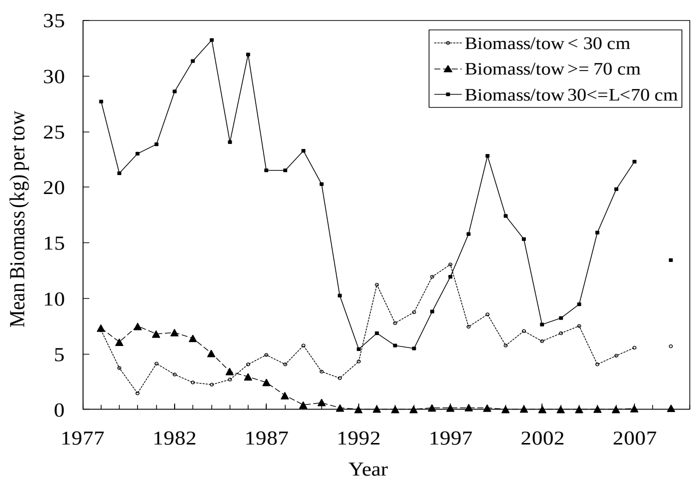


Fig. 20.4 Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass indices (mean weight (kg) per tow) by size class from Canadian autumn surveys in Div. 2J and 3K.

The Canadian autumn survey in Div. 3L has generally shown trends that are consistent with those from Div. 2J+3K. Autumn surveys within Div. 3NO have erratic deep-water coverage. Canadian autumn surveys in Div. 3M indicated a general decline over 1998 to 2003, and the only two surveys completed since then (2006 and 2007) remain relatively low.

STACFIS previously noted (NAFO *Sci. Coun. Rep*. 1993, p. 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 might have been more a reflection of Greenland halibut emigrating from the survey area to the deep waters of the Flemish Pass as opposed to a severe decline in the stock. However, since the mid-1990s, survey indices in the Regulatory Area and in Div. 2J and 3K has generally shown similar trends suggesting that emigration does not currently appear be an influential 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 VPA based assessments.

Canadian stratified-random spring surveys in Div. 3LNO. Abundance and biomass indices from the Canadian spring surveys in Div. 3LNO (Fig. 20.5) during 2007 and 2008 were slightly higher than values over 2002-2005, although these estimates were relatively imprecise. Both the abundance and biomass values of 2009 were very low.

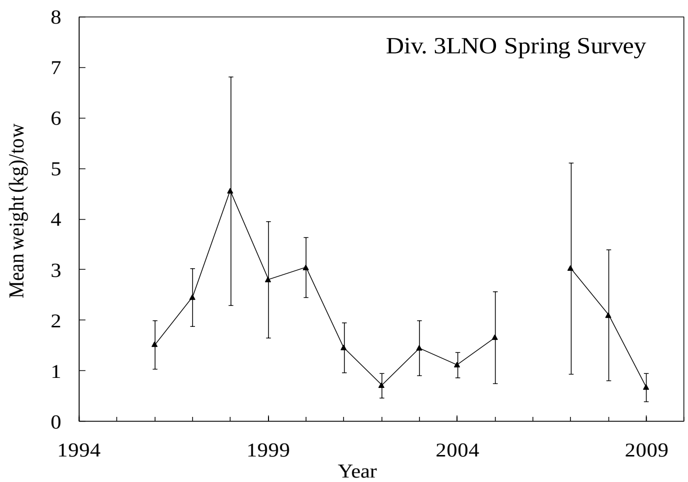


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M (Flemish Cap). Surveys conducted by the EU in Div. 3M during summer (SCR 10/23) indicate that the Greenland halibut biomass index (mean weight (kg) per tow) in depths to 730 m, increased in the 1988 to 1998 period (Fig. 20.6) to a maximum value in 1998. This biomass index declined consistently over 1998-2002. The 2002 – 2008 results were relatively stable, with the exception of an anomalously low value in 2003. In 2009, this index declined by 35%. The Flemish Cap survey has covered depths to 1460 m from 2004-2009. Biomass estimates over all depths covered (i.e. to 1460 m) doubled over 2005-2008 and remained high in 2009. The earlier portion of the 0-730m time series was adjusted to account for a change in both survey vessel and gear in 2003.

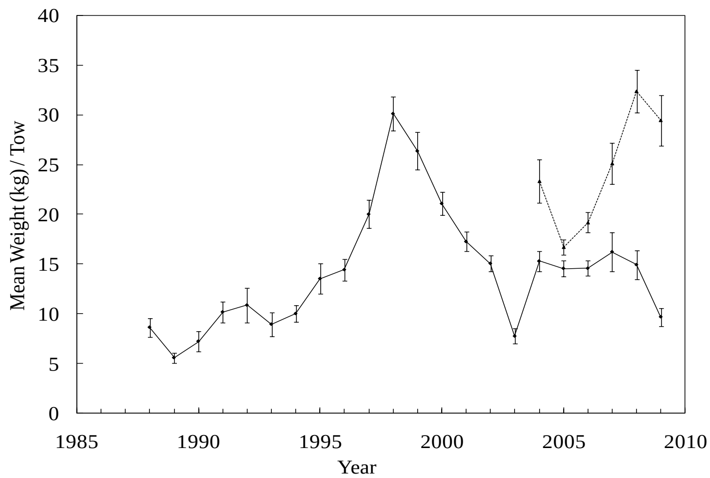


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (mean catch per tow ± 1 S.E.) from EU summer surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

EU-Spain stratified-random surveys in NAFO Regulatory Area of Div. 3NO. The biomass index (mean weight (kg) per tow; converted to Campelen trawl equivalents) for this survey of the NRA (SCR 10/08) increased from 1997 to 1998, but there was a general decline over 1999 to 2006 (Fig. 20.7). Over 2007-2009, the biomass index has increased four-fold.

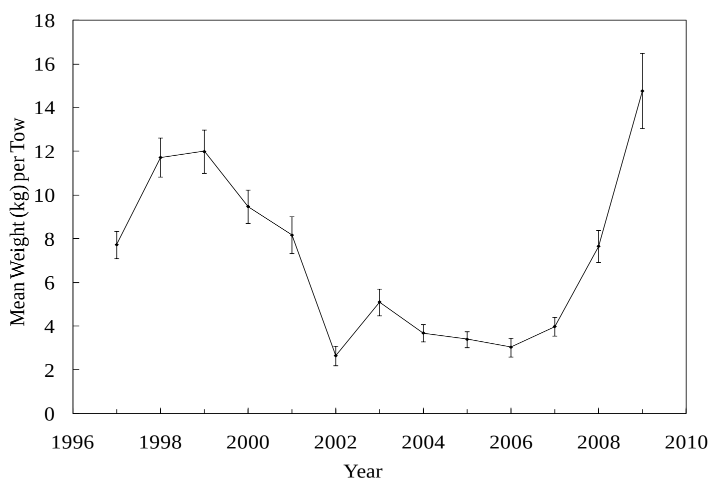


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in Div. 3NO.

Summary of research survey data trends. 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. Over 1995-2003, indices from the majority of the surveys generally provided a consistent signal in stock biomass (Fig. 20.8). The trend since 2004 through 2009 is less clear, most particularly in the past three years. These discrepancies complicate interpretations of overall resource status.

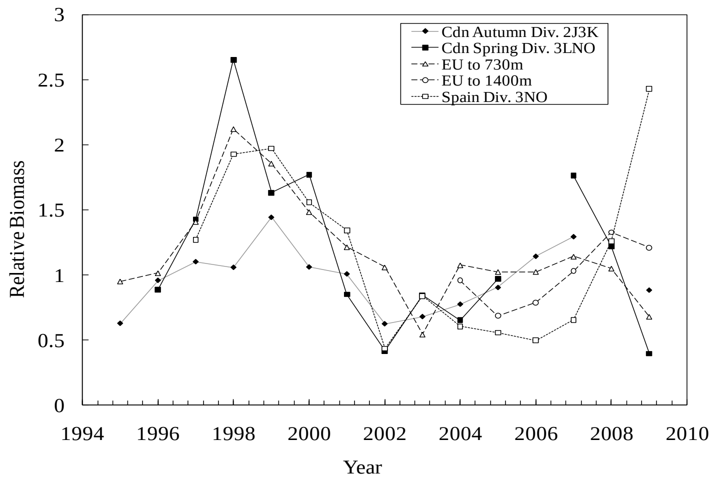


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices over 1996-2009 from Canadian autumn surveys in Div 2J3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and Spanish surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2009 average.

c) Estimation of Parameters

In the previous assessment of this stock, STACFIS concluded that it would not be appropriate to update that analytical assessment as the Canadian Div. 2J3K data for 2008 were not comparable to those from previous years (*NAFO Sci. Coun. Rep.*, 2009, p.189).

The EU-Spain Div. 3NO survey was included in exploratory runs during the 2005 assessment, but was not incorporated into the STACFIS agreed formulation owing to residual patterns over time. It has not been included in the assessment since then. The inclusion of the Spanish data will be re-evaluated in future assessments.

