PART A: SCIENTIFIC COUNCIL MEETING - 3-16 JUNE 2011

Contents

From back left: Ivan Tretiakov, Don Power, Rasmus Nygaard, Barb Marshall, Neil Campbell, Ricardo Alpoim, Antonio Vázquez, Ole Jørgensen, Dawn Maddock Parsons, Brian Healey, Bill Brodie, Rick Rideout, Mark Simpson, Carsten Hvingel, Ilya Skryabin, Romas Statkus

Front: Alexis Pacey, Rafael Duarte, Fernando Gonzalez, Diana Gonzales-Troncoso, Joanne Morgan, Gary Maillet, Jean-Claude Mahé, Antonio Avila de Melo, Margaret Treble, Mariano Koen-Alonso, Katherine Sosebee, Heino Fock, Vladimir Babayan

Missing: Fran Mowbray, Eugene Colbourne, Anna Akimova, Mar Sacau, Tom Nishida, Konstantin Fomin, Christian Möllmann , Anton Ellenbroeck

Chairs: Ricardo Alpoim (SC), Joanne Morgan (STACFIS), Carsten Hvingel (STACREC), Gary Maillet (STACFEN), Margaret Treble (STACPUB)

REPORT OF SCIENTIFIC COUNCIL MEETING

3-16 JUNE 2011

Chair: Ricardo Alpoim Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at the Johann Heinrich von Thünen Institut (vTI), Braunschweig, Germany, during 3-16 June 2011, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), the European Union (France, Germany, Lithuania, Portugal and Spain), Japan, the Russian Federation, and the United States of America. The Scientific Council Coordinator, Neil Campbell, was in attendance.

The Executive Committee met prior to the opening session of the Council to discuss the provisional agenda and plan of work.

After a warm welcome from Prof. Dr. Folkhard Isermeyer, the President of vTI, the opening session of the Council was called to order at 1000 hours on 3 June 2011. The provisional agenda was **adopted** with modification. The Scientific Council Coordinator, Neil Campbell, was appointed the rapporteur.

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

The opening session was adjourned at 1040 hours on 3 June 2011. 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 8 June 2011, the STACPUB report on 9 June 2011, the STACREC report on 11 June 2011, and the STACFIS report on 15 June 2011.

The concluding session was called to order at 0900 hours on 16 June 2011.

The Council considered and **adopted** the report the Scientific Council Report of this meeting of 3-16 June 2011. 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 1400 hours on 16 June 2011

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 Appendix V-VII.

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 2010

FROM THE SCIENTIFIC COUNCIL MEETING, 3-16 JUNE 2010

X. Meeting Reports

4. Working Group on Reproductive Potential, March 2010

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.*

STATUS: Scientific Council noted that two Designated Experts attended the workshop.

FROM THE SCIENTIFIC COUNCIL MEETING, 20-27 OCTOBER 2010

V. Other Matters

1. Catch and Effort Analysis using VMS Data

Scientific Council reiterates its previous recommendation in more general terms for consideration of all commercial fisheries, and **recommended** that *the catch and effort data from other sources, for example VMS and/or Observer data, continue to be investigated to validate commercial data obtained from summarized logbooks or STATLANT data*.

STATUS: Scientific Council notes progress on this work at the Secretariat, notes the ICES Study Group on VMS and **recommended** *further participation of the Scientific Council Coordinator in this group.*

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, are as follows:

STACFEN **recommended** *input from Scientific Council for development of new time series and data products for future use and any additional species that could be evaluated in relation to the environment.*

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** *development of annual environmental composite indices to complement environmental information provided to STACFIS for the Subareas of interest (SA 0-1, SA3-Div. 3M, SA3 and Div. 3LNO, widely distributed stocks SA 2-4).*

STACFEN **recommended** that *the appearance of good year-classes in 2010 be explored in relation to environmental conditions.*

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, are as follows:

STACPUB **recommended** that *the Journal of Northwest Atlantic Fishery Science be published each year/per volume.*

STACPUB **recommended** that *the proceedings of the Working Group on Reproductive Potential be published in the NAFO Scientific Studies Series.*

STACPUB **recommended** that *a Scientific Merit Award list be included at the back of future publications of the Scientific Council Report.*

STACPUB **recommended** that *the Scientific Council Coordinator be the General Editor. In future this should be included as part of the SC Coordinator's position.*

STACPUB **recommended** that *a CD be created to include all historical documents.*

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, are as follows:

STACREC **recommended** that *DEs compile historical catch data in as fine a scale (ideally by NAFO Division) and for as many years as possible.*

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.*

STACREC expressed concern about the possible inaccuracy of Greenland halibut age determination and therefore, STACREC **recommended** that *research be conducted to determine maximum ages and to improve age determination methods.*

STACREC **recommended** that *General Council seek approval from all Contracting Parties for sharing of survey data among members of Scientific Council for research aimed at addressing requests from Fisheries Commission.*

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 20-27 October 2010. The Scientific Council provided scientific advice on northern shrimp stocks for 2012. Updated advice for 2012 will be provided at the Annual Meeting in 2011 through an interim monitoring report.

a) Request for Advice on TACs and Other Management Measures for the Years 2012 and 2013

The Fisheries Commission at its meeting of September 2010 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.

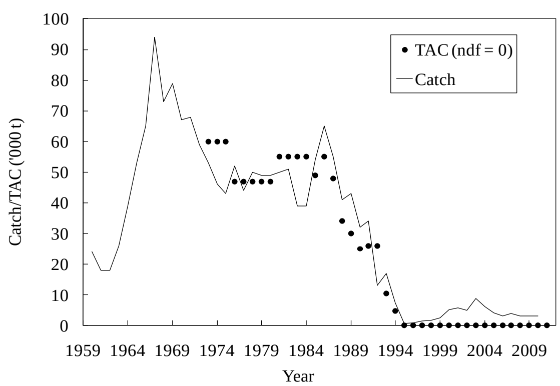
American plaice in Divisions 3LNO

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 2010 was 2 898 t, mainly taken in the Regulatory Area.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2008	2.5	1.9	ndf	ndf
2009	3.0	1.8	ndf	ndf
2010	2.9	1.5	ndf	ndf
2011			ndf	ndf

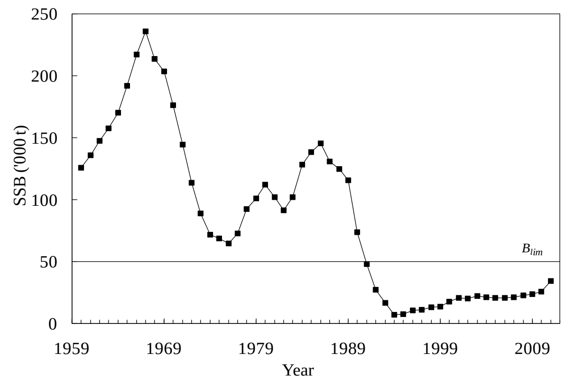
ndf No directed fishing.



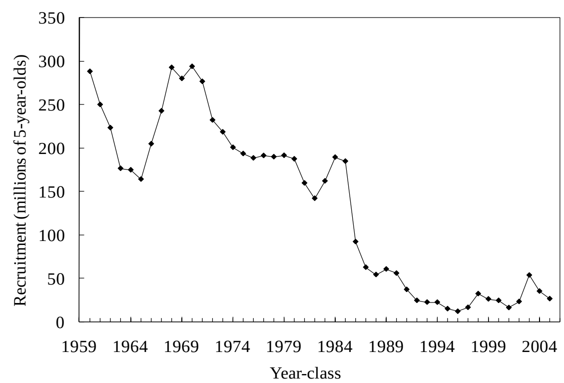
Data: Biomass and abundance data were available from: annual Canadian spring (1985-2010) and autumn (1990-2010) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2010.

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 from 1989-1996, where M was assumed to be 0.53 on all ages.

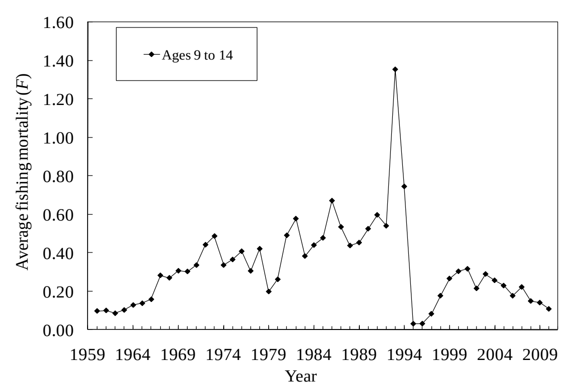
Biomass: Despite the increase in biomass since 1995, the biomass is very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and is currently at 34 000 t. B_{lim} for this stock is 50 000 t.



Recruitment: Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average.

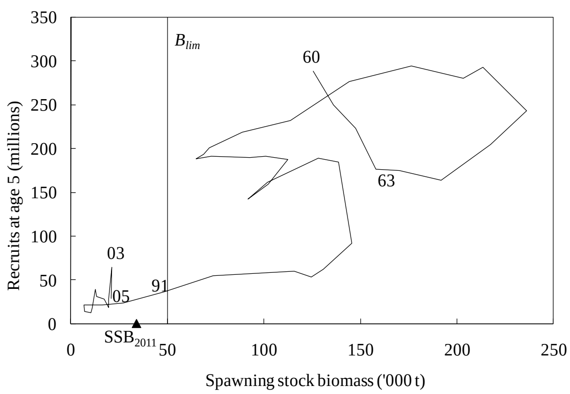


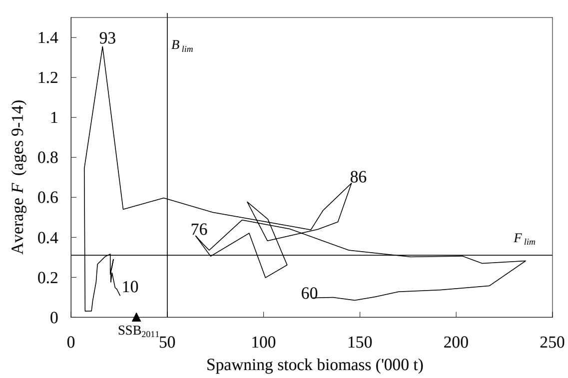
Fishing mortality: Fishing mortality on ages 9 to 14 has generally declined since 2001.



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}. Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average.

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 and this is currently the best estimate of B_{lim}. In 2011 SC adopted an F_{lim} of 0.31 for this stock based on F_{MSY} (see SC VII.1.d.i). 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: $F = 0$, $F= F_{2010}$ (0.11), and $F_{0.1}$ (0.16). Simulations were limited to a 2-year period. Recruitment was resampled from three sections of the estimated stock recruit scatter, depending on SSB.

SSB is projected to have a 50% probability of reaching B_{lim} by the start of 2014 (i.e. end of 2013) when F=0. Although SSB is also projected to increase slowly with $F_{current}$ and $F_{0.1}$ the probability of reaching B_{lim} by the start of 2014 under these scenarios is less than 50%.

	F = 0		
	SSB ('000 t)		
	p5	p50	p95
2011	29	33	38
2012	36	41	47
2013	42	48	56
2014	46	53	64

	F_{2010} = 0.11					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2011	29	33	37	3.2	3.6	4.1
2012	33	37	43	3.7	4.1	4.7
2013	36	41	47	3.9	4.3	4.9
2014	37	42	49			

	$F_{0.1}$ = 0.16					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2011	29	33	37	4.5	5.1	5.8
2012	32	36	42	5.0	5.7	6.5
2013	33	38	44	5.1	5.7	6.5
2014	33	38	45			

Recommendation: There should be no directed fishing on American plaice in Div. 3LNO in 2012 and 2013. 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 2013.

Sources of Information: SCS Doc. 11/4, 5, 7, 11; SCR Doc. 11/5, 19, 32, 37, 39

Redfish in Division 3M

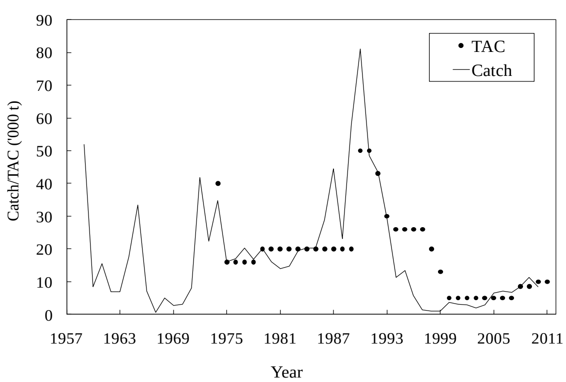
Background: There are 3 species of redfish, which are commercially fished on Flemish Cap: deep-water redfish *(Sebastes mentella)*, golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The present assessment evaluates the status of the Div. 3M beaked redfish stock, regarded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

Fishery and Catches: The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-1999, when a minimum catch around 1 100 t was recorded mostly as by-catch of the Greenland halibut fishery. An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. A new golden redfish fishery occurred on the Flemish Cap bank from September 2005 onwards on shallower depths above 300m, basically pursued by Portuguese bottom trawl and Russia pelagic trawl. Furthermore, the reopening of the Flemish Cap cod fishery in 2010 also contributed to the actual level of redfish catch of 8 500 t.

This new reality implied a revision of catch estimates, in order to split 2005-2010 redfish catch from the major fleets on Div. 3M into golden and beaked redfish catches.

	Catch ('000 t)			TAC ('000 t)	
Year	STACFIS		21A	Recommended	Agreed
2008	8.5[1]	4.3[2]	7.9	5	5
2009	11.3[1]	3.7[2]	8.7	8.5	8.7
2010	8.5[1]	5.4[2]	8.5[3]	10.0	10.0
2011				10.0	10.0

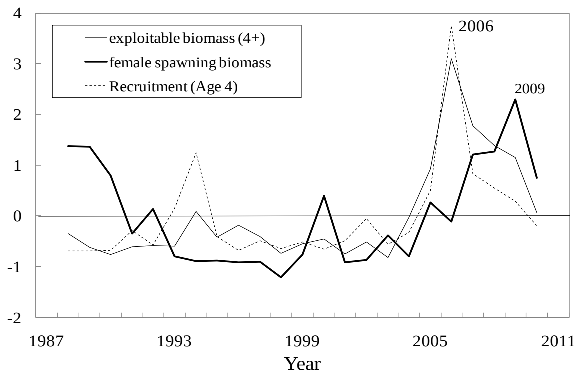
[1] Estimated total redfish catch
[2] Estimated beaked redfish catch
[3] Provisional.



Data: Catch-at-age data were available from 1989-2010, including by-catch information from the shrimp fishery from 1993-2004.

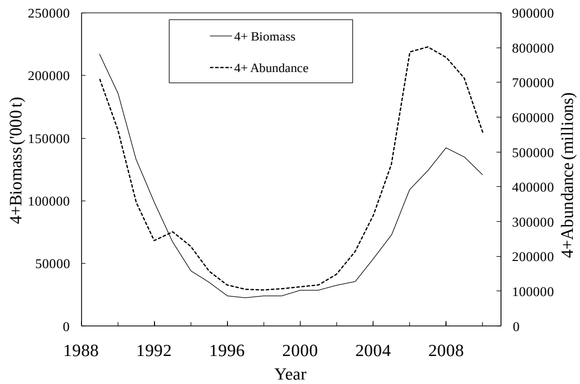
There are three bottom trawl survey series providing biomass indices as well as length and age data for the Flemish Cap redfish stocks; Russia (1983-93, 1995-96 and 2001-2002), EU (1988-2010) and Canada (1979-85 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic component for the 1988-92 period.

Assessment: Survey bottom biomass, female spawning biomass and recruitment were calculated from 1988-2010 EU surveys.



A virtual population (XSA) was carried out for 1989-2010. In order to adjust the model to the recent declines observed on survey exploitable and spawning biomass, that can only be explained by an increase in mortality other than fishing mortality, a sensitivity analysis was carried out, allowing an increase of natural mortality (M) from 0.1 to 1.0.

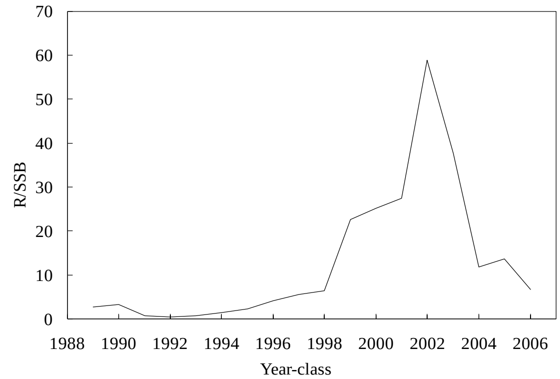
Taking into account the results of the sensitivity analysis the assessment was accepted with a natural mortality level at 0.4 for ages 4-6 through 2006-2010, and ages 7+ on 2009 and 2011. The assessment was considered reliable for projections.



Biomass: Experienced a steep decline from the 1989 until 1996. The exploitable stock was kept at a low level until the early 2000's, basically dependent on the survival and growth of the existing cohorts. Above average year classes coupled with high survival rates allowed a rapid growth of biomass and abundance since 2003 and sustained the stock at a high level on 2007-2008. However the stock decreased on the last couple of years for causes other than fishing and, despite the stock size being still above average level, there are no signs that the present decline rate is slowing down.

Spawning stock biomass: The continuous increase observed since 2000 was halted at 2008. Female spawning biomass drop from 2009 to 2010, but is still well above average. A marginal increase is expected in 2011 due to the individual growth of the female survivors from the abundant 2000-2002 year classes, now dominating the spawning biomass.

Fishing Mortality: Fishing mortality was at a high level until 1996 and dropped to a low level since 1997.



Recruitment: Increased from 1998 year class till 2002 year class, which gave the age 4 historical high, and declined afterwards as fast as it went up. Recruitment is on 2010 just below average.

State of the Stock: Scientific Council concluded that the declines of stock abundance and biomass, observed since 2008, were extended to the survey female spawning component in 2009-2010. These declines could not be explained by a commercial catch that has been chronically small for more than a decade. The assessment results can only reflect the declines foreseen by the EU survey if natural mortality is allowed to suffer an important increase since 2006.

Short term projections: Short term (2013) stochastic projections were obtained for female spawning stock biomass (SSB) and yield for *F* = 0, *F status quo* = 0.072 and $F_{0.1}$ = 1.98.

Results of the SSB and yield short term projections under the three *F* scenarios are tabulated bellow for 5%, 50% and 95% probability levels:

Female spawning biomass			
F = 0	2012	2013	2014
p5	23152	21838	19437
p50	26650	25030	22228
p95	30842	29035	25853
$F_{status\ quo}$=0.072	2012	2013	2014
p5	23152	20492	17088
p50	26650	23505	19590
p95	30842	27287	22875
$F_{0.1}$=1.976	2012	2013	2014
p5	23152	4861	1337
p50	26650	5708	1657
p95	30842	6873	2090

Yield		
F = 0	2012	2013
p5		
p50		
p95		
$F_{status\ quo}$=0.072	2012	2013
p5	2904	2519
p50	3279	2894
p95	3772	3430
$F_{0.1}$=1.976	2012	2013
p5	42499	10914
p50	48469	14295
p95	56542	23830

Between 2011 and 2014 the female spawning stock biomass (SSB) is expected to record a decrease under no fishing mortality or under *F status quo* within 22-31%. With the actual $F_{0.1}$ a short term reduction of the SSB in the order of 94% is expected, along with catches much higher than the correspondent SSB.

Under these circumstances fishing at $F_{0.1}$ is not a management option. Between 2011 and 2014 the female spawning stock biomass (SSB) is expected to decrease either under no fishing mortality or under *F status quo.*

Recommendation: In order to sustain the female spawning stock biomass on the short term fishing mortality should be kept at its present low level. This would correspond to an expected average 2012-2013 beaked redfish catch under *F status quo* of 3 087 t. Catch for all redfish species combined in Div. 3M in 2012 and 2013 should not exceed 6 500 t.

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

Special Comments: Scientific Council expressed its concern not only for the uncertainty around the actual level of natural mortality but also for the lack of research regarding the possible causes responsible for the severe decline of the stock from 2006 onwards.

$F_{0.1}$ will always be dependent on the magnitude of the underlying natural mortality. In the actual yield per recruit analysis the adopted high level of natural mortality lead to a very high $F_{0.1}$.

The next assessment will be in 2013.

Sources of Information: SCR Doc. 11/21, 26; SCS Doc. 11/4, 5,7,11.

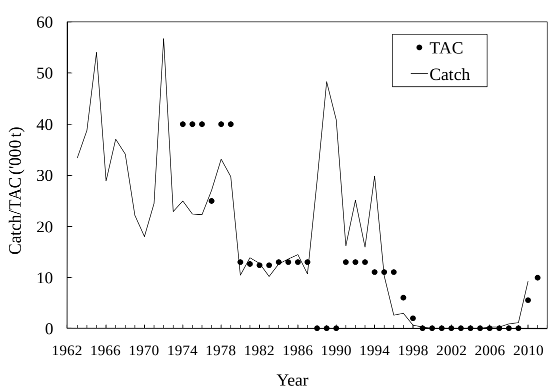
Cod in Division 3M

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 and a catch of 9 192 t was estimated by STACFIS. A 10 000 t was established for 2011.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2007	0.3	0.1	ndf	ndf
2008	0.9	0.4	ndf	ndf
2009	1.2	1.2	ndf	ndf
2010	9.2	4.4	4.1	5.5
2011			<10	10

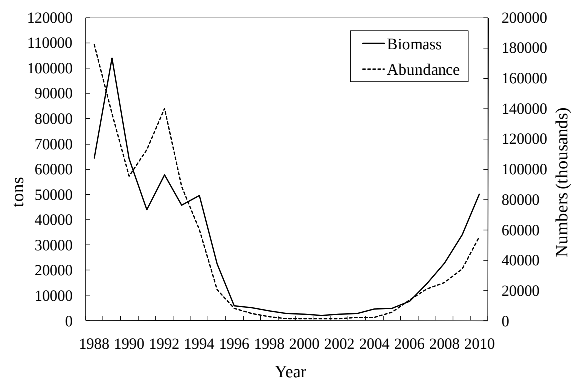
ndf No directed fishing.



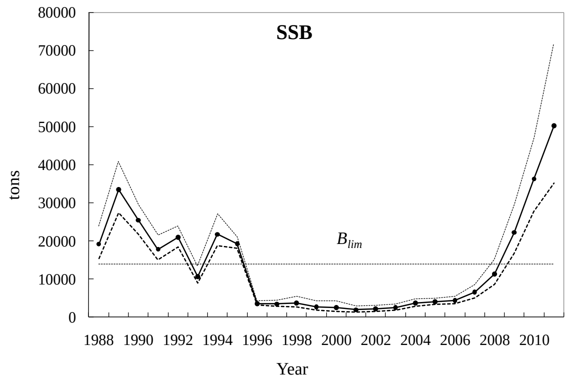
Data: Length and age compositions of the 2002-2005 commercial catches were not available. Length distributions were available for 2006-2009, although sampling levels were low. For 2010 there were samples for EU-Lithuania, Norway, EU-Portugal, EU-Spain and EU-UK. Abundance at age indices were available 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 2009-2010 age-length keys from Portuguese catch were available. In 2010 there was an age-length key for another reader from Spanish catches. Maturity ogives are available from the EU survey for the entire period.

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

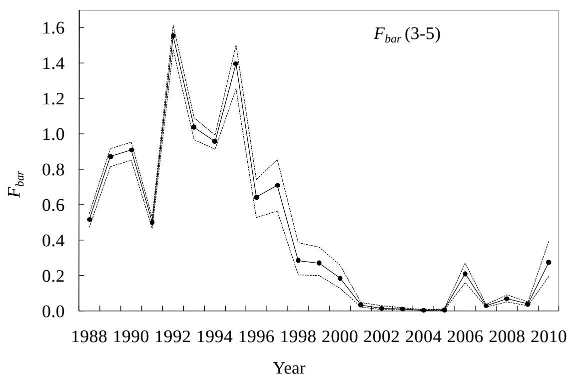
Total Biomass and Abundance: Estimated total biomass and abundance show an increasing trend in both values in recent years, being the increase in biomass higher than the one in abundance. While total biomass is at the level of the beginning of the 90´s, abundance is still below those values.



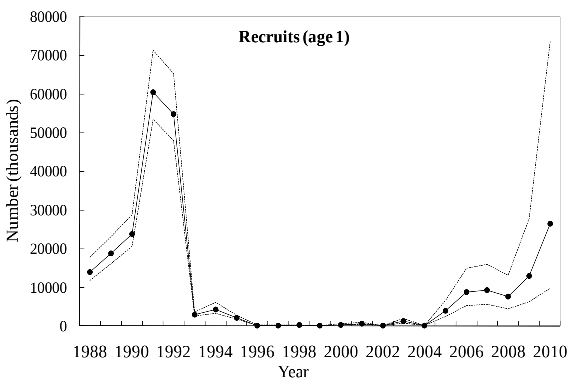
SSB: Spawning stock biomass increases from 2004, with the biggest increase taking place during 2008-2011. The big increase in the last four years is largely due to five reasonably abundant year classes, those of 2005-2009, as well as to the larger weight at age and the younger age of maturity observed in recent years.



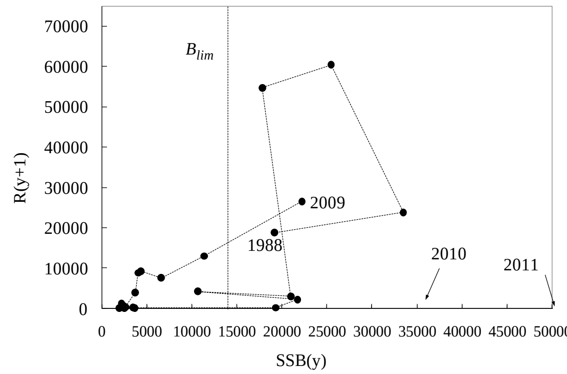
Fishing mortality: Very low from 2001 to 2009. In 2010 the F_{bar} level increased because of the reopening of the fishery. F_{2010} (0.28) exceed F_{max} (0.21).



Recruitment: After recruitment failures during 1996-2004, values are higher in 2005-2010, although still below the levels of the late 80´s.



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 2011.

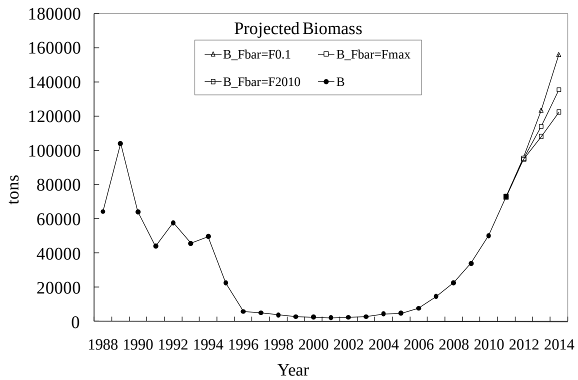


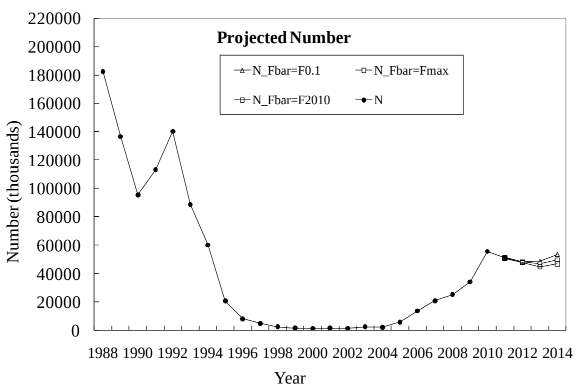
State of the Stock: There has been a significant spawning biomass increase, with levels much above B_{lim}, although abundance remains still lower than in the beginning of the time series. As a result of changes noted in weight and maturity, it is unclear whether the meaning of spawning biomass as an indicator of stock status is the same as in the earlier period. Whereas recruitment has been better during 2005-2010, it is below levels in the beginning of the assessment period.

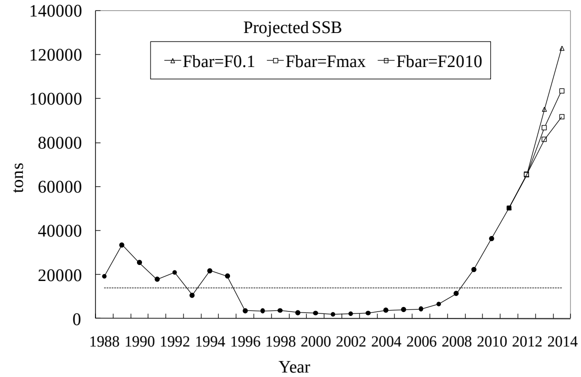
Stock Projections: Stochastic projections have been performed for 2012-2014 under three fishing mortality scenarios: (1) $F_{bar}=F_{0.1}$ (median=0.130); (2) $F_{bar}=F_{max}$ (median=0.210); (3) $F_{bar}=F_{2010}$ (median=0.280). All scenarios assumed that the Yield for 2011 is the established TAC (10 000 t).

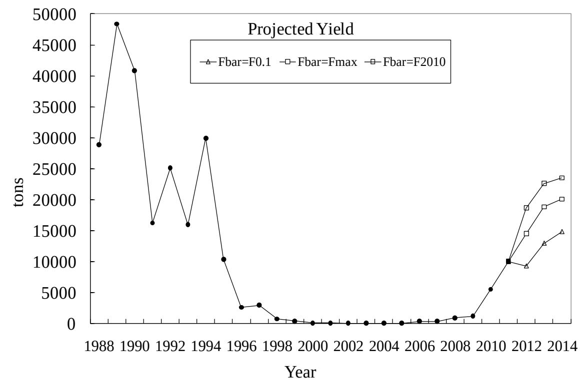
Under all scenarios, total biomass and SSB have a very high probability of reaching levels higher than all of the 1988-2011 estimates. However, this increase does not have_a counterpart in terms of population abundances, which are projected to remain at levels below those of the late 80's. That is because 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.

s	Total Biomass		SSB		Yield	
	50%	5%-95%	50%	5%-95%	50%	5%-95%
$F_{bar}=F_{0.1}$ (median=0.130)						
2011	73189	52141-101986	50552	35462-71721	10000	
2012	95728	65344-146081	65356	46705-91368	9280	4877-17991
2013	123564	76249-205415	95086	63313-149647	12935	6202-27183
2014	156044	85810-280853	122833	71976-220543	14787	6328-34513
$F_{bar}=F_{max}$ (median=0.210)						
2011	73150	52454-102247	50463	35370-71771	10000	
2012	95261	64375-144784	65352	46342-90997	14495	7515-28156
2013	114011	69539-196493	86759	57873-138002	18822	9067-39858
2014	135456	72483-252292	103508	59071-189912	20077	8391-46941
$F_{bar}=F_{2010}$ (median=0.280)						
2011	72842	52567-101887	50469	35508-71210	10000	
2012	94806	64733-145854	65617	46182-91109	18657	11178-32741
2013	108131	66332-187147	81408	54863-129666	22596	12031-43942
2014	122401	65132-235496	91737	53843-167645	23519	10668-51584









Recommendation: Scientific Council advises that catches in 2012 should not exceed the level of $F_{0.1}$ (9 280 t).

Special Comments: The next full assessment of this stock will be in 2012.

Sources of Information: SCR Doc. 11/21, 28, 38; SCS Doc. 11/04, 05, 07.

American plaice in Division 3M

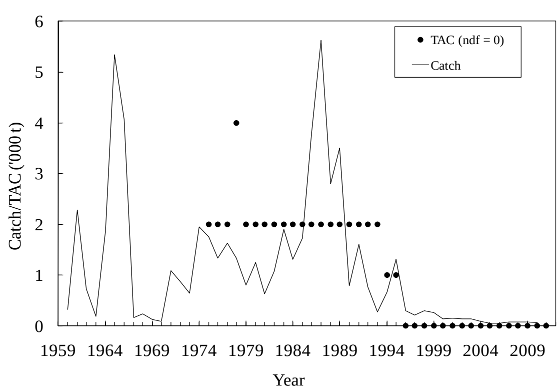
Background: The stock occurs mainly at depths shallower than 600 m on Flemish Cap. Catches are taken mainly by otter trawl, primarily in a bycatch fishery of the Contracting Parties since 1992.

Fishery and Catches: Nominal catches increased during the mid-1960s, reaching a peak of about 5 341 t in 1965, followed by a sharp decline to values less than 1 100 t until 1973. Since 1974, when catches of this stock became regulated, catches ranged from 600 t (1981) to 5 600 t (1987). After that catches declined to 275 t in 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. Catch for 2010 was estimated to be 63 t.

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

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2008	0.1	0.1	ndf	ndf
2009	0.1	0.1	ndf	ndf
2010	0.1	0.1	ndf	ndf
2011			ndf	ndf

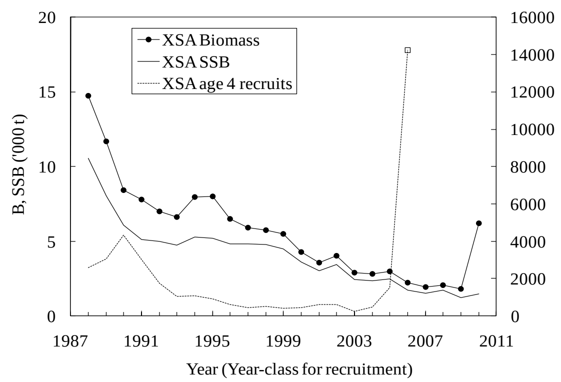
ndf No directed fishing.



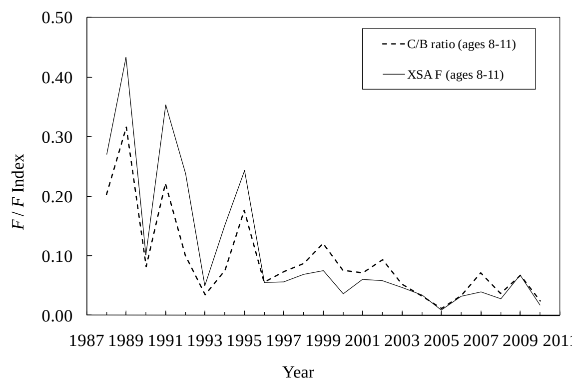
Data: Length compositions were available from the 1988 to 2010 fisheries. Abundance and biomass from surveys were available from USSR/Russia (1972-2002), EU (1988-2010) and Canada (1978-1986). Age-length keys were available from EU surveys (1988-2010).

Assessment: An analytical assessment (XSA) was presented, the analyses was not accepted as a basis to estimate stock size but was accepted as illustrating the trends in the stock.

Biomass: SSB is at a very low level, due to consistent year-to-year recruitment failure from the 1991 to 2005 year classes. Stock biomass increased in recent years due to the improved recruitment since 2006 (mainly due to the 2006 year class).



Fishing Mortality: Both fishing mortality index (C/B) and XSA fishing mortality declined from the mid-1980s to the mid-1990s and since 2000 fluctuated below 0.1. Recent *F* is at a very low level.



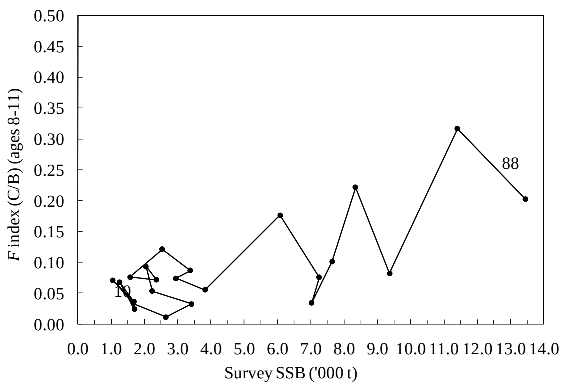
Recruitment: 1991 to 2005 year classes are estimated to be weak. Since 2006 the recruitment improved, particularly the 2006 year class.

State of the Stock: This stock continues to be in a very poor condition. Recruitment improved recently and these year classes will be recruiting to SSB over the next few years. Although the level of catches since 1996 is low, all the analysis indicates that this stock is kept at a very low level.

Recommendation: There should be no directed fishery on American plaice in Div. 3M in 2012, 2013 and 2014. Bycatch should be kept at the lowest possible level.

Reference Points: STACFIS is not in position to provide proxies for biomass reference points at this time.

Both fishing mortality index (C/B) and XSA estimates of fishing mortality are quite low, despite this spawning stock biomass remains at a very poor level.



The yield-per-recruit analysis gave $F_{0.1}$ = 0.175 and F_{max} = 0.425.

Special Comments: The next Scientific Council full assessment of this stock will be in 2014.

Sources of Information: SCR Doc. 08/26; 11/21, 41; SCS Doc. 08/5, 6; 09/12, 14; 10/7; 11/4, 5

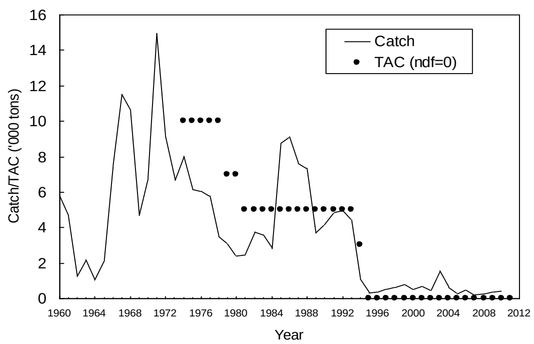
Witch flounder in Divisions 3NO

Background: The stock mainly occurs in Div. 3O along the southwestern slopes of the Grand Bank but appears to move onto the shallow banks seasonally. It has been fished mainly in winter and springtime on spawning concentrations.

Fishery and Catches: Catches exceeded the TAC by large margins during the mid-1980s, but then declined steadily to less than 1 200 t in 1994, when it was agreed there would be no directed fishing on the stock. Since then, catches have averaged about 500 t; in 2009 and 2010 the catch was estimated to be 376 and 421 t respectively.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2008	0.3	0.2	ndf	ndf
2009	0.4	0.1	ndf	ndf
2010	0.4	0.1	ndf	ndf
2011			ndf	ndf

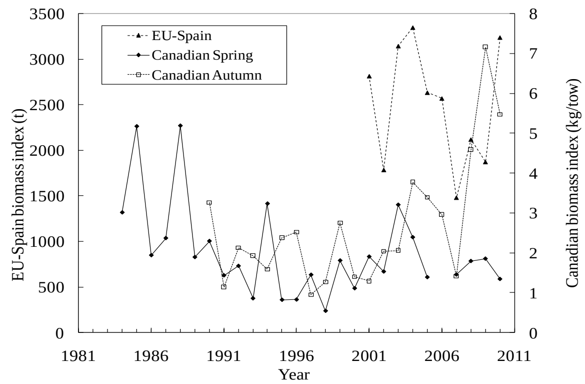
ndf No directed fishing.



Data: Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring surveys during 1984-2010 and autumn surveys during 1990-2010. Biomass data is available from the Spanish Div. 3NO spring surveys during 1995-2001 in Pedreira units and 2001-2010 in Campelen units.

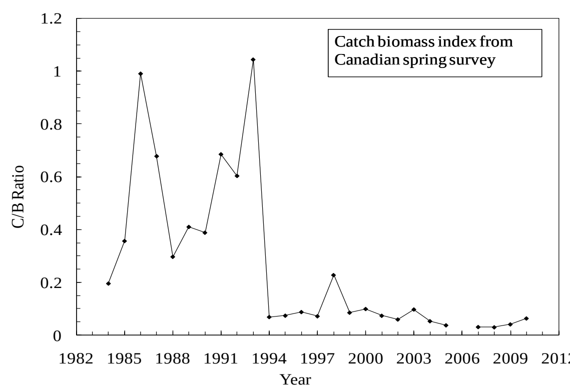
Assessment: No analytical assessment was possible with current data.

Biomass: Survey biomass decreased from the mid-1980s until the mid to late 1990s. Since then the Canadian spring RV index increased slightly and remains stable at a low level. The Canadian autumn survey and EU - Spain survey indices show an increasing trend in recent years. There is no information on SSB.



Recruitment: Recruitment, based on Canadian surveys, (defined as fish less than 21cm) has generally been poor since 2002.

Fishing mortality: The ratio of catch to survey index, a proxy for *F*, suggests fishing mortality has been low since a moratorium on directed fishing was imposed in 1994.



State of the Stock: There are signs of improvement in stock status, notably the increases in Canadian autumn survey indices in 2008-2010, but there is considerable uncertainty. A comparison of the three survey series shows inconsistent trends in recent years, and the increased estimates from the survey series generally have wide confidence limits. Increases in some indices in 2008-2010 could not be explained from available data from length frequencies. Catch/biomass ratio remains relatively low, increasing slightly in recent years with the increased catch.

Recommendation: No directed fishing on witch flounder in 2012, 2013 and 2014 in Div. 3N and 3O to allow for stock rebuilding. Bycatches in fisheries targeting other species should be kept at the lowest possible level.

Reference Points: Not determined.

Special Comments: The next Scientific Council assessment of this stock is scheduled for 2014.

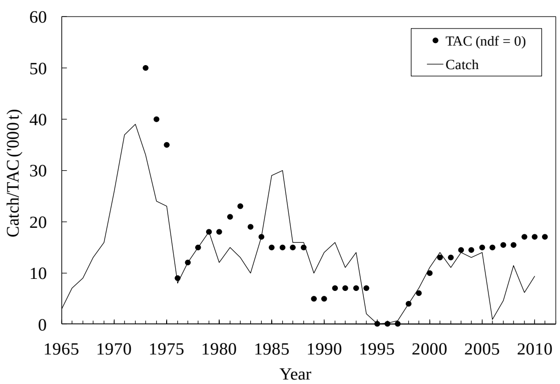
Sources of Information: SCR Doc. 11/6, 29, 37; SCS Doc. 11/5, 6, 9.

Yellowtail flounder in Divisions 3LNO

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

Fishery and Catches: There was a moratorium on directed fishing from 1994 to 1997, and small catches were taken as by-catch in other fisheries. The fishery was re-opened in 1998 and catches increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches from 2001 to 2005 ranged from 11 000 t to 14 000 t. Since then, catches have been below the TAC and in some years, have been very low.

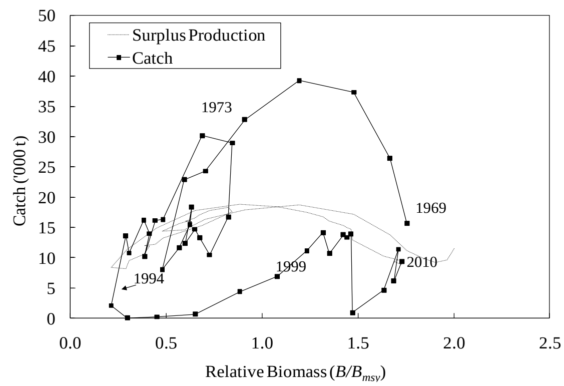
	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2008	11.4	11.3	15.5	17.0
2009	6.2	5.5	<85% F_{msy}	17.0
2010	9.4	9.1	<85% F_{msy}	17.0
2011			<85% F_{msy}	17.0

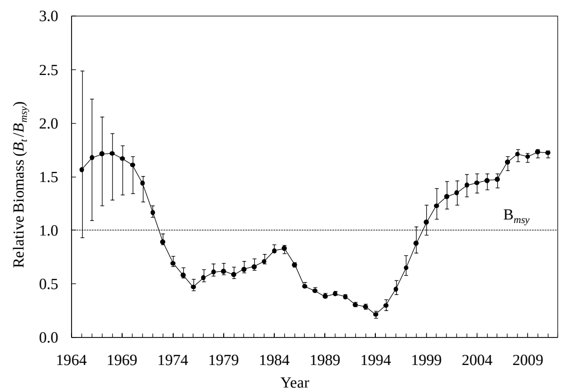


Data: Abundance and biomass indices were available from: annual Canadian spring (1971-82; 1984-2010) and autumn (1990-2010) bottom trawl surveys; annual USSR/Russian spring surveys (1972-91); and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). Length frequencies of the catch from Canada (Div. 3LNO), EU-Portugal (Div. 3N) and EU-Spain (Div. 3NO) were also available for 2010.

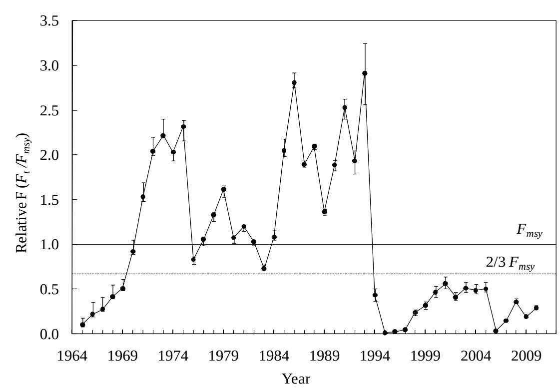
Assessment: An analytical assessment using a stock production model was accepted to estimate stock status in 2011.

Biomass: Biomass estimates in all surveys have been relatively high since 2000. Relative biomass from the production model has been increasing since 1994, is estimated to be above the level of B_{msy} after 1999, and is 1.7 times B_{msy} in 2011.





Fishing Mortality: From 2007-2010 *F* averaged about 25% of F_{msy}.



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

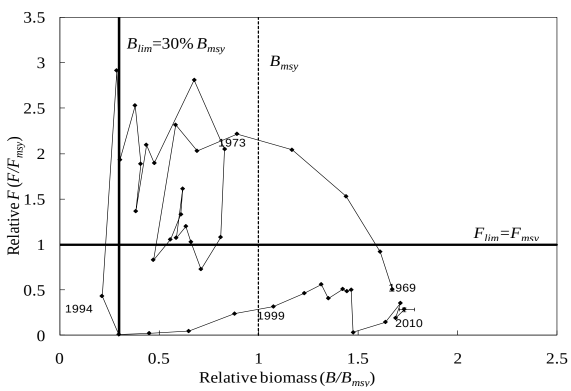
State of Stock: The stock is above B_{msy} and *F* is less than 1/3 F_{msy}. Stock size has steadily increased since 1994 and is currently estimated to be 1.7 times B_{msy}.

Catch Projections in 2012-13: Catch projections (in '000 t) at two levels of catch in 2011 and various levels of *F* are shown below.

Projected *F* (catch 2011=17 000t)	Catch 2012	Catch 2013
F_{2010}	8.9	9.0
$2/3\ F_{msy}$	19.9	18.9
$75\%\ F_{msy}$	22.2	20.8
$85\%\ F_{msy}$	25.0	22.9
F_{msy}	28.8	25.7
Projected *F* (catch 2011=8 979t)	**Catch 2012**	**Catch 2013**
F_{2010}	9.4	9.4
$2/3\ F_{msy}$	21.0	19.6
$75\%\ F_{msy}$	23.4	21.6
$85\%\ F_{msy}$	26.2	23.8
F_{msy}	30.4	26.8

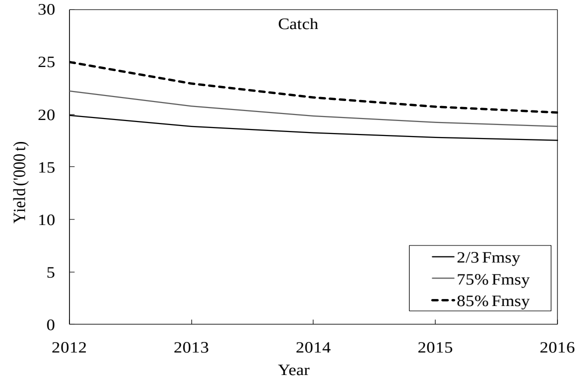
Recommendation: *F* options of up to 85% F_{msy} are considered to have a low risk of exceeding F_{lim} (=F_{msy}) in 2012 and 2013, and are projected to maintain this stock well above B_{msy}.

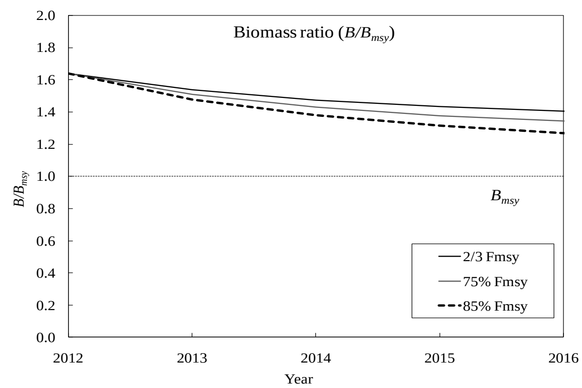
Reference Points: Scientific Council considers that 30% B_{msy} is a suitable limit reference point (B_{lim}) for stocks where a production model is used. At present, the risk of the stock being below B_{lim} = 30% B_{msy} is approximately zero. Currently the biomass is estimated to be above B_{lim} and *F*, below F_{lim} (=F_{msy}) so the stock is in the safe zone as defined in the NAFO Precautionary Approach Framework.



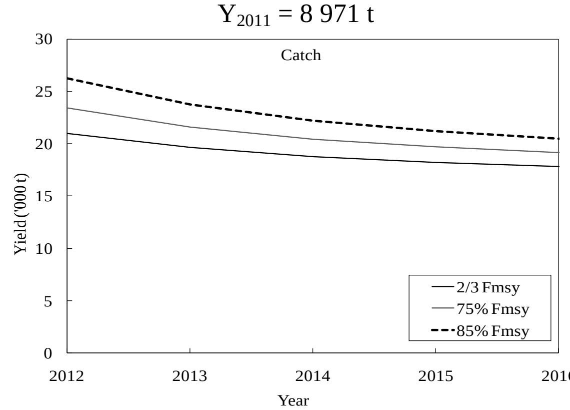
Medium Term Considerations: F_{msy} was estimated to be 0.25. Projections were carried out assuming two levels of catch in 2011 followed by constant fishing mortality from 2012-2016 at several levels of *F*. Although yields are projected to decline in the medium term at both levels of catch in 2011 for 2/3 F_{msy}, 75% F_{msy}, and 85% F_{msy}, at the end of the projection period, biomass is still projected to be above B_{msy}.

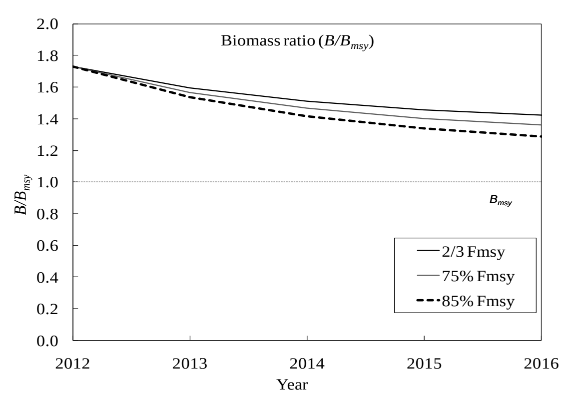
Y_{2011} = 17 000 t





Y_{2011} = 8 971 t





Special Comment: Scientific Council noted that the yellowtail flounder fishery takes cod and American plaice as by-catch. 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 2013.

Sources of Information: SCR Doc. 11/6, 33, 34, 37; SCS Doc. 11/4, 5, 7, 9, 11.

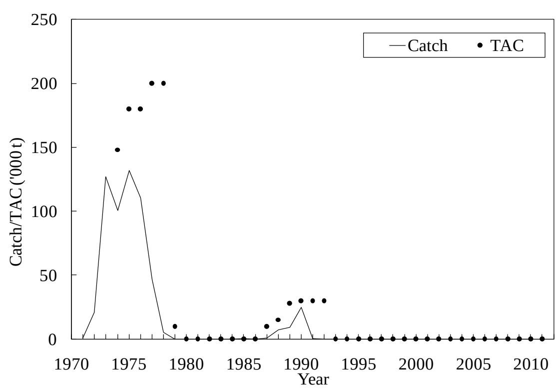
Capelin in Divisions 3NO

Fishery and catches: The directed fishery was closed in 1992 and the closure has continued through 2010. No catches have been reported for this stock since 1993.

Year	Catch ('000 t)	TAC ('000 t)
2008	0	ndf*
2009	0	ndf
2010	0	ndf
2011		ndf

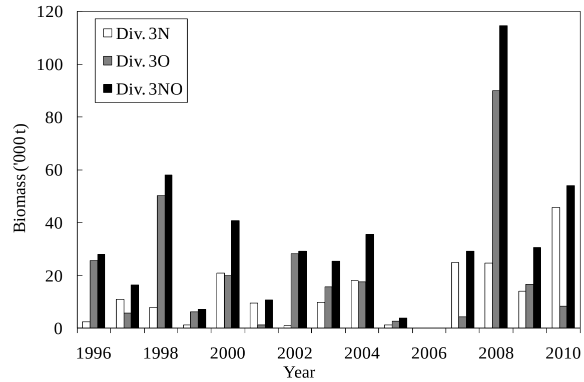
* ndf = no direct fishing

Data: Capelin catches from Canadian bottom trawl surveys conducted in 1990-2010, as well as historical data sets from Russian and Canadian trawl acoustic surveys directed to capelin.

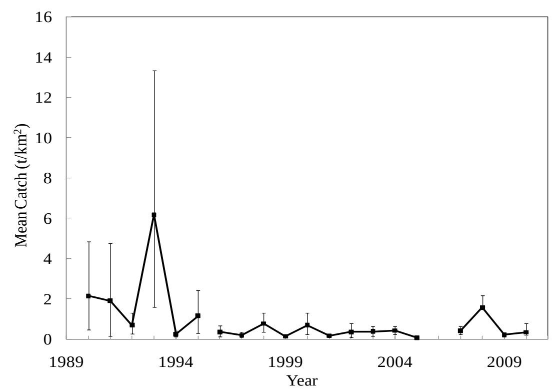


Assessment: No analytical assessment was possible with current data.

Biomass: The only indicator of stock dynamics presently available is capelin biomass indices obtained during Canadian stratified-random bottom trawl surveys. In 1996-2010 survey biomass of capelin in Div. 3NO varied from 3.9 t to 114.7 thousand t. In 2009-2010, survey biomass was 30.6 and 54.1 thousand t respectively; when the average for the period from 1996 was estimated as 34.5 thousand t. Estimates in 2006 are not compatible because of poor survey coverage in that year.



Mean catch index: In 1996-2010 the mean catch per km^2 varied between 0.06 and 1.56. In 2009 and 2010, this parameter was 0.21 and 0.33 respectively.



Recommendation: No directed fishery on capelin in Div. 3NO in 2012-2013.

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

The next full assessment will be in 2013.

Source of Information: SCR Doc. 11/18.

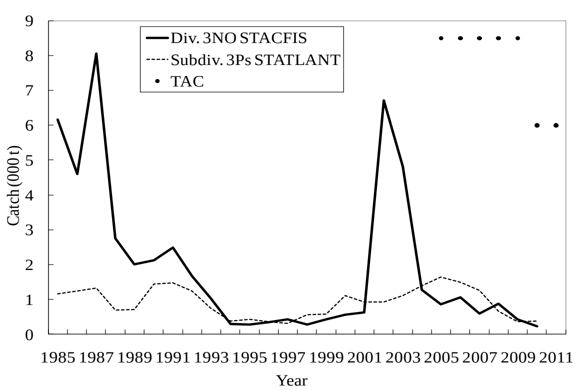
White hake in Divisions 3NO

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

Fishery and Catches: Catches in Div. 3NO peaked in 1985 at 8 100 t, then declined from 1988 to 1994 (2 090 t average). Average catch was low in 1995-2001 (464 t), then increased to 6 718 t and 4 823 t in 2002 and 2003, respectively, following recruitment of the large 1999 year class. Total catch decreased to an average of 767 t in 2005-2009, and was 226 t in 2010.

Catches of white hake in Subdiv. 3Ps were at their highest in 1985-1993, averaging 1 114 t, decreasing to an average of 668 t in 1994-2003. Subsequently, catches in Subdiv. 3Ps averaged 1 440 t in 2004-2007, and 443 t average in 2008-2010.

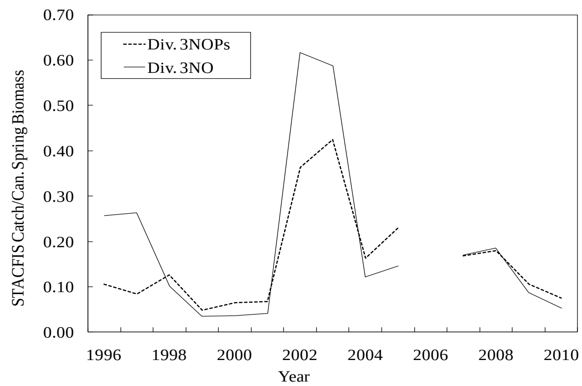
	Catch (000 t)			
	Div.3NO		Subdiv.3Ps	Div. 3NO
Year	STACFIS	21	21	TAC ('000 t)
2008	0.9	0.9	0.6	8.5
2009	0.4	0.5	0.3	8.5
2010	0.2	0.2	0.4	6
2011				6



Data: Length frequency data from the Canadian fishery (1994-2010), EU-Spain (2002, 2004), EU-Portugal (2003-2004, 2006-2010), and Russian Federation (2000-2007) were available. Biomass and abundance indices were available from annual Canadian spring bottom trawl surveys in Div. 3NOPs (1972-2010), autumn in Div. 3NO (1990-2010), and EU-Spain Div. 3NO spring surveys in the NAFO Regulatory Area (2001-2010).

Assessment: No analytical assessment was possible.

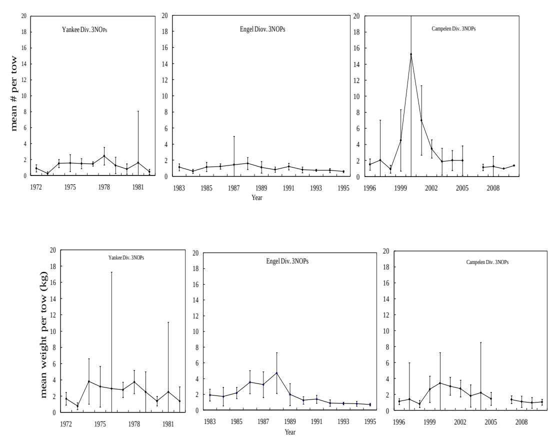
Fishing Mortality: Relative fishing mortality (STACFIS catch/Canadian spring biomass) has fluctuated, but increased considerably for 2002-2003. Current estimates of Relative *F* are comparable to levels observed from 1996-2001.



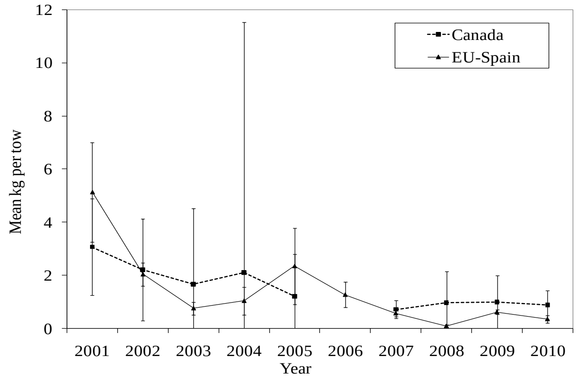
Recruitment: The 1999 year-class was large, but no large year class has been observed since then.

Biomass: The biomass of this stock increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has decreased and remains at levels comparable to the beginning of the Canadian Campelen spring time series in 1996-1999.

Canadian Spring Survey



Comparison of the Canadian spring survey in all of Div. 3NO and the Spanish Div. 3NO survey in the NRA show that both series have similar temporal trends.



State of the Stock: The biomass increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has decreased and remains at levels comparable to the period 1996-1999.

Recommendation: Given the current low level of recruitment, Scientific Council advises that the current TAC of 6 000 t is unrealistic and that catches of white hake in Div. 3NO in 2012 and 2013 should not exceed their current levels.

Reference Points: Reference points with respect to a precautionary approach for this species have not been determined.

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

Sources of Information: SCR Doc. 11/07, 22; SCS Doc. 11/05, 07, 09.

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b) Monitoring of Stocks for which Multi-year Advice was Provided in 2010

i) Finfish

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

In 2010: 2-year advice was provided for 2011 and 2012 for Cod in Div. 3NO, Redfish in Div. 3LN, Redfish in Div. 3O, Thorny skate in Div. 3LNO, Witch flounder in Div. 2J+3KL, Northern shortfin squid in SA 3+4.

The Scientific Council reviewed the status of the six stocks (interim monitoring) at this June 2011 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 Cod in Div. 3NO: (2010) 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.

Recommendation for Redfish in Div. 3LN: (2010) 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.

Recommendation for Witch flounder in Div. 2J + 3KL: (2010) 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.

Recommendation for Redfish in Div. 3O: (2010) 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.

Recommendation for Thorny skate in Div. 3LNO: (2010) 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.

Recommendation for Northern shortfin squid in SA 3+4:.(2010) 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.

c) Stocks under a Management Strategy Evaluation

The Fisheries Commission adopted in 2010 an MSE approach for Greenland halibut stock in Subarea 2 + Division 3KLMNO (FC Working Paper 10/7). This approach considers a survey based harvest control rule (HCR) to set a TAC for this stock on an annual basis for the next four year period. The Fisheries Commission requests the Scientific Council to:

a) annually monitor and update the survey slope and to compute the TAC according to HCR adopted by the Fisheries Commission according to Annex 1 of FC Working Paper 10/7.

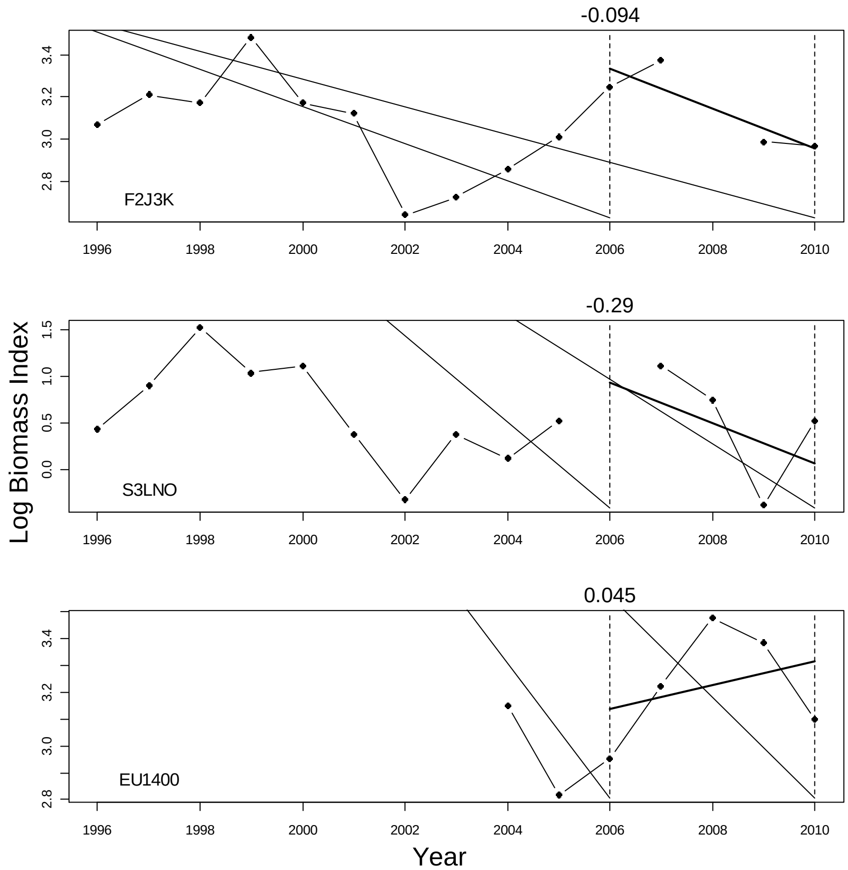
b) provide guidance on what constitutes "exceptional circumstances".

c) provide advice on whether or not the "exceptional circumstances" provision should be applied.

Scientific Council responded:

a) *annually monitor and update the survey slope and to compute the TAC according to HCR adopted by the Fisheries Commission according to Annex 1 of FC Working Paper 10/7.*

Survey slopes were computed over the most recent five years (2006-2010) and are illustrated below. The data series included in the HCR computation are the Canadian Autumn Div. 2J3K index ("F2J3K"), the Canadian Spring Div. 3LNO index ("S3LNO"), and the EU Flemish Cap index covering depths from 0-1400m ("EU1400"). Averaging the individual survey slopes yields *slope*= -0.1130. Therefore, 17185*[1+2*(-0.1130)] = 13 301 t. However, as this change exceeds 5%, the HCR constraint is activated and TAC_{2012} = 0.95*17185=16 326 t.



b) *provide guidance on what constitutes "exceptional circumstances".*

The HCR adopted by Fisheries Commission was tested during September 2010 under a suite of operating models (conditioned using XSA or SCAA) and found to be robust. Exceptional circumstances may generally be defined as any event or observation which is outside of the range of possibilities included within the MSE.

Some examples which could constitute exceptional circumstances in the Greenland halibut application may include catches outside the range tested in the MSE, or, differences between simulated and observed surveys.

c) *provide advice on whether or not the "exceptional circumstances" provision should be applied.*

At present, Scientific Council does not have the distributions of simulated survey indices, fishing mortality or biomass available to determine if the present status of resource is consistent with all operating models (OMs) on which the HCR was tested.

Comparisons were made between updated assessment results and XSA OMs; and the 2011 age 5-9 biomass from the updated XSA assessment is within the 5^{th} and 95^{th} percentiles of simulated biomass for all XSA OMs.

Given that exceptional circumstances have yet to be defined, determination of whether of not they are occurring is not possible. Further, extensive analysis by Scientific Council and/or decisions by Fisheries Commission may be required to determine whether or not the degree of differences between MSE assumptions/results and ongoing data collection are “exceptional enough” to warrant ignoring the HCR generated TAC in favour of other measures.

Specific to the Greenland halibut application, Scientific Council noted:

Catch over-run. The assumed catches in 2010 applied in all simulation testing during WGMSE were based on the TAC over-runs over the period 2004-2009 and ranged from 19.5 Kt to 23.2 Kt, with a median simulated catch 2010 of 20.7 Kt. However, the STACFIS estimate of catch for 2010 is 26.2 Kt, which is 26% higher than the median catch applied in simulation testing. Scientific Council notes that the estimated catch for 2010 exceeds the range included in WGMSE evaluations, and the degree of difference between MSE assumptions and current catch estimates may constitute an Exceptional Circumstance.

In addition, WGMSE evaluations assumed that in all years subsequent to 2010, removals would exactly equal the TAC generated from the HCR. That is, there is no allowance for TAC over-runs. Continued catch over-runs would increase the probability that updated assessments will differ from the distribution of results from the set of OMs considered during WGMSE.

Differences between simulated and observed surveys. If the observed surveys in the coming years fall outside the range of simulated surveys in the MSE, this may constitute an Exceptional Circumstance.

d) Special Requests for Management Advice

i) Reference point for Div. 3LNO A. plaice, Div. 3NO Cod, Div. 3LN redfish (Item 7)

Fisheries Commission requests the Scientific Council to identify F_{msy}, *identify* B_{msy} *and provide advice on the appropriate selection of an upper reference point for biomass (e.g.* B_{buf}*) for 3LNO American Plaice, 3NO cod and 3LN redfish.*

Scientific Council responded:

Results of the last assessments of these stocks (2010) were used in the estimation of reference points. Div. 3LN redfish is assessed using a surplus production model (ASPIC) and the reference points for that stock are derived directly from the results of the ASPIC. For Div. 3NO cod and Div. 3LNO American plaice reference points were obtained though simulation by running the population to equilibrium with the dynamics determined by the spawner-recruit relationship, together with weights, maturity and partial recruitment vectors. Scientific Council notes that the available data for Div. 3NO cod and Div. 3LNO American plaice do not span the entire production curve and therefore large uncertainty in the estimated reference points can be expected.

	Div. 3LNO American plaice	Div. 3NO cod	Div. 3LN redfish
F_{msy}	0.31	0.30	0.13
B_{msy}	242 000 t SSB	248 000 t SSB	186 000 t

B_{buf} is a stock biomass level above B_{lim} that is required in the absence of analyses of the probability that current or projected biomass is below B_{lim}. All three of the stocks in the present request have analyses of the probability that biomass is below B_{lim} and a B_{buf} is not required. For these stocks an additional zone(s) between B_{lim} and B_{msy} in the NAFO Precautionary Approach Framework could be considered.

Changes in population biology and in fishing practices can have a large impact on the estimated level of some reference points. For example, for Div. 3LNO American plaice, although the estimate of F_{msy} of 0.31 is considered to be the most appropriate at this time, estimates of F_{msy} ranged from 0.21 to 0.47 depending on the period used to compute the input parameters. These reference points therefore need to be reevaluated on a regular basis, the frequency of which will be stock specific depending on how much change there is in biological parameters and fisheries selectivity over time.

The use of any of these reference points in a precautionary approach framework or rebuilding plan needs to be evaluated for any stock to which they are applied. There needs to be a harvest control rule (management strategy) which is mathematically explicit in order to allow formal testing. Any proposed management/rebuilding strategy should be subject to robustness testing to determine the merit of the proposed strategy. This should then be followed by full management strategy evaluation. All such analyses conducted for the Fisheries Commission should be thoroughly peer reviewed by Scientific Council.

ii) Stock recruit relationship and B_{lim} for Div. 3NO cod (Item 8)

Fisheries Commission requests the Scientific Council to review the stock recruit relationship for 3NO cod and the historical productivity regime used in setting the B_{lim} value of 60 000t.

Scientific Council responded:

The stock recruit data for Div. 3NO cod from the most recent assessment (2010) were examined. Six different stock recruit models were fit to these data. While no particular S-R approach is strongly supported by the data, the Loess smoother fitted to log recruitment provides a general description of the past response of recruitment to SSB and can be used as a basis for deriving reference points. This model gives an estimate of B_{lim} of about 60 000 t.

