NORTHWEST ATLANTIC FISHERIES ORGANIZATION

Scientific Council Reports 2011

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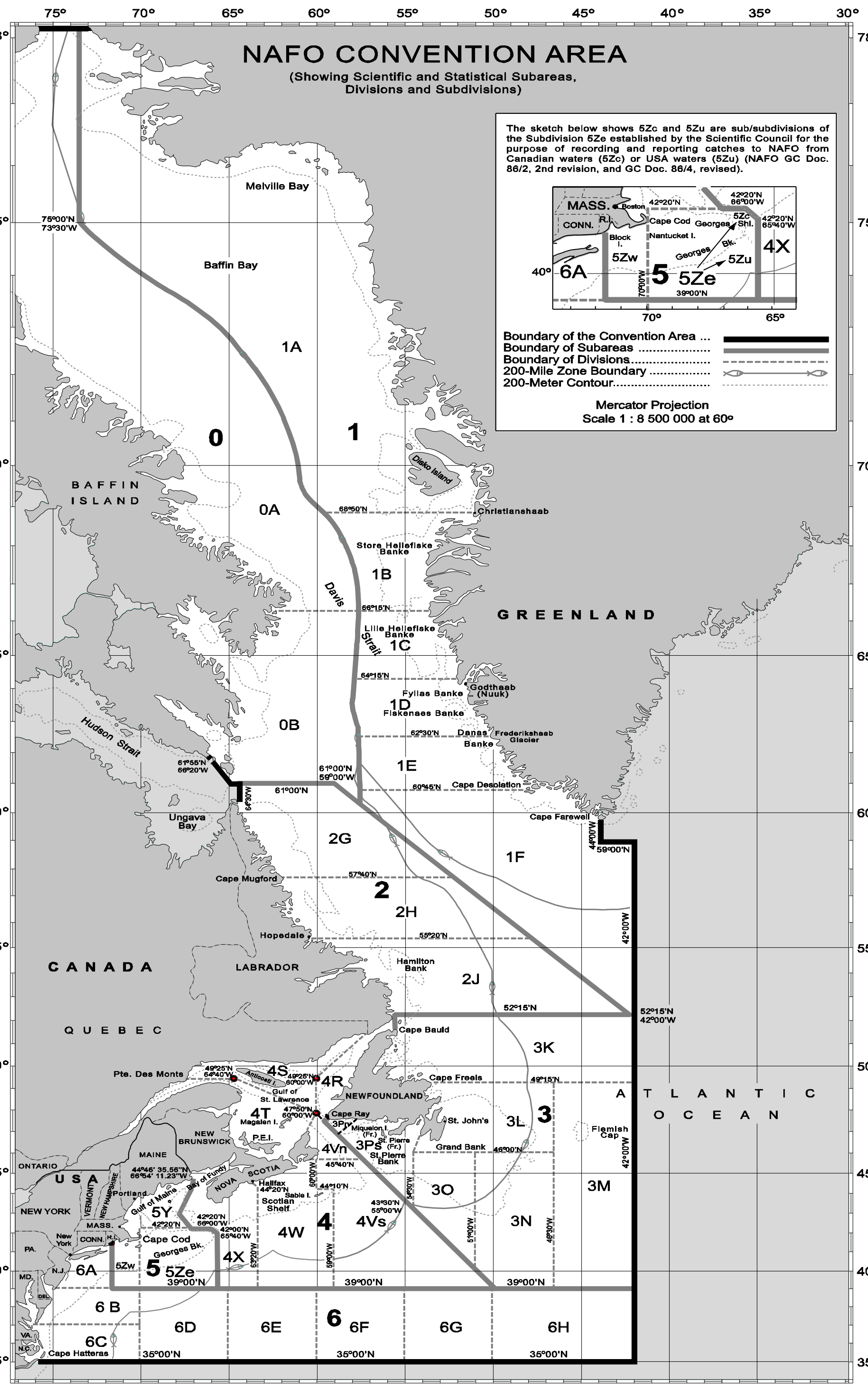
PREFACE

This thirty-second issue of *NAFO Scientific Council Reports* containing reports of Scientific Council Meetings held in 2011 is compiled in five sections: **Part A** - Report of the Scientific Council Meeting during 3-16 June 2011 which addressed most of the annual requests for scientific advice on fisheries management and ecosystem considerations; **Part B -** Report of the Scientific Council Meeting 1-12 September 2011, which provided the updated shrimp advice for consideration at the Annual Meeting; **Part C** - Report of the Scientific Council Annual Meeting during 19-23 September 2011, **Part D** - Report of the Scientific Council Meeting during 19-26 October 2011, which addressed the requests for scientific advice on northern shrimp, and **Part E** - the Agendas, Lists of Research and Summary Documents, List of Representatives, Advisers, Experts and Observers, and List of Recommendations relevant to Parts A, B, C and D.


NAFO CONVENTION AREA
(Showing Scientific and Statistical Subareas, Divisions and Subdivisions)
The sketch below shows 5Zc and 5Zu are sub/subdivisions of the Subdivision 5Ze established by the Scientific Council for the purpose of recording and reporting catches to NAFO from Canadian waters (5Zc) or USA waters (5Zu) (NAFO GC Doc. 86/2, 2nd revision, and GC Doc. 86/4, revised).
Boundary of the Convention Area
Boundary of Subareas
Boundary of Divisions
200-Mile Zone Boundary
200-Meter Contour
Mercator Projection
Scale 1 : 8 500 000 at 60°
Melville Bay
Baffin Bay
BAFFIN ISLAND
GREENLAND
Davis Strait
Hudson Strait
Ungava Bay
CANADA
LABRADOR
QUEBEC
NEWFOUNDLAND
ATLANTIC OCEAN
USA
0
1
2
3
4
5
6
0A
0B
1A
1B
1C
1D
1E
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4Vn
4Vs
4W
4X
5Y
5Ze
5Zw
5Zc
5Zu
6A
6 B
6C
6D
6E
6F
6G
6H
Flemish Cap
Grand Bank
Hamilton Bank
Cape Farewell
Cape Desolation
Cape Mugford
Hopedale
Cape Bauld
Cape Freels
Cape Ray
Cape Cod
Cape Hatteras
Georges Bk.
Gulf of Maine
Bay of Fundy
Scotian Shelf
Gulf of St. Lawrence
St. John's
Halifax
Portland
Boston
NOVA SCOTIA
NEW BRUNSWICK
P.E.I.
MAINE
NEW YORK
ONTARIO
MASS.
CONN.
Christianshaab
Store Hellefiske Banke
Lille Hellefiske Banke
Fyllas Banke
Fiskenaes Banke
Godthaab (Nuuk)
Frederikshaab Glacier
Danas Banke
Disko Island
75°00'N 73°30'W
61°00'N
52°15'N 42°00'W
39°00'N
35°00'N
42°00'W
44°00'W
59°00'N

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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.

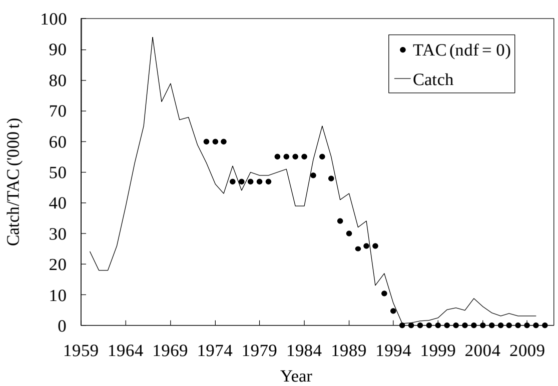
American plaice in Divisions 3LNO

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

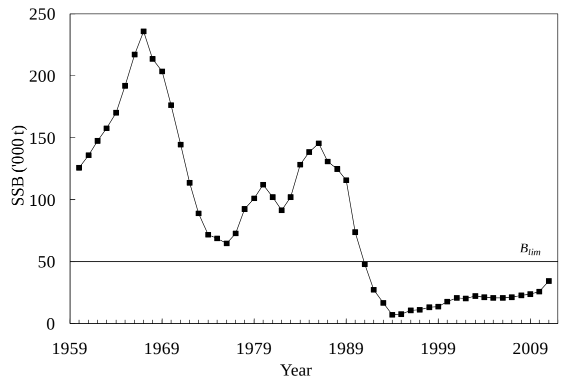
ndf No directed fishing.



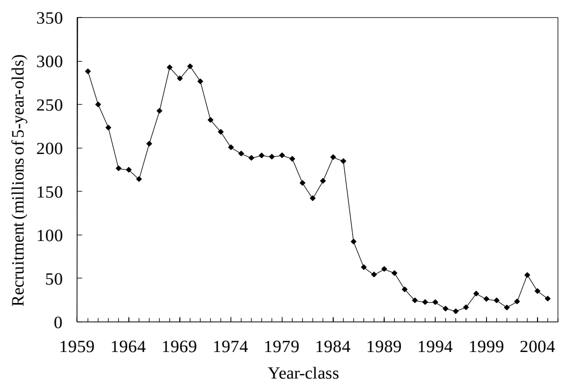
Data: Biomass and abundance data were available from: annual Canadian spring (1985-2010) and autumn (1990-2010) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch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

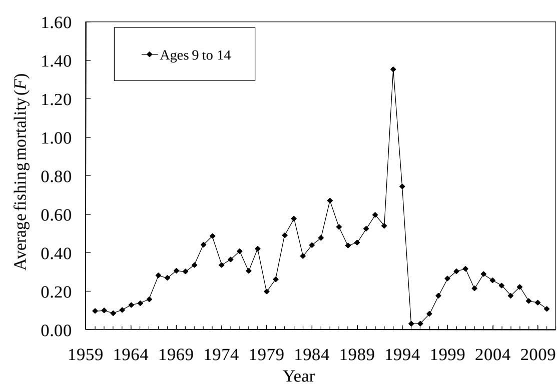
Biomass: Despite the increase in biomass since 1995, the biomass is very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and is currently at 34 000 t. B_{lim} for this stock is 50 000 t.



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.

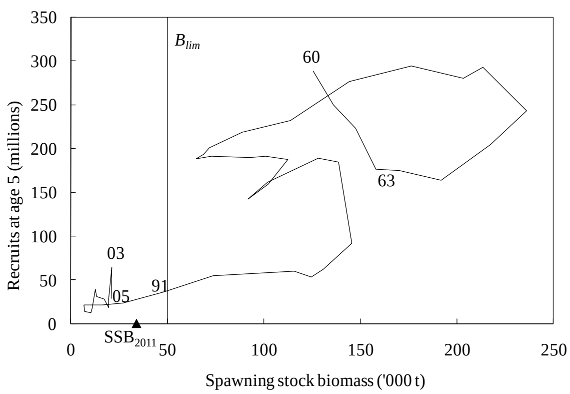


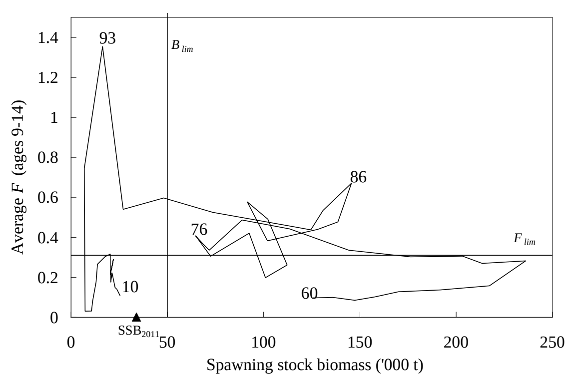
Fishing mortality: Fishing mortality on ages 9 to 14 has generally declined since 2001.



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

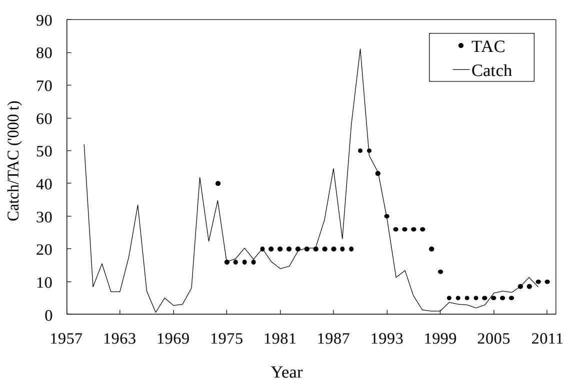
Background: There are 3 species of redfish, which are commercially fished on Flemish Cap: deep-water redfish *(Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The present assessment evaluates the status of the Div. 3M beaked redfish stock, regarded 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

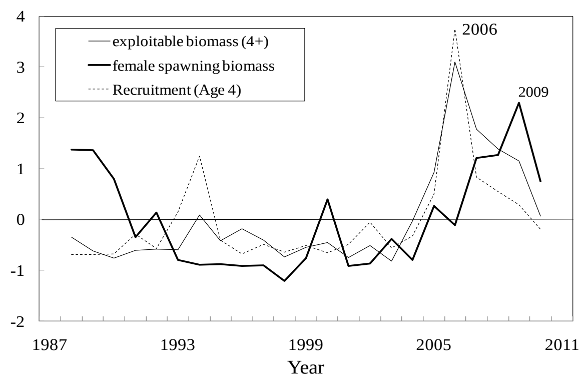
[1] Estimated total redfish catch
[2] Estimated beaked redfish catch
[3] Provisional.



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

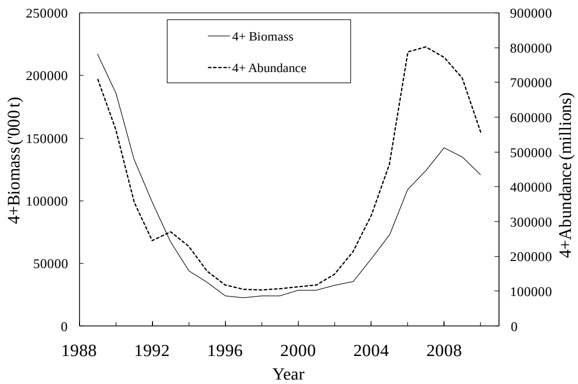
There are three bottom trawl survey series providing biomass indices as well as length and age data for the Flemish Cap redfish stocks; Russia (1983-93, 1995-96 and 2001-2002), EU (1988-2010) and Canada (1979-85 and 1996). The Russian survey was complemented with an acoustic estimate of the redfish pelagic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

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

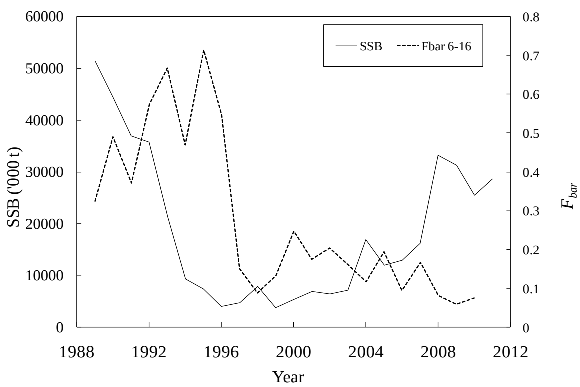


A virtual population (XSA) was carried out for 1989-2010. In order to adjust the model to the recent declines observed on survey exploitable and spawning biomass, that can only be explained by an increase in mortality other than fishing mortality, a sensitivity analysis was carried out, allowing an increase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

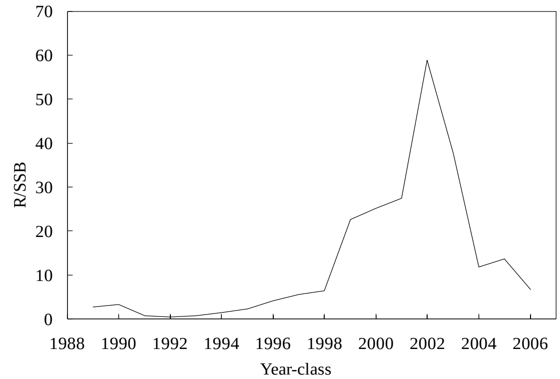


Biomass: Experienced a steep decline from the 1989 until 1996. The exploitable stock was kept at a low level until the early 2000's, basically dependent on the survival and growth of the existing cohorts. Above average year classes coupled with high survival rates allowed a rapid growth of biomass and 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		
$F_{\text{status quo}}$=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.

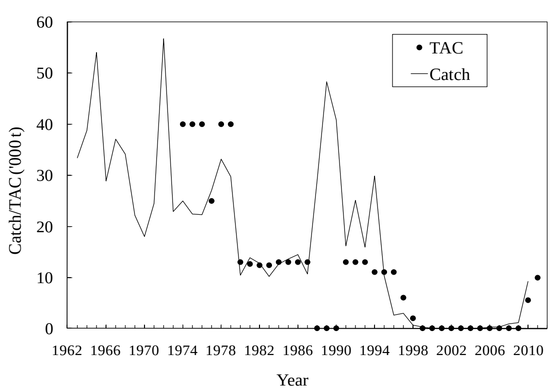
Cod in Division 3M

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

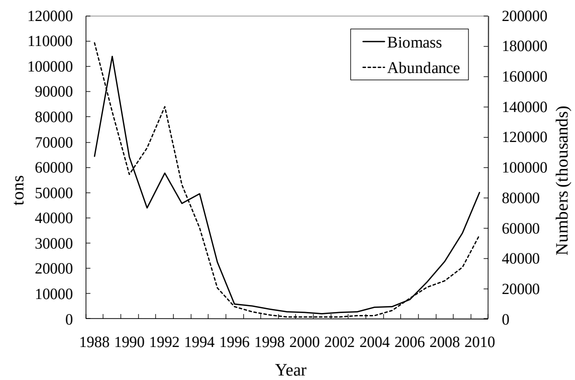
ndf No directed fishing.



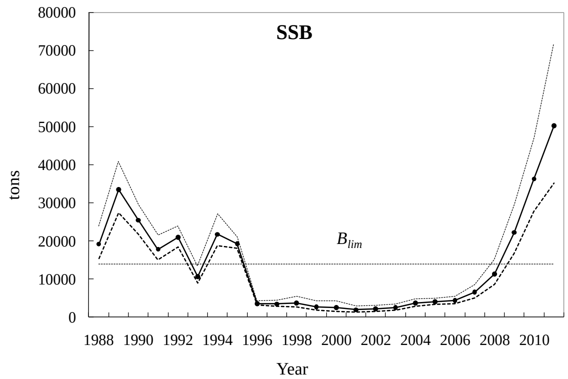
Data: Length and age compositions of the 2002-2005 commercial catches were not available. Length distributions were available for 2006-2009, although sampling levels were low. For 2010 there were samples for EU-Lithuania, Norway, EU-Portugal, EU-Spain and EU-UK. Abundance at age indices were available 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.

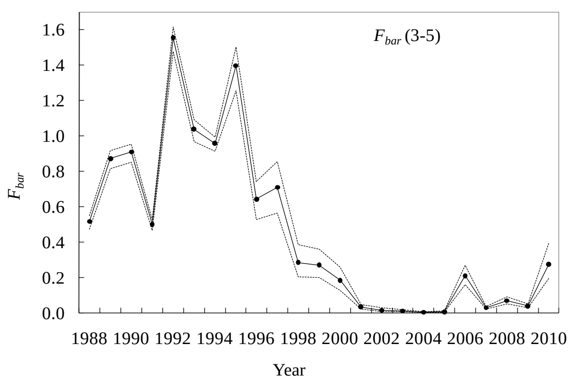
Total Biomass and Abundance: Estimated total biomass and abundance show an increasing trend in both values in recent years, being the increase in biomass higher than the one in abundance. While total biomass is at the level of the beginning of the 90´s, abundance is still below those values.



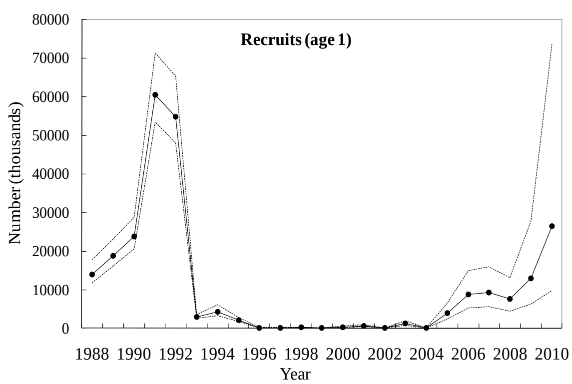
SSB: Spawning stock biomass increases from 2004, with the biggest increase taking place during 2008-2011. The big increase in the last four years is largely due to five reasonably abundant year classes, those of 2005-2009, as well as to the larger weight at age and the younger age of maturity observed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



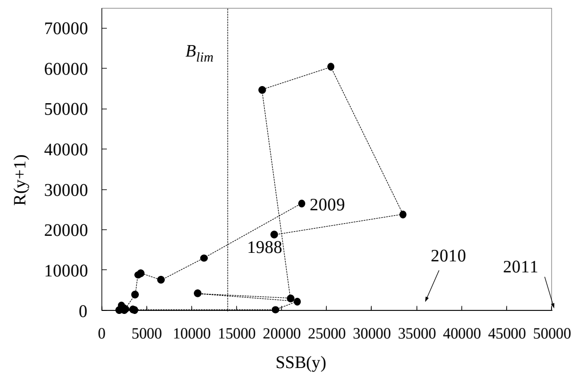
Fishing mortality: Very low from 2001 to 2009. In 2010 the F_{bar} level increased because of the reopening of the fishery. F_{2010} (0.28) exceed F_{max} (0.21).