A series of XSA analyses (SCR Doc. 10/40) were conducted to examine sensitivities to the input data and also to re-examine whether XSA parameter settings used were still appropriate. Much of the investigations on data-sensitivity focused on how best to incorporate all available information from the EU Flemish Cap survey, considering that this survey was extended to 1400m depth in 2004. Investigation of the consistency of the abundance at age data for various depth groupings of the EU data (shallow, deep and combined) revealed some differences in trends (at age) amongst these groupings, reflecting the overall differences in trend in the shallow and deep portions of this survey in recent years (see also SCR Doc. 10/23).

Recent assessments have included the following age disaggregated data series in the XSA calibration data set: (i) Canadian Autumn Div. 2J3K, (ii) Canadian Spring Div. 3LNO, and (iii) EU Summer Div. 3M (0-700m) data. The potential inclusion of the EU survey data from deep water was considered in two different ways. First, a time series of MNPT for depths 700-1400m (only) over 2004-2009 was included in the analysis as a new series in addition to (i)-(iii) above. Secondly, the EU survey data was separated into two distinct time-series: the shallower water index (0-700m) from 1995-2003, and data from the entire depth range (0-1400m) over 2004-2009. Following a comparison of the diagnostics from each of these runs, and considering the correlation results, it was felt that it would be most appropriate to split the index into two distinct time-periods in VPA analyses.

Retrospective analyses using this tuning data set revealed a consistent estimate of declining fishing mortality since 2003. This consistency warranted further exploration to potentially reducing the amount of F-shrinkage applied in estimation of fishing mortality in the terminal year. Such investigations were also conducted during the 2008 assessment of this stock, but as a result of increases in the retrospective bias when less shrinkage was applied, the settings at that time remained unchanged. In this assessment, these biases were much reduced, and it was agreed that reducing the strength of the shrinkage would be appropriate. The following XSA settings and data series were included in the final accepted run:

Catch data from 1975 to 2009, ages 1 to 14+				
Tuning Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M, 0-700m)	1995	2003	1	12
EU summer survey (Div. 3M, 0-1400m)	2004	2009	1	13
Canadian autumn survey (Div. 2J3K)	1996	2009	1	13
Canadian spring survey (Div. 3LNO)	1996	2009	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 3 years				
S.E. of the mean to which the estimates are shrunk = 1.0				
Oldest age survivor estimates shrunk towards the mean *F* of ages 10 - 12				
S.E. of the mean to which the estimates are shrunk = 0.5				
Minimum standard error for population estimates from each cohort age = 0.5				
Individual fleet weighting not applied				

d) Other Studies

Preliminary statistical catch-at-age. A preliminary assessment of stock size using a statistical catch at age formulation was presented and compared to the XSA estimates (from an XSA formulation using the same settings as in the 2008 assessment). The model used is available from the NOAA website and is available as an executable as well as original ADMB code (http://nft.nefsc.noaa.gov/ASAP.html). The same data set was used in both models, and included catch and survey updated to 2009 (SCR 10/44). Diagnostics showed a poor fit but improvement could be obtained by fine tuning the input parameters and sensitivity analysis. Residuals from the survey index showed similar pattern of conflicting trends as for the XSA. This was also reflected in the large differences in the observed versus predicted total catch and proportions at age in the mid 1990s to the mid 2000s. Retrospective analysis showed a better stability with no pattern. Results for population estimates were overall similar in terms of trends but magnitudes of inter-annual variations are higher for the statistical catch at age model.

e) Assessment Results

As in recent assessments, the XSA diagnostics reveal serious problems in the model fit. The standard errors of the log-scale survey catchability parameters exceed 0.5 at most survey-ages. Darby and Flatman (1994) note that: “values greater than 0.5 indicate problems with that age for the fleet.” Further, the survey-specific estimates of survivors indicate some inconsistencies. Residual patterns indicate severe model fit issues, including year and cohort effects, as well as evidence of the conflicting signals in some of the survey information. Should these problems continue the reliability of this assessment must be reconsidered. However, noting that the XSA provides a way to derive a signal from sometimes conflicting data, and after much debate, STACFIS accepted this assessment noting that careful attention must continue to be paid to model diagnostics in future assessments.

i) Extended Survivors Analysis (XSA)

Biomass (Fig. 20.9): 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. Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2010, as weaker year-classes have recruited to the biomass. Estimates of 2010 survivors from the XSA are used to compute 2010 biomass assuming the 2010 stock weights are equal to the 2007-2009 average. The 2010 5+ biomass is estimated to be about 102 000 t. The 10+ biomass peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2010.

Fishing Mortality (Fig. 20.10): High catches in 1991-94 resulted in average fishing mortality over ages 5 to 10 (F_{5-10}) exceeding 0.70. F_{5-10} increased over 1995-2003 with increasing catch, but declined after 2003 under the FC rebuilding plan. F_{5-10} in 2009 is estimated to be 0.25. Note that although F_{5-10} decreased from 2008 to 2009, the total fishing mortality over all age groups increased, reflecting a slight change in commercial selectivity.

Recruitment (Fig. 20.11): The current assessment indicates that all recent year-classes are well below average strength. These year-classes will recruit to the exploitable biomass in the next few years.

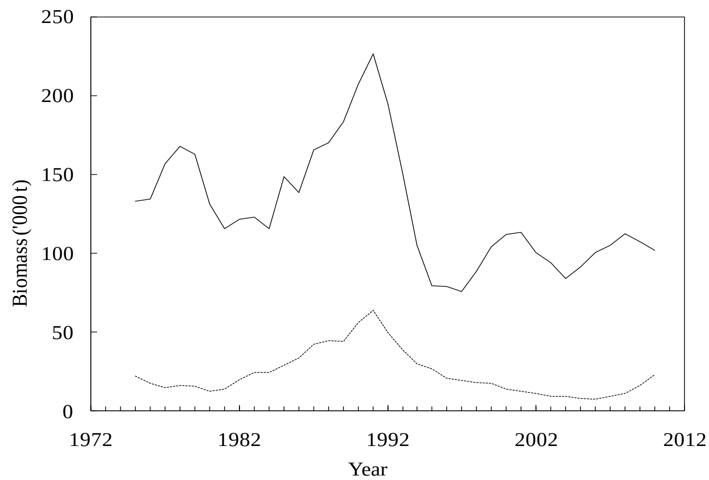


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated exploitable (5+ biomass; solid line) and 10+ biomass (dashed line) from XSA.

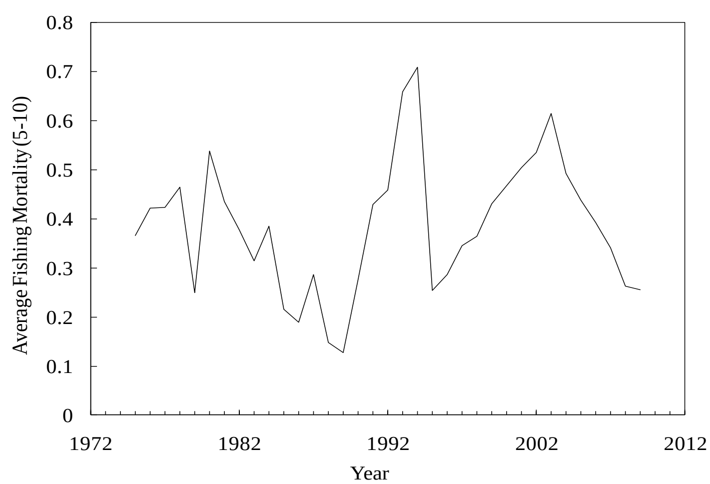


Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: Estimated fishing mortality (averaged over ages 5-10) from XSA.

Fig. 20.11. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA.

STACFIS noted that estimates of exploitable biomass are higher than previously reported estimates over 2004-2008 (Fig. 20.12). This difference primarily arises as a result of the addition of the deep-water information from the EU survey to the analysis as well as a reduction in the amount of *F*-shrinkage applied. (Refer to Section c) for rationale to reduce the effect of shrinkage.)