The Scientific Council will review in detail the biological reference points in the context of the PA framework when the SSB has reached half the current estimate of B_{lim}. In order to conduct this review a number of stock recruit pairs are required once the stock has reached and exceeded 30 000 t of SSB. The most recent estimate of SSB (from the 2010 assessment) for this stock is 12 700 t. In the most optimistic projection scenario (F=0) the stock will not be above 30 000 t of SSB until 2012. It will be 2015 before recruitment at age 3 produced by the 2012 SSB is observed.

There is no basis at this stage to suggest a B_{lim} lower than 60 000 t of SSB.

iii) Capelin distribution in Div. 3L (Item 9)

Noting that distribution and historical catches of capelin have also occurred in 3L, the Scientific Council is requested to provide the Fisheries Commission with available information on the occurrence and distribution of capelin in 3L and to advise on further research requirements.

Scientific Council responded:

Annual spring (May) acoustic surveys of the Div. 3L portion of the Div. 2J+3KL capelin stock are available from 1988-1992, 1996, 1999-2005 and 2007-2010. The area covered is important for smaller, usually immature capelin and provides an index of this stock component. Capelin distribution within Div. 3L varies seasonally, with capelin coming inshore to spawn in the late spring and early summer. Throughout the rest of the year they are distributed over the shelf and the shelf break. During the period of high abundance in the late 1980s capelin densities were high in the coastal to mid-shelf region in the spring of the year. With the decline in capelin abundance in the early 1990s the distribution shifted, with a larger fraction found along the shelf break, in deeper waters and in closer proximity to the seabed. This distribution has continued into the 2000s, with capelin in the most recent survey year (2010) at a historically low biomass, less than one percent of that recorded during the 1980s. Changes in abundance and availability have also occurred in inshore fishery catches in Div. 3L. In 1980s catches occurred from St. Mary's Bay to Bonavista Bay, now fishing occurs predominantly in Trinity and Bonavista Bays with much reduced catches in Conception Bay.

Research on mechanisms controlling capelin cohort strength and growth is on-going. The most pressing research requirement for this stock (Div. 2J3KL) is a synoptic survey to estimate stock biomass, and allow for assessment of exploitation rates.

iv) Mid-water trawl mesh size for Div. 3LN redfish (Item 10)

Fisheries Commission requests the Scientific Council to examine the consequences resulting from a decrease in mesh size in the mid-water trawl fishery for redfish in Div. 3LN to 90mm or lower.

No new data is available on redfish selectivity in Division 3LN therefore Scientific Council is not in a position to offer advice on this issue at this time.

v) Management measures for blue whiting(Item 11)

Blue whiting (Micromesistius poutassou) is a widely distributed species, which can be found in the open ocean as a semi-pelagic species and in shallower waters close to the bottom. Blue whiting is largely fished in the North Eastern-Atlantic by pelagic trawls. The North East Atlantic Fisheries Commission (NEAFC) defined a minimum mesh size of 35mm when fishing for blue whiting with pelagic trawls in its regulatory area. Interest is increasing for developing fishing opportunities on this stock in the NAFO Regulatory Area, specifically in the boundary with the NEAFC RA, Division 1F, sub area 2 and Division 3K.

The Fisheries Commission requests the Scientific Council to give advice on the following measures to be adopted for the blue whiting:

a) Change in the classification of blue whiting in the species table (Annex II of NAFO CEM), from classification as a groundfish species to a pelagic species, consistent with the NEAFC classification.

The Scientific Council responded:

Blue whiting (*Micromesistius poutassou*) is a small pelagic gadoid that is widely distributed in the eastern part of the North Atlantic. The highest concentrations are found along the edge of the continental shelf in areas west of the British Isles and on the Rockall Bank plateau where it occurs in large schools at depths ranging between 300 and 600 m but is also present in almost all other management areas between the Barents Sea and the Strait of Gibraltar and west to the Irminger Sea (ICES CM 2009/LRC: 12 - SIMWG). In the North-Atlantic, blue whiting adults carry out active feeding and spawning migrations in the same area as herring and mackerel. Blue whiting has consequently played an important role in the pelagic ecosystems of the area, both by consuming zooplankton and small fish, and by providing a food resource for larger fish and marine mammals (ICES CM 2009/RMC:06 - PGNAPES).

There is growing evidence that there may be several components in the Northeast Atlantic blue whiting stock. It is difficult to determine how many possible sub-populations may exist (ICES CM 2009/LRC - SIMWG). There is very little information about the distribution of the blue whiting in the NRA. Probably the distribution of the ICES blue whiting stock extends into the eastern waters of the NRA in some years.

Based on in blue whiting ecology, distribution and fishery it seems reasonable to change the NAFO classification of the blue whiting to a pelagic species as it is in NEAFC Scheme of Control and Enforcement (NEAFC 2010. Scheme of Control and Enforcement)

b) In line with conservation and management measures in force in the NEAFC Regulatory Area, adoption of a minimum mesh size for pelagic and semi-pelagic trawls which would include in paragraph 1 of Article 13 – Gear Requirements the following:

- g) 35 mm for blue whiting in the fishery using pelagic trawls in Subarea 2 and Divisions 1F, 3K and 3M.

The Scientific Council responded:

Besides the introduction (first paragraph) of the Fisheries Commission request 11 refers to NRA Division 1F, subarea 2 and Division 3K, item b) of the request refers to Subarea 2 and Divisions 1F, 3K and 3M. Scientific Council **recommended** that *Division 3M should not be considered for a possible mesh size change.*

Despite Fisheries Commission responses to the Scientific Council request to clarify the “mid-water trawl”, “pelagic trawl” and “semi pelagic trawl” gears definition (NAFO, 2011), Scientific Council still thinks that it is necessary to clarify the definitions and characteristics of the gears classified under the NAFO mid-water trawls category.

There is no available information about the blue whiting fishery or distribution in NAFO Regulatory Area.

In the North Atlantic, the main fisheries on blue whiting take place in the Faroese region, west of Scotland and around the Porcupine Bank (ICES Divisions Vb, VIIa and VIIc). The multi-national fleet currently targeting blue whiting consists of several types of vessels but the bulk of the catch is caught with large pelagic trawlers. In EU-Spain and EU-Portugal (ICES Divisions VIIIc and IXa) blue whiting is mainly taken as by-catch in mixed trawl fisheries (ICES CM 2010/ACOM:15 - WGWIDE).

Discards of blue whiting are thought to be small in the pelagic fishery. Most of the blue whiting is caught in directed fisheries for reduction purposes. In general, discards are assumed to be minor in the blue whiting directed fishery (ICES CM 2009/LRC - SIMWG).

NAFO Scientific Council does not have information on selectivity of the pelagic and semi pelagic trawl gears for the blue whiting. Information about blue whiting selectivity for trawl gears is available from Fonseca *et al.* (2000). This study presents the selectivity for blue whiting for different fisheries (Table below). All of these are demersal mixed fisheries, except for the Spanish pair trawlers that targeted the blue whiting.

Based on this information Scientific Council advises that 35 mm is not appropriate for this fishery and suggest a 60 mm mesh size. This should be considered as a new fishery in the area, and despite to being a pelagic fishery, should be carried out under the NAFO protocols for experimental fisheries.

Blue whiting **no MLS established**

Country/Gear	Date	L_{50} 55 mm	L_{50} 70 mm	L_{50} 80 mm	SF 55 mm	SF 70 mm	SF 80 mm
PT – crustacean trawl	October 98	22.5	25.5	31.2	3.9	3.6	3.9
	July/August 99	---	26.7	---	---	3.9	---

Country/Gear	Date	L_{50} 45 mm	L_{50} 65 mm	L_{50} 80 mm	L_{50} 100 mm	SF 45 mm	SF 65 mm	SF 80 mm	SF 100 mm
SP – small opening trawl	December 98	18.6	23.7	---	---	4.1	3.7	---	---
	August 99	---	---	24.8	---	---	---	3.1	---

Country/Gear	Date	L_{50} 45 mm	L_{50} 65 mm	L_{50} 80 mm	L_{50} 100 mm	SF 45 mm	SF 65 mm	SF 80 mm	SF 100 mm
SP – high opening trawl	April 99	18.2	22.3	22.6	---	4.1	3.4	2.8	---
	August/September 99	17.2	21.1	---	---	3.8	3.3	---	---
SP – pair trawl	December 98	17.5	24.1	---	Not tested	3.9	3.7	---	Not tested
	August 99	14.8	---	---	---	3.3	---	---	---

L_{50} – in cm (total length)

References

Fonseca P., A. Campos, A Garcia, F. Cardador, M. Meixide, A. Padín, F. Theret, M. Meillat and F. Morandeau. 2000. Final Report of Trawl Selectivity Studies in Region 3. Study Contract nº 96/61.

ICES. 2009. Report of the Stock Identification Methods Working Group (SIMWG), By Correspondence. ICES CM 2009/LRC:12. 22 pp.

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ICES. 2010. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 28 August - 3 September 2010, Vigo, Spain. ICES CM 2010/ACOM:15: 612 pp.

NAFO, 2011. Report of the Standing Committee on International Control (STACTIC), 9-10 May 2011. FC Doc 11/03, Serial No. N5892

NEAFC. 2010. Scheme of Control and Enforcement

vi) Catch estimation for Div. 3LNO thorny skate(Item 12)

Catches of thorny skate in Div. 3LNO averaged 18 000 t between 1985 and 1991 and declined to 7 500 t in 1992-1995. Since 2000, estimated catches averaged 9 000 t. No analytical assessment has been performed and the current advice is based on the decline of the survey indices, which have been stable at low levels since 1996. However, relative fishing mortality has been relatively constant at around 17% between 1998 and 2004 and declined to 5% from 2005. Scientific Council has recommended that catches in 2011 and 2012 should not exceed the last three years average catch (approximately 5 000 t). The Fisheries Commission requests the Scientific Council to clarify the reason behind using the last three years period as the basis for the advice and to provide alternative options. In its examination, the Scientific Council should also take into account the relative stability of all survey indices since 1996 and furthermore consider the information that relative fishing mortality has declined to low levels.

The Scientific Council responded:

To ensure that populations of commercially exploited fish, such as thorny skate are within healthy biological limits their population size and age structure should be such that full reproductive capacity is achievable. As well, a healthy population should be expected to not exhibit population fragmentation or contraction/hyperaggregation. In addition, to ensure long term sustainable yields, a population is required to have solid, stable recruitment to compensate for fishery yields.

In the case of thorny skate in Div. 3LNO, despite a number of years of reduced fishing mortality the biomass remains at a low level. In fact, while the Canadian RV indices appear stable at low levels, the EU-Spain Div. 3NO index, which samples skate in the NRA of NAFO Div. 3NO has been declining since 2006. This decline coincides with a period of reduced skate landings and reduced fishing effort. Commercial catches of thorny skate reported by NAFO in Div. 3LNO declined from an averaged 18 000 t annually (1985-1991) to 7 500 t in 1992-1995, and catch in the last 5 years has averaged near 4,944t. In addition, there is no indication of healthy robust recruitment into the population. It should also be noted that the density of thorny skate in Div. 3LNO is still predominately on the southern Grand Banks in Div. 3NO. Historically, thorny skate had been widely distributed throughout the Grand Bank.

It should also be noted that thorny skate has a very low reproductive capacity – they are slow growing and produce few offspring. A strategy which reduces the removal rate when the stock status is low, such as in the case of thorny skate, could promote rebuilding to provide long term yields and conservation of the resource.

Average STACFIS catch, based on the recent catch history are provided in the table below. The average catch over various time spans ranges between 4 000 -7 000 t with a mode around 5 000 t.

Average STACFIS catch of thorny skate (Div. 3LNO) over various time spans:

#Years	Time Span	Average Catch
2	2009-2010	3978
3	2008-2010	5121
4	2007-2010	4739
5	2006-2010	4944
6	2005-2010	4825
7	2004-2010	5470
8	2003-2010	6234
9	2002-2010	6847
10	2001-2010	7083

vii) Protection of coral and sponges (Item 13)

Mindful of the NEREIDA mission, the international scientific effort led by Spain to survey the seafloor in the NAFO Regulatory Area,

Recognizing that the Coral and Sponge Protection Zones closed to bottom fishing activities for the protection of vulnerable marine ecosystems as defined in Chapter 1 Article 16 Paragraph 3 is in place until December 31, 2011,

Mindful of the call for review of the above measures based on advice from the Scientific Council,

Fisheries Commission requests that Scientific Council review any new scientific information on the areas defined in Chapter 1 Article 16 Paragraph 3 which may support or refute the designation of these areas as vulnerable marine ecosystems. In the event that new information is not available at the time of the Fisheries Commission meeting in September 2011, prepare an overview of the type of information that will be available and the timeline for completion.

Sources of Information: SCS Doc. 08/10, 08/24, 09/06, 10/19, 10/24 and references therein.

Although a full review of all NEREIDA results is not yet available, Scientific Council have focused their efforts in the study and analysis of different streams of data from the Sackville Spur (Closed Area # 6). The goal was to provide, at minimum, a more comprehensive look of one of the close areas currently in place. These results can be considered as a first order approximation of what would be expected to find in other closed areas with similar characteristics. In addition to the focalized efforts on Sackville Spur, some data analyses for other areas like Flemish Cap south, Flemish Cap east (Closed Area # 4), and Flemish Cap northeast prong (Closed Area 5) were also pursued.

The battery of studies and analyses done for the Sackville Spur (Closed Area # 6) rendered some important results about the benthic communities in this area which support the designation of this area as a VME. It was found that both benthic organisms' biomass as well as biodiversity is higher within the closed area, and that there were differences in the composition of the benthic community within and outside the closed area. Furthermore, the number of non-sponge benthic taxa is significantly and positively related to both depth and sponge densities, supporting the notion that sponge grounds have an important structural role in defining these benthic systems.

In the Flemish Cap northeast prong (Closed Area # 5), the work done documented the existence of a gradient of benthic communities with depth, transitioning from coral dominated communities at ~2450m depth, to corals intermixed with sponges around 2000m, to sponge dominated grounds at 1500m, and to a diverse community of corals, sponges and other benthic taxa at ~1300m depth. This is probably the most interesting arrangement of corals and sponges communities documented so far in the NRA. It is worth noting that the lower boundary of the Closed Area # 5 does not reach sufficiently deep waters to protect the entire gradient of coral and sponges assemblages. Therefore it would be advisable to extend the lower boundary of this closed area up to the 2500m contour.

Based upon the above findings, as well as prior studies, Scientific Council confirms that the original rationale and basis for identifying and establishing closed areas to protect significant concentrations of VME-defining corals and sponges was appropriate.

The processing of samples and analysis of the data collected during the NEREIDA project is still ongoing. A stream of results and studies are expected to become available over the next few years, but precise timelines for completion are dependent on the continuation of the funding and resources that had supported these research efforts until now. Many of these sources have already expired or are scheduled to finish in 2011. If current efforts aimed to secure additional funding are successful, a full analysis of NEREIDA data streams and collections is expected to be completed by 2014.

viii) GIS Framework and SASI model (Item 14)

Noting the response from the Scientific Council in June 2010 regarding simulation modeling in a GIS framework: "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."

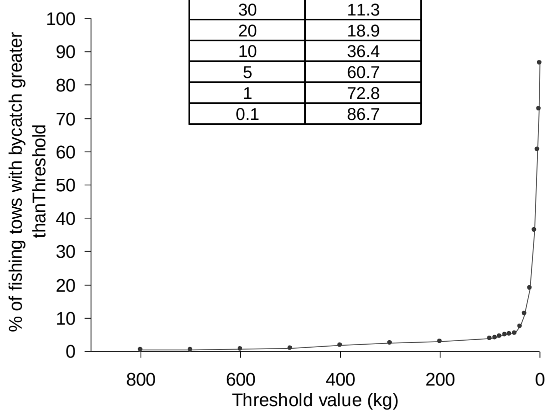
The Fisheries Commission requests that the Scientific Council: 1) acquire the requisite data and apply the model to the extent possible to the NRA, and 2) consider whether the SASI model used by the US New England Fisheries Council should be incorporated into the aforementioned GIS framework as a means of integrating significant adverse impacts into the approach.

Significant efforts were made to enhance and improve the GIS framework, and to apply it to the NRA, outside the closed areas, for the evaluation of VME-defining species bycatch threshold levels for encounter protocols. These efforts included a complete and open sharing of raw data among scientists of different Contracting Parties, a full engagement and collaboration with the staff at the NAFO Secretariat for the generation of VMS effort maps, as well as gathering information from actual commercial tows to capture their characteristics as realistically as possible within the GIS framework.

The key results from this analysis can be summarized in the following figure:

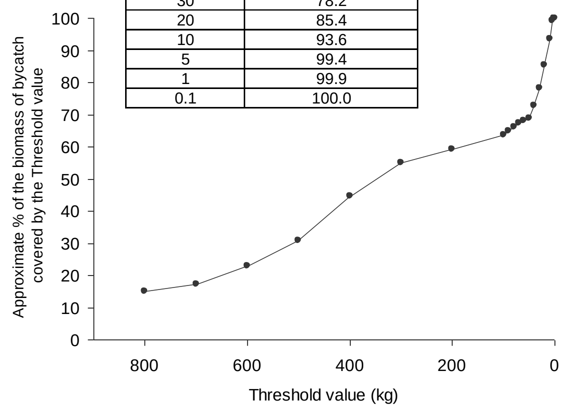
Impact of different threshold values on the fishery

Threshold value	% tows > Threshold
800	0.4
700	0.5
600	0.7
500	1
400	1.7
300	2.5
200	2.9
100	3.9
90	4.1
80	4.5
70	4.9
60	5.1
50	5.5
40	7.5
30	11.3
20	18.9
10	36.4
5	60.7
1	72.8
0.1	86.7



Impact of different threshold values on conservation

Threshold value	Approximate % of bycatch covered by the threshold level
800	15.1
700	17.3
600	22.9
500	30.8
400	44.6
300	55.0
200	59.4
100	63.8
90	64.9
80	66.1
70	67.5
60	68.2
50	69.0
40	72.9
30	78.2
20	85.4
10	93.6
5	99.4
1	99.9
0.1	100.0



At the present time, these results are relying on a simulation exercise intended to capture as much realism as possible. However, detailed and accurate reporting on bycatch of VME-defining species (sponges in this case) during commercial fishing operations is essential to validate the results from models like this, as well as to refine its accuracy and performance.

This GIS framework can generate outputs like the ones presented in the figures above, but it can also be used to provide estimations of biomass of sponge bycatch per effort, if selectivity values are available. The above analyses assume 100% catchability, but implementing other catchability values is possible.

The results obtained from the application of the GIS framework, indicate that the current encounter threshold for sponges bycatch is rarely met. If the intension of the threshold is to accomplish protection of sponges outside the closed areas this analysis therefore indicates that the threshold needs to be reduced. The above analysis can serve as a guide for this exercise. It is also considered very important to maximize efforts in the reporting of bycatch of corals and sponges, regardless of whether these bycatches hit or not the thresholds indicated in the encounter protocols.

Part 2: Consideration of the SASI model for its potential integration with the GIS framework, and its application to the NRA.

The Swept Area Seabed Impact model (SASI) addresses a different set of questions than the GIS framework, and hence, there is no particular benefit in merging both approaches into a single software application. SASI structure provides another tool to explore significant adverse impacts, but its current configuration/parameterization is not directly applicable to the NRA, however, the possibility of developing a SASI-like a tool for the NRA is expected to be explored further through the invitation extended to Brad Harris, a SASI expert from the University of

Massachusetts, to join the Scientific Council Working Group of Ecosystem Approaches to Fisheries Management (WGEAFM).

viii) Fishery impact assessments (Item 15)

Recognizing the initiatives on vulnerable marine ecosystems (VME) through the work of the WGFMS, and with a view to completing and updating fishery impact assessments, the Scientific Council is requested to provide the Fisheries Commission at its next annual meeting in 2011: 1) guidance on the timing and frequency of fishing plans/assessments for the purpose of evaluating significant adverse impacts on VMEs; 2) a framework for developing gear/substrate impact assessments to facilitate reporting amongst the Contracting Parties.

Part 1: Guidance on timing and frequency of fishing plans/assessments

At the present time, no fishing plan/assessment has been submitted in the new format, so there is no actual procedural experience on which a more thorough guidance and feedback, not just on timing and frequency, but also on content can be provided. Nonetheless, some observations can be made that may be of utility.

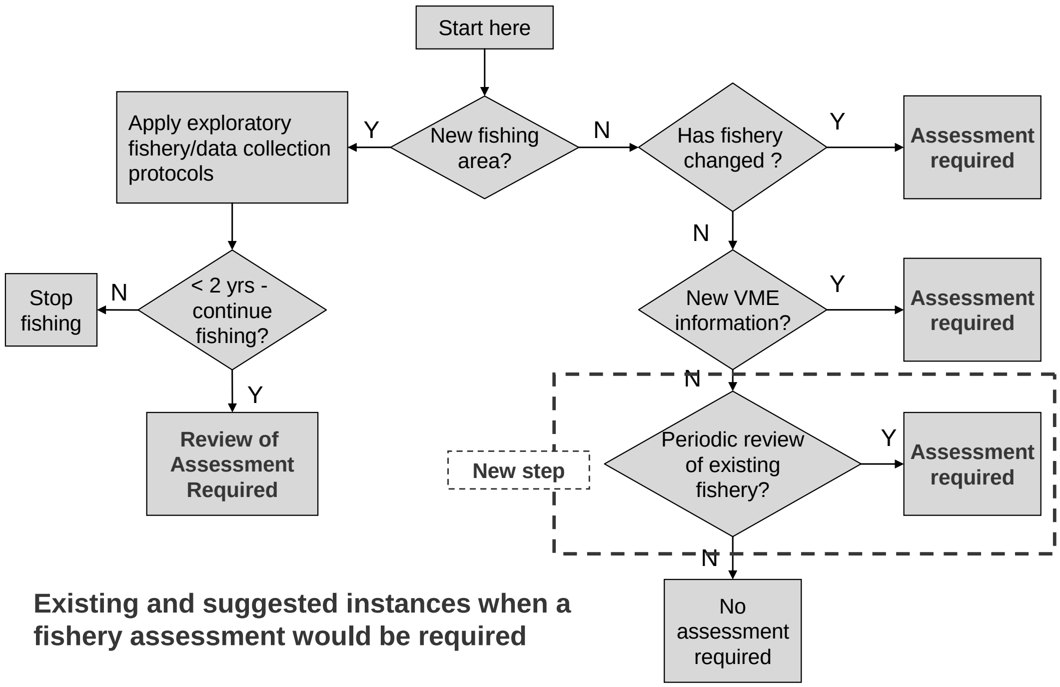
With regards to timing, the current NCEM provisions (Article 4bis) indicate that an assessment should be submitted no less than two weeks prior to the beginning of the June meeting of Scientific Council (SC). The intent of this is that Council would submit conclusions and recommendations to Fisheries Commission (FC) which, together with the advice received by its Working Group of Fisheries Scientists and Managers, would make decisions and recommendations pertaining to the assessment in the following September meeting. This assumes the intent of the proponents is to start fishing on Jan 1 of the following year. However, this timeline does may not allow for sufficient time for SC to prepare an adequate review of the submitted assessment. SC rules of procedure state that the SC Agenda for the June meeting must be finalized two months prior to the meeting; it would be important to respect this timeline in order to provide, a least in principle, a minimal amount of time for SC to review the submitted assessment.

This timeline essentially implies that the submission of an assessment should take place approximately 8-9 months prior to the intended start of the fishery. However, the review of assessments by Scientific Council would most likely require input from STACFIS, which meets in June, but may also require input from the SC WGEAFM, which typically meets in December. Considering these circumstances, it would be advisable that fisheries assessments are submitted one year prior to the FC meeting at which a decision on the assessment is expected to be made; assessment submission should be tabled at the FC and SC meeting during the September Annual Meeting of the year prior to the one where the decision should be made. This would allow SC to have enough time to circulate the assessment among all necessary groups with sufficient time for their reviews to be available at the SC June meeting prior to the FC meeting that would make a decision about the assessment.

With respect to frequency, current procedures do not establish any specific frequency for fisheries assessments. For example, in new fishing grounds, an assessment is triggered by the request of pursuing exploratory fishing, and another one is required two years later if the Contracting Parties request to continue fishing after the exploratory fishing phase. On existing fishing grounds, assessments are triggered by a) significant changes in the fishery, or b) new scientific information on VMEs in a particular area becomes available. On these grounds, it is worth noting that there should be an established process for reporting and reviewing possible VME encounters, and that SC needs data from fisheries to address questions on whether VME have been detected during fishing, and/or to evaluate if significant changes in the fishery have occurred. Current procedures allow FC to request updates on previously assessed fisheries, but there is no provision whatsoever that requires a periodic assessment of an existing fishery within the fishery footprint.

Given the lack of experience, it is difficult to gauge how demanding the review process of fisheries plans/assessments may be, or how this additional workload may affect the ability of SC to continue delivering the advice required within currently expected timelines. Until some assessments are actually submitted and reviewed, their true impact on regular SC activities will remain unknown.

Nonetheless, after examining the regulations that currently defines the frequency of assessments, Scientific Council suggests that a structure similar to the one depicted in the flowchart below, may help develop a more consistent approach to the submission and reviews of fisheries plans/assessments. This flow chart includes assessments required under current regulations, but it also incorporates new instances when an assessment would be required (e.g. periodic review of existing fisheries). The frequency of these periodic reviews would be better determined once some experience on assessments is gained, but one would expect it to be on a multiyear cycle.



Part 2: Guidance on framework for gear/substrate impact assessment to facilitate reporting amongst Contracting Parties

Scientific Council considered the development of an impact assessment framework, but could not provide a comprehensive approach at this time. SC noted that such frameworks exist in other RFMOs, and that further review of these frameworks and investigations into the particular requirements in the NAFO areas is needed. SC also noted that it would be useful for the continuing work on this matter if the request could be somewhat elaborated to give clearer directions on the work needed. Depending on the scope of such a framework SC also notes that this would require a considerable workload on SC members and that additional data from fishing activities will likely be required (e.g. an enhanced data collection protocol, fishery data on corals sponges, etc).

ix) Reduction/elimination of scientific tasks of observers (item [16])

Fisheries Commission requests the Scientific Council to evaluate any negative scientific impacts resulting from reduction/elimination of the scientific tasks specified under Article 28 of the NAFO CEM.

Scientific Council notes that the Observer Program (Article 28) whilst primarily aimed at maintaining compliance also include items of potential value to the work of Scientific Council: item 4a,b,c. However as the observer reports do generally not contain the information specified, e.g. on catch composition and discard by haul, the reports are of limited value to Scientific Council. On the other hand should the reports contain information as specified in Article 28 clause 4, such information should be very useful to Scientific Council. Also Scientific Council has some concerns whether the procedures for appointing and training the individual observers will secure the data quality needed.

Therefore, removing "scientific tasks specified under Article 28 of the NAFO CEM" will mean little change to the work of the Scientific Council.

Scientific Council notes that part of Article 28 regarding the collection of scientific information is now covered by the scientific observer programs as set up by some Contracting Parties.

2. Coastal States

a) Request by Denmark (Greenland) for Advice on Management in 2011 (Annex 3A)

i) Roundnose grenadier in SA 0+1 (Item 1)

Advice for roundnose grenadier in Subarea 0+1 was in 2008 given for 2009-2011. Denmark (on behalf of Greenland) requests the Scientific Council to *provide advice on the scientific basis for the management of Roundnose grenadier in Subarea 0+1 for 2012-2014.*

The Scientific Council responded:

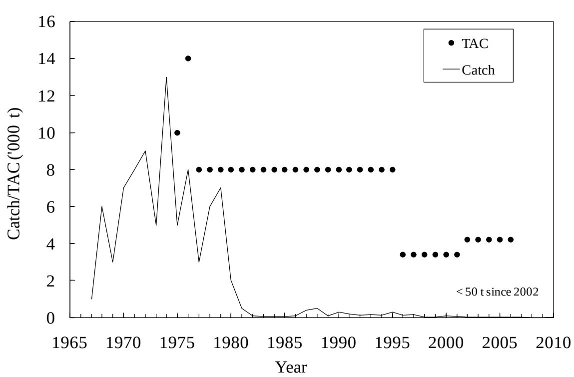
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 0 + 1

Background: The roundnose grenadier stock in Subarea 0 and 1 is believed to be part of a stock widely distributed in the Northwest Atlantic. The biomass was in 1987 estimated to be about 100 000 t but decreased dramatically in the late 1980s and early 1990s possibly because of migration out of the area. There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978.

Fishery and Catches: Roundnose grenadier is taken as bycatch in the Greenland halibut fishery. A total catch of 11 t was reported from 2010. 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.

	Catch ('000 t)		TAC ('000 t)	
Year	21	STACFIS	Recommended	Agreed[1]
2008	0.00	0.00	ndf[2]	
2009	0.00	0.00	ndf[2]	
2010	0.01	0.01	ndf[2]	
2011			ndf[2]	

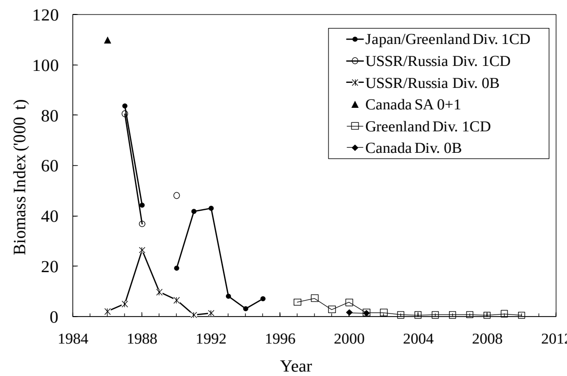
[1] No TAC set for 2007-2011
[2] ndf:No directed fishing, catches restricted to by-catch in other fisheries.



Data: There has been conducted a number of surveys in the area since 1986 but not any survey that covers the entire area or the entire period which makes direct comparison between survey series difficult. Generally the biomass has declined from the late 1980s and early 1990s to a very low level in recent years.

Assessment: No analytical assessment could be performed.

Biomass: In the Greenland survey in 2010 the biomass in Div. 1CD was estimated at 581 t, the second lowest level in the time series, and the biomass is hence still at the very low level seen since 1993 and the stock is composed of small fish.



Recruitment: Not known.

Fishing Mortality: Level not known

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

Recommendation: There should be no directed fishing for roundnose grenadier in Subareas 0 and 1 in 2012-2014. Catches should be restricted to bycatches in fisheries targeting other species.

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 1980s and early 1990s are not directly comparable with recent estimates these are far below what was seen previously. The survey time series from the 1980s and the early 1990s are, however, too short to be used for estimation of reference points.

Special Comments: The next full assessment of this stock will take place in 2014.

Sources of Information: SCR Doc. 11/09; SCS Doc. 11/06.

ii) Redfish and other finfish in SA 1 (item 2)

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 *provide 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)) on the scientific basis for the management of in Subarea 1A for 2012-2014.*

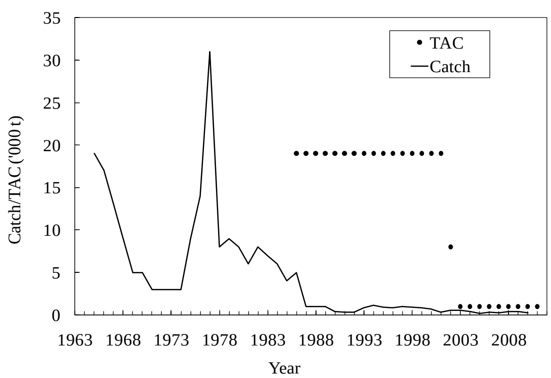
Demersal Redfish (Sebastes spp.) in Subarea 1

Background: 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.

Fishery and Catches: 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. In 2010, 251 t were reported including 85 t reported to Greenland as by-catch in the shrimp fishery.

	Catch	TAC (‘000 t)	
	(‘000 t)	Recommended	Autonomous
2008	0.4	ndf	1
2009	0.4	ndf	1
2010	0.3	ndf	1
2011		ndf	1

ndf - No directed fishery



Data: Biomass and abundance indices were available from the EU-Germany groundfish survey (1982-2010), The Greenland Shrimp Fish survey (1992-2010), The Greenland-Japan deep-sea survey (1987-1995) and The Greenland deep-sea survey (1997-2010).

Assessment: No analytical assessment could be performed.

Fishing mortality: Unknown for both stocks.

Golden redfish

Biomass: The biomass of golden redfish in SA1 has generally been increasing since 2002, but is still far below the 1982 survey estimate.

Recruitment: Recruitment of age 5 has been generally increasing since 2002.

State of the Stock: The stock has revealed some recovery potential due to both increased recruitment and SSB. However, biomass remains far below the 1982 EU-German survey estimate. The stock remains at a low level.

Deep-sea redfish

Biomass: An increase in biomass has been observed in the Greenland deep-sea Survey and in SSB in the EU-German survey in recent years. However, the SSB indices derived from the EU-German survey are below the 1980s values. The stock remains at a low level.

Recruitment: Recruitment has been low in recent years.

State of the stock: The increase in SSB observed in the EU-German survey since 2002, is below the initial 1980s values. The stock remains at a low level.

Recommendation: No directed fishery should occur on demersal redfish in Subarea 1 in 2012, 2013 and 2014 and bycatches in other fisheries be kept at the lowest possible level.

Reference points: Scientific Council was unable to propose reference points for either of the stocks.

This stock will next be assessed in 2014.

Other finfish in Subarea 1

Background: Other finfish in NAFO SA1 refers to Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*), American plaice (*Hippoglossoides platessoides*) and thorny skate (*Amblyraja radiata*).

Fishery and Catches:

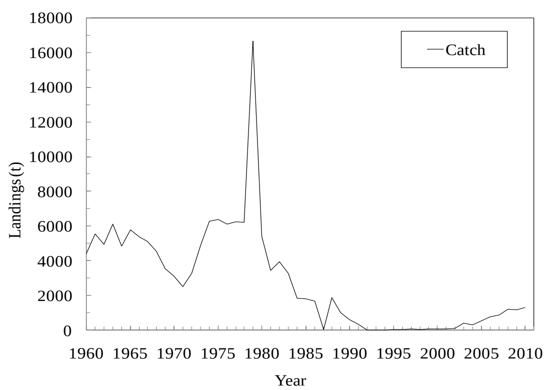
Atlantic wolffish and spotted wolffish

Catch statistics for both wolffish species are combined, since no species-specific data are available from logbooks or factory landings reports. Catches of wolffish in SA1 were at a level around 5 000 t/yr from 1960 to 1980. Catches then decreased to <100 t/yr during the 1980s and remained low until 2002. Since then catches have increased gradually to 1300 t in 2010.

Recent nominal catches (t) for wolffish.

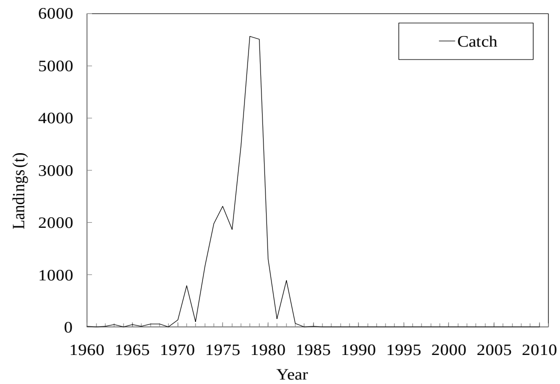
	Catch	TAC ('000 t)	
	('000 t)	Recommended	Autonomous
2008	1.2	ndf	1
2009	1.2	ndf	1
2010	1.3	ndf	1
2011		ndf	1

ndf – No directed fishery, catches restricted to bycatch in other fisheries.



American plaice

Catches of American plaice developed during the 1970s, decreased in the beginning of the 1980s and has been at a very low level since then. In the past decade there have been no reported catches or by-catches of American plaice in SA1.



Thorny skate

Catches of thorny skate are reported as skates combined (SKA), but it seems likely that thorny skate constitutes a significant proportion of the reported catches. Catches or reporting seems to have been sporadic but were >100 t/yr in 1984 and 1985.

Research survey data

EU-German groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982, covering NAFO 1BCDEF from the 3-mile limit to the 400 m isobaths.

The Greenland Shrimp Fish survey. Annual abundance and biomass indices were derived from the random stratified bottom trawl survey commencing in 1992, covering NAFO 1ABCDEF from 50 to 600 m isobaths.

Assessment: No analytical assessment could be performed for any of the stocks.

Fishing mortality: unknown for all of the stocks.

Atlantic wolffish

Biomass: After an increase in biomass from 2002 to 2005 the indices have decreased again in the EU-German groundfish survey, and indices are far below the values of the beginning of the time series.

Recruitment: Recruitment has been decreasing in the recent 5 years, but recruitment was above average in the preceding decade. The Atlantic wolffish stock in SA1 is mainly composed of small individuals.

State of the stock: Although, the Stock of Atlantic wolffish has shown some recovery potential due to increased recruitment and slightly increasing biomass trends in the past decade, the stock remains at a low level.

Spotted wolffish

Biomass: Biomass indices for spotted wolffish are currently above average values in the EU-German groundfish survey.

Recruitment: Unknown. No new distinct year-classes can be identified in the length distributions in past years, and the increasing biomasses since 2002 may rely on immigration from areas not covered by the surveys.

State of the stock: Unknown.

American plaice

Biomass: The biomass has been increasing since 2002 in both surveys. Nevertheless, the biomass indices of the EU-German groundfish survey are far below their initial values of the 1980s.

Recruitment: Incidents of above average recruitment have been observed since the mid 1990s.

State of the stock: The stock of American plaice has shown recovery potential with incidents of higher recruitment and increasing biomass indices in both surveys since 2002. However, the stock remains at a low level.

Thorny skate

Biomass: Biomass indices in both surveys are far below their initial values.

Recruitment: Unknown.

State of the stock: The stock remains at a low level.

Recommendation: No directed fishery in SA1 for *Atlantic wolffish*, *American plaice* and *thorny skate* in 2012, 2013 and 2014. By-catches of these species should be kept at the lowest possible level.

Scientific Council was unable to provide advice on the catch level for spotted wolffish.

Reference points: For all of the stocks Scientific Council was unable to propose reference points for Atlantic wolffish, spotted wolffish, American plaice and thorny skate in SA1.

Special comments: Scientific Council noted that a differentiation of the species of wolffish in landing reports and logbooks could improve the knowledge of the stocks of wolffish.

These stocks will next be assessed in 2014.

iii) Greenland halibut in Div. 1A inshore (item 4)

Advice for Greenland halibut in Subarea 1A inshore was in 2010 given for 2011-2012. Denmark (on behalf of Greenland), requests the Scientific Council to *continue to monitor the status of Greenland halibut in Subarea 1A inshore annually, and should significant change in stock status be observed, the Scientific Council is requested to provide updated advice as appropriate.*

The Scientific Council responded as follows:

The Scientific Council reviewed the status of this stock at the June 2011 meeting. Analysis of logbook data has provided an additional source of information. Scientific Council considers that for Disko Bay there is a general impression of a decreasing stock in recent years, while for Upernavik and Uummannaq there are indications of stable stock sizes. There is no evidence of any significant change in stock status therefore there is no basis upon which to provide updated advice. Then next Scientific Council assessment of this stock will be in 2012.

iv) West Greenland shrimp audit of management in 2011 (Annex 3B, item 1)

Denmark, on behalf of Greenland, requests the Scientific Council to *do an audit of the shrimp management plan to be available simultaneous with, or preferably immediately before, the annual shrimp advice in November 2011 with a view to include recommendations in the determination of the shrimp TAC for 2012.*

As the shrimp group in the Scientific Council has estimated that the current reference points in section 20 of the shrimp management plan are too conservative, the Scientific Council is furthermore requested, *with reference to section 20 in the management plan, to recommend specific threshold values as the appropriate threshold reference points in relation to* B_{msy}, B_{lim} *and* Z_{msy} *as soon as the limits of the biomass is exceeded.*

This request for advice is deferred to October 2011.

v) Additional information on the stock and management regarding the striped pink shrimp (P. montagui) in SA 0 and 1 in 2012 and years ahead (Annex 3C)

Greenland is in the process of establishing the necessary documentation for obtaining MSC certification for its shrimp fishery in West Greenland and in that respect Greenland has been asked to provide additional information on the stock and management regarding the Striped pink shrimp (*P. montagui*) in Subarea 0 and 1 in 2012 and years ahead.

As *P. montagui* is the main retained bycatch species in the fishery for Northern shrimp (*P. borealis*), the Council is requested for advice on *measures that might be applied in the fishery for P. borealis to maintain the stock of P. montagui within safe biological limits.*

The Scientific Council is in other words asked for advice on *whether the stock of the main retained bycatch species P. montagui is within safe biological limits and on measures that might be applied in the fishery for P. borealis to maintain the stock of the main retained bycatch species P. montagui within safe biological limits.*

This request for advice is deferred to October 2011.

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 (Annex 2, Item 1a) and Denmark (on behalf of Greenland) (Annex 3, Item 3) as regards Greenland halibut in SA 1, requested Scientific Council to *advise on appropriate TAC levels for 2012, 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:

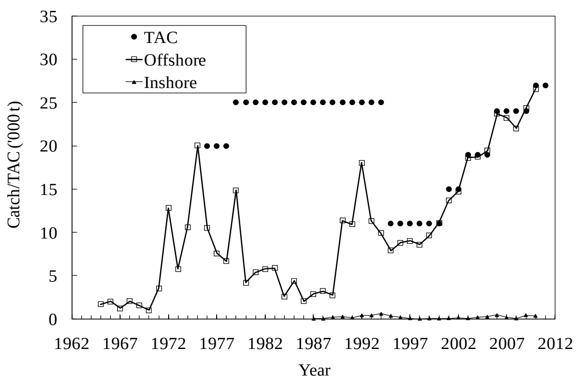
Greenland halibut in SA 0 + Div. 1A offshore and Div. 1B-1F

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 26 900 t in 2010 primarily due to increased effort in Div. 0A and in Div. 1A but effort was also increased in Div. 0B and 1CD in 2010.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recc.	Agreed
2008	22	23	24[1]	24
2009	25	24	24[1]	24
2010	27	21	27[1]	27
2011			27[1]	27

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

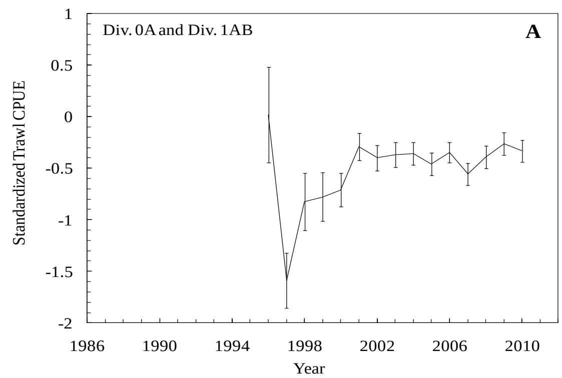


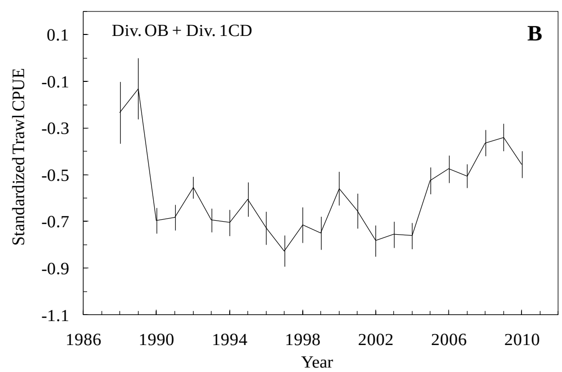
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2010 were available from Div. 0A, Div. 1A and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2010.

Assessment: No analytical assessment could be performed.

Commercial CPUE indices. Combined standardized catch rates in Div. 0A and Div. 1AB have been stable during 2002-2010.

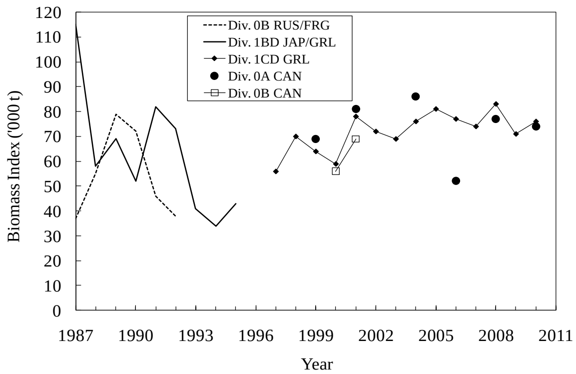
The combined Div. 0B and 1CD standardized catch rates have been stable during 2002 - 2004. Since then the standardized catch rates have increased gradually and were in 2009 at the highest level seen since 1989. CPUE decreased in 2010 but is still at a high level.



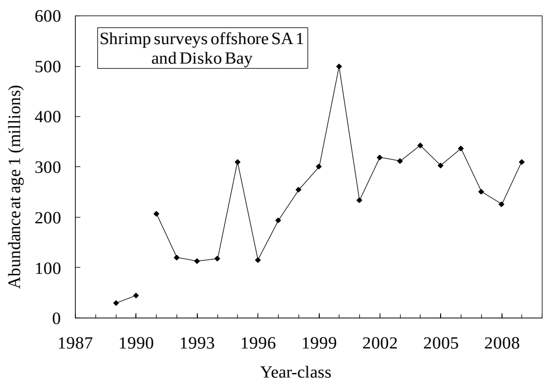


Biomass: The biomass in Div. 0A (to 73°N) decreased slightly between 2008 and 2010 but has been stable in the recent 12 years. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has been gradually decreasing during 2004-2009 but increased again in 2010 to a level slightly above the average for the time series (1991-2010).

The survey biomass in Div. 1CD increased gradually between 1997 and 2008, decreased in 2009 but increased again in 2010 to a level slightly above the average for the fourteen year time series.



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 and 2009 year-classes were above average. The recruitment of the 2007 - 2009 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 and deep sea surveys have been stable in recent years. Survey biomass in Div. 0A and Div. 1A and CPUE indices in Div. 0A and 1AB have been stable in recent years.

Div. 0B+1C-F: Length compositions in the catches and deep sea surveys have been stable in recent years. Survey biomass in Div. 1CD has been stable. CPUE indices in Div. 0B and 1CD have shown an increasing trend in recent years but decreased between 2009 and 2010. The CPUE is, however, still above at the level observed in the 1990s.

Recommendation: Div. 0A+1AB: Considering the recent increases in TAC, the relative stability in biomass and CPUE indices for Greenland halibut in Div. 0A and 1AB Scientific Council advises for Div. 0A and Div. 1A off shore + Div. 1B that the TAC for 2012 should not exceed 13 000 t.

Div. 0B+1C-F: Taking into account the recent increases in TAC, the stability in biomass and relative stability in CPUE indices for Greenland halibut in Div. 0B and Div. 1CD Scientific Council advises for Div. 0B and Div. 1C-F that the TAC for 2012 should not exceed 14 000 t.

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

Special Comments: Scientific Council noted that there is considerable uncertainty about accuracy in the current age reading methods. Results from validation for the SA0 and Div. 1A (offshore) and 1B-F stock indicate longevity is greater and growth rates lower than previously estimated.

The next Scientific Council assessment of this stock will be in 2012.

Sources of Information: SCR Doc. 11/09, 10, 17, 27; SCS Doc. 11/06, 09, 10, 11.

3. Scientific Advice from Council on its Own Accord

a) Oceanic (Pelagic) Redfish

Pelagic redfish (*Sebastes mentella*) in NAFO SA 1 and SA 2, 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 26 April - 3 May 2011.

In early 2009 the stock structure of the Oceanic redfish (*S. mentella*) was reviewed by the Study Group on Redfish Stock Structure (WKREDS) which met at ICES Headquarters 22-23 January 2009 and based on their review on ICES advice which is now given separately for shallow pelagic *S. mentella* and deep pelagic *S. mentella*. The shallow pelagic *S. mentella* management unit distribution includes the NAFO Subarea 1 and 2.

The NWWG was not able to evaluate the state of either of these stocks. Based on a scheduled acoustic-trawl survey in June 2011, an assessment and advice will be provided in the autumn 2011. Therefore, Scientific Council will not able to review and comment on the advice for these stocks for 2012 until after ICES provides the assessment in autumn 2011. Catches for 2010 in the shallow pelagic *S. mentella* stock were 2 419 t, 1 074 t of which were caught in NAFO Division 1F.

The ICES advice for the fishery in 2011 is therefore the same as the advice given in 2009 for the 2010 fishery: "ICES advises on the basis of precautionary considerations that no directed fishery should be conducted and by-catch of this stock in non-directed fisheries should be kept as low as possible. A recovery plan should be developed. Given the very low state of the stock, the directed fishery should be closed in 2010 irrespective of whether the recovery plan has been developed by that time or not."

NEAFC set a zero TAC for the shallow pelagic *S. mentella* management unit for 2011.

b) Roughhead Grenadier in SA 2 + 3 (Monitor)

The Scientific Council reviewed the status of this stock (interim monitoring) at this meeting. Based on overall indices for the current year, Scientific Council found no significant change in the status of this stock. The next full assessment of this stock is planned to be in 2013.

VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

1. Scientific Council, September 2011

Scientific Council noted that the Annual Meeting will be held 19-23 September 2011 at the Westin Hotel, Halifax, Nova Scotia, Canada. There will be a WebEx meeting in advance of this to prepare advice on shrimp stocks.

2. Scientific Council, October 2011

The Scientific Council noted that the dates and venue of the next Scientific Council/NIPAG meeting will be held from 19-26th October 2011 at the NAFO Secretariat, Dartmouth, Canada.

3. Scientific Council, June 2012

Scientific Council agreed that its June meeting will be held on 1-14 June 2012 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada.

4. Scientific Council, September 2012

Scientific Council noted that the Annual Meeting will be held in 17-21 September 2012. 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 2012

Scientific Council noted that the Scientific Council/NIPAG meeting will be held in October 2012. The meeting will be in Tromsø, Norway.

6. ICES/NAFO Joint Groups

a) WGHARP, August 2011

The next meeting of WGHARP will be held in St. Andrews, Scotland, 15-19 August 2011.

b) NIPAG, October 2011

The dates and venue of this NIPAG meeting will be 19-26th October 2011 at the NAFO Secretariat, Dartmouth, Canada.

c) WGDEC, March 2012

The Working Group on Deep-water Ecology will meet at ICES, Copenhagen, Denmark, 26-30 March 2012.

d) NIPAG, October 2012

The dates and venue of this NIPAG meeting will be decided at the 2011 meeting. The meeting will be held in October 2012 in Tromsø, Norway.

7. Scientific Council Working Groups

a) WGEAFM, December 2011

WGEAFM will meet at the NAFO Secretariat, Dartmouth, Canada, on 30 November - 9 December 2011.

b) WGRP, March-April 2011

The next planned meeting of the working group on reproductive potential will be in the latter half of 2012. Dates and venue are to be determined.

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Topics for Future Special Sessions

No proposals for special sessions have been received.

X. MEETING REPORTS

1. Working Group on EAFM, December 2010

The Scientific Council Working Group on Ecosystem Approaches to Fisheries Management (WGEAFM), met at the NAFO Headquarters, Dartmouth, Canada, on December 1-10, 2010. The final report of this meeting is available as SCS Doc. 10/24 at the NAFO website.

WGEAFM currently operates within a set of long term Themes and Terms of Reference (ToR) that were approved by NAFO Scientific Council (SC) in June 2010 and are being systematically addressed by the group over several meetings. These Themes and ToRs build on the "*Roadmap for Developing an Ecosystem Approach to Fisheries for NAFO*" (Roadmap to EAF) proposed by WGEAFM in its 2^{nd} meeting (Vigo, 1-5 February 2010). In addition, WGEAFM also provides guidance to Scientific Council on specific ecosystem-related issues and requests from Fisheries Commission.

In terms of the "Roadmap to EAF", the 3rd meeting of WGEAFM delineated ecoregions and ecosystem-level units in the NW Atlantic, focusing particularly on the Newfoundland and Labrador Shelf, the Flemish Cap and the Scotian Shelf; similarly developed regions for the Northeast US Continental Shelf were also presented at the meeting. WGEAFM also began the discussion of models and approaches to calculate fisheries production potential, based on the advances on this topic done for the Northeast US Continental Shelf.

In addition to the above work, the WGEAFM also provided the scientific information and guidance to Scientific Council required to address three ecosystem-related requests from Fisheries Commission made in September 2010. This work involved a review and summary of new analyses and information regarding VMEs coming from the NEREIDA project, the implementation of the GIS framework developed by WGEAFM for the estimation of threshold values for sponges in the deepwater groundfish fisheries on the NRA, the assessment of the Swept Area Seabed Impact model (SASI) and its potential use in the NRA, as well as the provision of guidance regarding timing and frequency for fisheries assessment, and ways for developing a framework for the assessment of gear/substrate impact assessments to facilitate reporting amongst the contracting parties.

This meeting, more than previous meetings, has benefited from the participation of scientific experts from other research groups/projects who have shared their spatial data. This collaboration has benefited the group and greatly enhanced the quality and applicability of the output. It is hoped that the expansion of the group continues for the benefit of all contracting Parties concerned in their efforts to promote sustainable fisheries and maintain diverse and healthy ecosystems. The timing of this meeting, being held in early December, has assisted in this wider participation. The timing is beneficial for another reason, as it allows for the early planning of responses to requests from Scientific Council, many of which were formulated in September by Fisheries Commission.

It was proposed that the 4th WGEAFM meeting to take place in November 30-December 09, 2011, at the NAFO Headquarters in Dartmouth, Canada.

WGEAFM proposed that its 4th meeting should continue addressing the long-term ToRs described as:

Theme 1: Spatial considerations

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.

Theme 2: Status, functioning and dynamics of NAFO marine ecosystems.

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

Theme 3: Practical application of ecosystem knowledge to fisheries management

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.

More specifically, work during the 4th WGEAFM meeting is proposed to be focused on:

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

It is expected that additional analyses from the NEREIDA project and surveys will become available; these new studies will be presented and discussed under this ToR.

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

Updates and new analysis related to ecoregion delineation and ecosystem-level unit identification work (e.g. incorporation of taxomomic layers, variations in ecoregion boundaries over time) are expected to be presented and discussed under this ToR.

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

Work under this ToR will be focused in the exploration of methods to estimate fisheries production potential at the scale of the ecosystem-level units identified during the 3rd WGEAFM meeting. These analysis are expected to include fisheries production potential models (see ToR4c in the WGEAFM Report), but they may also explore other modelling avenues (e.g. aggregate biomass models)

In addition to the work focused on the ToRs indicated above, WGEAFM would also be expected to dedicate time to address specific ToRs related to SC and/or FC requests.

If time allows, any study not pertaining to the focal ToRs indicated above, but still of relevance for addressing WGEAFM long-term ToRs may also be presented and discussed.

Scientific Council considerations

Scientific Council took notice of the progress made by WGEAFM, and approved the plans for the next meeting in November 30 – December 09 2011 at the NAFO Headquarters.

Further developments by SC of the work of WGEAFM

In addition to the input provided by SC WGEAFM (SCS 10/24), SC engaged itself in a detailed examination of the work provided, and in some cases, even exploring further some of the WGEAFM analyses.

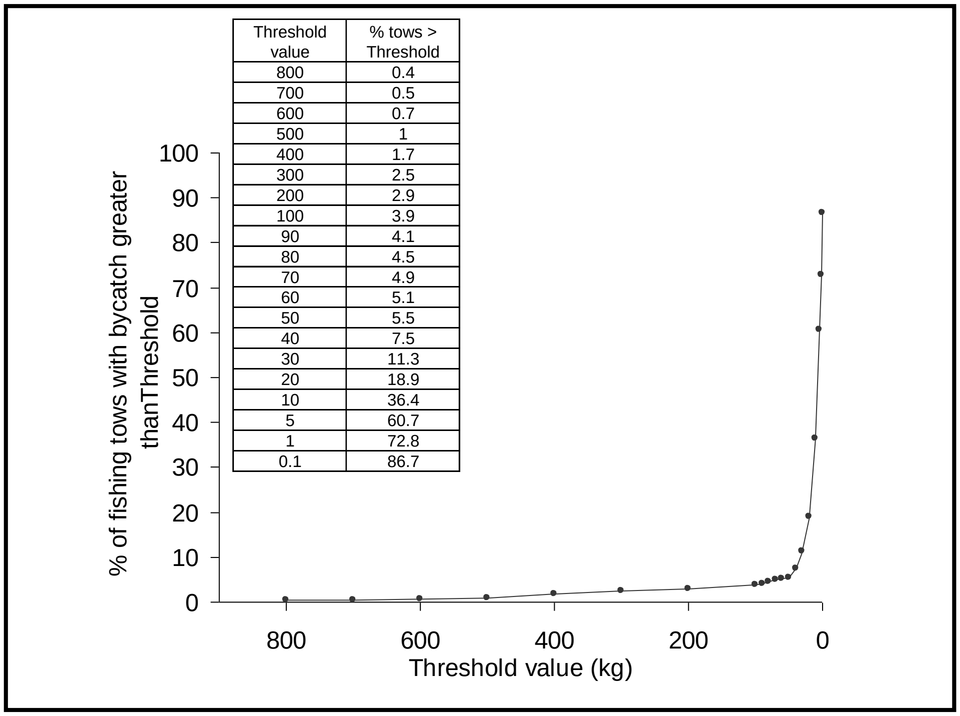
GIS framework

Significant efforts were made to enhance and improve the GIS framework, and to apply it to the NRA, outside the existing closed areas, for the evaluation of VME-defining species bycatch threshold levels for encounter protocols. These efforts included a complete and open sharing of raw data among scientists of different contracting parties, a full engagement and collaboration with the staff at the NAFO Secretariat for the generation of VMS effort maps, as well as gathering information from actual commercial tows to capture their characteristics as realistically as possible within the GIS framework.

In keeping with the view that encounter protocols should be gear/taxon specific, the analysis only considered **sponge** bycatch thresholds applicable to the **groundfish** fishery operating in the NRA between 700 and 2000 m depth (i.e. mainly Greenland halibut), which is the fishery with the highest likelihood of encountering sponges given their area of operation.

The essence of this analysis involved: a) the generation of both sponge bycatch, and fishing effort raster maps, b) the simulation of 1500 commercial sets based on the effort map and characteristic length of commercial tows, and c) calculation of the simulated sponge bycatch in each one of those 1500 tows based upon the sponge bycatch map. In the generation of the sponge bycatch map, as well as in the generation of simulated tows, it was considered the existence of current closed areas (i.e. no simulated tow fished in a closed area, nor the high sponge densities inside closed areas were considered when building the sponge bycatch surface).

The key results from this analysis can be summarized in the following figure:

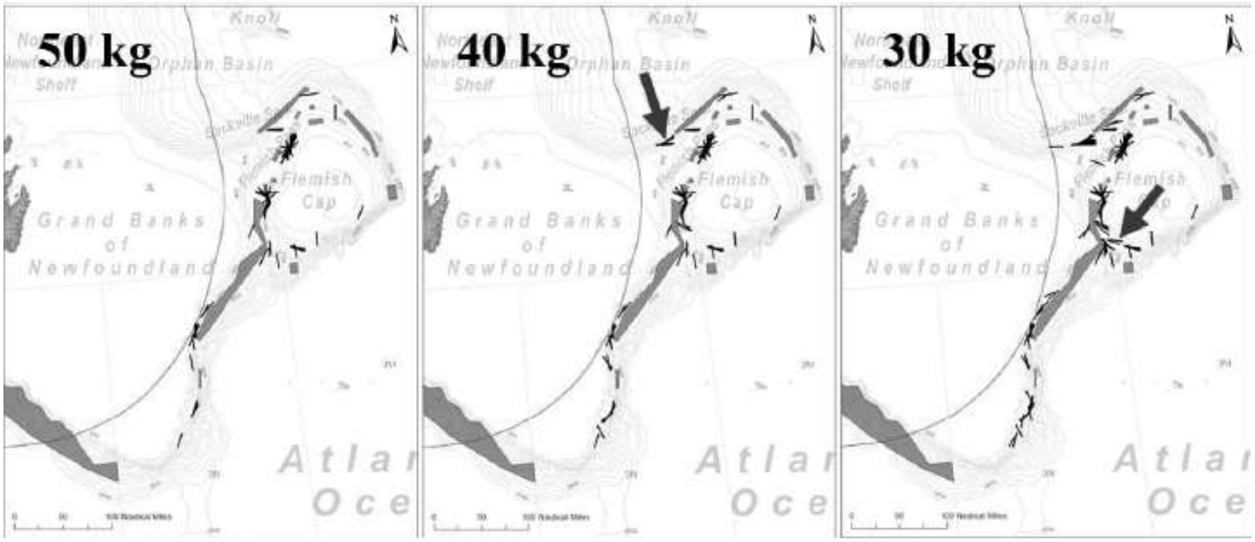


Threshold value	% tows > Threshold
800	0.4
700	0.5
600	0.7
500	1
400	1.7
300	2.5
200	2.9
100	3.9
90	4.1
80	4.5
70	4.9
60	5.1
50	5.5
40	7.5
30	11.3
20	18.9
10	36.4
5	60.7
1	72.8
0.1	86.7

These results show that it is extremely unlikely that any commercial fishing tow will ever encounter the current bycatch threshold level of 800 kg. A clear transition can be observed in the range of 30-50 kg threshold values. For thresholds greater than 50 kg, very few tows are affected whereas for thresholds lower than 30 kg, the number of affected tows increases rapidly.

For example, these results indicate that a much higher protection to sponge grounds can be provided with a minimum impact on fishing activities. If the threshold level is reduced from 800 kg to 30 kg, 11% of the commercial fishing tows operating between 700 m and 2000 m depth are expected to encounter this threshold level.

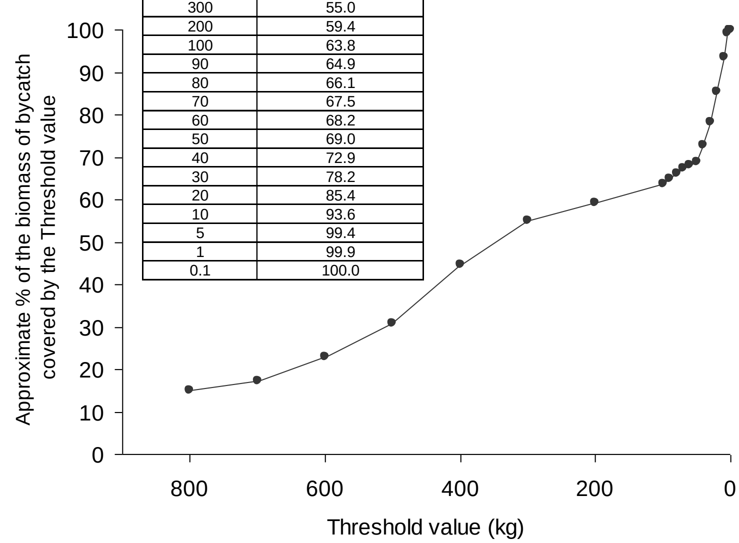
On the other side, the enhanced protection provided by a lower threshold, acting in conjunction with existing closures, can significantly improve NAFO capability for protecting VMEs, both in terms of protection of actual concentrations, as well as in terms of early detection of aggregations not yet discovered. The analysis indicates that, if threshold values between 30-50 kg are considered, very specific locations are the ones where these thresholds are expected to be encountered. The following maps show the simulated tows where the 50, 40, and 30 kg are encountered. The arrows in the 40 and 30 kg thresholds indicate the additional areas that are protected by each one of these threshold values in comparison with the previous value. These regions correspond to boundary areas of existing closed areas, or areas where high concentrations of sponges have been reported (SCS Doc. 09/06), but where not covered by any closed area. A reduction of the threshold value between 50-30 kg will be providing and additional level of protection particularly to these areas.



Since encounter protocols only trigger a response after a threshold value has been hit, and until better understanding of the ecological significance of different densities of VME species becomes available, one possible way of thinking about the benefits provided by different threshold values is the level of coverage of the bycatch for which a given threshold value triggers a response. In this case, the concept of “coverage” essentially is the theoretical amount of sponge bycatch that would be avoided if the threshold could protect the sponges before the actual encounter takes place. For example, an approximate calculation indicates that threshold values between 30 and 50 kg would be expected to cover (“avoid”) 78 and 69% respectively of the sponge bycatch by weight occurring outside the closed areas.

The approximate relationship between the threshold value and the estimated percentage of sponge bycatch covered is presented in the figure below.

Threshold value	Approximate % of bycatch covered by the threshold level
800	15.1
700	17.3
600	22.9
500	30.8
400	44.6
300	55.0
200	59.4
100	63.8
90	64.9
80	66.1
70	67.5
60	68.2
50	69.0
40	72.9
30	78.2
20	85.4
10	93.6
5	99.4
1	99.9
0.1	100.0



At the present time, this conclusion is relying on a simulation exercise intended to capture as much realism as possible. However, detailed and accurate reporting on bycatch of VME-defining species (sponges in this case) during commercial fishing operations is essential to validate the results from models like this, as well as to refine its accuracy and performance.

This GIS framework can generate outputs like the ones presented in the figures above, but it can also be used to provide estimations of biomass of sponge bycatch per effort, if selectivity values are available. The above analyses assume 100% catchability, but implementing other catchability values is straightforward.

The results obtained from the application of the GIS framework, indicate that the current encounter threshold for sponges bycatch is rarely met. If the intension of the threshold is to accomplish protection of sponges outside the closed areas this analysis therefore indicates that the threshold needs to be reduced. The above analysis can serve as a guide for this exercise. It is also considered very important to maximize efforts in the reporting of bycatch of corals and sponges, regardless of whether these bycatches hit or not the thresholds indicated in the encounter protocols.

SASI model

The Swept Area Seabed Impact model (SASI) was developed by the New England Fisheries Management Council (NEFMC) Habitat Plan Development Team to 1) assess fishing impacts on Essential Fish Habitat and 2) to develop new spatial fishery management measures (e.g. habitat closed areas) on the Northeast US Continental Shelf.

Briefly put, SASI quantifies adverse impacts of fishing by combining, in a geo-referenced framework, fishing effort information with the vulnerability of the particular habitat to that particular type of fishing effort (i.e. gear). Fishing effort is standardized to a common currency (area swept) which takes in consideration the actual contact of the gear with the bottom, while vulnerability is typified considering the geology of the bottom, the shear stress to which habitats are exposed, as well as suite of habitat components.

On the other hand, the GIS framework was intended to simulate by-catch of sessile taxa in commercial fishing operations based of the distribution of the taxa in the NRA and the distribution and characteristics of the fishing operations. At the present time, this framework has only been applied to sponges, but it can also be applied to the three VME coral taxa (large and small gorgonians and sea pens). This work (see above) provides an avenue to improve management tools for the protection of VMEs (e.g. thresholds to be used in encounter protocols).

After comparing both approaches, it was concluded that the SASI model and the GIS framework are designed to address different questions, and so there is no simple means of integrating the two models into a single computational environment. Equally important, there is no particular advantage of trying to do so; each model is addressing valid questions in their own right. Upon reviewing the SASI methodology and structure, it was considered that even though in its current parameterization and configuration SASI is not directly applicable to the assessment of significant adverse impacts in the NRA, the general framework it provides and the possibilities for customization of that framework show promise for future use in the NRA. Such explorations would require a detailed examination and adaptation of some of the basic matrices used in SASI (e.g. vulnerabilities), so they can reflect the nature of the ecosystems in the NRA. SASI was developed for application in a (comparatively) shallow shelf system, while fishing operations in the NRA often involve fishing at much larger depths and on shelf break habitats.

In summary, SASI addresses a different set of questions than the GIS framework, and hence, there is no particular benefit in merging both approaches into a single application. SASI structure provides another tool to explore significant adverse impacts, but its current configuration/parameterization is not directly applicable to the NRA, however, the possibility of developing a SASI-like a tool for the NRA is expected to be explored further through the invitation extended to Brad Harris, a SASI expert from the University of Massachusetts, to join the Scientific Council Working Group of Ecosystem Approaches to Fisheries Management (WGEAFM).

2. Working Group on Reproductive Potential, Mar 2011

The NAFO Working Group on Reproductive Potential is comprised of 21 members representing 10 countries (Canada, Denmark, Germany, Greece, Iceland, Norway, Russia, Spain, United Kingdom, and USA).

Over the past year, Working Group members worked inter-sessionally by correspondence and ad hoc meetings at other scientific forums to address the ToRs approved by Scientific Council in June 2008. Several meetings of the EU COST Research Network Action Fish Reproduction and Fisheries (FRESH) (Coordinator: Fran Saborido-Rey, Spain) were also held in the past year. Following recommendations from the 2010 Scientific Council Meeting, the two groups continued to maintain an informal, mutual working relationship over the past year. This enabled the development of collaborations among scientists that benefited addressing NAFO ToRs and avoided duplication of effort between the groups allowing the WG to bring more results to the attention of Scientific Council. Recognizing that the term of FRESH has recently been completed, the Scientific Council congratulates FRESH on its great success and thanks FRESH for is close cooperation and collaboration with the WG on Reproductive Potential.

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)

The autodiametric method to expedite the estimation of fecundity of Greenland halibut was developed by Spanish and Canadian researchers (R. Domiqnguez-Petit, R. Rideout and others). This method once validated will assist to develop long-term, fecundity data bases for this species.

A resource handbook that provides detailed methodology for the estimation of input variables (e.g., age/size at sexual maturity, egg production) for the estimation of stock reproductive potential over a wide suite of fish species is being developed. This handbook will address one of the main aims of this ToR: to provide uniform and standardized procedures along with the pros and cons of various methods. An outline of the handbook's chapters is provided. Preparation of chapters has been ongoing for approximately one year, includes over 30 contributors and is showing strong progress, particularly in Chapters 3 and 4 which are the more comprehensive chapters. The next year's activities will see this contribution come near to completion.

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)

The effects of age and temperature on spawning time in cod and haddock stocks of both sides of the Atlantic were investigated. Results showed that age of fish influences spawning time in a step function rather than linear. There was significant annual variation in spawning time but little evidence of a direct effect of temperature. Spawning time in the Northwest Atlantic cod stocks has become later in recent years (J. Morgan, P. Wright and R. Rideout).