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.

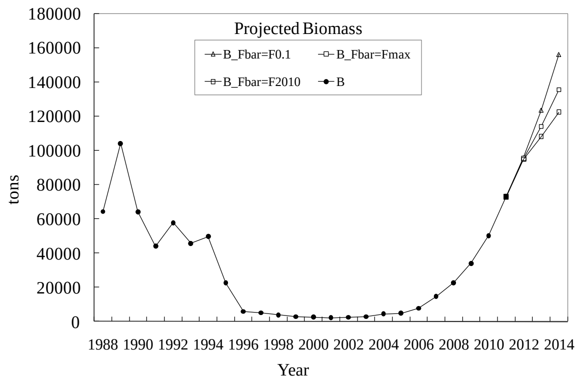


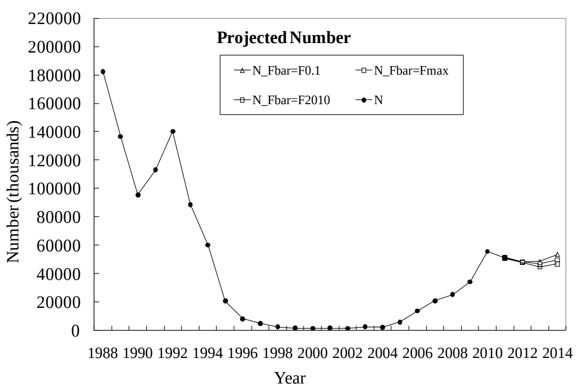
State of the Stock: There has been a significant spawning biomass increase, with levels much above B_{lim}, although abundance remains still lower than in the beginning of the time series. As a result of changes noted in weight and maturity, it is unclear whether the meaning of spawning biomass as an 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.

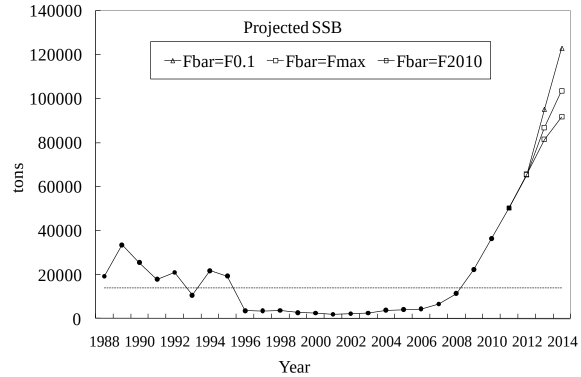
Stock Projections: Stochastic projections have been performed for 2012-2014 under three fishing mortality scenarios: (1) $F_{bar}=F_{0.1}$ (median=0.130); (2) $F_{bar}=F_{max}$ (median=0.210); (3) $F_{bar}=F_{2010}$ (median=0.280). All scenarios assumed that the Yield for 2011 is the established TAC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

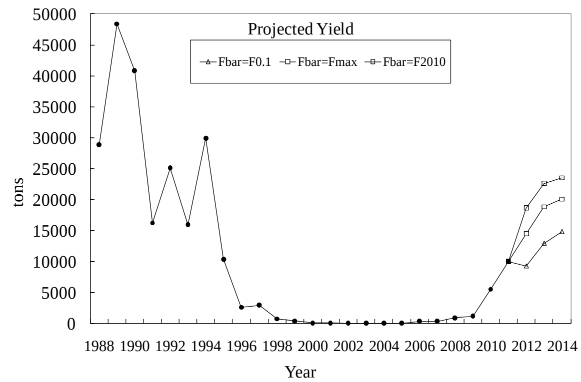
Under all scenarios, total biomass and SSB have a very high probability of reaching levels higher than all of the 1988-2011 estimates. However, this increase does not have_a counterpart in terms of population abundances, which are projected to remain at levels below those of the late 80's. That is because 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 50%	Total Biomass 5%-95%	SSB 50%	SSB 5%-95%	Yield 50%	Yield 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

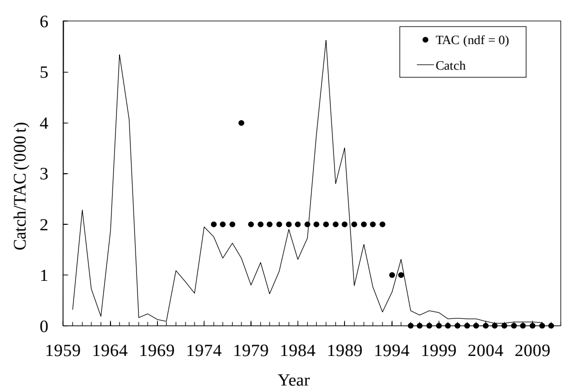
Background: The stock occurs mainly at depths shallower than 600 m on Flemish Cap. Catches are taken mainly by otter trawl, primarily in a bycatch fishery of the Contracting Parties since 1992.

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

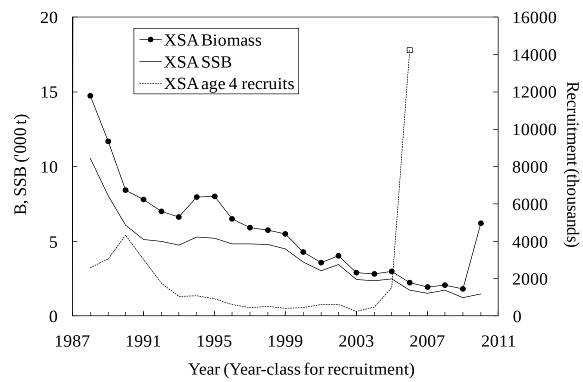
ndf No directed fishing.



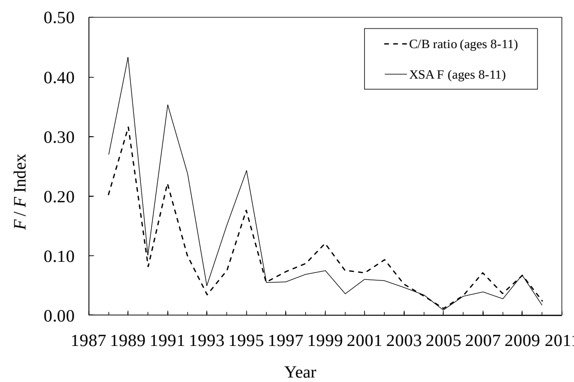
Data: Length compositions were available from the 1988 to 2010 fisheries. Abundance and biomass from surveys were available from USSR/Russia (1972-2002), EU (1988-2010) and Canada (1978-1986). Age-length keys were available from EU surveys (1988-2010).

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.



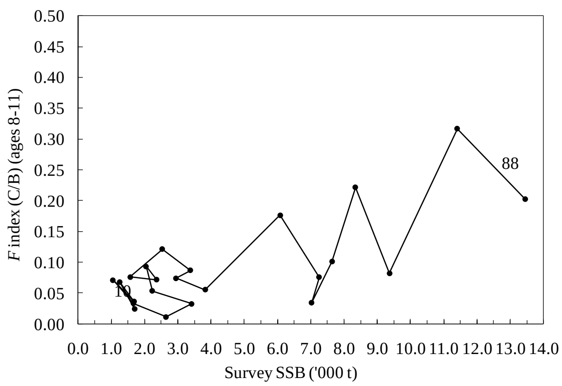
Recruitment: 1991 to 2005 year classes are estimated to be weak. Since 2006 the recruitment improved, particularly the 2006 year class.

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

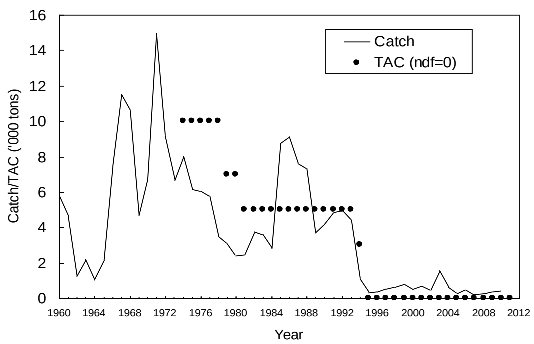
Witch flounder in Divisions 3NO

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

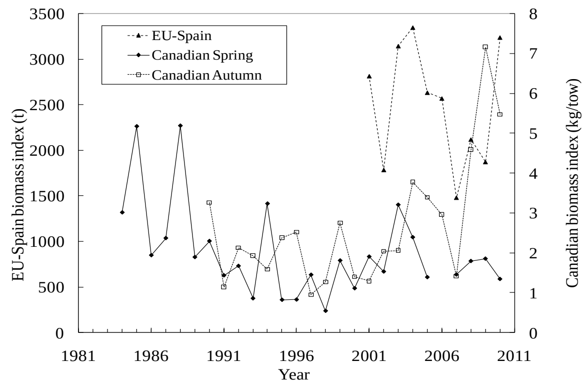
ndf No directed fishing.



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.

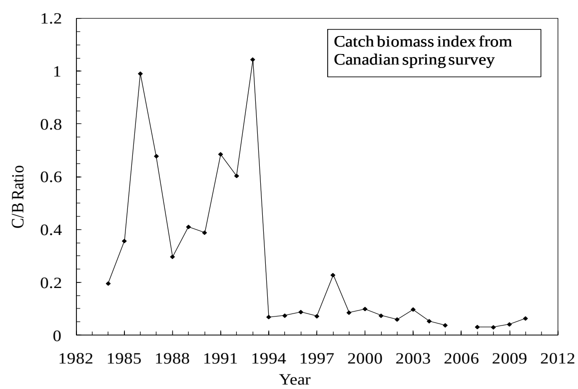
Assessment: No analytical assessment was possible with current data.

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.

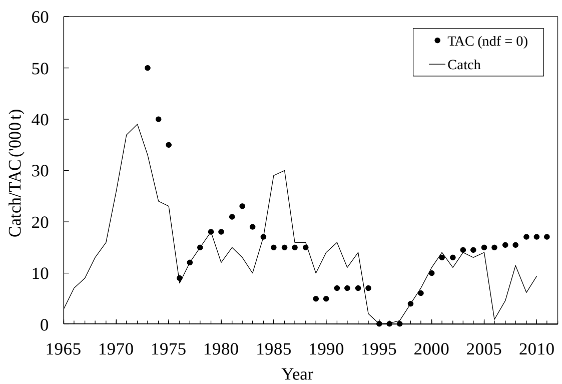
Sources of Information: SCR Doc. 11/6, 29, 37; SCS Doc. 11/5, 6, 9.

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.

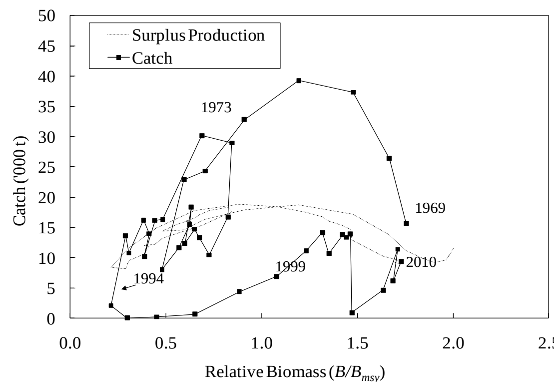
Year	Catch ('000 t) STACFIS	Catch ('000 t) 21	TAC ('000 t) Recommended	TAC ('000 t) Agreed
2008	11.4	11.3	15.5	17.0
2009	6.2	5.5	<85% F_{msy}	17.0
2010	9.4	9.1	<85% F_{msy}	17.0
2011			<85% F_{msy}	17.0

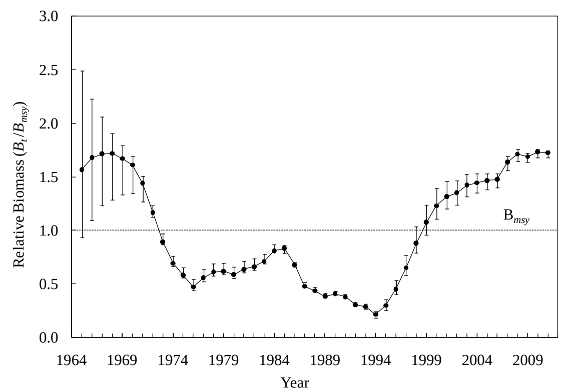


Data: Abundance and biomass indices were available from: annual Canadian spring (1971-82; 1984-2010) and autumn (1990-2010) bottom trawl surveys; annual USSR/Russian spring surveys (1972-91); and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2010). Length frequencies of the catch from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

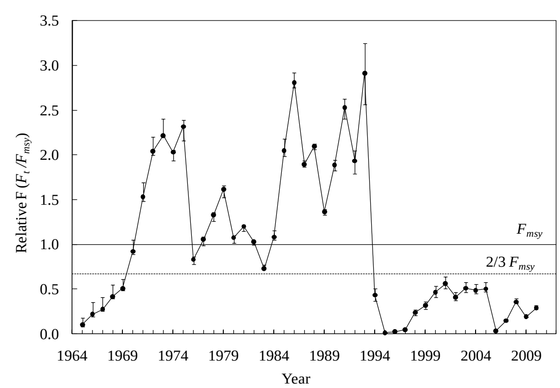
Assessment: An analytical assessment using a stock production model was accepted to estimate stock status in 2011.

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.

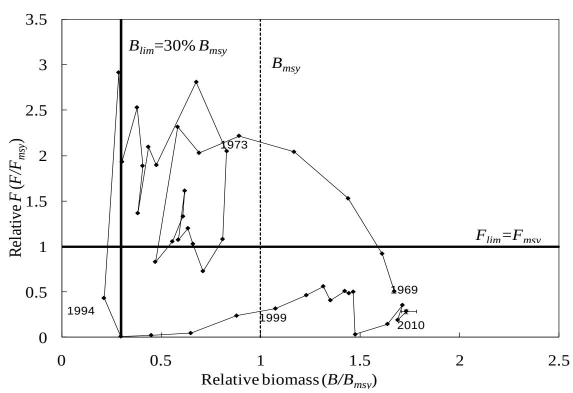
State of Stock: The stock is above B_{msy} and F is less than 1/3 F_{msy}. Stock size has steadily increased since 1994 and is currently estimated to be 1.7 times B_{msy}.

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

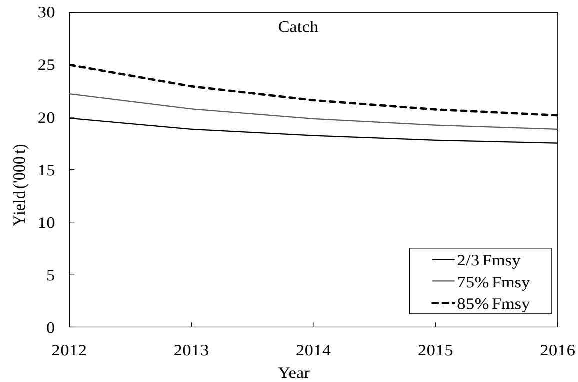
Recommendation: *F* options of up to 85% F_{msy} are considered to have a low risk of exceeding F_{lim} (=F_{msy}) in 2012 and 2013, and are projected to maintain this stock well above B_{msy}.

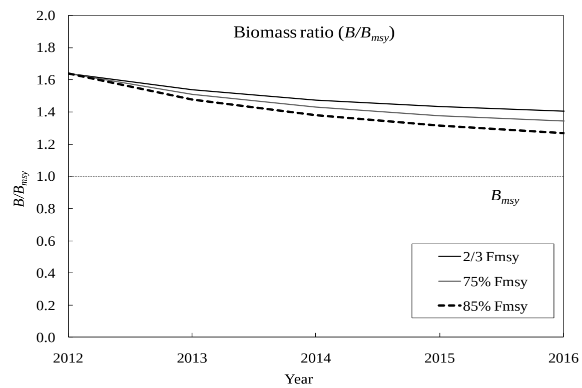
Reference Points: Scientific Council considers that 30% B_{msy} is a suitable limit reference point (B_{lim}) for stocks where a production model is used. At present, the risk of the stock being below B_{lim} = 30% B_{msy} is approximately zero. Currently the biomass is estimated to be above B_{lim}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



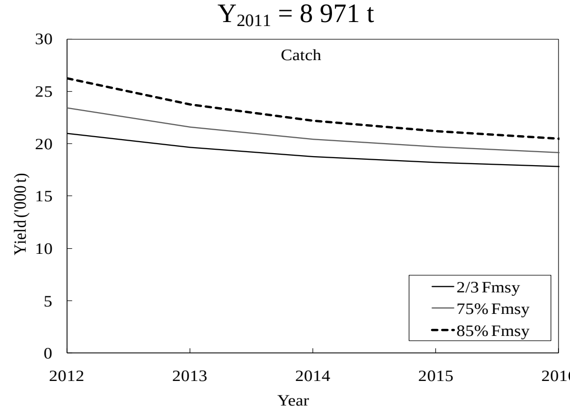
Medium Term Considerations: F_{msy} was estimated to be 0.25. Projections were carried out assuming two levels of catch in 2011 followed by constant fishing mortality from 2012-2016 at several levels of *F*. Although yields are projected to decline in the medium term at both levels of catch in 2011 for 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}.

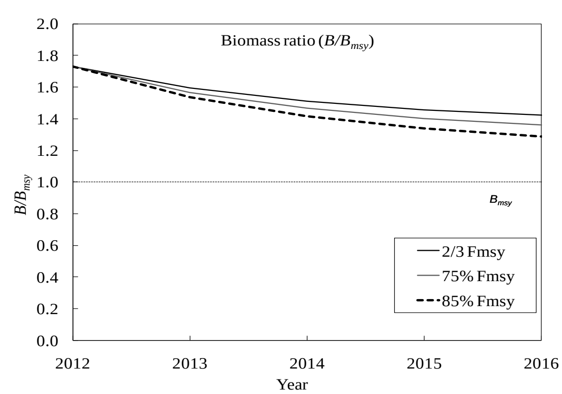
Y_{2011} = 17 000 t





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.

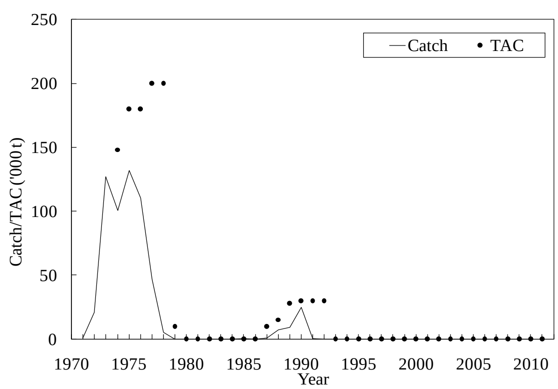
Capelin in Divisions 3NO

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

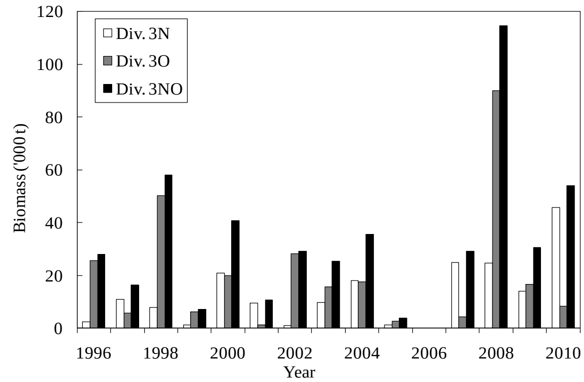
* ndf = no direct fishing

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.