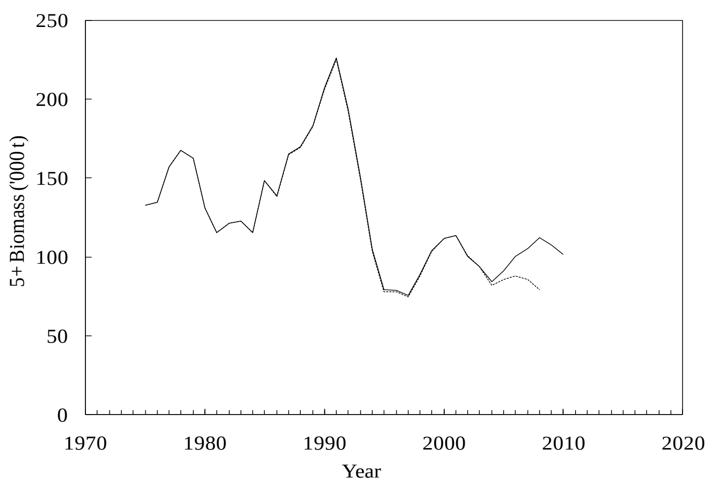


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated ages 5+ biomass (000 t) from the 2008 Scientific Council assessment (dashed line) and from the 2010 Scientific Council assessment.

f) Retrospective Analysis

A three-year retrospective analysis of the XSA was conducted by eliminating successive years of catch and survey data. This timeframe is shorter than the retrospective analyses considered in recent assessments; considering that the EU 0-1400m survery series is available since 2004, three years was considered the maximum number of years which should be removed from the tuning dataset. Fig- 20.13 - 20.15 present the retrospective estimates of 5+ biomass, average fishing mortality at ages 5-10 and age 1 recruitment. Estimates of 5+ biomass and fishing mortality are consistent in the first two years of the retrospective analysis, but there are some large differences if three years of data are removed. Recent recruitment estimates appear to be somewhat unstable, with larger differences if three years of data are removed, particularly for historic cohorts.

Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; 5+ biomass.

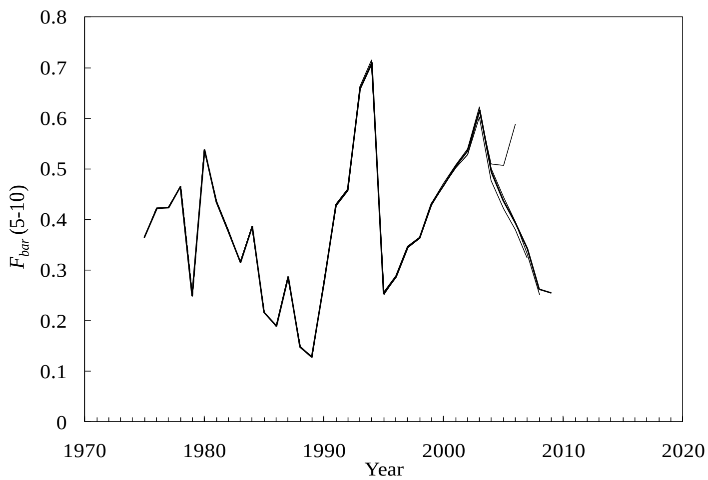


Fig. 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

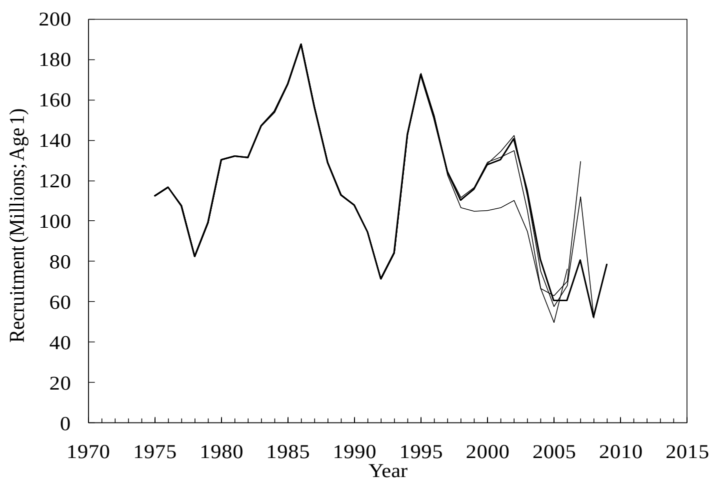


Fig. 20.15. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

State of the Stock: Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2010, as weaker year-classes have recruited to the biomass. The level of recent estimates is higher than reported in previous assessments, as a result of including the new deep-water information from the EU survey, as well as a reduction in the amount of *F*-shrinkage required. The 10+ biomass peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2010. Average fishing mortality (over ages 5-10) has been decreasing since 2003. Recent recruitment has been far below average.

g) Reference Points

i) Precautionary approach reference points

Precautionary approach reference points could not be determined for this stock at this time.

ii) Yield per recruit reference points

F_{Max} is computed to be 0.39 and $F_{0.1}$ is 0.21, assuming weights at age and a partial recruitment equal to the average of each of these quantities over the past 3 years. A plot of these reference levels of fishing mortality in relation to stock trajectory (Fig. 20.16) indicates that the current average fishing mortality (0.255) is near the $F_{0.1}$ level.

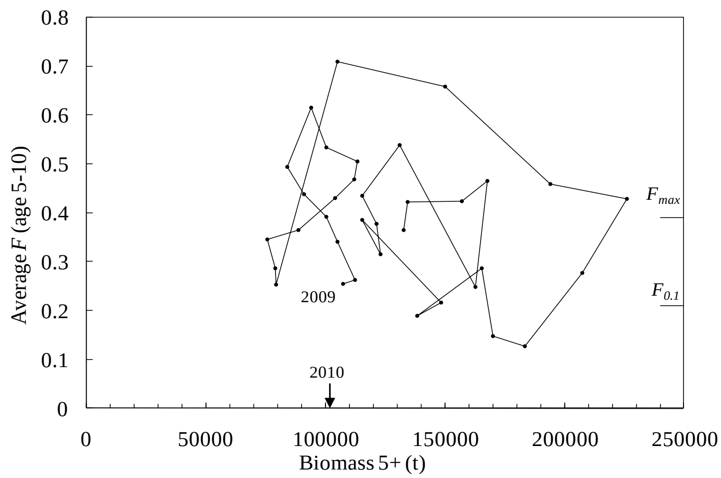


Fig. 20.16 Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory with relation to yield per recruit reference points. The 2010 estimate of biomass (102 000 t) is indicated on the biomass axis.

h) Projections

STACFIS emphasizes that all projections are contingent upon the accuracy of estimates of survivors. Reservations about the quality of the XSA estimates of survivors are expressed above and these reservations extend to projections of future population dynamics. 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 a minimal measure of uncertainty associated with the evolution of the stock under the different harvesting option evaluated.

In order to evaluate the population trends in the near term, stochastic projections from 2010 to 2014 were conducted assuming average exploitation pattern and weights-at-age from 2007 to 2009, and with natural mortality fixed at 0.2. Assuming the catch in 2010 remains at the 2009 level (23 150 t), the following projection scenarios were considered:

- constant fishing mortality at $F_{0.1}$ (0.21)
- constant fishing mortality at F_{2009} (0.26)
- constant landings at 16 000 t, and
- constant landings at 23 150 t.

An additional projection was undertaken assuming that the catches in 2010 will match the TAC of 16 000t and remain constant at this level in 2011-2013.

The projection inputs are summarized in Table 20.1 with the variability in the projection parameters described by the coefficients of variation (column CV in the table). Numbers at age 2 and older at 1st of January 2010 and corresponding CVs are computed from the XSA output. For the stochastic projections, recruitment was bootstrapped from the 1999-2008 age 1 numbers from the XSA. Scaled selection pattern and corresponding CVs are derived from the 2007 to 2009 average from the XSA. Weights at age in the stock and in the catch and corresponding CVs are also computed from the 2007-2009 average input data. Natural mortality was assumed to be 0.2 with a CV of 0.15. The stochastic distributions were generated using the @Risk software. The distribution was assumed lognormal for the numbers at age and normal for the other input data.

Table 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: Inputs for projections.

Name	**Value**	**Uncertainty (CV)**	**Name**	**Value**	**Uncertainty (CV)**
Population at age in		2010	Selection pattern		(2007-2009)
N1	Bootstrap (1999-2008)		sH1	0.000	0.000
N2	64301	0.58	sH2	0.000	0.000
N3	35112	0.32	sH3	0.000	0.000
N4	44308	0.30	sH4	0.006	0.002
N5	27197	0.22	sH5	0.055	0.020
N6	21831	0.17	sH6	0.365	0.119
N7	21215	0.15	sH7	1.497	0.067
N8	17570	0.14	sH8	1.897	0.088
N9	10525	0.13	sH9	1.294	0.054
N10	4281	0.14	sH10	0.893	0.173
N11	2320	0.15	sH11	0.646	0.113
N12	884	0.17	sH12	0.446	0.103
N13	517	0.17	sH13	0.401	0.130
N14	685	0.16	sH14	0.401	0.130
Weight in the catch		(2007-2009)	Weight in the stock		(2007-2009)
WH1	0.000	0.00	WS1	0.000	0.00
WH2	0.000	0.00	WS2	0.000	0.00
WH3	0.000	0.00	WS3	0.000	0.00
WH4	0.278	0.01	WS4	0.000	0.00
WH5	0.394	0.02	WS5	0.394	0.02
WH6	0.599	0.03	WS6	0.599	0.03
WH7	0.862	0.03	WS7	0.862	0.03
WH8	1.163	0.03	WS8	1.163	0.03
WH9	1.572	0.04	WS9	1.572	0.04
WH10	2.028	0.04	WS10	2.028	0.04
WH11	2.653	0.05	WS11	2.653	0.05
WH12	3.141	0.03	WS12	3.141	0.03
WH13	3.844	0.10	WS13	3.844	0.10
WH14	4.702	0.06	WS14	4.702	0.06
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

Projection Results

For each of the scenarios considered, projection results (Table 20.2 and Fig. 20.17 - 20.22) of forecast yield up to 2013, exploitable (ages 5+) biomass, and ages 10+ biomass to 2014 are presented. Note that projected yield under $F_{0.1}$ is close to 16 000 t over 2011-2013. Thus under both the $F_{0.1}$ and 16 000 t constant catch options, total biomass is projected to increase by approximately 10%. In the case for which the 2010 catches are assumed to be 16 000 t in both 2010 and also in the projection period, total biomass is projected to increase by 20% by 2014.