Viability and development during early life phases of Atlantic cod and Baltic cod in relation to paternity and water temperature were investigated through laboratory experiments. Results showed that paternity and temperature interacted to influence embryonic survival and larval characteristics to a significant extent indicating adaptive ability to temperature changes exists and can be expressed through female mate choice (F. Dahlke, S. Politis, M. Peck and E. Trippel).

Fecundity, egg characteristics and embryonic development of captive Greenland halibut from the Gulf of St. Lawrence were investigated. Findings demonstrated that contrary to most groundfish in the NAFO area, Greenland halibut is a single batch spawner. Hatching time is strongly dependent on incubation temperature. At 2ºC, 4°C and 6°C, the time at 50% hatching is 46, 30, and 24 days, respectively. Egg buoyancy experiments also confirm that the eggs are bathypelagic and that important changes in buoyancy in the last 3-4 days before hatching result in hatching of the larvae in the upper part of the water column.

Fish reproductive strategies in relation to trophic dynamics of their environment are being investigated for over 30 fish species. These reproductive traits are being matched with evidence that food amount or food type affect egg production in fishes (lead R. McBride).

Examination of reproductive strategies and fecundity type regulation through food availability in marine fish was made. A manuscript for publication is being pursued. (C. van Damme, A. Rijnsdorp, M. Dickey-Collas and O.S. Kjesbu).

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)

Environmental and fishing limitations to the rebuilding of the northern Gulf of St. Lawrence cod stock were examined (published in *Can. J. Fish. Aquat. Sci.,* **68**: 618-631). Time series of life history traits were analysed during the time period of stock collapse and the period of expected but failed recovery. Estimates of the *r*, intrinsic rate of increase (measure of stock productivity) were negative when the stock collapsed, indicating the biomass would have decreased even without fishing. Given the similarities in environmental conditions and key life history traits, the pattern for this stock may have been repeated in other low productive Northwest Atlantic cod stocks over the past 20 years (Y. Lambert).

The mean lengths of spawners were estimated annually for five stocks: Barents Sea cod, Grand Banks cod and Grand Banks American plaice, North Sea haddock and North Sea plaice and varied greatly (range 10-30 cm depending on stock). An examination was made as to whether stocks dominated by small individuals have lower reproductive rates (total egg production divided by SSB) than those with large individuals (T. Marshall, J. Morgan, P. Wright, A. Rijnsdorp).

Environmental influences on SRP were investigated using the intrinsic rate of population increase r, derived from life table analysis, that incorporates characteristics (e.g. growth rate, fecundity, etc.) which are also associated with SRP. Trends in r were compared among nine Atlantic cod stocks. Stock specific environmental variables, including a global climatic variable (Northwest Atlantic Oscillation) and life history characteristics relative to r were analyzed to further investigate the environmental influences on SRP. (L. O'Brien and 9 others).

Notice has been made that more fully exploring a stock's reproductive potential is most important or critical when a stock becomes depleted, here a multitude of factors such as sex ratio, spawning sites, number of brooders, etc may come into play, over and above the actual level of egg production. A review was made of the potential factors that can have a significant affect on reproductive potential of a stock over a broad range of species and life histories. These should be included, particularly under stressed conditions, to more appropriately represent a stock's ability to produce viable eggs and larvae (R. Nash and O.S. Kjesbu).

A study was conducted to determine if recruitment is better predicted using more complex indices of reproductive potential[1] . This study examined four NAFO stocks: Div. 3LNO American plaice, Div. 3NO cod, Div. 3M cod and SA 2+ Div. 3KLMNO Greenland halibut. Stock recruit models paired with complex indices of RP gave a better estimate of recruitment in slightly more than half of the tests conducted. When there were larger trends in the reproductive biology (maturity at age, sex ratio and egg production) more complex indices of RP were more likely to provide a better estimate of recruitment. For 3M cod recruitment prediction was clearly improved by using more complex indices of reproductive potential, while for Greenland halibut the best predictions of recruitment came from 10+ biomass. The results for Div. 3LNO American plaice and Div. 3NO cod were intermediate (J. Morgan, A. Perez-Rodriguez and F. Saborido-Rey).

The highlight for ToR 3 was the Workshop on Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species that was recently held at the University of Aberdeen, Scotland on April 12-14, 2011. This Workshop has been a key deliverable for the NAFO WG on Reproductive Potential for

[1] M. Joanne Morgan, Alfonso Perez-Rodriguez, and Fran Saborido-Rey. 2011. Does increased information about reproductive potential result in better prediction of recruitment? *Can. J. Fish. Aquat. Sci.*, 68: 1361–1368.

sometime and has now been successfully completed. This workshop was held in conjunction with the EU COST Action Fish Reproduction and Fisheries (FRESH).

The objectives of this workshop were to provide workshop participants with expert advice in implementing information on reproductive potential into the assessment of their stocks and to review and recommend best practices for incorporating information about growth, maturation, condition and fecundity into management of harvested marine species.

The workshop was organized by Tara Marshall (UK), Joanne Morgan (Canada), Loretta O'Brien (USA), Iago Mosqueira (UK) and Santiago Cervino (Spain). Invited presenters were Bridget Green (Australia), Adriaan Rijnsdorp (Netherlands), Peter Wright (UK), Coby Needle (UK), Paul Spencer (USA) and Liz Brooks (USA). Presentations were also made by Joanne Morgan and Santiago Cervino (Spain). The presentations were made under 4 themes: ESTIMATING STOCK REPRODUCTIVE POTENTIAL; IMPLEMENTING ESTIMATES INTO ASSESSMENTS; ARE WE DOING IT BETTER, WORSE OR JUST DIFFERENTLY?; and CODING IT UP. Following the presentations in each theme, areas for further discussion were identified and groups formed to participate in these discussions and report back to plenary. The presentations and discussions allowed people with diverse backgrounds to become familiar with the techniques used to compute SRP, the potential impact of SRP on our perception of stock status and some of the issues around incorporating SRP into scientific advice.

In addition to the organizers and invited speakers, 16 others participated in the workshop. Two NAFO Designated Experts participated; F. González Costas and Dawn Maddock Parsons. The support of NAFO for the attendance of these two DEs and for the organizer L. O'Brien is gratefully acknowledged.

Conclusions of the workshop

It is clear that the incorporation of more complex indices of SRP can make a difference in the perception of stock status. The past trajectory of the stock can be affected as can the estimated limit reference points and current stock status relative to those reference points. In addition, perceptions of projected stock status can vary depending on the information that is incorporated into estimates of SRP. It is also clear that there are no real technical impediments to incorporating this information.

Trends in biological parameters and the quality of the data on these parameters are both important components. There will be a greater difference in perception of stock status if there are large trends in reproductive parameters and advice is more likely to be improved by the incorporation of these data into estimates of SRP. The ability to detect trends in biological parameters will be affected by the quality of the data that are collected (one must be able to detect the signal in the noise). The quality of the data will also affect the ability to detect any difference in various estimates of SRP and will have an impact on the likelihood of improving advice.

Variation in weight at age and in maturity at age are both common and can have a large impact on perceived SRP. Often weight at age is from commercial catch at age and is calculated using an invariant length weight relationship. It is likely that variation in weight at age is greater than currently thought as a result of variation in condition. Consideration should be given to updating length weight relationships on an ongoing basis. Maturity at age should be estimated where possible by cohort and macroscopic classification scales verified with histology.

In general it has been found that changes in fecundity are small and have not had a great impact in variation in SRP. However, data on fecundity tend to be limited and more data should be collected to determine if this is indeed the case.

The collection of data on weight, maturity, sex ratio and fecundity is encouraged. Only through the collection of good quality data on these factors can we begin to fully determine how much of an influence there is of not incorporating them into our advice.

Work on whether or not advice is improved by incorporating more biology into our estimates of SRP is only beginning. These studies should be continued and applied to more stocks and species with more varied reproductive strategies. The best approach is likely to be within a management strategy evaluation context. This type of process would require the input of both modelling experts and experts in species biology.

The 10th Meeting of the NAFO Working Group on Reproductive Potential is proposed to be held in the latter half of 2012 (further details to be defined by local organizers). This will be the third and proposed final meeting for the 3rd Set of ToRs.

Scientific Council noted the major advances made on the 3rd set of ToR by the working group. Council was particularly pleased by the *Workshop on Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species* that was held at the University of Aberdeen, Scotland in April. Council looks forward to the final report addressing the current sent of ToRs.

3. Report from WGDEC, Feb-Mar 2011

The terms of reference (ToR) for the WGDEC meeting of 2011 are listed in Section 2 of the report (http://www.ices.dk/reports/ACOM/2011/WGDEC/wgdec_2011_final.pdf). ToR(a), was a request for advice to update records of deep-water vulnerable marine ecosystems (VMEs) in the North Atlantic and where appropriate advise on new or revised areas to be closed to bottom fisheries for the purposes of conservation of VMEs. New data from a range of sources including multibeam echosounder surveys, trawl surveys, long-line surveys, fishermen's knowledge, habitat modelling and remote seabed imagery surveys were available for several areas under the regulation of the EC, Norway, NEAFC and NAFO. In the NE Atlantic these included Rockall Bank, the Anton Dohrn Seamount, Hatton Bank, Reykjanes ridge, Norwegian shelf, and the Bay of Biscay. In the NW Atlantic the areas included the Grand Banks/Flemish cap and an area west of Greenland.

A revised boundary is suggested for the northwest Rockall closure (NEAFC regulated) based on new observations on VMEs in the area and information from fishermen. New data from multibeam and camera surveys on the Anton Dohrn Seamount (EC regulated) indicate extraordinary concentrations of VMEs on the steep sides of the seamount. Two possible closure boundary options are proposed that would confer protection to VMEs on this seamount. New data from observers on long-line vessels operating in the Hatton bank area and multibeam data suggest the presence of VMEs outside the current closure. As WGDEC was aware of new trawl by-catch data from the Hatton area that could be highly informative, no revision to the boundary was suggested for the time being. New data on VMEs in the Bay of Biscay (EC regulated) was available. Several areas of VME concentrations are identified that indicate where closures would be best sited to protect VMEs in this area. In the northwest Atlantic (NAFO regulated) new data were available from observers on trawlers suggesting the presence of VMEs in areas currently open to bottom fishing on the slope of the Grand Banks and in an area to the west of Greenland. Two historical observations from the Reykjanes ridge area (NEAFC regulated) are reported in which significant bycatch of sponges and corals were taken. One of these lies within a closed area. No revisions to boundaries in this area are proposed.

To address ToR (b) a conceptual model and template was designed for a database of VME records in the North Atlantic. As the database is to be hosted by the ICES this was agreed and developed directly with the ICES Data Centre with clear linkages to the OSPAR habitats database. The aim is to have this operational by 2012. For ToR (c) WGDEC reviewed the report of WKMARBIO with special reference to deep-water ecosystems and the development of indicators for monitoring trends in diversity and community structure. For ToR (d) a very brief review of the application of productivity/susceptibility analysis to deep-water fisheries and ecosystems is presented. A shortage of published material and higher priority ToRs meant that this was only covered in minimal detail. ToR (e) required the group to review and comment on the ICES Study Group Designing Network Marine Protected Areas under a Changing Climate. The report was taken to be a work-in progress and there was rather limited application to deep-water ecology. In particular ocean acidification and the three-dimensional location of habitats were highlighted as important issues in designing MPA networks in deep-water ecosystems. For ToR (f) new information relevant to VME encounter rules (move-on criteria) was reviewed. A simulation study on sponge bycatch in the NW Atlantic suggests thresholds levels needs to be considerably reduced to be effective. An assessment of the consequences of bottom trawling on seamounts under the move-on rule was made and concluded it would not be an effective means of protecting VMEs on seamounts. In ToR (g) an examination of environmental factors influencing sponge distributions in the North Atlantic was made using updated records. For ToR (h) a joint meeting was held with WGDEEP and the European Commission to discuss the value and uses of fisheries independent survey data.

4. Meetings Attended by the Secretariat

a) PICES (October 2010)

The Executive Secretary, Dr Vladimir Shibanov, attended the 2010 PICES Annual Meeting in Portland, Oregon, USA. Observers from 35 international and regional agencies were present, represented by 430 scientists and managers from 16 countries. The focus of the meeting was fisheries science in the North Pacific but there was also a more global flavour. Dr Vladimir Shibanov, Dr Anthony Thompson and Barbara Marshall created a powerpoint presentation in advance of this meeting entitled “NAFO Scientific Council Advisory Process”, which Dr Shibanov delivered.

This presentation charted the development of ICNAF into NAFO, the scope of the NAFO Convention and Regulatory Areas, the species and stocks which are assessed. The presentation also detailed the changes in the NAFO Convention which address the ecosystem approach to management, the structure of NAFO, the role of the Scientific Council in the advisory process, the opening of the process to outside observers and touched on future areas of cooperation between NAFO and PICES. This included traditional areas of cooperation such as joint symposia, working groups and workshops, the possibility of joint publication activities and closer cooperation between Secretariats, and what if any lessons can be learned from the experiences of NAFO in the establishment of a new North Pacific RFMO.

b) FAO By-catch meeting (December 2010)

The FAO meeting “Technical Consultations to Develop International Guidelines on Bycatch Management and Reduction of Discards” was held in Rome, Italy, on 4 – 10 December 2010. NAFO was represented by Fisheries Commission Coordinator, Dr Ricardo Federizon.

Managing bycatch is an integral component of implementing the ecosystem approach to fisheries and the FAO Committee on Fisheries (COFI) recommended that a Technical Consultation to Develop International Guidelines on Bycatch Management and Reduction of Discards be convened to develop an initial draft of the guidelines. This draft was forwarded to the Technical Consultation (this meeting) for review and finalization. Participation in the Technical Consultation was open to all FAO Members. RFMOs and NGOs were also invited as observers to the Technical Consultation. There were 36 member states represented. Of these, nine flag States/delegation are also Contracting Parties of NAFO: Canada, EU, Iceland, Japan, Norway, Republic of Korea, the Russian Federation, USA, and Faroe Islands.

The report of the Technical Consultation and the draft International Guidelines on Bycatch Management and Reduction of Discards were endorsed by COFI at their meeting in February 2011. The Guidelines are intended to assist States and RFMOs in the management of bycatch and reduction of discards in conformity with the FAO Code of Conduct for Responsible Fisheries.

There are 13 sections in the Guidelines. Six sections are specifically relevant to RFMOs as these sections elaborate on the course of action the RFMOs may take:

- Management Framework;
- Bycatch Management Planning;
- Data Collection and Bycatch Assessments;
- Research Development;
- Measures to Manage Bycatch and Reduce Discards; and
- Monitoring, Control and Surveillance (MCS).

These guidelines will be forwarded to STACTIC for consideration at a future meeting.

5. ICES Strategic Initiative on Stock Assessment Methods (SISAM)

ICES Strategic Initiative on Stock Assessment Methods (SISAM). Workshop on Reviews of Recent Advances in Stock Assessment Models World-wide: "Around the World in AD Models" (WKADSAM).

In 2010, ICES commenced a Strategic Initiative on Stock Assessment Methods (SISAM) to review the state of the art in stock assessment modeling and to reinvigorate the methodology used by ICES working groups in the provision of management advice. The initial meeting of this three-year initiative was a workshop to review advances in stock assessment methods (WKADSAM), hosted by IFREMER in Nantes, France from 27 September - 1 October, 2010. To facilitate a wide-ranging review and in order to obtain a global perspective, invitations to the workshop were distributed worldwide to various national and international organizations and agencies which develop methods and/or conduct fish stock assessment. An invitation from ICES was received by the Scientific Council Coordinator in July 2010. At the request of the SC Executive Committee, Brian Healey (Science Branch, Fisheries and Oceans Canada, St. John's, NL, Canada) attended WKADSAM to represent NAFO.

To collate, review and comment on stock assessment methods currently in use around the world, the terms of reference for WKADSAM were to:

a) Determine the key techniques and approaches used to assess fish stocks

b) Consider *inter alia* utility, ease of use, estimation procedures, robustness, suitability to different data richness, applicability to data poor situations, and relevance of assumptions in the models

c) Summarize the advantages and disadvantages of the various methods, and describe the appropriate use.

d) Comment on demonstrations by model developers of the utility of methods with case studies and simulated datasets, focusing on the question: What problem has the method fixed?

e) Prepare the groundwork for a following workshop in 2011 or 2012

This workshop was co-chaired by Coby Needle (Marine Scotland, Aberdeen, Scotland) and Chris Legault (NMFS, Woods Hole, USA). As the meeting approached, it became clear that the ToRs were confusing some participants, particularly the degree to which detailed evaluation of various methods would be applied to common case studies. The chairs clarified that the intent was not to initiate a competition to find the best model applied to a particular case study, but to focus upon discussion of methods used worldwide and produce a catalogue of these methods.

The title of the workshop itself was somewhat of a misnomer in that advances in stock assessment were not confined to software developed within ADMB (ADMB Project 2009). In fact the majority of the methods described appeared to be coded in software other than ADMB.

There was considerable discussion over differing classes of software and methods, distinguishing between: i) Flexible, multipurpose packages; ii) specific, data issue-driven approaches and iii) custom models/software. Detailed overviews of the several models / assessment packages were given:

Method/Model	**Presenter**
SAM – State Space Assessment Model	Anders Nielsen (DTU Aqua)
BREM – Biomass Random Effects Model	Verena Trenkel (IFREMER)
SS3 - Stock Synthesis	Richard Methot (NOAA)
MULTIFAN-CL - Statistical, length-based, age-structured model	Shelton Harley (Secretariat of Pacific Community)
CASAL - generalized age- or length-structured fish stock assessment model	Matt Dunn (NIWA)
TINSS – generic statistical catch at age	Steve Martell (UBC)
CSA – catch survey analysis	Benoit Mesnil (IFREMER)
ADAPT VPA	Chris Legault (NOAA)
ASAP - Age Structured Assessment Program	Chris Legault (NOAA)
SURBA – Survey Based assessment	Coby Needle (Marine Scotland)
XSA	Chris Darby (CEFAS)

B-ADAPT Chris Darby (CEFAS)

Additional details can be found in Section 2 and Annex 2 of the WKADSAM report (ICES, 2010 and references therein).

ICES have recently restructured their stock assessment process. Assessments are organized into two categories: benchmark assessments and update assessments Update assessment are conducted inside the regular relevant working groups on an annual or multi-annual basis and must conform to fixed methodology described in the "Stock Annex" document. The update assessments are peer reviewed by "review groups" which are external to the working group. During a benchmark assessment, the data and modeling approach are subjected to additional scrutiny, and the utility of applying alternate methods is investigated. Benchmarks assessments are held on a multi-annual basis and are planned following the conclusions of the relevant assessment review groups. Following the conclusions of the benchmarks working group, the Stock Annex is updated. An interesting and informative contribution to WKADSAM was a presentation from Lionel Pawlowski (IFREMER, Lorient) which reviewed ICES stocks subjected to benchmark assessments in recent years. This presentation identified the assessment approach applied pre-benchmark, that recommended by the benchmark, and the route subsequently followed by the working group post-benchmark. Pre-benchmark assessments were largely XSA/VPA approaches, and post-benchmark more complex models tended to be applied, such as SAM (state-space stock assessment model) and SCAA. However, it was also explained that the ability to move to more complex methods was also highly reliant on the availability of an appropriate methodological expertise (if not the software developer) to progress. Related to this, an account describing why it was necessary to change assessment methods for Northern and Southern Hake was given, along with detail on the choice of model/package and the process of gaining familiarity with the chosen package. This contribution also echoed that expert input was required. Notably, it was reported "*Setting up the northern hake model took about three months of two dedicated people, who were experienced with modeling but unfamiliar with SS at the outset.*" (see p.70, ICES, 2010).

A discussion of common issues and important decisions facing many stock assessments (led by Doug Butterworth, MARAM, Univ. of Cape Town) focused on the following five points:

1. **Plus-group paucity**. Plus groups may often have limited catch or survey data, but can be important in model fitting. Different models and even variations in model formulations with respect to plus groups can lead to substantial differences in estimates of resource status and associated reference points.

2. **Estimation – separate vs. combined**. Different assessment models incorporate different data in fitting models (e.g. fitting to catch-at-age or assuming catch exact). Further, they may incorporate different stock dynamic processes in a separate or combined estimation approach (e.g. stock-recruitment parameters).

3. **Catchability – constant or time-varying**.

4. **Model Selection**. Are choices for the "best" assessment model subjective or statistical? It was noted that statistical testing can be hampered by issues such as multi-modal likelihoods and/or usage of different data sets.

5. **SCAA vs. VPA**. Assumption of exact catch at age can be an important one; and VPA backwards convergence may provide an artificial level of comfort.

As part of ICES' SISAM initiative, there are plans to hold a conference in 2012 – however, very limited detail and work planning information related to this conference were available to WKADSAM.

References

ADMB Project. 2009 AD Model Builder: automatic differentiation model builder. Developed by David Fournier and freely available from admb-project.org.

ICES, 2010. Report of the Workshop on Reviews of Recent Advances in Stock Assessment Models World-wide: "Around the World in AD Models". ICES CM 2010/SSGSUE:10. URL: http://www.ices.dk/workinggroups/ViewWorkingGroup.aspx?ID=472

NAFO Scientific Council will continue to monitor developments under SISAM and participate if it will extend its collective expertise.

6. ICES - WGNARS

The ICES Working Group on the Northwest Atlantic Regional Sea (WGNARS), met at the Bedford Institute of Oceanography, Dartmouth, Canada, on February 8-10, 2011. The final report of this meeting is available as ICES CM 2011/SSGRSP:01 at the ICES website. Mariano Koen-Alonso, co-chair of NAFO SC WGEAFM attended this meeting.

Within the ICES structure, WGNARS is one of the expert groups under the Steering Group on Regional Seas Programme (SSGRSP), which in turns report to the Science Committee (SCICOM). WGNARS and SSGRSP are currently developing the science to support future advice on marine resource management, and are expected to eventually develop more close linkages to the ICES Advisory Committee (ACOM). WGNARS is co-chaired by Steve Cadrin, University of Massachussets, and Catherine Johnson, Fisheries and Oceans Canada.

WGNARS long term objective is to develop an integrated ecosystem assessment (IEA) of the Northwest Atlantic Ocean, but in the short term its work is focused on developing scientific support for the development of ecosystem approaches to management in the region.

During its second meeting, WGNARS addressed issues related to a) ecosystem approaches frameworks, where among other topics the history and activities of NAFO SC WGEAFM was presented, b) socio-economic components of IEAs, c) spatial planning, d) ecosystem indicators and climate/environmental drivers, e) thresholds and indicators, and f) signal propagation on the shelf and slope.

When comparing WGNARS and NAFO SC WGEAFM, it is clear that both groups have similar general goals (e.g. development of IEAs as a key element of ecosystem approaches), but also differ in terms of the background and expertise of their memberships, as well as their needs to provide tailored advice for specific requests. WGNARS work does not provide advice to any specific management organization, while WGEAFM work is linked to the needs for advice within NAFO structure and timelines. Some other differences included: a) WGNARS deals with a wide spectrum of human activities, while WGEAFM is bounded by the fisheries-specific mandate of NAFO, b) WGNARS work is focused on shelf and coastal systems, while WGEAFM work involves shelf and deep-sea systems, c) WGNARS membership includes social scientists and is addressing socio-economic aspects of ecosystem approaches, while WGEAFM lacks this expertise and it is not actively working on these aspects, and d) WGNARS membership is mainly composed by North American scientists (USA and Canada), while WGEAFM membership is more reflective of NAFO Contracting Parties (i.e. USA, and Canada, but also EU [Spain, Portugal, UK], and Russia), and hence, operational and functional issues may be affected by different sets of constraints for each working group.

In terms of coordination between ICES WGNARS and NAFO WGEAFM, both working groups can complement each other in several aspects, as well as develop close collaborations in others. Both working groups have been recently created, and are still developing their working dynamics, and consolidating their research activities. With the intent of maintaining close linkages, avoiding duplication of efforts, and promoting collaborations and positive feedbacks between the two groups, it was agreed that, as an initial step for developing these collaborations, efforts should be made to ensure that the chairs and/or co-chairs of both working groups can attend to each other's meetings, as well as to include them in each other's mailing lists. As both working groups evolve, more formal linkages between them may need to be explored sometime in the future.

The 3rd ICES WGNARS is schedule to take place in the Spring of 2012 at Woods Hole, USA.

Scientific Council considerations

Scientific Council took notice of the activities of ICES WGNARS, and encourage continued efforts to explore and promote linkages and communication between ICES WGNARS and WGEAFM.

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. Election of Chairs

A nomination committee, established by the Council at the beginning of this meeting composed of Ole Jørgensen (Denmark – Greenland), Vladimir Babayan (Russia), Bill Brodie (Canada) & Antonio Vázquez (EU-Spain), proposed the following candidates. The Scientific Council noted these positions will be for a two year period beginning immediately after the September 2011 Annual Meeting.

For the office of Chair of Scientific Council, Carsten Hvingel (Norway) was nominated by the Committee. The Council elected him by unanimous consent.

For the office of Chair of the Standing Committee on Fisheries Science (STACFIS), Jean-Claude Mahé (EU-France) was nominated by the Committee. The Council elected him by unanimous consent.

For the office of the Chair of the Standing Committee on Publications (STACPUB), Margaret Treble (Canada) was nominated by the Committee. The Council elected her by unanimous consent.

For the office of the Chair of the Standing Committee on Research Coordination (STACREC), Don Stansbury (Canada) was nominated by the Committee. The Council elected him by unanimous consent.

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

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

2. General Plan of Work for September 2011 Annual Meeting

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

3. Timing of Advice

Scientific Council noted that the advice on shrimp stocks is required at the start of the September meeting, and that this has not always been possible in previous years. It was agreed to hold a meeting by WebEx in advance of the September 2011 meeting to produce the required advice.

4. Other Matters

No items were raised.

XII. OTHER MATTERS

1. Designated Experts

Scientific Council noted that Ivan Tretiakov (Russian Federation) is now the designated expert for Capelin 3LNO.

2. Sponsorship of PICES/ICES/IOC Climate Change symposium sponsorship, May 2012

In May 2008, PICES, ICES and IOC convened the first International Symposium on "Effects of Climate Change on the World's Oceans" in Gijón, Spain, and it attracted 400 scientists from 48 countries. PICES, ICES and IOC plan to hold a second global ocean symposium from May 15–19, 2012, in Yeosu, Korea, under the title "The Living Ocean and Coast: Diversity of Resources and Sustainable Activities".

NAFO was offered a formal invitation to be a co-sponsor of this event. Scientific Council considered this request but felt that in the current economic climate it would be very difficult for scientists active in the NAFO community to obtain funding from their institutions to travel to Korea, therefore it was not possible to endorse this sponsorship.

3. Stock Assessment Spreadsheets

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

4. Fisheries Managers and Scientists Working Groups

Scientific Council expressed some concerns with the role of Fisheries Commission Working Groups which require scientific input. In principle Scientific Council supports the increase of dialogue between scientists, managers and fishers, but notes the increased workload this places on scientists and feels that any new science should be peer reviewed by Scientific Council before consideration by managers. If it is felt that Scientific Council lacks the experience to address a particular issue, it is within the remit of Contracting Parties to support the work of Scientific Council by adding additional members with the required skills and knowledge to their delegations.

5. 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.

6. Merit Awards

a) Scientific Merit Award

In June 2008, Scientific Council adopted 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.

In 2011, Dr Vladimir A. Rikhter was nominated for a Scientific Merit Award by the representative of the Russian Federation, Dr. Vladimir Babayan. Dr. Rikhter began his scientific activities at BaltNIRO (now AtlantNIRO) in September 1959, specializing in the fishery resources of the Northwestern Atlantic Ocean. This coincided with an outburst of fishing efforts and scientific activities by the USSR at this time. During this period large aggregations of redfish were found in the Flemish Cap area, silver hake and red hake on Georges Bank and the New England Shelf, as well as aggregations of several other species. Fisheries research and exploratory fishing expeditions were conducted regularly, and between 1960 and 1990 numbered more than 330. In a scientific career spanning more than 50 years, Dr. Rikhter took part in more than 10 of these long-term research expeditions, covering the areas of Labrador, Newfoundland and Georges Bank.

Dr. Rikhter made a substantial contribution to the work of first ICNAF and later NAFO, preparing over 80 scientific papers. He was also active member of Scientific Council, in 1982-1983 as Chair of STACPUB, and between 1984-1985 as Chair of Scientific Council. Next year Dr. Rikhter is concluding his scientific career, and Scientific Council would like to take this opportunity to thank him for his efforts over the years and to wish him a long and happy retirement. The award of a Scientific Merit Award to Dr. Rikhter was approved unanimously.

b) Chair's Merit Award

Scientific Council acknowledges the dedication and hard work of retiring Chairs with a merit award.

7. Budget Items

The budget for the current year 2011 was presented to Scientific Council.

It is currently unclear if a workshop or conference on new assessment methods will be held in 2012 or 2013. NAFO is a co-sponsor of this initiative, therefore an increase in the *ad hoc* budget was proposed by Scientific Council to cover this eventuality. Other budget items remain as requested by Scientific Council and as approved by General Council.

The 2012 budget was discussed by Scientific Council and will be presented to STACFAD in September 2011 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.

8. Other Business

i) Scientific Council – Thank-you to Tony Thompson

Scientific Council would like to thank Dr. Anthony Thompson for the guidance and tireless support he provided during his time as Scientific Coordinator at the NAFO Secretariat. His work ethic and proactive input into the work of Council and its various committees, working groups and publications was exemplary. This was much appreciated by the Council, particularly in recent times when the Council faced additional requests for scientific advice related to Vulnerable Marine Ecosystems. Dr. Thompson's experience and attention to detail also helped to improve the efficiency of the Council in the short time he held this post. For all this support, the Council expresses its gratitude and wishes him every success as he moves on to new challenges.

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 2011, 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 2011 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, thanked Heino Fock for his work as local coordinator for the meeting and thanked the hosts for the excellent facilities which they provided. There being no other business the meeting was adjourned at 1400 hours on 16 June 2011.

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

Chair: Gary Maillet Rapporteur: Eugene Colbourne

The Committee met at the Forum, Johann Heinrich von Thünen-Institut in Braunschweig, Germany, on 4 and 9 June 2011, 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, Lithuania and Spain), Russian Federation, USA and Japan.

Highlights of Climate and Environmental Conditions in the NAFO Convention Area for 2010

- The North Atlantic Oscillation (NAO) index during winter 2009/2010 was exceptionally negative and as a consequence, weakening westerlies over the Northwest Atlantic resulted in remarkable air temperature anomalies of 4º to 10ºC warmer than normal.

- Annual mean air temperatures were above normal throughout the NAFO Convention Area by 2-3 standard deviations (SD) and at a record high at some northern sites on Baffin Island, West Greenland and the Labrador Coast. Remarkable positive anomalies were observed over the western Arctic over Baffin Bay and Davis Strait with anomalies greater than +8°C during the winter months.

- Sea-ice extent and duration was below normal in the Labrador Sea in 2010. Sea-ice extent and duration on the Newfoundland and Labrador Shelf decreased in 2010 for the 15th consecutive year, with the annual average reaching a record low. Sea ice was essentially absent from the Scotian Shelf only the 2nd time in 42 years.

- Oceanographic conditions off West Greenland during the summer 2010 were characterised by above normal presence of cold-lower salinity Polar Water carried to the area by the East Greenland current. Despite record-high air temperature anomalies, sea surface temperatures in West Greenland were only slightly above normal along with low salinity conditions that reflect greater proportions of Polar Water compared to the warm-higher salinity Irminger Water that combines to form the West Greenland Current.

- In 2010, convection in the central Labrador Sea was limited to the upper 200 m of the water column consistent with the above normal air and sea surface temperatures and mild winter conditions. This is the 3rd consecutive year with reduced vertical mixing and a dramatic change 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.

- Time series records back to mid-1990's to present demonstrate a strong trend in warming and saltier conditions in both the upper water column and the layer impacted by convection in the Labrador Sea Basin.

- The environmental composite index which integrate a number of meteorological and physical oceanographic time series, ranked 2nd highest in the 61-year time series extending back to 1950 across the Newfoundland and Labrador Shelves. A similar composite index on the Scotian Shelf and Gulf of Maine in 2010 ranked 4th highest over a 41-year time series with a fairly uniform distribution of anomalies throughout the region.

- The upper layer baroclinic transport of the shelf-slope component of the Labrador Current off southern Labrador and Flemish Pass remained above the long-term average in 2010, consistent with increased transport observed in recent years.

- The cross sectional area of <0°C (CIL) water mass, remained below normal along all ocean sections across the Newfoundland and Labrador Shelves with the Flemish Cap (47N) section displaying the 2nd lowest CIL on record.

- A composite bottom temperature index for the spring multi-species surveys (3PLNO) in 2010 was the 4th warmest in the past 2 decades, while that of the fall surveys (2J3KLNO) was the warmest on record.

- Ocean temperatures on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas were above normal during 2010. Bottom temperatures were only slightly above normal compared to northern Subareas.

- The stratification of the upper 50 m of the water column was below normal in eastern Newfoundland waters whereas on the Scotian Shelf it strengthened compared to 2009 with 2010 ranking as the third most stratified in the 64 year record.

- The trends in shallow and deep nitrate inventories, the principal limiting nutrient to primary productivity, were below normal across the NAFO Subareas in 2010.

- The 2010 annual anomalies in surface phytoplankton blooms were well below normal in northern Subareas across the Hudson Strait, Labrador Shelf, and Labrador Sea to the Greenland Shelf (0B, 1, 2H) in contrast to record-high positive anomalies observed along the Newfoundland-Grand Banks extending southwards to the eastern Scotian Shelf.

- The timing of the production cycle occurred significantly earlier by approximately 1 month in 2010 based on the analysis of composite satellite imagery for 22 statistical sub-regions extending across the NAFO Subareas.

- Enhanced abundance of zooplankton was observed for the northern Subareas (2J to 3LNO) in 2010 with some of the highest positive anomalies observed in the 12-year time series.

- Overall, the combined composite indices of inventories and abundances across lower trophic levels (nutrients, phytoplankton, and zooplankton) generally exhibit weak associations (i.e. positive correlations) between adjacent levels and high interannual variability.

1. Opening

The Chair opened the meeting by welcoming participants to this June 2011 Meeting of STACFEN.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 11/001, 11/011, 11/012, 11/013, 11/014, 11/015, 11/016, 11/030, and SCS Doc. 11/06, 11/08, 11/09, 11/10.

2. Appointment of Rapporteur

Eugene Colbourne (Canada) was appointed rapporteur.

3. Review of Recommendations in 2010

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.

STATUS: The proposed Scientific Council budget was approved; see NAFO SC Working Paper No. 10/25 (Revision 3), and agenda item # 4.

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.*

STATUS: The Committee is in the process of developing new composite environmental time series that will be used in conjunction with recruitment indices to investigate potential linkages. Also, see agenda item #9.

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".*

STATUS: The proposed Scientific Council budget was approved; see NAFO SC Working Paper No. 10/25 (Revision 3), and agenda item # 11.

4. Invited Speaker

The Chair introduced this year's invited speaker Dr. Christian Möllmann (Institute for Hydrobiology and Fisheries Science, University of Hamburg, KlimaCampus, Grosse Elbstrasse 133, D-22767 Hamburg, Germany. Tel. +49 40 42838 6621, E-mail: *christian.moellmann@uni-hamburg.de*, *http://www.uni-hamburg.de/ihf/christianmoe.html*). The following is an abstract of his presentation entitled "**Towards the ecosystem approach – using ecosystem process knowledge in Eastern Baltic cod (*Gadus morhua callarias* L.) stock assessment"**:

Integrated ecosystem assessments (IEA) are a crucial prerequisite for the implementation of the ecosystem approach (EA) to management of the marine environment and their resources. A first step towards IEAs and the EA is the use of knowledge on ecosystem structure and function in the assessment of commercially important fish stocks. In other words, the status and potential future stock development of the target species needs to be evaluated in its ecosystem context, d.h. its relationships to abiotic variables and foodweb processes. Here I review work conducted within the *ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea* (WGIAB) related to the Eastern Baltic cod stock. First, I will present results of trend and status assessments of the Baltic Sea integrating over all trophic levels, and related studies on ecosystem functioning. Afterwards I present a case study showing the use of derived ecosystem knowledge in the operational stock assessment framework of Baltic cod serving short-term management decisions. Furthermore, I will show modelling efforts on evaluating potential long-term futures of the cod stock, focusing on a multi-model approach ("Biological Ensemble Modelling"). Finally, I will outline future steps towards a future IEA for the Baltic Sea.

The invited lecture presented by Dr. Möllmann was well received by Scientific Council and stimulated discussion regarding the advantages of this approach in fisheries science, current challenges, and future planned work into further implementation and refinement of IEAs and the EA. In general, this presentation highlighted the need to "understand your system" and "use your knowledge" to further management objectives in the assessment of natural resource populations and the ecosystem approach.

5. Integrated Science Data Management (ISDM formerly MEDS) Report for 2010

(SCR Doc. 11/015)

A review of the Integrated Science Data Management (ISDM formerly MEDS) Report for 2010 was presented in **SCR Doc. 11/15**. 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 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 2011 required the submission to ISDM of a completed oceanographic inventory form for data collected in 2010, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2010. The data of highest priority are those from the standard sections and stations, as described in NAFO SCR DOC., No. 1, Serial N 1432, 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 2010 are included. This report will also provide an update on other ISDM activities during 2010. 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.

Highlights of the Integrated Science Data Management (ISDM formerly MEDS) Report for 2010:

Since 1975, MEDS, now ISDM, has been the regional environmental data centre for ICNAF and subsequently NAFO and as such is required to provide an inventory of all environmental data collected annually by contracting countries of NAFO within the convention area. The following is the inventory of oceanographic data obtained by ISDM during 2010 and updates on other activities in the area.

i) **Hydrographic Data Collected in 2010**

Data from 1,961 oceanographic stations collected in the NAFO area sent in delayed mode to ISDM in 2010 have been archived, of which 1047 were CTDs and 554 were bottles. A total of 333,809 stations were received through the GTSPP (Global Temperature and Salinity Profile Programme) and have been archived.

ii) **Historical Hydrographic Data Holdings**

Data from 4,254 oceanographic stations collected prior to 2010 were obtained and processed during 2010, of which 1,400 were vertical CTDs, 1,899 were towed CTDs, 278 were BTs and 677 were bottle data.

iii) **Thermosalinograph Data**

A number of ships have been equipped with thermosalinographs to collect surface temperature and salinity data while the vessels are under way. These are transmitted as station data via satellite and radio links. In 2010, we received 754 surface observations of temperature and salinity from 4 cruises.

iv) **Drifting Buoy Data**

A total of 162 drift-buoy tracks within NAFO waters were received by ISDM during 2010 representing 364,648 buoy messages.

v) **Wave Data**

During 2010, ISDM continued to process and archive operational surface wave data on a daily basis around Canada. One-dimensional and directional wave spectra, calculated variables such as the significant wave height and peak period, concurrent wind observations, if reported, and the raw digital time series of water surface elevations were stored. A total of 19 wave buoy stations were operational in the NAFO area during 2010 which is 1 more than in 2009.

vi) **Tide and Water Level Data**

ISDM continued to process and archive operational tides and water level data that were reported on a daily to monthly basis from the Canadian water level network. ISDM archived observed heights with up to a 1-minute sampling interval, hourly heights and monthly instantaneous extremes collected around Canada. Approximately 1.8 million new readings were updated every month from the Canadian permanent gauge network. The historical tides and water level data archives presently holds over 600 million digital records with the earliest dating back before the turn of the century. Data from 93 tide and water level gauges were processed during 2010 with 55 in the NAFO region. The data is quality controlled using ISDM software and is available for download from ISDM web site: www.isdm.gc.ca/isdm-gdsi/twl-mne/index-eng.htm.

vii) **Current Meter Data**

In 2010 The Bedford Institute of Oceanography (BIO) recovered and processed data from 26 current meters instruments in the NAFO area. An additional 46 instruments were recovered with data that requires further processing. Data and products are available from BIO at: www.mar.dfo-mpo.gc.ca/science/ocean/database/data_query.html

viii) **Activity Updates**

ISDM reported on other activities during 2010:

Argo is an international program to deploy profiling floats on a 3 by 3 degree grid in the oceans of the world. Each profiling float samples and reports both temperature and salinity from 2000m to the surface every 10 days. Some of the newer floats now also report oxygen. Data are distributed on the Global Telecommunications System (GTS) within 24 hours of collection and made available on two Global servers located in France and the US. ISDM role is to carry out the processing of the data received from Canadian floats, to distribute the data on the GTS and the global servers within 24 hours and to handle the delayed mode processing. During 2010, the Canadian Argo program deployed 16 Argo floats in the NAFO region, including 4 oxygen floats and produced 1308 temperature and salinity profiles and 77 oxygen profiles.

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

This committee was again funded in 2010-11 to a total of $827 k. From this 17, projects were funded with about 1/6 going to data rescue, and 1/4 for building archives for data that had none. The other funds were spread over improving infrastructure, building a metadata repository, and supporting continuing work to create a detailed gridded bathymetry around Canada. Some funded initiatives included a national multispecies tagging system and the rescue of multi-regional freshwater temperature data.

2010-11:

There were 3 projects directly concerned with data rescue funded at $125K

Five were targeted to build archives for data where none now exist funded at $211K

A total of 17 projects were approved for NSDMC funding from the $827k total

Aquatic Invasive Species are a major threat to Canada's fisheries and aquaculture industry and have been entering Canadian waters for centuries but never as rapidly as today. Every decade, some 15 alien species establish themselves in our coastal or inland waters. In the absence of their natural predators, the most aggressive of them spread rapidly. They can radically alter habitat, rendering it inhospitable for native species. The zebra mussel and sea lamprey are examples of such species that have greatly affected the Great Lakes. The Canadian Aquatic Invasive Species database and web application was developed by ISDM in 2004-5 with the objectives to provide a geo-referenced repository for all invasive species observations gathered in Canada and to create a decision making tool that would illustrate trends and movements over time and various locations for proactive action. Currently, there is data from the Great Lakes, the Maritimes and some from the Vancouver area. Most of the data are observations of location name, long-lat, species name, date and any metadata provided.

The DFO Atlantic Zone Monitoring Programme activities include regular sampling for 7 fixed stations and 13 standard sections, and research missions in the AZMP area to collect other physical, chemical and biological data. As part of ISDM's activities in data management, ISDM continues to build and maintain the AZMP web site: www.isdm.gc.ca/isdm-gdsi/azmp-pmza/index-eng.html. The data and information on the site includes:

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

References

List of NAFO Standard Oceanographic Sections and Stations. The reprint of NAFO SCR DOC., NO. 1, Serial N1432, 9p. Printed and distributed by: NAFO, P.O. Box 638, Dartmouth, Nova Scotia, Canada B2Y 3Y9.

6. Results of Ocean Climate and Physical, Biological and Chemical Oceanographic Studies in the NAFO Convention Area

Subareas 0 and 1. A review of meteorological, sea ice and hydrographic conditions in West Greenland in 2010 was presented in **SCR Doc. 11/01**. In winter 2009/10, the North Atlantic Oscillation (NAO) index was exceptionally negative resulting in a weakening of the westerly winds over the North Atlantic Ocean. Often this results in warmer conditions over the West Greenland region. The air temperature was much higher than normal during winter especially over the southern Baffin Bay. The annual air temperatures were even more extreme with record high temperature anomaly at Nuuk in West Greenland. Upper layer temperatures over the Fylla Bank in mid-June temperatures were 0.7°C above average conditions in 2010 but salinities were lower at 0.2 below normal. At the southern sections on top of the shelf a thick low saline pool of Polar Water was observed from Cape Farewell to Maniitsoq and to a lesser degree on top of Fylla Bank suggesting above normal presence of Polar Water in southern regions. The presence of Irminger Water in the West Greenland waters was high in 2010. Pure Irminger Water (waters of Atlantic origin) could be traced north to the Sisimiut section. The mean (400–600 m) temperature west of Fylla Bank (st.4) was high and the salinity record high. For the same depth interval at Maniitsoq (st.5) and Sisimiut (st.5), the salinities were the second highest observed yet with very high temperature. In the Disko Bay off Ilulissat (st.3), the bottom temperature and salinity has decreased since 2009 to only about average, but still generally above values before mid-1990.

A review of meteorological, sea ice and hydrographic conditions around Greenland in 2010 was presented in SCR Doc. 11/30 and SCS Doc. 11/06. Atmospheric and hydrographic conditions off West Greenland in 2010 are presented based on the CTD (temperature-conductivity-depth) data from autumn German ground fish survey and satellite observations. NAO index is normally used to describe the atmosphere circulation pattern over the North Atlantic and was strongly negative in 2010. This resulted in extreme warm atmospheric conditions over the whole western North Atlantic. The mean air temperature at Nuuk station in west Greenland was 2.6 °C in 2010 and reached its highest value in the whole series of observations since 1876. Based on the satellite data, the sea surface temperature showed positive anomalies up to 4°C over the Greenland shelf and Labrador Sea, following the warm atmospheric conditions. We found, that the long term trend of the sea surface temperature over the Greenland shelf comprises 0.5°C for the period 1982-2010. Similar positive trend can be seen in the temperature of the subsurface shelf waters, whereas the salinity of these waters shows no significant trend, but strong interannual variability. The salinity, temperature and volume of the Irminger Sea Water component of the West Greenland Current were high in 2010, which can be explained by continued slow phase of the Subpolar Gyre, beginning around the mid-1990s.

Subareas 1 and 2. A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2010 was presented in **SCR Doc. 11/11**. The Labrador Sea experienced very warm winter surface air temperatures in 2010 similar to the previous year; temperatures ranged from approximately 10°C above normal in the northern region near Davis Strait to about 5°C above normal in the southern Labrador Sea. Sea surface temperature anomaly was more than 2°C in the Labrador Sea throughout the whole year. In 2010, wintertime convection was limited to the upper 200 m of the water column, a dramatic change from the deep convection event of 2008 when convection reached 1600 m. Maximum sea ice extent was below the long-term mean for this region. While the upper layer (10-150m) demonstrates a strong trend of increasing temperature since the mid-1990s, the trend in salinity is much weaker. In the layer impacted by convection (20-2000m), there is a strong increasing trend in both temperature and salinity since the mid-1990s. While temperature is now the highest in the record, salinity is still slightly less than that observed in the late 1960s.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador (NL) Region during 2010 was presented in **SCR Doc. 11/16** and **SCS Doc. 11-09**. The North Atlantic Oscillation index for 2010 was at a record low and as a consequence, outflow of arctic air masses to the Northwest Atlantic was much weaker than normal. This resulted in a broad-scale warming throughout the Northwest Atlantic from West Greenland to Baffin Island to Newfoundland relative to 2009. Air temperatures were above normal by 2-3 standard deviations (SD) and at a record high at some northern sites on Baffin Island and the Labrador Coast. Sea-ice extent and duration on the Newfoundland and Labrador Shelf decreased in 2010 for the 15th consecutive year, with the annual average reaching a record low. As a result of these and other factors, local water temperatures on the Newfoundland and Labrador Shelf warmed compared to 2009 and were above normal in most areas. Salinities on the NL Shelf were lower than normal throughout most of the 1990s, increased to above normal during most of the past decade but decreased to fresher-than-normal conditions in many areas in 2010. At Station 27 off St. John's, the annual depth-averaged water temperature increased to 2 SD above normal, the second highest on record. Annual surface and bottom temperatures at Station 27 were also above normal by 0.6°C (1 SD) and 0.64°C (1.7 SD) respectively. Bottom temperatures at Station 27 were slightly below normal in 2009. The area of the Cold-Intermediate-Layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland Shelf during 2010 was below normal by 0.6 SD off Bonavista and 1 SD off Seal Island Labrador. Average temperatures conditions along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. Spring bottom temperatures in NAFO Divs. 3Ps and 3LNO during 2010 were above normal by up to 1 SD and as a result the area of the bottom habitat covered by water <0°C was significantly below normal. During the fall bottom temperatures in 2J were at a record high value, almost 2 SD above normal and 3K and 3LNO they were >1 SD above normal. The volume of CIL water on the NL shelf during the fall was below normal (3rd lowest since 1980) for the 16th consecutive year. A composite climate index derived from 26 meteorological, ice and ocean temperature and salinity time series show a peak in 2006, a declining trend in 2007-09 and a sharp increase in 2010 to the 2nd highest in 61 years, indicating warmer than normal conditions throughout the area.

An investigation of the biological and chemical oceanographic conditions in subareas 2 to 5 was presented in **SCR Doc. 11/13.** Data collected in 2010 from fixed coastal stations, oceanographic transects, and ships of opportunity ranging from the Labrador-Newfoundland and Grand Banks Shelf (Subarea 2 and 3), extending south along the Scotian Shelf and the Bay of Fundy (Subarea 4) and into the Gulf of Maine (Subarea 5) are presented and referenced to previous information from earlier periods when available. We review the information concerning the interannual variations in inventories of nutrients (nitrate), chlorophyll *a* and indices of the spring bloom inferred from satellite imagery, as well as the abundance of major taxa of zooplankton collected as part of the 2010 Atlantic Zone Monitoring Program (AZMP). In general, nitrate inventories in NAFO Subareas 2 and 3 were below normal, consistent with available data further south in Subareas 4 in 2010. The nutrient anomaly time series for Subareas shows large interannual and spatial variability throughout the 12-year record. Lower than normal surface phytoplankton blooms were detected with satellite imagery in northern Subareas across the Labrador Shelf, Labrador Sea, and Greenland Shelf in 2010. Enhanced blooms were detected along the central and southern Subareas extending across the Gulf of St. Lawrence, Newfoundland Shelf and Grand Banks to the eastern Scotian Shelf in 2010. The timing of the production cycle occurred significantly earlier across the entire Northwest Atlantic in 2010. Enhanced abundance of large and total copepods as well as non-copepod zooplankton were observed for the northern Subareas in 2010 with some of the highest standardized anomalies observed in the 12-year time series. The composite indices summing each of the zooplankton groups across the NAFO Subareas indicated a general declining trend over the 12-year time series until the abrupt increase in 2010. Overall, the combined composite indices of inventories and abundances across trophic levels (nutrients, phytoplankton and zooplankton) generally exhibit weak associations (i.e. correlations) between adjacent trophic levels and high interannual variability.

Subarea 4. A description of environmental information collected on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas during 2010 was presented in **SCR Doc. 11/12**. A review of the 2010 physical oceanographic conditions on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas indicates that above normal conditions prevailed. The climate index, a composite of 18 selected, normalized time series, averaged +1.0 (±0.8) SD with 13 of the 18 variables more than 0.5 SD above normal; compared to the other 41 years, 2010 ranks as the 4th warmest. The anomalies did not show a strong spatial variation. Bottom temperatures were above normal but not exceptionally so with anomalies for NAFO areas 4Vn, 4Vs, 4W, 4X and eastern Georges Bank of +0.2°C (0.5SD), +0.4°C (0.6SD), +0.6°C (0.8SD), +0.3°C (0.5SD), and +0.4°C (0.7SD) respectively.

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. 11/08**). A total of 1776 CTD (conductivity, temperature, depth) profiles were collected and processed on Northeast Fisheries Science Center (NEFSC) cruises during 2010. Of these 1753 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 5 cruises in 2010 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 2010, zooplankton community distribution and abundance were monitored on six surveys using 699 bongo net tows. Each survey covered all or part of the continental shelf from Cape Hatteras northward, up through the Mid-Atlantic Bight, across Southern New England waters and Georges Bank, and 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 13 transects across the Mid-Atlantic Bight from New York to the Gulf Stream. Cruise reports and data are available from the website: http://www.nefsc.noaa.gov/epd/ocean/MainPage/. The NEFSC's James J. Howard and Woods Hole Laboratories, U. S. Geological Service (USGS), and several collaborating academic institutions continued to conduct field programs to develop methods for mapping, characterizing, and developing hypotheses regarding benthic habitats and their macrobenthic and demersal communities during 2010. Several planned programs, however, were severely curtailed by redeployment of vessels and personnel to address the Deepwater Horizon crisis in the Gulf of Mexico.

7. Interdisciplinary Studies

The following studies were considered at the June 2011 Meeting:

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. 11/12**. An investigation of the oceanographic and lower-trophic-level biology has take place in the region of Orphan Knoll. This study has utilized existing data sets as well as collecting new data using shipboard and moored instrumentation over the period 2008-2010. Physical properties indicate that Orphan Knoll is in a boundary region between outflow from the Labrador Sea (subpolar gyre) and northward flow of the North Atlantic Current (subtropical gyre), with waters of primarily subpolar origin. However, near-bottom current measurements provide evidence for anti-cyclonic (clockwise) circulation around the knoll, and an upper-ocean incursion of more subtropical water from the North Atlantic Current was observed in one of the three study years. Chlorophyll, small phytoplankton and bacteria in the Orphan Basin-Orphan Knoll region show strong spatial and inter-annual variability, reflecting the complex and variable physical dynamics and growth conditions in the region. Overall, there is little evidence for enhanced lower trophic level biology in the water column above the knoll; however, the near-bottom anti-cyclonic circulation could have important implications for the benthic community.

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

In 2003 STACFEN began production of an annual climate status report to describe environmental conditions during the previous year. This web-based annual summary for the NAFO area includes an overview that summarizes the overall general climate changes for the previous year and a regional overview that provided climate indices from each of the Subareas. An update of the on-line annual ocean climate status summary for the NAFO Convention Area will be posted shortly. 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 (P. Fratantoni). The Chair and E. B. Colbourne agreed to working in conjuction with the NAFO Secretariat on an update of the online annual ocean climate status summary for the NAFO Convention Area for 2010. The development of new annual environmental composite indices for specific NAFO Subareas and Divisions are planned for addition to the web-based summary for 2012.

9. Environmental Indices and Links to Year Class Strength

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. The environmental conditions in 2010 coincided with higher primary and secondary productivity and continuing warm conditions throughout the NAFO Subareas. Enhanced productivity was also observed in 1999 on the Scotian Shelf and also coincided with good year-classes in a number of fish and invertebrate stocks. Similar observations of enhanced recruitment (personal communication) have been noted in 2010 for stocks. This does not imply cause and effect but does suggest further investigation is warranted.

10. The Formulation of Recommendations Based on Environmental Conditions

STACFEN **recommended** *input from Scientific Council for development of new time series and data products for future use and any additional species that could be evaluated in relation to the environment.*

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** *development of annual environmental composite indices to complement environmental information provided to STACFIS for the Subareas of interest (SA 0-1, SA3-Div. 3M, SA3 and Div. 3LNO, widely distributed stocks SA 2-4).*

STACFEN **recommended** that *the appearance of good year-classes in 2010 be explored in relation to environmental conditions.*

11. Review of Symposium on: "Hydrobiological and ecosystem variability in the ICES and NAFO area during the first decade of the XXI century".

The main mandate of the Symposium was to summarize and understand the hydro-biological variability observed during the decade of 2000-2009 in relation to longer time variability or change, and to quantify the interactions between the variability of climate, ocean environment, plankton, fish, mammals and seabirds in the north Atlantic marine ecosystems. In general, roughly equal contributions from the main themes were presented at the joint ICES/NAFO Symposium with 40+ oral presentations and 80 posters. There were ~ 140 registered participants at the symposium. However, the oral and poster contributions were predominately based on NE Atlantic studies with only a minor representation of the NW Atlantic representing less than 10%. The committee received comments from Steve Cadrin (NAFO Co-Chair), Anna Akimova and Eugene Colbourne (Scientific Steering Committee) regarding the major accomplishments, positive outcomes, and challenges for future Symposium.

Specific comments: The major ecosystem trends and patterns in each region of the N Atlantic were documented during the last decade and helped focus discussions on future research and interdisciplinary collaborations for the next decade. The major physical theme for the most recent decade was warming, and secondarily decreases in salinity in most regions. Changes in those principal drivers of seawater density influenced many ocean circulation patterns (strength of gyres, position of major currents, depth of mixed layers, etc.). Biological responses to physical changes varied among regions, with changes in timing of seasonal blooms or migrations, shifts in geographic distributions, and general changes in productivity. Several advances in understanding ecosystem processes were presented which I expect will inspire conference participants and readers of the proceedings to design future research.

The venue was excellent. Santander is a beautiful city and attracted people to the symposium (there were ~140 people registered). Our Spanish hosts did a great job of making us feel at home, with a warm reception and a nice dinner. The conference center had good facilities and was comfortable. We received many submissions (135), and many excellent submissions. I attribute the impressive submissions to the importance of the theme, reputation of past decadal symposia, the venue, and an attractive/informative flier. The regional organization of talks helped to integrate the physical and biological topics. The honoree diner was inspiring, and the honorees introductions and speeches gave a valuable historical context to the decadal focus.

Terms of Reference are needed to ensure the roles of the ICES and NAFO co-chairs, the scientific steering committee, the organizing committee, the local hosts, and the publication committee are clear well in advance of the meeting. Additional coverage in the northwest Atlantic is needed, together with studies from Greenland, southwestern part of Atlantic and North Sea, which were lacking in the most recent symposium. There is a strong desire to promote more collaborative research and communication between investigators working in such multidisciplinary fields as ocean climate and monitoring, lower trophic levels, and fishery sciences but, continues to remain an ongoing challenge. Overall, the joint symposium was highly successful and represents a further opportunity to continue to build upon our knowledge base as we move toward integrated assessments and the ecosystem approach. STACFEN wishes to expressly our appreciation of the efforts of Dr. Steve Cadrin, Anna Akimova, and Eugene Colbourne along with NAFO Scientific Council and the Secretariat for their hard work and financial support for the joint Symposium.

12. 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.

13. Other Matters

No other matters were raised in the committee.

14. Adjournment

Upon completing the agenda, the Chair thanked the STACFEN members for their excellent contributions, the Secretariat and the rapporteur for their support and contributions. Special thanks are extended to our German Hosts that provided an excellent venue for STACFEN, provision of logistical support, and warm hospitality.

The meeting was adjourned at 16:00 on 4 June 2011.

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

Chair: Margaret Treble Rapporteur: Alexis Pacey

The Committee met at the Johann Heinrich von Thünen-Institut, 38116 Braunschweig, Bundesallee 50, Germany on the 7 and 10 June 2011, 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, Lithuania, Spain, Portugal), 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 09:00 hours by welcoming the participants.

2. Appointment of Rapporteur

Alexis Pacey (NAFO Secretariat) was appointed rapporteur.

3. Adoption of Agenda

The Agenda as given in the Provisional Agenda (GFS/11-125, dated 01 April 2011) was adopted with the addition of item **6g Website update.**

4. Review of Recommendations in 2010

Recommendations from June

STACPUB had **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*.

STATUS: A booklet with waterproof pages containing the sponge guide has been prepared by the Secretariat. The electronic version of the sponge guide was uploaded to the NAFO website as *NAFO Scientific Council Studies 43*.

5. Review of Publications

a) Annual Summary

i) Journal of Northwest Atlantic Fishery Science (JNAFS)

STACPUB was informed that: Volume 42, The Role of Marine Mammals in the Ecosystem in the 21st Century volume was printed in June 2010 and there were 200 copies made.

A total of 11 papers have been submitted for publication in Volume 43, six of which have been accepted and are online; one has been accepted and is at the proofing stage, and the others are in the review process. The paper copies will be printed in November 2011. A print run of 150-200 copies will be considered.

DOIS/ASFA entries: The Secretariat has assigned someone to do the inputting of data. All papers are up-to-date.

In the past the publications department waited for papers to be finalized. Instead, each volume should be published at the end of the year and anything that is not ready or finalized, should be put to the next volume. Preference would be to have one single year as opposed to two years combined.

STACPUB **recommended** that *the Journal of Northwest Atlantic Fishery Science be published each year/per volume.*

ii) NAFO Scientific Council Studies

STACPUB was informed that: A sponge guide was printed in 2010 on waterproof paper and coil bound. It has a total of 48 pages and there were 135 copies made in 2010 and circulated with the CEM in December 2010. A further 135 copies were printed in 2011 for more specific distribution, mainly following requests from research laboratories. This publication is used to identify sponges in the NAFO Area.

iii) NAFO Scientific Council Reports

STACPUB was informed that: A total of 75 printed copies of the NAFO Scientific Council Reports 2010 (Redbook) volume (371 pages) were produced in April 2011.

iv) Progress report of meeting documentation CD

STACPUB was informed that: Approximately 100 copies of the Meeting Documentation CD 2010 were produced. The CD contains:

- GC/FC Proceedings 09-10
- GC/FC Report Sep 10
- SC Reports 2010
- NAFO Convention
- NCEM 2011
- Rules of Procedure
- Annual Report 2010

The CD will be placed in the back of both the 2010 Scientific Council Reports and the 2010/11 Meeting Proceedings for General Council and Fisheries Commission. Another 150 CDs will be distributed to a mailing list consisting of Libraries and Institutes.

STACPUB was informed of a working paper that contains information from a meeting of the Working Group on Reproductive Potential (WGRP) that took place in Aberdeen, Scotland in April 2011.

STACPUB **recommended** that *the proceedings of the Working Group on Reproductive Potential be published in the NAFO Scientific Studies Series.*

STACPUB noted that a list of Scientific Merit Award recipients is not found in any publications.

STACPUB **recommended** that *a Scientific Merit Award list be included at the back of future publications of the Scientific Council Report.*

6. Other Matters

a) Review of roles for JNAFS Editors (General, Associate and Guest)

The roles of General, Technical, Associate and Guest Editors, of the Journal of Northwest Atlantic Fisheries Science (JNAFS) have been somewhat informal and overlapping in the past. The ongoing smooth running of the Journal may be assisted by defining roles and responsibilities of each. Furthermore, the proper recognition of guest editors has been an unresolved issue for over a decade. The Publication Manager at the NAFO Secretariat now plays a larger role in the process than may have been the case when previous guidelines were given (e.g. Scientific Council Report 1988, p.102, Annex I), therefore this may be a good time to summarize the roles of editors and document the typical process a submitted paper goes through in both a regular and symposium edition.

General Editor

The General Editor acts as first point of contact for authors and He/She initially screens the submission depending on whether it is suitable for JNAFS. The paper is then forwarded to the relevant Associate Editor for review. The

General Editor drafts a foreword for each volume. The General Editor also returns rejected papers which are deemed to fall below required submission standards, together with an explanation as to why that decision has been made.

The Associate Editor

The responsibilities of Associate Editors include obtaining reviews by experts on the topic dealt with in the paper. They advise the lead author of changes required to make it acceptable, or why it is being rejected. The Associate Editor advises the General Editor about suitable scientific content and expression, requiring only standard technical editing for the Journal. The Associate Editor also advises the Technical Editor of those rejected papers which might be suitable for the Studies series.

Guest Editors

Guest Editors are the co-conveners of NAFO-sponsored symposia which have been selected to be the subject of a special edition of JNAFS. They encourage the contribution of papers from symposium attendees and otherwise fill the role of Associate Editor for a specific volume. Guest editors prepare an introductory paper summarizing the symposium and they are acknowledged for their contributions by having their names and affiliations on the title page of the volume, beneath the symposium title.

Technical Editor

The responsibilities of the Technical Editor include, technical copy-editing of accepted manuscripts, in conjunction with the Publication Manager, including checking equations, tables and figures, ensuring that all literature is correctly cited and that journal abbreviations are correctly used.

Publications Manager

The Publications Manager supports the Technical and General Editors of the Journal in producing the finished product and administering the procedural side of the process. This includes laying out the paper for print using specialist software, to standard layout rules and according to the JNAFS style guide. In addition ensuring the figures, tables and equations are laid out according to specific styles for JNAFS. Entering cited references into an on-line cross-reference program to locate relevant document object identifier numbers (DOIs) are part of the tasks. Once the paper has been sent to the technical editor for corrections, the final paper is then sent to the author for review and approval, and then finally to the General Editor. A final pdf is uploaded to the website, along with the html. The paper/DOI is then entered into the crossref.org database in an .xml format. All Journal articles and Scientific Council Reports are submitted yearly to ASFA by the Publications Manager.

b) JNAFS General Editor

STACPUB has traditionally formally appointed the General Editor for JNAFS. Dr. Anthony B. Thompson is currently the General Editor, but a new General Editor is required since he resigned. This role has been done by a Secretariat staff member except for a short period during 1985-86. An alternative would be to look for a qualified Scientific Council member from a Contracting Party.

STACPUB discussed the appointment of a General Editor. It was noted that Alexis Pacey, Publications Manager, has taken on some of the tasks previously handled by the General Editor, such as DOI cross referencing and ASFA indexing. It was suggested that there are advantages to having someone from the Secretariat take on the role of General Editor and it makes sense to assign these responsibilities to the SC Coordinator. Dr. Neil Campbell, the current SC Coordinator, has agreed to this.

STACPUB **recommended** that *the Scientific Council Coordinator be the General Editor. In future this should be included as part of the SC Coordinator's position.*

STACPUB would like to thank Dr. Anthony Thompson for his dedication and effort towards improving the Journal during his time as General Editor.

c) Update on digitization of NAFO historical documents and publications, and the ability to search

Over the last couple of years the digitization of the NAFO documents has been an ongoing project. The documents had to be scanned and meta-data for each document included.

The digitization has now been completed for all NAFO meeting documents including SCR, SCS, FC and GC from 1979-2000. 2000 to the present were already available electronically. The meta-data tags have to be added to the more recent documents. This phase of the project will be completed in the next couple of months. All these documents are available on the NAFO website.

The search feature that was developed for the JNAFS site can be adapted to search the meeting documents once the meta-tags have been updated. This phase will be completed in 2011.

The next phase of the project is to digitize the rest of the NAFO publications. This includes all Scientific Council Reports, Meeting Proceedings of the General Council and Fisheries Commission and Annual Reports. This will be completed over the next year.

As well, plans are being made to begin digitizing the ICNAF documents and publications. This will be done in a phased approach and files will be uploaded to the website as they are completed. These files will be text-searchable.

STACPUB **recommended** that *a CD be created to include all historical documents.*

d) Search function for NAFO documents, including DOIs and ASFA

STACPUB was informed that: DOI submissions for all JNAFS articles are completed and up to date. This will make it easier to find JNAFS articles on-line and will hopefully encourage authors to cite JNAFS articles more often. Currently, after every article that is published online, a DOI is submitted.

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 April 2011, all ASFA entries are up to date, partially thanks to an auto-indexing initiative created by the publisher ProQuest. The ASFA board meeting will take place in Ecuador in early September 2011 and there will be an opportunity to present NAFO’s report and other ASFA related issues.

STACPUB has some concerns regarding ASFA. The authors are currently listed as corporate. This is inaccurate and if it is possible it should be corrected. The Secretariat will look into this matter at the upcoming ASFA meeting.

e) American Fisheries Society Recommendation for Revision to Fish Species Naming Convention

The American Fisheries Society (AFS) and American Society of Ichthyologists and Herpetologists Joint Names Committee are the governing committee in North America that determines the scientific and common names of fishes. In 2010 this committee decided that the first letter in each word in the common names of fishes should be capitalized and the decision was accepted by the American Fisheries Society Executive Committee and reflected in the 7th Edition of the Names of Fishes AFS Special Publication. The decision to capitalize common names was made to better facilitate communication, particularly to a lay audience. For example it will help to clarify adjectives vs. common names. In the sentence “I caught a spotted gar.” is it referring to one of many species of gar with spots, or a *Lepisosteus oculatus* (Spotted Gar)? Fisheries and Oceans Canada’s Stock Assessment Secretariat has accepted the AFS recommendation and is beginning to implement it in their advisory documents and other publications.

STACPUB noted that other prominent journals have not yet adopted this naming convention (e.g. *ICES Journal of Marine Science*, *Canadian Journal of Fisheries and Aquatic Sciences*) and that STACPUB should wait for a few years to see if this change is generally adopted by other international journals.

f) Facebook and Twitter on the NAFO website

It is becoming common with organizations and businesses to establish a Facebook and Twitter account. It is a new form of communication referred to as social media. There may be some advantages to consider and it would be a Scientific Council initiative and not necessarily involve NAFO as a whole organization. STACPUB discussed the advantages and disadvantages and decided that at this point it is preferable to continue to improve the website and use the SharePoint for communication purposes.

g) Website update

The Secretariat has been working on updating the website and in the future it will have a new look and feel. There are plans to have an inspection area (compliance website), and eventually the whole NAFO website will be updated and integrated.

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 1130 hours on 10 June 2011.

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

Chair: Carsten Hvingel Rapporteur: Barbara Marshall

The Committee met at Johann Heinrich von Thünen Institut (vTI), Braunschweig, Germany, on 6 and 11 June 2011 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, Lithuania, Portugal and Spain), Russian Federation, and United States of America. The Scientific Council Coordinator and other members of the Secretariat were in attendance.

1. Opening

The Chair opened the meeting at 0900 hours on 6 June 2011, 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

Barbara Marshall was appointed as rapporteur.

3. Review of Previous Recommendations

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)*.

STATUS: The Secretariat compiled a working paper that outlined various catch related data. It was noted that there are some confidentiality issues surrounding the establishment of the catch estimates. It was noted that the agreed catch should be available, preferably by country but the sources need not necessarily be provided. The Secretariat was then requested to compile a table of catches used in the assessments, by stock, with numbers being taken from the STACFIS tables.

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.*

STATUS: The Secretariat did send out reminders to countries but the result was not very different from other years. This will continue to be done annually.

STACREC **recommended** that *DEs compile historical catch data in as fine a scale (ideally by NAFO Division) and for as many years as possible.*

STATUS: This recommendation has been reiterated and Designated Experts will be reminded of this request after the June meeting.

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.*

STATUS: This has been noted and will be done in this year's report.

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.*

STATUS: This issue was addressed by the WGEAFM at their meeting in December 2010 and is discussed further under item 4.a.iii.

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.*

STATUS: This is discussed under item 6.

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.*

STATUS: This is discussed under item 6.

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.*

STATUS: Nothing to report and this recommendation is reiterated.

4. Fishery Statistics

a) Progress report on Secretariat activities in 2010/2011

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 2008-2010 up to 3 June 2011.