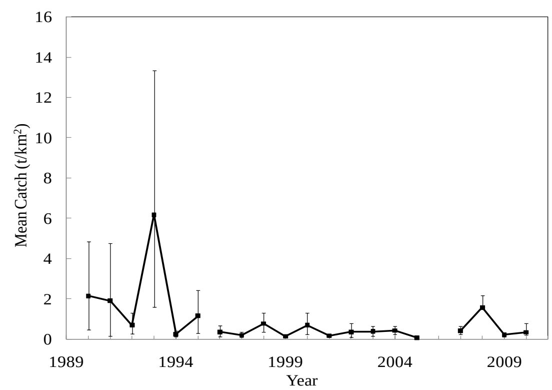


Assessment: No analytical assessment was possible with current data.

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.

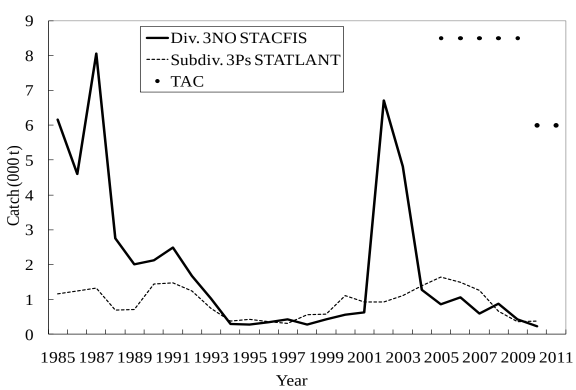
White hake in Divisions 3NO

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.

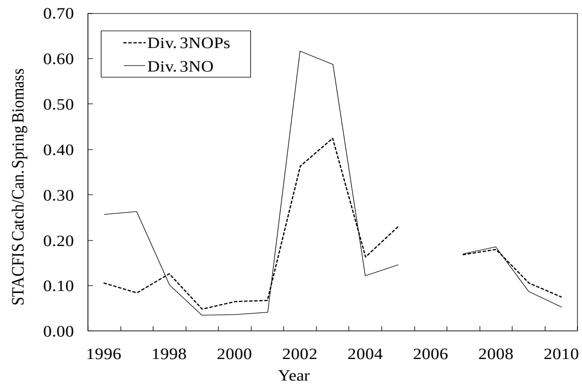
	Catch (000 t)			
	Div.3NO		Subdiv.3Ps	Div. 3NO
Year	STACFIS	21	21	TAC ('000 t)
2008	0.9	0.9	0.6	8.5
2009	0.4	0.5	0.3	8.5
2010	0.2	0.2	0.4	6
2011				6



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.

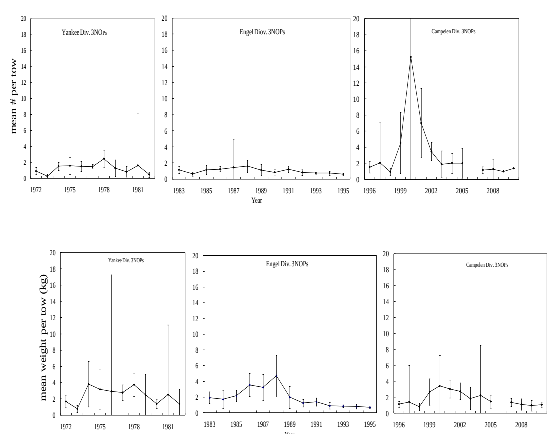
Fishing Mortality: Relative fishing mortality (STACFIS catch/Canadian spring biomass) has fluctuated, but increased considerably for 2002-2003. Current estimates of Relative *F* are comparable to levels observed from 1996-2001.



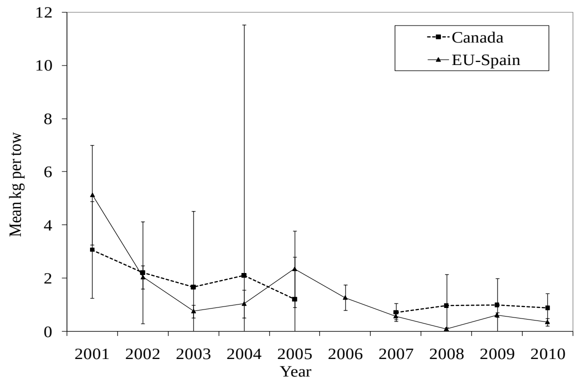
Recruitment: The 1999 year-class was large, but no large year class has been observed since then.

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.

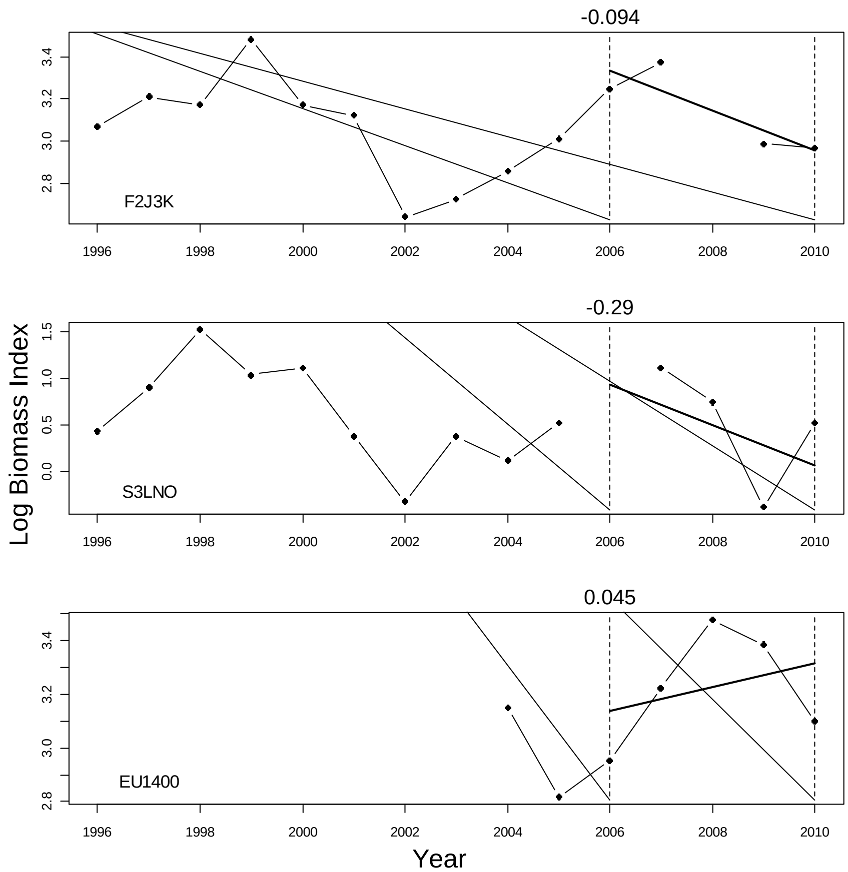
b) provide guidance on what constitutes "exceptional circumstances".

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}				SF			
		55 mm	70 mm	80 mm		55 mm	70 mm	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	---	
		L_{50}				**SF**			
		45 mm	65 mm	80 mm	100 mm	45 mm	65 mm	80 mm	100 mm
SP – small opening trawl	December 98	18.6	23.7	---	---	4.1	3.7	---	---
	August 99	---	---	24.8	---	---	---	3.1	---
		L_{50}				**SF**			
		45 mm	65 mm	80 mm	100 mm	45 mm	65 mm	80 mm	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	---	---
		L_{50}				**SF**			
		45 mm	65 mm	80 mm	100 mm	45 mm	65 mm	80 mm	100 mm
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)

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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.

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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)

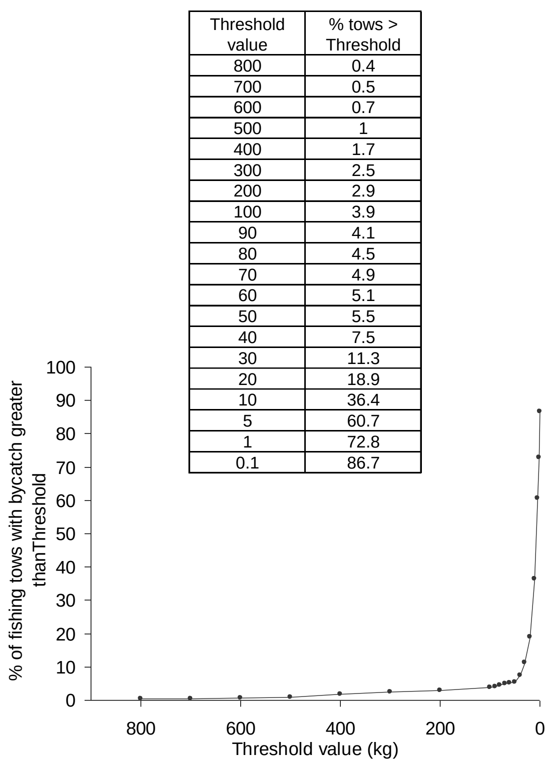
Noting the response from the Scientific Council in June 2010 regarding simulation modeling in a GIS framework: "To apply this model to the NRA, an agreed upon set of gear descriptions and tow duration/lengths for each fishing fleet segment would need to be created. Further estimation of retention efficiencies 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.

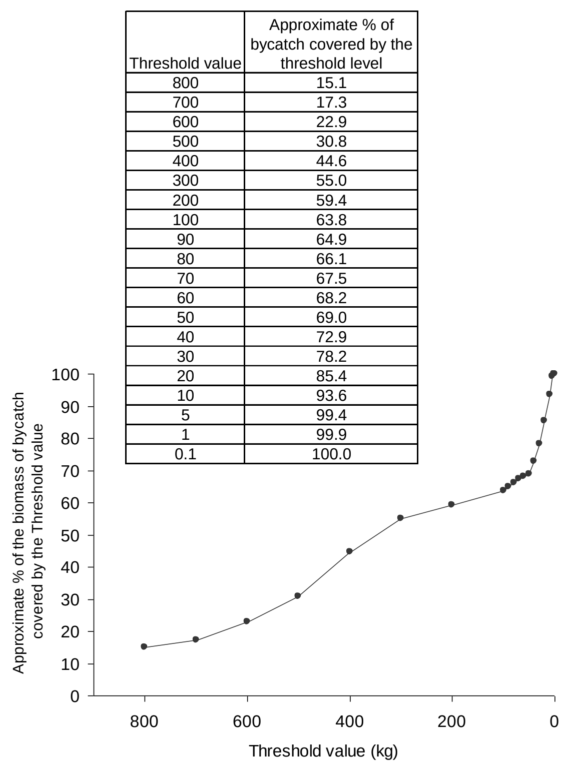
The key results from this analysis can be summarized in the following figure:

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.

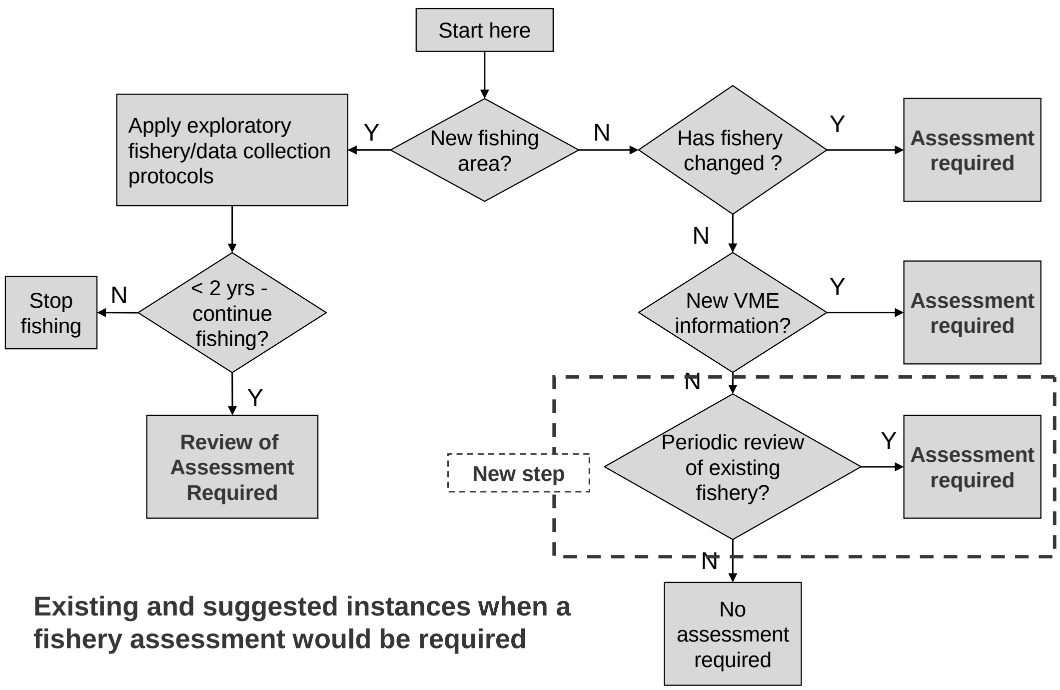
With regards to timing, the current NCEM provisions (Article 4bis) indicate that an assessment should be submitted no less than two weeks prior to the beginning of the June meeting of Scientific Council (SC). The intent of this is that Council would submit conclusions and recommendations to Fisheries 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.



Existing and suggested instances when a fishery assessment would be required

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:

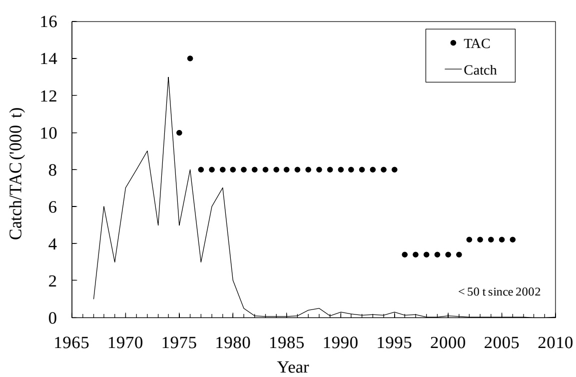
Roundnose Grenadier (Coryphaenoides rupestris) in Subareas 0 + 1

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]	

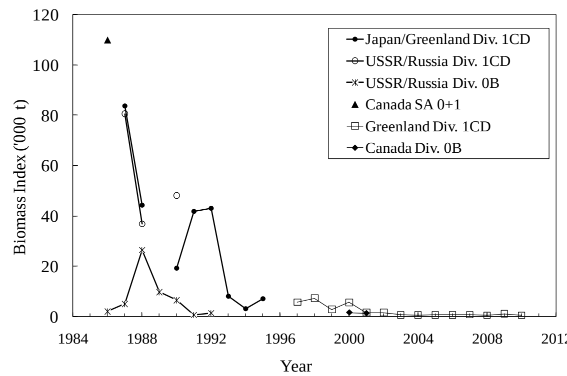
[1] No TAC set for 2007-2011
[2] ndf:No directed fishing, catches restricted to by-catch in other fisheries.



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.*

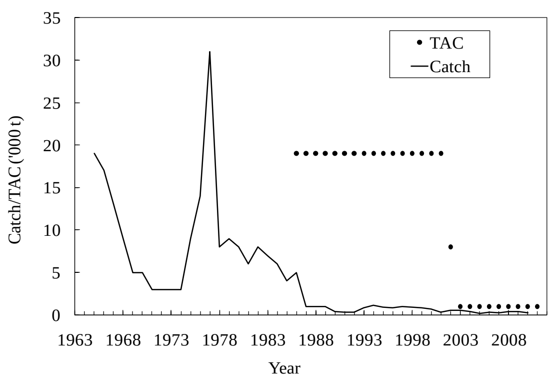
Demersal Redfish (Sebastes spp.) in Subarea 1

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:

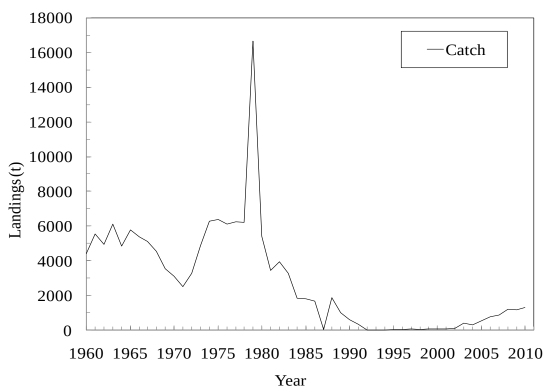
Atlantic wolffish and spotted wolffish

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.

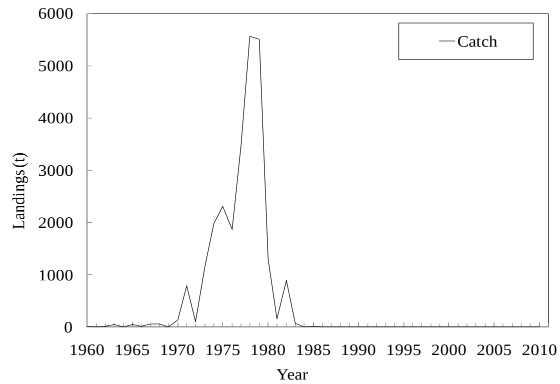
	Catch	TAC ('000 t)	
	('000 t)	Recommended	Autonomous
2008	1.2	ndf	1
2009	1.2	ndf	1
2010	1.3	ndf	1
2011		ndf	1

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:

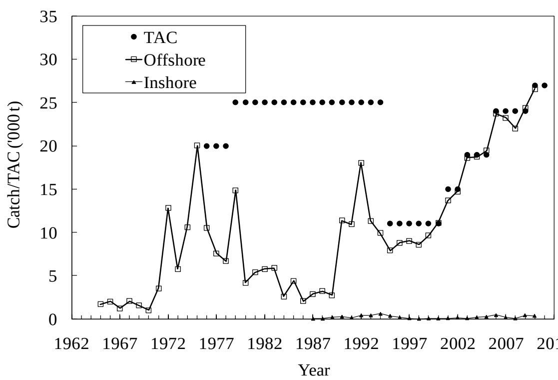
Greenland halibut in SA 0 + Div. 1A offshore and Div. 1B-1F

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.

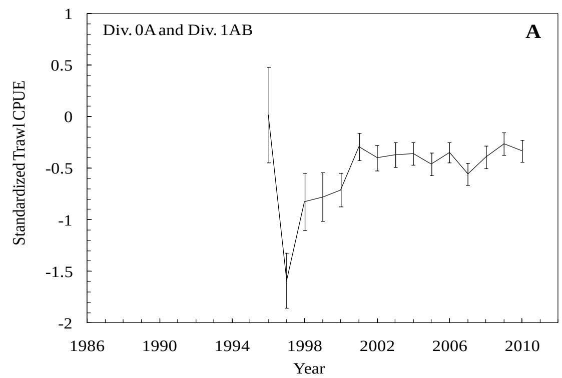


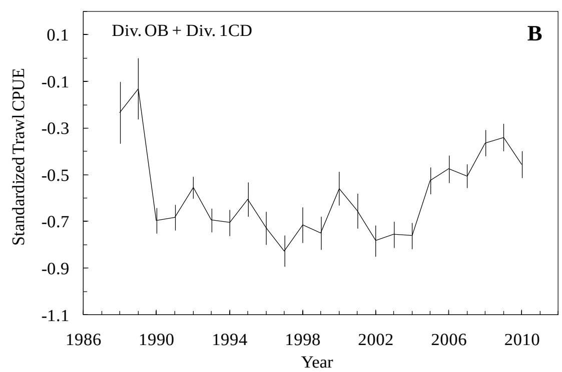
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2010 were available from Div. 0A, Div. 1A and Div. 1CD. Further, biomass and recruitment data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

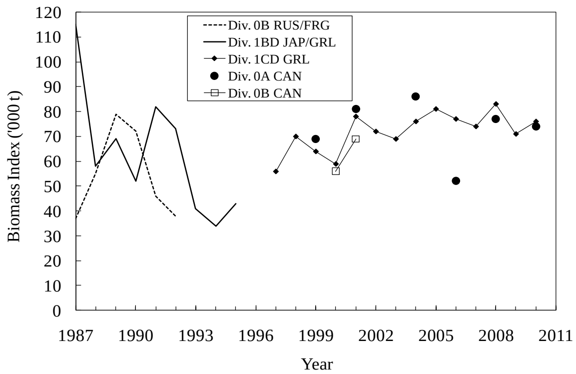
The combined Div. 0B and 1CD standardized catch rates have been stable during 2002 - 2004. Since then the standardized catch rates have increased gradually and were in 2009 at the highest level seen since 1989. CPUE decreased in 2010 but is still at a high level.