Total biomass remains stable under yields corresponding to F_{2009} fishing mortality, but is projected to decrease by 15% if catches remain at 23 200t through 2013. Fishing at F_{2009} for the period 2011-2013 would correspond to a reduction in catch from 17 500 t in 2011 to about 16 000 t in 2012 and 2013.

Table 20.2. Greenland halibut in Subarea 2 + Div. 3KLMNO: Results of Stochastic projections under various catch levels and fishing mortality options. Labels p5, p50, p95 refer to 5th, 50th and 95th percentiles of each quantity.

Status Quo Catch in 2010; F0.1 over 2011-2013

	5+ Biomass (000 t)					**Yield (000 t)**				**10+ Biomass (000t)**				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	93	86	87	88	93	23.2	12.1	11.8	11.9	20.1	26.9	31.7	34.3	34.6
p50	102	98	100	104	112	23.2	14.5	14.1	14.7	22.7	30.6	37.5	40.6	42.0
p95	113	113	116	128	139	23.2	17.8	16.9	18.2	25.9	35.3	43.7	48.0	49.6

Status Quo Catch in 2010; F_2009 over 2011-2013

	5+ Biomass (000 t)					**Yield (000 t)**				**10+ Biomass (000t)**				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	87	84	83	84	23.2	14.9	14.0	13.5	19.9	26.5	30.5	31.3	30.7
p50	102	98	96	98	103	23.2	17.5	16.3	16.4	22.7	30.6	35.7	36.8	36.4
p95	112	113	111	120	129	23.2	20.7	19.2	20.2	25.7	35.4	42.0	43.4	43.1

Status Quo Catch in 2010; 16,000t over 2011-2013

	5+ Biomass (000 t)					**Yield (000 t)**				**10+ Biomass (000t)**				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	85	81	79	87	23.2	16.0	16.0	16.0	19.9	26.4	30.3	29.6	28.0
p50	101	98	97	100	111	23.2	16.0	16.0	16.0	22.6	30.6	36.4	37.8	37.9
p95	112	111	113	124	140	23.2	16.0	16.0	16.0	25.8	35.3	43.5	47.6	49.3

Status Quo Catch over 2010-2013

	5+ Biomass (000 t)					**Yield (000 t)**				**10+ Biomass (000t)**				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	86	74	63	62	23.2	23.2	23.2	23.2	20.0	26.6	26.5	21.6	15.1
p50	101	98	90	83	86	23.2	23.2	23.2	23.2	22.6	30.5	32.7	28.9	23.5
p95	112	112	106	108	116	23.2	23.2	23.2	23.2	25.7	35.3	40.0	38.3	34.1

16,000t in 2010-2013

	5+ Biomass (000 t)					**Yield (000 t)**				**10+ Biomass (000t)**				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2010	2011	2012	2013	2014
p5	92	95	92	91	97	16.0	16.0	16.0	16.0	20.0	29.2	35.6	37.1	35.8
p50	102	107	107	109	120	16.0	16.0	16.0	16.0	22.7	33.8	42.3	45.6	45.9
p95	112	121	123	133	148	16.0	16.0	16.0	16.0	25.8	38.4	49.4	55.2	57.5

Table 20.3 provides growth rates of the exploitable (ages 5+), ages 10+ biomass, and ages 5-9 biomass relative to 2010, the terminal year of the current assessment. Note there are differences in the rates of increase in each of these columns reflecting changes in the age structure of the population, notably the improved status of the 10+ biomass in 2010 and subsequently through the projection period.

Table 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass growth (%) under various projections. The exploitable (5+) at the end of the projection period (2013) is compared to the biomass at the beginning of the projection (2008; 79 000 t) and the biomass in 2003, when the rebuilding plan was instituted (93 800 t).

Projection Scenario	Biomass Change [B(2014)-B(2010)]/B(2010)		
	Ages 5+	Ages 10+	Ages 5-9
Status Quo Catch in 2010; F0.1 over 2011-2013	10%	85%	-11%
Status Quo Catch in 2010; F_2009 over 2011-2013	1%	60%	-16%
Status Quo Catch in 2010; 16,000t over 2011-2013	10%	67%	-7%
Status Quo Catch over 2010-2013	-15%	4%	-21%
16,000t in 2010-2013	18%	102%	-6%

Table 20.4 presents the ratio of the exploitable (5 +) biomass at the end of the projection period to the target identified in the rebuilding plan. If catches are maintained at the current TAC level, total biomass is projected to be 80% of the 140,000 t, with five years remaining in the recovery plan. The potential of recovery to 140,000 t by 2014 is strongly dependent on future recruitment to the exploitable biomass, and recruitment has been very low in recent years.

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 t.

Projection Scenario	B(2014) / 140Kt
Status Quo Catch in 2010; F0.1 over 2011-2013	0.80
Status Quo Catch in 2010; F_2009 over 2011-2013	0.74
Status Quo Catch in 2010; 16,000t over 2011-2013	0.79
Status Quo Catch over 2010-2013	0.61
16,000t in 2010-2013	0.86

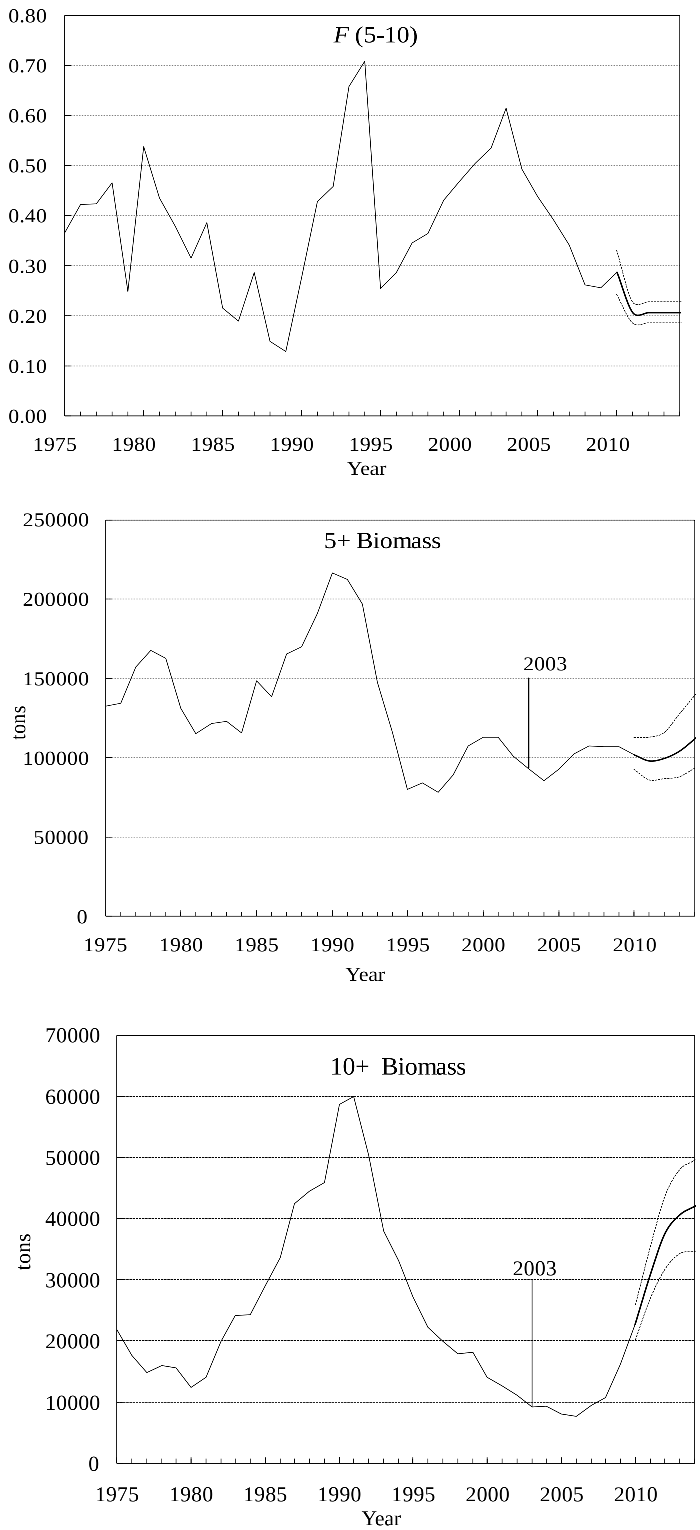


Fig. 20.17. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2010-2014 assuming status quo catch in 2010 and 2011-2013 catches correspond to the $F_{0.1}$ level. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 50th (thick line), and 95th percentiles are shown.