Country/Component	STATLANT 21A (deadline, 1 May)			STALANT 21B (deadline 31 August)		
	2008	2009	2010	2008	2009	2010
CAN-CA	30 Mar 09	31 Mar 10	31 Mar 11	31 Aug 09	30 Aug 10	
CAN-M						
CAN-SF	15 May 09	14 May 10	28 Apr 11	29 Apr 11	21 May 10	
CAN-G	10 Jun 09	2 Jun 10	29 Apr 11	6 Oct 09	1 Sep 2010	
CAN-N	27 May 09	29 Apr 10	29 Apr 11	31 Aug 09	3 Sep 10	
CAN-Q	27 Apr 09	11 Mar 11		11 Mar 11	11 Mar 11	
CUB						
E/EST	4 May 09	30 Apr 10	27 Apr11	4 Sep 09	26 Aug 10	
E/DNK	25 May 09	24 May 10		25 May 09	24 May 10	
E/FRA-M						
E/DEU	27 Apr 09	27 Apr 10	28 Apr 11	21 Aug 09	31 Aug 10	
E/NLD						
E/LVA	1 Apr 09	2 Jun 10	14 Apr 11	3 Aug 09	2 Jun 10	
E/LTU	10 Jun 09			22 Mar 11	22 Mar 11	
E/POL	2 Jun 09 (no fishing)	22 Jul 10 (no fishing)				
E/PRT	29 Apr 09	11 May 10	27 Apr 11	31 Aug 09	31 Aug 10	
E/ESP	2 Jun 09	3 Jun 10		2 Jun 09	3 Jun 10	
E/GBR	2 Jun 09	2 Jun 10	1 Jun 11	1 Sep 09	2 Jun 10	
FRO	16 Jun 09	1 Jun 10	6 May 11	16 Jul 09	1 Jun 10	6 May 11
GRL	23 Jun 10	28 Jun 10	27 Apr 11	23 Jun 10		
ISL	11 May 09	9 Jun 10 (no fishing)	4 May 11			
JPN	1 May 09			10 Aug 09		
KOR						
NOR	4 Jun 09	15 Apr 10	28 Apr 11		31 Aug 10	
RUS	18 May 09	3 Jun 10	27 Apr 11	9 Jul 09	21 Jun10 (Revised 13 Apr 11)	
USA	26 May 10	26 May 10	16 May 11			
FRA-SP	11 May 09	2 Jun 10	29 Ap 11	11 May 09	1 Sep 10	
UKR			20 Jan 11 (no fishing)			

ii) Labelling of STALANT catch figures in catch tables

STACREC agreed that that the use of provisional in the STACFIS catch tables was no longer useful. A cut-off date, usually the first day of the meeting, would be assigned and catch figures as of this date would be used. The catch figures from STATLANT could be checked annually to ensure the figures are up-to-date.

iii) Information collected by the Secretariat

Some information about sources of catch information available at the Secretariat including official catch statistics (STATLANT 21), provisional monthly catch summaries, VMS and catch reports, observer reports and inspection reports was presented.

iv) 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.*

STATUS: The WGEAM reviewed the 3-letter codes currently assigned to the coral and sponge species already included in the ASFIS database. The codes are poorly and inconsistently related to the scientific names therefore they would be difficult to use and likely prone to recording error. For example, the following codes do not follow a consistent abbreviation rationale: COL (*Corallium rubrum,* Sardinia coral), CEL (*Corallium elatius*, Momo, boke magai, misu coral), and QGA (*Spongia agaricina*, Elephant ear sponge). It was noted that a 3-letter code can have 17 576 combinations, and that nearly 11 000 have been already assigned. This means that future codes will increasingly lose their link to the names of the species they are being assigned to. Because of this, the group was of the opinion that the development of 3-letter ASFIS codes for corals and sponges in the northwest Atlantic would not be helpful for the purposes of easy and accurate recording.

5. Research Activities

a) Biological Sampling

i) Report on activities in 2010/2011

STACREC reviewed the list of Biological Sampling Data for 2010 (SCS Doc. 11/15) prepared by the Secretariat and noted that any updates will be inserted during the summer, prior to finalizing the SCS Document which will be published for the September 2011 Meeting.

ii) Report by National Representatives on commercial sampling conducted

Canada-Newfoundland (SCS Doc. 11/09, plus information in various SCR documents**):** 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 char (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).

Denmark/Greenland (SCS Doc. 11/10): Length frequencies were available from the Greenland trawl fishery in Div. 1A CPUE data were available from the Greenland trawl fishery in Div. 1AB and 1CD. (SCS Doc. 11/10). Length distributions were available from the inshore long line and gill net fishery in inshore in Div. 1A. CPUE data were available from the inshore longline fishery in Div. 1A

EU-Germany (SCS Doc. 11/06): Demersal fishing effort in 2010 in Division 1D inside the Greenland EEZ increased to 2490 hours thus reaching the level from 2007 with 2230 hours. The fishery was directed towards Greenland halibut (*Reinhardtius hippoglossoides*). By the end of 2010, reported landings of Greenland halibut amounted to 1691 t. The by-catch of roundnose grenadiers was 3.4 t in 2010 and thus similar to the by-catch from 2007 and 2008 (ca 4 t) but higher than in 2008 and 2009 with < 1 t. Wolffishes and skates were not reported as by-catch (presumably less than 1 ton). No fishery was undertaken for Atlantic cod and redfish. Size distributions and CPUEs are presented.

EU-Lithuania (SCS Doc. 11/04): Biological data have been collected by observers. Samples were taken from redfish in Div. 3M, cod in Div. 3LMN, Greenland halibut in Div. 3LM, American plaice in Div. 3MN, yellowtail flounder in Div. 3N, roughhead grenadier in Div. 3N and roundnose grenadier in Div. 3N.

EU-Portugal (SCS Doc 11/05): Data on catch rates were obtained from trawl catches for Greenland halibut (Div. 3LMNO), redfish (Div. 3LMNO), skates (Div. 3LNO) and cod (Div. 3M). Data on length composition of the catch were obtained for Greenland halibut (Div. 3LMNO), redfish *S. mentella* (Div. 3LMNO), American plaice (Div. 3LMNO), witch flounder (Div. 3LMNO) and thorny skate (Div. 3LMNO), cod (Div. 3MNO), redfish *S. marinus* (Div. 3LMO), roughhead grenadier (Div. 3LMN), spinytail skate (Div. 3LM), yellowtail flounder (Div. 3N), haddock (Div. 3O) and white hake (Div. 3O).

EU-Spain (SCS Doc. 11/07)**:** All effort and catch information in the Spanish Research Report are based on information from NAFO observers on board. In 2010 information from 1095 days was available while total effort of the Spanish fleet in NAFO Regulatory Area was 1524 days (72% coverage). Estimates of the Spanish catches by species and Division in 2010 base on the information collected by the NAFO Observers. The Spanish fleet has, at least, five different fisheries in NAFO Subarea 3 characterized by different mesh size, target species, depth and fishing area.

In addition to NAFO observers, IEO scientific observers were on board 396 fishing days that it means 26 % of the Spanish total effort. All length, age and biological information presented in this paper are based on sampling carried out by IEO scientific observers: 444 samples were taken in 2010, with 58 222 individuals of fourteen different species examined.

EU-Estonia: (SCS Doc. 11/13): Samples were collected by scientific observers on board fishing vessels for redfish in Div. 3L, 3M, 3N and 3O, Greenland halibut in Div. 3L and 3M and for shrimp in Div. 3L and 3M. Length distribution and length frequencies of *Sebastes sp*. bycatch in the shrimp fishery in 2007-2010, Greenland halibut in 2009-2010 and redfish in 2009-2010 were presented.

Russia (SCS Doc. 11/11): In SA 1+2 Biological data on Greenland halibut from Div.1AD were collected by observers aboard Russian fishing vessels. In SA 3 biological data were collected by NAFO observers aboard fishing vessels for Greenland halibut in Div. 3LMN. roughhead grenadier in Div. 3LMN, roundnose grenadier in Div. 3LM, American plaice in Div. 3LN, threebeard rockling in Div. 3L, witch flounder in Div. 3LN, cod in Div. 3MN, northern wolffish in Div. 3LN, Atlantic wolffish in Div. 3L, black dogfish in Div. 3LN, blue hake in Div. 3LN, yellowtail flounder in Div. 3N, deep-water redfish (*Sebastes mentella*) in Div. 3LMN, golden redfish (*Sebastes marinus*) in Div. 3LN and Acadian redfish (*Sebastes fasciatus*) in Div. 3LMN.

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 2010 (by National Representatives and Designated Experts)

Canada (SCS Doc. 11/09) 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 2010 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2HJ3KLMNO. The spring survey in Div. 3LNOP was conducted from April to late June, and the portion in Div. 3LNO consisted of 288 tows with the Campelen 1800 trawl, by the research vessel *Alfred Needler*. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to December, and consisted of 699 tows with the Campelen 1800 trawl. Two research vessels were used: *Teleost* and *Alfred Needler*, and this survey continued a time series begun in 1977. Additional surveys during 2010, directed at various species using a variety of designs and fishing gears, were described in detail in SCS Doc. 11/09 and in other documents. Results from Canadian oceanographic surveys were discussed in detail in STACFEN.

EU-Spain (SCS Doc. 11/07): The Spanish bottom trawl survey in NAFO Regulatory area Div. 3NO was conducted from 30 May to 18 June 2010 on board R/V Vizconde de Eza using Campelen gear with a stratified design. A total of 95 valid hauls were carried out to a depth between 40 and 1 395 m. The results of the Spanish Div. 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. As in the years 1995 and 1996 few deeper strata were surveyed, the data obtained in those surveys are not representative for most of the species, so the data is presented since 1997 to 2009 for all the species, except for Yellowtail flounder, whose data are presented for the whole period, and for White hake, presented for the period 2001-2009 because before 2001 there are no data available. A total of 89 hydrographic profile samplings were made. The depth of profiles ranged between 37 and 1 450 m. Feeding habit studies of 25 species were made. A total of

3276 stomach contents were analyzed. Material for histological maturity, fecundity and growth studies of Cod, American place and Greenland halibut were taken.

In 2003 it was decided to extend the Spanish Div. 3NO survey toward Div. 3L (Flemish Pass). In 2010, 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 14th. 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 6 of them were nulls. Survey results, including abundance indices and length distributions of the main commercial species, are presented as Scientific Council Research documents. Survey results for Div. 3LNO of the northern shrimp (*Pandalus borealis*) were presented in SCR 10/63. Samples for histological (Greenland halibut, American plaice) and aging (Greenland halibut, American plaice, roughhead grenadier and cod) studies were taken. Feeding studies on Greenland halibut, American plaice, Atlantic cod and other species continued to be performed and 1559 stomach contents were analysed in depths of 119 to 1462 m. One hundred hydrographic profile samplings were made in a depth range of 115-1445 m.

EU-Spain and EU-Portugal (SCS Doc. 11/07, 05): 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 22th 2010. 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 158 and five of them were nulls. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, roughhead grenadier, shrimp 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, EU-United Kingdom, Canada and Russia (SCS Doc. 11/07): 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. The study is centered in NAFO Regulated Area and tries to give an answer to the urgent request in order to define in a precise way those areas which are candidate to become VMEs. This demarcation is a necessary step in the decision making process for the protection of these areas. Participation of various countries members of the NAFO contracting parties will provide to the NEREIDA project a multidisciplinary approach as well as the application of technologies and working protocols which will mean an active collaboration between institutions and organisms involved (Instituto Español de Oceanografía, Secretaría General del Mar, Consejo Superior de Investigaciones Científicas, Polar Research Institute of Marine Fisheries and Oceanography, Centre for Environment Fisheries & Aquaculture Science, Geological Survey of Canada, Canadian Hydrographic Service and Ecosystem Research Division-Fisheries and Oceans Canada (Bedford Institute of Oceanography). 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. Total survey area during 2009 was divided into three parts, each part covered by a different survey. In order to complete the study area, the time series started in 2009 continued in the summer of 2010 with three new surveys.

Denmark/Greenland: A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2010. In July-August 299 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.11/024).

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 1997-2010 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 2010 66 valid hauls were made. (SCR Doc. 11/009).

Greenland has conducted surveys primarily aimed at Greenland halibut in Div. 1A in 2001, 2004 and 2010. In 2010 the survey covered Div. 1A to 75°30’N at depths between 400 and 1500 m and 97 valid hauls were made (SCR Doc. 11/010).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2010 the longline survey was conducted in Uummannaq.

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2010 a total of 49 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 gill net survey in 2009.

EU-Germany (SCS Doc. 11/06): 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 2010, 57 valid hauls were carried while covering the complete 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.

USA (SCS Doc. 11/08): The USA Research Report provided an updated summary on the status of 36 finfish and shellfish stocks in US waters of the NAFO Convention Area. Summaries of environmental research are also provided including projects involved with hydrographic work, plankton studies, and benthic investigations. Projects studying biological aspects of several important commercial and recreational species including winter flounder, summer flounder, tomcod, and sturgeon are also highlighted in the report. Other highlights from the report include: increases in little skate and Acadian redfish biomass indices, during 2010, to record high values as well as near record highs for sea scallops; descriptions of research on marine mammals and sharks; inventory of number of ages collected and aged in 2010; an increase in observer coverage using At-Sea Monitors and Fisheries Observers; information on stock assessments and salmon and sea scallop research; and information on cooperative research, including a comparative study of two otter trawl sweeps.

ii) Surveys planned for 2011 and early 2012

Information was presented and representatives were requested to review and update before finalization of an SCS document in September.

c) Tagging Activities (SCS Doc. 11/12)

An SCS document was presented and Representatives were requested to review and update the information before the document is finalized in September.

d) ICES GHL ageing workshop, February 2011

An ICES sponsored workshop to examine age determination and validation for Greenland halibut (WKARGH) was held in Vigo, Spain, February 14-17, 2011. Previous workshops held in 1996 and 2006 noted the lack of precision with existing methods and the need for validation to ensure accuracy. Workshop participants reviewed information on age determination practices and results from recent research and the details can be found in the workshop report (ICES CM 2011/ACOM:41).

Best practices for age determination are: 1) to find a structure (e.g. otolith, scale, vertebrae) and an axis within that structure with continuous life-long growth; 2) to see if it is possible to distinguish zones along that axis and to verify that those zones are formed consistently every year; and 3) to develop reading rules according to the validation results and to train age readers to produce age estimates that on average are consistent with the true ages and with as high precision as possible. It is important to note the difference between precision and accuracy and to be aware that precision in age readings between two different readers or two different age structures (e.g. scales and otoliths) does not mean the ages are accurate.

Results from two otolith exchanges in 2005 and 2010 showed that bias is present in age readings between age readers and between methods for the size range examined (12-57 cm), although the degree and direction of the bias varies. Both the 2005 and 2010 exchanges suffered from a lack of samples from size classes greater than 57 cm.

Presentations were made on the effects of temperature on juvenile growth and growth rates of captive fish under experimental conditions. Absolute growth of Greenland halibut 1-2 years old varied between 6 and 10 cm depending on the temperature. Results from experiments on captive fish from the Gulf of St. Lawrence demonstrate the possibility of deriving a growth model that could potentially be used as the basis for the age-structured decomposition of this population’s length frequency using mixture models.

Several age reading methods for Greenland halibut were described and evaluated together with available validation (chemical marking and bomb radiocarbon analysis) and corroboration results (e.g. tracking of year classes, growth from marked and recaptured fish, otolith shape and growth, and age-length comparisons between regions). The different methods can be classified into two groups: A) Those that produce age-length relationships that broadly compare with the traditional methods described by the joint NAFO-ICES workshop in 1996 (ICES, 1997), typically indicating age around 10-12 years for 70 cm fish; and B) Several recently developed techniques that provide much higher longevity and approximately half the growth rate from 40-50 cm onwards (approx. 2.5 cm/yr) compared to the traditional method (approx. 5cm/yr). These typically produce age estimates around 20 years or more for 70 cm fish.

All available validation and corroboration results, both several published and a few unpublished, were in favour of group B methods. There are still validation works to be done in order to fully appreciate the full range of variability in the formation of annuli in otoliths from different stocks within different environmental regimes. There is also a need for improved precision, especially for the group B methods. Based on the review in this report, the relevant assessment working groups are advised to seriously consider how to proceed with age reading of their stocks.

STACREC discussed the results from this report and there was a comment that a slower growth rate would imply age at maturity would be substantially older than what we currently understand it to be. It was noted that there is a relatively wide range in age at length observed with these new methods that may be partly explained by the difference in growth and maximum size between males and females. Preliminary results from marked and re-captured fish in the Barents Sea suggest there may be slow and fast growing components within the same stock which could also affect overall interpretation of growth rate.

STACREC expressed concern about the possible inaccuracy of Greenland halibut age determination and therefore, STACREC **recommended** that *research be conducted to determine maximum ages and to improve age determination methods.*

e) Other Research Activities

i) Recovery strategies for straddling stocks: Div. 3LNO American plaice and Div. 3NO cod.

A new project under the Canadian International Governance Strategy received funding for up to 3 years commencing this year (2011).

The principal investigator is Peter A. Shelton (DFO, St John's). Collaborating researchers include Don Power (DFO Science), Joanne Morgan (DFO Science), Brian Healey (DFO Science), Rick Rideout (DFO Science), Diana Gonzalez Troncoso (Instituto Español de Oceanografia, Vigo, Spain), Ricardo Alpoim (Instituto Nacional dos Recursos Biológicos, I.P. INRB/IPIMAR Lisbon, Portugal).

The purpose of this project would be to (a) complete the development of full PA frameworks for Div. 3LNO Plaice and Div. 3NO cod, (b) develop and evaluate candidate rebuilding strategies for plaice and cod, and (c) interface with the new NAFO Fisheries Commission Working Group on Rebuilding Strategies. The objective is to achieve an accepted science-based and science-evaluated recovery strategy for both stocks which meets both Canadian Sustainable Fisheries Policy requirements and the NAFO Precautionary Approach. This would position both fisheries for future Marine Stewardship Council certification as sustainable fisheries.

To facilitate development of conservation plans and rebuilding strategies within NAFO for these 2 stocks, Fisheries Commission has created an FC WG of fishery managers and scientists (NAFO FC Doc. 10/11). This project will input into this WG through its contribution to the work of Scientific Council. All scientific contributions will first be peer reviewed within Scientific Council before being made available to the NAFO WG on Rebuilding Strategies.

Success of the project depends on the hiring of a suitable Post-doctoral fellow to take up a Visiting Scientist in Canadian Government Laboratories Fellowship for one year, renewable for two further years.

6. Data Sharing Arrangements

The NAFO Secretariat prepared a working paper giving some background to data sharing issues in NAFO. It was noted that while the situation had resolved itself since last year especially in light of the informal data sharing arrangements that had been made for the data used by the WGEAFM in December of 2010, there were still some issues. It was generally felt that while *ad hoc*, informal sharing does go on quite frequently between some scientists/countries it might be nice to have a more blanket and semi-formal arrangement. There were some discussions about central database repository for scientific information but it was felt that this may conflict with some country's arrangements. The process was seen as a two step approach, with the first step being the sharing of data. In the future, if required, database need and costs could be assessed.

STACREC **recommended** that *General Council seek approval from all Contracting Parties for sharing of survey data among members of Scientific Council for research aimed at addressing requests from Fisheries Commission.*

7. Observer Program

Fisheries Commission requests the Scientific Council to *evaluate any negative scientific impacts resulting from reduction/elimination of the scientific tasks specified under Article 28 of the NAFO CEM.*

STACREC notes that the Observer Program (Article 28) primarily aimed at maintaining compliance also include items of potential value to the work of Scientific Council: item 4a,b,c. However as the observer reports do generally not contain the information specified, e.g. on catch composition and discard by haul, the reports are of limited value to Scientific Council. On the other hand, should the reports contain information as specified in Article 28 clause 4 sampled according to scientific procedures, such information would be very useful to Scientific Council. However, STACREC has some concerns whether the procedures for appointing and training the individual observers will secure the data quality needed.

Therefore, removing "scientific tasks specified under Article 28 of the NAFO CEM" will mean little change to the work of the Scientific Council. STACREC also noted that part of Article 28 regarding the collection of scientific information is now covered by the scientific observer programs as set up by some Contracting Parties.

8. Use of VMS Data

Anton Ellenbroek of FAO presented the progress on the development of a D4Science Virtual Research Environment for Vessel Transmitted Information (VTI-VRE). As of June 2011 this offers 1. VMS data loading and visualization (e.g. based on speed), 2. Access to satellite products through Genesi-DR, 3, R-integration, 4. a Workspace to share and publish data in open and protected repositories (data) and registries (metadata) in a variety of statistical and geospatial formats.

The product is still in development, and only contains anonymous VMS data. The goals are to offer data sharing services across RFB boundaries to better understand spatial distribution dynamics, and to offer analytical services to resource-limited RFB's such as in the Southern hemispere.

The project receives EU FP7 funds, and funding has been secured until 2014. It is Open Source, and welcomes interested parties to express requirements that help build Communities of Practice that share data and resources that help implement the FAO Code of Conduct for Responsible Fisheries.

9. Cooperation with other Organizations

a) TXOTX

Technical Experts Overseeing Third Countries Expertise (TXOTX) is an EU funded project with the aim to identify key actions to improve research coordination directed at the assessment and management of shared fish resources.

More information can be found at www.txotx.net.

An invitation from the TXOTX Project Coordinator was received by NAFO to attend the final Workshop in Bilbao, Spain during 9-13 May 2011. NAFO Scientific Council Executive Committee nominated Mr. Fernando González-Costas (Instituto Español de Oceanografía) to attend the Workshop on behalf of NAFO. The workshop was chaired by Joseph E. Powers (Lousiana State University) and was attended by TXOTX partners, invited experts of different Regional Fishery Management Organizations (RFMOs) and other fisheries organizations.

The objective of this final workshop of the project was to review the previously developed recommendations in particular in relation to:

- Review the data available and the methodologies applied to scientific advice to fisheries management in different regions.
- Identify areas of similarity or possible overlap between different RFMOs.
- Improve the regional coordination between RFMOs.
- Recommendation for how regional networks should be established or improved.

The twenty most important draft recommendations of the Project were presented. Then regional groups (Pacific, Africa, South Atlantic, North Atlantic and India) were formed to review the recommendation primarily related to: Data availability, assessment and management strategies and socio economic aspects. The main conclusions of these groups were:

- In the North Atlantic the data availability is good contrary to most other regions. It is necessary to make an effort to have acceptable catch and effort data in many regions and it is important that the data have an acceptable quality.
- The RFMOs should be the instruments to promote and coordinate the fishery science in their geographical areas.
- The RFMOs should have science plans.
- It is necessary to clarify what management based on the Ecosystem Approach means and how it should be implemented.
- Moving to ecosystem based management requires more data and expertise. This is expensive and difficult to get.
- The assessments should be peer reviewed by external experts. It was not clear how to implement this external peer review.
- The assessment and management process should be more transparent and the communication between partakers should be more open.
- The availability of the socioeconomic data is very poor or absent and is difficult to include this kind of data in the assessments.

After that, it was decided to create groups by RFMOs (Tuna RFMOs, Non Tuna RFMOs and Third countries) to evaluate the other recommendations. The main conclusion of these groups was that it is necessary for the RFMOs to increase the allocation of resources (money, people, etc) to create a platform to foment and coordinate the science work. It was also concluded that in the areas of poor data availability it is necessary to promote scientific observers plans to obtain good quality data. Finally, examples of best practices were examined for some of the recommendations coming from the project. NAFO actions to implement the ecosystem approach, especially the work on Vulnerable Marine Ecosystems, were considered as a good example of best practice.

Fernando González-Costas was thanked for his attendance and for representing NAFO at this meeting. TXOTX was also thanked for inviting NAFO to the meeting.

10. Review of SCR and SCS Documents

The following papers were available to STACREC:

SCR Doc. 11/002, Serial No. N5877 by Valery V. Paramonov, Depth of catch of redfish (*Sebastes mentella*) and dependence of CPUE and length-weight characteristics from the depth of catch in North Atlantic

One of major fisheries commercial objects of North Atlantic is beaked redfish *Sebastes mentella.* Author generalized information of the own measurements of depth of fishing, CPUE, sizes and weight of redfish in 2003-2010 in three basic fishing regions in the opened part of ocean: Irminger Sea, Labrador Sea and Norwegian Sea. Conclusions are done about the features of seasonal, interannual and regional changeability of CPUE and length-weight characteristics in dependence of depth.

SCR Doc. 11/003, Serial No. N5878 by V.A. Rikhter and P.A. Bukatin, Comparative analysis of year-classes strength of some commercial fishes in the Atlantic and Pacific Oceans and adjacent seas

The year-classes strength of 72 fish populations was compared. In some cases simultaneous (in the same years) occurrence of abundant or poor year-classes was observed in several fish populations, including populations of different species separated by large distances. This similarity in population abundance dynamics seems to be non-random and is caused by the common reasons, in particular by the relationship between fish reproduction and the respective hydro- and atmospheric processes (Izhevskiy 1961, 1964). The years, when strong or weak year-classes appeared, were interpreted as the years with favorable and unfavorable environment conditions for year-classes abundance formation. The relationship between the number of cases of especially favorable and unfavorable conditions occurrence and the number of respective populations in certain areas of the World Ocean were considered as the indicator of fish stocks productivity increase and reduction.

SCR Doc. 11/023, Serial No. N5906 by Mónica Mandado and Antonio Vázquez, On otoliths sampling

The best strategy for otoliths sampling was tested by Monte Carlo simulation. The goodness criterion was the capacity of an analytical model to reproduce the simulated population. It was concluded that a stratified sampling is preferable to a random one. A stratified sampling of 20 otoliths by length class is the optimum for a species with 30-40 length classes. The effect of random error in age determination was also analyzed. It was concluded that the described Monte Carlo simulation is a useful tool to analyze sampling strategies.

SCR Doc. 11/008, Serial No.N5888 by Teodoro Patrocinio Ibarrola and Xabier Paz, Discards and by-catch in Spanish fleet targeting Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Divisions 3LMNO: 2008 and 2009.

This study analyses the discard and by-catch composition of the Spanish fleet targeting Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Divisions 3LMNO. During 2008 and 2009 the sampling coverage of the fishing effort was 20.6% and 16.5%, respectively. Data showed a reduced (4.3 %) but highly variable discard rate. The main discarded species were the macrourids *Macrourus berglax*, *Coryphaenoides rupestris* and *Nezumia bairdi*, together with other 2 fish species: *Antimora rostrata* and *Amblyraja radiata.* The target species (Greenland halibut) was intermittently discarded. The discard rate showed neither pattern nor trend. No significant catches of benthic invertebrate taxa indicators of vulnerable marine ecosystems (VMEs) were recorded.

11. Other Matters

a) Stock-by-stock Research Vessel Surveys Reported

In Studies No. 34 the Secretariat had compiled a report entitled “Stock-by-stock Research Vessel Surveys Reported, 1999-2000”. The Committee noted that in light of discussions about data sharing and making knowledge of data available it would be a good idea to compile this information for 2001-2010.

12. Adjournment

The Chair thanked the participants for their valuable contributions to the Committee. Special thanks were extended to the rapporteur and 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 1415 hours on 11 June 2011.

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

Chair: Joanne Morgan Rapporteurs: Various

I. OPENING

The Committee met at the Johann Heinrich von Thünen-Institut, Bundesallee 50, 38116 Braunschweig, Germany, from 3 to 16 June 2011, 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, Lithuania, Portugal and Spain), Japan, 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 Chair, 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.

II. GENERAL REVIEW

1. Review of Recommendations in 2010

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:

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.*

STATUS: 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.

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

STATUS: Catch estimates from some, but not all, national sampling programs were provided.

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

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.*

STATUS: Trawl data from Div. 0A from 2009 and 2010 have been acquired and were presented in 2011.

4. 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 SA 1 be further investigated.*

STATUS: No progress

5. Other Finfish in SA 1

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.*

STATUS: No progress

For other finfish in SA 1, 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

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

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.*

STATUS: New annual maturity ogives from the EU survey were provided this year for years 2008-2010. So, there are data from the EU survey for 1990-1998, 2001-2006 and 2008-2010. Maturities were modelled using a Bayesian framework which allowed for estimates in the years with missing data. 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 old in the late 1980s to just above 3 years old since about year 2000. Since 2005 it has been a slight increase in the A_{50}, reaching in 2010 a value of approximately 3.5 years.

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

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.*

STATUS: No progress

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.*

STATUS: These new realities implied a 2005- 2010 revision of redfish catch estimates, in order to split recent commercial catch of the major fleets on the Flemish Cap bank (EU-Portugal, Russian Federation and EU-Spain) into golden and beaked redfish and to have for each of the main fleets the available length sampling separated as well.

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

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 (e.g. Survey-based models or stock production models) be attempted in the next full assessment of Div. 3M American plaice.*

STATUS: Several XSA frameworks were considered. In addition to an analysis using the settings from the last assessment, further analyses were conducted investigating the impact of changing: the first age in the assessment (age 1, 3 or 4); the first year of the tuning fleet (1998 or 1994), *M* (0.2 or 0.1), and the first age at which q is independent of age (age 12 or 15). The run with age 4 as the first age in the assessment, 1994 as the first year of the tuning fleet, *M* equal to 0.2 and the age 12 as the first age at which q is independent of age (a4_t94) was choose for illustrate the trends in the stock.

The use of a VPA-type Bayesian model, the same used for the Div. 3M cod (SCR Doc. 08/26) was explored. Two different formulations were examined. The run1 results are very consistent with the XSA results, but run 2 showed an anomalous recruitment pattern and further exploration of the use of the model is needed.

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: The impact of changing the first age in the assessment (age 1, 3 or 4) was examined. The run with age 4 as the first age in the assessment, 1994 as the first year of the tuning fleet, *M* equal to 0.2 and the age 12 as the first age at which q is independent of age (a4_t94) was choose for illustrate the trends in the stock.

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

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.*

STATUS: No progress.

15. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) 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.*

STATUS: No progress.

16. Thorny Skate (*Amblyraja radiata*) in Div. 3LNO and Subdiv. 3Ps

d) Recommendations

STACFIS **recommended** that *further work be conducted on development of a quantitative stock model*.

STATUS: No progress

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

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.*

STATUS: Tissue samples have been collected and genetic studies are ongoing. The results will be presented to Scientific Council in 2012.

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 are sampled for age, sex and maturity whenever possible

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.*

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

STACFIS **recommended** that *survey conversion factors between the Engel and Campelen gear be investigated for this stock.*

STATUS: No progress

18. Roughhead Grenadier (*Macrourus berglax*) in SA 2+3

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.*

STATUS: New information was not available in this matter.

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

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.

STATUS: Information from the workshop is contained in the STACREC report, Item 5.d. Due to a strong temporal trend in the residuals of the age 1-4 data from the EU 0-1400m index over 2004-2010, an analysis identical to the update run aside from the exclusion of these data was conducted. The overall mean square index for the EU 0-1400m index was considerably improved, and model results were virtually identical. Both sets of results were compared and the only noticeable difference is in the estimated recruitment in the past few years.

STACFIS **recommended** *ongoing investigations into the assessment methods used*. This should include further explorations of the statistical catch at age model investigated this year.

STATUS: The statistical catch at age model was further investigated and results reported to STACFIS.

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

STATUS: Information from a recent workshop on this topic is contained in the STACREC report, Item 5.d.

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 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 Div. 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 Div. 3KLMNO be conducted* over a series of years, to the maximum depth possible.

STATUS: No progress.

21. Northern Shortfin Squid (*Illex illecebrosus*) in SA 3+4

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.*

STATUS: No progress has been made.

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 2010. 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 before the meeting commenced. This working group considered various sources of information including reported catches. Reported catches were updated with all available on 3 June 2011 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.

All catch estimates in this report are based on data available on 3 June 2011. These may be updated in future assessments if more data become available.

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 3 June 2010. A series of these tabulations from 2002–2010 will be found in the introductory catch table within the report for each stock. A summary for 2010 is as follows:

Stocks	STATLANT 21[1]	STACFIS
STOCKS OFF GREENLAND AND IN DAVIS STRAIT		
Greenland halibut in SA 0, Div. 1A offshore. & Div. 1B–F	21000	27000
Greenland halibut in Div. 1A inshore.	na	20600
Roundnose grenadier in SA 0+1	11	11
Demersal redfish in SA 1	0	251
Other finfish in SA 1	0	1315
STOCKS ON THE FLEMISH CAP		
Cod in Div. 3M	4 404	9 192
Redfish in Div. 3M	7 737	8 496
American plaice in Div. 3M	53	63
STOCKS ON THE GRAND BANKS		
Cod in Div. 3NO	329	946
Redfish in Div. 3LN	383	260
American plaice in Div. 3LNO	1471	2898
Yellowtail flounder in Div. 3LNO	9097	9366
Witch flounder in Div. 3NO	112	421
Capelin in Div. 3NO	0	0
Redfish in Div. 3O	4544	5233
Thorny skate in Div. 3LNOPs (Div. 3LNO portion)	531	3144
White hake in Div. 3NOPs (Div. 3NO portion)	211	227
WIDELY DISTRIBUTED STOCKS		
Roughhead grenadier in SA 2+3	231	941
Witch flounder in Div. 2J+3KL	179	183
Greenland halibut in SA 2 & Div. 3K–O	11092	26173
Short-finned squid in SA 3+4	101	101

na - not possible to distinguish inshore catches in STATLANT

[1] STATLANT 21 reported as of 3 June 2011

III. STOCK ASSESSMENTS

A. STOCKS OFF GREENLAND AND IN DAVIS STRAIT: SA0 AND SA1

Environmental Overview

(SCR Doc. 11/01, 11, 13 and 30)

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. The surface circulation off West Greenland is dominated by the north going West Greenland Current. It is primarily composed of cold low-saline Polar Water (PW) of the Arctic region and the temperate saline Irminger Water (IW) of the Atlantic Ocean. At intermediate depths Labrador Sea Water is found, and at the bottom overflow water from the Nordic Seas are found near the bottom. 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°C and salinities >34.5 is normally found at the surface offshore off the shelf break in this area.

Upper layer temperatures over the Fylla Bank in mid-June were 0.7°C above average conditions in 2010 but salinities were slightly lower than normal reflecting there presence of Polar water on the bank. During the autumn temperatures in the top 200 m layer were at 2.9°C above normal with salinities 0.2 above normal. At the southern sections on top of the shelf a thick low saline pool of Polar Water was observed from Cape Farewell to Maniitsoq and to a lesser degree on top of Fylla Bank suggesting above normal presence of Polar Water on the southern sections. Ocean colour data from satellite imagery indicated reductions in primary productivity on the Greenland Shelf in 2010.

The mean air temperature at Nuuk station in west Greenland was 2.6 °C in 2010 and reached its highest value in the whole series of observations since 1876. Based on the satellite data, the sea surface temperature showed positive anomalies up to 4°C over the Greenland Shelf. The Labrador Sea experienced very warm winter surface air temperatures in 2010 similar to the previous year; temperatures ranged from approximately 10°C above normal in the northern region near Davis Strait to about 5°C above normal in the southern Labrador Sea. Sea surface temperature anomaly was > 2°C in the Labrador Sea throughout the year. In 2010, wintertime convection was limited to the upper 200 m of the water column, a dramatic change from the deep convection event of 2008 when convection reached 1600 m. Maximum sea ice extent was below the long-term mean for this region. While the upper layer (10-150m) demonstrates a strong trend of increasing temperature since the mid-1990s, the trend in salinity was much weaker. In the layer impacted by convection (20-2 000m), there is a strong increasing trend in both temperature and salinity since the mid-1990s with the 2010 value exceeding that of the late 1960s. Nutrient inventories and primary productivity were also well below normal across the Labrador Sea according to ocean monitoring measurements and satellite imagery in 2010.

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

(SCR Doc. 11/009, 010, 017, 024, 027; SCS Doc. 11/06, 09, 10, 11)

a) Introduction

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 2001 advice has been given separately for the northern area (Div. 0A and Div. 1AB) and the southern area (Div. 0B and 1C-F).

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. 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 and remained at that level in 2007-2009. Catches increased from 24 800 t in 2009 to 26 900 t in 2010 (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, but the TAC was fished almost exclusively in Div. 0B and Div. 1CD. In 2000 there was set an additional TAC of 4 000 t for Div. 0A+1AB for 2001 and the TAC on 11 000 t was allocated to Div. 0B and Div. 1C-F. The TAC in Div. 0A + 1AB was increased to 8 000 t for 2003. Total advised TAC for 2004 and 2005 remained at 19 000 t. In 2006 the advised TAC for 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. The TAC remained at that level in 2011.

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 increased to 5 400 t in 2000 and to 8 100 t in 2001, primarily due to increased 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 to 12 400 t in 2009 and further to 13 225 t due to increased effort in Div. 0B

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 and remained at that level in 2010 – 6 400 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 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 due to increased effort in Div. 1A. Catches were at the same level during 2007 – 2009, but increased from 12 400 t in 2009 to 13 700 t in 2010 due to increased effort in Div. 1C-D.

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 decreased slightly from 6 700 t in 2009 to 6 400 t in 2010.

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, Russian Federation 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 2010, 2 230 t were taken by gillnet, 113 t by longline and 4 605 t by trawl.

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 2010, trawlers caught 3 745 t and 2 645 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, Russian Federation, Faroe Islands and EU (mainly Germany). These countries, except Japan, were also engaged in the fishery in the area in 2010. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 t in 2004 and there has not been any gill net fishery in the area since then. An offshore longline fishery in Div. 1CD took place during 1994-2002. Since then longline fishery has only taken place irregularly and with small catches. Inshore catches in Div. 1B-Div. 1F amounted to 362 t in 2010, which were mainly taken by gillnets. The offshore catches were taken by single and twin trawl.

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. Total catches increased gradually from about 100 t in 2000 to about 6 200 t in 2006-2010. All catches in recent years were taken by trawlers from Greenland, Russian Federation and Faroe Islands.

Recent catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	15	19	19	19	24	24	24	24	27	27
TAC	15	19	19	19	24	24	24	24	27	27
SA 0	7	9	10	10	12	11	11	12	13	
SA1 exl. Div. 1A inshore	7	10	10	10	12	12	12	12	14	
Total STATLANT 21 [1]	16[2]	20[3]	19[4]	20[4]	24[4]	23[4]	23	24	21	
Total STACFIS	15	19	19	20	24	23	22	25	27	

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.

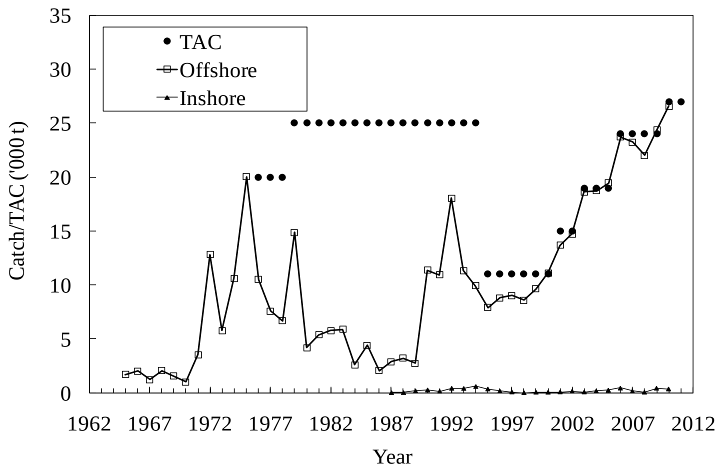


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

b) Input Data

i) Commercial fishery data

Information on length distribution was available from gill net 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 single trawl fishery in Div. 0A showed a mode of 47 cm while the mode was at 49 cm in the twin trawl fishery, which is within the range normally seen. The length distributions in the single and twin trawl fishery in Div. 0B were very similar with modes around 48-51 cm, for both types of gear, as seen in recent years.

Information on length distribution of catches was available from trawlers from Russian Federation and Greenland fishing in Div. 1A and from Russian Federation and Norwegian trawlers fishing in Div. 1D. In Div. 1A the mode was at 48 cm in both the Russian and Greenlandic trawl fishery. In recent years the trawl catches have been dominated by fish on 44-52 cm. In Div. 1D the catches by Russian Federation and Norway showed clear modes around 50-53 cm. The mode in catches has been within this range for several years but there was a tendency towards slightly larger fish especially in the Norwegian fishery than seen in previous years.

Standardized catch rates from Div. 0A declined slightly in 2007 but increased in 2008 and 2009 to decrease again in 2010 to about an average level. Standardized trawl catch rates have been relatively stable over the past 10 years.

Standardized catch rates in Div. 1AB have been declining between 2006 and 2008 but has been increasing since then and was in 2010 on the highest level in the time series.

The combined Div. 0A+1AB standardized CPUE series decreased slightly between 2009 and 2010, but has been stable since 2002 (Fig 1.2)

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. The CPUE decreased between 2009 and 2010 to the level seen in the 90's. The decrease was seen for twin trawlers while the CPUE for single trawlers increased.

Standardized catch rates in Div. 1CD decreased gradually from 1989-1997 but have shown an increasing trend since then. CPUE decreased between 2009 and 2010 but the CPUE is, however, still among the highest seen in recent years.

The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001; catch rates in 1988 and 1989 are from one 4000 GT vessel fishing alone in the area. Catch rates decreased somewhat in 2002 but has increased again and was in 2006 at the highest level seen since 1989. CPUE decreased very slightly in 2007, but increased significantly in 2008 and increased further to the highest level seen since 1989 in 2009. CPUE decreased slightly in 2010 but the CPUE is still among the highest in the time series. (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.

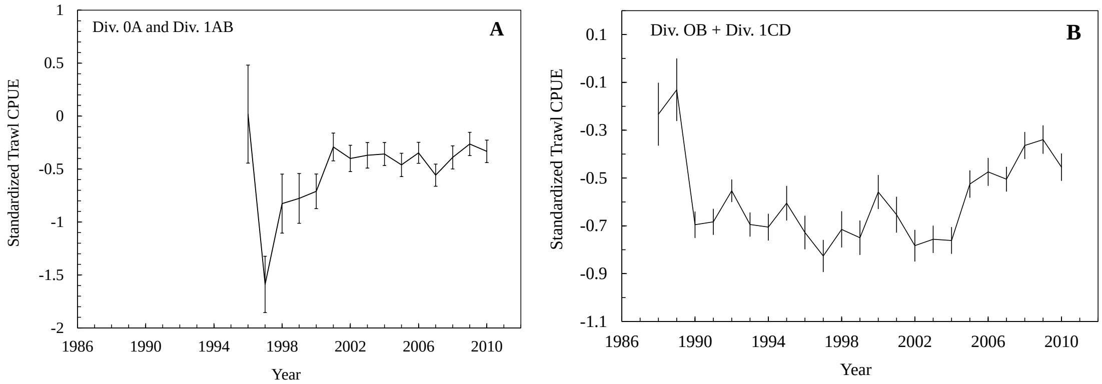


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawler CPUE from Div. 0A and Div. 1AB with ± S.E . B: Combined standardized trawler CPUE from Div. 0B and Div. 1CD with ± S.E.

ii) Research survey data

Japan-Greenland and Greenland deep sea surveys. During the period 1987-95 bottom trawl surveys were conducted in Subarea 1 jointly by Japan and Greenland (the survey area was re-stratified and the biomass estimates were recalculated in 1997). 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 in 2009, but increased again in 2010 to 76 000 t which is above average for the time series (Fig. 1.3). The abundance increased between 1997 and 2001 and has been relatively stable since 2002.

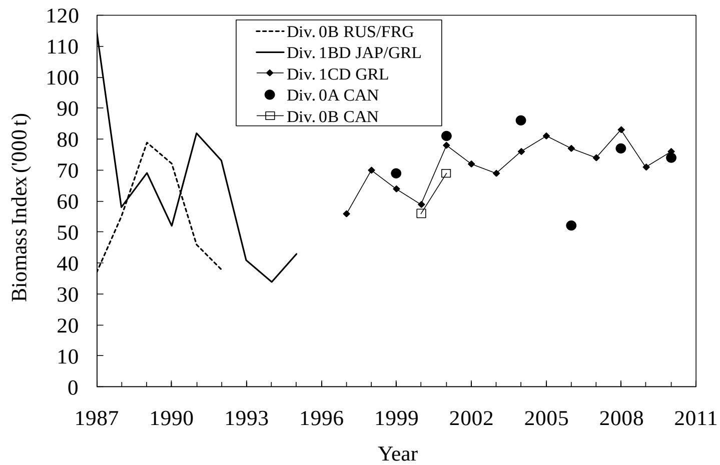


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from bottom trawl surveys. Note, incomplete coverage of the 2006 survey in Div. 0A and that survey estimates from Div. 0A does not include surveys in the northern part in 2004 and 2010. Further, the survey estimates from Div. 1A in 2001, 2004 and 2010 are not included.

Greenland deep sea survey in Baffin Bay (Div. 1A). Greenland has conducted surveys primarily aimed at Greenland halibut in the Baffin Bay in 2001, 2004 and 2010. The biomass and abundance of Greenland halibut was in 2010 estimated as 79 300 t and $1.04*10^8$ specimens, respectively. The surveys did not cover the same areas but a comparison of the biomass and abundance in areas covered both in 2001 and 2010 showed an increase in biomass from 46 500 t in 2001 to 52 000 t in 2010 while there was a decrease in abundance from 101.8 mill. in 2001 to 63.5 mill. in 2010. The biomass in the area covered both in 2004 and 2010 was estimated to 47 244 t and 38 600 t, respectively while the abundance was estimated at 58.8 mill. and 54.4 mill., respectively. The length in 2010 ranged from 20 cm to 105 cm. The overall length distribution (weighted by stratum area) was dominated by a mode at 45 cm, while the mode was at 46 cm at depths > 800 m.

Canadian deep sea survey in Baffin Bay (Div. 0A). Canada has conducted surveys in the southern part of Div. 0A (to 73°N) in 1999, 2001, 2004, 2006, 2008 and 2010. 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 1001-1500 m and accounted for 11 000 – 13 000 t of biomass in previous surveys. Biomass and abundance was in 2010 estimated to 74 272 t and $1.1*10^8$ which is slightly below the estimates from 2008 on 77 182 t $1.16 * 10^8$, respectively. Mean biomass per tow decreased from 1.67 t/km^{-2} in 2008 to 1.53 t/km^{-2} in 2010 which is the lowest in the time series. The overall length distribution ranged from 6 cm to 99-cm with a mode at 39 cm similar to that seen in previous survey.

In 2010 the survey also covered the northern part of Div. 0A from 73°N to 75°35'N, which has not been surveyed since 2004. The biomass and abundance increased from 45 900 t and $4.85*10^7$ to 46 500 t and $6.74*10^7$, respectively. In 2010 a large portion the depth stratum 750-1000 m was not surveyed due to ice, which underestimates the biomass and abundance. The mean catch per tow increased from 0.85 t/km^{-2} to 1.18 t/km^{-2}. The length ranged from 21 to 78 cm with a single mode at 39 cm and there were more small, < 45 cm, fish in 2010 compared to 2004.

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). Since then off shore biomass decreased gradually to 17 000 t in 2009 but increased again in 2010 to 22 500 t, which is slightly above average for the time series. The biomass and abundance time series were recalculated in 2004 based on better depth information and new strata areas. The survey gear was changed in 2005, but the 2005-2010 figures are adjusted for that.

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 (2000 year class (Fig.1.4)) 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 gradually to 226 million in 2009. The number of one year old increased again in 2010 to 315 million, which is slightly above the average for the time series. The increase in recruitment in the total survey area between 2009 and 2010 was caused by an increase in recruitment in the inshore Disko Bay and Div. 1A north of 70°N. The figures were recalculated in 2007, based on the new stratification, but it did not change the over all trends in the recruitment.

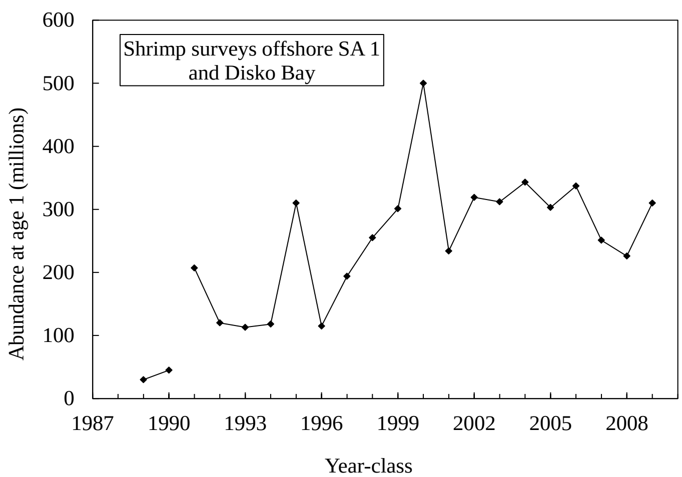


Fig. 1.4. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1).

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 to 2009 year-classes were below average.

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 in 2011 concluded that there is considerable uncertainty about accuracy in the current age reading methods (see section in STACREC report) and the age reading procedure is currently under revision hence no age based analysis are presented.

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 26 900 t in 2010 primarily due to increased effort in Div. 0A and in Div. 1A but effort was also increased in Div. 0B and 1CD in 2010.

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 2010 were available from Div. 0A, Div. 1A and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2010.

Assessment: No analytical assessment could be performed.

Commercial CPUE indices. Combined standardized catch rates in Div. 0A and Div. 1AB have been stable during 2002-2010.

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. CPUE decreased in 2010 but is still at a high level.

Biomass: The biomass in Div. 0A (to 73°N) decreased slightly between 2008 and 2010 but has been stable in the recent 12 years. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has been gradually decreasing during 2004-2009 but increased again in 2010 to a level slightly above the average for the time series (1991-2010).

The survey biomass in Div. 1CD increased gradually between 1997 and 2008, decreased in 2009 but increased again in 2010 to a level slightly above the average for the fourteen year time series.

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 and 2009 year-classes were above average. The recruitment of the 2007 - 2009 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 and deep sea surveys have been stable in recent years. Survey biomass in Div. 0A and Div. 1A and CPUE indices in Div. 0A and 1AB have been stable in recent years.

Div. 0B+1C-F: Length compositions in the catches and deep sea surveys have been stable in recent years. Survey biomass in Div. 1CD has been stable. CPUE indices in Div. 0B and 1CD have shown an increasing trend in recent years but decreased between 2009 and 2010. The CPUE is, however, still above at the level observed in the 1990s.

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

For Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore), in 2010 STACFIS **recommended** that *catch rates in the gill net 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.* Trawl data from Div. 0A from 2009 and 2010 have been acquired and was presented in 2011.

For Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore), STACFIS **recommended** that *catch rates in the gill net fisheries in Div. 0A and 0B from 2009, 2010 and 2011 should be made available before the assessment in 2012.*

The next assessment will be in 2012.

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

Interim monitoring report (SCR Doc. 11/24 43 SCS Doc. 11/10)

a) Introduction

The inshore fishery for Greenland halibut developed in the beginning of the twentieth century, but has increased during the past 20 years. The fishery is concentrated in the Disko Bay, the Uummannaq Fjord and in the fjords near Upernavik, 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.

i) Fisheries and catches

Disko Bay: Landings increased from about 2000 t in the mid 1980's and peaked in 2004 with more than 12000 t. From 2006 landings decreased and in 2009 only 6300 t was landed. However, in 2010 catches have increased to 8500 t (Table 2.1 and Fig 2.1)

Uummannaq: landings increased from a level of 3 000 t in the mid 1980s and peaked in 1999 at a level of more than 8000 t. Landings then decreased and from 2002 were at a level of 5000 to 6000 t. In 2010, 6200 t was landed, which is an increase compared to recent years (Table 2.1 and Fig 2.1).

***Upernavik*:** landings increased from the mid 1980s and peaked in 1998 at a level of 7000 t. This was followed by a period of decreasing catches, but since 2002 catches have increased and in 2010 5900 t were landed (Table 2.1 and Fig 2.1).

Table 2.1. Recent landings and advice ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	7.9	7.9	na	ni	ni	ni	ni	8.8	8.8	8.0
Disko Bay – TAC							12.5	8.8	8.8	8.0
Disko Bay - Catch	11.7	11.6	12.9	12.5	12.1	10.0	7.7	6.3	8.5	
Recommended TAC	6.0	6.0	na	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Uummannaq - TAC							5.0	5.0	5.0	5.0
Uummannaq - Catch	5.4	5.0	5.2	4.9	6.0	5.3	5.4	5.5	6.2	
Recommended TAC	4.3	4.3	na	na	na	na	na	na	na	na
Upernavik - TAC							5.0	5.0	6.0	6.0
Upernavik - Catch	3.0	3.9	4.6	4.8	5.1	4.9	5.5	6.5	5.9	
Division 1A Unknown				0.8						
STACFIS Total	20.1	20.5	22.7	22.9	23.2	20.6	18.9	18.3	20.6	

na no advice.
ni no increase in effort.

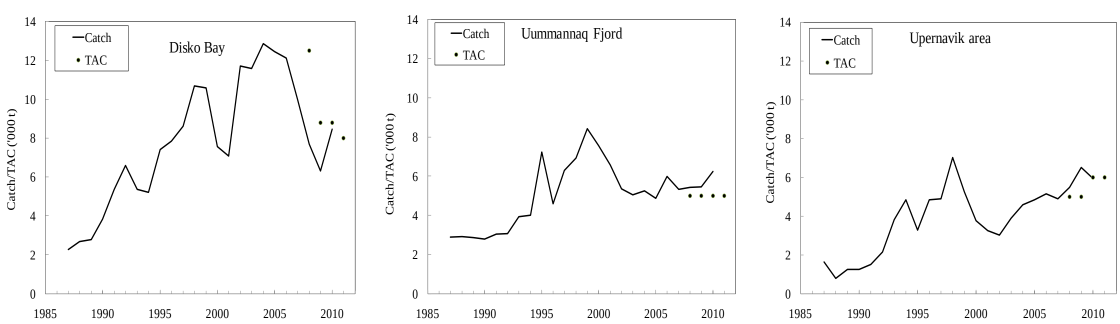


Fig. 2.1. Greenland halibut in Div. 1A inshore: catches and TAC in Disko Bay, Uummannaq and Upernavik.

b) Data

i) Commercial fishery data

Logbooks have been mandatory for vessels above 30 feet since 2008, but voluntary logbooks from 2006 and 2007 were also available. Length frequencies from factory landings were available. No age readings were performed in 2010, although otoliths were collected and archived for potential future processing.

ii) Research survey data

The Greenland Shrimp Fish survey: Annual abundance and biomass indices were derived from the stratified random bottom trawl survey commencing in 1992, covering NAFO Div. 1ABCDEF from 50 to 600 m isobaths. This survey includes the Disko bay.

The Disko Bay Gillnet survey: An inshore longline survey has been conducted in the Disko bay since 1993, but the survey was changed to a gillnet survey in 2001. This survey was not conducted in 2009.

The Uummannaq longline survey: The longline survey in Uummannaq has not been updated since 2007 due to research vessel technical problems.

The Upernavik longline survey: A longline survey was conducted in Upernavik in 2010 for the first time since 2002. However the stations conducted in 2010 have poor overlap with the prior survey period and therefore needs further analysis.

iii) The standardized logbook CPUE series.

Standardized CPUE series were produced on logbooks. However, the model only explained 23 to 30% of the variability in the data. The 2006 estimates were based on very few logbooks in all areas, and can hardly be regarded representative. Likewise, the 2011 CPUE estimate should be regarded preliminary, since it is based on few logbooks provided within the first few months of 2011 and no correction for effect of month has been made.

Disko Bay: The standardized logbook CPUE series reveals a substantial decrease in CPUE in Disko bay of about 30% from 2007 to 2010 (Fig 2.2).

Uummannaq: The standardized CPUE series seems to have been stable from 2007 to 2010 (Fig 2.3).

Upernavik: The standardized CPUE series seems to have been stable from 2007 to 2010 (Fig 2.4).

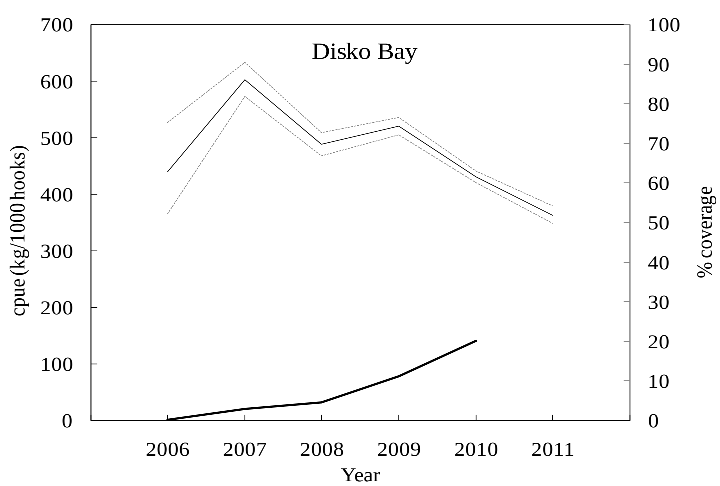


Fig. 2.2 Greenland halibut in Div. 1A inshore: Disko Bay GLM: logcpue=overall mean + year + vessel +-1SE and percentage of catch covered by longline logbooks to total landings.

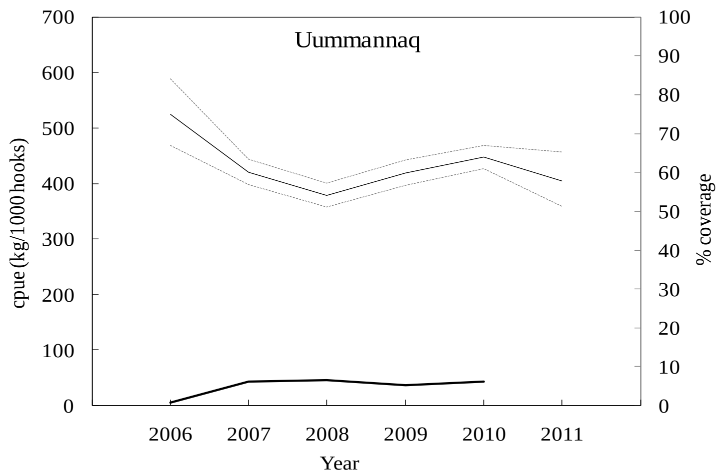


Fig. 2.3 Greenland halibut in Div. 1A inshore: Uummannaq GLM: logcpue=overall mean + year + vessel +-1SE and percentage of catch covered by longline logbooks to total landings.

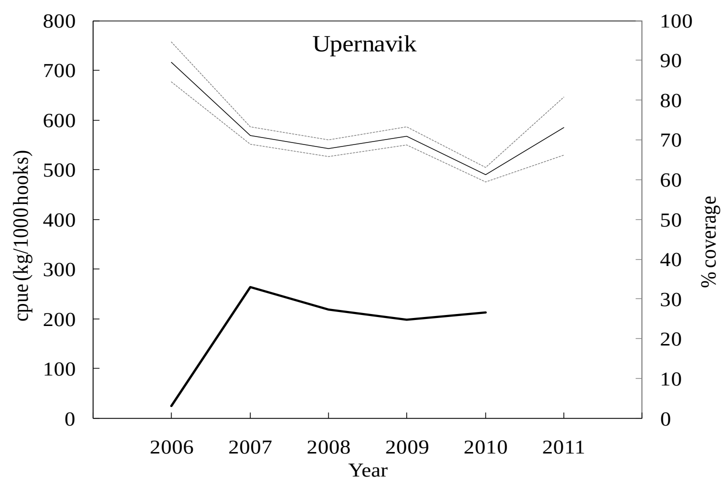


Fig. 2.4 Greenland halibut in Div. 1A inshore: Upernavik GLM: logcpue=overall mean + year + vessel +-1SE and percentage of catch covered by longline logbooks to total landings.

Mean length in landings and development in percentage of the *age 10 and younger* in the catches.

Disko Bay: Mean length in landings decreased from 2001 in both the summer and the winter fishery, and have dropped to the lowest value observed (Fig 2.5). Percentage of age-class 10 and younger has increased in the Disko Bay from 2002 to 2009 to 90% (Fig. 2.5).

Uummannaq: Mean length has decreased in the summer fishery since 2004 and the winter fishery since 2007 (Fig. 2.6). The percentage of age 10 and younger has increased from 2006 to 2009 to 80% and is at the same high level as in the 1990s (Fig. 2.6).

Upernavik: Mean length in catches has remained stable since 1999 but has decreased in 2010 and 2011 (Fig. 2.7). The percentage of age-class 10 and younger was at a lower level in 2008 and 2009 than the end 1990s (Fig. 2.7)

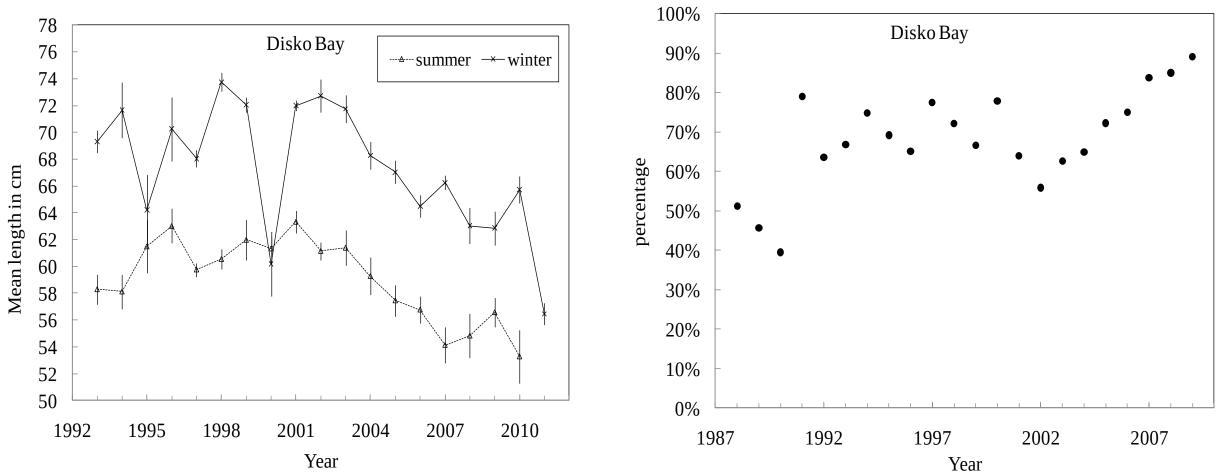


Fig.. 2.5 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Ilulissat +95% Cl (left) and in percentage of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year (right). (no data in 2010)

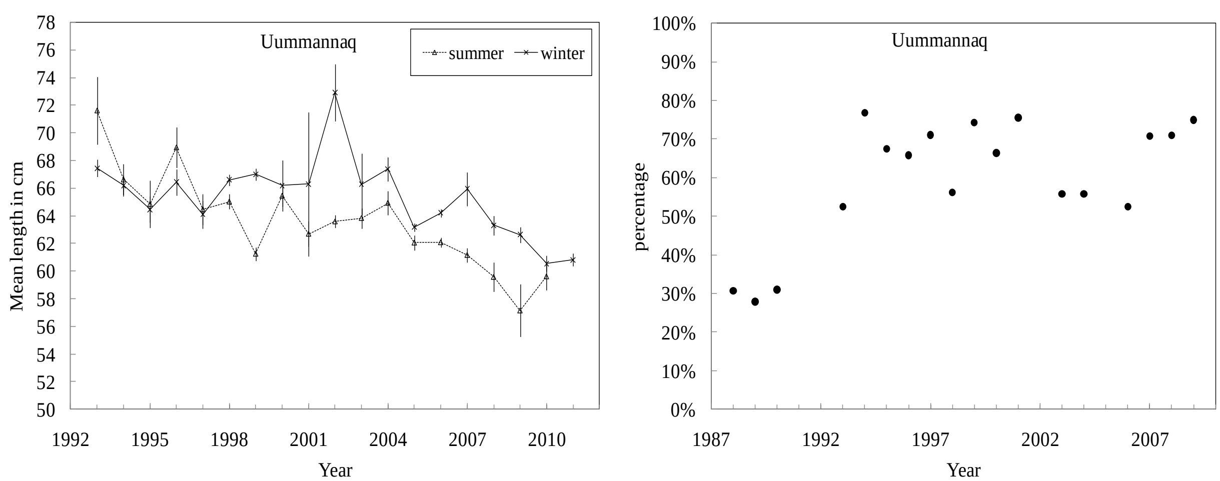


Fig. 2.6 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Uummannaq +95% Cl(left) and in percentage of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year (right). (no data in 2010)

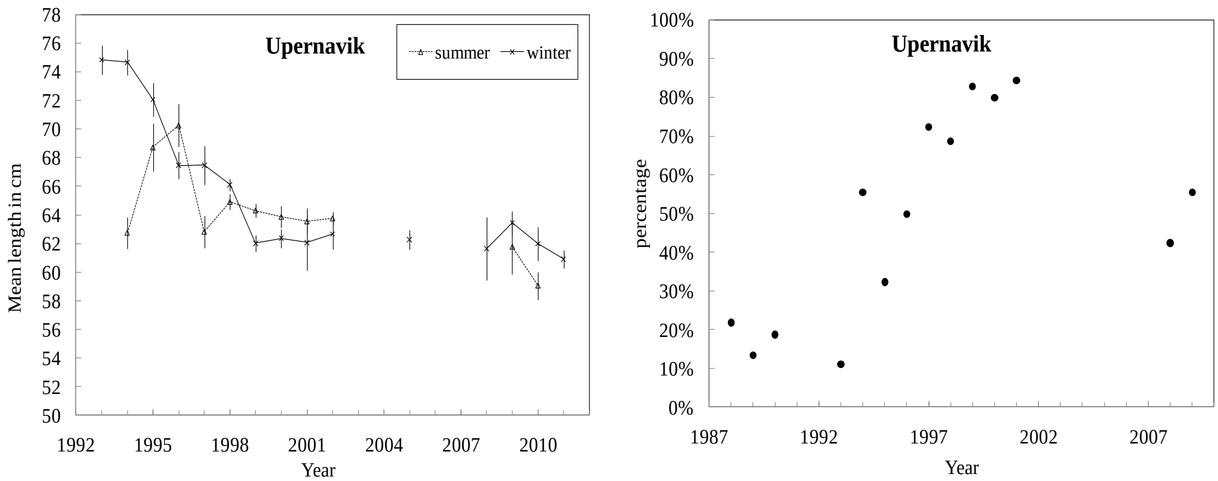


Fig. 2.7. Mean length of Greenland halibut in commercial longline catches from Upernavik +95% Cl (left) and in percentage of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year (right). (no data in 2010)

iv) Survey results

Disko Bay: The Gillnet survey targets the pre-fishery recruits between 35 and 50 cm. Both CPUE and NPUE decreased in 2006 and 2007, but the 2008 and 2010 standardized CPUE estimates are at average levels and the NPUE above average (fig 2.8).

The Greenland Shrimp Fish trawl survey in the Disko Bay mainly catches individuals less than 50 cm. The survey biomass and abundance indices decreased sharply from 2004, but stabilized in 2008 and 2009. The 2010 estimate is higher than seen in 2008 and 2009 (fig 2.9).

Recruitment indices from the Greenland Shrimp Fish trawl survey in 2008 and 2009 of age 1 are below average, but the 2010 estimate is at about the average level seen in the recent decade (Fig. 9). However recruitment of age 1 (Fig. 2.9) to 3 (not shown) in the recent decade, has been above the average seen until 1995.

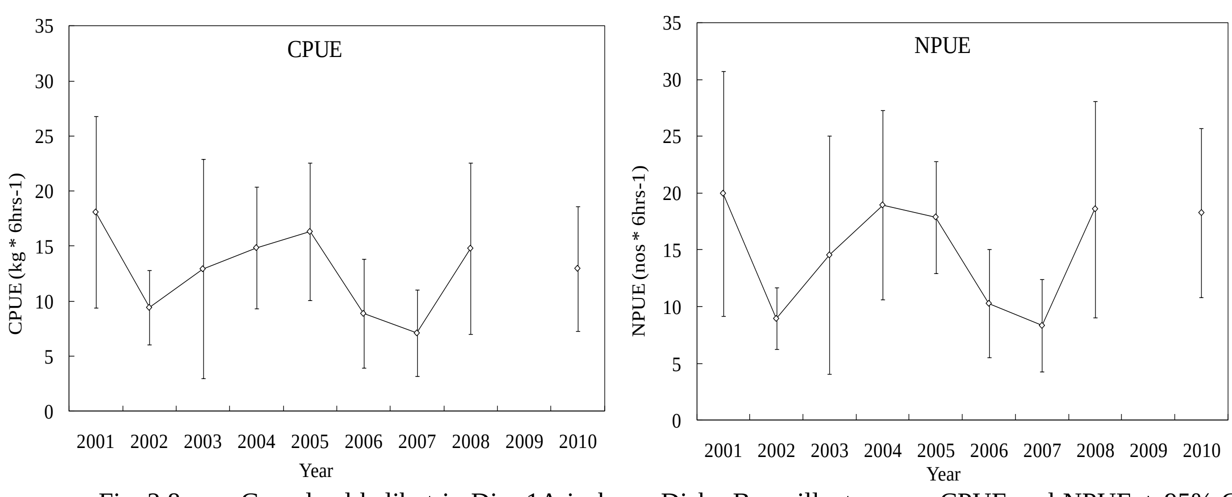
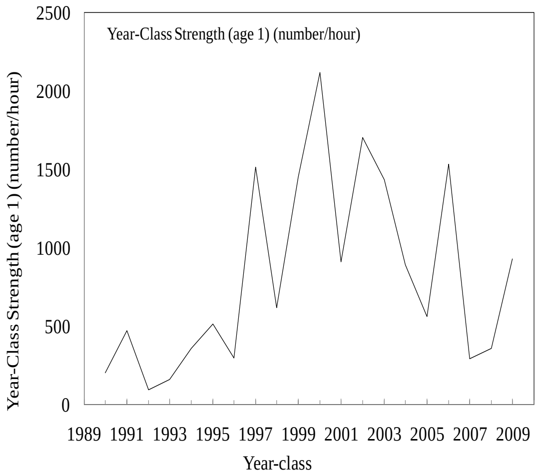


Fig. 2.8. Greenland halibut in Div. 1A inshore: Disko Bay gillnet survey CPUE and NPUE + 95% CI indicated.