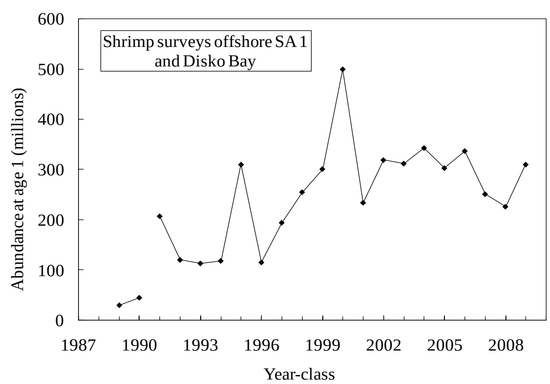


Biomass: The biomass in Div. 0A (to 73°N) decreased slightly between 2008 and 2010 but has been stable in the recent 12 years. The biomass in the shrimp survey, which is almost exclusively found in Div. 1AB, has been gradually decreasing during 2004-2009 but increased again in 2010 to a level slightly 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 2nd 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.

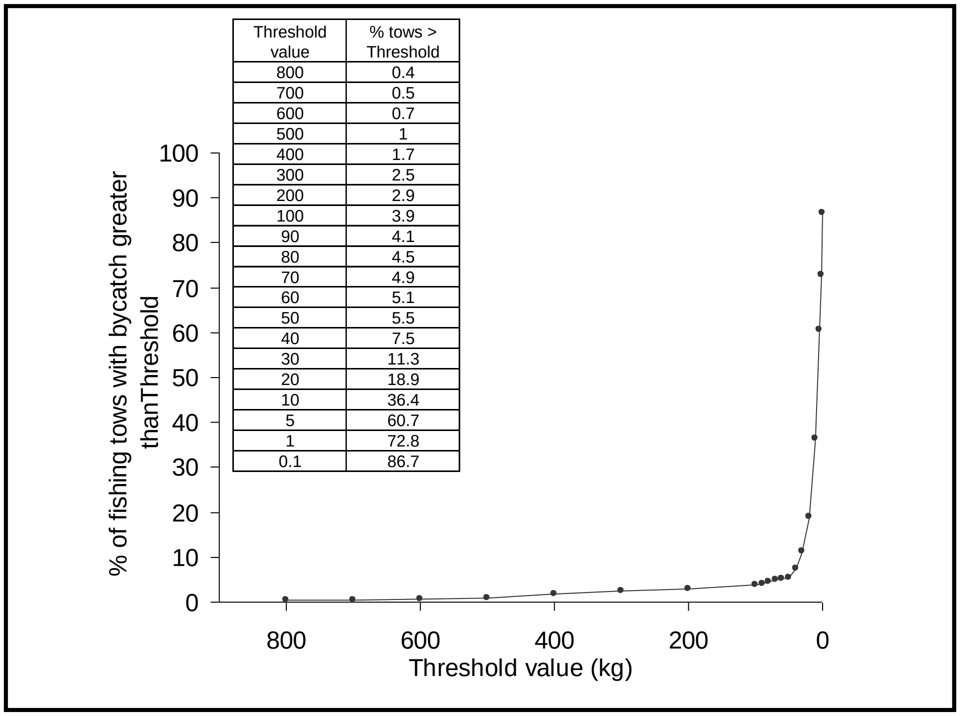
GIS framework

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:

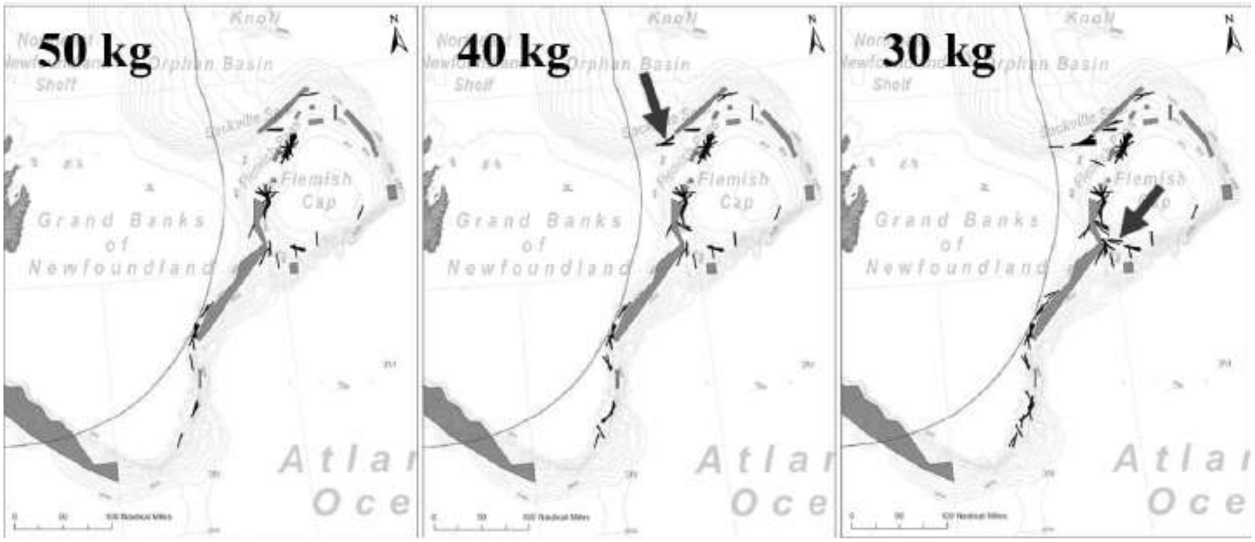


Threshold value	% tows > Threshold
800	0.4
700	0.5
600	0.7
500	1
400	1.7
300	2.5
200	2.9
100	3.9
90	4.1
80	4.5
70	4.9
60	5.1
50	5.5
40	7.5
30	11.3
20	18.9
10	36.4
5	60.7
1	72.8
0.1	86.7

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.

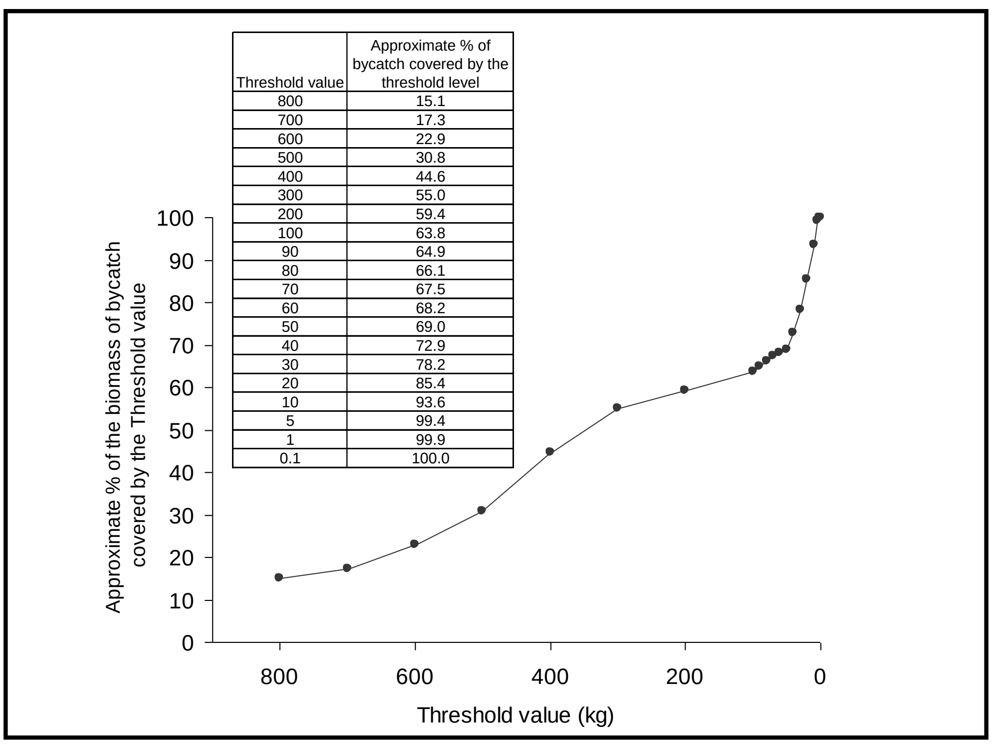
For example, these results indicate that a much higher protection to sponge grounds can be provided with a minimum impact on fishing activities. If the threshold level is reduced from 800 kg to 30 kg, 11% of the commercial fishing tows operating between 700 m and 2000 m depth are expected to encounter 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 (3^{rd} lowest since 1980) for the 16^{th} 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 2^{nd} 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 4^{th} 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.

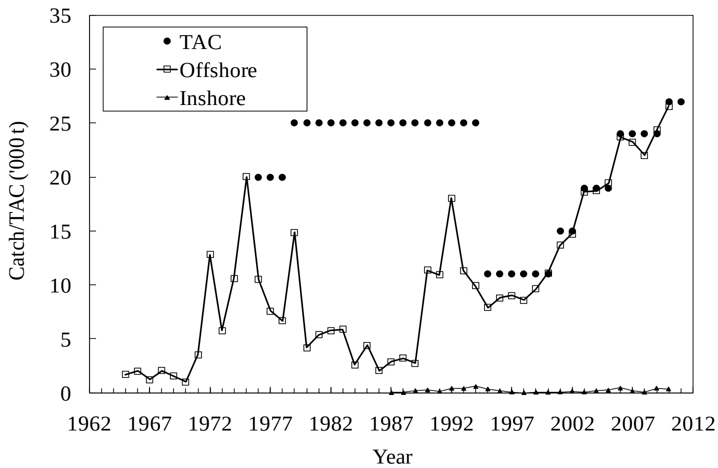


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

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.

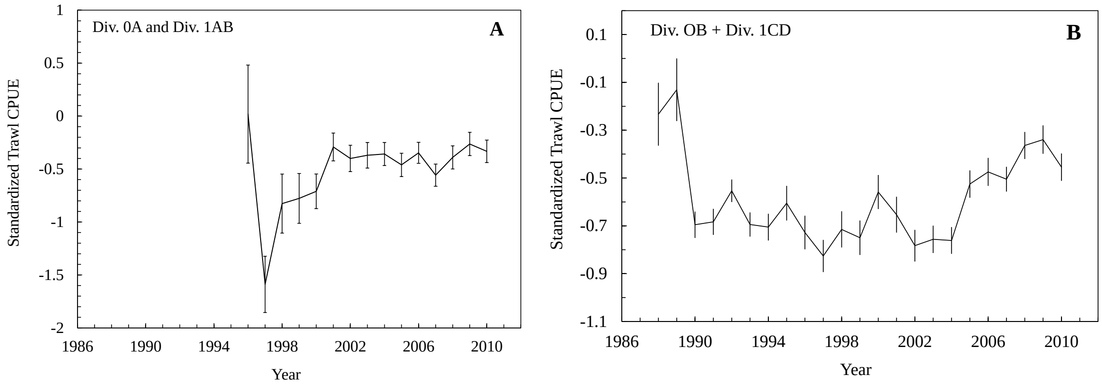


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawler CPUE from Div. 0A and Div. 1AB with ± S.E . B: Combined standardized trawler CPUE from Div. 0B and Div. 1CD with ± S.E.

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.

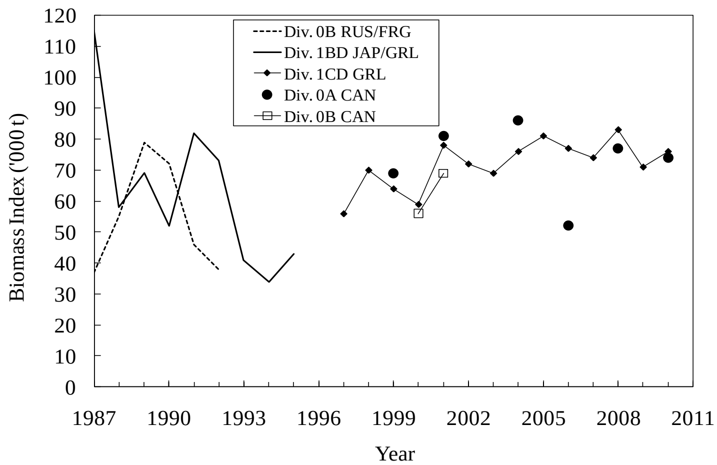


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass estimates from bottom trawl surveys. Note, incomplete coverage of the 2006 survey in Div. 0A and that survey estimates from Div. 0A does not include surveys in the northern part in 2004 and 2010. Further, the survey estimates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

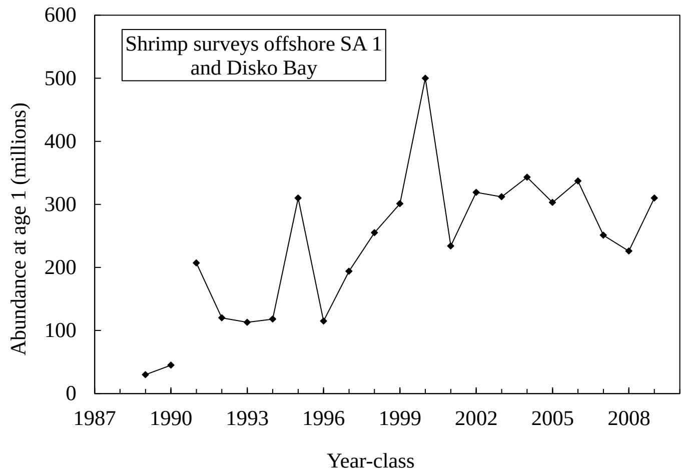


Fig. 1.4. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1).

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.

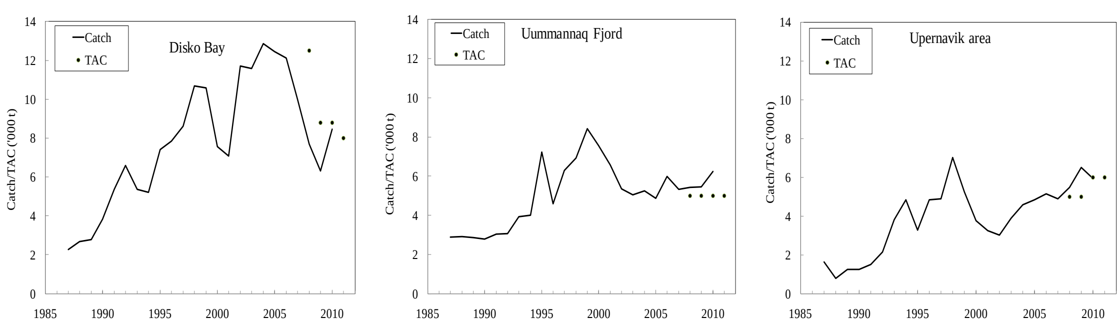


Fig. 2.1. Greenland halibut in Div. 1A inshore: catches and TAC in Disko Bay, Uummannaq and Upernavik.

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).

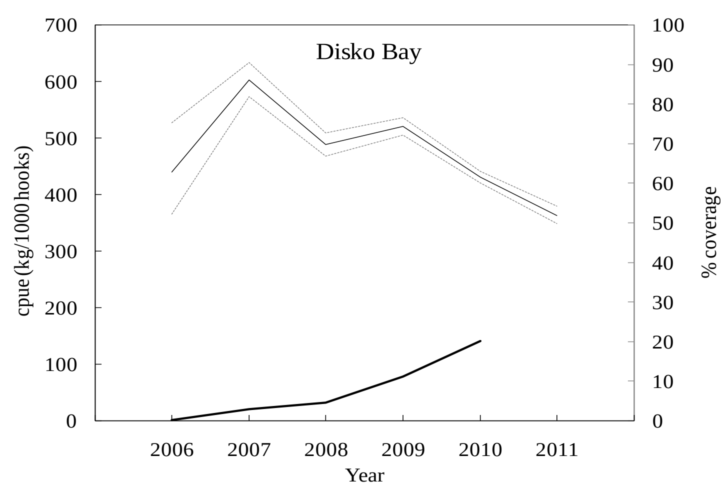


Fig. 2.2 Greenland halibut in Div. 1A inshore: Disko Bay GLM: logcpue=overall mean + year + vessel +-1SE and percentage of catch covered by longline logbooks to total landings.

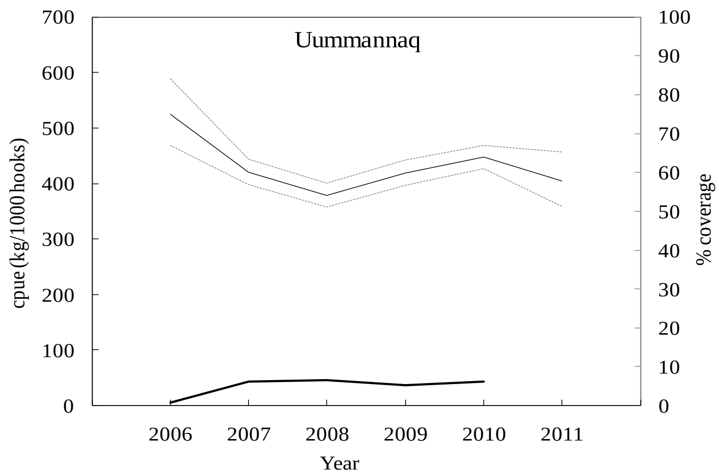


Fig. 2.3 Greenland halibut in Div. 1A inshore: Uummannaq GLM: logcpue=overall mean + year + vessel +-1SE and percentage of catch covered by longline logbooks to total landings.

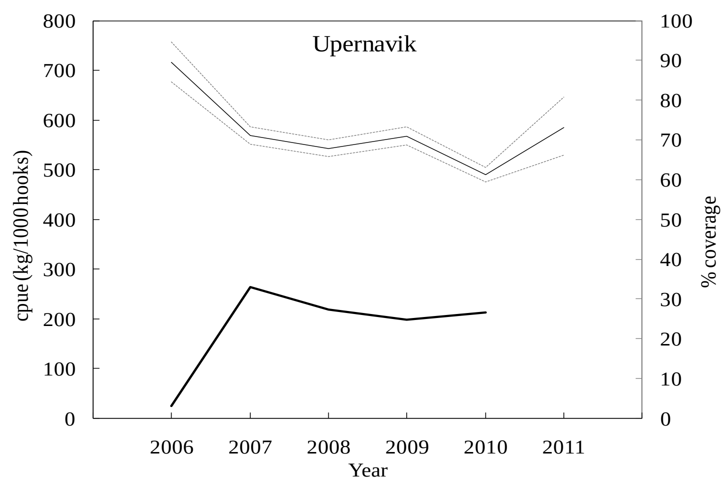


Fig. 2.4 Greenland halibut in Div. 1A inshore: Upernavik GLM: logcpue=overall mean + year + vessel +-1SE and percentage of catch covered by longline logbooks to total landings.