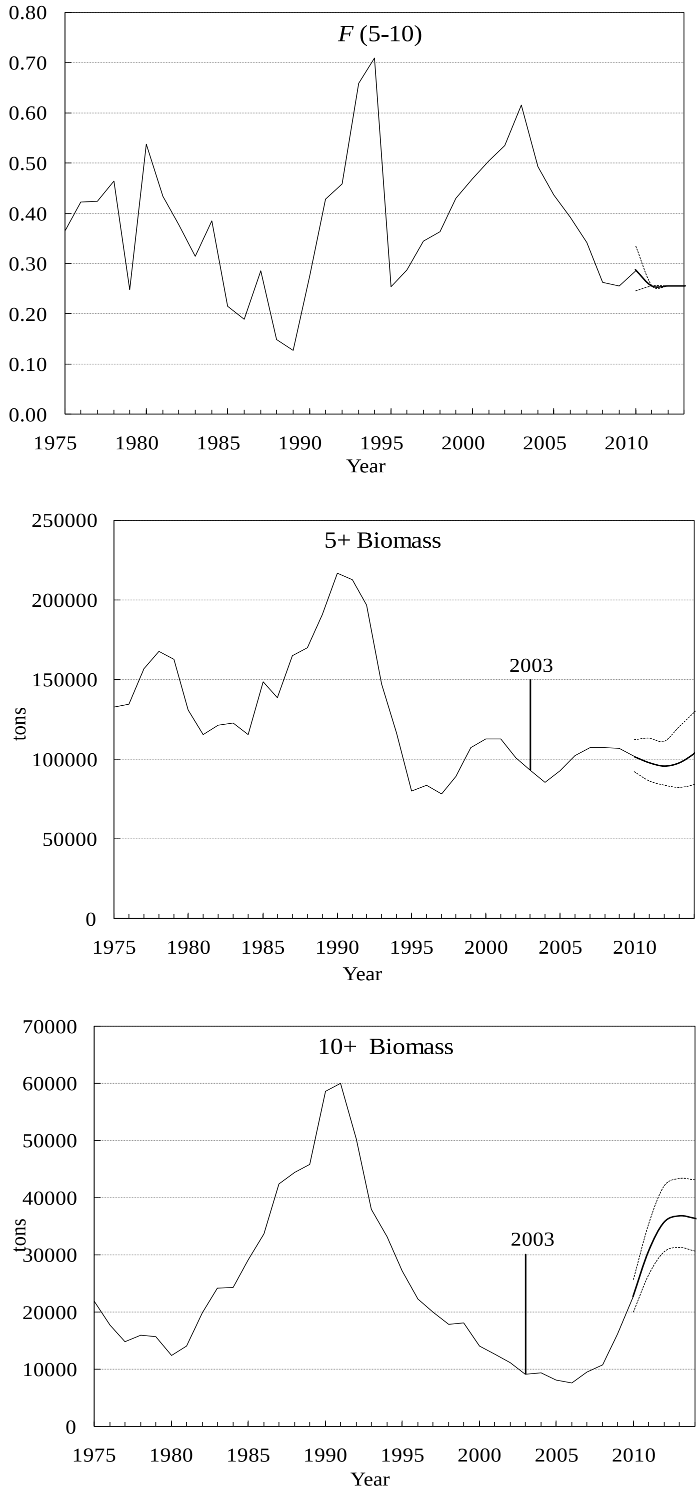
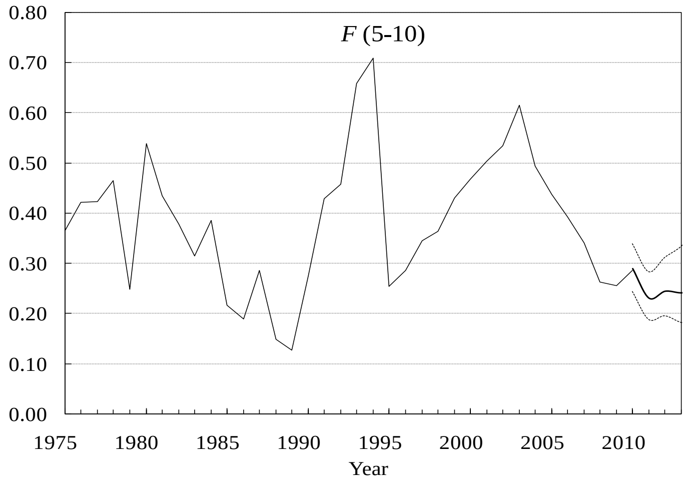
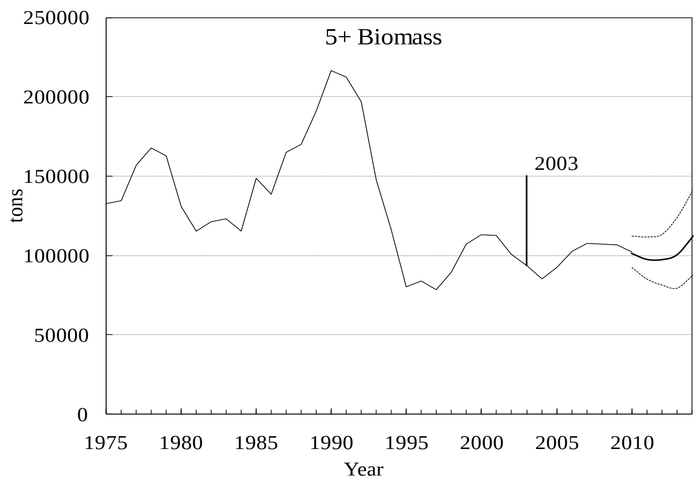


Fig. 20.18. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2010-2014 assuming status quo catch in 2010 and 2011-2013 catches correspond to the F2009 level. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 50th (thick line), and 95th percentiles are shown.





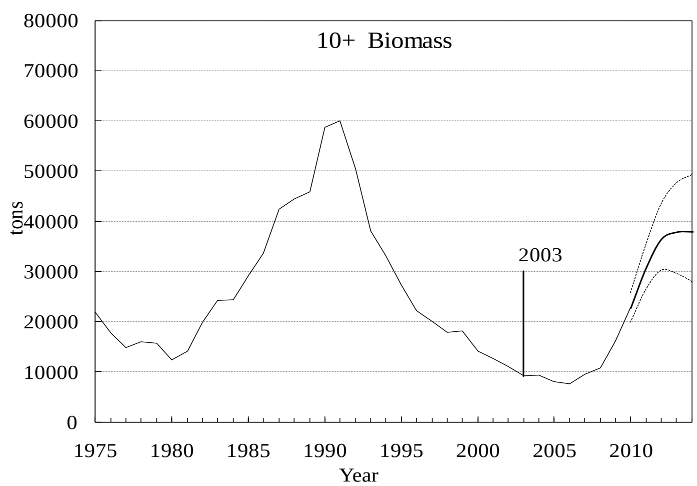


Fig. 20.19. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2010-2014 assuming status quo catch in 2010 and 2011-2013 catches equal 16 000 t. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5^{th}, 50^{th} (thick line), and 95^{th} percentiles are shown.