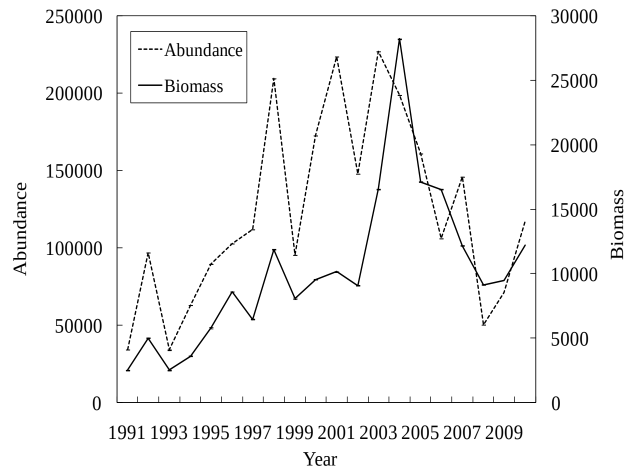


Fig. 2.9. Greenland halibut in Div. 1A inshore: Abundance ('000) and Biomass (t) indices for Greenland halibut in the Greenland Shrimp Fish trawl survey in Disko Bay (left), and year-class strength of age one from this survey (left).

c) Conclusions:

No analytical assessment could be performed on any of the stocks.

Fishing mortality: unknown for all of the stocks

Disko Bay: The consistent decrease the logbook CPUE and in the mean length in landings and the increase in exploitation of age-class 10 and younger, all indicate that the fishery is currently dependent on incoming year-classes entering the fishery. The high values of CPUE and NPUE in the Gillnet survey and the slightly increasing survey biomass in the Greenland Shrimp Fish survey in the Disko bay, indicates some recovery potential. However the general impression is a decreasing stock in recent years.

Uummannaq: The stable Landings since 2002 and the stable or slightly increasing logbook CPUE series and the survey indices until 2007, indicate a stable stock. However the slowly decreasing trend in average length in the landings since 2004 and the increasing exploitation of age 10 and younger in recent years indicate greater dependence of incoming year-classes. However, there are no indications of any imminent change in the stock since the most recent assessment.

Upernavik: Mean length in the commercial landings has been stable from 1999 to 2009, but has decreased slightly in 2010 and 2011. Exploitation of age 10 and younger in the catches was less in 2009 than prior to 2001. The logbook CPUE has been stable from 2007 to 2010. The general impression is a stable stock. However, there is currently no advice given for Upernavik.

Based on the data for the current year there is nothing to indicate a change in the status of the stocks.

The next full assessment is planned for 2012.

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

(SCR Doc. 11/009; SCS Doc. 11/06)

a) Introduction

The roundnose grenadier stock in Subarea 0 and 1 is believed to be part of a stock widely distributed in the Northwest Atlantic. The biomass was in 1987 estimated to be about 100 000 t but decreased dramatically in the late 1980s and early 1990s possibly because of migration out of the area. There has been no directed fishery for roundnose grenadier in SA 0+1 since 1978.

b) Fishery and Catches

Roundnose grenadier is taken as bycatch in the Greenland halibut fishery. A total catch of 11 t was reported from 2010. 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:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Agreed TAC[1]	4.2	4.2	4.2	4.2	4.2					
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.03	0.04	0.02	0.01	0.02	0.01	0.00	0.00	0.01	
STACFIS Catch	0.03	0.04	0.02	0.01	0.02	0.03	0.00	0.00	0.01	

ndf : No directed fishing.
[1] No TAC set for 2007 – 2011.

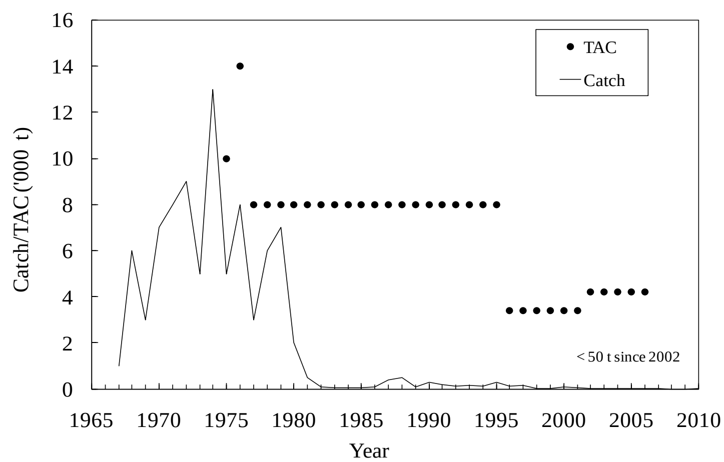


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2011.

c) Data Overview

Research survey data. There has been conducted a number of surveys in the area since 1986 but not any survey that covers the entire area or the entire period which makes direct comparison between survey series difficult. Generally the biomass has declined from the late 1980s and early 1990s to a very low level in recent years.

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. Russian Federation 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 1997-2010 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, 2008 and 2010 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 2010 the biomass in Div. 1CD was estimated at 581 t compared to 1 151 t in 2009 and the biomass is back at the second lowest level observed and is hence still at the very low level observed since 1993. Almost all the biomass was found in Div. 1D at depths greater than 800 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.

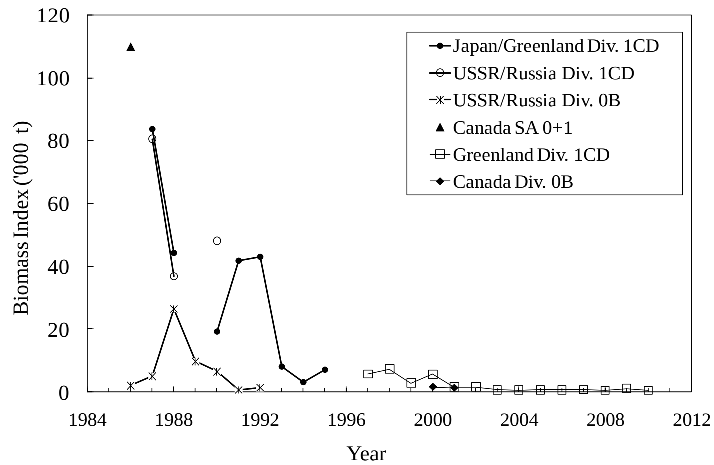


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland, Canadian and Greenland surveys in Div. 0B and Div.

d) Assessment Results

No analytical assessment could be performed.

Biomass: In the Greenland survey in 2010 the biomass in Div. 1CD was estimated at 581 t, the second lowest level in the time series, and the biomass is hence still at the very low level seen since 1993 and the stock is composed of small fish.

Recruitment: not known.

Fishing mortality: not known.

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

e) 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 1980s and early 1990s are not directly comparable with recent estimates these are far below what was seen previously. The survey time series from the 1980s and the early 1990s are, however, too short to be used for estimation of reference points.

The next full assessment of this stock will take place in 2014.

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

(SCR Doc. 07/88; 11/04, 09, 24, 40; SCS Doc. 11/10)

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.

i) Fisheries and Catches

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. In 2010, 251 t were reported including 85 t reported to Greenland as bycatch in the shrimp fishery (Fig 4.1). Recent catch figures now include the reported amount of small redfish discarded by shrimp vessels (from 2007). Sorting grids have been mandatory since October 2000, in order to reduce the amount of juvenile redfish taken as by-catch in the shrimp fisheries. A study conducted in 2006 and 2007 indicated that redfish caught in the Greenland shrimp fishery are composed mainly of small redfish between 6 and 13 cm. Another fraction of the catches, mainly commercially sized golden redfish, are taken as a by-catch in the inshore fishery, targeting Greenland halibut and cod.

Recent catches ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TAC	19	8	1	1	1	1	1	1	1	1
STATLANT 21	0.1	0	0.3	0.2	0.4	0.3	0	0.02	0	
STACFIS Catch	0.5	0.5	0.3	0.2	0.4	0.3	0.4	0.4	0.3	

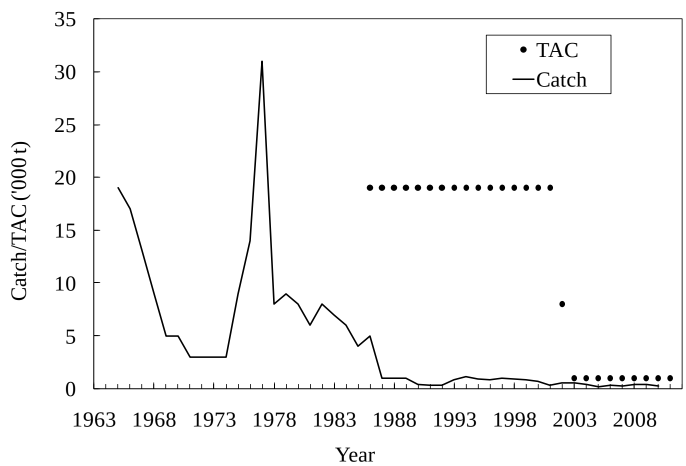


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

b) Data

i) Commercial fishery data

No data on length distributions in catches were available. Redfish do appear in the Greenland logbooks, but since redfish are not the target species no CPUE is presented.

ii) Research survey data

EU-Germany groundfish survey. Annual abundance and biomass indices were derived from stratified random bottom trawl surveys commencing in 1982, covering NAFO Div. 1BCDEF from the 3-mile limit to the 400 m isobaths.

The Greenland shrimp fish survey. Annual abundance and biomass indices were derived from the stratified random bottom trawl survey commencing in 1992, covering NAFO Div. 1ABCDEF from 50 to 600 m isobaths.

The Greenland-Japan deep-sea survey. (1987-1995) Annual abundance and biomass indices for deep-sea redfish were derived from the stratified random trawl survey targeting Greenland halibut in NAFO Div. 1CD from 400m to 1500 m isobaths.

The *Greenland deep-sea survey*. (1997-2010) Annual abundance and biomass indices for deep-sea redfish were derived from the stratified random trawl survey targeting Greenland halibut in NAFO Div. 1CD from 400m to 1500 m isobaths.

c) Assessment

Golden redfish. The indices of the EU-Germany survey decreased in the 1980s and were at a very low level in the 1990s. However, the survey has revealed increasing biomass indices of golden redfish (≥17cm) since 2004, and the 2010 estimate is the highest observed since 1986 (Fig 4.2). The result of the EU-German GLM shows similar results.

Deep-sea redfish. The indices of the EU-Germany survey and the EU-Germany GLM have fluctuated at a low level throughout the time series, but with very low values since 2007. The fluctuating trend could be caused by poor survey overlap with the depth distribution of the deep-sea redfish stock. The Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (1997-2010) indices were at a low level from 1993 to 2007, but in 2008 a substantial increase in biomass was found (Fig 4.3). The indices have decreased since then, but are still among the higher values seen since 1990.

Pre-recruit redfish (<17 cm. both species combined). Abundance indices of juvenile redfish (both species combined) in the EU-German survey fluctuated between 50 and 100 million individuals from 1985 to 2000. Since then abundance indices have been at a very low level (Fig 4.4) Abundance indices of both redfish species combined in the Greenland Shrimp Fish survey have decreased from a level of around 1500 million individuals in the mid 1990s to around 100 million individuals in 2010.

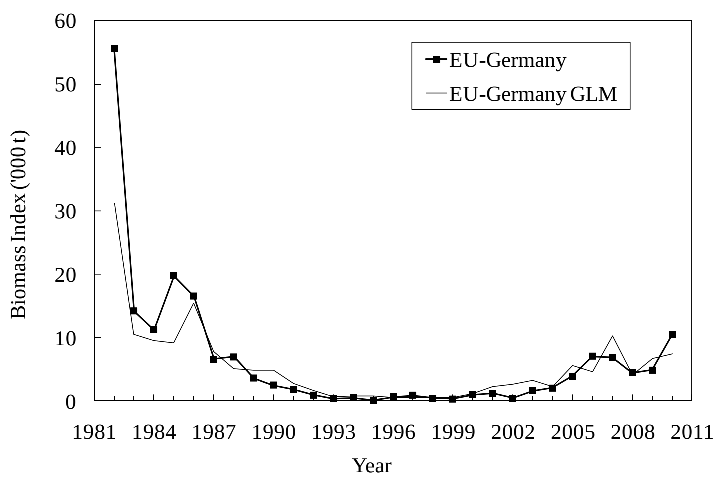


Fig. 4.2. Redfish in Subarea 1: Golden redfish (≥17 cm) survey biomass indices derived from the EU-German groundfish survey.

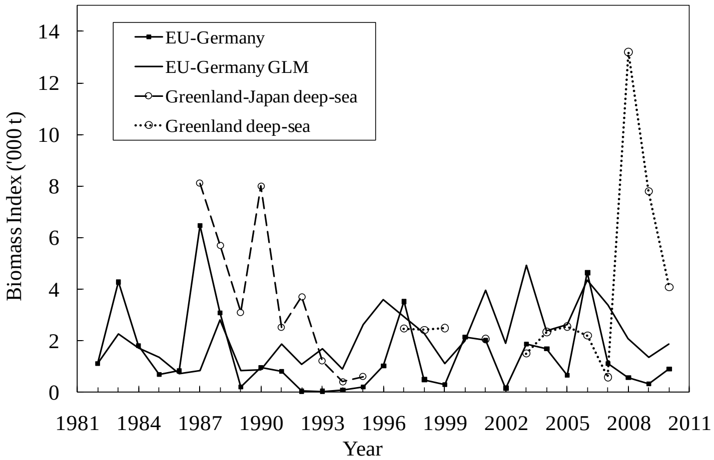


Fig. 4.3. Redfish in Subarea 1: Deep-sea redfish (≥17 cm) survey biomass indices derived from the EU-Germany groundfish survey and from the Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (1997-2010).

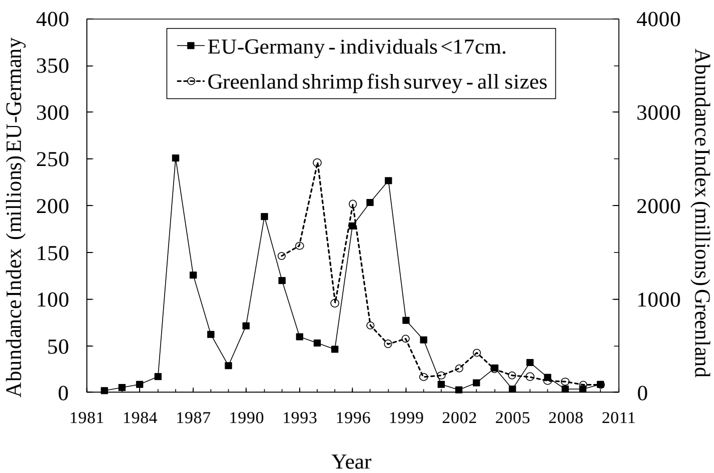


Fig. 4.4. Redfish in Subarea 1: Deep-sea redfish and golden redfish combined survey abundance indices for EU-Germany survey (juvenile individuals <17cm) and the Greenland Shrimp Fish survey. (Notice the different scales).

d) Estimation of Parameters

Golden redfish. The golden redfish spawning stock biomass was estimated assuming knife edge maturity at 35 cm, applied to the length disaggregated abundance indices derived from the EU-Germany survey. The length group 17-20 cm was chosen as recruitment indices at age 5. SSB and recruitment indices decreased in the 1980s and remained at a very low level until 2002 (Fig. 4.5). Since then both spawning stock and recruitment have increased and the 2010 estimate is the highest values of both SSB and recruitment observed since the 1980s. The increasing recruitment at age 5 observed since 2006, coincides with some of the first year-classes of redfish protected by the sorting grids implemented in the trawl fishery directed to shrimp since 2002, but could also be caused by migration from neighboring areas.

Deep-sea redfish. The Deep-sea redfish spawning stock biomass was estimated assuming knife edge maturity at 30 cm applied to the length disaggregated abundance indices derived from the EU-Germany survey. The length groups 17-20 cm was chosen as recruitment indices at age 5. SSB decreased in the 1980s and remained at a very low level until 2002 (Fig. 4.6). Since then spawning stock has been increasing and the 2010 estimate is among the higher values seen in the past 20 years, except for 2006. Recruitment has in general been low throughout the time-series with sporadic events of high recruitment in the later part of the 1990s (Fig. 4.6).

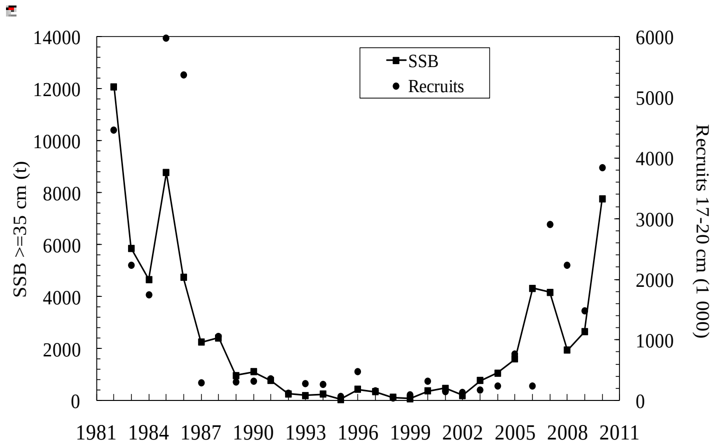


Fig. 4.5. Redfish in Subarea 1: Golden redfish SSB and recruitment indices derived from the EU-Germany groundfish survey.

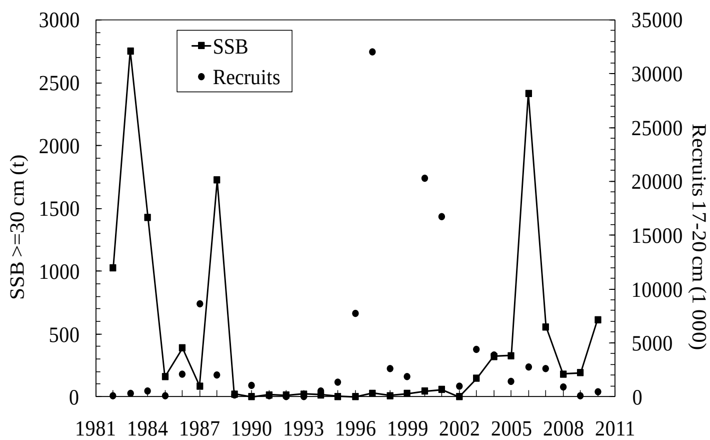


Fig. 4.6. Redfish in Subarea 1: Deep-sea redfish SSB and recruitment indices derived from the EU-Germany groundfish survey.

e) Assessment results

No analytical assessment could be performed for either of the stocks.

Fishing mortality: Unknown for both stocks.

Golden redfish

Biomass: The biomass of golden redfish in SA1 has generally been increasing since 2002, but is still far below the 1982 survey estimate.

Recruitment: Recruitment of age 5 has been generally increasing since 2002.

State of the stock: The stock has revealed some recovery potential due to both increased recruitment and SSB. However, biomass remains far below the 1982 EU-Germany survey estimate. The stock remains at a low level.

Deep-sea redfish

Biomass: An increase in biomass has been observed in the Greenland deep-sea Survey and in SSB in the EU-German survey in recent years. However, the SSB indices derived from the EU-Germany survey are below the 1980s values. The stock remains at a low level.

Recruitment: Recruitment has been low in recent years.

State of the stock: The increase in SSB observed in the EU-Germany survey since 2002, is below the initial 1980s values. The stock remains at a low level.

f) Research recommendations

For redfish in Subarea 1, STACFIS **recommended** that *the GLM procedure applied to the EU-Germany survey data for redfish ≥17 cm should also be investigated for the pre recruits <17 cm.*

For redfish in Subarea 1, 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 2014

5. Other Finfish in SA 1

(SCR Doc. 07/88; 11/04, 24, 25; SCS Doc. 11/10)

a) Introduction

Other finfish in NAFO Subarea 1 refers to Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*), American plaice (*Hippoglossoides platessoides*) and thorny skate (*Amblyraja radiata*). In the past decade, these stocks have mainly been taken as a by-catch in fisheries targeting Cod, Greenland halibut and shrimp, both inshore and offshore in SA1. To reduce the number of juvenile fish discarded in the trawl fishery targeting shrimp, sorting grids have been mandatory since October 2000 (fully implemented offshore in 2002), resulting in a nearly complete protection of individuals above a certain species specific size (typically 20 cm).

i) Fishery and Catches

Atlantic wolffish and spotted wolfish: Catch statistics for both wolffish species are combined, since no species-specific data are available from logbooks or factory landings reports. Catches of wolffish in SA1 were at a level around 5 000 t/yr from 1960 to 1980 (Fig 5.1.). Catches then decreased to <100 t/yr during the 1980s and remained low until 2002. Since then catches have increased gradually to 1 300 t in 2010. The majority of the catches since 2002 of wolffish originate from factory landing reports implying that catches are mainly taken inshore by small vessels less than 30 feet, since these vessels are not obligated to provide logbooks. Offshore logbook reported catches of wolffish amounts to less 30 t/yr since 2008 and none as a shrimp fishery by-catch.

American plaice: Catches of American plaice developed during the 1970s, decreased in the beginning of the 1980s and has been at a very low level since then (Fig 5.2). In the past decade there have been no reported catches or bycatches of American plaice in SA1.

Thorny skate: Catches of thorny skate are reported as skates combined (SKA), but it seems likely that thorny skate constitutes a significant proportion of the reported catches. Catches or reporting seems to have been sporadic but were >100 t/yr in 1984 and 1985 (Fig 5.3.).

By-catch of other finfish in the shrimp fishery: The by-catch of juvenile finfish discarded in the shrimp fishery after the implementation of sorting grids has been estimated to 0.24 % American plaice, 0.01% Atlantic wolffish and 0.001% spotted wolffish, of the shrimp catch.

Recent nominal catches (t) for wolfish.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
STATLANT 21A	87	306	313	515	764	880	1195	35	[1]	
STACFIS	118	393	313	515	764	880	1195	1175[1]	1315[1]	

[1] Provisional (Greenland catch and STATLANT combined)

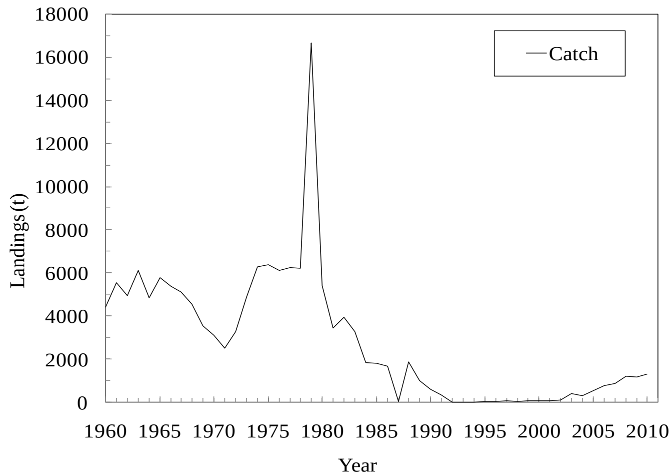


Fig 5.1. Other finfish in SA 1: Catches of spotted wolffish and Atlantic wolffish in SA1 combined from 1960 to 2010.

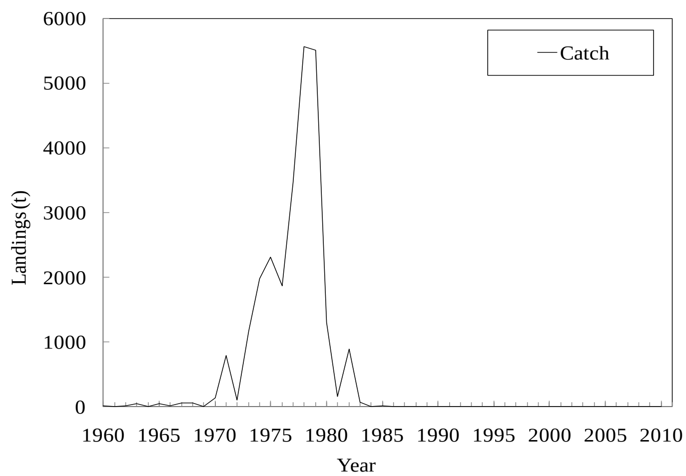


Fig 5.2. Other finfish in SA 1: Catches of American plaice in SA1 from 1960 to 2010.

Fig 5.3. Other finfish in SA 1: Catches of skates in SA1 from 1960 to 2010.

b) Data

i) Commercial fishery data

No data on length distribution in catches were available. Wolffish do appear in the logbooks but since wolffish are not the target species no CPUE is presented. Skates and American plaice do not appear in Greenland logbooks or in Greenland factory landing reports. Also, no quantitative information on the amount of juvenile fish discarded in the by-catches of the shrimp fishery was available.

ii) Research survey data

EU-German groundfish survey. Annual abundance and biomass indices were derived from stratified-random bottom trawl surveys commencing in 1982, covering NAFO Div. 1BCDEF from the 3-mile limit to the 400 m isobaths.

The Greenland shrimp fish survey. Annual abundance and biomass indices were derived from the random stratified bottom trawl survey commencing in 1992, covering NAFO Div. 1ABCDEF from 50 to 600 m isobaths.

c) Assessment

Atlantic wolffish: Biomass indices decreased in the 1980s in the EU-Germany groundfish survey. From 2002 to 2005 biomass indices increased in both surveys to above average levels. After 2005 the biomass has shown a decreasing trend in both surveys (Fig. 5.4.). The stock is mainly composed of individuals less than 45 cm with almost no individuals above 60 cm.

Spotted wolffish: Biomass indices decreased in the 1980s in the EU-Germany groundfish survey, but increased in both surveys after 2000 to above average levels (Fig 5.4.). No distinct new incoming year classes were observed prior to the increasing biomasses and the surveys may not fully cover the distribution of this stock. The stock consists of all sizes including very large individuals with no signs of distinct year-classes, except for a mode at 12 cm in 2010.

American plaice: Biomass indices decreased in the 1980s in the EU-Germany groundfish survey. From 2002 to 2005 biomass indices increased somewhat, but has since then decreased again. The general trend has however been increasing during the past decade (Fig. 5.4). The stock is mainly composed of individuals less than 35 cm.

Thorny skate: Biomass indices decreased in the 1980s in the EU-Germany groundfish survey and have remained at low levels since 1991 (Fig 5.4.). In the Greenland Shrimp Fish survey, some of the lowest index values are found within the last 6 years (Fig 5.4.). Length distributions of thorny skate in recent years typically reveal clear modes at 12-13 cm but also at 43 to 45.

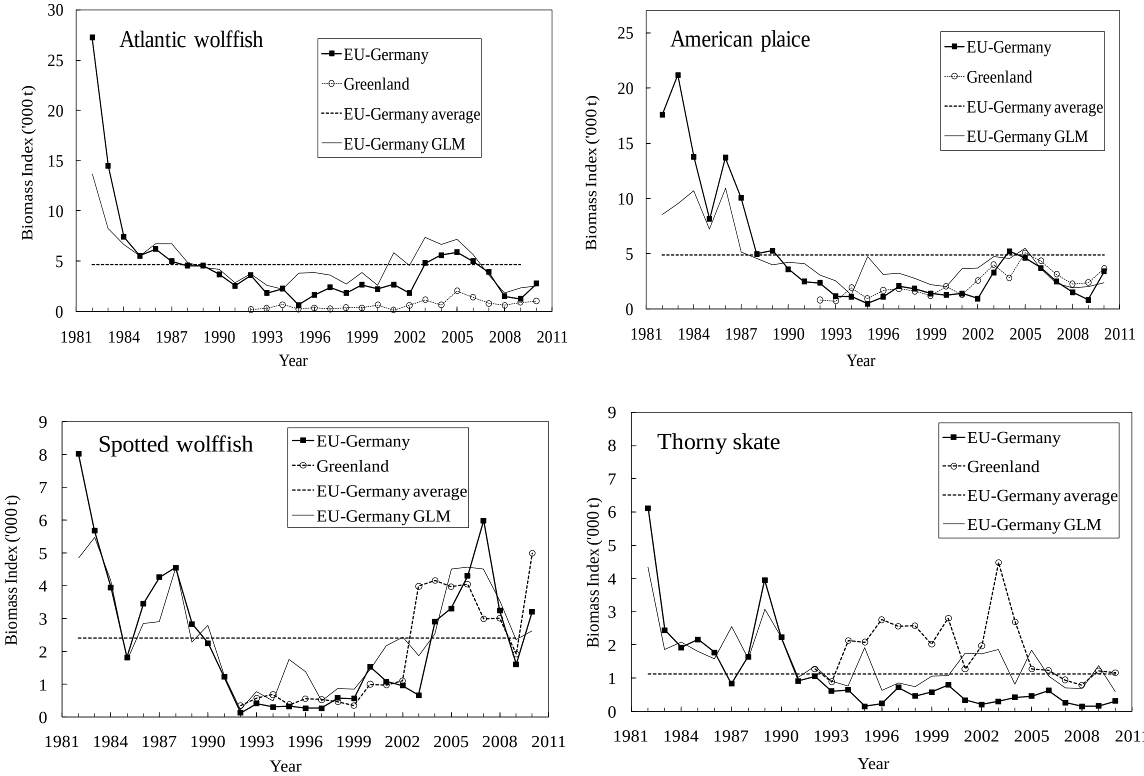


Fig. 5.4. Other finfish in SA 1: survey biomass indices.

d) Estimation of Parameters

Atlantic wolffish: The estimation of Atlantic wolfish SSB was performed using a length-maturity ogive and recruitment was estimated as fish of 15-20 cm representing 3 year old recruits. Since 1982, the SSB decreased and remained severely depleted until the early 1990s (Fig. 5.5). In contrast, recruitment increased almost continuously until 1994 and has varied considerably since then. During the past 5 years both SSB and recruitment has been at a low level.

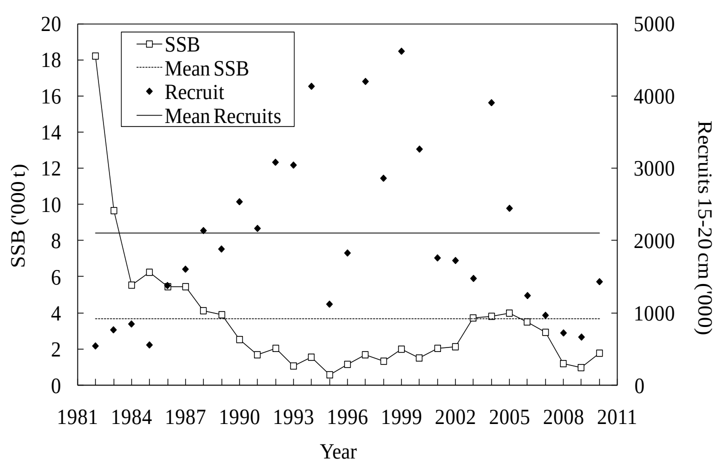


Fig. 5.5. Other finfish in SA 1: Atlantic wolffish in SA1. SSB and recruitment indices as derived from the EU-Germany groundfish survey.

American plaice: American plaice SSB was derived from German length disaggregated abundance indices to which a length-maturity ogive was applied. Recruitment is presented as abundance of small fish 15-20 cm representing age group 5. During 1982-91, the SSB decreased continuously and remained low until 2002 (Fig. 5.6.). SSB increased in 2003 and 2004, but is still considered to be at low level compared to the early and mid-1980s. From 2005 to 2009, both SSB and recruitment decreased to pre 2003 levels. However, in 2010 SSB has increased and recruitment is at the highest level observed since the 1980s.

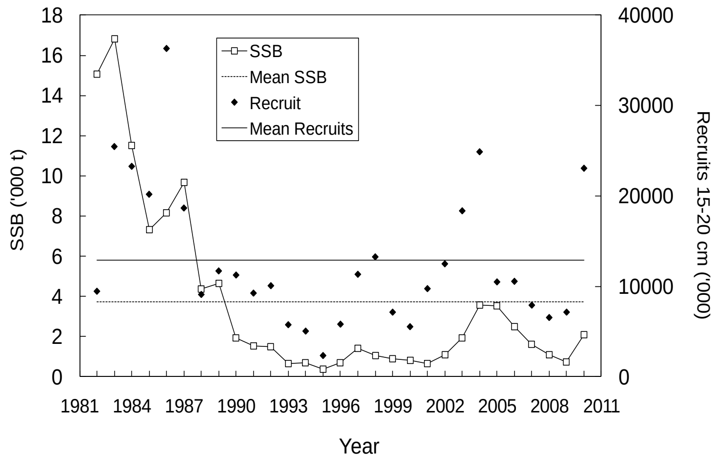


Fig. 5.6 Other finfish in SA 1: American plaice SSB and recruitment indices as derived from the EU-Germany groundfish survey.

e) Assessment results:

No analytical assessment could be performed for any of the stocks.

Fishing mortality: unknown for all of the stocks.

Atlantic wolffish

Biomass: After an increase in biomass from 2002 to 2005 the indices have decreased again in the EU-German groundfish survey, and indices are far below the values of the beginning of the time series.

Recruitment: Recruitment has been decreasing in the recent 5 years, but recruitment was above average in the preceding decade. The Atlantic wolffish stock in SA1 is mainly composed of small individuals.

State of the stock: Although, the Stock of Atlantic wolffish has shown some recovery potential due to increased recruitment and slightly increasing biomass trends in the past decade, the stock remains at a low level.

Spotted wolffish

Biomass: Biomass indices for spotted wolffish are currently above average values in the EU-German groundfish survey.

Recruitment: Unknown. No new distinct year-classes can be identified in the length distributions in past years, and the increasing biomasses since 2002 may rely on immigration from areas not covered by the surveys.

State of the stock: Unknown.

American plaice

Biomass: The biomass has been increasing since 2002 in both surveys. Nevertheless, the biomass indices of the EU-German groundfish survey are far below their initial values of the 1980s.

Recruitment: Incidents of above average recruitment have been observed since the mid 1990s.

State of the stock: The stock of American plaice has shown recovery potential with incidents of higher recruitment and increasing biomass indices in both surveys since 2002. However, the stock remains at a low level.

Thorny skate

Biomass: Biomass indices in both surveys are far below their initial values.

Recruitment: Unknown.

State of the stock: The stock remains at a low level.

f) Reference Points

Due to a lack of appropriate data, STACFIS was unable to propose any limit or buffer reference points for fishing mortality or spawning stock biomass for Atlantic wolffish, spotted wolffish, American plaice and thorny skate in SA1.

g) Research Recommendation

For other finfish in SA 1, STACFIS **recommended** that *the species composition and quantity of other finfish discarded in the shrimp fishery in SA1 be further investigated.*

For other finfish in SA 1,STACFIS **recommended** 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 by-catch.*

These stocks will next be assessed in 2014.

B. STOCKS ON THE FLEMISH CAP: SA 3 AND DIV. 3M

Environmental Overview

(SCR Doc. 11/13 and 16)

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 Newfoundland 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 anti-cyclonic (clockwise) gyre. The entrainment of North Atlantic Current water around the Flemish Cap, rich in inorganic dissolved nutrients generally supports higher primary and secondary production compared with the adjacent shelf waters. The stability of this circulation pattern may also 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.

Surface temperatures on the Flemish Cap were slightly above normal in 2010 while near-bottom temperatures on the remained above normal by > 1 standard deviation (SD). Surface salinities were also above normal by 0.4 SD. In the deeper (>1000 m) waters of the Flemish Pass and across the Flemish Cap, bottom temperatures generally range from 3°– 4°C. The baroclinic transport in the offshore branch of the Labrador Current through the Flemish Pass increased from >2 SD below normal in 2008 to about normal in 2009-10 by about 0.8 SD. Primary and secondary productivity was enhanced in the Flemish Pass and Cap in 2010.

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

(SCR Doc. 11/21, 11/28, 11/38; SCS Doc. 11/04, 11/05, 11/07)

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 according to Canadian Surveillance reports. Those fleets were not observed since 2000. 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 and a catch of 9 192 t was estimated by STACFIS. For 2011, a 10 000 t TAC was established.

Recent TACs and catches ('000 t) are as follow:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	5.5	10
STATLANT 21	0.0	0.0	0.0	0.0	0.1	0.1	0.4	1.2	4.4	
STACFIS	0.0	0.0	0.0	0.0	0.3	0.3	0.9	1.2	9.2	

ndf No directed fishery

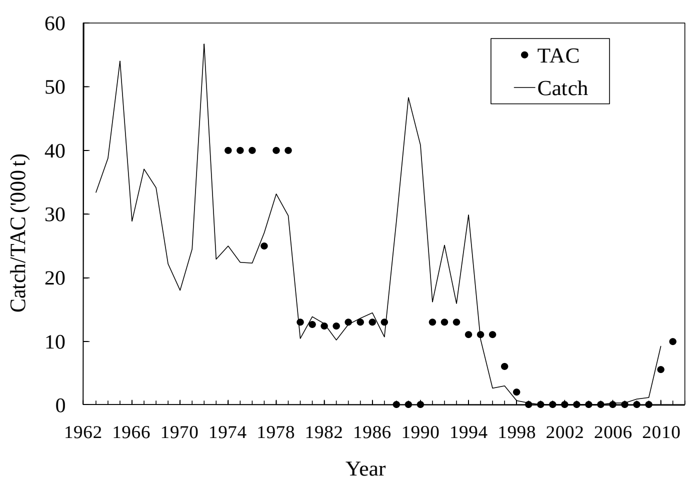


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch line includes estimates of misreported catches since 1988. No direct fishery is plotted as 0 TAC.

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 2010, when the fishery was reopening, there was a good sampling level. There were length distributions for EU-Lithuania, Norway, EU-Portugal, EU-Spain and EU-UK. The mode for Portugal and Spain was 54 cm; instead for UK was 90 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 and 2010 an age-length key from Portuguese catches was available. In 2010 there were two different readers for the Portuguese and the Spanish data, and the ALK from the reader of the Portuguese ALK was decided to use because he is the same as last years and survey data. In 2009 and 2010 age 4 was the most caught.

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 survey 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/Russian Federation 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 survey biomass showed a general decline over the time period of the survey.

A stratified-random bottom trawl survey was conducted by Canada in 1996, as part of an overall survey of Div. 2GHJ and 3KLMNO. Survey biomass was estimated at 9 300 t.

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 survey 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 year classes since 2005 has contributed to the increase in biomass. In 2010 the biomass decreased slightly, reaching a value of 69 000 t.

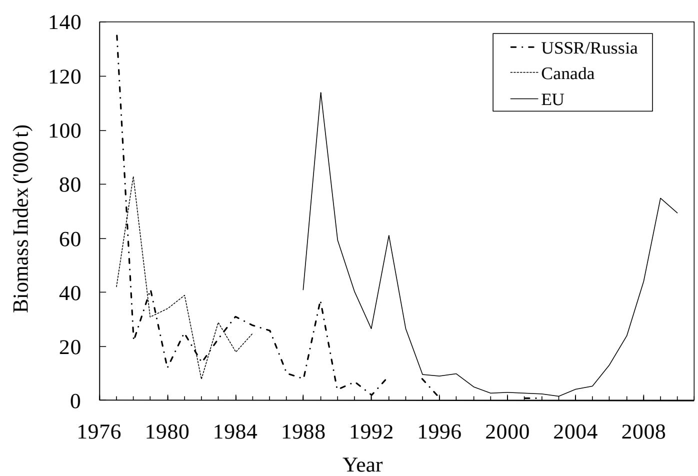


Fig. 6.2. Cod in Div. 3M: survey biomass estimates from surveys.

There is also a general increase in abundance, but it is less strong than biomass increase, reflecting the fact that stock weight at age has generally increased in recent years. Abundance at age indices were available from the EU Flemish Cap survey. After several above average recruitments (age 1) during 1988-1992, the EU Flemish Cap survey indicates poor recruitments during 1996-2004, even obtaining observed zero values in 2002 and 2004. Since 2005 increased recruitments has been observed. In particular, the age 1 index in 2010 is the third largest in the EU series (Fig. 6.3).

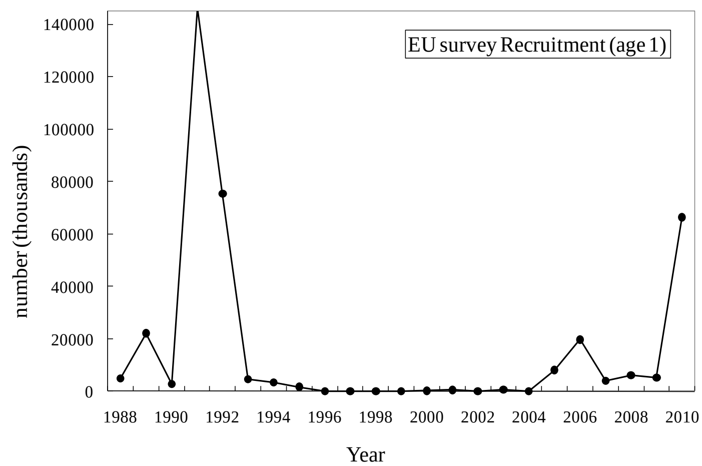


Fig. 6.3. Cod in Div. 3M: Number of recruits (age 1) in the EU survey, 1988-2010.

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 2010 the lengths of all the ages except ages 3 and 7 decreased with respect to 2009, but they are still well above the level of the beginning of the series.

New annual maturity ogives from the EU survey were provided this year for years 2008-2010. So, there are data from the EU survey for 1990-1998, 2001-2006 and 2008-2010. Maturities were modelled using a Bayesian framework which allowed for estimates in the years with missing data. 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 old in the late 1980s to just above 3 years old since about year 2000. Since 2005 it has been a slight increase in the A_{50}, reaching in 2010 a value of approximately 3.5 years.

c) Estimation of Parameters

In 2008 onwards 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 1988-2010, except for 2002-2005, for which only total catch is available;

Tuning: numbers at age from the EU Flemish Cap survey data for 1988-2010;

Ages: from 1 to 8+ in both cases;

Catchability analysis: dependent on stock size for ages 1 to 2;

Priors: for survivors at age at the end of the final assessment year, for survivors from the last true age in every year, for fishing mortalities at age and total catch weight for years without catch numbers at age, for numbers at age of the survey and for the natural mortality. Prior distributions were set as last year assessment.

d) Assessment Results

Note that estimates of SSB are available for 2011, whereas biomass estimates are available to 2010 only. This difference arises because there are no age 1 recruitment estimates for 2011, which are an important component of the total, but not spawning, biomass.

Total Biomass and Abundance: Estimated total biomass and abundance show an increasing trend in both values, being the increase in biomass higher than the one in abundance. While total biomass is at the level of the beginning of the 1990s, the abundance is still well below those values (Fig. 6.4).

Spawning stock biomass: Estimated median SSB (Fig. 6.5) increases from 3 727 t (2 921-4 831 t, 90% CI) in 2004 to 50 291 t (35 132-71 833 t, 90% CI) in 2011, reaching the highest value of the series. The biggest increase has taken place during 2008-2011. This is well above B_{lim}, which is 14 000 t. The big increase in the last three years is largely due to five reasonably abundant year classes, those of 2005-2009, and to their early maturity.

As new maturity ogives are available for years 2008-2010 and the stock is quickly changing its biological parameters (mean weight at age and maturity at age), it resulted in a change of the SSB of the stock. In order to see the differences that the new maturity ogives can lead, the results for total biomass and SSB of last year assessment (with the maturity ogives just up to 2006) and the new one (with the update maturity ogives) are presented in Fig. 6.5 and 6.6. It can be seen that, although last year there was a projected SSB for 2010 of 55 992 t, this year the SSB for that year is only 36 278 t. That is because with the new maturity ogives the individuals start to mature at an older age than with the last year maturity ogives, affecting SSB but not total biomass. Total biomass has had more or less the same picture last year and this year. For last year the biomass for 2009 was 39 702 t, and for this year assessment the 2009 value is 34 003 t.

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 due to changes in the weight at age and mature proportions at age.

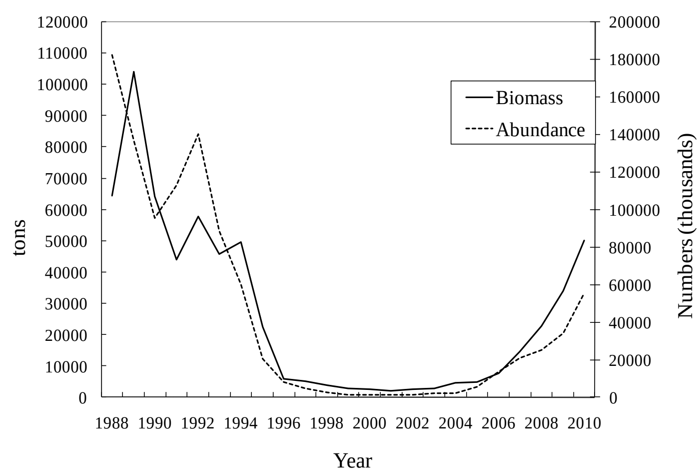


Fig. 6.4. Cod in Div. 3M: Biomass and abundance estimates for years 1988 to 2010. The numbers are in thousands.

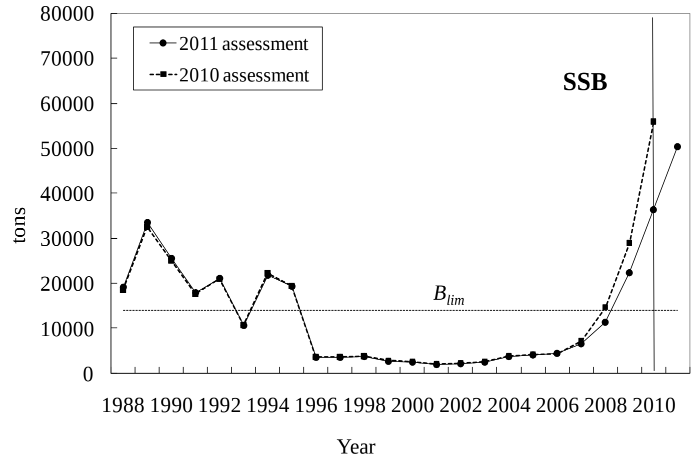


Fig. 6.5. Cod in Div. 3M: Median SSB estimates for years 1988 to 2011. The horizontal dashed line is the B_{lim} level of 14 000 t. The vertical line indicates the 2010 SSB. Data from this year and last year assessments.

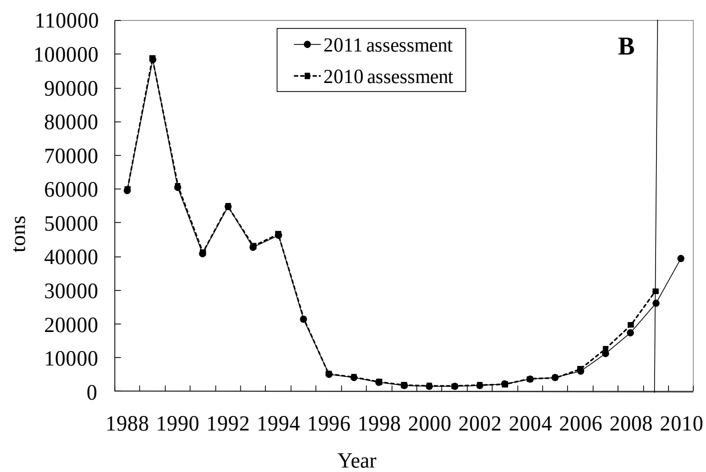


Fig. 6.6. Cod in Div. 3M: Median total Biomass estimates 1988 to 2010. The vertical line indicates the 2009 biomass. Data from this year and last year assessments.

Recruitment: After a series of recruitment failures between 1996 and 2004, recruitment values in 2005-2010 are higher, although still below the levels of the late 1980s (Fig. 6.7). There is considerable uncertainty associated with the two most recent values, as indicated by the wide 90% probability limits.

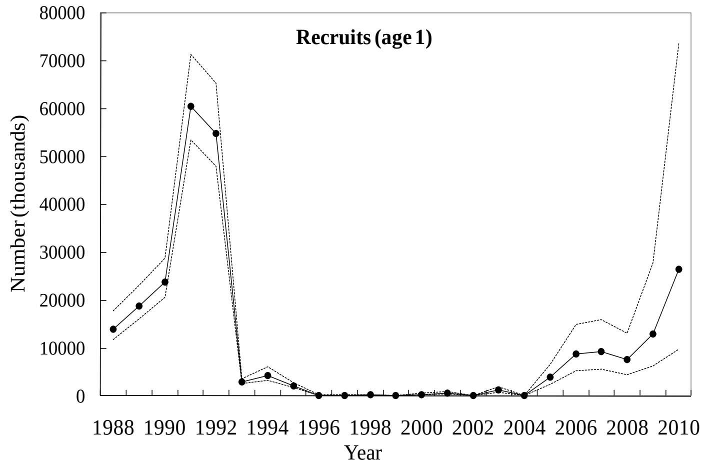


Fig. 6.7. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2010.

Fishing mortality: F_{bar} (ages 3-5) is estimated to have been at very low levels in most years from 2001 to 2009 (Fig. 6.8). An increase is observed in 2006, which is mainly due to high fishing mortality rates at ages 3 and 4. In 2010 the F_{bar} level increased as a result of the reopening of the fishery. $F_{statuquo}$ (F_{bar}=0.28) exceed F_{max} (F_{bar}=0.21).

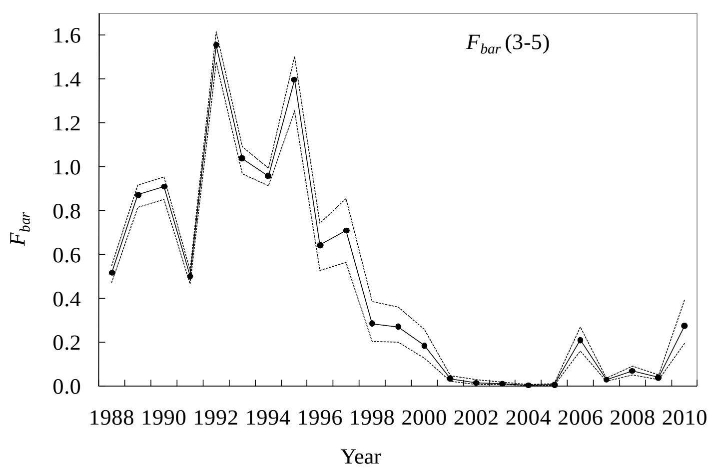


Fig. 6.8. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2010.

e) Retrospective analysis

A six-year retrospective analysis with the Bayesian model was conducted by eliminating successive years of catch and survey data. Fig. 6.9 to 6.11 present the retrospective estimates of age 1 recruitment, SSB and F_{bar} at ages 3-5.

Retrospective analisys show a slight overstimation of recruitment in recent years (Fig. 6.9), while the SSB and fishing mortality in recent years are consistant (Fig. 6.10 and 6.11).

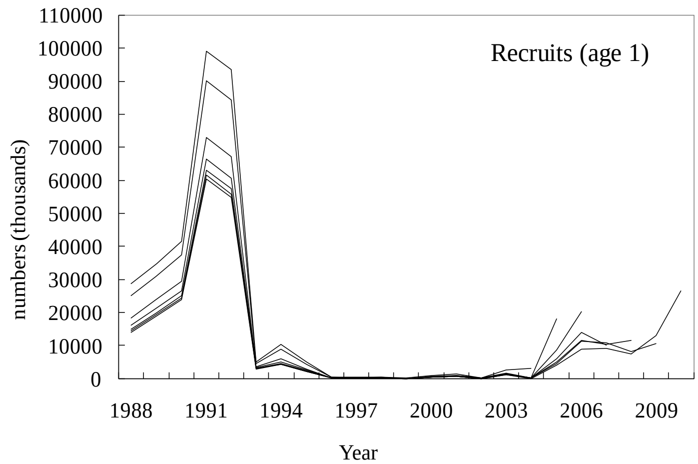


Fig. 6.9. Cod in Div. 3M: Retrospective results for recruitment.

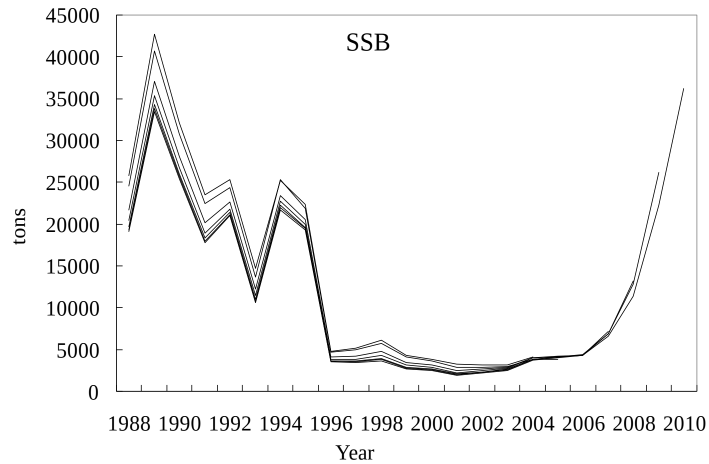


Fig. 6.10. Cod in Div. 3M: Retrospective results for SSB.

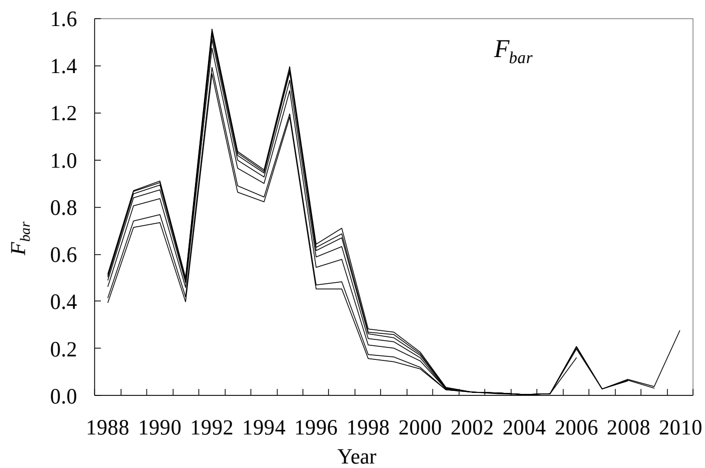


Fig. 6.11. Cod in Div. 3M: Retrospective results for F_{bar}.

f) State of the stock

There has been a significant increase in spawning biomass, with levels much above B_{lim}, although abundance remains lower that in the beginning of the time series. 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 2005-2010, 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 results than XSA for the common period, the validity of the current B_{lim} value is not in question. Fig. 6.12 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. 6.13 shows a stock-F_{bar} plot.

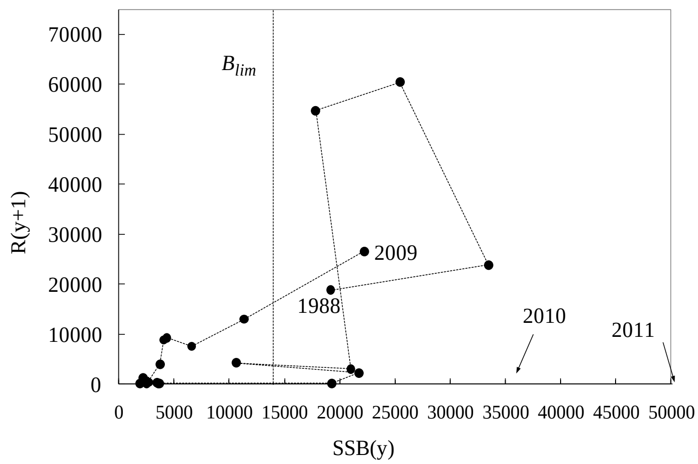


Fig. 6.12. Cod in Div. 3M: Stock-Recruitment (posterior medians) plot

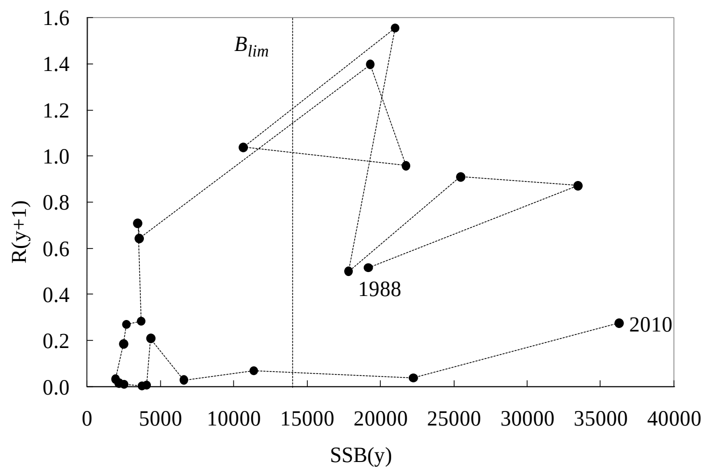


Fig. 6.13. Cod in Div. 3M: Stock-F_{bar}(3-5) (posterior medians) plot

Figure 6.14 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_{2010}.

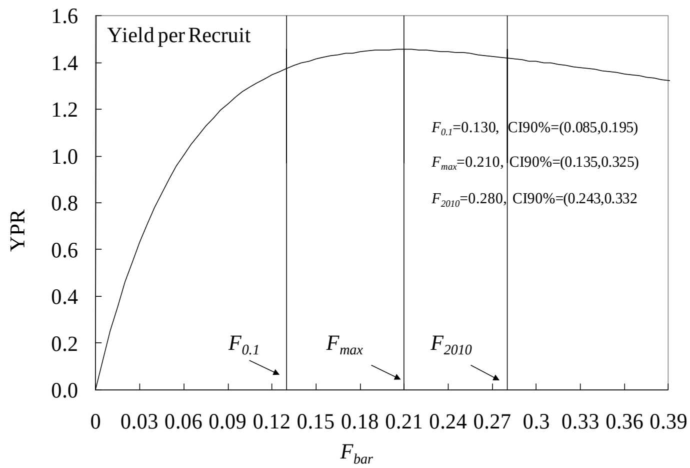


Fig. 6.14. Cod in Div. 3M: Bayesian Yield per recruit

h) Stock projections

Stochastic projections of the stock dynamics over a 3 year period (2012-2014) 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 2011: estimates from this assessment.

Recruitments for 2011-2014: Recruits per spawner were drawn randomly from the last six years of the assessment (2005-2010), as these are the years in which recruitment has started to recover.

Maturity ogive: Drawn randomly from the maturity ogives (with their associated uncertainty) of years 2008-2010.

Weight-at-age in stock and weight-at-age in catch: Drawn randomly from the values in 2008-2010.

PR at age for 2011-2014: Equal to 2010 PR, the first year with direct fishery since 1999.

F_{bar}*(ages 3-5)*: Three scenarios were considered. All scenarios assumed that the yield for 2011 is the established TAC (10 000 t):

(Scenario 1) $F_{bar}=F_{0.1}$ (median value = 0.130).

(Scenario 2) $F_{bar}=F_{max}$ (median value = 0.210).

(Scenario 3) $F_{bar}=F_{2009}$. (median value = 0.280).

Figures 6.15 to 6.18 summarize the projection results under the three 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 high probability of reaching levels equal or higher than all of the 1988-2011 estimates (Fig. 6.15, 6.17), 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. 6.16a,b). 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 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. 6.18).

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)					
2011	52141	73189	101986	35462	50552	71721		10000	
2012	65344	95728	146081	46705	65356	91368	4877	9280	17991
2013	76249	123564	205415	63313	95086	149647	6202	12935	27183
2014	85810	156044	280853	71976	122833	220543	6328	14787	34513
				$F_{bar}=F_{max}$ (median=0.210)					
2011	52454	73150	102247	35370	50463	71771		10000	
2012	64375	95261	144784	46342	65352	90997	7515	14495	28156
2013	69539	114011	196493	57873	86759	138002	9067	18822	39858
2014	72483	135456	252292	59071	103508	189912	8391	20077	46941
				$F_{bar}=F_{2010}$ (median=0.280)					
2011	52567	72842	101887	35508	50469	71210		10000	
2012	64733	94806	145854	46182	65617	91109	11178	18657	32741
2013	66332	108131	187147	54863	81408	129666	12031	22596	43942
2014	65132	122401	235496	53843	91737	167645	10668	23519	51584

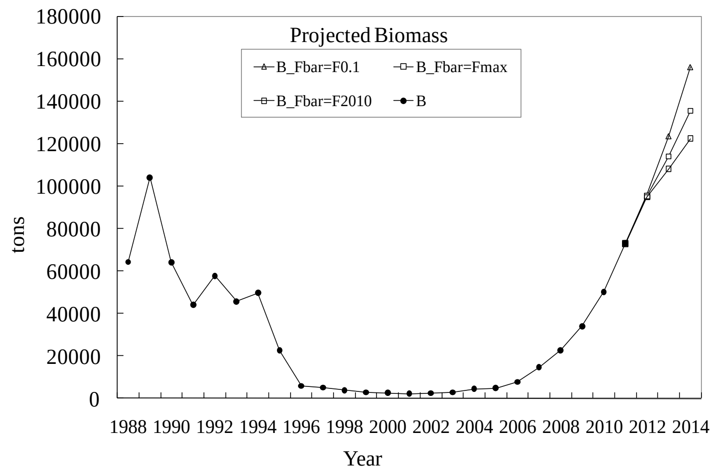


Fig. 6.15. Cod in Div. 3M: Projected Total Biomass under all the Scenarios.

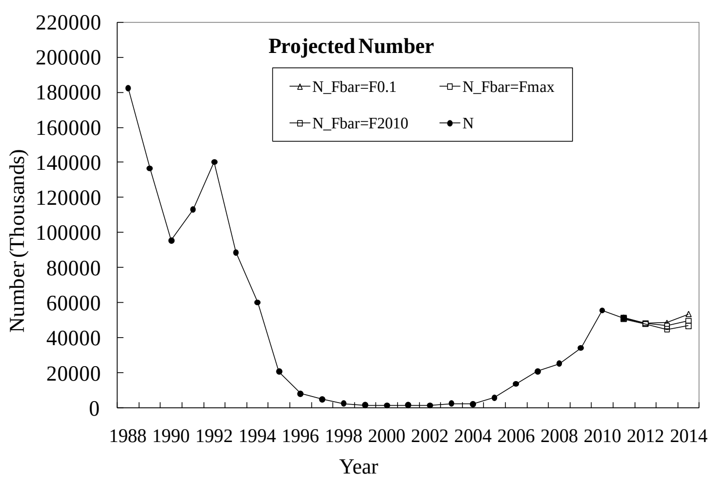


Fig. 6.16a. Cod in Div. 3M: Projected Total Abundance under all the Scenarios.

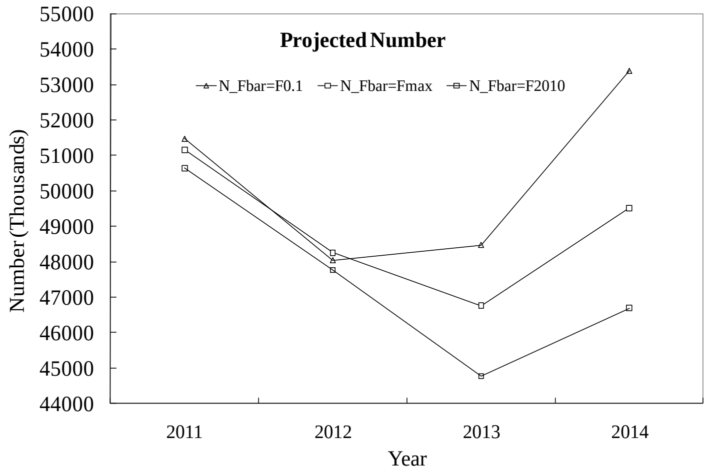


Fig. 6.16b. Cod in Div. 3M: Projected Total Abundance under all the Scenarios. Projected years only.

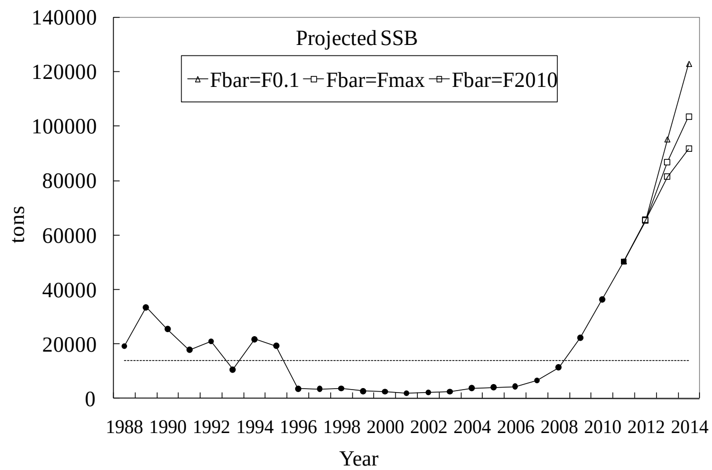


Fig. 6.17. Cod in Div. 3M: Projected SSB under all the Scenarios.

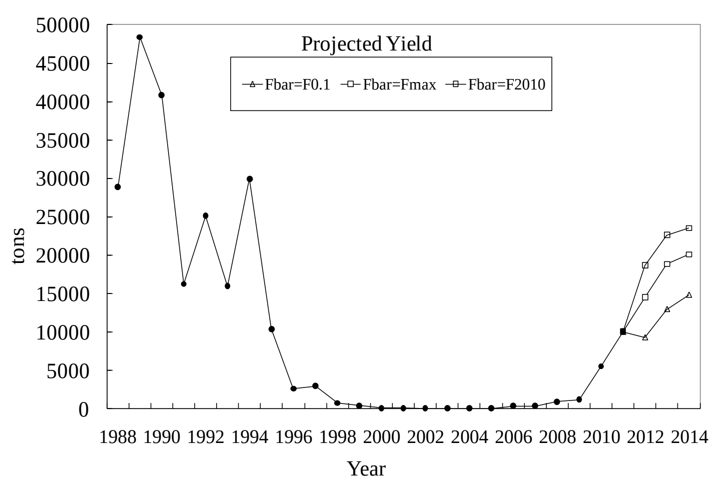


Fig. 6.18. Cod in Div. 3M: Projected removals under all the Scenarios.

i) Research recommendations

For cod in Div. 3M, STACFIS **recommended** that *an age reader comparison exercise be conducted.*

The next full assessment for this stock will be in 2012.

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

(SCR Doc. 11/21, 26; SCS Doc. 11/4, 5,7,11).

a) Introduction

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

i) Description of the fishery

The redfish fishery in Div. 3M increased from 20 000 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 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 with most of the catch taken by Portugal. From July 2004 to July 2006 EU Flemish Cap survey showed a 3.5 fold increase in bottom biomass of both golden and beaked redfish. Redfish catches followed that increase and were kept at a relative high level of 7 000-11 000 t between 2006 and 2010.

The rapid increase of golden redfish biomass allowed a new golden redfish fishery from September 2005 onwards on shallower waters above 300 m. So, over the most recent years there were two redfish fisheries occurring at depths above (golden redfish) and below (beaked redfish) 300m, basically pursued by Portuguese bottom trawl and Russian pelagic trawl. Furthermore, the important increase of cod biomass occurring since 2006, with increasing cod by-catches and finally the reopening of the Flemish Cap cod fishery in 2010 with a TAC of 5 500 t, implied another contribution to the maintenance of a relatively high level of redfish catches, in this case associated with increasing fishing effort directed to cod.

These new realities implied a 2005- 2010 revision of redfish catch estimates, in order to split recent commercial catch of the major fleets on the Flemish Cap bank (EU-Portugal, Russian Federation and EU-Spain) into golden and beaked redfish and to have for each of the main fleets the available length sampling separated as well.

The redfish by-catch in the Div. 3M shrimp fishery (once an important part of fishing mortality on the earlier ages, from 1993 until 2003) declined in 2004, but remains unknown for 2006-2010.

Recent TACs, catches and by-catch ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	5	5	5	5	5	5	5	8.5	10.0	10.0
TAC	5	5	5	5	5	5	5	8.5	10.0	10.0
STATLANT 21	3.0	2.0	3.1	6.4	6.3	5.6	7.9	8.7	8.5	
STACFIS Total catch[1]	2.9	1.9	2.9	6.6	7.2	6.7	8.5	11.3	8.5	
STACFIS Catch[2]	2.9	1.9	2.9	4.1	6.0	5.1	4.3	3.7	5.4	

[1] Estimated redfish catch of all three redfish species.
[2] Estimated beaked redfish catch (plus estimated redfish by-catch in shrimp fishery up to 2005).

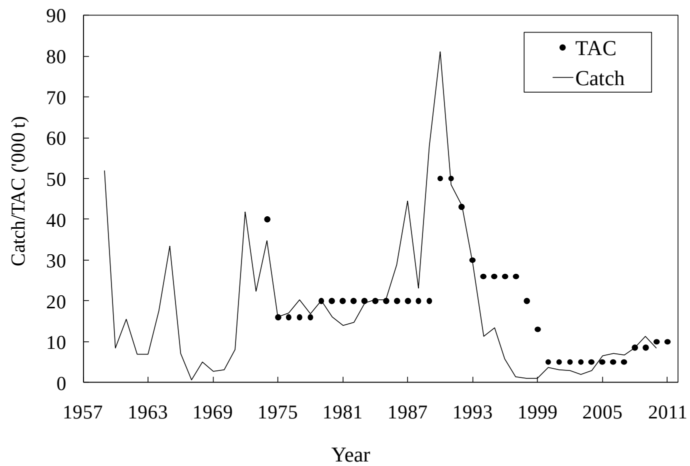


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

b) Input Data

The Div. 3M redfish assessment is focused on beaked redfish, regarded as a management unit composed of two populations from two very similar species: the Flemish Cap *S. mentella* and *S. fasciatus*. The reason for this approach is the historical dominance of this group in the Div. 3M redfish commercial catch until 2005. During the entire series of EU Flemish Cap surveys beaked redfish also represents the majority of redfish survey biomass (71%).

i) Commercial fishery and by-catch data

Sampling data. Most of the commercial sampling data available for the Div. 3M redfish stocks since 1989 are from the Portuguese fisheries. Length sampling data from Russian Federation, Japan and EU-Spain were also available for several years and used to estimate the length composition of the commercial catches for those fleets in those years. The annual length composition of the Portuguese trawl catch was applied to the rest of the commercial catches. The 1998-2010 3M beaked redfish commercial length weight relationships from the Portuguese commercial catch were used to compute the mean weights of all commercial catches and corresponding catch numbers at length.