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)

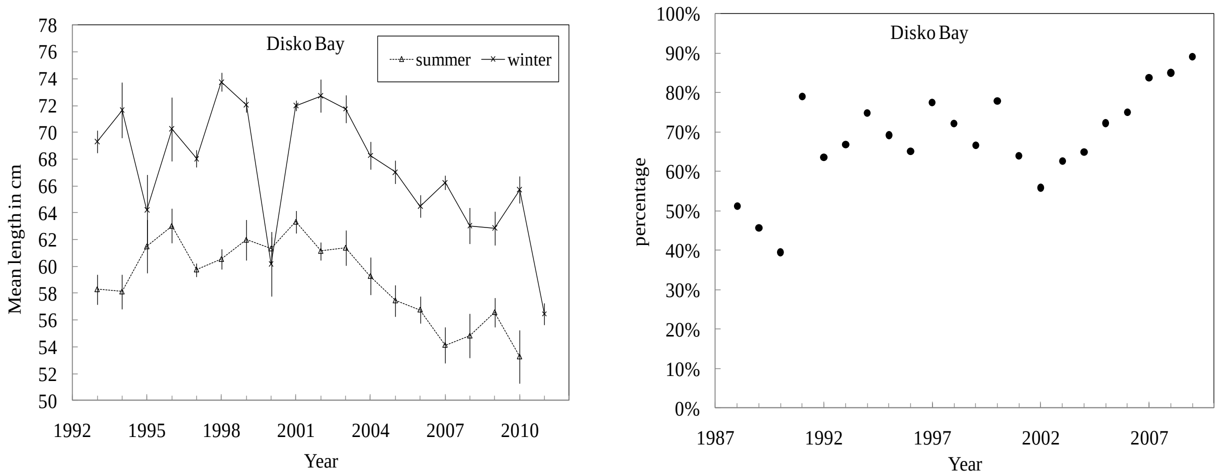


Fig.. 2.5 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Ilulissat +95% Cl (left) and in percentage of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year (right). (no data in 2010)

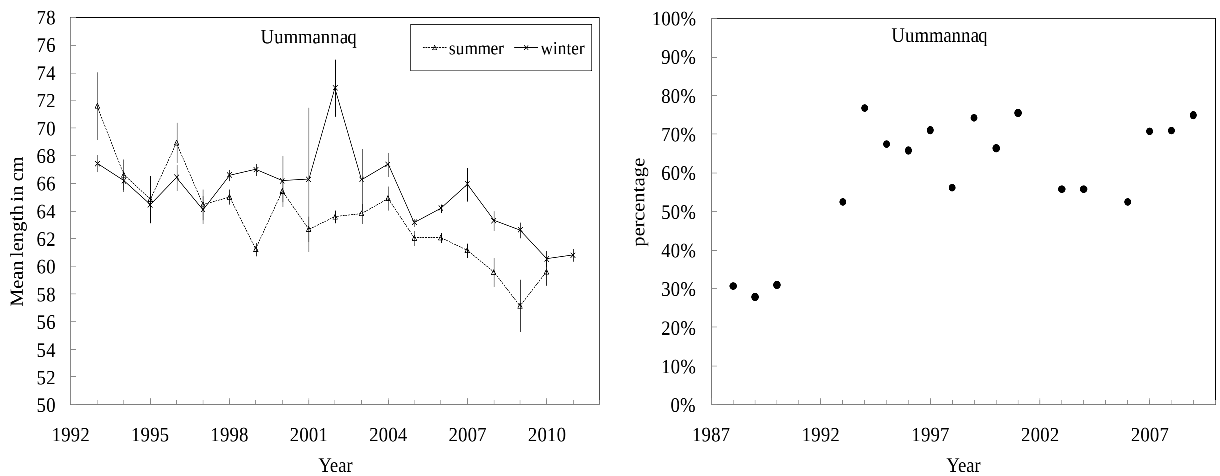


Fig. 2.6 Greenland halibut in Div. 1A inshore: Mean length of Greenland halibut in commercial longline catches from Uummannaq +95% Cl(left) and in percentage of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year (right). (no data in 2010)

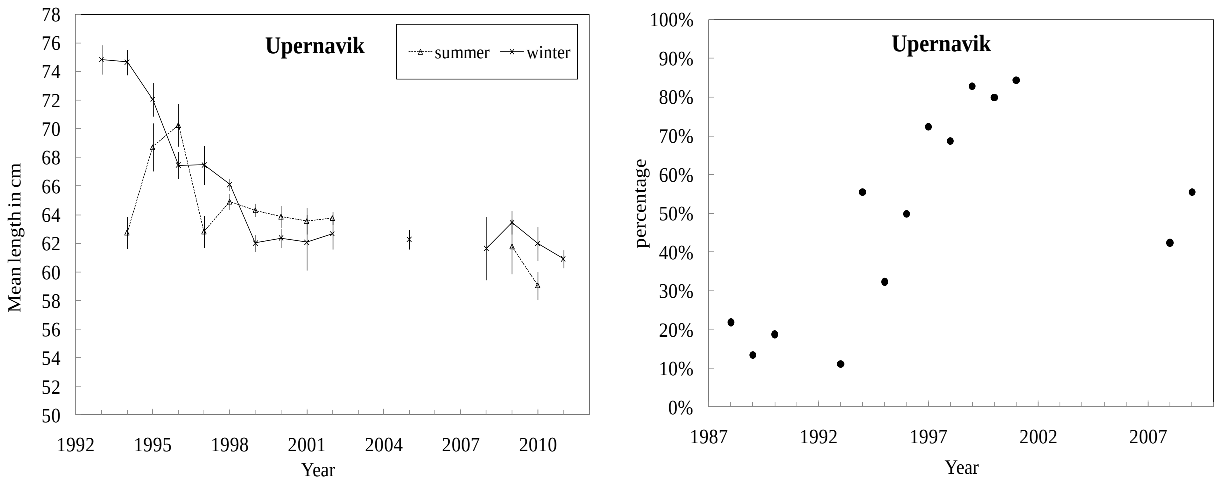


Fig. 2.7. Mean length of Greenland halibut in commercial longline catches from Upernavik +95% Cl (left) and in percentage of the *age 10 and younger* expressed as percentages of those age groups in commercial landings by year (right). (no data in 2010)

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.

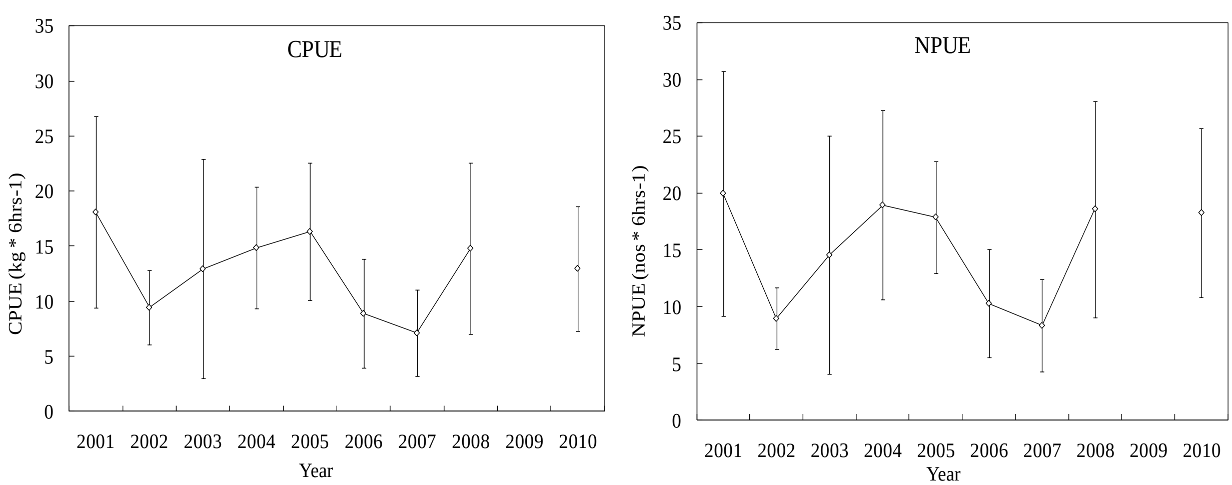


Fig. 2.8. Greenland halibut in Div. 1A inshore: Disko Bay gillnet survey CPUE and NPUE + 95% CI indicated.

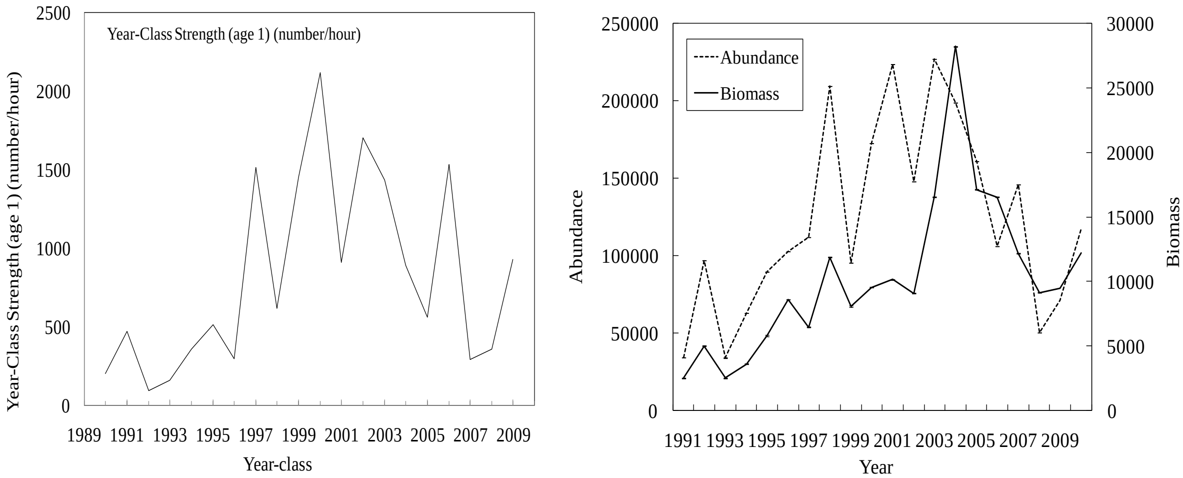


Fig. 2.9. Greenland halibut in Div. 1A inshore: Abundance (‘000) and Biomass (t) indices for Greenland halibut in the Greenland Shrimp Fish trawl survey in Disko Bay (left), and year-class strength of age one from this survey (left).

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.

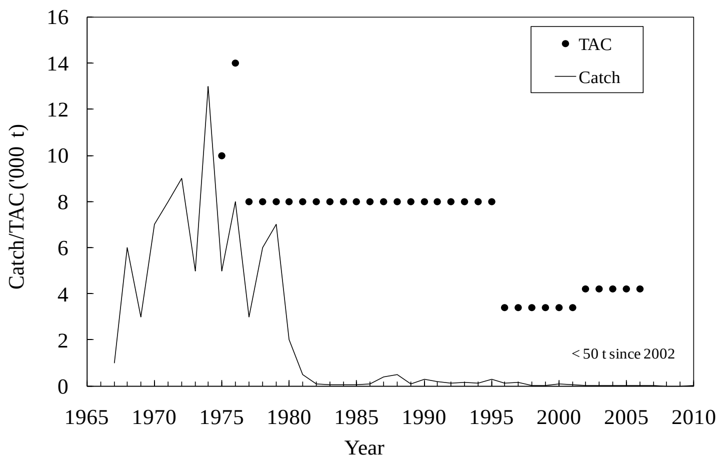


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2011.

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.

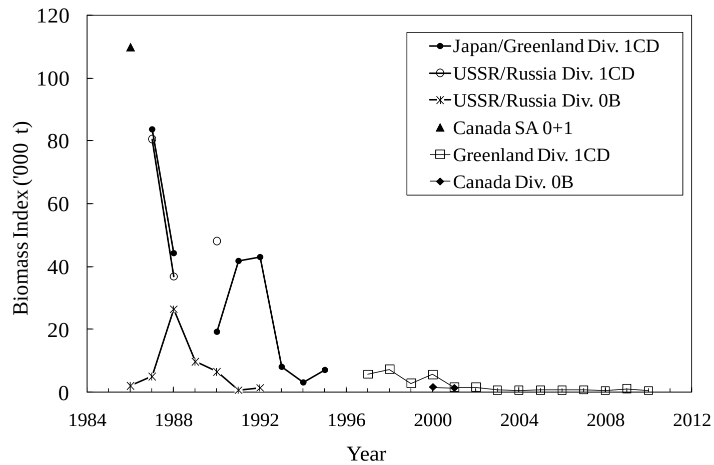


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland, Canadian and Greenland surveys in Div. 0B and Div.

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	

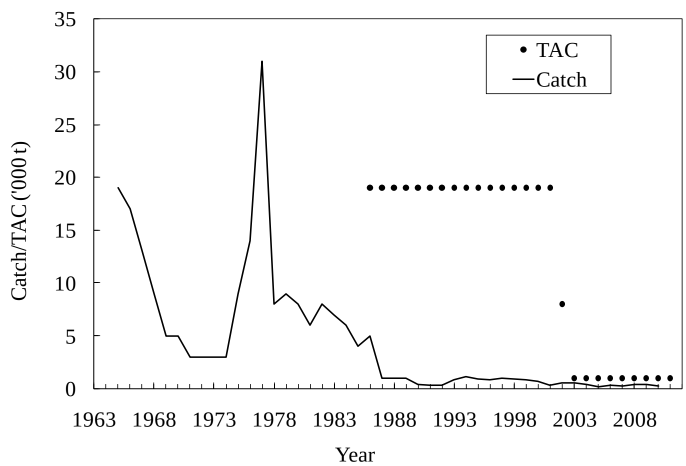


Fig. 4.1. Redfish in Subarea 1: catches and TAC.

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.

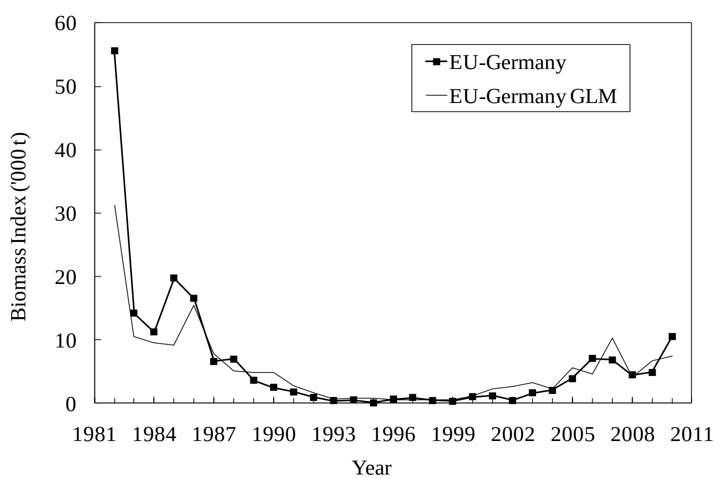


Fig. 4.2. Redfish in Subarea 1: Golden redfish (≥17 cm) survey biomass indices derived from the EU-German groundfish survey.

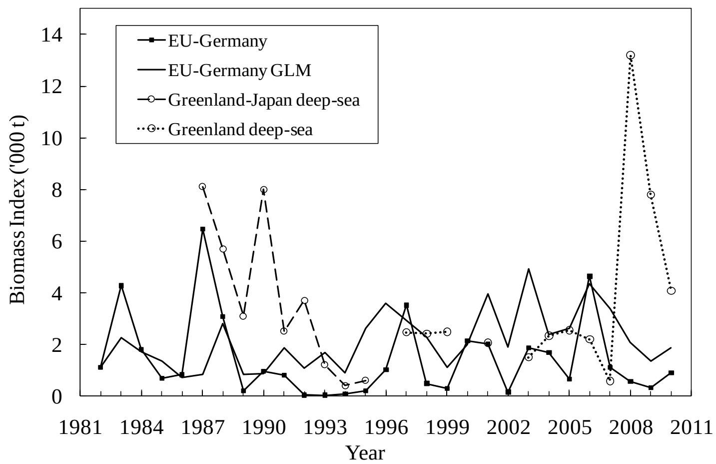


Fig. 4.3. Redfish in Subarea 1: Deep-sea redfish (≥17 cm) survey biomass indices derived from the EU-Germany groundfish survey and from the Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (1997-2010).

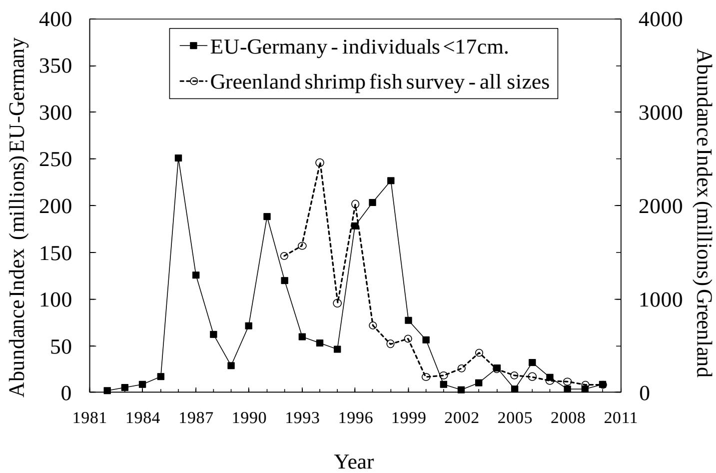


Fig. 4.4. Redfish in Subarea 1: Deep-sea redfish and golden redfish combined survey abundance indices for EU-Germany survey (juvenile individuals <17cm) and the Greenland Shrimp Fish survey. (Notice the different scales).

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).

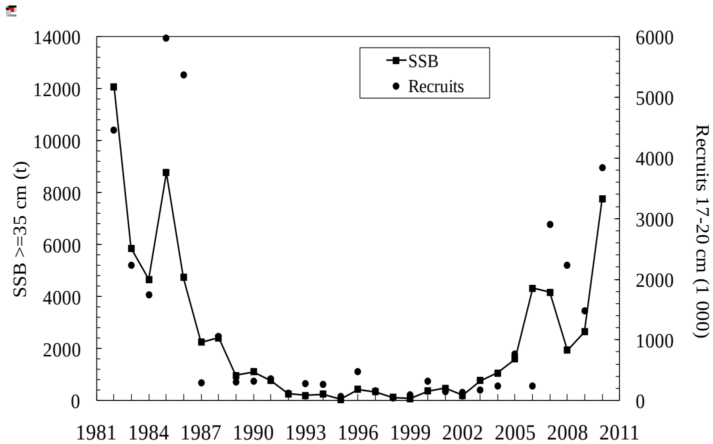


Fig. 4.5. Redfish in Subarea 1: Golden redfish SSB and recruitment indices derived from the EU-Germany groundfish survey.

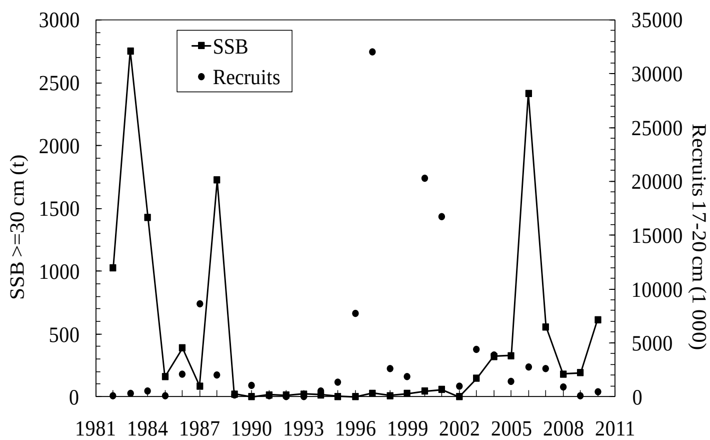


Fig. 4.6. Redfish in Subarea 1: Deep-sea redfish SSB and recruitment indices derived from the EU-Germany groundfish survey.

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)

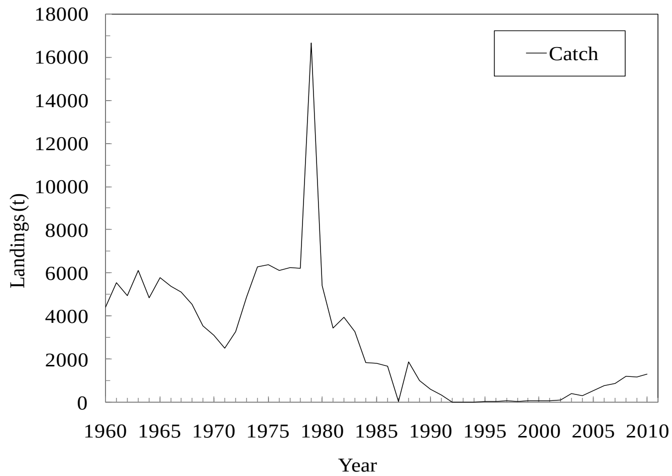


Fig 5.1. Other finfish in SA 1: Catches of spotted wolffish and Atlantic wolffish in SA1 combined from 1960 to 2010.

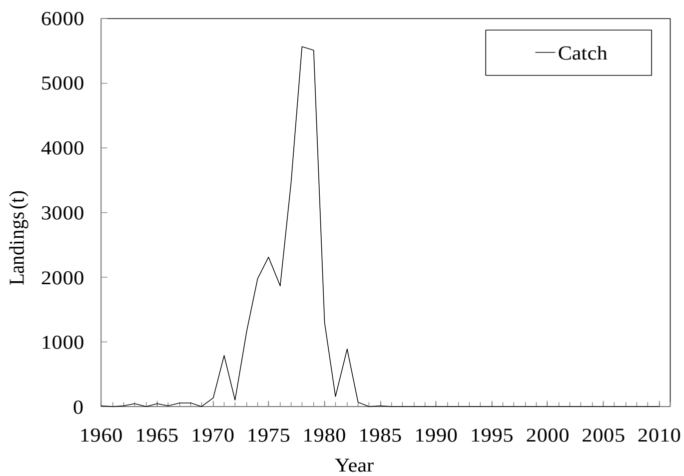


Fig 5.2. Other finfish in SA 1: Catches of American plaice in SA1 from 1960 to 2010.

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.