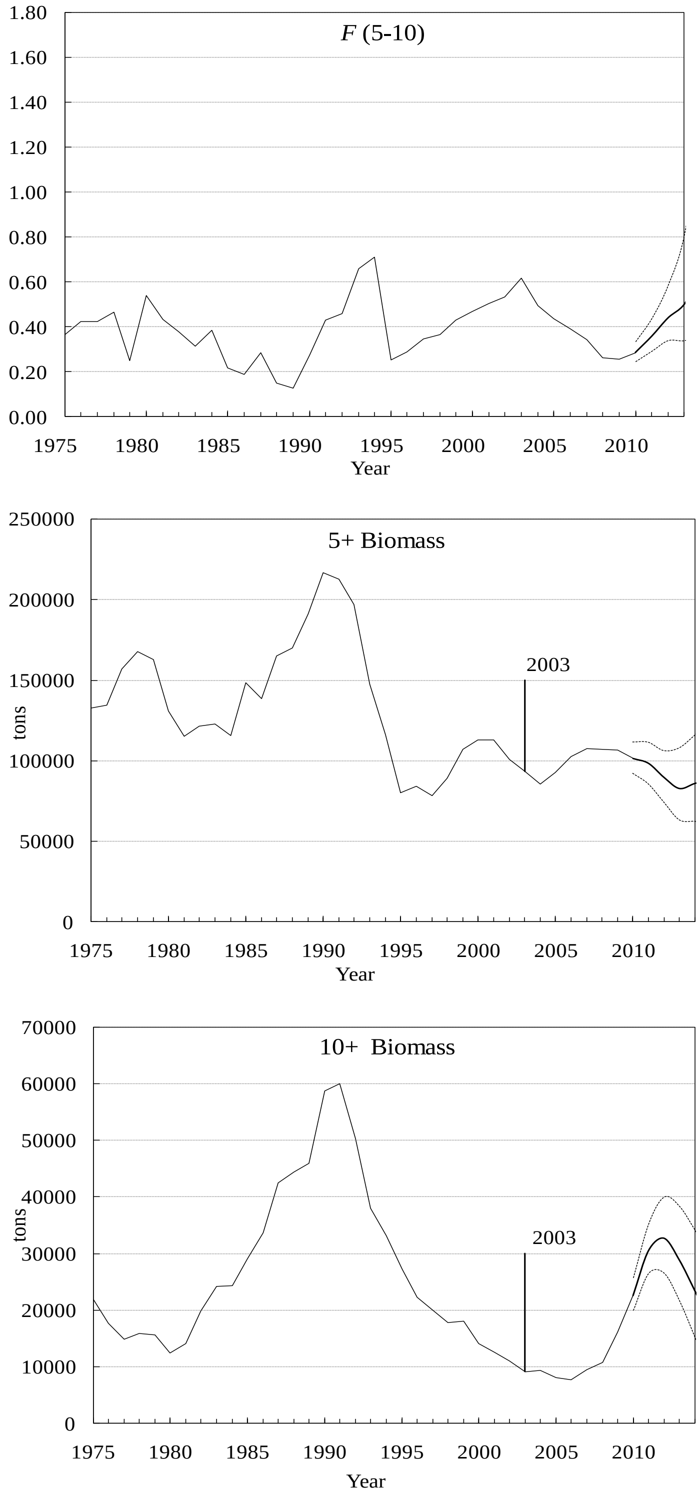


Fig. 20.20. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2010-2014 under constant removals of 23, 150 t. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 25th, 50th (thick line), 75th, and 95th percentiles are shown.

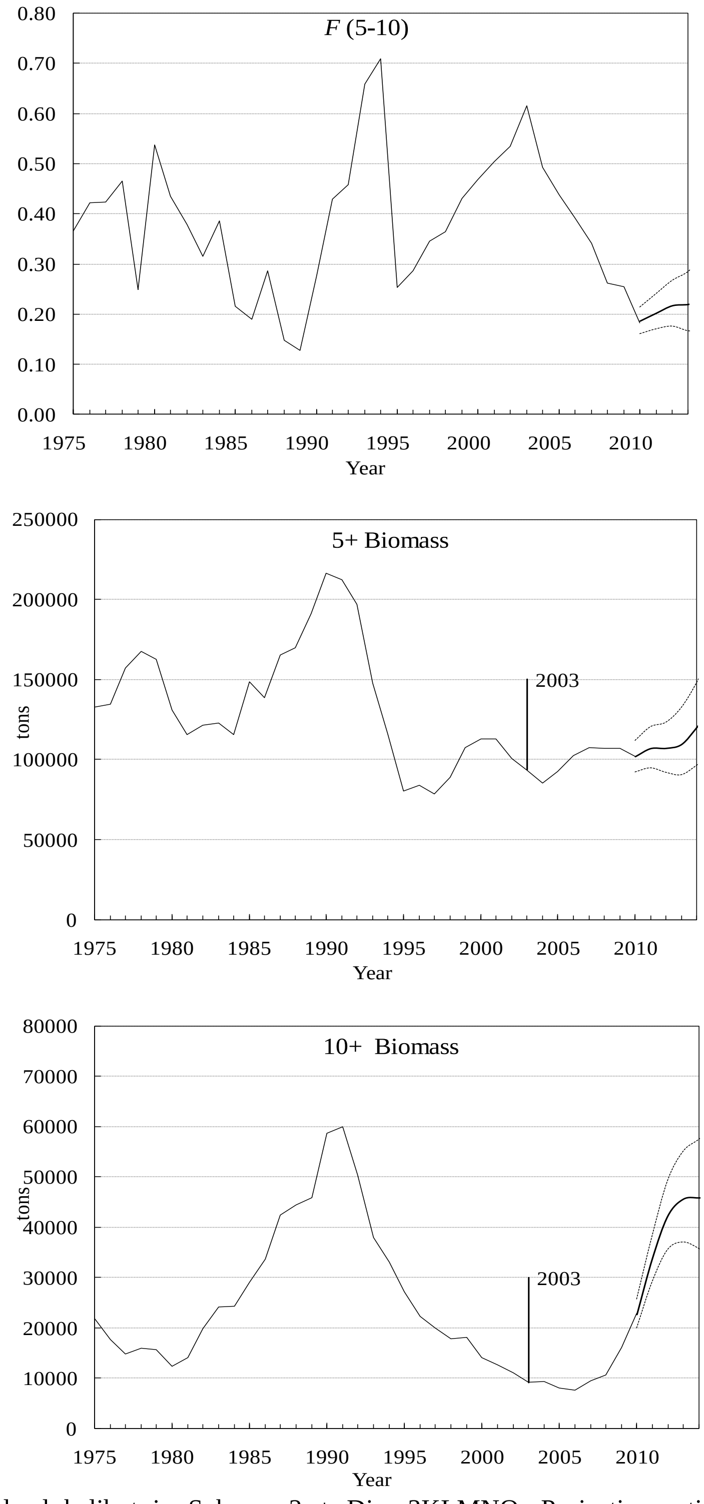


Fig. 20.21. Greenland halibut in Subarea 2 + Div. 3KLMNO: Projection estimates of average fishing mortality, 5+ biomass, and 10+ biomass over 2010-2014 assuming catches in 2010 and also 2011-2013 correspond to 16 000 t. The biomass level of 2003 (year in which rebuilding plan developed) is highlighted. The 5th, 50th (thick line), and 95th percentiles are shown.

i) Research Recommendations

STACFIS **recommended** *further study of the data available to assess this stock as well as the data series included in the analytical assessment*. This could include methods to construct a single age-disaggregated commercial CPUE index. Any relevant results from the ageing workshop for Greenland halibut that is planned for 2011 should be considered.

STACFIS **recommended** *ongoing investigations into the assessment methods used*. This should include further explorations of the statistical catch at age model investigated this year.

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

Previous survey experiments have noted that the depth distribution of Greenland halibut extends beyond 1500m, the maximum depth of the survey information currently available to assess this stock. Considering that very few age 10+ fish are captured in either commercial fisheries or in trawl surveys, STACFIS reiterated its **recommendation** that *exploratory deep-water surveys for Greenland halibut in Subarea 2 and Div. 3KLMNO be conducted using gears other than bottom trawls to compliment existing survey data*.

Tagging experiments could provide information on movement, growth rates and validate the current aging methods. STACFIS **recommended** that *tagging experiments of Greenland halibut in Subarea 2 and Div. 3KLMNO be conducted*.

Recognizing that the available survey series, taken individually or in combination, do not cover the entire range of this stock, STACFIS **recommended** *that a synoptic survey of Greenland halibut in Subarea 2 and Div. 3KLMNO be conducted* over a series of years, to the maximum depth possible.

This stock will be next assessed during June 2011.

21. Northern Shortfin Squid (*Illex illecebrosus*) in SA 3+4

(SCR Doc. 98/59, 75, 01/22, 06/46, 10/31)

a) Introduction

i) Description of the fisheries

Fisheries for northern shortfin squid in Subareas 3 and 4 consist of a Canadian inshore jig fishery in Subarea 3, and prior to 2000, an international bottom trawl fishery for silver hake, squid and argentine in Subarea 4. A USA bottom trawl fishery also occurs in Subareas 5+6. Historically, international bottom trawl and mid-water fleets participated in directed squid fisheries in Subareas 3, 4 and 5+6. Occassionally, very low catches are taken in Subarea 2.

In Subareas 3+4, a TAC of 150 000 t was in place during 1980-1998. It was set at 75 000 t for 1999 and at 34 000 t since then. Subareas 3+4 catches declined sharply from 162 100 t in 1979 to 100 t in 1986, then subsequently increased to 11 000 t in 1990. During 1991-1995, catches in Subareas 3+4 ranged between about 1 000 t and 6 000 t, and in 1997, increased to 15 600 t; the highest level since 1981. After 1997, catches ranged between 100 t in 2001 and 7 000 t in 2006. Catches in Subareas 3+4 totaled 700 t in 2009 (SCR Doc. 10/31).

Since this annual species is considered to constitute a single stock throughout Subareas 2 to 6 (SCR Doc. 98/59), trends in Subareas 3+4 must be considered in relation to those in Subareas 5+6. Subarea 5+6 catches ranged between 2 000 t and 24 900 t during 1970-1997. During 1998-2003, catches in Subareas 5+6 declined from 23 600 t to 6 400 t. Catches increased sharply in 2004 to the highest catch on record (26 100 t), but then declined to 9 000 t in 2007. Thereafter, catches in Subareas 5+6 increased to 18 400 t in 2009 (Fig. 21.1).