Redfish by-catch in numbers at length for the Div. 3M shrimp fishery is available for 1993-2004, based on data collected on Canadian and Norwegian vessels. The commercial and by-catch length frequencies were summed to establish the total removals at length. These were converted to removals at age using the *S. mentella* age-length keys with both sexes combined from the 1990-2010 EU surveys. Annual length weight relationships derived from Portuguese commercial catch were used for determination of mean weights-at-age.

On the first years of the assessment, before 1993, age group 8 was the most abundant in the commercial catch, moving back to age 4 and 5 in 1993-1995 at the beginning of the Div. 3M shrimp fishery. The expansion of the shrimp fishery with sorting grids and the decline of the redfish fishery led to even younger modal age groups between 1996 and 2004, when age 2 was the most abundant in the redfish catch most of the years. Catch at age doesn't include redfish bycatch since 2005 and the most abundant age group in the redfish catch increased since then to ages between 6 and 9. Nevertheless in 2010 modal age in the catch return to younger age 5.

ii) Research survey data

In June 2003 a new Spanish research vessel, the *RV Vizconde de Eza* (VE) replaced the *RV Cornide de Saavedra* (CS) that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 time series the original survey indices for beaked redfish have been converted to the new vessel units so that each former time series could be comparable with the correspondent new indices obtained from 2003 onwards.

Survey bottom biomass and survey female spawning biomass were calculated based on the abundance at length from EU bottom trawl survey for the period 1988-2010 and on the Div. 3M beaked redfish length weight relationships from EU survey data for the same period. Female spawning biomass was calculated applying length maturity ogives derived from data collected during the 1992-94 and 1999 EU surveys.

Age compositions for Div. 3M beaked redfish EU survey stock and mature female stock from 1989 to 2010 were obtained using the *S. mentella* age length keys mentioned above. Mean weights-at-age were determined using the EU survey annual length weight relationships.

Survey results. Exploitable biomass (ages 4 and older) declined on the first years of the interval till 1990, fluctuating at low level since then until 2003. A sequence of increasingly strong year classes (2000-2002) lead rapidly the stock to a maximum in 2006. The size of the most recent year classes recruiting at age 4 (2003-2006) declined as fast as their predecessors went up. The exploitable biomass follow very similar trend to recruitment and both series are in the vicinity of their respective average levels on the terminal year. As for the survey indices related to female spawning stock component their increase observed since 2002 was halted with a drop from 2009 to 2010, but still keeping its size well above average (Fig. 7.2).

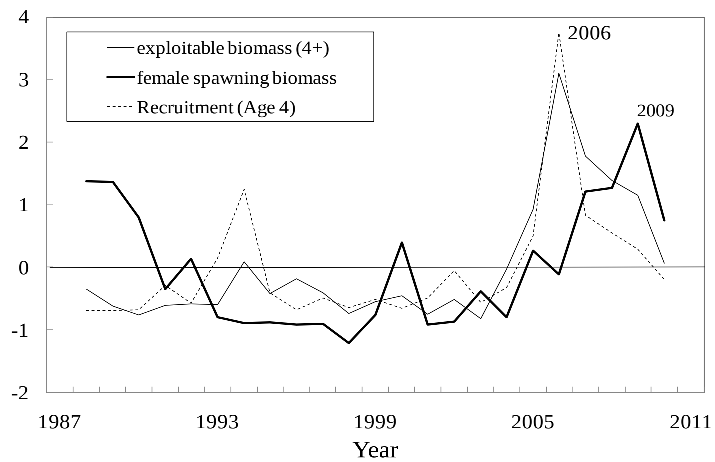


Fig. 7.2. Beaked redfish in Div. 3M: standardized biomass, female spawning biomass and recruitment at age abundance from EU surveys (1988-2010). Each series standardized to the mean and unit standard deviation.

Despite a sequence of abundant year classes and a low to very low exploitation regime over the last fifteen years, survey results suggest that the beaked redfish stock has not been able to hold its growth and sustain an above average level, suffering instead a severe decline on the second half of the 2000s. This unexpected downward trend on stock size can be attributed to mortality other than fishing mortality.

An increase in redfish natural mortality is likely to be associated to cod growth on Flemish Cap. Not only in terms of abundance but also in terms of individual growth, cod shows a consistent increase from 2006 onwards, faster in its stock biomass. The magnitude of the likely increase of redfish natural mortality has been analysed in the sensitivity analysis of the present assessment.

c) Estimation of Parameters

The expected proportion of mature females found at each age and year for Div. 3M beaked redfish was calculated using the proportion of mature females found in survey stock abundance-at-age. These annual female "maturity ogives" were used in the Extended Survival Analysis to get annual female spawning biomass.

A first standard Extended Survivors Analysis (XSA) (Shepherd, 1999)[2] for the period 1989-2010 was run. Natural mortality was kept constant at the usual level of 0.1. The month of peak spawning (larval extrusion) for Div. 3M

[2] SHEPHERD, J. G. 1999. Extended survivors analysis: an improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci.*, **56**(5): 584-591.

S. mentella, was taken to be February, and was used for the estimate of the proportion of fishing mortality and natural mortality before spawning. EU survey abundance at age was used for calibration. The XSA model specifications are given below:

Catch data from 1989 to 2010, ages 4 to 19+

Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1989	2010	4	18

Natural Mortality (*M*) is assumed 0.1 for all years, ages.
Tapered time weighting not applied
Catchability independent of stock size for all ages
Catchability independent of age for all ages
Terminal year survivor estimates not shrunk towards a mean F
Oldest age survivor estimates not shrunk towards the mean F of previous ages
Minimum standard error for population estimates from each cohort age = 0.5

Going back to the survey trends for year class strength at age 4 (Fig. 7.2), exploitable stock and female spawning stock biomass (SSB) it is obvious that the first two components started their decline earlier, on 2006, while the third component started later, on 2009. Over recent years (2006-2010) the major contribution to the survey exploitable biomass came from ages 4 to 6 while for female spawning stock biomass the major contribution came from ages 7 and older. So, when considering a set of runs for a range of *M*'s higher than the standard value of 0.1 commonly adopted for redfish species, these facts determined the definition of two time/age boxes where natural mortality increased: (1) 2006-2010 for ages 4 to 6, and (2) 2009-2010 for ages 7 and older. For years before 2006 *M* was kept at 0.1.

The interval of magnitude for natural mortality to be considered on the sensitivity runs was set from 0.1 to 1.0. On each of the sensitivity runs natural mortality was kept constant within the boxes predefined above. Finally two other runs were performed with *annual* natural mortality increasing in the boxes at the same rate of the Flemish Cap 1) cod abundance and 2) cod biomass.

The goodness of fit of the model for each of the *M* options is given by the sum of squared log catchability at age resisuals for 2006-2010, the most recent period where the survey indices declined and is assumed that *M* increased. These results have a minimum *SS* plateau, for *M* between 0.4 and 0.6 (Fig. 7.3), with the objective function located in the vicinity of *M* = 0.55.

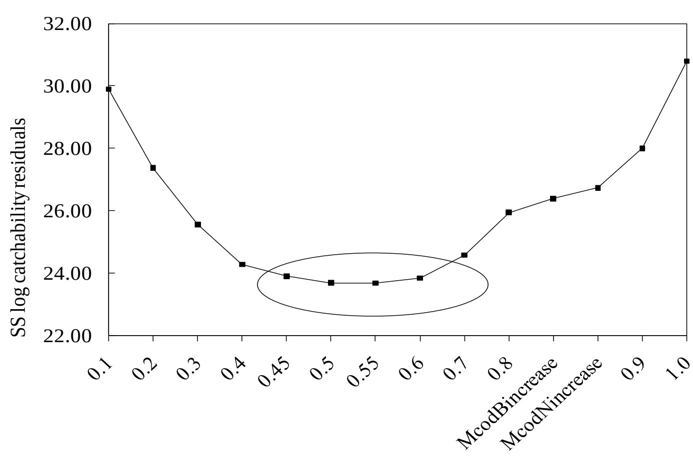


Fig. 7.3. Beaked redfish in Div. 3M: goodness of fit of XSA_{2011} for several *M* options between 2006 and 2010.

The exploitable and female spawning biomass trends given by *M* = 0.4 are plotted against the trends given by the survey and the standard *M*, with all series standardized to the respective mean and unit standard deviation (Fig. 7.4 and Fig. 7.5).

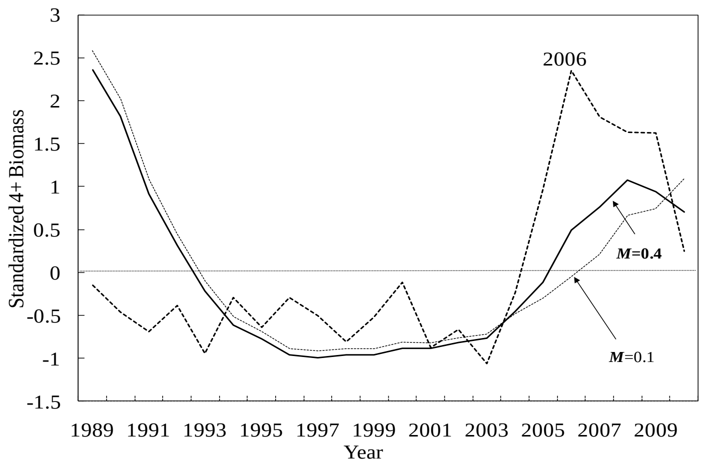


Fig. 7.4. Beaked redfish in Div. 3M: standardized 4+ biomass given by XSA $_{M=0.4\ \mathrm{to}\ 0.6}$ versus EU survey$_{1989\text{-}2010}$ and XSA$_{M=0.1}$. Each series standardized to the mean and unit standard deviation.

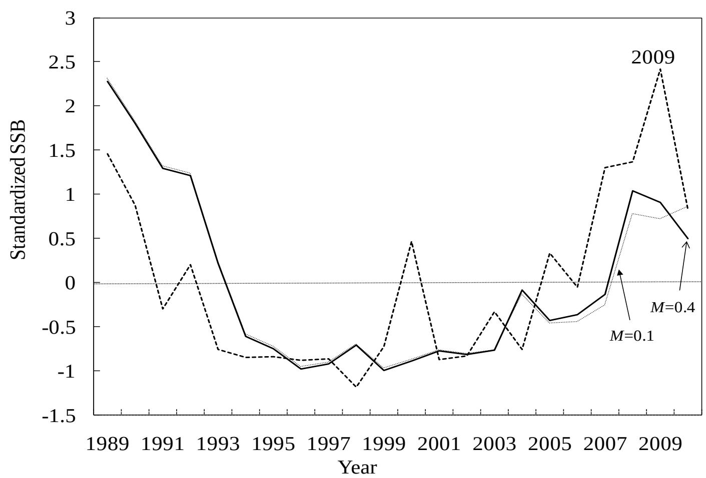


Fig. 7.5. Beaked redfish in Div. 3M: standardized spawning stock biomass XSA $_{M=0.4\ \mathrm{to}\ 0.6}$ versus EU survey$_{1989\text{-}2010}$ and XSA$_{M=0.1}$. Each series standardized to the mean and unit standard deviation.

Trends from the *M*=0.4 were in line with the survey decline, while the standard run ignores the recent survey trends allowing the stock to continue to growth. The key diagnostics of the five XSA runs with *M* ranging from 0.40 to 0.60 are similar, suggesting that *M* going up from 0.4 to 0.55 (the “best” *M* option corresponding to a minimum sum of squared log catchability resisuals) gives only a marginal improvement on the diagnostics of the assessment. Therefore, *M* = 0.4 was chosen as it is the least different from the standard *M* = 0.1.

Taking into account the results of the sensitivity analysis a natural mortality level at 0.4 was fixed in the present XSA assessment for ages 4-6 through 2006-2010, and ages 7+ on 2009 and 2011. Nevertheless STACFIS expressed its concern not only for the uncertainty around the actual level of natural mortality but also for the lack of research regarding the possible causes responsible for the severe decline of the stock from 2006 onwards.

d) Assessment Results

XSA diagnostics show high standard errors associated with the average catchability at age and year patterns in catchability residuals. From 2004 onwards residuals are generally of much smaller size and the marked negative/positive pattern of the past is lost. An improvement on recent residual patterns is observed when XSA increase *M* from standard 0.1 to 0.4. A 2011-2007 retrospective XSA was also carried out (Fig. 7.6). When compared to previous assessments, this retrospective analysis presents more consistent trends namely as regards female spawning biomass and average fishing mortality, coupled with a non systematic bias signal.

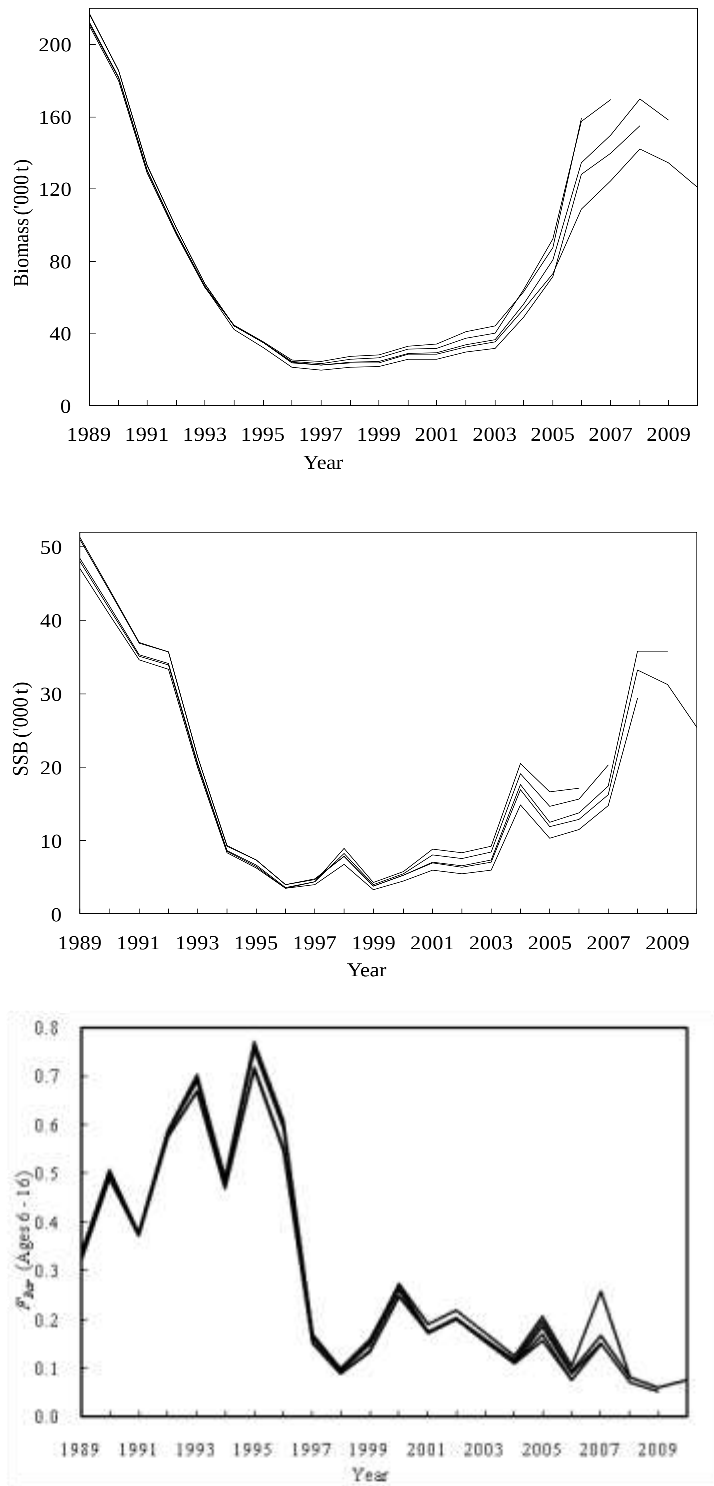


Fig. 7.6. Beaked redfish in Div. 3M: XSA retrospective analysis, 2011-2007: exploitable 4+ biomass, female spawning biomass and average fishing mortality.

Taking into account both the consistency of the results with the survey trends and the improvement of the diagnostics from the previous assessments, the 2011 XSA assessment was accepted, with the increase of natural mortality previously defined.

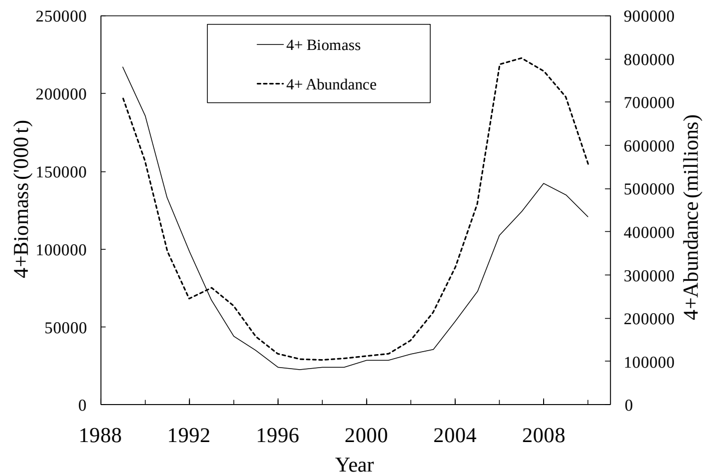


Fig. 7.7. Beaked redfish in Div. 3M: age 4+ biomass and Age 4+ abundance trends from XSA.

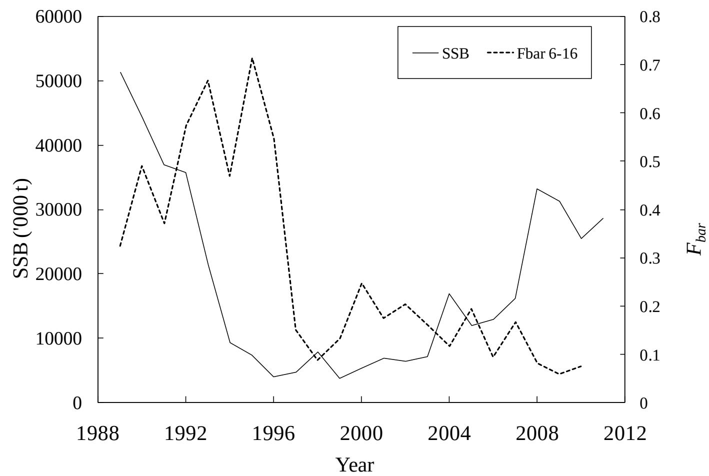


Fig. 7.8. Beaked redfish in Div. 3M: female spawning biomass and fishing mortality trends from XSA.

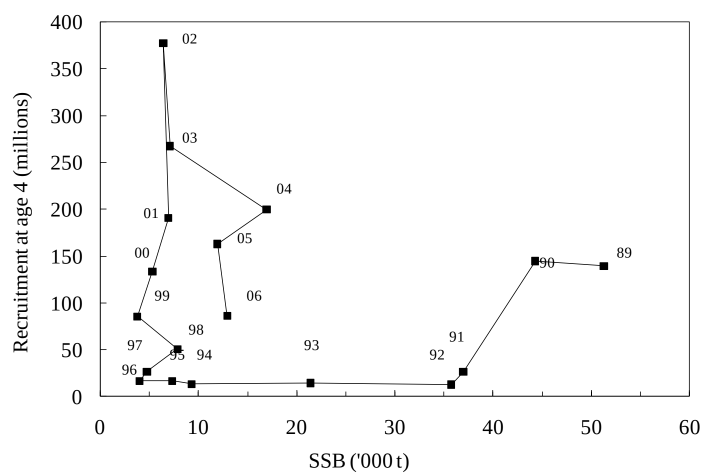


Fig. 7.9. Beaked redfish in Div. 3M: Stock/Recruitment plot (labels indicate age class).

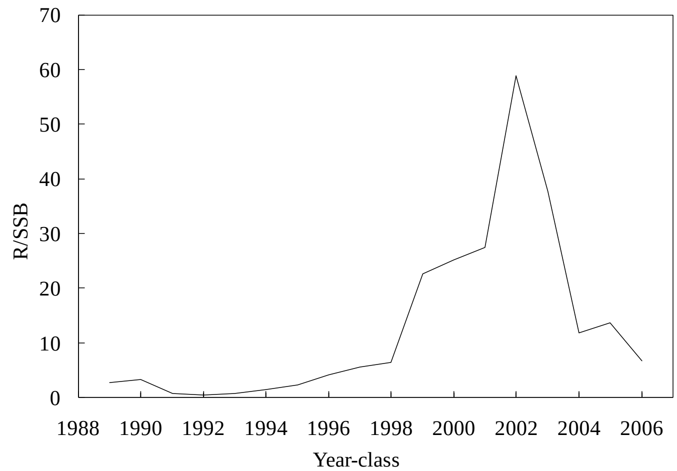


Fig. 7.10. Beaked redfish in Div. 3M: recruitment per thousand t of SSB .

Biomass and abundance (Fig. 7. 7): Experienced a steep decline from the 1989 till 1996. The exploitable stock was kept at a low level until the early 2000's, basically dependent on the survival and growth of the existing cohorts. Above average year classes coupled with high survival rates allowed a rapid growth of biomass and abundance since 2003 and sustained the stock at a high level on 2007-2008. However the stock decreased on the last couple of years for causes other than fishing and, despite the stock size being still above average level, there are no signs that the present decline rate is slowing down.

Spawning stock biomass (Fig. 7.8): The continuous increase observed since 2000 was halted at 2008. Female spawning biomass drop from 2009 to 2010, but is still well above average. A marginal increase is expected in 2011 due to the individual growth of the female survivors from the abundant 2000-2002 year classes, now dominating the spawning biomass.

Fishing Mortality (Fig. 7.8): High commercial catches (at a maximum level between 1989 and 1993) led to high fishing mortalities through the first half of the 1990's. Fishing mortality fell between 1996 and 1997 and since then has been kept at a low level.

Recruitment (Fig. 7.9 and 7.10): Increased from 1998 year class till 2002 year class, which gave the age 4 historical high, and declined afterwards as fast as it went up. Recruitment is on 2010 just below average. The reproductive potential of the stock increased steadily on the late 1990's-early 2000s but fell from 2002 to 2004 and record a further decline on 2006. This apparent decline on reproductive potential may reflect higher natural mortalities at pre-recruited ages, rather than the return to a low productivity regime.

The conclusions of the present assessment are not in line with previous assessments: the declines on survey stock abundance and biomass first observed in 2007-2008 were confirmed in 2009-2010 and extended to the survey female spawning component. These new declines could not be explained by a commercial catch that has been chronically small for more than a decade. The new assessment results can only reflect the declines foreseen by the survey if natural mortality is allowed to suffer an important increase since 2006, first just over the younger ages and later on covering the full age spectrum.

e) Short term projections

Short term (2013) stochastic projections were obtained for female spawning stock biomass (SSB) and yield for $F = 0$, *F status quo* = 0.072 and $F_{0.1} = 1.98$. The same *F* as the projection *F* was assumed in 2011.

F status quo is defined as the 2008-2010 average $F_{6\text{-}16}$ given by the XSA assessment and partial recruitment (PR) was derived from the relative *F* at age for the last 3 years, with associated errors.

In order to get a new $F_{0.1}$ in line with the accepted increase of $M = 0.4$ a yield per recruit analysis has been carried out. On this analysis the true ages of a cohort were extend up to age 30. Mean weights at age in the catch and in the stock were given by the respective averages for the last 10 years. The adopted partial recruitment (PR) was derived from the average *F* at age for the last 10 years, given by the XSA assessment, using the average level of fishing mortality within ages 16 to 18 as the reference level to calculate the PR vector. Even with the less severe flat top PR option (PR = 1 for ages 16 and older), $F_{0.1}$ will always be dependent on the magnitude of the underlying natural mortality. In the present yield per recruit analysis the adopted high level of natural mortality lead to a very high $F_{0.1}$.

No stock recruitment relationship was assumed and so recruitment varies randomly around its 1989-2008 geometric mean. The 2009 and 2010 recruitments were excluded from the average due to the greater uncertainty of their estimate by the present XSA.

Uncertainty is associated to the usual vectors needed to forward projections, with the exception of natural mortality, which was fixed at 0.4 for all ages and years. Maturity ogive, as well as stock and catch weights at age are the 2008-2010 averages with associated errors.

	Population in 2011		Exploitation pattern		Stock weights		Catch weights		Maturity	
Age		CV		CV		CV		CV		CV
4	52392	0.794	0.368	0.020	0.112	0.010	0.130	0.022	0.008	0.006
5	55776	0.354	0.596	0.031	0.138	0.011	0.143	0.010	0.012	0.005
6	68801	0.326	0.798	0.022	0.176	0.007	0.188	0.021	0.045	0.011
7	56595	0.236	0.962	0.017	0.209	0.016	0.224	0.007	0.113	0.041
8	50113	0.347	0.951	0.021	0.255	0.025	0.268	0.008	0.227	0.103
9	47930	0.274	1.125	0.023	0.292	0.032	0.308	0.019	0.361	0.110
10	27546	0.259	1.432	0.011	0.338	0.028	0.341	0.022	0.503	0.080
11	19662	0.244	1.909	0.011	0.392	0.026	0.401	0.045	0.646	0.023
12	13509	0.192	2.396	0.027	0.384	0.056	0.398	0.038	0.564	0.110
13	6520	0.203	2.482	0.044	0.481	0.054	0.477	0.070	0.756	0.058
14	2587	0.166	4.050	0.023	0.460	0.029	0.488	0.013	0.717	0.021
15	1043	0.190	1.685	0.030	0.555	0.074	0.525	0.010	0.696	0.159
16	1039	0.160	3.943	0.025	0.545	0.054	0.540	0.035	0.756	0.220
17	598	0.179	2.607	0.022	0.580	0.102	0.589	0.108	0.761	0.266
18	427	0.185	3.554	0.053	0.594	0.196	0.537	0.085	0.794	0.088
19	3292	0.185	3.554	0.053	0.606	0.141	0.647	0.121	0.765	0.181

F status quo was applied to the 2010 survivors at age 5+ coupled with the geometric mean recruitment at age 4 (population at the beginning of 2011), in order to get the starting population at the beginning of 2012 (the same level of recruitment is fixed for 2012). Being the internal and external standard errors from XSA diagnostics two measures of the uncertainty around the survivor estimate for each age, their average was adopted as the coefficients of variation associated with the starting population at age.

Results of the SSB and yield short term projections under the three *F* scenarios are tabulated bellow for 5%, 50% and 95% probability levels:

Female spawning biomass											
F = 0	2012	2013	2014	$F_{status\ quo}$=0.072	2012	2013	2014	$F_{0.1}$=1.976	2012	2013	2014
p5	23152	21838	19437	p5	23152	20492	17088	p5	23152	4861	1337
p50	26650	25030	22228	p50	26650	23505	19590	p50	26650	5708	1657
p95	30842	29035	25853	p95	30842	27287	22875	p95	30842	6873	2090

Yield								
F = 0	2012	2013	$F_{status\ quo}$=0.07	2012	2013	$F_{0.1}$=1.976	2012	2013
p5			p5	2904	2519	p5	42499	10914
p50			p50	3279	2894	p50	48469	14295
p95			p95	3772	3430	p95	56542	23830

Between 2011 and 2014 the female spawning stock biomass (SSB) is expected to record a decrease under no fishing mortality or under *F status quo* within 22-31%.

With $F_{0.1}$ a short term reduction of the SSB in the order of 94% is expected, along with catches much higher than the correspondent SSB.

f) Reference Points

No updated information on biological reference points was available.

g) Research Recommendations

STACFIS **recommended** that, *in order to confirm the most likely redfish depletion by cod on Flemish Cap, and be able to have an assessment independent approach to the magnitude of such impact and to the size structure of the redfish most affected by cod predation, the existing feeding data from the past EU surveys be analyzed and made available.* STACFIS also **recommended** that *this important line of ecosystem research based on the feeding sampling routine of the EU survey catch be done on an annual basis.*

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

The next full assessment for this stock is planned to be in 2013.

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

(SCR Doc. 08/26; 11/21, 41; SCS Doc. 08/5, 6; 09/12, 14; 10/7; 11/4, 5)

a) Introduction

The American plaice stock occurs mainly at depths shallower than 600 m on Flemish Cap. Catches are taken mainly by otter trawl, primarily in a bycatch fishery of the Contracting Parties since 1992.

Nominal catches increased during the mid-1960s, reaching a peak of about 5 341 t in 1965, followed by a sharp decline to values less than 1 100 t until 1973. Since 1974, when catches of this stock became regulated, catches ranged from 600 t (1981) to 5 600 t (1987). After that catches declined to 275 t in 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. Catch for 2010 was estimated to be 63 t.

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

Recent catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
STACFIS	0.1	0.1	0.1	0.05	0.05	0.1	0.1	0.1	0.1	

ndf No directed fishing.

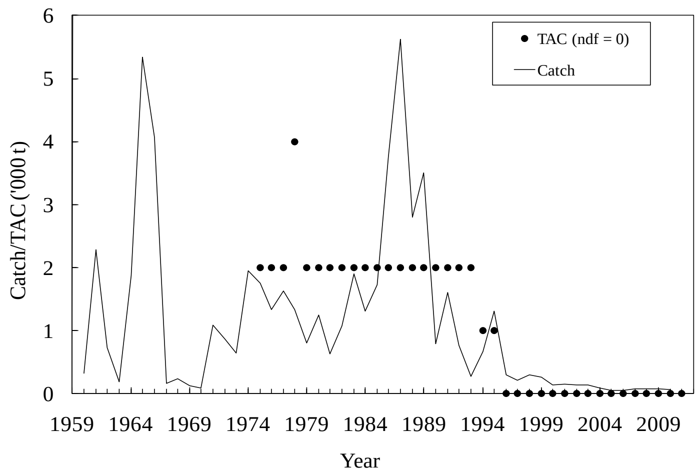


Fig. 8.1. American plaice in Div. 3M: STACFIS catches and agreed TACs. No directed fishing is plotted as 0 TAC.

b) Input Data

i) Commercial fishery data

EU-Portugal provided length composition data for the 2007, 2009 and 2010 trawl catches. Russian Federation provided length composition data for the 2007 and 2008 trawl catches. EU-Estonia provided length composition data for the 2008 trawl catches. EU-Lithuania provided length composition data for the 2010 trawl catches. With the exception of the EU-Estonia length composition in 2008, all the other length frequencies were used to estimate the length and age compositions for the 2007-2010 total catch. Ages 4 to 6 and older than 10 years old (particularly 16+) were the most abundant ones in the catches from 2007-2010.

ii) Research survey data

The series of research surveys conducted by the EU since 1988 was continued in July 2010. In June 2003 a new Spanish research vessel, the RV Vizconde de Eza replaced the RV Cornide de Saavedra that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 survey indices, the original mean catch per tow, biomass and abundance at length distributions for American plaice have been converted to the new vessel units so that each former time series could be comparable with the correspondent new indices obtained since 2003 with the RV Vizconde de Eza. The methodology for convert the series was accepted by STACFIS in 2005 (SCR Doc. 05/29). The results of the calibration show that the new RV Vizconde de Eza is 33% more efficient than the former RV Cornide de Saavedra in catching American plaice.

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

Although the USSR/Russian survey series shows higher variability, it showed a decreasing trend during the 1986-93 period. Abundance and biomass from the Russian survey in 2001 were the lowest of the series. Canadian survey biomass and abundance between 1978 and 1985 were around 6 700 t and 10 million fish. Both indices from the Canadian survey in 1996 were at the same level of the ones from the EU survey (Fig. 8.2 and 8.3). A continuous decreasing trend in abundance and biomass indices was observed from the beginning of the EU survey series. The 2007 abundance and biomass were the lowest of the series. Since 2007, due to recruitment improvement (in particular the 2006 year class), the biomass and abundance indices increased, but are still at a low level.

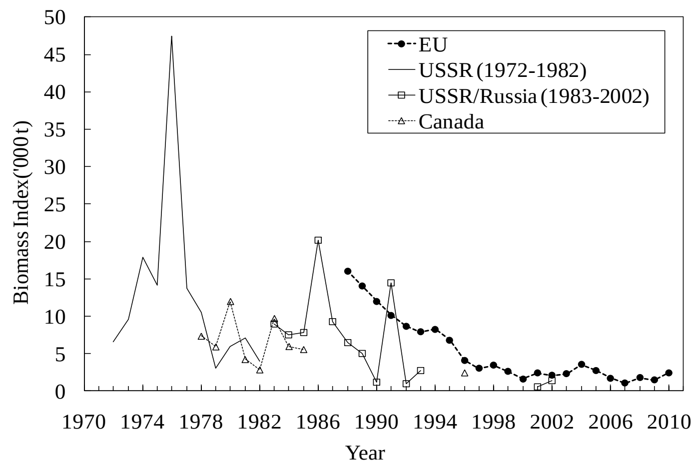


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys. EU survey data prior to 2003 converted to RV Vizconde de Eza equivalents.

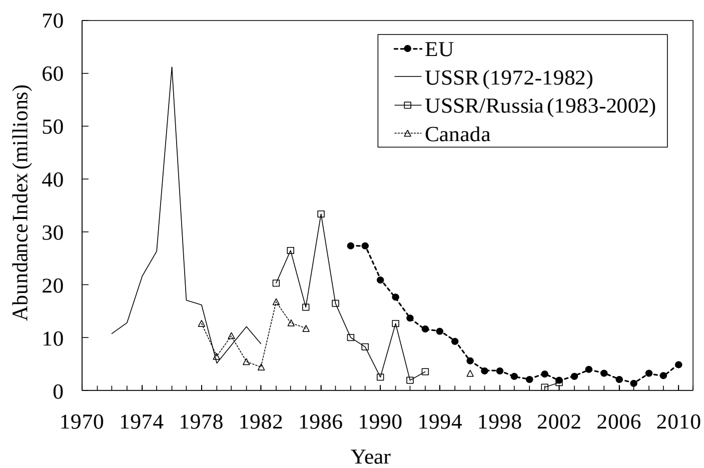


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys. EU survey data prior to 2003 converted to RV Vizconde de Eza equivalents.

Age 4, corresponding to the 2006 year class, was dominant in the 2010 EU survey. Between this year class and the 1990 year class, the recruitment was very poor as shown by EU survey indices.

In the EU surveys an index of spawning stock biomass (50% of age 5 and 100% of age 6 plus) has been declining since 1988. A minimum was recorded in 2007.

c) Estimation of Parameters

A fishing mortality index (*F*) is given by the catch and EU survey biomass ratio for ages fully recruited to the fishery.

A partial recruitment vector for American plaice in Div. 3M was revised assuming flat topped partial recruitment and adjusting a relative mean index-at-age to a general logistic curve. This index was derived by determining the ratio between the 1988-2010 age composition of the catch and American plaice EU survey abundance. Both data sets were standardized to numbers-per-thousand prior to analysis.

Following the STACFIS recommendation in 2008 several XSA frameworks have been considered. In addition to an analysis using the settings from the last assessment, further analyses were conducted investigating the impact of changing: the first age in the assessment (age 1, 3 or 4); the first year of the tuning fleet (1998 or 1994), *M* (0.2 or 0.1), and the first age at which q is independent of age (age 12 or 15). All the runs have the following settings:

- No year weights were applied, due to the short time series.
- Final estimates not shrunk towards mean F.
- Minimum Log (S.E.) for the terminal population estimates derived from each fleet (Threshold se) was 0.5.

The *log* catchability residuals and results, of all sets were compared. Due to year effects in the residuals, the presence of a retrospective pattern, low fishing mortality in relation to *M*, inconsistency in the absolute abundance (and hence SSB) and fishing mortality estimates, none of the analyses were accepted as a basis to estimate stock size. Nevertheless, the estimated trends from all analyses were generally consistent (Fig. 8.4 and 8.5). The run with age 4 as the first age in the assessment, 1994 as the first year of the tuning fleet, *M* equal to 0.2 and the age 12 as the first age at which q is independent of age (a4_t94) was choose for illustrate the trends in the stock.

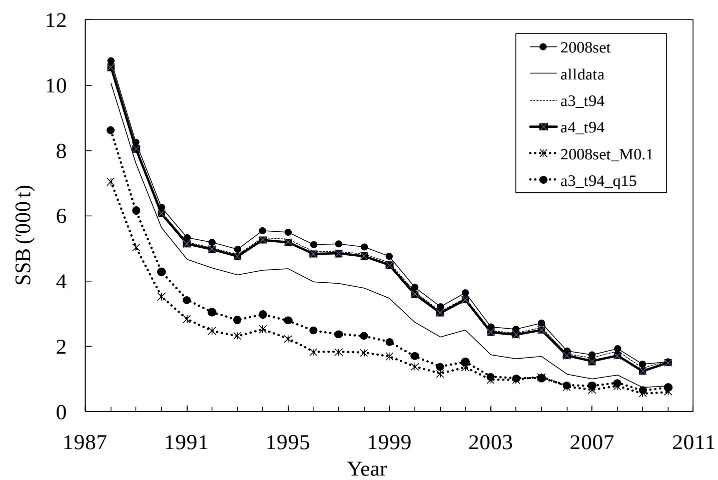


Fig. 8.4. American plaice in Div. 3M: trends in *SSB* in the XSA explorative runs.

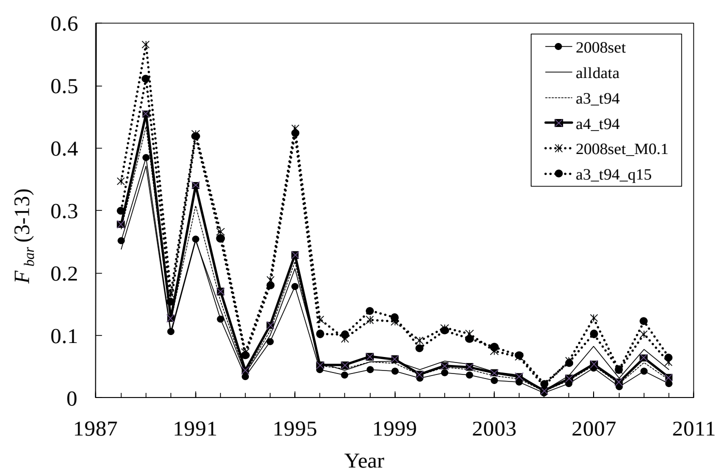


Fig. 8.5. American plaice in Div. 3M: trends in *F* in the XSA explorative runs.

Following a second STACFIS recommendation in 2006 the use of a VPA-type Bayesian model, the same used for the Div. 3M cod (SCR Doc. 08/26) was explored.

The model input data for the two runs performed were:

Catch data: catch numbers and mean weight at age for 1988-2010.

Catchability analysis: dependent on stock size for the first age considered.

Priors: for survivors at age at the end of the final assessment year, for survivors from the last true age at the end of every year, for numbers at age of the survey and for the natural mortality.

Run 1: *Tuning*: numbers at age from the EU Flemish Cap survey data for 1988-2010

Ages: from 1 to 16+.

Run 2: *Tuning*: numbers at age from the EU Flemish Cap survey data for 1994-2010

Ages: from 4 to 16+.

The run1 results are very consistent with the XSA results (Fig. 8.6), but run 2 showed an anomalous recruitment pattern and further exploration of the use of the model is needed.

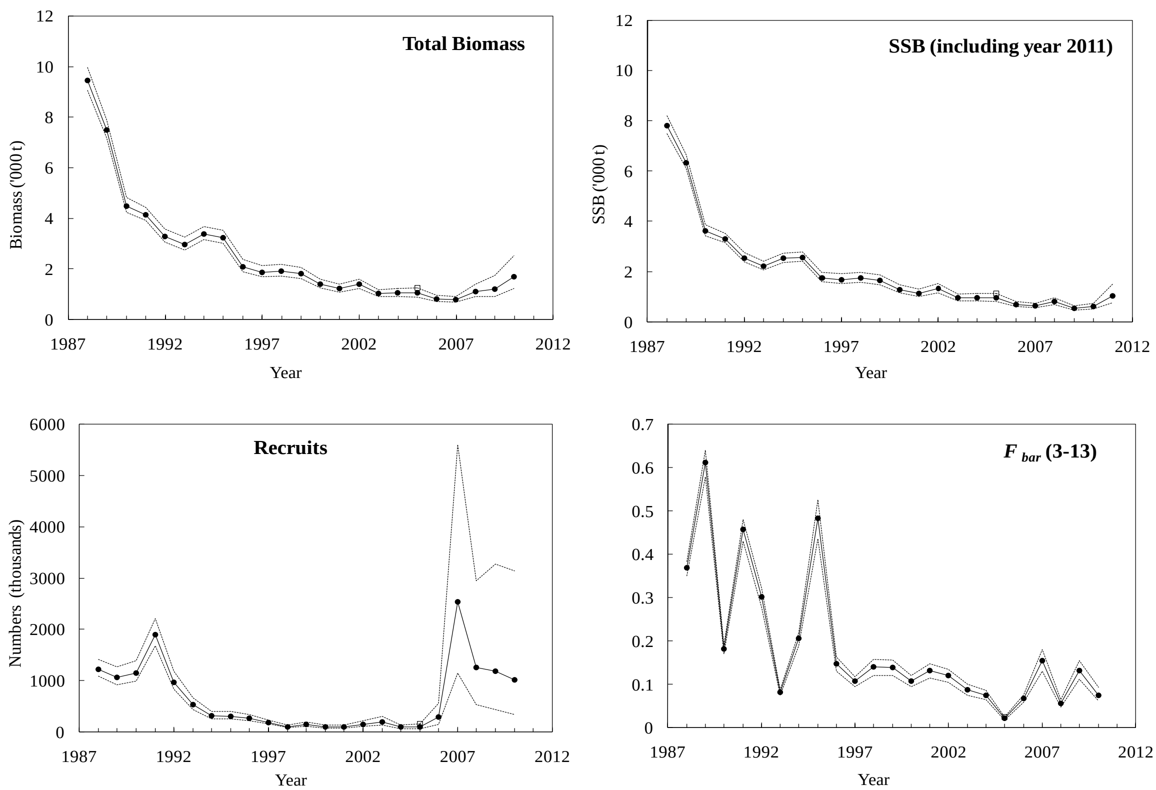


Fig. 8.6. American plaice in Div. 3M: stock trends in the VPA-type Bayesian model explorative run 1.

d) XSA and Surveys results

Both fishing mortality index (C/B) and XSA fishing mortality declined from the mid-1980s to the mid-1990s (Fig. 8.7) and since 2000 fluctuated below 0.1. Recent *F* is at a very low level.

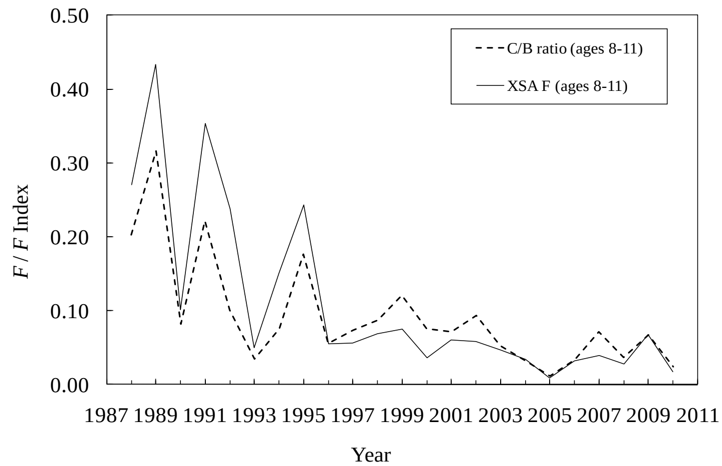


Fig. 8.7. American plaice in Div. 3M: fishing mortality (catch/biomass) index from EU survey (ages 8-11) and XSA estimated fishing mortality (ages 8-11).

The EU survey and XSA indicates no sign of recruitment from 1991 to 2005 year class, with only weak year-classes expected to be recruited to the SSB for at least the next two years. Spawning stock biomass is at a very low level, due to consistent year-to-year recruitment failure since the beginning of the 1990s until 2006 (Fig. 8.8). Stock biomass increased in recent years due to the improved recruitment since 2006 (mainly due to the 2006 year class).

Because the value estimated by the XSA for the age 4 in 2010 is determined by one point from the EU-survey, the value of the 2006 year class (age 4 in 2010) should be considered preliminary (Fig. 8.8). Nevertheless the 2006 year class has already shown that is a strong year class at age 1, 2 and 3 in the corresponding 2007, 2008 and 2009 EU surveys.

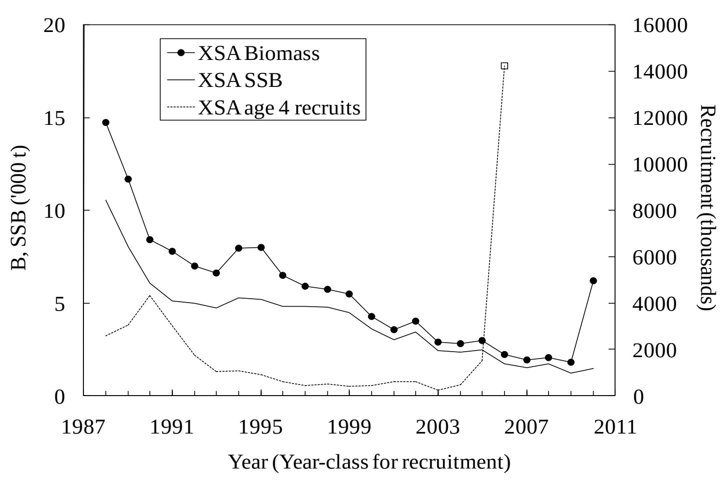


Fig. 8.8. American plaice in Div. 3M: biomass, spawning stock biomass (SSB) and corresponding recruitment from XSA

e) Assessment Results

Biomass: SSB is at a very low level, due to consistent year-to-year recruitment failure from the 1991 to 2005 year classes. Stock biomass increased in recent years due to the improved recruitment since 2006 (mainly due to the 2006 year class).

Fishing Mortality: Both fishing mortality index (C/B) and XSA fishing mortality declined from the mid-1980s to the mid-1990s and since 2000 fluctuated below 0.1. Recent *F* is at a very low level.

Recruitment: 1991 to 2005 year classes are estimated to be weak. Since 2006 the recruitment improved, particularly the 2006 year class.

State of the Stock: This stock continues to be in a very poor condition. Recruitment improved recently and these year classes will be recruiting to SSB over the next few years. Although the level of catches since 1996 is low, all the analysis indicates that this stock is kept at a very low level.

f) Reference Points

STACFIS is not in position to provide proxies for biomass reference points at this time.

Both fishing mortality index (C/B) and XSA estimates of fishing mortality are quite low, despite this spawning stock biomass remains at a very poor level (Fig. 8.9).

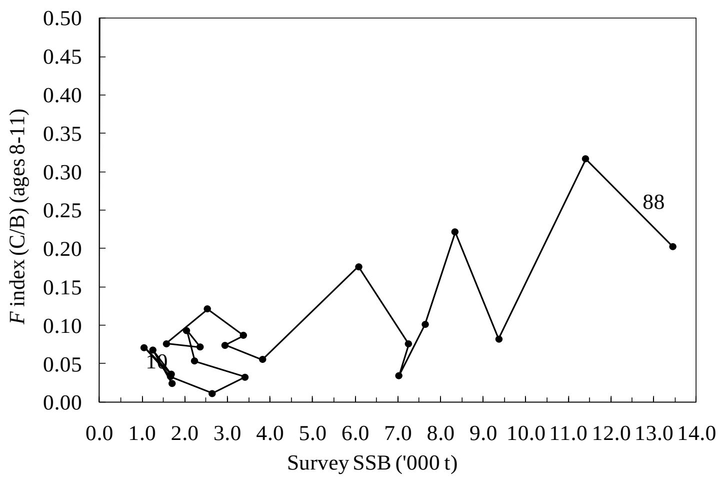


Fig. 8.9. American plaice in Div. 3M: stock trajectory within the NAFO PA framework.

The following set of parameters was used for the yield-per-recruit analysis: M = 0.2; exploitation pattern described above; maturity of 50% at age 5 and 100% at age 6 plus; and an average mean weights-at-age in the catch and in the stock for the period 1988-2010. This analysis gave $F_{0.1}$ = 0.175 and F_{max} = 0.425.

g) Research Recommendations

Average F in recent years has been very low relative to *M*. Efforts were made to apply to this stock a VPA-type Bayesian model, but so far this task need to be completed. At this moment the use of other methods than XSA is not expected to change the perception of the Div. 3M American plaice stock due to its very poor condition. Nevertheless STACFIS reiterates this research recommendation.

Therefore STACFIS **recommended** that *the utility of the XSA must be re-evaluated and the use of alternative methods (for e.g. survey based models stock production models) continue to be attempted in the next assessment of Div. 3M American plaice.*

For Div. 3M American plaice, some common ages in the catch are outside of the *Fbar* range, therefore STACFIS **recommended** that *other ranges of ages in* F_{bar} *be explored.*

For Div. 3M American plaice, due to the recent good recruitment at low SSB, STACFIS **recommended** *to explore the Stock/Recruitment relationship and* B_{lim}.

This stock will be full assessed in 2014.

C. STOCKS ON THE GRAND BANK: SA 3 AND DIV. 3LNO

Environmental Overview

(SCR Doc. 11/13 and16)

The water mass 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 the mid-2000s and to <10% in 2010.

The annual surface temperatures at Station 27 (Div. 3L) have been near-normal or above normal since 2002 and was about 1 standard deviation (SD) above normal in 2010. Bottom temperatures at Station 27 increased to the 3rd highest in 2010 at +1.7 SD above normal. Vertically averaged temperatures have increased to the 2nd highest on record in 2010 (+1.9 SD). Annual surface salinities at Station 27 decreased from +0.2 SD in 2009 to about -0.7 SD in 2010, the freshest since 1995. In 2010, the water column average salinity was the lowest since the early 1990s. The annual average stratification index was below normal in the 2010. The mixed layer depth (MLD), estimated as the depth of maximum density gradient is highly variable on the inner NL Shelf, particularly during the winter months. During 2010 the annual averaged MLD and the winter (March only) values were shallower than normal while the spring values were deeper than normal. Spring bottom temperatures in Div. 3LNO during 2010 were above normal by up to 1 SD and as a result, the area of the bottom habitat covered by water <0°C was significantly below normal. During the autumn, bottom temperatures in 3LNO were >1 SD above normal. The volume of CIL water on the NL Shelf during the autumn was below normal (3rd lowest since 1980) for the 16th consecutive year. Bottom temperatures in Div. 3LNO generally ranged from <0°C on the northern Grand Bank and in the Avalon Channel to 3.5°C along the shelf edge. Over the southern areas, bottom temperatures ranged from 2° to 8°C with the warmest bottom waters found on the Southeast Shoal and along the edge of the Grand Bank in Div. 3O. Nutrient inventories for both shallow and deep layers were depleted in 2010 due to the enhanced primary and secondary productivity in the region. On the Grand Banks productivity was the highest observed in the 12-year time series.

9. Cod (*Gadus morhua*) in NAFO Div. 3NO

Interim Monitoring Report (SCR 11/05; SCS Doc. 11/05, 07, 09, 11)

a) Introduction

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 then declined to 950 t in 2010.

Recent nominal catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	1.2	1.6	0.9	0.6	0.3	0.7	0.7	0.6	0.3	
STACFIS	2.2	4.3-5.5[1]	0.9	0.7	0.6	0.8	0.9	1.1	0.9	

[1]STACFIS could not precisely estimate the catch. Figures are the range of estimates.

ndf: No directed fishery and by-catches of cod in fisheries targeting other species should be kept at the lowest possible level.

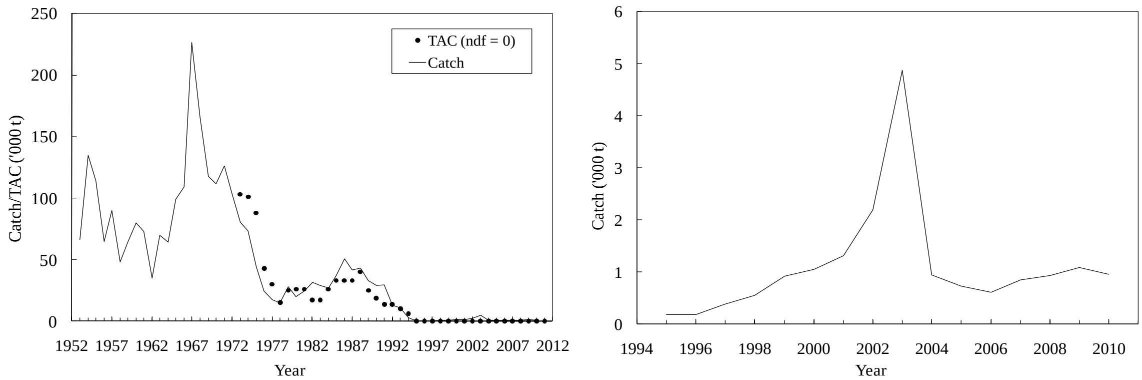


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) Data Overview

Canadian bottom trawl surveys. Canadian spring and autumn surveys were conducted in Div. 3NO during 2010. The spring survey biomass index declined from 1984 to its lowest level in 1995, with the exception of intermittent increases in 1987 (series maximum) and in 1993 (Fig. 9.2). Except for a brief period of improvement from 1998 to 2000 the index remained low to 2008. There was a substantial increase in 2009, the highest in the index since 1993, resulting from improved recruitment from the 2005-2007 year classes. The index declined substantially in 2010 and is the lowest of the past four surveys due to lower estimates of those same year classes. The trend in the autumn biomass index is similar to the spring series (Fig. 9.2).

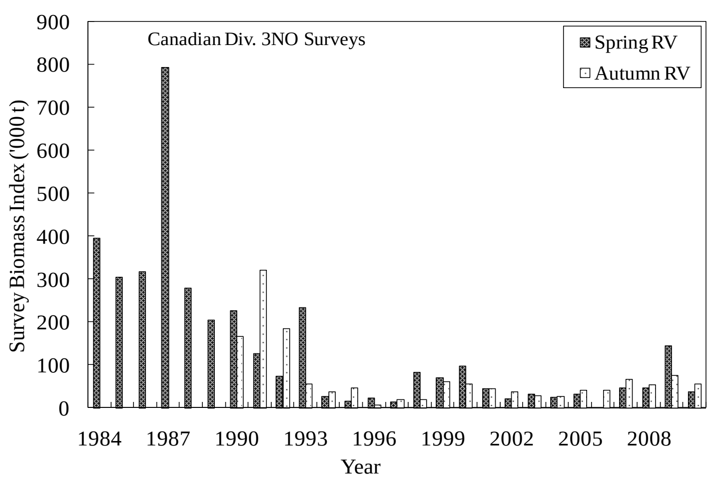


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian spring and autumn research surveys.

EU-Spain bottom trawl survey. Stratified-random surveys were conducted by EU-Spain in the NRA area of Div. 3NO in May/June in 2010. The mean weight per tow was relatively low and stable from 1997-2005 with the exception of large increases in 1998 and 2001 (Fig. 9.3). These large increases were influenced by a few large sets in those years. Since 2006 there has been a steady increase to the highest estimate in the series in 2010. The increase was due to improved recruitment from the 2005-2007 year classes.

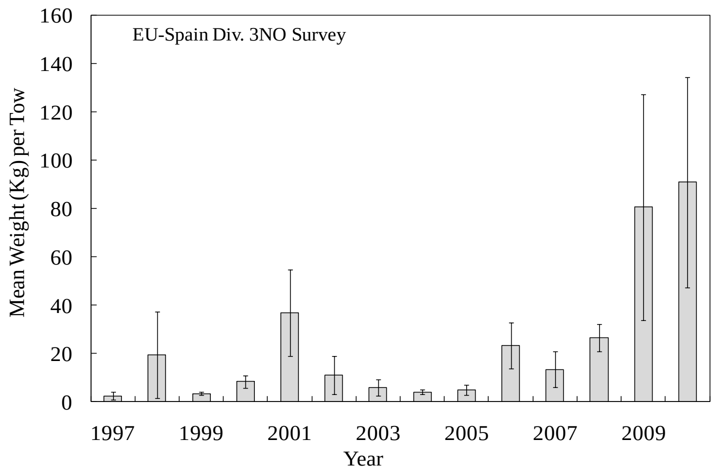


Fig. 9.3. Cod in Div. 3NO: mean weight per tow (± 1 s.d.) from EU-Spain Div. 3NO surveys.

c) Conclusion

In the previous assessment, STACFIS concluded that total biomass and spawning biomass remained low but had improved in recent years to levels just prior to the moratorium, and, that SSB was still well below B_{lim} (60 000 t). Based on survey indices for 2010, there is an indication of decline in both Canadian surveys and a marginal increase in the EU-Spain survey. Consequently, the 2010 surveys indices are not considered to indicate a significant change in the status of the stock.

The next full assessment of this stock is planned to be in 2013.

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

Interim Monitoring Report (SCR Doc. 11/06; SCS Doc. 11/04,05, 07, 11, 14)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3LN, the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics and the surveys.

Reported catches oscillated around an average 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. From 1998-2009 a moratorium has been in place and catches were taken as bycatch, primarily in the Greenland halibut fishery, by EU-Portugal and EU-Spain. The fishery reopened in 2010 and estimated catches increased to 4 100 t.

Recent nominal catches and TACs ('000 t) for redfish are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	3.5
Agreed TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	3.5
STATLANT 21	1.0	1.3	0.7	0.7	0.2	0.2	0.4	0.3	2.9	
STACFIS Catch	1.2	1.3	0.6	0.7	0.5	1.7	0.6	1.1	4.1	

ndf : No directed fishing.

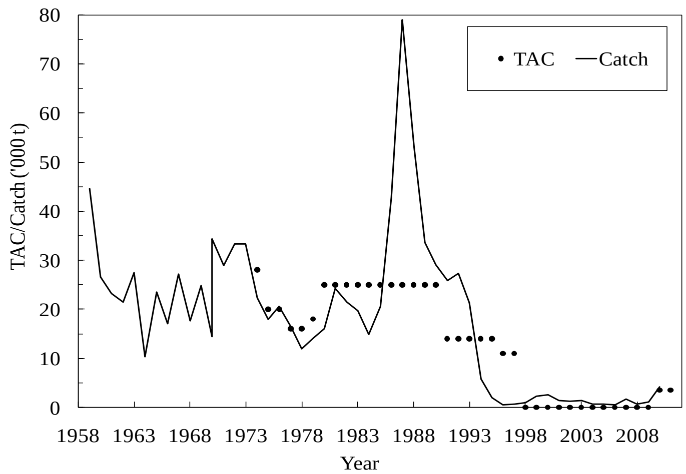


Fig. 10.1. Redfish in Div. 3LN: catches and TACs (ndf = 0).

b) Data Overview

i) Research surveys

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 1990/1991 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.

Since 1983 Russian bottom trawl surveys in NAFO Div. 3LMNO turn to stratified-random, following the Canadian stratification for Subarea 3. On 1995 the Russian bottom trawl series in NAFO Subarea 3 was discontinued.

In 1995 EU-Spain started a new stratified-random bottom trawl spring survey on NAFO Regulatory Area of Div. 3NO. Until 2001 this survey series suffered changes regarding depth contour, vessel and gear. In 2010 former Div. 3NO redfish survey indices have been transformed to the actual vessel/gear units and so the Spanish survey in Div. 3N has been the last survey to be included in the assessment framework.

Most of the available surveys in Div. 3L and Div. 3N have been incorporated in the assessment framework for this stock and have been standardized in order to be presented on Fig. 10.2. .

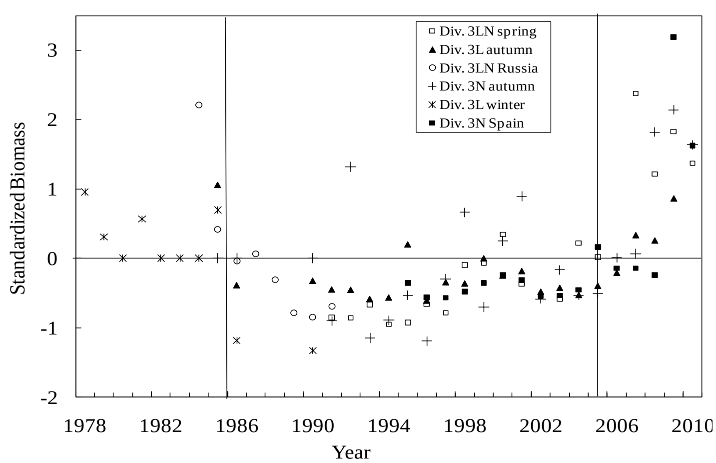


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2010). Each series is standardized to the mean and unit standard deviation.

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, as response to catches raising from an average of 21 000 t (1965-1985) to 41 500 t (1986-1992). Redfish survey bottom biomass in Div. 3LN remained well bellow average level until 1998 and start a discrete (but 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 till 2010, 100% of the biomass indices were at or above the average of their own series on 1978-1985, only 25% on 1986-2005, and 84% on 2006-2010.

c) Estimation of Stock Parameters

i) Relative exploitation

Ratios of catch to Canadian spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy of fishing mortality (Fig. 10.3). Spring survey series was chosen since is usually carried out on Div. 3L and Div. 3N during May until the beginning of June, and so can give an index of the average biomass at the middle of each year.

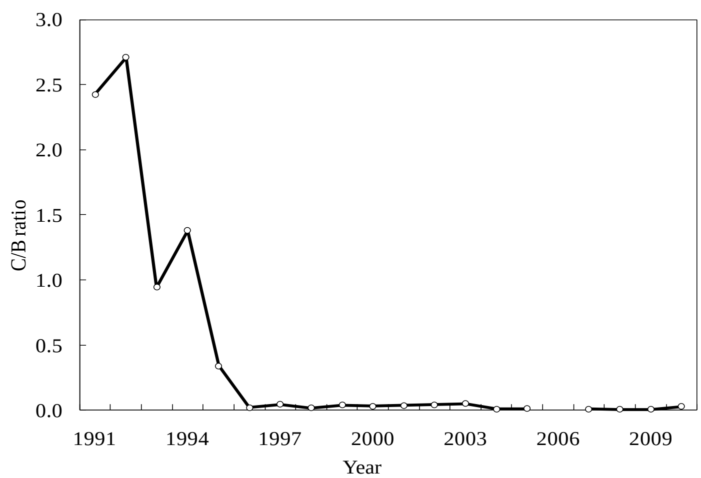


Fig. 10.3. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (1991-2010).

Catch/Biomass ratio declined from 1991 to 1996, with a drop between 1992 and 1993. From 1996 onwards this proxy of fishing mortality is kept at a level close to zero.

d) Conclusions

There is nothing to indicate a change in the status of the stock. The increase of the catch with the reopening of the fishery in 2010, have not altered the perception of the stock given by the available surveys.

The next full assessment of this stock is planned for 2012.

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

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO

(SCS Doc. 11/4, 5, 7, 11; SCR Doc. 11/5, 19, 32, 37, 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 2010 was 2 898 t, mainly taken in the Regulatory Area (Fig. 11.1).

Recent nominal catches and TACs ('000 t) are as follows:

	2002	2003[1]	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	3.2	3.7	2.7	2.4	0.9	1.5	1.9	1.8	1.5	
STACFIS Catch	4.9	6.9-10.6	6.2	4.1	2.8	3.6	2.5	3.0	2.9	

[1] In 2003, STACFIS could not precisely estimate the catch
ndf : No directed fishing.

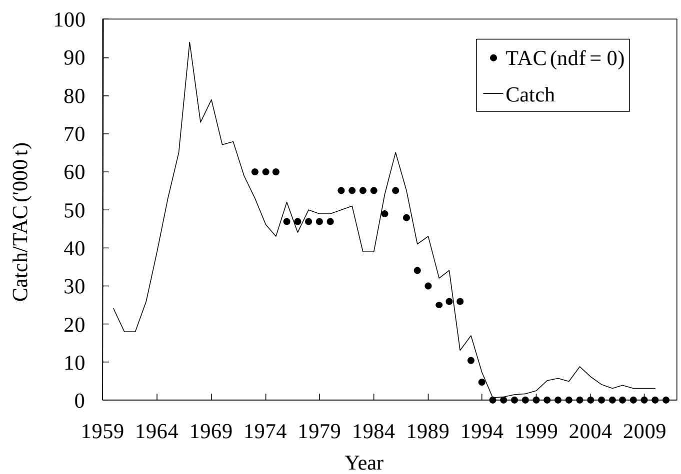


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

b) Input Data

Biomass and abundance data were available from: annual Canadian spring (1985-2010) and autumn (1990-2010) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). The Canadian spring survey in 2006 did not adequately cover many of the strata in Div. 3NO and therefore results were not used in the assessment. Likewise, in 2004, coverage of strata from Div. 3L in the Canadian autumn survey was incomplete, and results were therefore not used in the assessment. Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2010.

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 2010 by-catch in the Canadian fishery and length sampling of by-catch in the Canadian, EU-Spain, EU-Portugal and Russian (only one length frequency) fisheries. Catch-at-age in the Canadian by-catch ranged from ages 4 to 19 and catches were comprised mainly of fish aged 6 to 11, with the peak being the 2003 year class.

In 2010 there was a large peak at 32-35 cm in the American plaice bycatch of the Spanish Greenland halibut fishery as well as a number of minor modes at smaller sizes. The Spanish bycatch in the skate fishery was dominated by fish that were between 33 and 47 cm. The bycatch in the EU-Portugal fishery consisted mainly of fish between 30 and 40 cm.

Total catch-at-age for 2010 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 - 12 dominated the 2010 catch.

ii) Research survey data

Canadian stratified-random bottom trawl surveys. Biomass (mean weight per tow) and abundance (mean number per tow) estimates for Div. 3LNO from the spring survey declined during the late 1980s-early 1990s. Biomass estimates increased from 1996 to 2008 but declined in 2009 to levels of the late 1990s (Fig. 11.2). The 2010 biomass estimate increased by approximately 23% compared to the 2009 value. Abundance has fluctuated since 1996 with a slight increase over the period until 2008, followed by a drop in 2009. In 2010 abundance increased by 27% relative to 2009 (Fig. 11.2). 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.

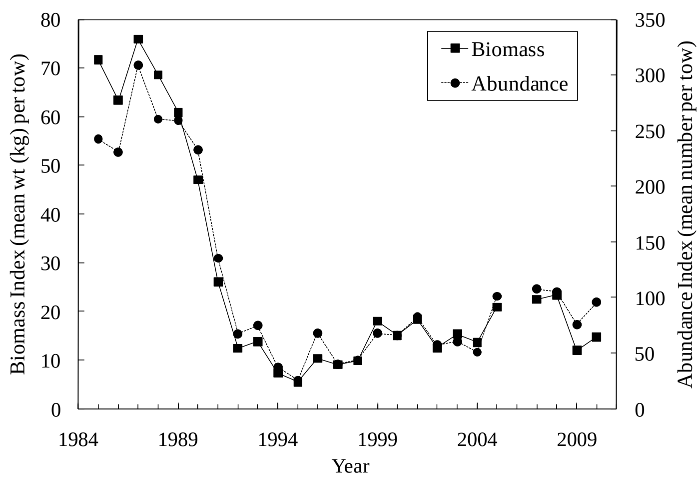


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys (Data prior to 1996 are Campelen equivalents and since then are Campelen).

Biomass and abundance indices from the autumn survey declined from 1990 to the early-mid 1990s. Both indices have shown an increasing trend since 1995 but remain well below the level of the early-1990s (Fig. 11.3). The decline in abundance between 2008 and 2009 was followed by an increase in biomass by 12% and abundance by 17% in 2010. The proportion of fish aged 0-5 years has been increasing slightly in the autumn survey since 1998.

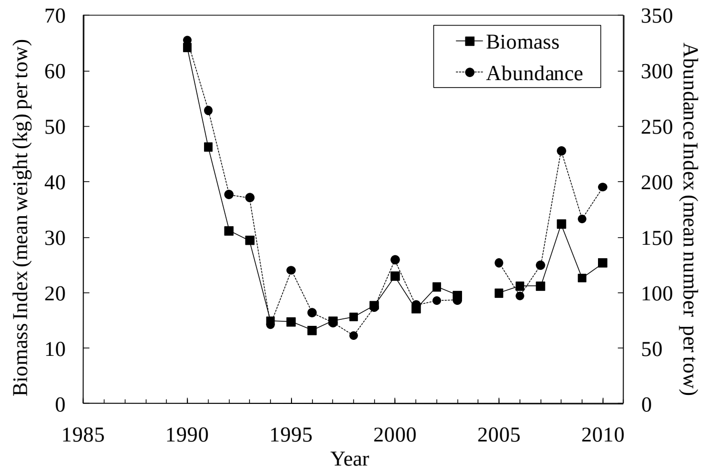


Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys (Data prior to 1995 are Campelen equivalents and since then are Campelen).

Stock distribution for Canadian Surveys. Historically the largest portion of this stock was located in Div. 3L but the highest declines in survey indices were experienced in this region. The stock now appears more heavily concentrated in Div. 3N in the NAFO Regulatory Area. Results from Canadian spring and autumn surveys both suggest that 57% of the stock biomass was located in Div. 3N in 2010.

EU-Spain Div. 3NO Survey. From 1998-2010, surveys have been conducted annually by EU-Spain in the Regulatory Area in Div. 3NO. 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 length 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 the 2010 values being higher than 2009 but substantially lower than those in 2006 (Fig. 11.4).