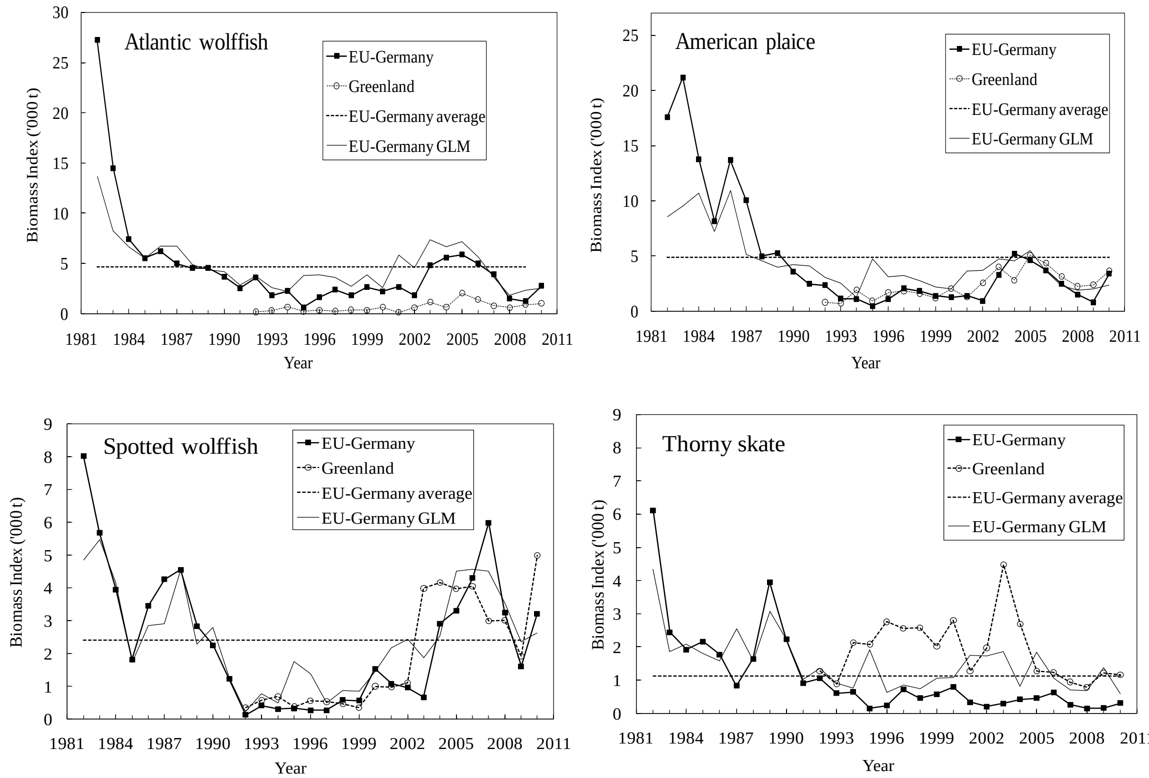


Fig. 5.4. Other finfish in SA 1: survey biomass indices.

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.

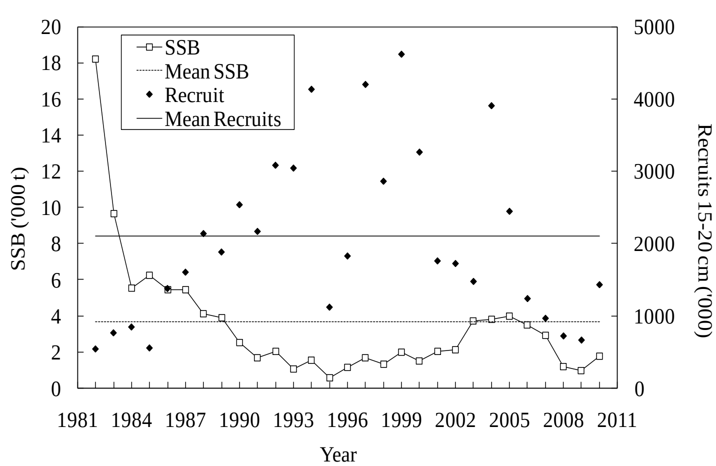


Fig. 5.5. Other finfish in SA 1: Atlantic wolffish in SA1. SSB and recruitment indices as derived from the EU-Germany groundfish survey.

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.

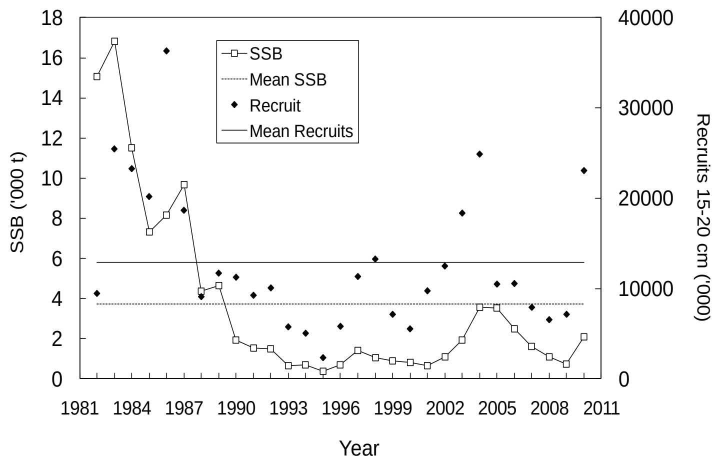


Fig. 5.6 Other finfish in SA 1: American plaice SSB and recruitment indices as derived from the EU-Germany groundfish survey.

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

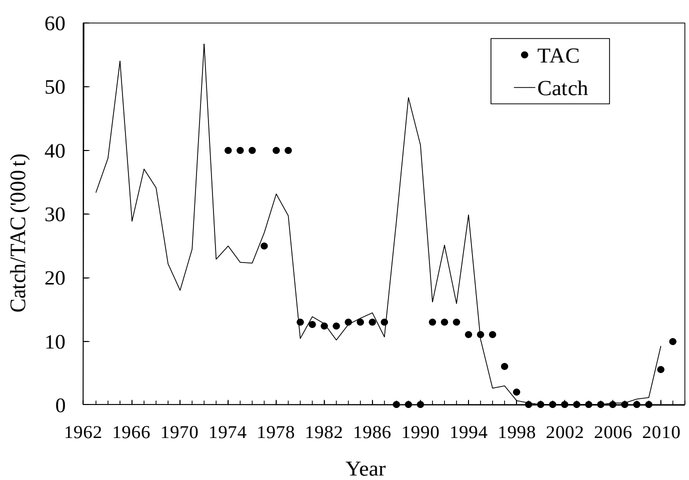


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch line includes estimates of misreported catches since 1988. No direct fishery is plotted as 0 TAC.

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.

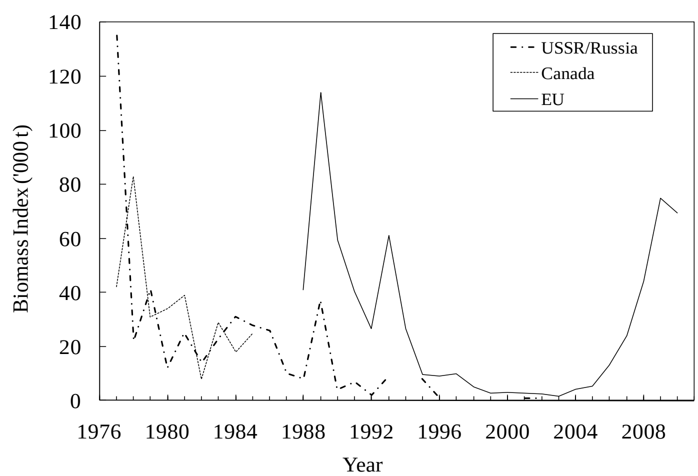


Fig. 6.2. Cod in Div. 3M: survey biomass estimates from surveys.

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).

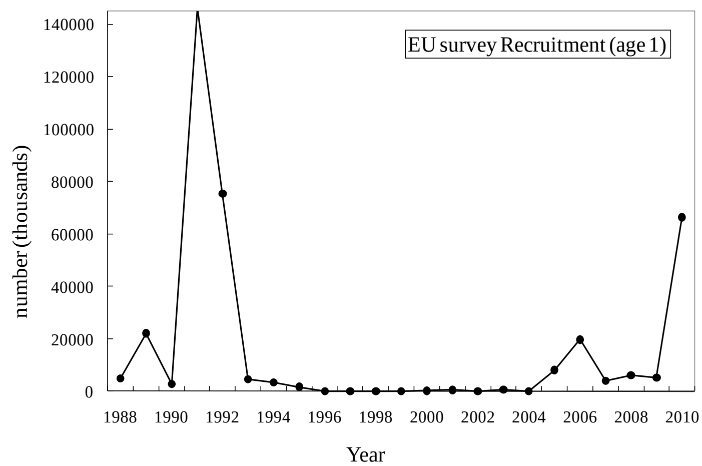


Fig. 6.3. Cod in Div. 3M: Number of recruits (age 1) in the EU survey, 1988-2010.

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.

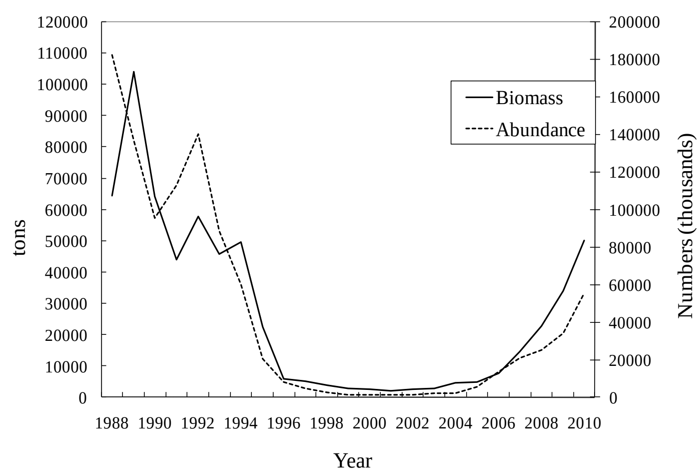


Fig. 6.4. Cod in Div. 3M: Biomass and abundance estimates for years 1988 to 2010. The numbers are in thousands.

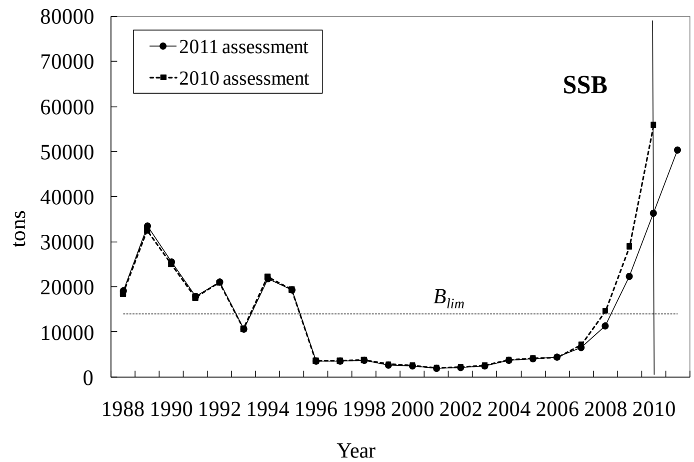


Fig. 6.5. Cod in Div. 3M: Median SSB estimates for years 1988 to 2011. The horizontal dashed line is the B_{lim} level of 14 000 t. The vertical line indicates the 2010 SSB. Data from this year and last year assessments.

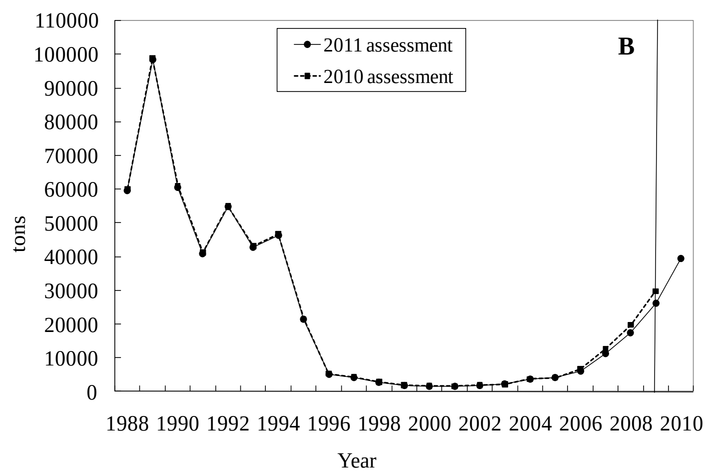


Fig. 6.6. Cod in Div. 3M: Median total Biomass estimates 1988 to 2010. The vertical line indicates the 2009 biomass. Data from this year and last year assessments.

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.

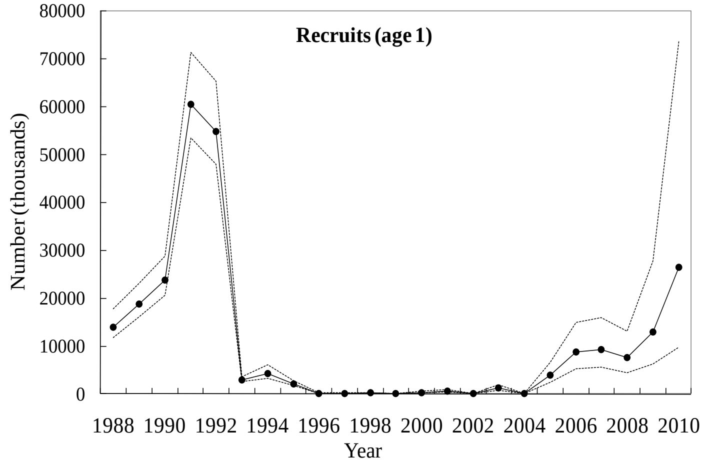


Fig. 6.7. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2010.

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).

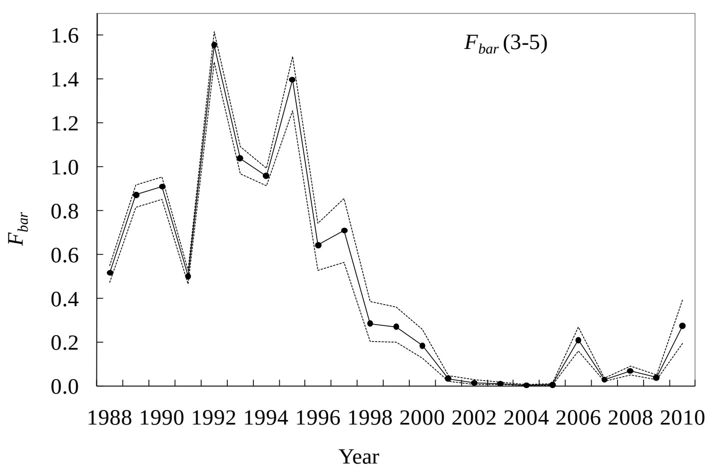


Fig. 6.8. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2010.

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).

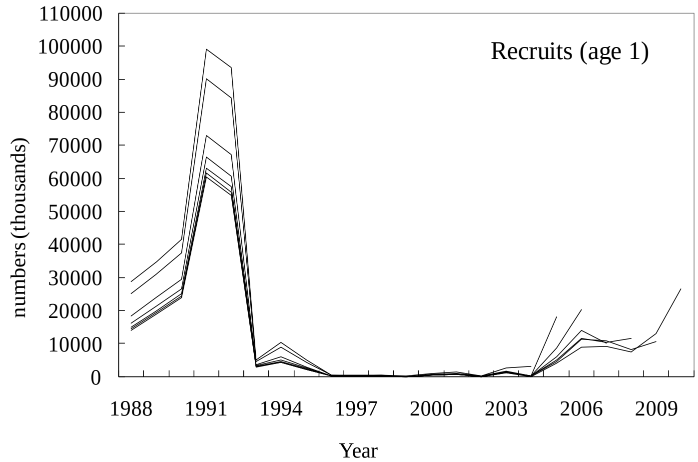


Fig. 6.9. Cod in Div. 3M: Retrospective results for recruitment.

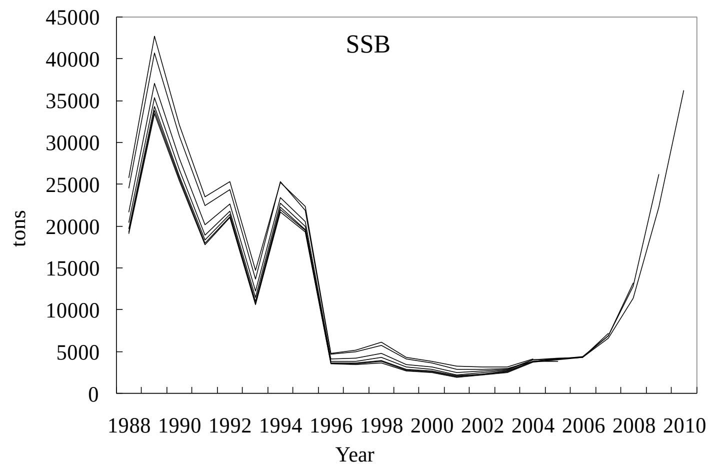


Fig. 6.10. Cod in Div. 3M: Retrospective results for SSB.

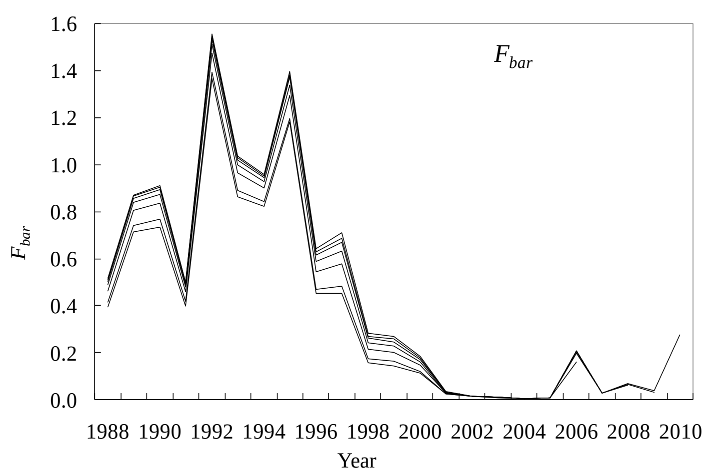


Fig. 6.11. Cod in Div. 3M: Retrospective results for F_{bar}.

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.

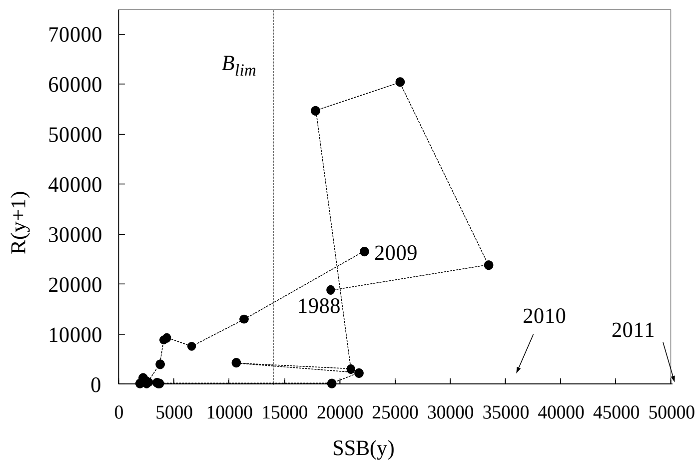


Fig. 6.12. Cod in Div. 3M: Stock-Recruitment (posterior medians) plot

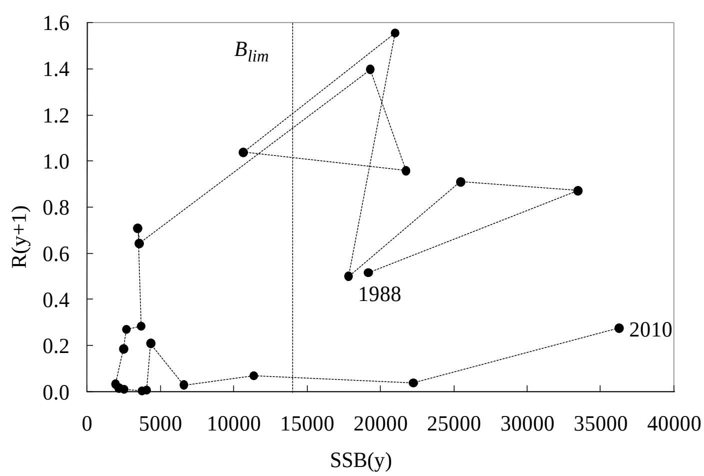


Fig. 6.13. Cod in Div. 3M: Stock-F_{bar}(3-5) (posterior medians) plot

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}.