Recent catches and TACs ('000 t) are as follows:

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
TAC SA 3+4	34	34	34	34	34	34	34	34	34	34
STATLANT 21A SA 3+4	<0.1	0.2	1.1	2.3	0.6	6.9[2]	0.2[2]	0.5[1,2]	0.7[1]	
STATLANT 21A SA 5+6	4.0	2.7	6.4	25.0	12.0	13.5	8.9[1]	15.9[1]	18.4[1]	
STACFIS SA 3+4	<0.1	0.2	1.1	2.6	0.6	7.0[2]	0.2[2]	0.5[2]	0.7[2]	
STACFIS SA 5+6	4.0	2.8	6.4	26.1	12.0	13.9	9.0	15.9	18.4	
STACFIS Total SA 3-6	4.1	3.0	7.5	28.7	12.6	20.9	9.2	16.4	19.1	

[1] Provisional.
[2] Includes amounts (ranging from 12-48 t) reported as unspecified squid species.

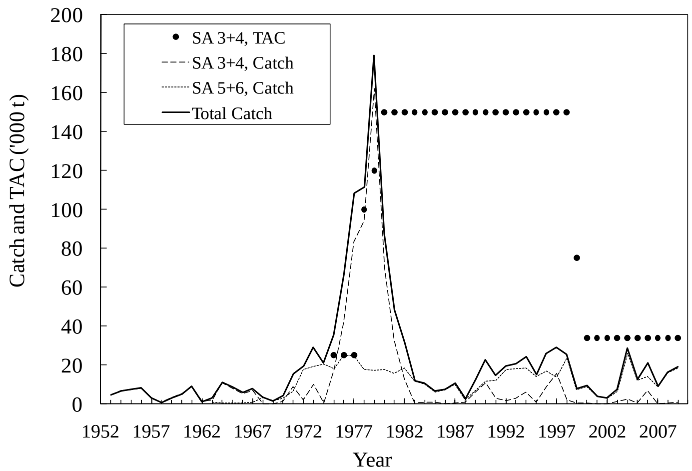


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs in relation to catches from Subareas 5+6 and the total stock.

b) Input Data

i) Commercial fishery data

Nominal catches were available for Subareas 3+4, during 1953-2009, and for Subareas 5+6 during 1963-2009. Catches from Subareas 5+6, prior to 1976, may not be accurate because distant-water fleets did not report all squid catch by species. The accuracy of the Subareas 3+4 catches prior to the mid-1970s is unknown. Fairly high catches of *Loligo pealeii* and unspecified squid species were reported to NAFO by CA (Maritimes Region), during 2004-2005 and 2008-2009, respectively. These catches in the NAFO 21A database may actually have been *I. illecebrosus* catches, but this possibility could not be confirmed, and therefore, the catches were not included in the assessment (SCR Doc. 10/31). Subarea 4 *Illex* catches represent a combination of catches from the Canadian Observer Program Database during a period of 100% fishery coverage (1987-1998) plus catches from the Maritimes Region Fisheries Database (MARFIS), formerly the Zonal Interchange Format Database, and the NAFO 21A database. Catches from Subarea 3 and any catches from Subarea 2 were extracted from the Fishery Statistics Division of the Department of Fisheries and Oceans, Newfoundland Region and the NAFO 21A Database.

ii) Research survey data

Fishery-independent indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were available from stratified, random bottom trawl surveys conducted by Canada on the Scotian Shelf (Div. 4VWX) during July of 1970-2009 and in the southern Gulf of St. Lawrence (Div. 4T) during September of 1971-2009 (SCR Doc. 10/31). Different vessels were used to conduct the July Div. 4VWX survey during the periods of 1970-1981 (RV *A. T. Cameron*), 1982 (RV *Lady Hammond*), 1983-2003 and in 2005 (CCGS *Alfred Needler*), and 2004 as well as 2006-2009 (CCGS *Teleost*). There are no vessel conversion coefficients available with which to standardize *I. illecebrosus* catch rates from the Div. 4VWX surveys prior to 2004. The 2004 indices contained in the 2006 assessment (SCR Doc. 06/46) were adjusted to account for significant catchability differences between the

CCGS *Alfred Needler* and the CCGS *Teleost* based on preliminary results of a 2005 paired-tow study. However, the final study results suggested no significant difference in catchability at an α level of 0.05 ($p = 0.095$). Therefore, a vessel conversion factor was not applied to the 2004 indices included herein. The Div. 4VWX survey occurs before or at the start of the fisheries and indices derived from the survey are assumed to represent relative biomass and abundance levels at the start of the fishing season. Indices were also available for bottom trawl surveys conducted by the USA in Subareas 5+6 during September-October of 1967-2009. Surveys in Div. 4T and Subareas 5+6 occur at or near the end of the fisheries and the indices are assumed to represent relative abundance and biomass levels at the end of the fishing season. Vessel changes during the Div. 4T surveys included use of the CCGS *Wilfred Templeman* during 2003 and the CCGS *Alfred Needler* and CCGS *Teleost* during 2004-2005. The CCGS *Teleost* has been utilized since 2006. The Div. 4T survey indices were adjusted for diel and vessel catchability differences during 1985-2009. There was no data available to adjust the 2003 indices accordingly and indices for years prior to 1985 did not require diel correction factors because the Div. 4T surveys were conducted during the daytime. Indices from the Subareas 5+6 surveys were standardized for all gear and vessel changes that occurred during the time series. Survey biomass indices for Div. 4VWX and Subareas 5+6 during 1970-1997 (Fig. 21.2) were positively correlated and the indices were also positively correlated with the total catches from Subareas 3-6 during the same time period (SCR Doc. 98/59).

Abundance and biomass indices for Subarea 3 were derived from the EU bottom trawl survey of the Flemish Cap (Div. 3M) conducted by Spain and Portugal during July of 1988-2009. The indices were standardized for a vessel (from the RV *Cornide de Saavedra* to the RV *Vizconde de Eza*) and gear change (from a Lofoten trawl to a Campelen 1800 shrimp trawl) that occurred in 2003 (SCR Doc. 01/22). Biomass indices from this survey do not track the same trends as the Div. 4VWX biomass indices, probably because the Flemish Cap represents marginal *Illex* habitat during most years. The Div. 4T indices are of much lower magnitude, but appear to track the trends in the July survey in Div. 4VWX during years of high relative abundance (Fig. 21.2).

Of the three surveys that are conducted in Subareas 3+4, the Div. 4VWX surveys provide the best indices of relative biomass in Subareas 3+4 because of the timing of the survey and broad sampling coverage of *Illex* habitat. Relative biomass indices from the Div. 4VWX surveys were highest during 1976-1981, averaging 12.6 kg/tow, indicating a period of high productivity. During 1982-2008, the average was much lower at 3.0 kg/tow indicating a low productivity period. (Fig. 2, Table 2). In 2009, the relative biomass index from the Div. 4VWX July survey (6.0 kg/tow) was near the 1982-2008 average for the low productivity period.

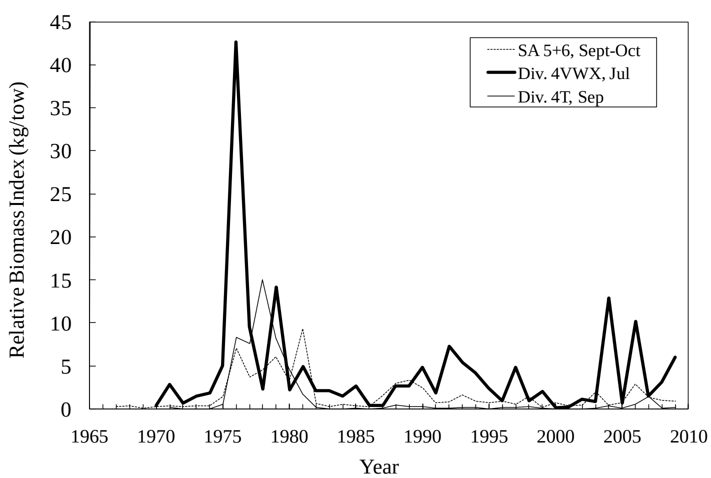


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices in Div. 4VWX during July, in Div. 4T during September, and in Subareas 5+6 during September-October. The Div. 4VWX indices could not be standardized for vessel changes that occurred during 1982 and 1983.

iii) Biological studies

Annual mean body weights of squid from the July survey in Div. 4VWX declined sharply during 1982-1983, following a period of much higher mean weights during 1976-1981 (Fig. 21.3). Mean body weight increased gradually thereafter, and in 1999 (119 g), reached the highest value since 1981, but then declined sharply to the second lowest level on record in 2000 (32 g). Similar trends were evident in Subareas 5+6, with higher mean body weights during 1976-1981 than thereafter, but with a record low occurring in 2005 (67 g). During most years since 2001, squid from both surveys have been of similar size. During 2006-2009, the mean body weights of squid caught in the Div. 4VWX surveys declined from 137 g to 86 g, a size near the 1982-2008 average of 80 g (SCR Doc. 10/31).