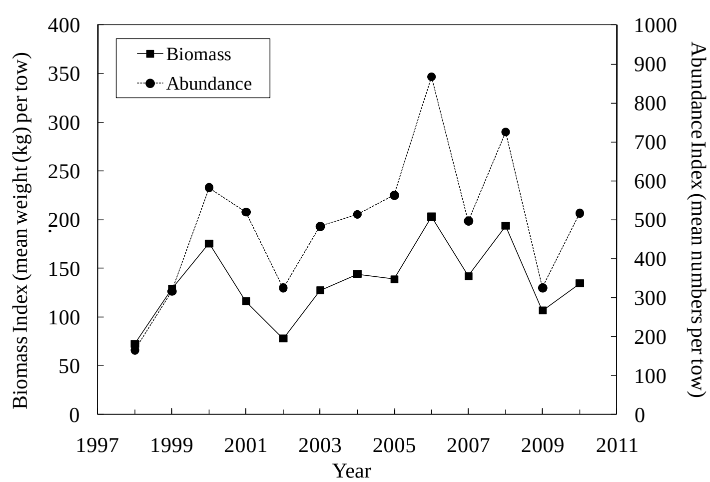


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from the EU-Spain Div. 3NO survey (Data prior to 2001 are Campelen equivalents and since then are Campelen).

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 1960's to mid 1970's, 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 less than 8 years compared to 11 years for cohorts at the beginning of the time series.

L_{50} declined for both sexes but has been stable or increased somewhat in recent cohorts. The current L_{50} for males of about 19 cm is 3 to 4 cm lower than the earliest cohorts estimated. The L_{50} of most recent cohorts for females is in the range of 35-36 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 2010. 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.

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 (1960-2010) (ages 5-15+);

– Canadian spring RV survey (1985-2010) (no 2006 value) (ages 5-14);

– Canadian autumn RV survey (1990-2010) (no 2004 value) (ages 5-14); and

– EU-Spanish Div. 3NO survey (1998-2010) (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 from 1989-1996, where *M* was assumed to be 0.53 on all ages.

d) Assessment Results

The model provides a good fit to the data with a mean square of the residuals of 0.29. 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 11.5). 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. 11.6).

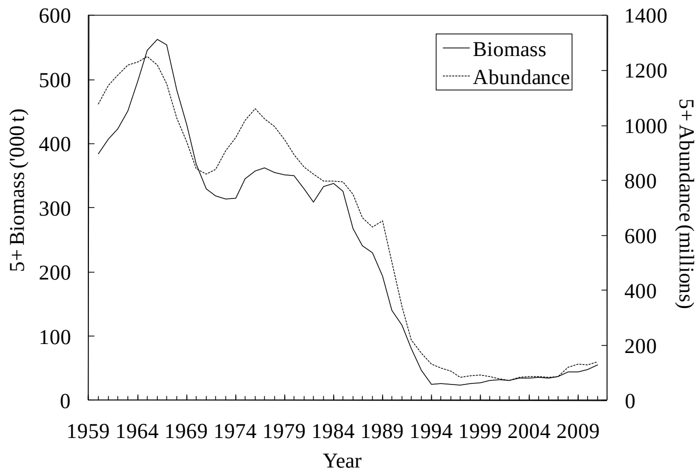


Fig. 11.5. American plaice in Div. 3LNO: population abundance and biomass from VPA

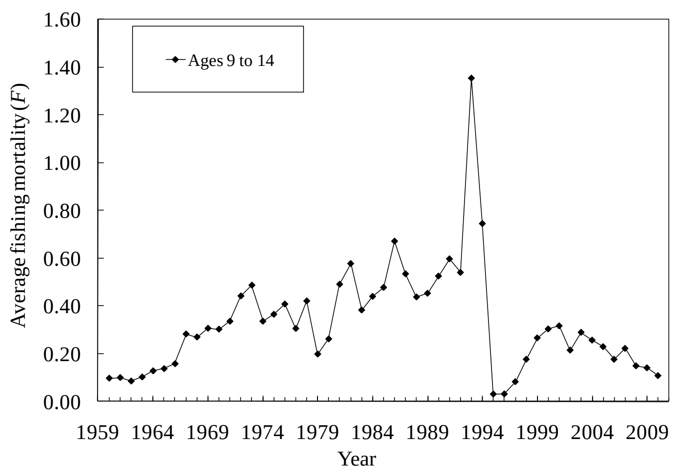


Fig. 11.6. American plaice in Div. 3LNO: average fishing mortality from VPA.

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. 11.7). Since then the SSB has been increasing, reaching about 34 000 t in the current year, an increase of 33% from 2010. Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average (Fig. 11.8).

The current assessment estimated the 2010 SSB to be 26 000 t, down 21% from the 33 000 t that was estimated in the 2010 assessment. Differences are in part due to stock weights at age for 2010 being reduced in the 2011 assessment. These differences are linked to the fact that stock weights at age for 2010 could actually be estimated in the 2011 assessment whereas in the 2010 assessment they were based on the assumption that stock weights were equal to the geometric mean of the previous three years. The data now available on the stock weights at age are lower than the assumed values. In addition, numbers at age for most ages in the SSB for 2010 are estimated in the 2011 assessment to be less than they were in the 2010 assessment (Fig. 11.9). The combination of reduced numbers and weights result in the 2010 SSB being lower in the current assessment.

Biomass: Despite the increase in biomass since 1995, 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 34, 000 t. B_{lim} for this stock is 50 000 t.

Recruitment: Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average.

Fishing mortality: Fishing mortality on ages 9 to 14 has generally declined since 2001.

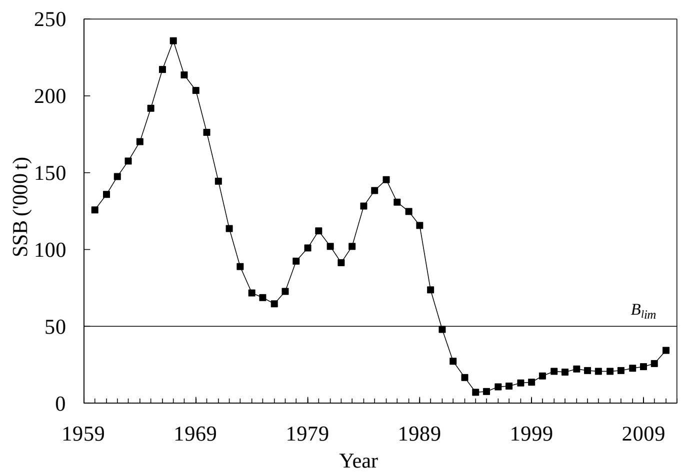


Fig. 11.7. American plaice in Div. 3LNO: spawning stock biomass from VPA.

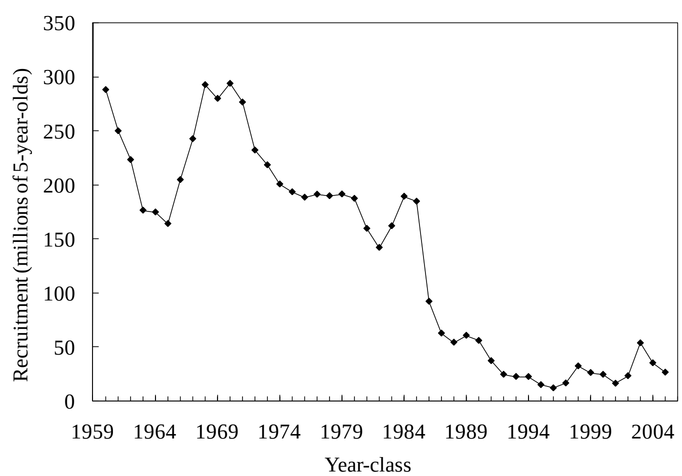


Fig. 11.8. American plaice in Div. 3LNO: recruits (at age 5) from VPA.

Retrospective patterns: A five year retrospective analysis was conducted by sequentially removing one year of data from the input data set (Fig. 11.9). For the second consecutive assessment there is a retrospective pattern present that was more obvious than typically observed in previous assessments. The SSB has been overestimated for each of the last four years.

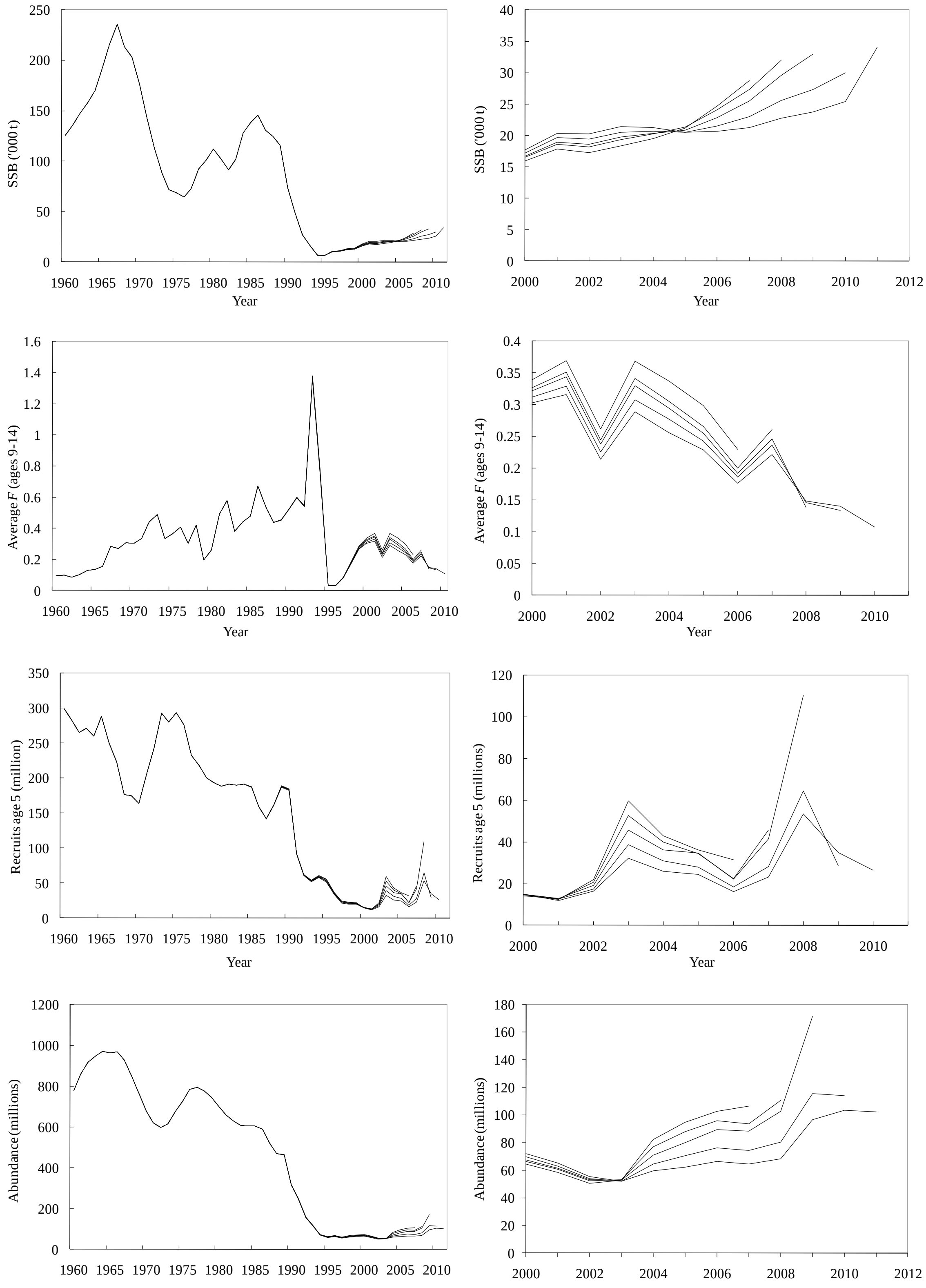


Fig 11.9 American plaice in Div. 3LNO: retrospective analysis of SSB, average *F* (ages 9-14), recruitment (age 5) and 6+ population numbers.

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}. Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long-term average.

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 and this is currently the best estimate of B_{lim} (Fig. 11.10). In 2011 STACFIS adopted an F_{lim} of 0.3 consistent with stock history and dynamics for this stock (see SC VII.1.d.i). The stock is currently below B_{lim} and current fishing mortality is below F_{lim} (Fig. 11.11).

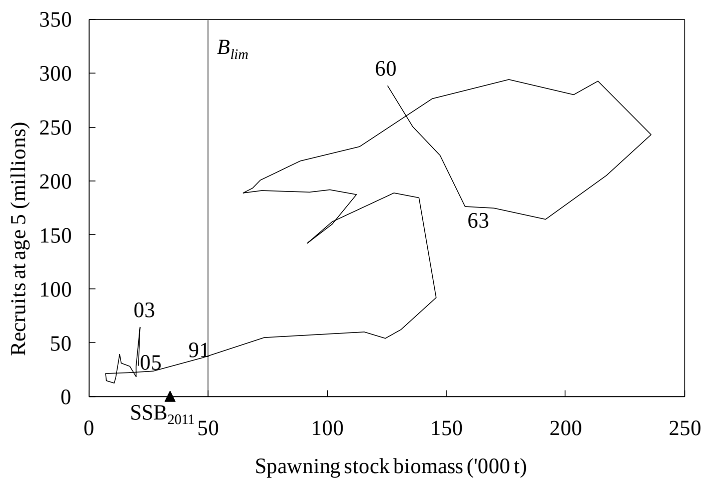


Fig. 11.10. American plaice in Div. 3LNO: stock recruit scatter. The vertical line is B_{lim}.

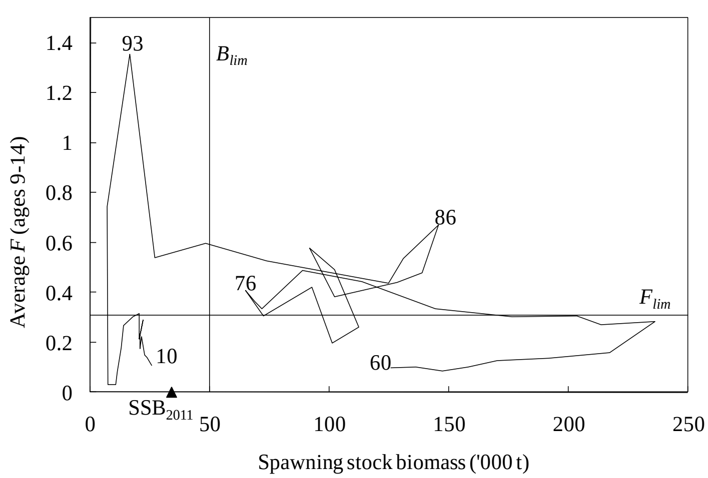


Fig. 11.11. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework.

f) Short Term Considerations

Simulations were carried out to examine the trajectory of the stock under 3 scenarios of fishing mortality: $F = 0$, $F= F_{2010}$ (0.11), and $F_{0.1}$ (0.16). 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 2011 population numbers ('000)	CV on population estimate	Weight-at-age mid-year (avg. 2008-2010)	Weight-at-age beginning of year (avg. 2008-2010)	Maturity-at-age (avg. 2008-2010)	Rescaled PR relative to ages 9-14 (avg. 2008-2010)
5			0.200	0.174	0.013	0.030
6	21469	0.323	0.281	0.239	0.060	0.129
7	22676	0.234	0.361	0.317	0.234	0.281
8	27826	0.194	0.476	0.425	0.554	0.553
9	9347	0.174	0.566	0.532	0.776	0.687
10	4754	0.174	0.723	0.657	0.916	0.638
11	5567	0.163	0.829	0.787	0.979	0.628
12	4467	0.158	1.093	0.978	0.995	1.053
13	3882	0.151	1.279	1.230	0.999	1.291
14	1041	0.169	1.571	1.461	1	1.703
15	1142	0.181	1.829	1.673	1	1.703

Simulations were limited to a 2-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. SSB is projected to have a 50% probability of reaching B_{lim} by the start of 2014 (i.e. end of 2013) when F=0. Although SSB is also projected to increase slowly with $F_{current}$ and $F_{0.1}$ the probability of reaching B_{lim} by the start of 2014 under these scenarios is less than 50% (Table 13.1). The current projections predict yield to increase slightly from 2011 to 2012 under $F_{current}$ and $F_{0.1}$ followed by little or no increase in yield in 2013.

Table 13.1 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
2011	29	33	38
2012	36	41	47
2013	42	48	56
2014	46	53	64

	F_{2010} = 0.11					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2011	29	33	37	3.2	3.6	4.1
2012	33	37	43	3.7	4.1	4.7
2013	36	41	47	3.9	4.3	4.9
2014	37	42	49			

	$F_{0.1}$ = 0.16					
	SSB ('000 t)			Yield ('000 t)		
	p5	p50	p95	p5	p50	p95
2011	29	33	37	4.5	5.1	5.8
2012	32	36	42	5.0	5.7	6.5
2013	33	38	44	5.1	5.7	6.5
2014	33	38	45			

The next full assessment of this stock is expected to be in 2013.

g) Research Recommendations

For American plaice in Div. 3LNO, STACFIS **recommended** that *ADAPT model formulations that estimate the F ratio between the plus group and the last true age be investigated and that model fit and resulting retrospective patterns be compared to the current formulation that has an F ratio constraint of 1.*

For American plaice in Div. 3LNO, STACFIS **recommended** that *investigations be undertaken to compare ages obtained by current and former Canadian age readers.*

12. Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO

(SCR Doc. 11/6, 33, 34, 37; SCS Doc. 11/4, 5, 7, 9, 11)

a) Introduction

There was a moratorium on directed fishing from 1994 to 1997, and small catches were taken as bycatch in other fisheries. The fishery was re-opened in 1998 and catches increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches from 2001 to 2005 ranged from 11 000 t to 14 000 t. Since then, catches have been below the TAC and in some years, have been very low. The low catch in 2006 was 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 in 2010 catches were 9 400 t.

Recent catches and TACs ('000 t) are as follows:

	2002	2003[1]	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	13.0	14.5	14.5	15.0	15.0	15.5	15.5	< 85% F_{msy}[2]	< 85% F_{msy}[2]	< 85% F_{msy}[2]
TAC	13.0	14.5	14.5	15.0	15.0	15.5	15.5	17	17	17
STATLANT 21	10.4	13.0	13.4	13.9	0.6	4.4	11.3	5.5	9.1	
STACFIS	10.8	13.5-14.1	13.4	13.9	0.9	4.6	11.4	6.2	9.4	

[1] In 2003, STACFIS could not precisely estimate the catch.
[2] SC recommended any TAC up to 85% F_{msy} in 2009-2011.

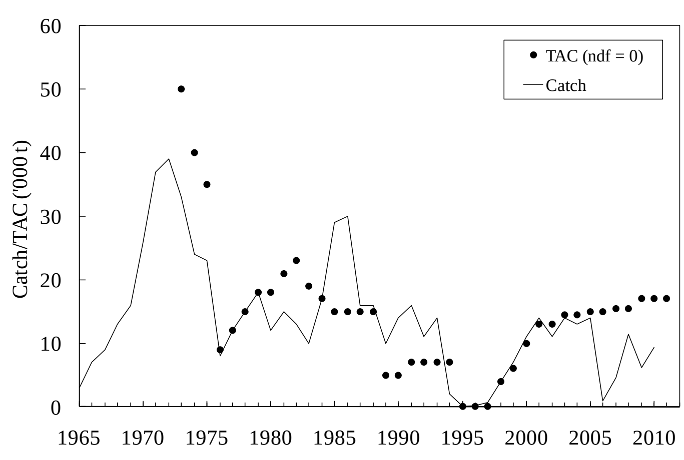


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

b) Input Data

Abundance and biomass indices were available from: annual Canadian spring (1971-82; 1984-2010) and autumn (1990-2010) bottom trawl surveys; annual USSR/Russian Federation spring surveys (1972-91); and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). Length frequencies of the catch from Canada (Div. 3LNO), EU-Portugal (Div. 3N) and EU-Spain (Div. 3NO) were also available for 2010.

i) Commercial fishery data

Length Frequencies (SCR Doc. 11/33; SCS Doc. 11/5, 7). Length frequencies were available from the 2010 yellowtail flounder fisheries by Canada, EU-Spain and EU-Portugal. Catch from the Canadian fishery in 2010 was very similar in length distribution as previous years, and yellowtail flounder ranged in size from 18-56cm with a mode at 37cm. Lengths from yellowtail flounder taken in the Spanish fishery for Greenland halibut (135mm mesh) in Div. 3NO were slightly smaller, with a mode at 34-36cm and a narrower range of 30-44mm. Portuguese bycatch of Div. 3N yellowtail flounder in the 135mm mesh had a mode of 38cm and range of 28-60cm. Yellowtail flounder is also caught in the 280mm mesh of the skate fishery, and fish taken in this gear ranged in size from 16-48cm (mode=36) from EU-Spain in Div. 3NO and for the Portuguese catch, this gear had 2 modes of size caught (26cm and 32cm) and ranged in size from 20-38cm.

ii) Research survey data

Canadian stratified-random spring surveys (SCR Doc. 11/34). 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, declined in 2009, but increased in 2010. Since 1999, the index of trawlable biomass has been variable, but remains well above the level of the late 1980s and early 1990s.

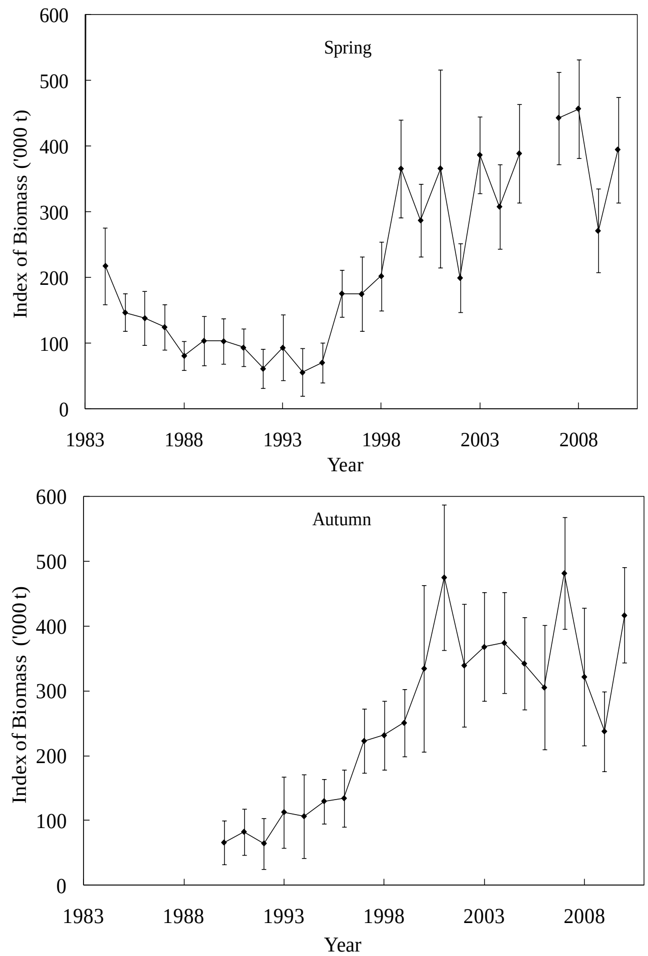


Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx 95% confidence intervals, from Canadian spring and autumn surveys. Values are Campelen units or, prior to autumn 1995, Campelen equivalent units.

Canadian stratified-random autumn surveys (SCR Doc. 11/34). 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. The estimate of biomass in 2010 increased again, to be third highest in the series.

EU-Spain stratified-random spring surveys in the Regulatory Area of Div. 3NO. (SCR Doc. 11/06) Beginning in 1995, EU-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 2000-2010 (Fig. 12.3).

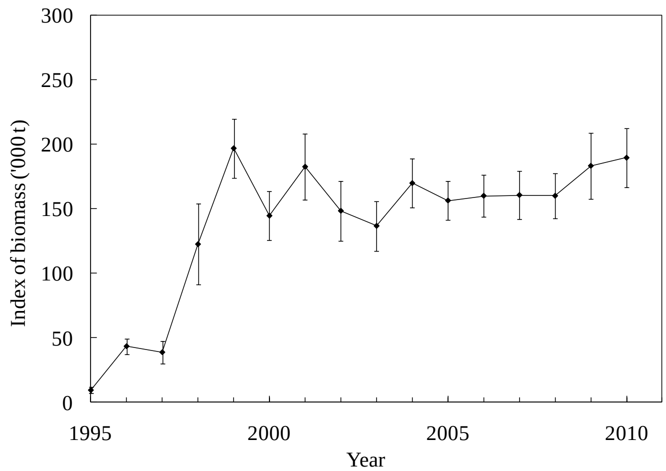


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the EU-Spain spring surveys in the Regulatory Area of Div. 3NO ±1SD. Values are Campelen units or, prior to 2001, Campelen equivalent units.

Stock distribution (SCR Doc. 11/34, 37). In all surveys, yellowtail flounder were most abundant 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 1999-2010 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 93m in both seasons.

c) Estimation of Parameters

(SCR Doc. 11/33)

The assessment of Div. 3LNO yellowtail flounder in 2009 used a non-equilibrium surplus production model (ASPIC; version 5.33). In order to investigate potential differences in estimation of parameters using an updated version of ASPIC (version 5.34), the 2009 assessment formulation and indices were input into the new version. Parameter estimates and population trajectories from this comparison run were nearly identical to the 2009 assessment. STACFIS accepted the results using version 5.34 of ASPIC, with one minor change to the model specification, to assess the current state of this stock.

The accepted model formulation for 2011 was: Catch data (1965-2010, with catch set to the TAC, 17 000 t, in 2011), Russian spring surveys (1984-91), Canadian spring (Yankee) surveys (1971-82), Canadian spring (1984-2010 omitting 2006) surveys, Canadian autumn (1990-2010) surveys and the EU-Spain spring (1995-2010) surveys.

d) Assessment Results

(SCR Doc. 11/34)

*Recruitment***:** Total numbers of juveniles (<22 cm) from spring and autumn surveys by Canada and spring surveys by EU-Spain are given in Fig. 12.4 scaled to each series mean. High catches of juveniles seen in the autumn of 2004 and 2005 were not evident in either the Canadian or EU-Spain spring series. Although no clear trend in recruitment is evident, the number of small fish was above the 1996-2010 average in the Canadian surveys of 2010. The spring survey by EU-Spain has shown lower than average numbers of small fish in the last four surveys. Based on a comparison of small fish (<22 cm) in research surveys, recent recruitment appears to be about average.

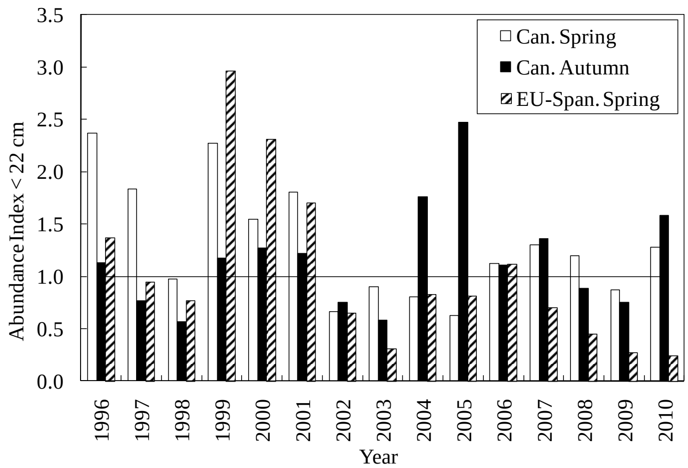


Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile length index estimated from 1996 to 2010 annual spring and autumn surveys by Canada (Can.) and annual spring surveys by EU-Spain (EU-Span.).

Stock Production Model: (SCR Doc. 11/33). The surplus production model results are very similar to the 2009 assessment results, and indicate that stock size increased rapidly after the moratorium in the mid-1990s and has now begun to level off. Bias-corrected estimates from the model suggests that a maximum sustainable yield (*MSY*) of 18 910 t can be produced by total stock biomass of 74 160 t (B_{msy}) at a fishing mortality rate (F_{msy}) of 0.25.

Biomass: Biomass estimates in all surveys have been relatively high since 2000. The analysis showed that relative population size (B/B_{msy}) was below 1.0 from 1973 to 1998. Relative biomass from the production model has been increasing since 1994, is estimated to be above the level of B_{msy} after 1999, and is 1.7 times B_{msy} in 2011 (Fig. 12.5).

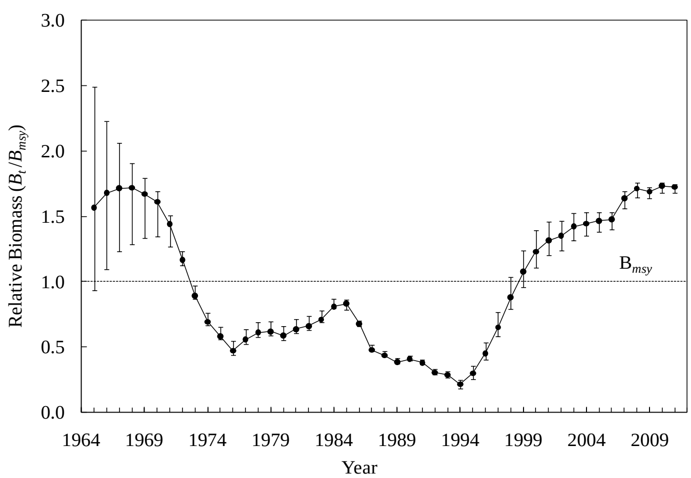


Fig. 12.5. Yellowtail flounder in Div. 3LNO: bias corrected relative biomass trends with approximate 80% confidence intervals.

Fishing Mortality: Relative fishing mortality rate (F/F_{msy}) was above 1.0, in particular from the mid-1980s to early-1990s when the catches exceeded or doubled the recommended TACs (Fig. 12.6). *F* has been below F_{msy} since 1994. From 2007-2010 *F* averaged about 25% of F_{msy}.

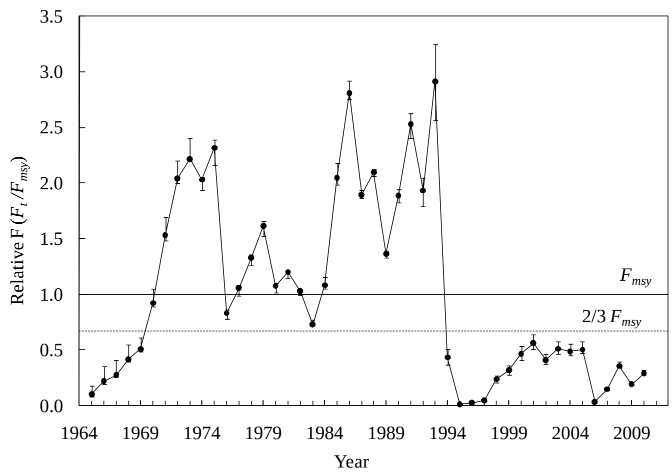


Fig. 12.6. Yellowtail flounder in Div. 3LNO: bias corrected relative fishing mortality trends with approximate 80% confidence intervals.

Since the moratorium (1994-97) was put in place, the catch remained below the estimated surplus production levels until 2008, when the catch slightly exceeded surplus production. In 2010, catch was near the estimated surplus production (Fig. 12.7). Since the moratorium (1994-97), the catches have been low enough to allow the stock to grow.

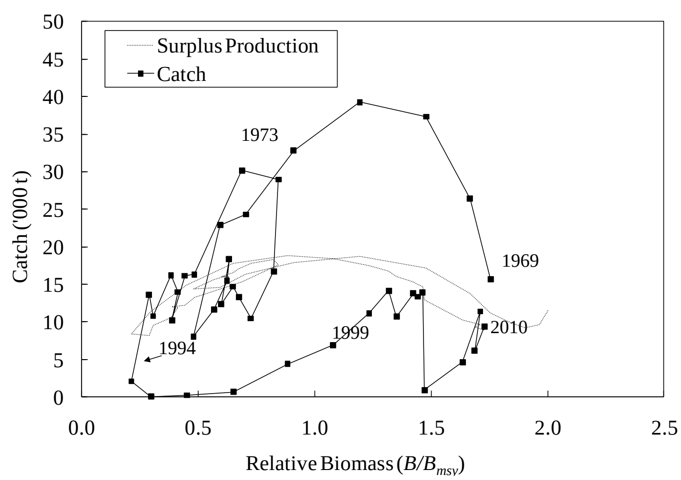


Fig. 12.7. Yellowtail flounder in Div. 3LNO: catch trajectory.

e) Medium Term Considerations:

Medium-term projections were carried out by extending the ASPIC bootstrap projections (500 iterations) forward to the year 2016 assuming two levels of catch in 2011 (TAC level (17 000 t) and the average of the 2008-2010 catch (8 979 t)) followed by constant fishing mortality from 2012-2016 at several levels of F (F_{2010}, 2/3 F_{msy}, 75% F_{msy}, and 85% F_{msy}, and F_{msy}). The projections are conditional on the estimated values of r, the intrinsic rate of population growth and K, the carrying capacity.

F_{msy} was estimated to be 0.25. Although yields are projected to decline in the medium term at both levels of catch in 2011 for 2/3 F_{msy}, 75% F_{msy}, and 85% F_{msy} (Table 12.1; Fig. 12.8), at the end of the projection period, biomass is still projected to be above B_{msy}.

Table 12.1. Medium-term projections for yellowtail flounder. The 5th, 50th and 95th percentiles of projected biomass, catch and relative biomass B/B_{msy}, are shown, for projected F values of F_{2010}, 2/3 F_{msy}, 75% F_{msy} and 85%F_{msy}. The results are derived from ASPIC bootstrap runs (500 iterations) with catch constraints in 2011 of 17 000 t (TAC) and 8 979 t (mean catch 2008-2010).

		Projections with catch in 2011 = 17 000 t (TAC)														
		Projected Biomass					Projected Catch (000 tons)					Projected Relative Biomass (B/B_{msy})				
		2012	2013	2014	2015	2016	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
F_{2010}	5	114	116	117	118	118	8.9	9.0	9.1	9.1	9.1	1.59	1.62	1.65	1.66	1.67
	50	121	123	125	126	126	8.9	9.0	9.1	9.1	9.2	1.64	1.67	1.69	1.70	1.70
	95	158	161	163	164	165	8.9	9.0	9.1	9.2	9.3	1.67	1.69	1.71	1.72	1.73
2/3 F_{msy}	5	114	106	102	99	97	19.8	18.8	18.1	17.7	17.3	1.59	1.50	1.44	1.40	1.36
	50	121	114	109	106	104	19.9	18.9	18.2	17.8	17.5	1.64	1.54	1.48	1.43	1.41
	95	158	151	146	142	140	20.2	19.4	18.9	18.5	18.2	1.67	1.58	1.53	1.49	1.47
75% F_{msy}	5	114	104	99	95	93	22.2	20.7	19.7	19.1	18.6	1.59	1.48	1.40	1.34	1.30
	50	121	112	106	102	99	22.2	20.8	19.9	19.2	18.8	1.64	1.51	1.43	1.38	1.34
	95	158	149	142	138	134	22.6	21.5	20.7	20.1	19.7	1.67	1.56	1.49	1.45	1.41
85% F_{msy}	5	114	102	95	91	88	24.9	22.8	21.5	20.5	19.9	1.59	1.45	1.35	1.28	1.23
	50	121	110	102	97	94	25.0	22.9	21.6	20.7	20.2	1.64	1.48	1.38	1.31	1.27
	95	158	146	138	132	128	25.5	23.8	22.7	21.9	21.3	1.67	1.53	1.45	1.39	1.35
F_{msy}	5	114	99	90	85	81	28.6	25.5	23.6	22.2	21.2	1.59	1.40	1.28	1.19	1.13
	50	121	106	97	91	86	28.8	25.7	23.8	22.5	21.6	1.64	1.43	1.31	1.23	1.17
	95	158	143	132	125	120	29.4	27.0	25.3	24.1	23.2	1.67	1.50	1.39	1.31	1.26

		Projections with catch in 2011 = 8 979 t (mean catch 2008-2010)														
		Projected Biomass					Projected Catch (000 tons)					Projected Relative Biomass (B/B_{msy})				
		2012	2013	2014	2015	2016	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
F_{2010}	5	120	119	119	119	119	9.4	9.4	9.3	9.3	9.3	1.67	1.67	1.67	1.68	1.68
	50	130	130	129	129	129	9.4	9.4	9.4	9.4	9.4	1.73	1.72	1.72	1.72	1.72
	95	169	169	169	169	169	9.5	9.5	9.5	9.6	9.6	1.75	1.75	1.74	1.74	1.74
2/3 F_{msy}	5	120	110	104	101	98	20.9	19.5	18.6	18.1	17.6	1.67	1.55	1.47	1.41	1.37
	50	130	120	113	109	106	21.0	19.6	18.8	18.2	17.8	1.73	1.59	1.51	1.46	1.42
	95	169	159	152	148	144	21.3	20.2	19.5	19.0	18.7	1.75	1.64	1.56	1.52	1.49
75% F_{msy}	5	120	108	101	97	94	23.2	21.4	20.2	19.4	18.9	1.67	1.52	1.43	1.36	1.31
	50	130	118	110	105	102	23.4	21.5	20.4	19.6	19.1	1.73	1.57	1.47	1.40	1.36
	95	169	157	149	143	139	23.7	22.3	21.3	20.7	20.2	1.75	1.61	1.53	1.47	1.43
85% F_{msy}	5	120	106	97	92	89	26.1	23.5	22.0	20.9	20.1	1.67	1.49	1.38	1.30	1.24
	50	130	115	106	100	96	26.2	23.8	22.2	21.2	20.5	1.73	1.54	1.42	1.34	1.29
	95	169	154	144	137	132	26.7	24.7	23.4	22.5	21.9	1.75	1.58	1.48	1.42	1.37
F_{msy}	5	120	102	92	86	82	30.2	26.5	24.2	22.7	21.5	1.67	1.45	1.30	1.20	1.13
	50	130	112	101	94	89	30.4	26.8	24.6	23.1	22.1	1.73	1.49	1.34	1.25	1.19
	95	169	150	138	129	123	31.0	28.1	26.2	24.9	24.0	1.75	1.54	1.42	1.34	1.28

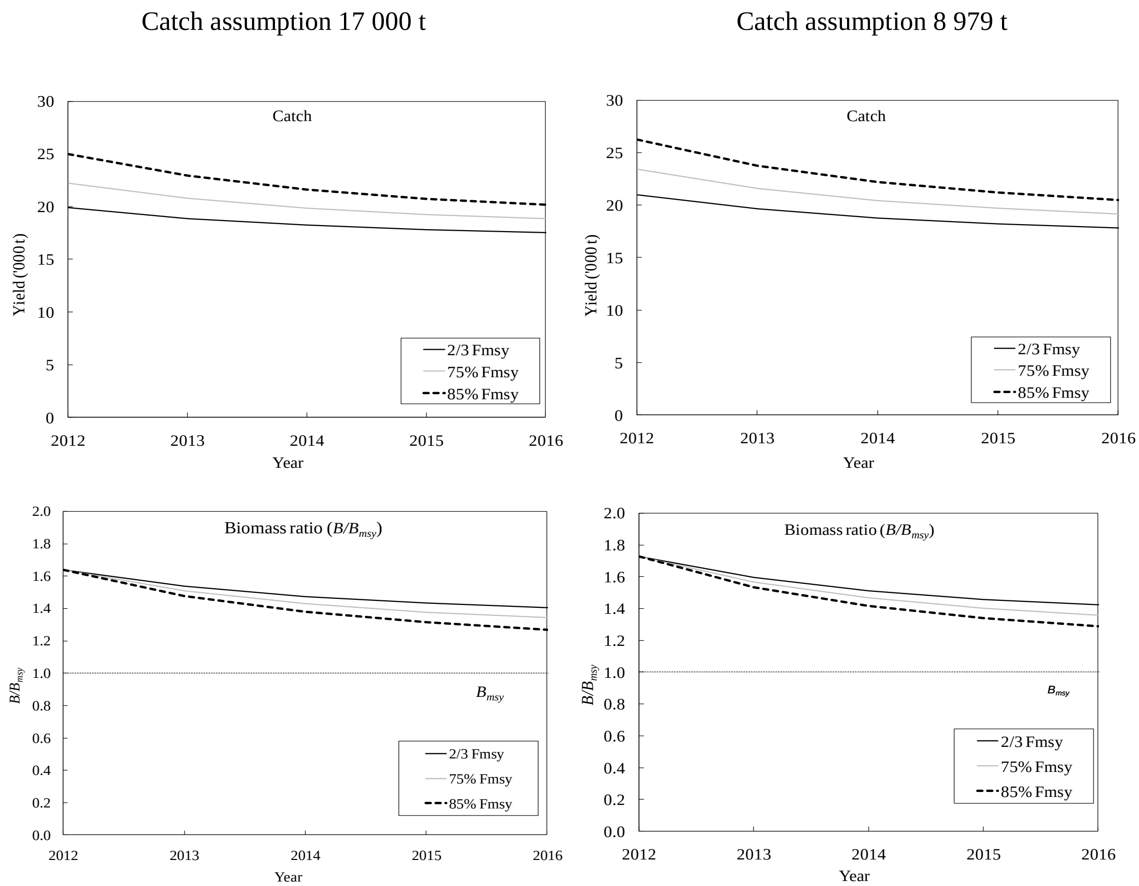


Fig. 12.8. Yellowtail flounder in Div. 3LNO: medium term projections for two catch scenarios and at three levels of F (2/3 F_{msy}, 75% and 85% F_{msy}). Top panels show projected catch and lower panels are projected relative biomass ratios (B/B_{msy}). Results are median values derived from ASPIC bootstrap runs (500 iterations) with catches of 17 000 t (left) and average catch of 2008-2010 (8979 t) (right) assumed in 2011.

f) Reference Points:

The surplus production model outputs indicate that the stock is presently above B_{msy} and F is below F_{msy} (Fig. 12.9). Scientific Council considers that 30% B_{msy} is a suitable limit reference point (B_{lim}) for stocks where a production model is used. At present, the risk of the stock being below B_{lim} = 30% B_{msy} is approximately zero.

Currently the biomass is estimated to be above B_{lim} and F, below F_{lim} (=F_{msy}) so the stock is in the safe zone as defined in the NAFO Precautionary Approach Framework.

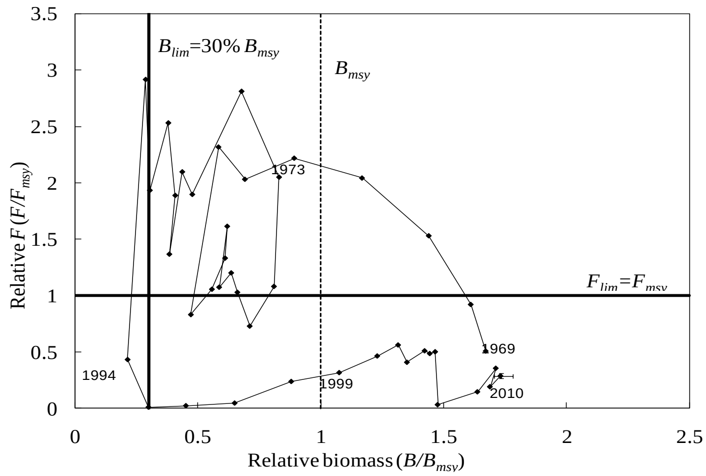


Fig. 12.9. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in the surplus production analysis, under a precautionary approach framework.

g) State of the Stock

The stock is above B_{msy} and F is less than 1/3 F_{msy}. Stock size has steadily increased since 1994 and is currently estimated to be 1.7 times B_{msy}.

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

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

(SCR Doc. 11/6, 29, 37; SCS Doc. 11/5, 6, 9)

a) Introduction

Catches since 1960 ranged from 222 t in 2007 to 14 965 t in 1971 (Fig. 13.1). Catches increased over the early 1980s but then declined steadily to less than 1 200 t in 1994, when it was agreed there would be no directed fishing on the stock. Since then, catches have averaged about 500 t; in 2010 the catch was estimated to be 421 t, taken mainly in the NRA.

Recent catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.7	0.9	0.6	0.3	0.2	0.2	0.2	0.1	0.1	
STACFIS	0.4	0.9-2.2[1]	0.6	0.3	0.5	0.2	0.3	0.4	0.4	

[1] In 2003, STACFIS could not precisely estimate the catch.
ndf = No directed fishery.

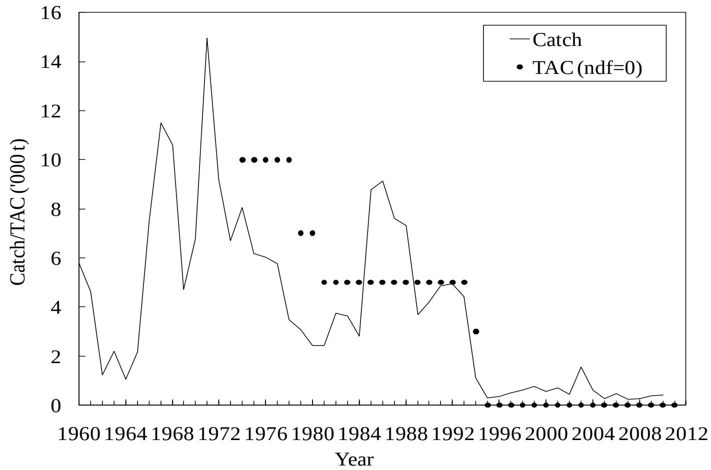


Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as TAC = 0.

b) Data Overview

i) Commercial fishery data

Catch and effort. There were no recent catch per unit effort data available.

Length frequencies. Length sampling was available from by-catches in directed fisheries for other species by EU-Spain, EU-Portugal, and Russian Federation in 2010. The EU-Spain data, from Div 3N Greenland halibut fishery (135 mm mesh) showed most of the catch was between 36 and 43 cm in length, with a peak at 39. In the Portuguese data for Div. 3N (130 mm mesh size); lengths between 28cm and 46cm dominated the catch, with a modal class at 40 cm (mean length of 39 cm). In Div. 3O (130 mm mesh size) the Portuguese catch showed more small fish, as lengths between 26cm and 34cm dominated the catch, with a modal class at 32 cm. In Div. 3O, with 280 mm mesh size, lengths between 28cm and 44cm dominated the catch, with no modal class, mean length of 38 cm). For Russian Federation, sampling of witch by-catch in Div. 3N showed the length of witch flounder ranged from 31 to 52 cm, with mean length 43 cm. Individuals from 37 to 43 cm in length made up the bulk of catches.

ii) Research survey data

Canadian spring RV survey mean weight per tow. The combined Div. 3NO estimates of mean weight per tow generally declined until the mid 1990's, then increased slightly, 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.

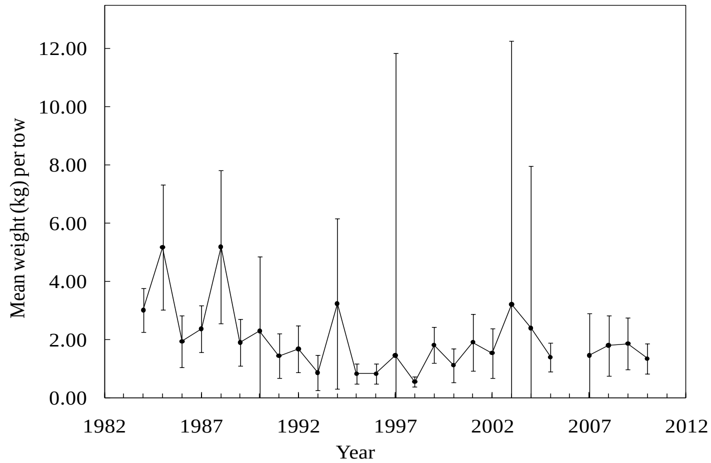


Fig. 13.2. Witch flounder in Div. 3NO: mean weights per tow from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units.

Canadian autumn RV survey mean weight per tow. Trends in the autumn survey are complicated slightly by variable coverage of the deeper strata from year to year. With the exception of a low value of 1.4 kg/tow in 2007, the combined index in Div. 3NO from the autumn survey (Fig. 13.3) has shown a general increasing trend from 1997, reaching the highest value in the time series in 2009, at 7.2 kg/tow. The 2010 value of 5.5 is the second highest in the series.

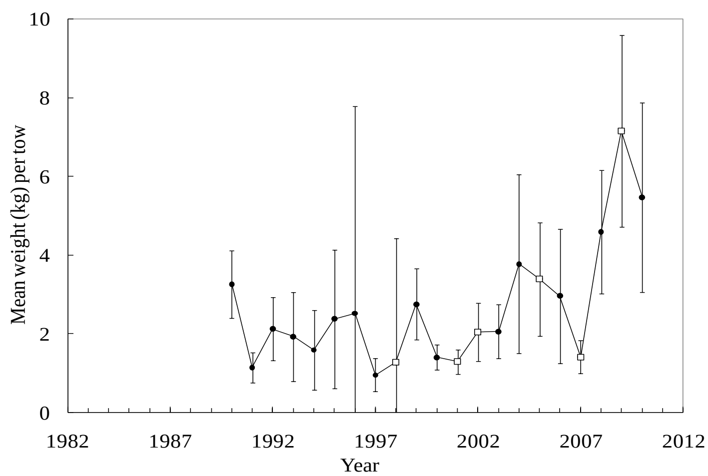


Fig. 13.3. Witch flounder in Div. 3NO: mean weights per tow from Canadian autumn surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols refer to years in which more than 50% of the deep water (> 730 m) strata were covered by the survey.

EU - Spain Div. 3NO RV survey biomass. Surveys have been conducted annually from 1995 to 2010 by EU-Spain in the Regulatory Area in Div. 3NO. Surveys in 1995 and 1996 were done to a maximum of depth of 900 m, and to a maximum depth of 1462 m from 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 (Fig. 13.4). In the *Campelen* gear time series, the biomass index has been variable but decreased slightly up to 2007, then increased up to 2010 to a level similar to 2003-04.

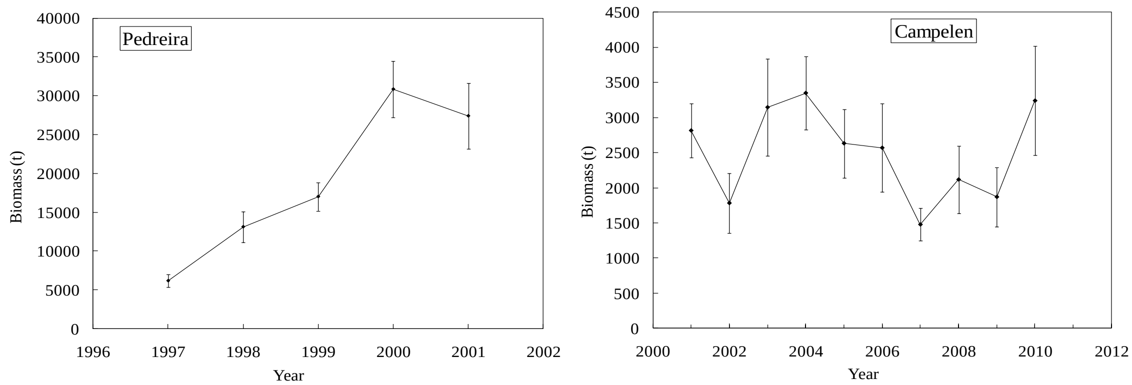


Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from EU-Spain Div. 3NO surveys (± 1 standard deviation). Data from 1997-2001 is in Pedreira units; data from 2001-2010 are Campelen units. Both values are present for 2001.

Length frequencies: Length frequencies in the Canadian surveys appear to be fairly consistent since 1995, with few fish > than 50 cm, and a mode generally around 40 cm. There have been very few strong peaks (presumably year classes) that could be followed in successive years. There have been no strong peaks at lengths less than 21 cm, which would possibly indicate large year classes, since 2002. Highest levels of small fish were in the late 1990s, and values since 2002 have been below the mean. The higher abundance of smaller fish in the 1998-2000 surveys may be contributing to the apparent improvement in the stock in recent years, but if so, it is not possible to see any progression of these cohorts in the length frequency data. Thus the large increases in the fall survey indices since 2007 cannot be explained with available length frequency data.

Based on the length frequencies in the EU-Spain surveys, the best recruitment values occurred in 2002-2005, but since 2008 they have been very poor.

Distribution: Analysis of distribution data from the surveys showed that this stock is mainly distributed in Div. 3O along the southwestern slope of the Grand Bank. In most years the distribution is concentrated toward this slope but in certain years, a higher percentage is distributed in shallower water. There are also seasonal differences, with witch tending to be distributed more along the slope in spring, and further on the bank in autumn. In years where all strata are surveyed to a depth of 1462 m in the autumn survey, generally less than 5% of the witch biomass was found in the deeper strata (731-1462 m), although a higher percentage of fish were found in these depths in Div. 3N than in Div. 3O.

c) Assessment Results

There is no analytical assessment for this stock, and there has been no ageing conducted for a number of years. Previous exploratory investigations using an ASPIC non-equilibrium production model were attempted, but the results indicated poor model fit and are not thought to describe dynamics of this stock.

Biomass: Survey biomass decreased from the mid-1980s until the mid to late 1990s. Since then the Canadian spring RV index increased slightly and remains stable at a low level. The Canadian autumn survey and EU - Spain survey indices show an increasing trend in recent years. There is no information on SSB.

Recruitment: Recruitment, based on Canadian surveys (defined as fish less than 21cm) has generally been poor since 2002.

Fishing mortality: The ratio of catch to survey index, a proxy for F, suggests fishing mortality has been low since a moratorium on directed fishing was imposed in 1994 (Fig. 13.5).

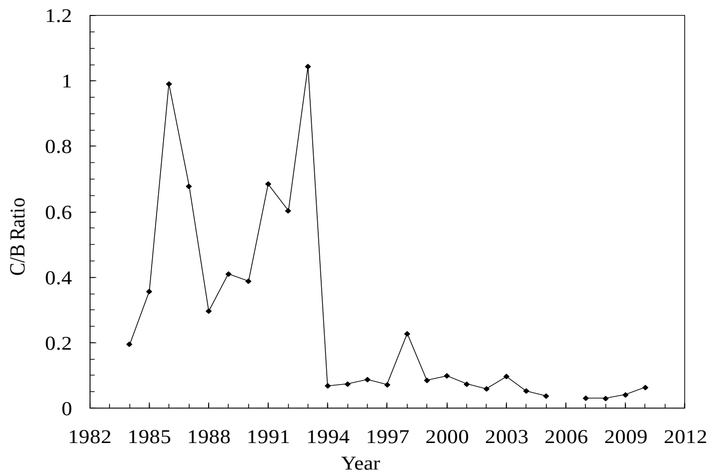


Fig. 13.5. Witch flounder in Div. 3NO: Catch divided by biomass estimates from the Canadian spring survey, 1984-2010.

State of the stock: There are signs of improvement in stock status, notably the increases in Canadian autumn survey indices in 2008-2010, but there is considerable uncertainty. A comparison of the three survey series shows inconsistent trends in recent years, and the increased estimates from the survey series generally have wide confidence limits. Increases in some indices in 2008-2010 could not be explained from available data from length frequencies. Catch/biomass ratio remains relatively low, increasing slightly in recent years with the increased catch.

d) Reference points

Precautionary reference points have not been developed for this stock.

The next full assessment of this stock is planned to be in 2014.

e) Research Recommendations

STACFIS **recommended** *further investigation of recruitment trends for witch flounder in Div. 3NO.* This should include analysis of trends in abundance in the survey series, as well as examination of areal distribution of small witch flounder, particularly in years where deeper strata are covered by surveys. STACFIS noted that analyses of recruitment will rely on length frequency data, as no ageing has been conducted on this stock since the early 1990s.

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

(SCR Doc. 11/18)

a) Introduction

The fishery for capelin started in 1971 and catch was highest in the mid-1970s with a maximum catch of 132 000 t in 1975. The directed fishery was closed in 1992 and the closure has continued through 2010 (Fig. 18.1). No catches have been reported for this stock since 1993.

Nominal catches and TAC's ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	na	na	na	na	na	na	na	na	na	na
Catch[1]	0	0	0	0	0	0	0	0	0	

[1]No catch reported or estimated for this stock
na = no advice possible

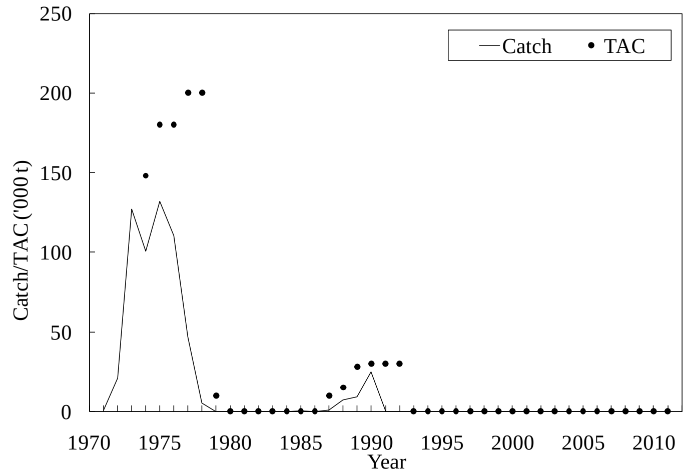


Fig. 14.1. Capelin in Div. 3NO: catches and TACs (ndf = 0).

b) Data Overview

Research survey data. Trawl acoustic surveys of capelin on the Grand Bank previously conducted by Russian Federation 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 1996-2010, when a Campelen trawl was used as a sampling gear, survey biomass of capelin in Div. 3NO varied from 3 900 to 114 652 t (Fig.14.2), at the average value for this period is 32 850 t. In 2005, survey biomass of capelin in Div. 3NO was 3 900 t, the lowest level since 1996; estimates in 2006 are not compatible because of poor survey coverage in that year. In 2007 survey biomass increased and was 29 300 t. In 2008 the biomass index sharply increased to 114 600 t. In 2009-2010, trawl biomass decreased and was 30 579 and 54 059 t correspondingly.

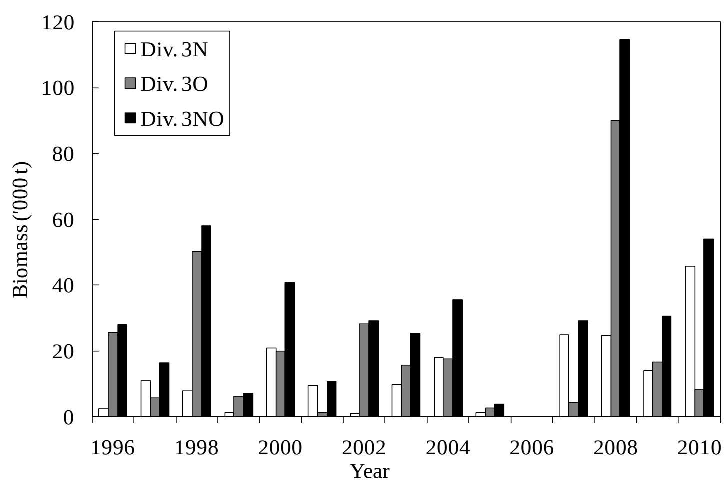


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates from Canadian spring surveys in 1996-2010.

c) Estimation of Stock Condition

Since interpolation by density of survey 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 1990-2010. However, if the proportion of zero and non-zero catches change, the index may not be comparable between years.

Survey catches were standardized to 1 km^2 from 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 1996-2010, the mean catch varied between 0.06 and 1.56. In 2009 and 2010, this parameter was 0.21 and 0.33, respectively (Fig. 18.3).

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

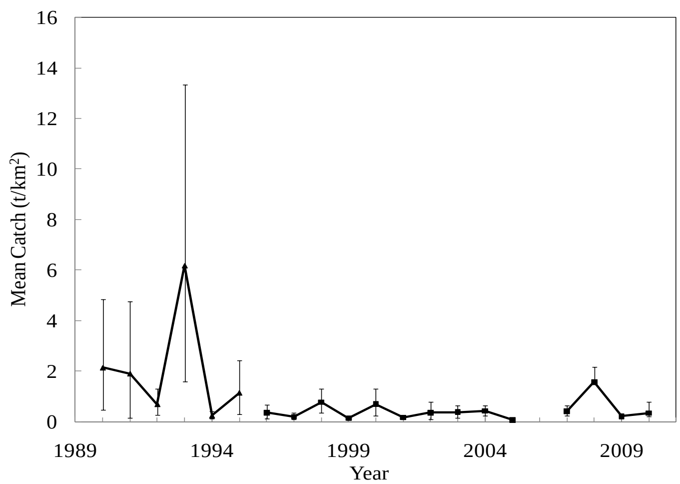


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km^2) from Canadian spring surveys in 1996-2010. Estimates prior to 1996 are from Engel and from 1996-2010 are from Campelen. Survey in 2006 was incomplete.

d) Assessment Results

It is not clear that the data satisfactorily reflects the stock distribution and stock status. In spite of recent increases in survey indices, STACFIS considers that the stock is at relatively low level.

e) Precautionary Reference Points

STACFIS is not in a position to determine biological reference points for capelin in Div. 3NO.

f) 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.*

This stock is expected next to be fully assessed in 2013.

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

Interim Monitoring Report (SCS Doc. 11/04, 05, 07, 09, 11)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3O; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics and RV surveys. Within Canada's fishery zone redfish in Div. 3O have been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, whereas catch was only regulated by mesh size in the NRA of Div. 3O. In September 2004, the Fisheries Commission adopted TAC regulation for redfish in Div. 3O, implementing a level of 20 000 t per year for 2005-2008. This TAC applies to the entire area of Div. 3O.

Nominal catches have ranged between 3 000 t and 35 000 t since 1960 and have been highly variable with several distinct periods of rapid increase and decrease (Fig. 15.1). Up to 1986 catches averaged 13 000 t, increased rapidly and peaked at 35 000 t in 1988, then declined to 5 100 t by 1997. Catches increased to 20 000 t in 2001 then declined to 5 200 t in 2007. Since then catches have ranged between 4 000 t to 6 400 t with the 2010 catch estimated at 5 200 t.

Nominal catches and TACs ('000 t) for redfish in the recent period are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC				NR	NR	NR	NR	NR	NR	NR
TAC[1]	10	10	10	20	20	20	20	20	20	20
STATLANT 21	19.4	21.5	6.4	11.9	11.0	7.5	5.0	6.4	4.5	
STACFIS	17.2	17.2	3.8	11.3	12.6	5.2	4.0	6.4	5.2	

[1] 2002-2004 only applied within Canadian EEZ.
NR: Scientific Council unable to advise on an appropriate TAC

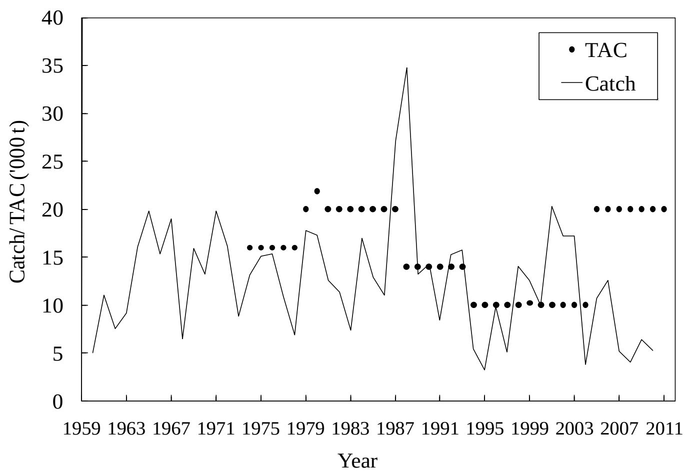


Fig. 15.1. Redfish in Div. 3O: catches and TACs. The TAC for 1997-2004 applied only within the Canadian EEZ.

b) Data Overview

Surveys. Canadian spring and autumn surveys were conducted in Div. 3O during 2010. Results of bottom trawl surveys for redfish in Div. 3O have at times indicated a considerable amount of variability, both between seasons and years, making it difficult to interpret year to year changes in the estimates. In general, the survey mean weight (kg) per tow has been increasing in both indices since the mid-2000s (Fig. 15.2). For each survey series the average over 2008-2010 represents a fourfold increase compared to the average over 2001-2003, a period that includes some of the lowest estimates for each series. The recent trend in abundance from the surveys is very similar to the trend in biomass.

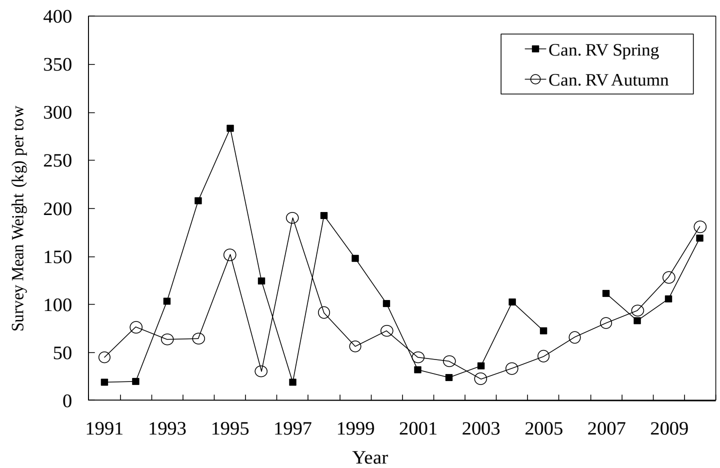


Fig. 15.2. Redfish in Div. 3O: Mean weight (kg.) per tow from Canadian surveys in Div. 3O (Campelen equivalent estimates prior to autumn 1995; error around estimates not plotted in order to visualize trend).

c) Conclusion

Catches declined from 2009 to 2010 while survey indices have increased, indicating improvement but no substantial change in the status of the stock.

d) Recommendations

For redfish 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.*

The next full assessment of this stock is planned to be in 2013.

16. Thorny skate (*Amblyraja radiata*) in Div. 3LNO and Subdiv. 3Ps

Interim Monitoring Report (SCR Doc. 11/07; SCS Doc. 11/ 05, 07, 09)

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 the 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. For 2010 and 2011, the TAC for Div. 3LNO has been reduced to 12 000 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, Russian Federation, 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. Average STACFIS catch in Div. 3LNO for 2005-2010 was 4 947 t. Current catches in 2010 are the lowest recorded in Div. 3LNOPs since the commencement of the directed skate fishery.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Div. 3LNO:										
TAC				13.5	13.5	13.5	13.5	13.5	12	12
STATLANT 21	11.6	14.3	11.8	3.5	5.5	6.2	5.6	5.7	0.5	
STACFIS	11.8	11.6	9.3	4.2	5.8	3.6	7.4	4.5	3.1	
Subdiv. 3Ps:										
TAC				1.05	1.05	1.05	1.05	1.05	1.05	1.05
STATLANT 21[1]	1.6	1.8	1.3	1.0	1.0	1.6	1.4	0.6	0.3[2]	
Div. 3LNOPs:										
STATLANT 21	13.3	16.0	13.1	4.5	6.5	7.8	7.0	6.3	5.3	
STACFIS	13.4	13.4	10.6	5.2	6.8	5.2	8.8	5.1	3.5	

[1] Based on ZIF landings (STATLANT 21 not available)

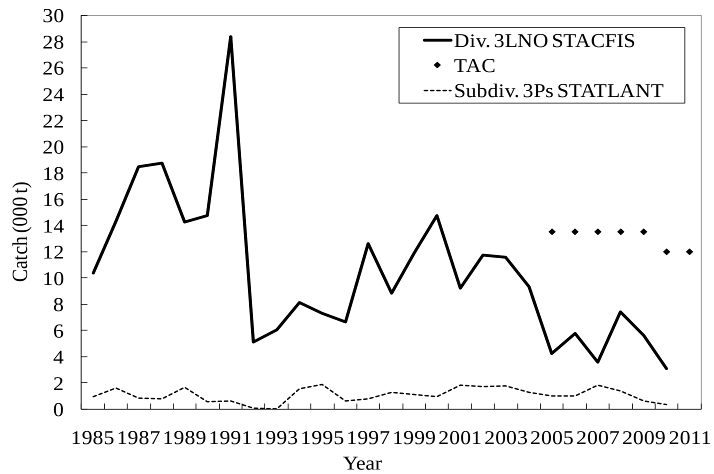


Fig. 16.1. Thorny skate catch in Div. 3LNO and Subdiv. 3Ps and TAC.

b) Data Overview

i) Commercial fisheries

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 Russian Federation (1998-2009).

In 2008-2009, commercial length distributions from EU-Spain, EU-Portugal, and Russian Federation 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 Russian Federation, 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 Russian Federation (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 Russian Federation. 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 Russian Federation 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 Russian Federation was limited to only 59 skates, and Canada did not measure skate lengths in Div. 3LNO to compare with those of previous years.

During 2010, the range of sizes caught by EU-Portugal was significantly smaller than that of EU-Spain: 28-48 cm range with a 38-cm mode, and 24-94 cm with a 72–cm mode, respectively in the directed skate fisheries (280 mm mesh) of Div. 3LNO in the NRA. In 2010 in other trawl fisheries (130-135 mm mesh) conducted in Div. 3LNO EU-Portugal caught a range of sizes similar to that observed in 2009.

No standardized commercial catch per unit effort (CPUE) exists for thorny skate.

ii) Research surveys

Canadian spring surveys. Standardized mean number and weight per tow are presented in Fig. 16.2 for Div. 3LNOPs. Catch rates of thorny skate in Div. 3LNOPs declined from the mid1980s until the early 1990s. Since 1996, indices have been relatively stable at historically low levels (Fig. 16.2).