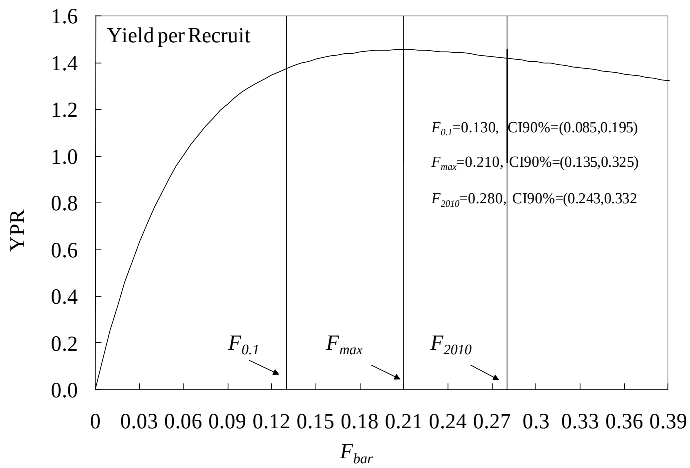


Fig. 6.14. Cod in Div. 3M: Bayesian Yield per recruit

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

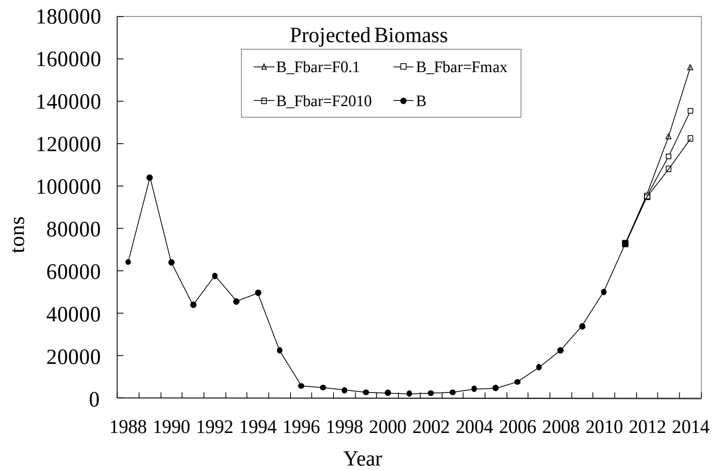


Fig. 6.15. Cod in Div. 3M: Projected Total Biomass under all the Scenarios.

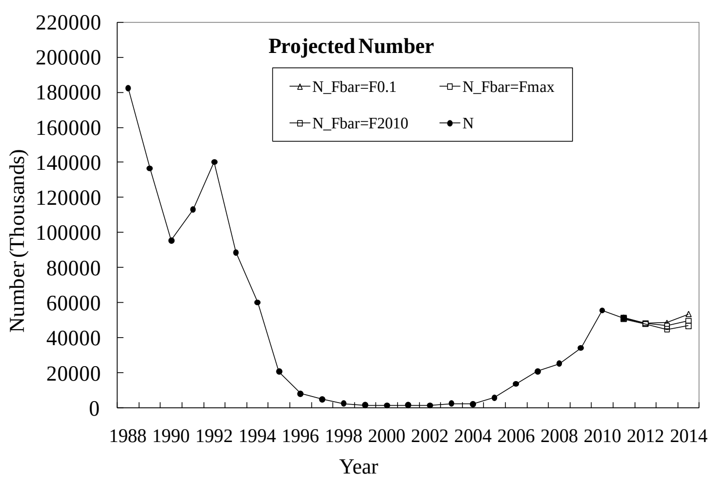


Fig. 6.16a. Cod in Div. 3M: Projected Total Abundance under all the Scenarios.

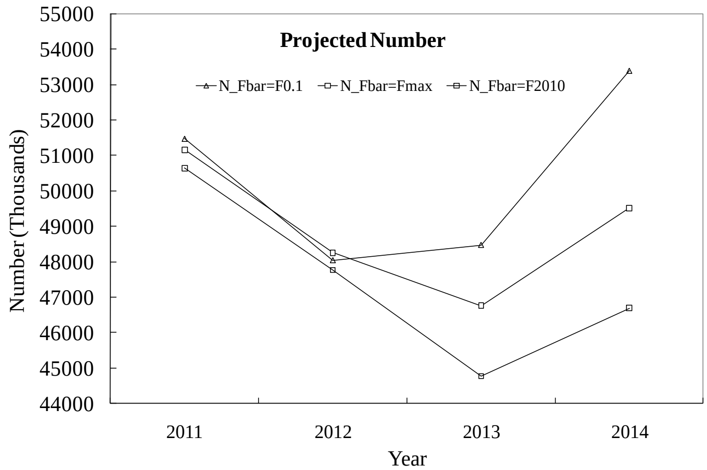


Fig. 6.16b. Cod in Div. 3M: Projected Total Abundance under all the Scenarios. Projected years only.

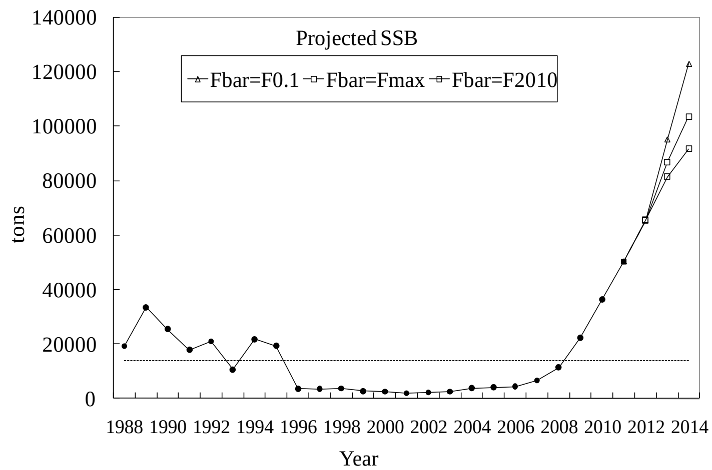


Fig. 6.17. Cod in Div. 3M: Projected SSB under all the Scenarios.

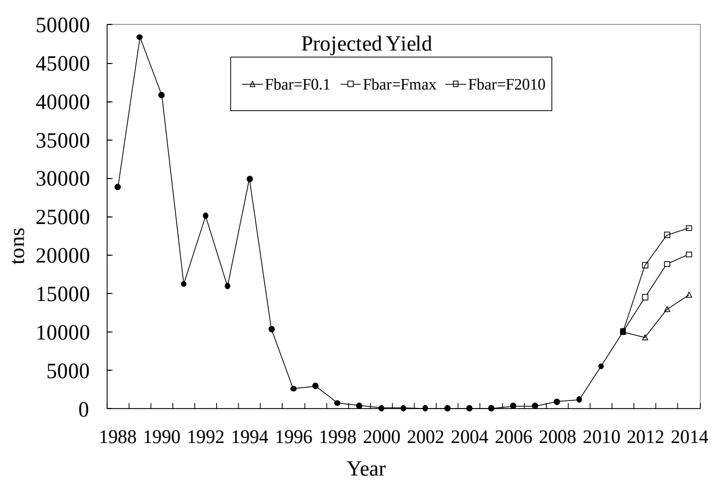


Fig. 6.18. Cod in Div. 3M: Projected removals under all the Scenarios.

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).

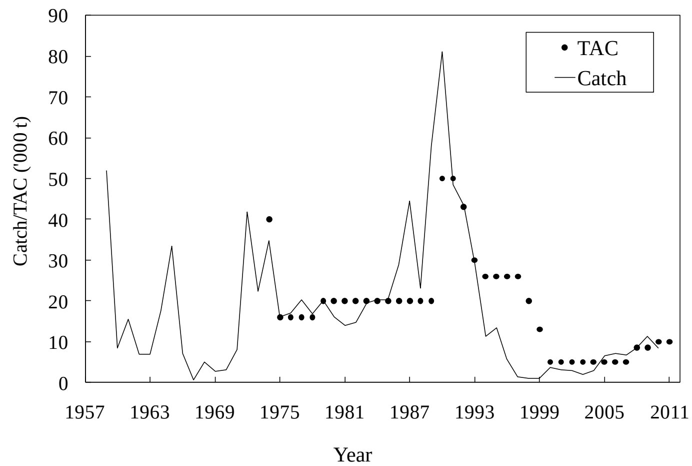


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

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).

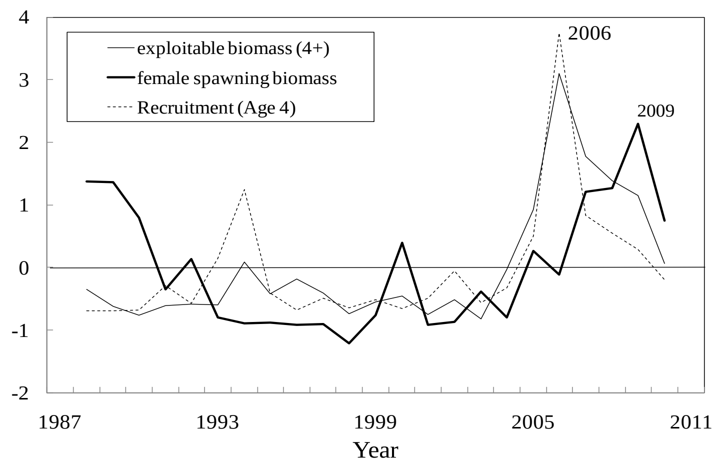


Fig. 7.2. Beaked redfish in Div. 3M: standardized biomass, female spawning biomass and recruitment at age abundance from EU surveys (1988-2010). Each series standardized to the mean and unit standard deviation.

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.

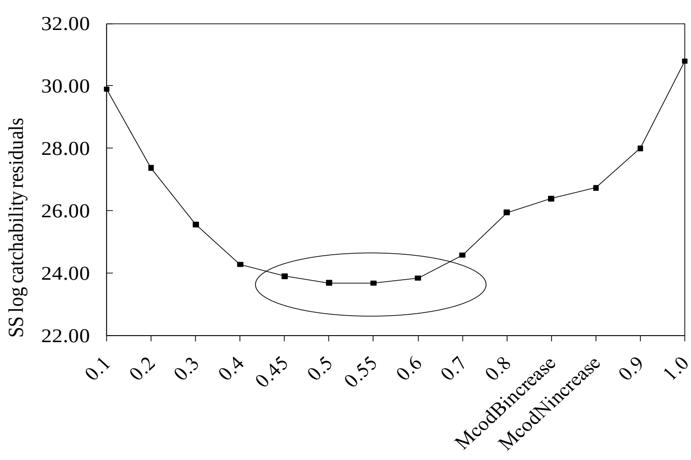


Fig. 7.3. Beaked redfish in Div. 3M: goodness of fit of XSA_{2011} for several *M* options between 2006 and 2010.

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).

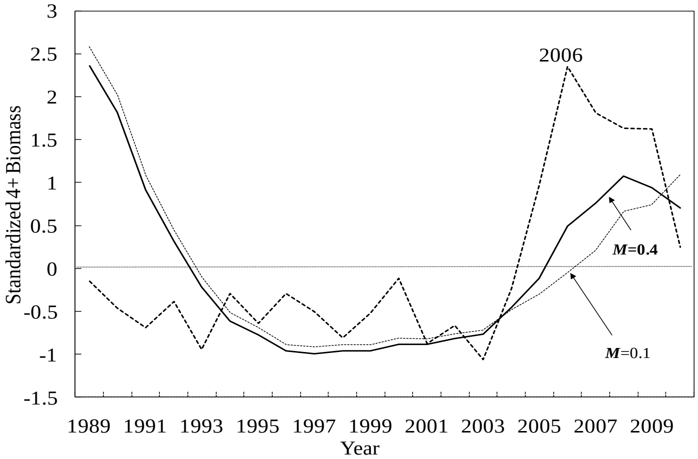


Fig. 7.4. Beaked redfish in Div. 3M: standardized 4+ biomass given by XSA $_{M=0.4\ \text{to}\ 0.6}$ versus EU survey$_{1989\text{-}2010}$ and XSA$_{M=0.1}$. Each series standardized to the mean and unit standard deviation.

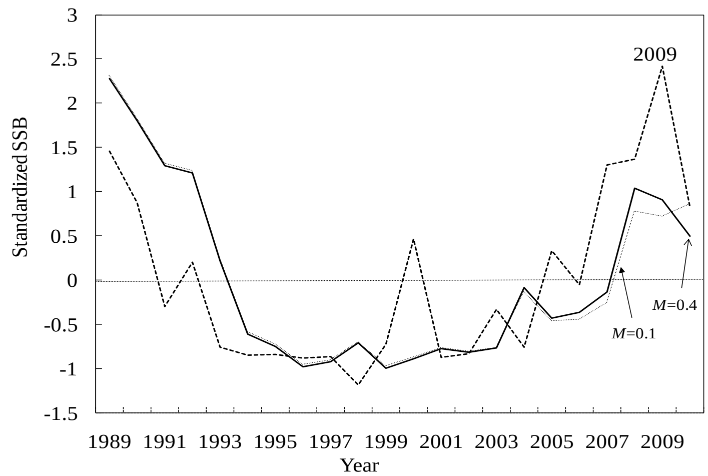


Fig. 7.5. Beaked redfish in Div. 3M: standardized spawning stock biomass XSA $_{\text{M=0.4 to 0.6}}$ versus EU survey$_{1989\text{-}2010}$ and XSA$_{\text{M=0.1}}$. Each series standardized to the mean and unit standard deviation.

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.

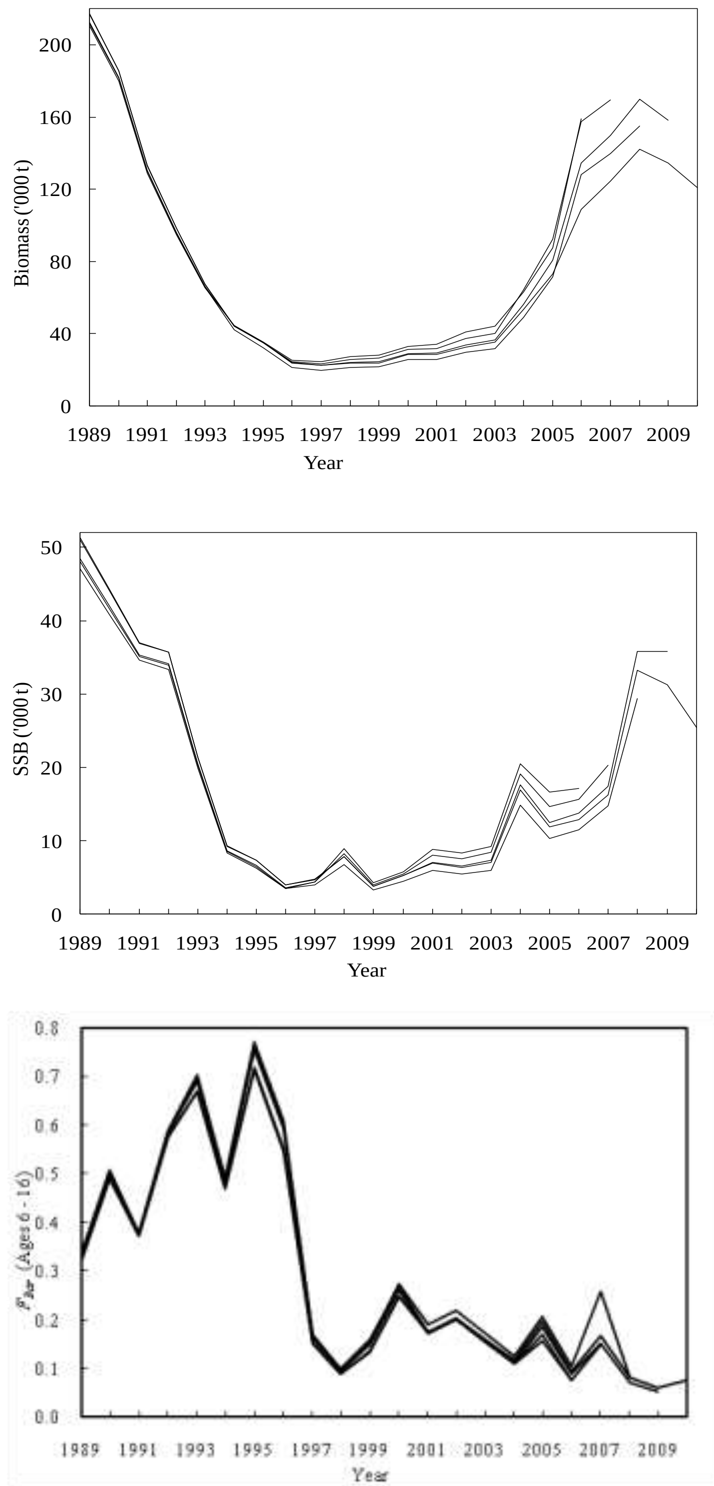


Fig. 7.6. Beaked redfish in Div. 3M: XSA retrospective analysis, 2011-2007: exploitable 4+ biomass, female spawning biomass and average fishing mortality.

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.

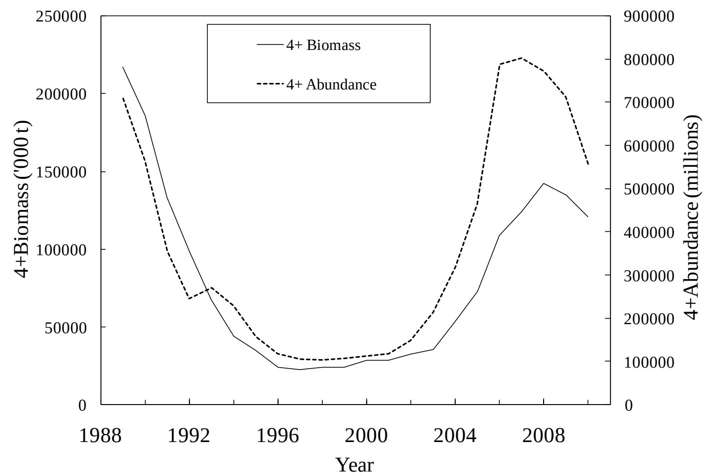


Fig. 7.7. Beaked redfish in Div. 3M: age 4+ biomass and Age 4+ abundance trends from XSA.

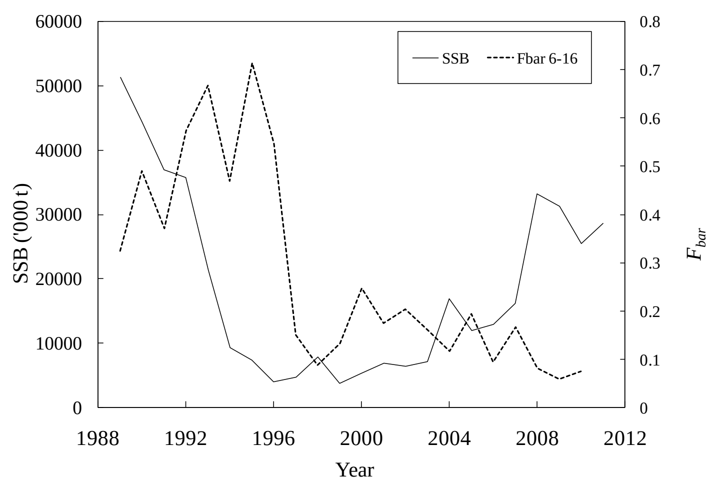


Fig. 7.8. Beaked redfish in Div. 3M: female spawning biomass and fishing mortality trends from XSA.

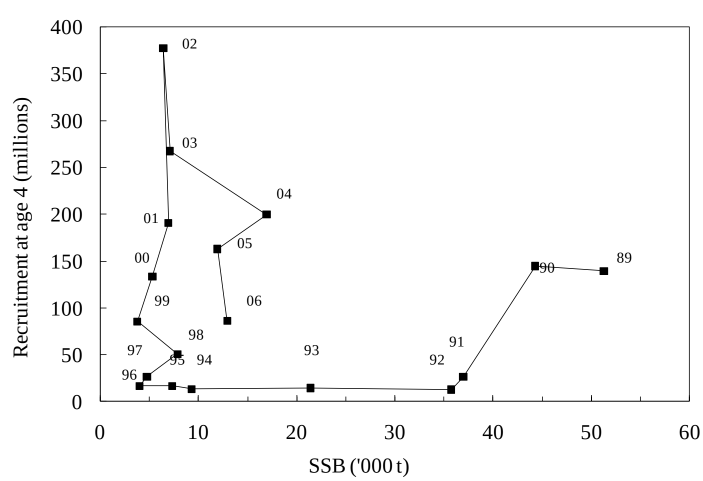


Fig. 7.9. Beaked redfish in Div. 3M: Stock/Recruitment plot (labels indicate age class).