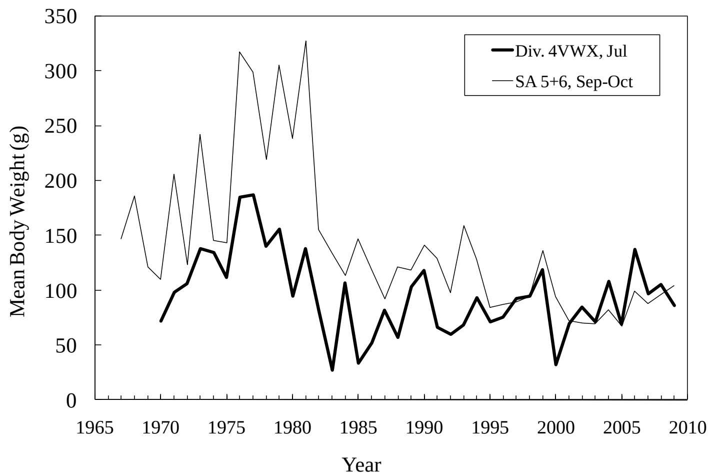


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weight of squid in the Div. 4VWX surveys during July and in the Subareas 5+6 surveys during September-October.

iv) Relative fishing mortality indices

Relative fishing mortality indices (Subareas 3+4 nominal catch/Div. 4VWX July survey biomass index) in Subareas 3+4 were highest during 1978-1980, within the 1976-1981 period of highest catch (Fig. 21.4). During 1982-2008, the indices were much lower and averaged 0.15. The indices have been below the 1982-2008 average since 2001 and declined to the lowest level on record (0.01) in 2009.

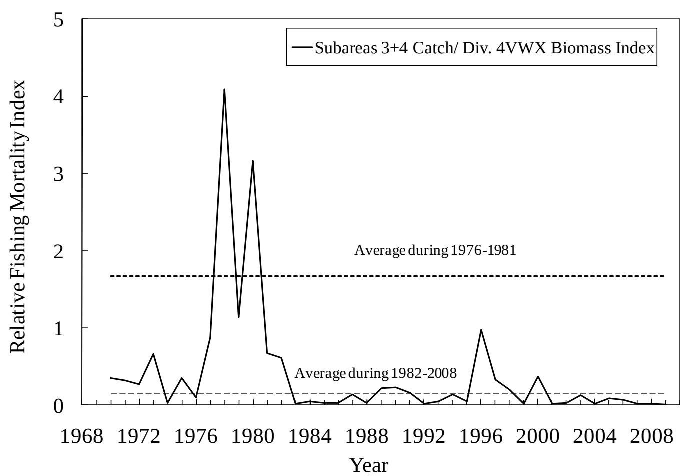


Fig. 21.4. Northern shortfin squid in Subareas 3+4: relative fishing mortality indices.

c) Assessment Results

Biomass: Relative biomass indices from the Div. 4VWX surveys were highest during 1976-1981, averaging 12.6 kg/tow, indicating a period of high productivity. During 1982-2008, the average was much lower at 3.0 kg/tow indicating a low productivity period. In 2009, the relative biomass index from the Div. 4VWX July survey (6.0 kg/tow) was near the 1982-2008 average for the low productivity period.

Body Size: Annual mean body weights of squid from the Div. 4VWX surveys declined markedly during 1982-1983, following a period of much higher mean weights during 1976-1981. Squid size increased gradually thereafter, and in 1999, reached the largest size since 1981. Mean body weight declined to the second lowest level on record in 2000 (32 g), then increased gradually to 137 g in 2006. Thereafter, mean body weight declined to 86 g in 2009, a size near the 1982-2008 average (80 g).

Relative Fishing Mortality Indices: Relative fishing mortality indices were highest during 1978-1980 and averaged 1.67 during the period of highest catch (1976-1981). During 1982-2008, the indices were much lower and averaged 0.15. The indices have been below the 1982-2008 average since 2001 and declined to the lowest level on record (0.01) in 2009.

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

State of the Stock: In 2009, the relative biomass index and mean body weight of squid from the Div. 4VWX July survey were near their 1982-2008 averages for the low productivity period. In addition, the relative fishing mortality index was the lowest on record in 2009. These stock status indicators suggest that the Subareas 3+4 stock component remained in a state of low productivity during 2009 and that relative fishing mortality indices were also very low.

The next full assessment of this stock is planned for 2013.

d) Research Recommendations

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

IV. OTHER MATTERS

1. FIRMS Classification for NAFO Stocks

The revised table reflects changes made in the classification of stocks according to the judgement of STACFIS at the June meeting in 2010. In the present table no stocks are considered to have a high fishing mortality. This is the result of an increase in stock size for some stocks and a reduction in effort. The Stock Classification system is not intended as a means to convey the scientific advice to Fisheries Commission, and should not be used as such. Its purpose is to respond to a request by FIRMS to provide such a classification for their purposes. The category choices do not fully describe the status of some stocks. Scientific advice to the Fisheries Commission is to be found in the Scientific Council report in the summary sheet for each stock.

Stock Size (incl. structure)	Fishing Mortality			
	None–Low	Moderate	High	Unknown
Virgin–Large		3LNO Yellowtail flounder		
Intermediate	3M Redfish 3LN Redfish	3LNO Northern shrimp[1] SA0+1 Northern shrimp[1] DS Northern shrimp[1]		
Small	3M Cod SA3+4 Northern shortfin squid	SA2+3KLMNO Greenland halibut		3NOPs White hake 3LNOPs Thorny skate
Depleted	3M American plaice 3LNO American plaice 2J3KL Witch flounder 3NO Cod 3M Northern shrimp[1]			SA1 Redfish SA0+1 Roundnose grenadier 3NO Witch flounder
Unknown	SA2+3 Roughhead grenadier 3NO Capelin 3O Redfish Greenland halibut in Disko Bay[2]	0&1A Offsh. & 1B–1F Greenland halibut		Greenland halibut in Uummannaq[2] Greenland halibut in Upernavik[2] SA2+3 Roundnose grenadier

[1] Shrimp will be re-assessed in Nov 2010
[2]Assessed as Greenland halibut in Div. 1A inshore

2. Other Business

a) Designated Experts

STACFIS was pleased to welcome Lisa Hendrickson (USA) as Designated Expert for Northern shortfin squid in SA 3 & 4 and thanked her for agreeing to take on this task.

b) Other business

SCR Doc. 10/22. Alternative conversion factors between RV Cornide de Saavedra and RV Vizconde de Eza on Flemish Cap

Catchability of fishes is known to be affected by changes in gear, survey timing, and research platform. In 2003 the RV Cornide de Saavedra was replaced by the RV Vizconde de Eza in the annual EU Flemish Cap survey (NAFO Division 3M); as part of this change, paired fishing tows were carried-out in 2003 and 2004. Although conversion factors were developed for some commercial species, there is also a need of conversion factors for non-commercial species. The goal of this study was to develop these factors for all fish species, *Pandalus borealis* and *Illex illecebrosus*. When sample sizes were too small, conversion factors were evaluated for operational groups defined by general body shape and species habitat. Relative fishing efficiency between vessels was analyzed using fixed effects conditional distribution models with and without fish size as covariate. Results indicated that RV Vizconde de Eza had a significantly higher fishing efficiency than RV Cornide de Saavedra. However, only *Pandalus borealis* and *Illex illecebrosus* presented size-dependent differences in fishing efficiency, with a remarkably greater catchability for RV Vizconde de Eza at smaller sizes. These differences may be explained by differences in gear characteristics and winch-related equipment and operation between the vessels. Conversion factors for key commercial species obtained in this study were higher than those found in previous analyses.

The results of this study were different from previous studies in that there was no length effect for most fish species and the difference in the two vessels was generally greater. Discussion centered around whether or not these differences were related to differences in data selection and/or different methodology.

One of the main differences in data selection was the elimination of comparative fishing tows where one vessel had a codend cover. The effect of this cover could be examined by including a factor for this in the model. A better understanding of whether or not differences are due to use of different data or methodology could be examined by using the method developed in this study on the data included in the previous conversion studies. A more detailed examination of which paired hauls should be included in the development of conversion factors should also be carried out.

STACFIS concluded that the results of this study point to a need to further investigate the conversion factors for species in the EU Flemish Cap survey.

SCR Doc. 10/36. Vázquez, A. and M. Mandado. Random Retrospective Pattern in Fish Stock Assessment.

Several indices were proposed to measure disagreement among results of a retrospective analysis. They were analyzed by numerical simulation in response to random variability in partial recruitment, catch at age numbers and survey indices. The potential use of a retrospective index as an indicator of accuracy in VPA results is explored. It was concluded that, for the analyzed retrospective indices, the lowest value does not imply the lowest bias. Any test based on a retrospective index can only be used to reject an analysis when values are higher that certain levels, but not to verify the goodness of fit. STACFIS noted that the method seems promising and encouraged further development.

V. ADJOURNMENT

STACFIS Chair of thanked the Designated Experts for their competence and very hard work and the Secretariat for its great support. The STACFIS Chair also thanked Designated Experts, the Chair of Scientific Council, and the Scientific Council Coordinator for their support and help.