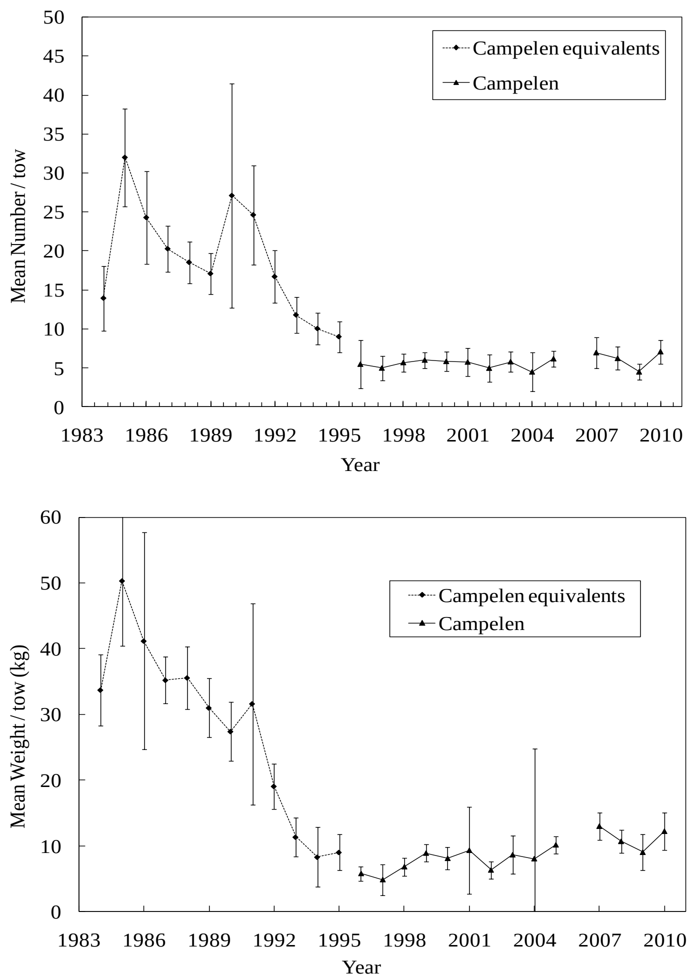


Fig. 16.2. Thorny skate in Div. 3LNOPs, 1984-2010: estimates of Campelen-equivalent and Campelen mean numbers (Upper panel) and mean weights (Lower panel) per tow from Canadian spring surveys. Survey in 2006 was incomplete.

Canadian autumn surveys. 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.

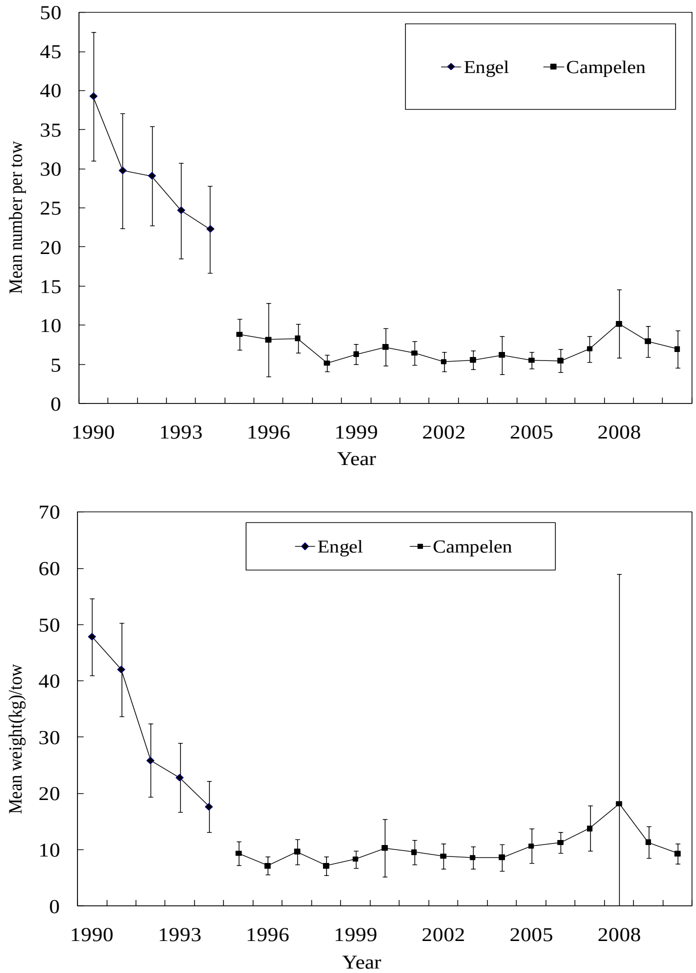


Fig. 16.3. Thorny skate in Div. 3LNO, 1990-2010: estimates of mean numbers and mean weights per tow (unconverted) from Canadian autumn surveys. Note that Engel data in 1990-1994 and Campelen data in 1995-2010 are not directly comparable.

EU-Spain surveys. The biomass trajectory from the EU-Spain surveys was very similar to that of Canadian spring surveys until 2006 (Fig. 16.4). Since 2007 the two indices have been divergent with the EU-Spain index declining, while the Canadian Div. 3NO index is generally increasing. EU-Spain survey indices in the NRA of Div. 3L are available for 2006-2010 but have yet to be considered due to the short time series.

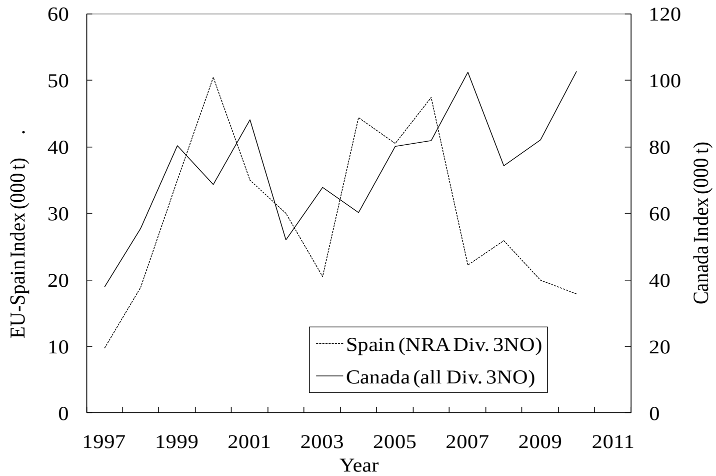


Fig. 16.4. Thorny skate in Div. 3NO: estimates of biomass from EU-Spain spring surveys and Canadian RV spring surveys from 1997-2010.

c) Conclusion

Although the state of the stock is unclear, the survey biomass has been relatively stable from 1996 to 2010 at low levels. With an update of abundance and biomass indices for 2010, there is nothing to indicate a significant change in the status of this stock.

The next full assessment of this stock is planned for 2012.

d) Research Recommendations

For thorny skate in Div. 3LNOPs, STACFIS **recommended** that *further work be conducted on development of a quantitative stock model. Exploration of Bayesian surplus production models has been initiated.*

For thorny skate in Div. 3LNOPs, STACFIS **recommended** that *due to the divergence in EU-Spain and Canadian spring surveys that analysis of the Canadian and EU-Spain indices be conducted for consistency and variation in relationship to spatial extent.*

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

(SCR Doc. 11/07, 22; SCS Doc. 11/05, 07, 09)

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 Russian Federation 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 Russian Federation in 2005-2010. 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 first implemented by Fisheries commission in 2005 at 8 500 t, and then reduced to 6 000 t for 2010 and 2011.

From 1970-2009, white hake catches in Div. 3NO fluctuated, averaging approximately 2 000 t, exceeding 5 000 t in only three years during that period. Catches peaked in 1985 at approximately 8 100 t (Fig. 17.1). With the restriction of fishing by other countries to areas outside Canada's 200-mile limit in 1992, non-Canadian landings fell to zero. Average catch was low in 1995-2001 (464 t), then increased to 6 718 t in 2002 and 4 823 t in 2003; following recruitment of the large 1999 year class. STACFIS reported catches decreased to an average of 767 t in 2005-2009, and were 226 t in 2010 in Div. 3NO.

Commercial catches of white hake in NAFO Subdiv. 3Ps were less variable, averaging 1 114 t in 1985-93, 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, then decreased to a 443 t average in 2008-2010; with the 380 t reported in 2010.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Div. 3NO:										
TAC	-	-	-	8.5	8.5	8.5	8.5	8.5	6	6
STATLANT 21	5.4	6.2	1.9	1.0	1.2	0.7	0.9	0.5	0.2	
STACFIS	6.8	4.8	1.3	0.9	1.1	0.6	0.9	0.4	0.2	
Subdiv. 3Ps:										
STATLANT 21	0.9	1.1	1.2	1.4	1.3	1.2	0.6	0.3	0.4	

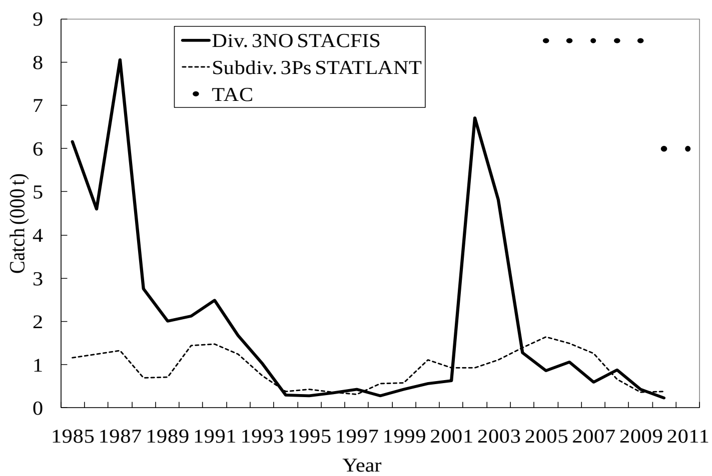


Fig. 17.1. White hake in Div. 3NO and Subdiv. 3Ps: Total catch of white hake in NAFO Div. 3NO (STACFIS) and Subdivision 3Ps (STATLANT21). The Total Allowable Catch (TAC) for Div. 3NO is indicated on the graph.

b) Input Data

i) Commercial fishery data

Length composition. Length frequencies were available for Canada (1994-2010), EU-Spain (2002, 2004), EU-Portugal (2003-2004, 2006-2010), and Russian Federation (2000-2007). In the Canadian fishery in 2004-2010, peak lengths caught by longlines in Div. 3O and Subdiv. 3Ps were generally 58-78 cm, although in Div. 3Ps in 2010 the fishery caught mainly 47-83 cm white hakes. For that period, gillnets in Div. 3O and Subdiv. 3Ps caught mainly 64-78 cm; and peak lengths for trawls in Div. 3O and Subdiv. 3Ps were 57-77 cm. Sizes reported by EU-Spain and EU-Portugal were mainly in the 31-62 cm range. Russian Federation reported a much wider range of sizes; mainly from 25-78 cm.

ii) 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 2010. 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 2010. 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 1995-2010. 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 2003-2010, the population remained at a 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.

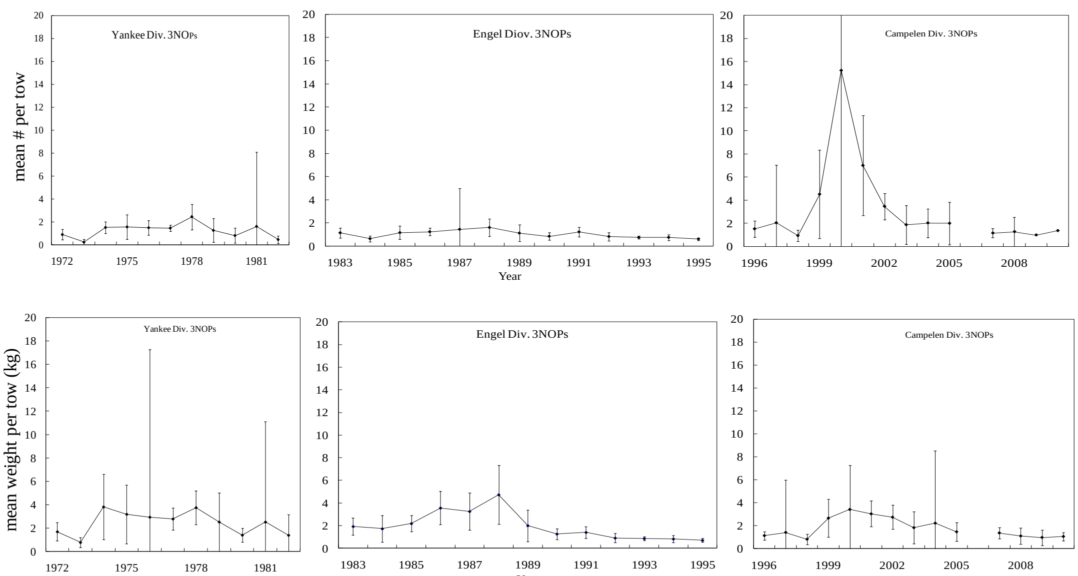


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: mean number and mean weight per tow from Canadian spring research surveys, 1972-2010. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. The Yankee, Engel, and Campelen time series are not standardized, and are thus presented on separate panels.

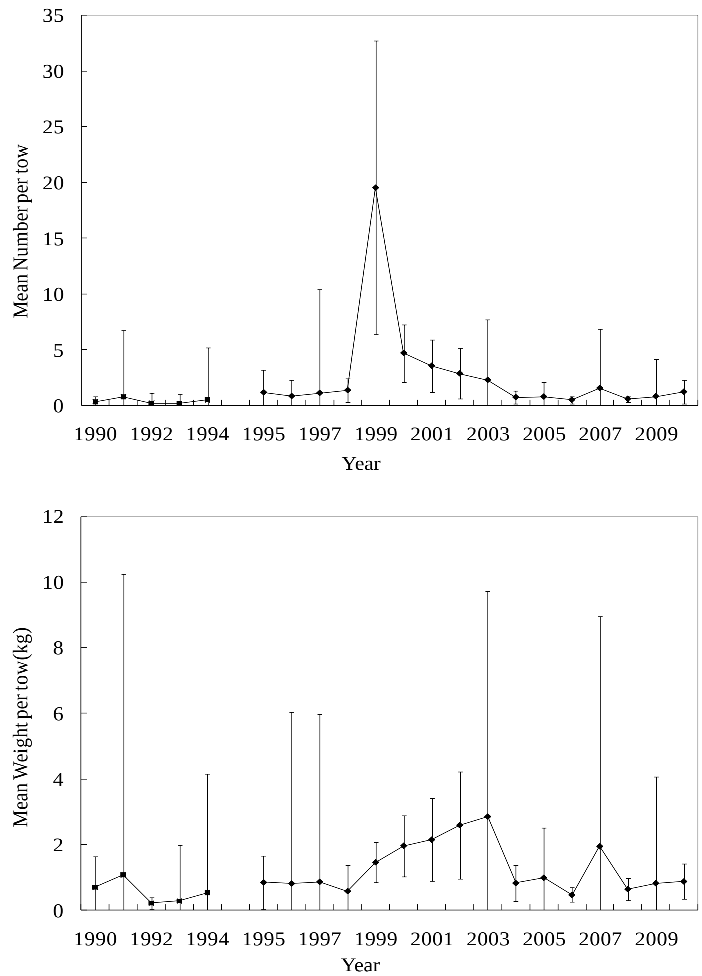


Fig. 17.2b White hake in Div. 3NO: mean numbers (upper Panel) and mean weights (lower Panel) per tow from Canadian autumn surveys, 1990-2010. The Engel (■, 1990-1994) and Campelen (♦, 1995-2010) time series are not standardized.

EU-Spanish 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 2010 (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 and 2010, the Spanish index increased slightly relative to 2008. The overall trend is similar to that of the Canadian spring survey index (Fig. 17.3).

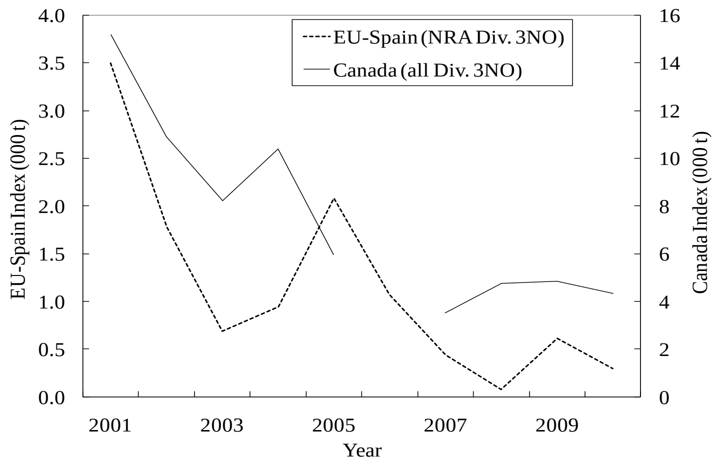


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from EU-Spain Campelen spring surveys in 2001-2010 compared to Canadian spring survey indices in all of Div. 3NO. Estimates from 2006 Canadian survey are not shown, since survey coverage in that year was incomplete.

iii) Biological studies

Distribution. White hake in Div. 3NO and Subdiv. 3Ps are confined largely to an area associated with the warmest bottom temperatures (4-8°C) along the southwest edge of the Grand Banks, edge of the Laurentian Channel, and southwest coast of Newfoundland.

White hake distribute at different locations during various parts of their life cycle. Fish < 27 cm in length (1st year fish) occur almost exclusively on the Grand Bank in shallow water. Juveniles (2+ years) are widely spread, and a high proportion of white hake in the Laurentian Channel portion of Subdiv. 3Ps are juveniles. Mature adults concentrate on the southern slope of the Bank in Div. 3NO and along the Laurentian Channel in Subdiv. 3Ps.

Maturity. Maturity at size was estimated for each sex separately, using Canadian Campelen spring survey data from 1996-2010. Length at 50% maturity (L_{50}) is different between sexes; with fifty percent of males maturing at 39 cm, and fifty percent of females maturing at 54 cm. However, L_{50} was very similar for each sex between Div. 3NO and Subdiv. 3Ps (Fig. 17.4).

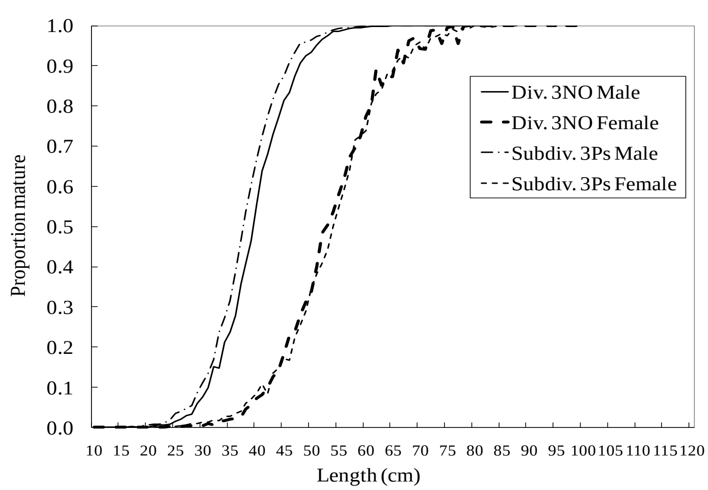
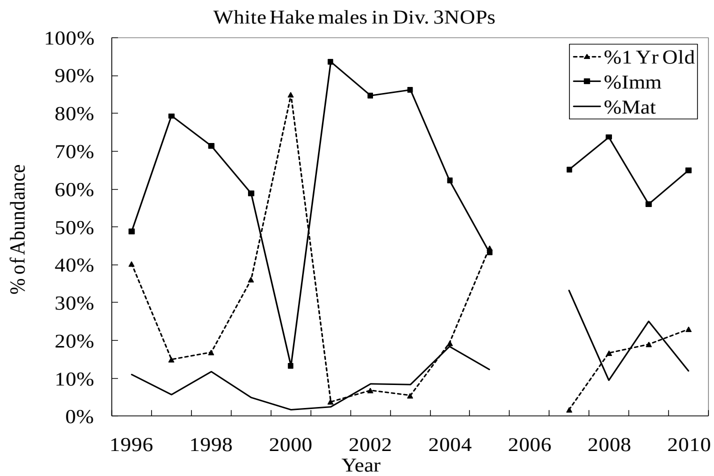


Fig. 17.4. White hake in Div. 3NO and Subdiv. 3Ps: ogives calculated for each sex from Canadian spring surveys and averaged over 1996-2010.

Life stages. Canadian spring survey trends in abundance for 1996-2010 were staged based on length as one year olds, 2+ juveniles, and mature adults (Fig. 17.5). Recruitment of one year old male and female white hake was highest in 2000, and has since declined. There are currently no indications of increased abundance of either mature or young-of-the-year white hake.



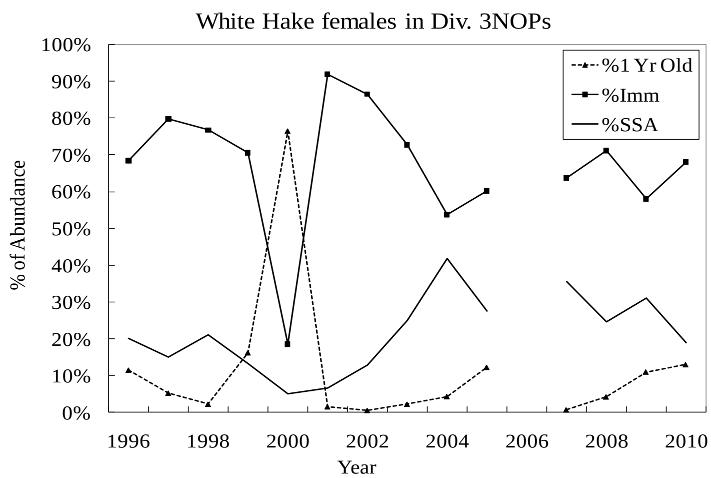


Fig. 17.5. White hake in Div. 3NO and Subdiv. 3Ps: Proportion of stages in terms of abundance by sex from Canadian Campelen spring survey data in 1996-2010. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

iv) 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. The 1999 and 2000 year-classes were large, but no large year class has been observed in recent years.

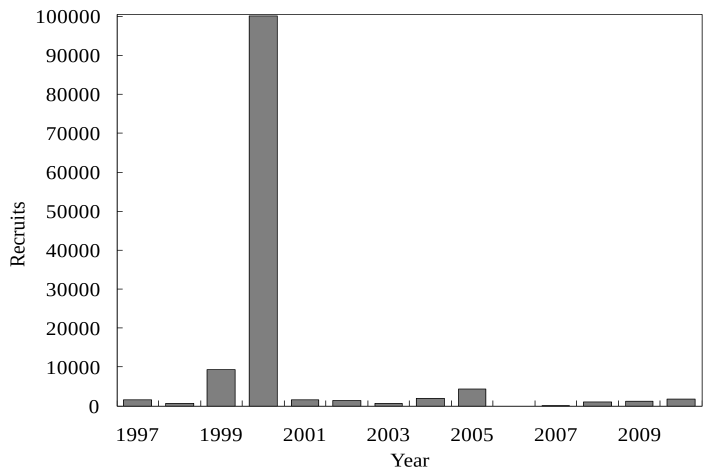


Fig. 17.6. White hake in Div. 3NO and Subdiv. 3Ps: recruits from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2010. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

c) Assessment Results

*Biomass:*The biomass of this stock increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has decreased and remains at levels comparable to the beginning of the Canadian Campelen spring time series in 1996-1999.

Recruitment: The 1999 year-class was large, but no large year class has been observed since then.

*Relative F (commercial catch/Canadian spring survey biomass):*Using STACFIS agreed commercial catch and Canadian spring survey biomass index, estimates of relative *F* were calculated for white hake in Div. 3NO and Div. 3NOPs. Relative fishing mortality (Rel. *F*) has fluctuated, but increased considerably for 2002-2003 (Fig. 17.7). Current estimates of Relative *F* are comparable to levels observed from 1996-2001.

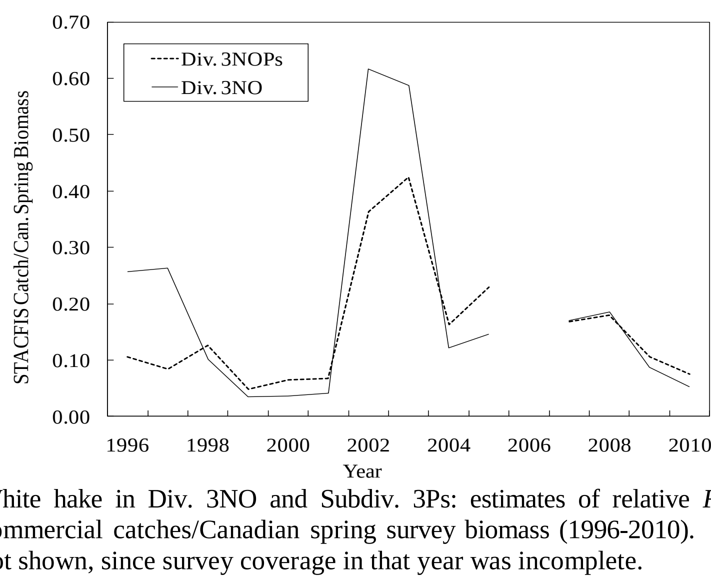


Fig. 17.7. White hake in Div. 3NO and Subdiv. 3Ps: estimates of relative *F* from STACFIS agreed commercial catches/Canadian spring survey biomass (1996-2010). Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

State of the stock: The biomass increased in 2000 with the large 1999 year-class. Subsequently, the biomass index has decreased and remains at levels comparable to the period 1996-1999.

d) Reference Points

Reference points with respect to a precautionary approach for this species have not been determined.

e) Research Recommendations

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

STATUS: Tissue samples have been collected and genetic studies are ongoing. The results will be presented to Scientific Council in 2012.

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.*

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

STACFIS **recommended** that *survey conversion factors between the Engel and Campelen gear be investigated for this stock.*

STATUS: No progress.

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 are sampled for age, sex and maturity whenever possible.

For white hake in Div. 3NO and Subdiv. 3Ps, STACFIS **recommended** that *the maturity time series be analyzed to investigate any potential annual changes in maturity.*

D. WIDELY DISTRIBUTED STOCKS: SA 2, SA 3 AND SA 4

Environmental Overview

(SCR Doc. 11/13, 14 and 16)

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1-2ºC and salinities of 32-33.5. Labrador Slope Water flows southward along the shelf edge and into the Flemish Pass region, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3°-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.

Sea-ice extent and duration on the Newfoundland and Labrador Shelf decreased in 2010 for the 15th consecutive year, with the annual average reaching a record low. As a result of these and other factors, local water temperatures on the Newfoundland and Labrador Shelf warmed compared to 2009 and were above normal in most areas in 2010.

Salinities on the NL Shelf were lower than normal throughout most of the 1990s, increased to above normal during most of the past decade but decreased to fresher-than-normal conditions in many areas in 2010. At Station 27 off St. John's, the annual depth-averaged water temperature increased to 1.9 standard deviation (SD) units above normal, the second highest on record. Annual surface and bottom temperatures at Station 27 were also above normal by 1 SD and 1.7 SD, respectively. The area of the Cold-Intermediate-Layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland and southern Labrador Shelf during 2010 was below normal. Average temperature conditions along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. A composite climate index derived from 26 meteorological, ice and ocean temperature and salinity time series show a peak in 2006, a declining trend in 2007-09 and a sharp increase in 2010 to the 2nd highest in 61 years, indicating warmer than normal conditions throughout the area.

Above normal ocean temperature also prevailed further south on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas. A climate index, a composite of 18 selected, normalized time series, averaged +1.0 SD with 13 of the 18 variables more than 0.5 SD above normal; compared to the other 41 years, 2010 ranks as the 4th warmest. Overall, the January to April 2010 ice coverage and ice volume were the second lowest in the 42-year-long record. Bottom temperatures were above normal but not exceptionally so with anomalies of +0.5-1.0 for NAFO Subarea 4. The volume of the Cold Intermediate Layer (CIL), defined as waters with temperatures <4^{o}C, was reduced in 2010 from 4 840 km^3 compared to the long-term mean value of 5 510 km^3 and a slight, 100 km^3 decrease from 2009. Stratification on the Scotian Shelf in 2010 strengthened compared to 2009; overall 2010 ranked as the third most stratified in the 64-year record. In general, nitrate inventories in NAFO Subareas 2-4 were below normal in 2010. Overall, primary and secondary productivity increased across these Subareas in 2010 compared to previous years.

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

Interim Monitoring Report (SCR Doc. 11/07; SCS Doc. 11/04, 05, 07, 09 and 11)

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.

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 (6 725 t); since then until 1997 total catches have been about 4000 t. In 1998 and 1999 catches increased and were near the level of 7 000 t. From then, catches decreased to 3000-4000 t in 2001–2004 and to 700 t in 2007. In the 2007-2010 period catches were at similar low level. A total catch of 941 t was estimated for 2010 (Fig. 18.1). 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:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
STATLANT 21	1.7	1.8	1.7	1.3	0.6	0.5	0.4	0.7	0.2	
STACFIS Catch	3.1	3.7	4.2-3.8[1]	3.2	1.5	0.7	0.8	0.6	0.9	

[1] In 2003, STACFIS could not precisely estimate the catch

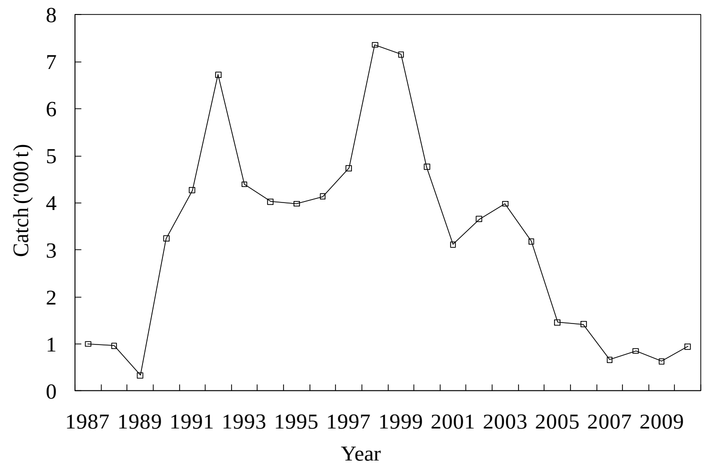


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

b) Data Overview

i) Surveys

There is no survey index covering the total distribution, in depth and area, of this stock. The Canadian fall 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 show a general increase trend since the beginning of the series up to mid-2000s. Since then the Canadian Div. 2J+3K series has continued to increase while the Spanish Div. 3NO index has decreased (Fig. 18. 2).

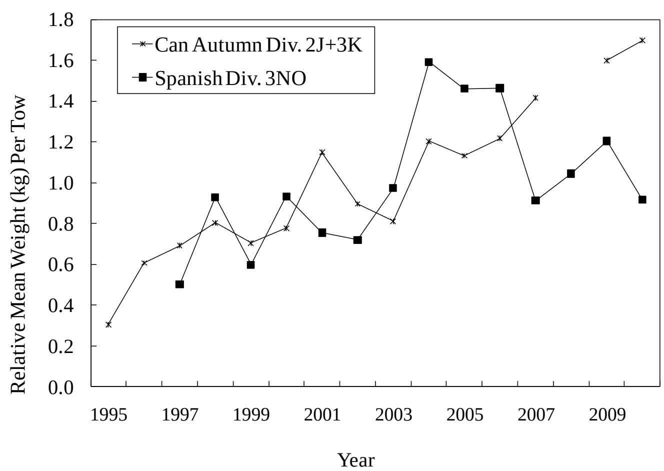


Fig. 18.2. Roughhead grenadier in Subareas 2+3: Relative (to the mean) mean weight per tow from the Canadian autumn (Div. 2J+3K) survey and Spanish Div. 3NO survey.

The catch/biomass (C/B) ratios have a clear decline trend in the 1995-2005 period and since then are stable at low levels (Fig. 18.3). The low level observed in the last years is due to the fact that all surveys indices present relatively high biomass and catches were at low level.

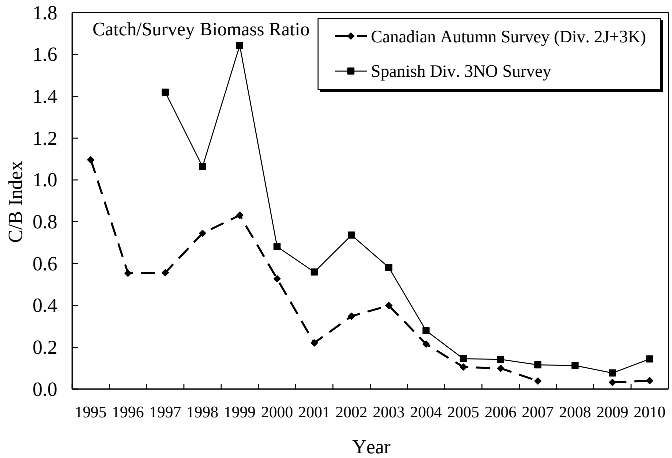


Fig. 18.3. Roughhead grenadier in Subareas 2+3: The catch/biomass (C/B) ratios from the Canadian autumn (Div. 2J+3K) survey and Spanish Div. 3NO survey.

c) Conclusion

Based on overall indices for the current year, there is no significant change in the status of the stock to modify the most recent full assessment.

The next full assessment of this stock is planned to be in 2013.

d) Research Recommendation

In 2010 STACFIS **recommended** that *further investigation on recruitment indices for roughhead grenadier in Subarea 2 and 3 will be carried out.*

STATUS: New information was not available in this matter.

For roughhead grenadier in SA 2+3, STACFIS **recommended** to *study the possibility of including in future assessments all surveys series for roughhead grenadier before 1995.*

19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL

Interim Monitoring Report (SCS Docs. 11/05, 11/07, 11/09, 11/11)

a) Introduction

The fishery for witch flounder in NAFO Divisions 2J, 3K and 3L 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%. The catches in 1997 and 1998 were estimated to be about 850 and 1 100 t, respectively, most of which was reported from the Regulatory Area of Div. 3L. From 1999 to 2004 catches were estimated to be between 300 and 800 t. Since 2005, catches have averaged less than 200 t (183 t in 2010).

Recent catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21A	0.7	0.5	0.3	0.2	0.1	0.1	0.1	0.1	0.2	
STACFIS	0.4	0.7	0.8	0.2	0.1	0.1	0.1	0.1	0.2	

ndf: no directed fishing.

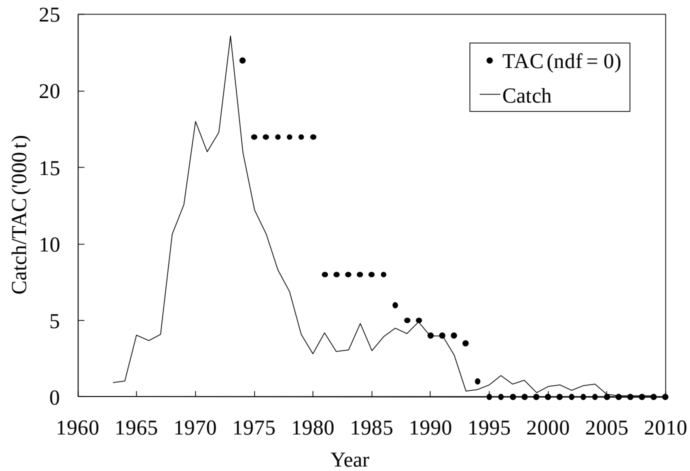


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) Data Overview

i) Surveys

Canadian surveys were conducted in Div. 2J3KL during autumn 2010 (Fig 19.2). The survey biomass estimates have shown an increasing trend since 2003, although estimates are imprecise. Estimates in 2010 were similar to 2009 values. 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 Doc. 09/012). Results in these years may, therefore, not be comparable to other years.

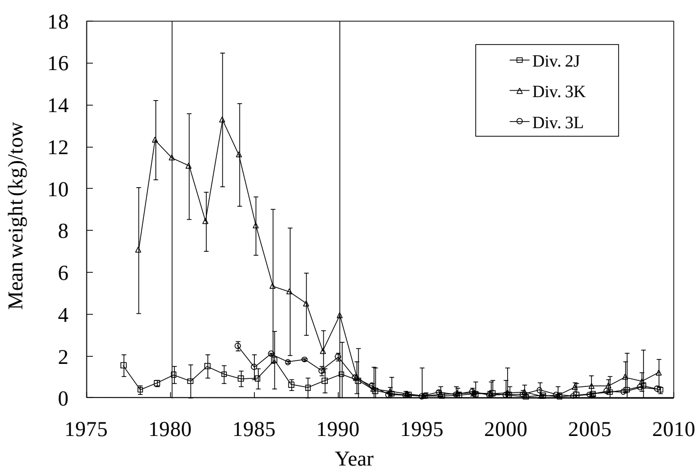


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow (with 95% confidence limits) from Canadian autumn surveys. Values are Campelen units or, prior to 1995, Campelen equivalent units.

Distributions of witch flounder in the Canadian autumn survey for 2010 was similar to previous surveys and are shown in Fig 19.3.

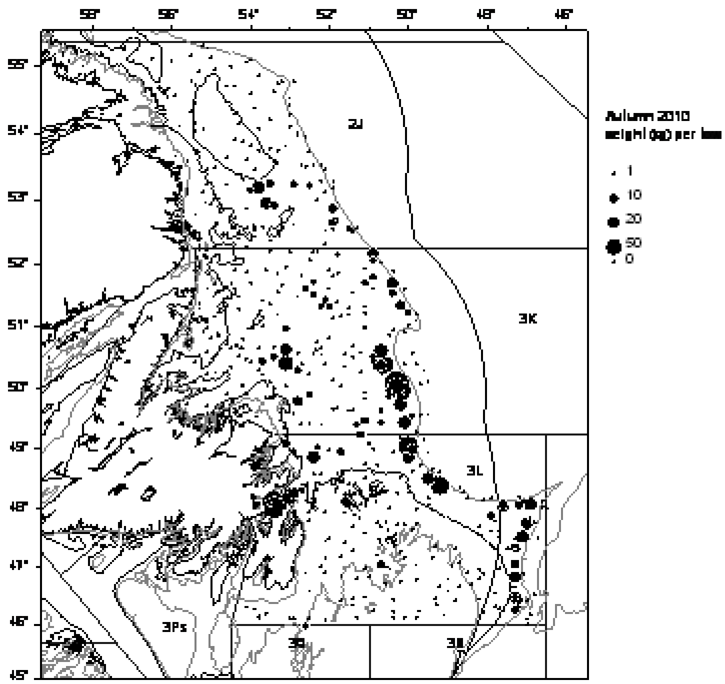


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per tow from the Canadian autumn survey in 2010.

c) Conclusion

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

The next full assessment of this stock is scheduled for 2013.

d) Research Recommendations

Witch flounder catch reported as taken in NAFO Div. 3M has the potential to belong to the Div. 2J3KL witch flounder stock, therefore STACFIS **recommended** that *the origin of the catch of witch flounder reported as caught in NAFO Div. 3M be explored.*

For witch flounder in Div. 2J, 3K and 3L, STACFIS **recommended** that *methods to improve the estimates of abundance and biomass from the Canadian autumn surveys be explored (for example excluding strata from the estimate where witch flounder are known not to occur).*

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

(SCR Doc. 09/12,22; 11/05,19,21,31,35,36,44; SCS Doc. 11/04,05,07,09,11; FC Doc 03/13, 10/12)

a) Introduction

Fishery and Catches: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by Fisheries Commission (FC). 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. 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). Though much lower than values of the early 2000s, estimated catch over 2004-2010 has exceeded the TAC by considerable margins. TAC over-runs have ranged from 22%-64%, despite the reduction in effort. The STACFIS estimate of catch for 2010 is 26 170 t (64% over-run). In 2010, Fisheries Commission implemented a survey-based harvest control rule (FC Doc. 10/12) to generate annual TACs over at least 2011-2014.

Recent catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	40	36	16	nr*	nr*	nr*	nr*	<10.5*,2	<8.8*,2	<14.5*,2
TAC	44	42	20	19	18.5	16	16	16	16	17†
STATLANT 21	31	31	16	18	18	15	15	14	11	
STACFIS	34	32-38[1]	25	23	24	23	21	23	26	

nr – no recommendation
* – evaluation of rebuilding plan
† – TAC generated from HCR
1 In 2003, STACFIS could not precisely estimate the catch.
2 SC 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.

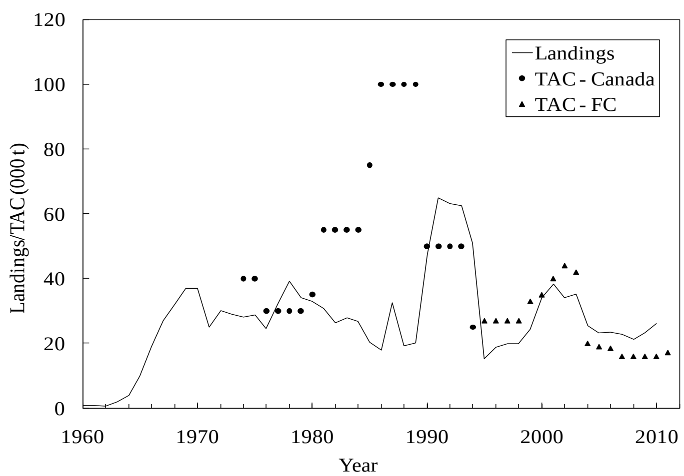


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) Input Data

Standardized estimates of CPUE were available from fisheries conducted by Canada, EU- Spain and EU-Portugal. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2+3KLMNO (1978-2010), EU in Div. 3M (1988-2010) and EU-Spain in Div. 3NO (1995-2010). Commercial catch-at-age data were available from 1975-2010.

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, however the 2010 value declined by 50% from the 2007 – 2009 estimates. At present, most of the Canadian landings come from Divs. 2J3K (SCR Doc. 11/44).

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN over 1988-2010 (SCS Doc. 11/05) declined sharply in 1991 from initial levels. Consistent increases were estimated over the mid-1990s until 2000. The standardized CPUE was recently very high, but in 2010 declined to only 30% of that in the previous year. In 2010, 97% of the Portuguese catch was taken in Div. 3LM.

Spatial analysis of catch and effort trends of the Spanish fleet (SCR Doc. 09/22, SCS Doc. 11/07) indicated the area being fished by this fleet has contracted as effort has been substantially reduced since 2003 under the Fisheries Commission rebuilding plan. Fishing is now concentrated within Div. 3LM. The standardized CPUE for the Spanish fleet has also increased considerably after 2005, but unlike the other two series it remains relatively high.

Unstandardized catch rates from the Russian fleet over 1998-2009 (SCS Doc. 10/05) indicate similar patterns as in the other fleets. In 2010, 89% of the catch by Russian Federation came from Div. 3L.

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 over the 2006-2009 period, but in 2010, only the Spanish CPUE remains at a relatively high level. (Fig 20.2).

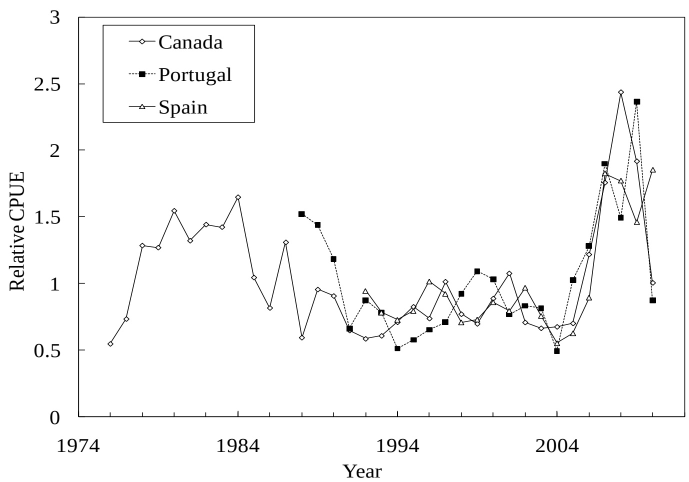


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2010 average.)

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 2010 were presented. Length samples of the 2010 fishery were provided by EU-Lithuania, EU-Spain, EU-Portugal, Russian Federation and Canada. Aging information was available for Russian, Spanish and Canadian fisheries. Due to aging inconsistencies, an age-length key from Canadian commercial samples was applied to calculate the total 2010 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 8% 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 Doc. 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. The increasing trend has not continued in 2009 and 2010; the biomass index has declined by approximately 30% from the 2007 level (SCR Doc. 11/31). 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 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 2010 abundance index has improved over recent levels due to a relatively large number of age 1 fish surveyed in Div. 2J+3K.

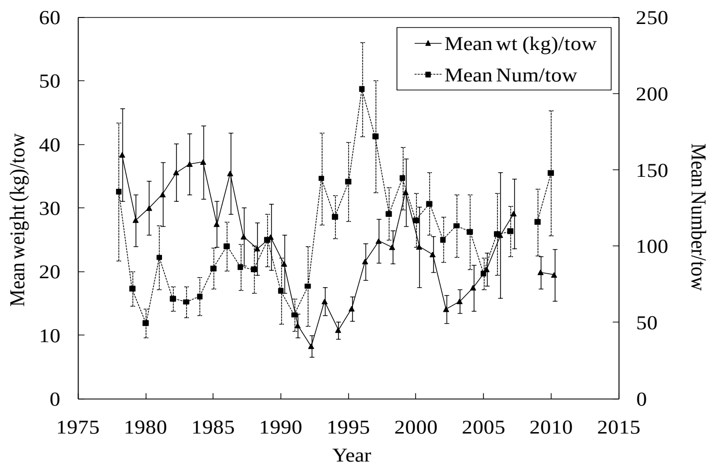


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

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 and as such are not useful for inferring stock status. 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, 1993) an apparent redistribution of the resource in the early 1990s. Thus, the declining trend in the Canadian autumn surveys in Div. 2J and 3K from the mid-1980s to the early 1990s might have been more a reflection of Greenland halibut emigrating from the survey area to the deep waters of the Flemish Pass as opposed to a severe decline in the stock. However, since the mid-1990s, survey indices 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. 20.4) 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 2010 are below the time-series average.

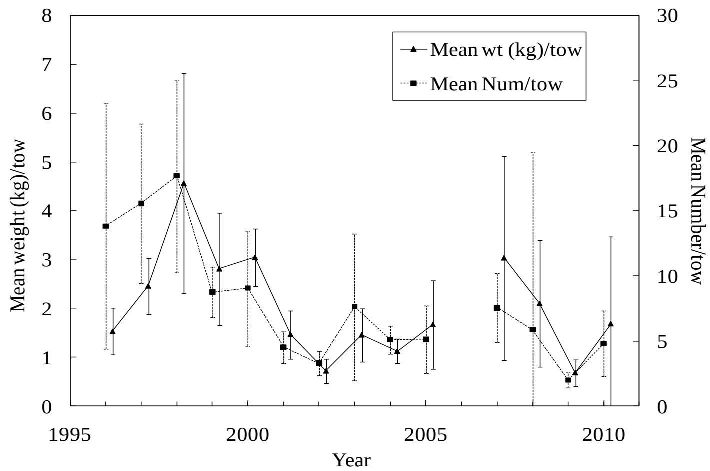


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M (Flemish Cap): Surveys conducted by the EU in Div. 3M during summer (SCR Doc. 11/21) 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. 20.5) 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 and 2010, the index has decreased and is presently relatively low. The Flemish Cap survey was extended to cover depths down to 1460 m beginning in 2004. Biomass estimates over the full depth range doubled over 2005-2008 and remained high in 2009. The 2010 estimate is 25% lower than the 2009 value.

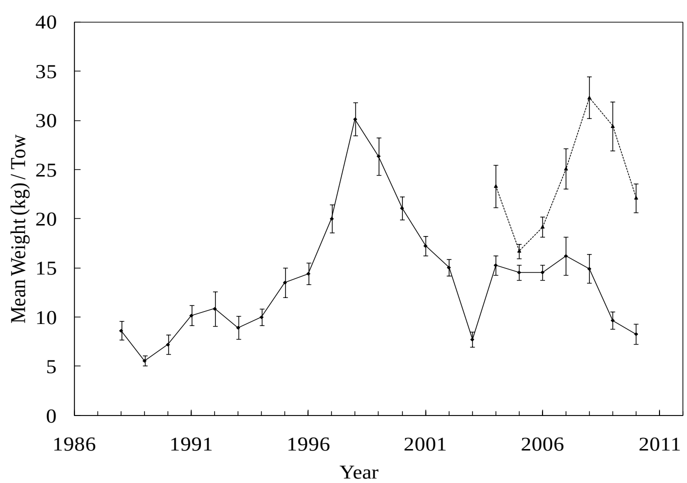


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (mean catch per tow ± 1 S.E.) from EU summer surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

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 Doc. 11/05) generally declined over 1999 to 2006 (Fig. 20.6). Over 2007-2009, the biomass index has increased four-fold. Survey results from 2010 indicate the index remains at this higher level.

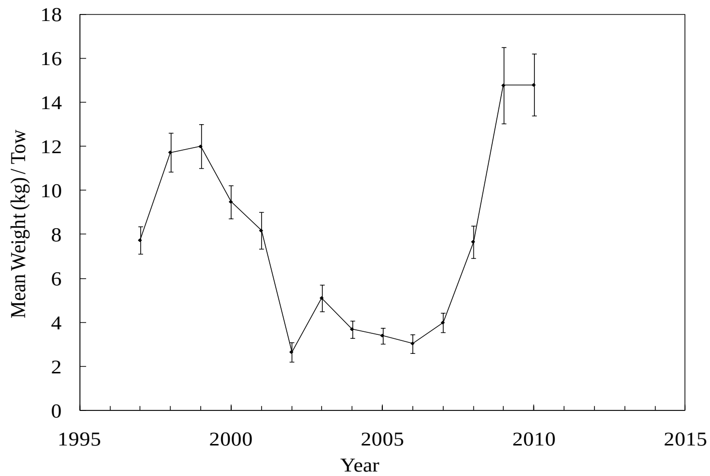


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in the NRA of Div. 3NO.

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 the 1995-2003, indices from the majority of the surveys generally provided a consistent signal in stock biomass (Fig. 20.7). The trend since 2004 shows greater divergence, yet generally suggest declines in stock biomass over 2008-2010. These discrepancies complicate interpretations of overall resource status.

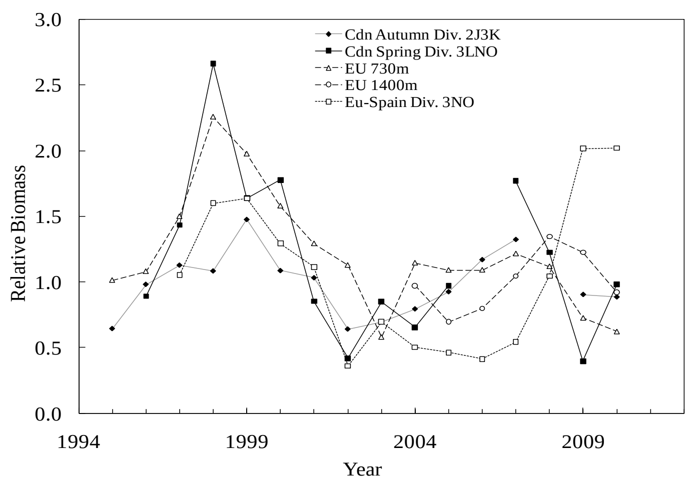


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices from Canadian autumn surveys in Div 2J+3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and EU-Spain surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2010 average.

c) Estimation of Parameters

In the previous assessment, 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. The final run included the following age disaggregated data series in the calibration data set: (i) Canadian Autumn Div. 2J+3K, (ii) Canadian Spring Div. 3LNO, (iii) EU summer Div. 3M (0-700m) for 1995-2003 only, and (iv) EU summer Div. 3M (0-1400m) over 2004-2010.

Two XSA analyses were considered in the present assessment. First, an updated analysis using the data series and settings from the previous assessment was considered. The data series used and XSA settings applied were as follows:

Catch data from 1975 to 2010, 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	2010	1	13
Canadian autumn survey (Div. 2J3K)	1996	2010	1	13
Canadian spring survey (Div. 3LNO)	1996	2010	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

Due to a strong temporal trend in the residuals of the age 1-4 data from the EU 0-1400m index over 2004-2010, a second analysis identical to the update run aside from the exclusion of these data was conducted. The overall mean square index for the EU 0-1400m index was considerably improved, and model results were virtually identical. Both sets of results were compared and the only noticeable difference is in the estimated recruitment in the past few years. The results shown below pertain to the update run which is more consistent with the data series applied in the MSE (and model settings in the case of the XSA operating models).

d) Other Studies

Statistical catch-at-age: An assessment of stock size using a statistical catch at age formulation was presented and compared to estimates from the XSA update run described above. The model used (ASAP) 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). This analysis expands upon the preliminary formulation that was presented in 2010. The data set used in the ASAP 2011 model (catch and surveys) included the data used in the XSA 2011 formulation (SCR Doc. 11/36) but included also the Spanish Div. 3NO survey for ages 2 to 13. Diagnostics still showed a poor fit as in 2010. Residuals from the survey index showed similar pattern of conflicting trends as for the XSA but less pronounced. This was however due to the fitting of predicted catches which showed very high deviations from the observed catch (e.g. up to 60% in the early 2000s.). Observed versus predicted proportions at age in the catches also showed a poor fit for some years from the mid 1990s to mid 2000s. Retrospective analysis showed better stability than the XSA 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. A run fitting the predicted catch to the observed resulted in similar results as the XSA formulation. This highlights the continuing problem of quality of input data.

Aging Validation: Age determination of Greenland halibut is relatively difficult, and it is thought that some individuals are likely underaged. Additional information from a recent workshop on this topic is contained in the STACREC report, Item 5.d.

e) Extended Survivors Analysis (XSA) 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 for many 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 these results.

Biomass (Fig. 20.8): The fishable biomass (age 5+) declined to low levels in 1995-97 due to very high catches and high fishing mortality. It increased during 1998-2000 due to greatly reduced catches, much lower fishing mortality and improved recruitment. Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2011, in part due to weaker year-classes recruiting to the biomass. Estimates of 2011 survivors from the XSA are used to compute 2011 biomass assuming the 2011 stock weights are equal to the 2008-2010 average. The 2011 5+ biomass is estimated to be about 84 000 t. The 10+ biomass peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2011 and is presently about 25% of the total 5+ biomass.

Fishing Mortality (Fig. 20.9): High catches in 1991-94 resulted in average fishing mortality over ages 5 to 10 (F_{5-10}) exceeding 0.70. F_{5-10} increased over 1995-2003 with increasing catch, but declined after 2003 under the Fisheries Commission rebuilding plan. F_{5-10} in 2010 has increased and is estimated to be 0.37.

Recruitment (Fig. 20.10): The current assessment indicates that year-classes about to recruit to the exploitable biomass are well below average strength. The 2009 and 2010 estimates of recruitment are considerably improved, but will not recruit to the fishery for at least another three years. Further, recent estimates are based on limited data, and the recruitment signal from the various surveys is not consistent.

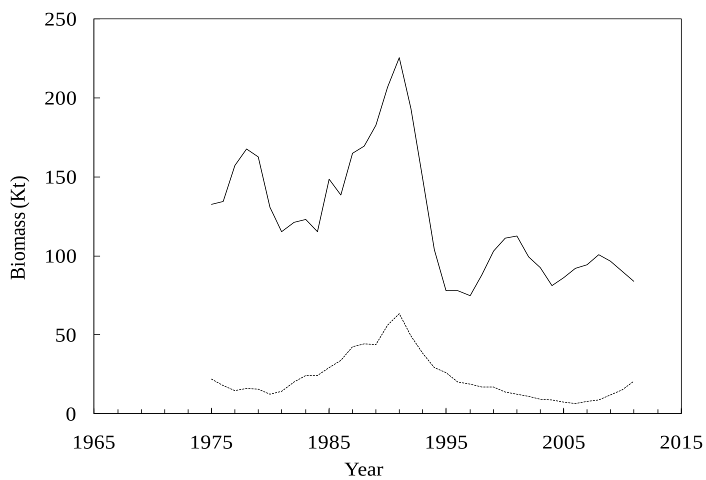


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated exploitable (5+ biomass; solid line) and 10+ biomass (dashed line) from XSA.

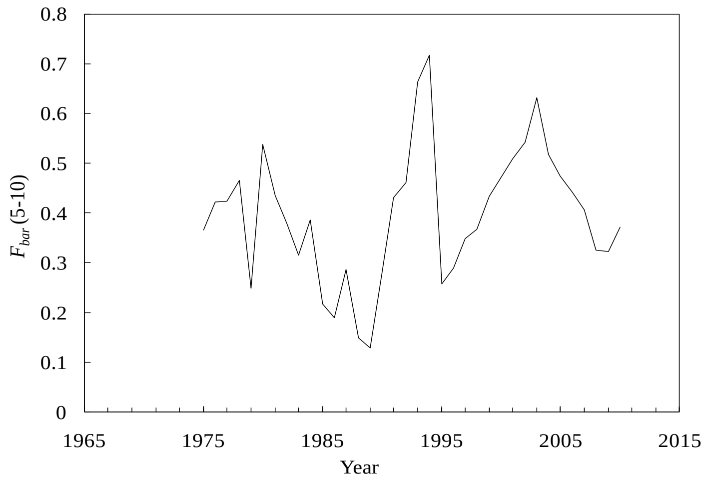


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: Estimated fishing mortality (averaged over ages 5-10) from XSA.

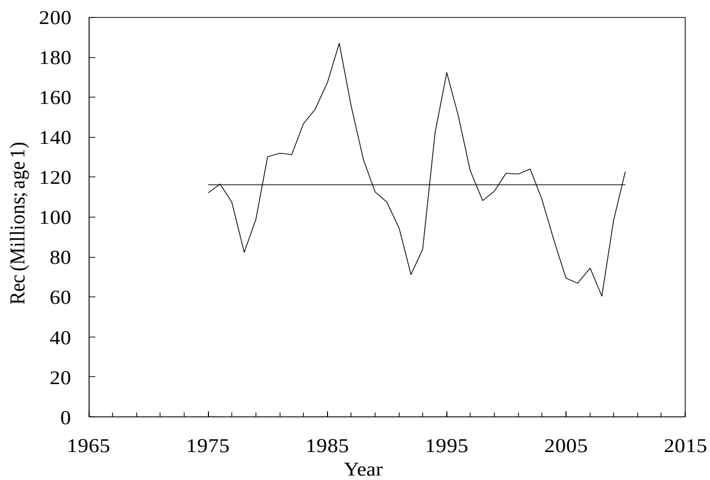


Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA. Horizontal reference line indicates mean recruitment.

f) Retrospective Analysis

A four-year retrospective analysis of the XSA was conducted by eliminating successive years of catch and survey data. Fig- 20.11 - 20.13 present the retrospective estimates of 5+ biomass, average fishing mortality at ages 5-10 and age 1 recruitment. The estimates of 5+ biomass and fishing mortality in the current assessment differ from that in the previous assessment, with indication that biomass was over-estimated and fishing mortality underestimated. Recent recruitment estimates appear to be somewhat unstable, and there are relatively large revisions to cohorts which are now aged 7-10 years old.

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

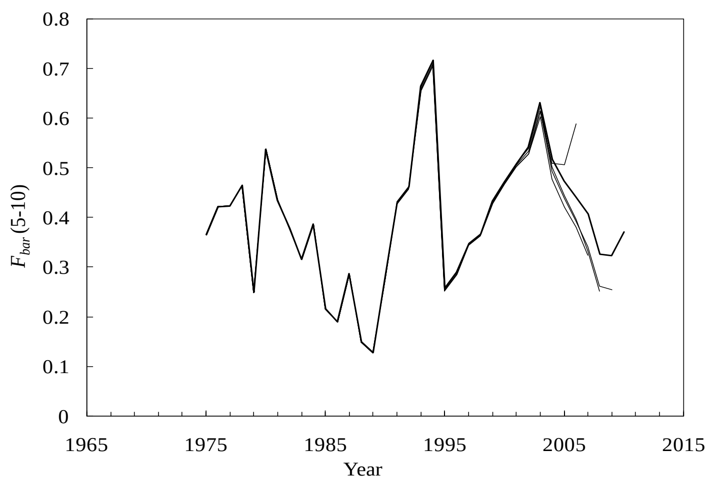


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

Fig. 20.13. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; age 1 recruitment.

State of the Stock: Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2011, in part due to weaker year-classes recruiting to the biomass. The 10+ biomass peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2011. Average fishing mortality (over ages 5-10) has decreased considerably since 2003. The 2010 estimate of fishing mortality has increased due to higher catches coupled with the poor recruitment to the exploitable biomass. Year-classes about to recruit to the exploitable biomass are well below average strength.

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 0.41 and $F_{0.1}$ is 0.22, 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. 20.14) indicates that the estimated average fishing mortality for 2010 (0.37) is near the F_{max} level.

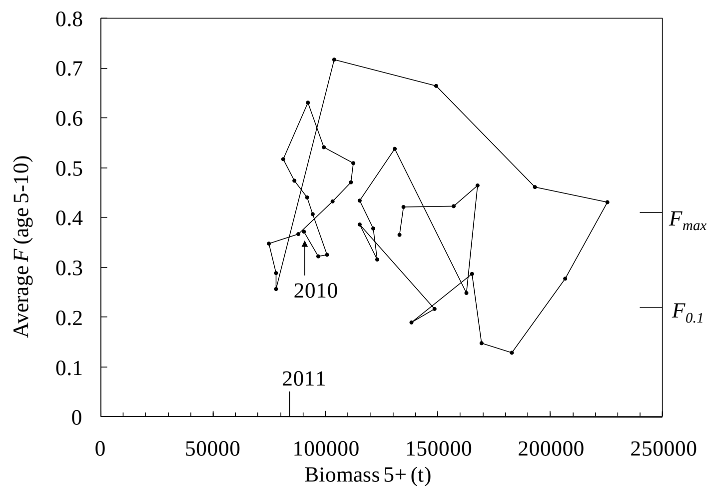


Figure 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory in relation to yield per recruit reference points. The 2011 estimate of biomass (84 000 t) is indicated on the biomass axis.

References

NAFO 1993. STACFIS REPORT.

NAFO 2004. STACFIS REPORT.

h) Research Recommendations

For Greenland halibut in Subarea 2 + Div. 3KLMNO, STACFIS **recommended** *ongoing investigations into the assessment methods used*. This should include further explorations with the statistical catch at age model.

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

Previous survey experiments have noted that the depth distribution of Greenland Halibut extends beyond 1500m, the maximum depth of the survey information currently available to assess this stock. 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.*

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*.

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.

21. Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4

Interim Monitoring Report

a) Introduction

Since 2001, catches in Subareas 3+4 have ranged between 57 t in 2001 to about 7 000 t in 2006 but have generally been less than 700 t (Fig. 21.1). In 2010, the catch was 120 t and was mostly taken from Div. 3KL (83%).

Recent catches and TACs ('000 t) are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TAC SA 3+4	34	34	34	34	34	34	34	34	34	34
STATLANT 21 SA 3+4	0.2	1.1	2.3	0.6	6.9[1]	0.2[1]	0.5[1]	0.7[1]	0.1[1]	
STATLANT 21 SA 5+6[2]										
STACFIS SA 3+4	0.2	1.1	2.3	0.6	6.9	0.2	0.5	0.7	0.1	
STACFIS SA 5+6	2.8	6.4	26.1	12.0	13.9	9.0	15.9	18.4	15.8	
STACFIS Total SA 3-6	3.0	7.5	28.4	12.6	20.8	9.2	16.4	19.1	15.9	

[1] Includes amounts (ranging from 12-43 t) reported as either Unspecified Squid or *Illex* that may have been misidentified as *Loligo* in Subarea 4.

[2] Statistics for SA 5+6 are included because there is no basis for considering separate stocks in SA 3+4 and SA 5+6

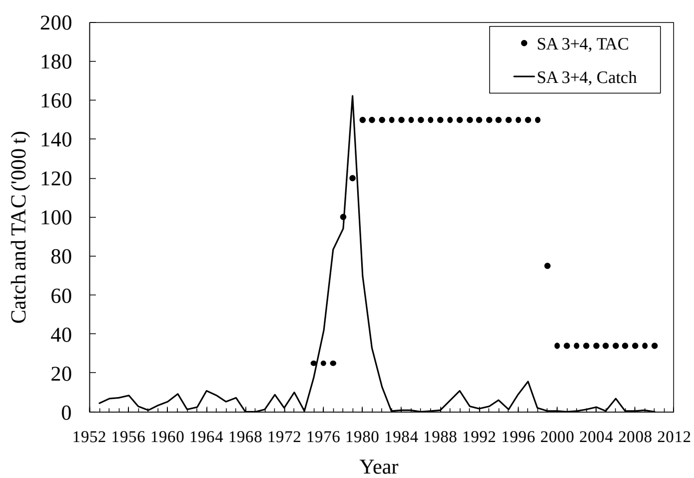


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

b) Data Overview

The index of relative biomass is the Div. 4VWX July Canadian survey which has fluctuated widely since 2003. The third and fourth highest values in the time series occurred in 2004 and 2006, but both years were followed by very low values. The 2010 index (1.8 kg/tow) decreased from 2009 (6.0 kg/tow, Fig. 21.2) and was below the average for the low productivity period which began in 1982.

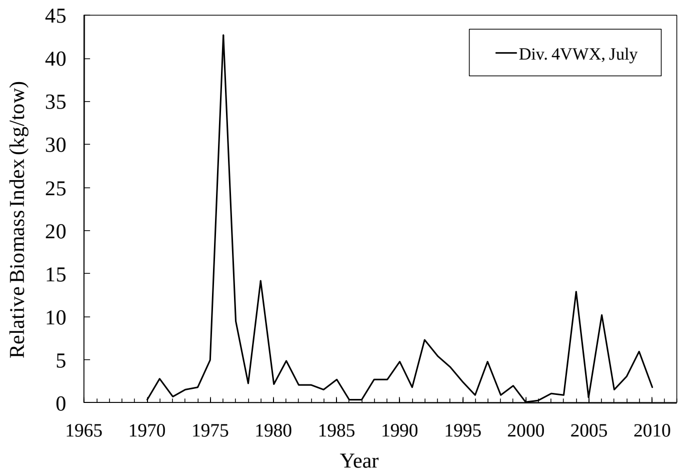


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices from the July survey in Div. 4VWX.

The mean weight of squid from the Div. 4VWX survey increased marginally from 86 g in 2009 to 92 g in 2010; a value that was slightly above the 1982-2009 average (Fig. 21.3) but remains below the average from the high productivity period.

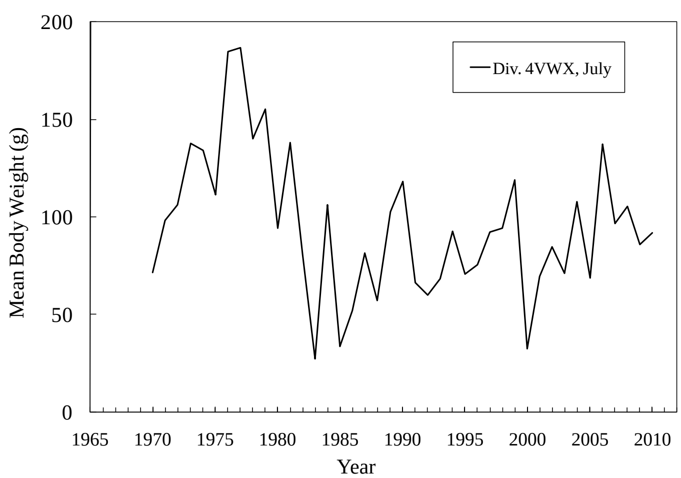


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX.

Catch/biomass ratios (relative fishing mortality indices) have been very low since 2001(Fig. 21.4).

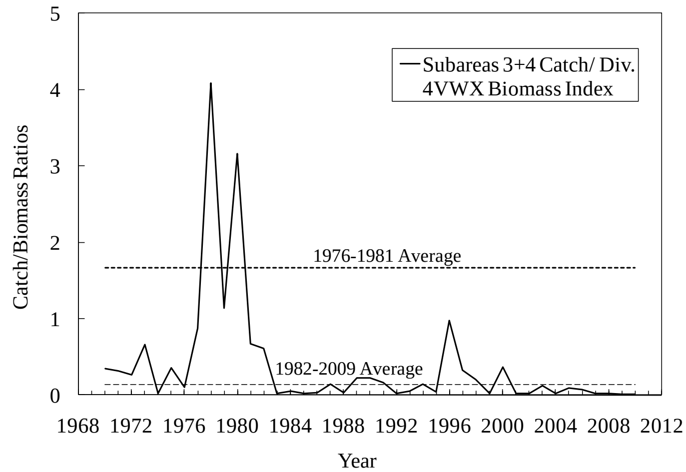


Fig. 21.4. Northern shortfin squid in Subareas 3+4: Catch/Biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index) for Northern shortfin squid in Subareas 3+4.

c) Conclusion

In 2010, the biomass index from the Div. 4VWX survey was slightly below and mean body weight was slightly above the 1982-2009 mean for the low productivity period while remaining below the high productivity average. Catch/biomass ratios have also been very low since 2001. In 2010, the stock remained in a state of low productivity.

The next full assessment of this stock is scheduled for 2013.

d) Research Recommendation

In 2010 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 has been made.

IV. STOCKS UNDER A MANAGEMENT STRATEGY EVALUATION

1. Greenland halibut in SA2 and Div. 3KLMNO

This stock is taken under D. Widely Distributed Stocks: SA 2, SA 3 and SA 4.

V. 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 2011. 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]	3M Cod	
Small	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 3NO Witch flounder 3M Northern shrimp[1]			SA1 Redfish SA0+1 Roundnose grenadier
Unknown	SA2+3 Roughhead grenadier 3NO Capelin 3O Redfish	0&1A Offsh. & 1B–1F Greenland halibut		Greenland halibut in Uummannaq[2] Greenland halibut in Upernavik[2] SA2+3 Roundnose grenadier Greenland halibut in Disko Bay[2]

[1] Shrimp will be re-assessed in Nov 2011
[2]Assessed as Greenland halibut in Div. 1A inshore

2. Other Business

There was no other business.

V. ADJOURNMENT

STACFIS Chair thanked the Designated Experts for their competence and very hard work and the Secretariat for its great support. The STACFIS Chair also thanked the Chair of Scientific Council, and the Scientific Council Coordinator for their support and help. The meeting was adjourned at 1600 on 15th June.