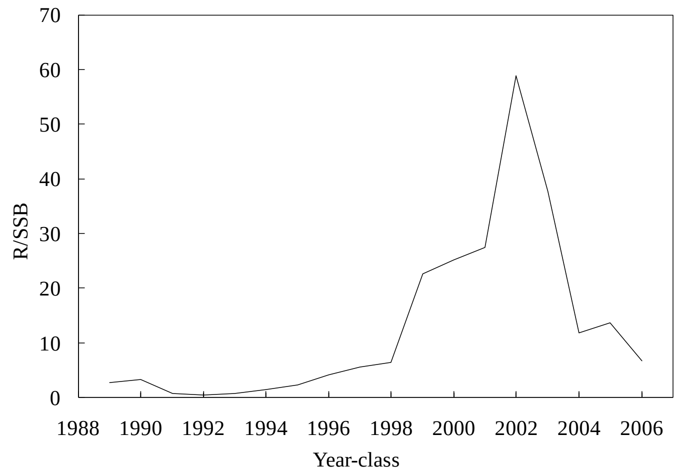


Fig. 7.10. Beaked redfish in Div. 3M: recruitment per thousand t of SSB .

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.

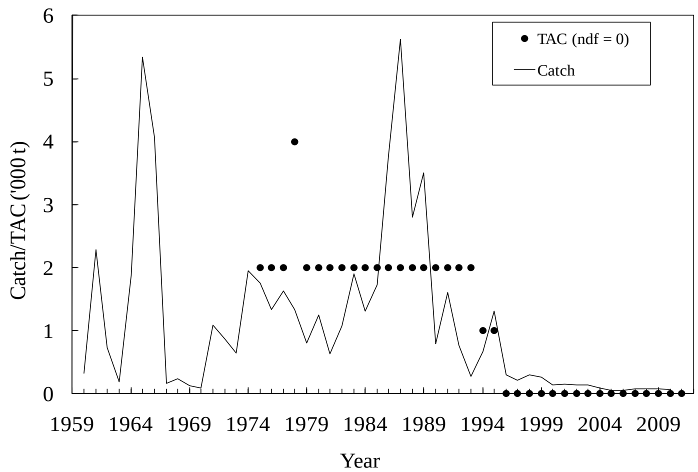


Fig. 8.1. American plaice in Div. 3M: STACFIS catches and agreed TACs. No directed fishing is plotted as 0 TAC.

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.

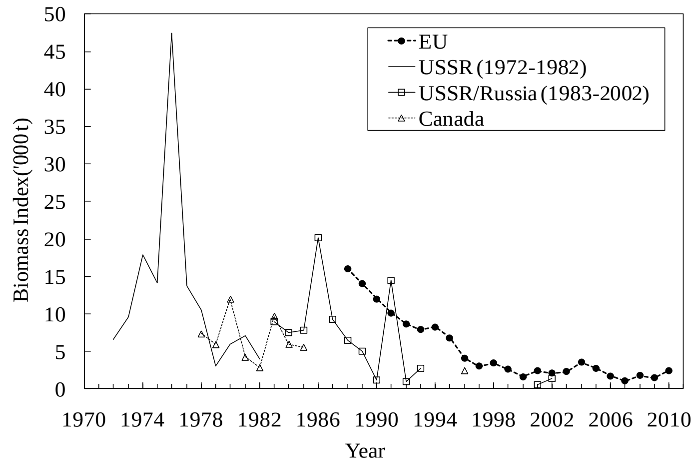


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys. EU survey data prior to 2003 converted to RV Vizconde de Eza equivalents.

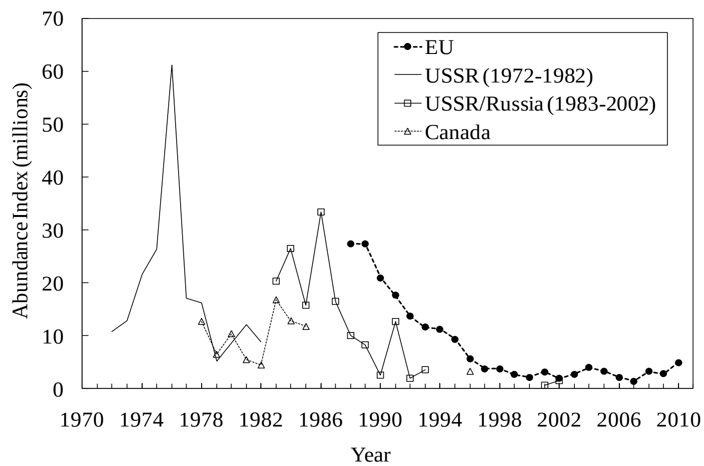


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys. EU survey data prior to 2003 converted to RV Vizconde de Eza equivalents.

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.

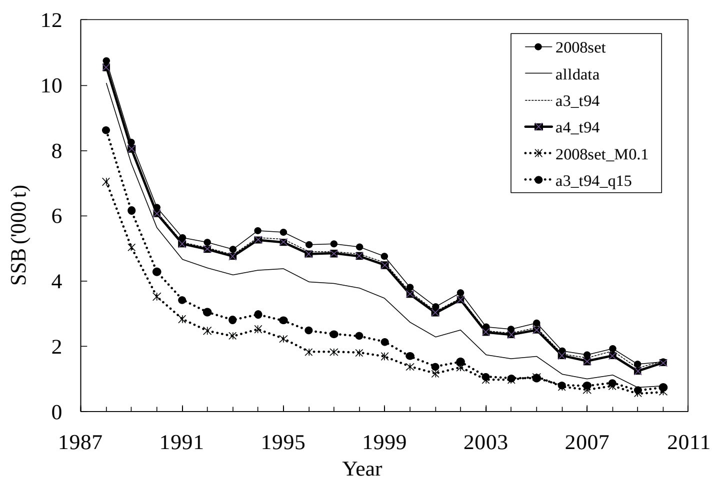


Fig. 8.4. American plaice in Div. 3M: trends in *SSB* in the XSA explorative runs.

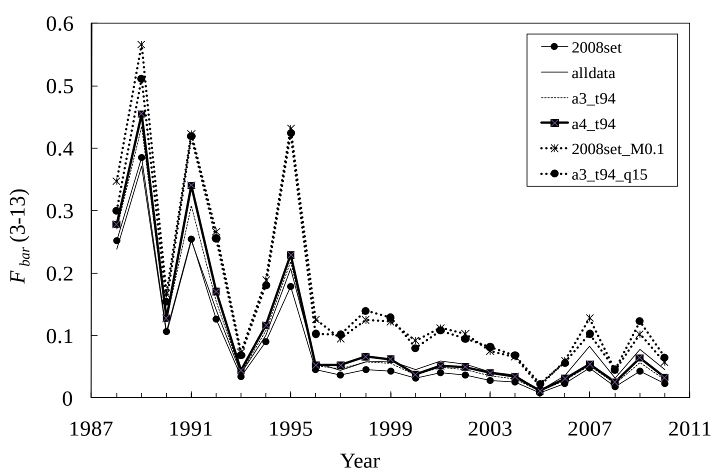


Fig. 8.5. American plaice in Div. 3M: trends in *F* in the XSA explorative runs.

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.

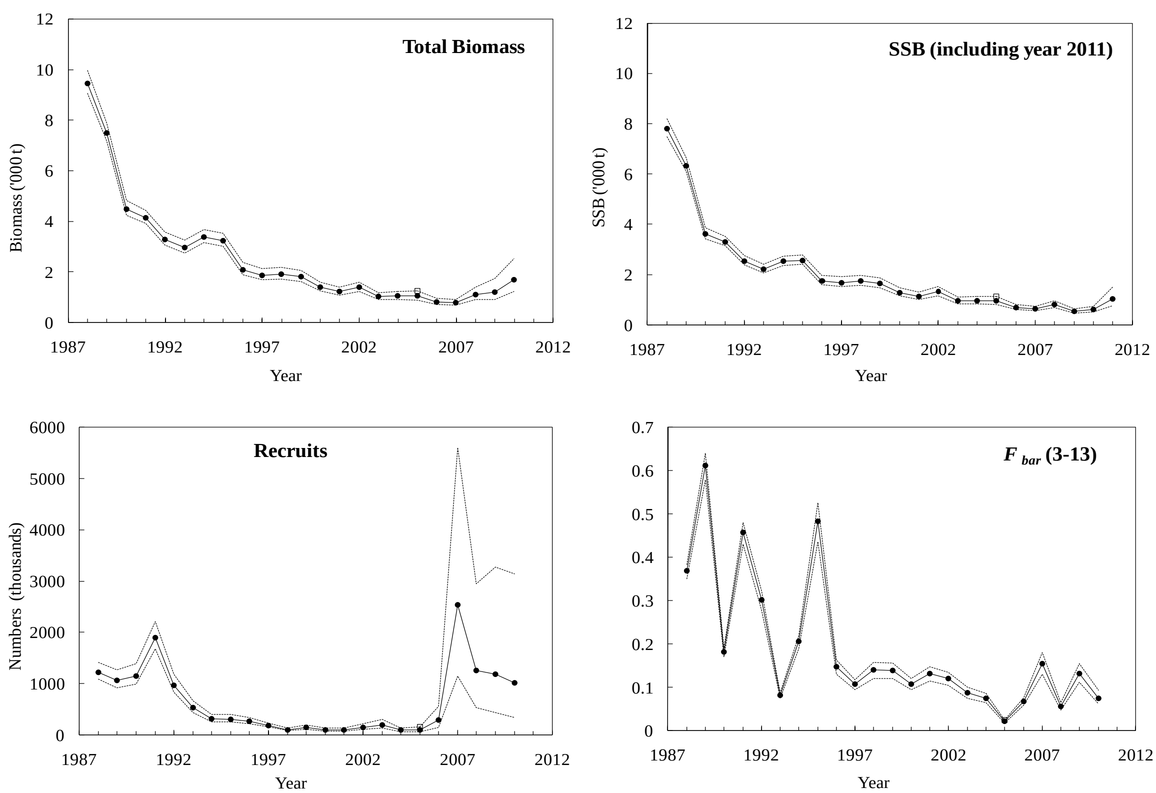


Fig. 8.6. American plaice in Div. 3M: stock trends in the VPA-type Bayesian model explorative run 1.

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.

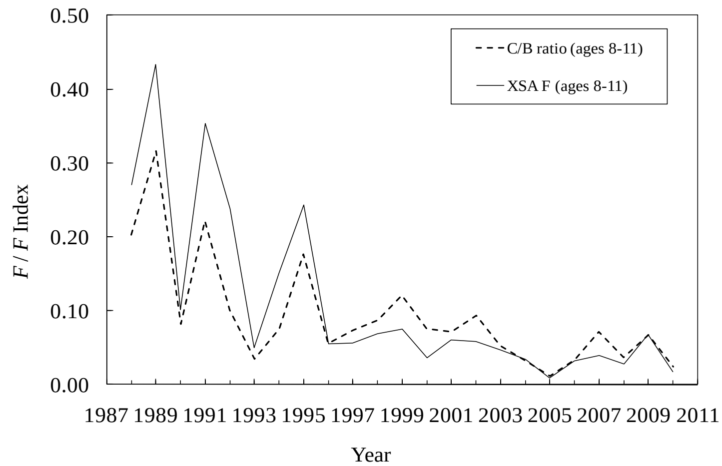


Fig. 8.7. American plaice in Div. 3M: fishing mortality (catch/biomass) index from EU survey (ages 8-11) and XSA estimated fishing mortality (ages 8-11).

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.

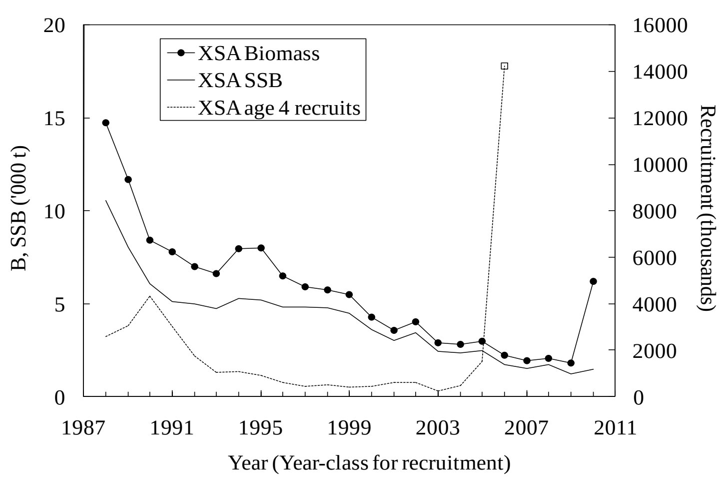


Fig. 8.8. American plaice in Div. 3M: biomass, spawning stock biomass (SSB) and corresponding recruitment from XSA

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).

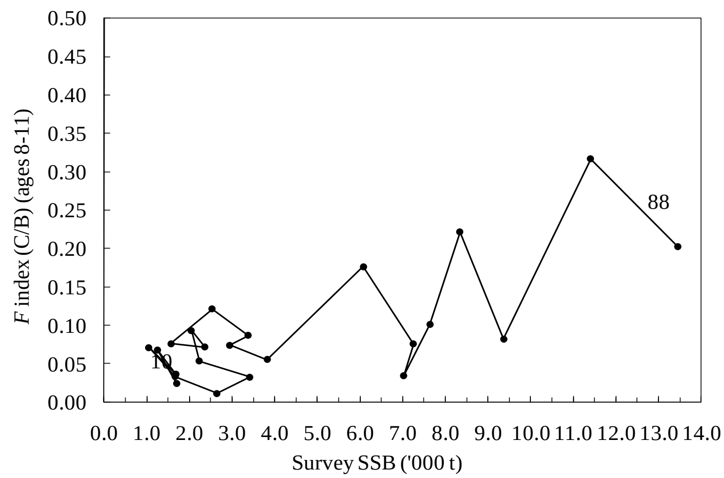


Fig. 8.9. American plaice in Div. 3M: stock trajectory within the NAFO PA framework.

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.

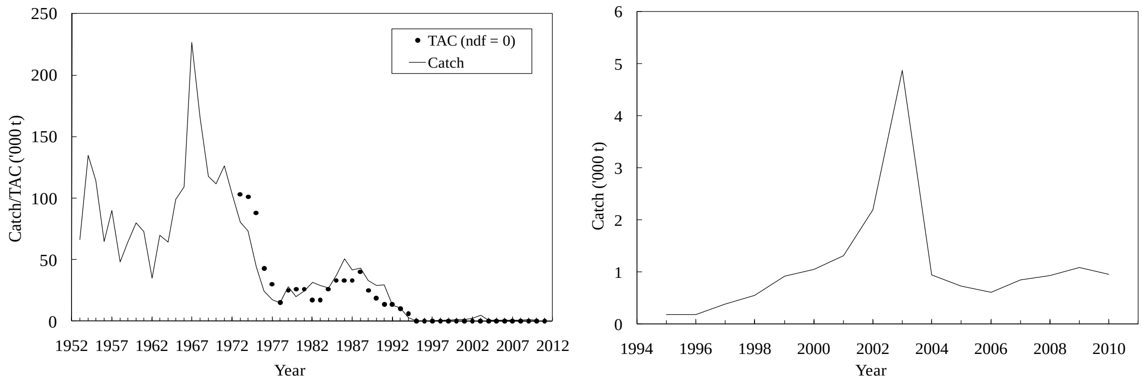


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

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).

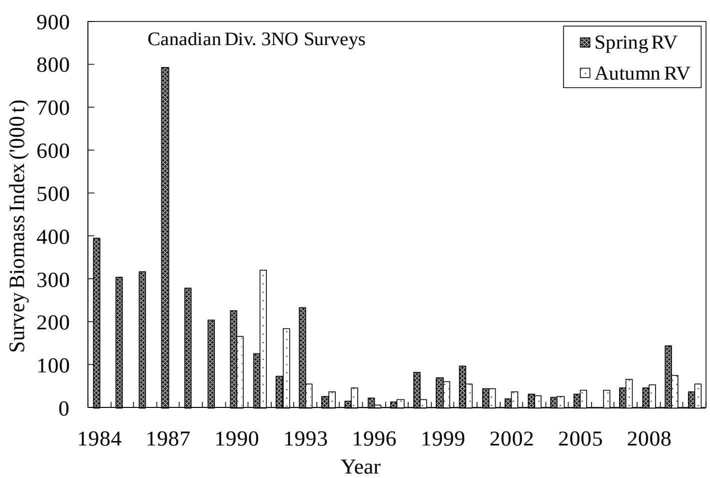


Fig. 9.2. Cod in Div. 3NO: mean number per tow from Canadian spring and autumn research surveys.

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.

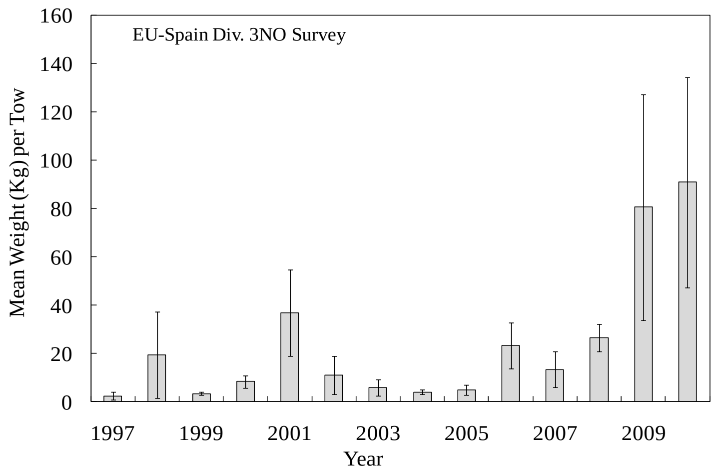


Fig. 9.3. Cod in Div. 3NO: mean weight per tow (± 1 s.d.) from EU-Spain Div. 3NO surveys.

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.

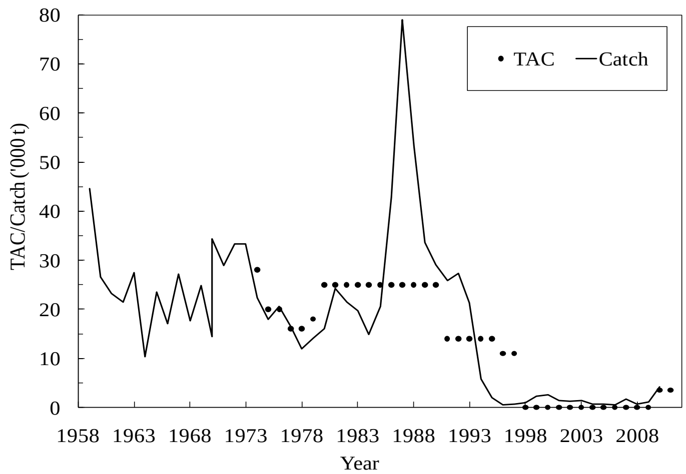


Fig. 10.1. Redfish in Div. 3LN: catches and TACs (ndf = 0).

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. .

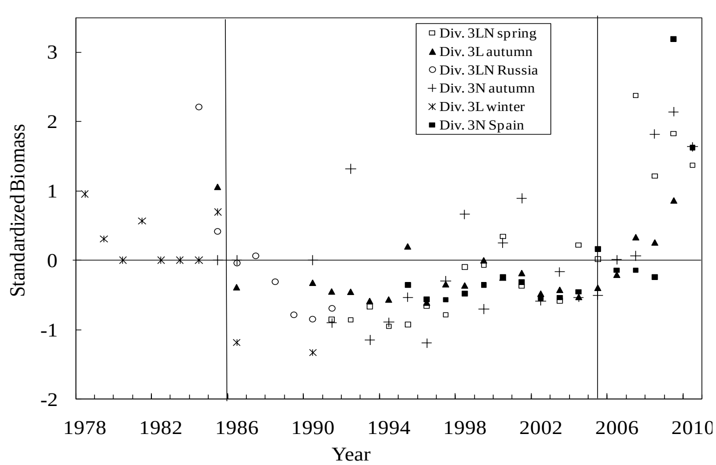


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2010). Each series is standardized to the mean and unit standard deviation.

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.

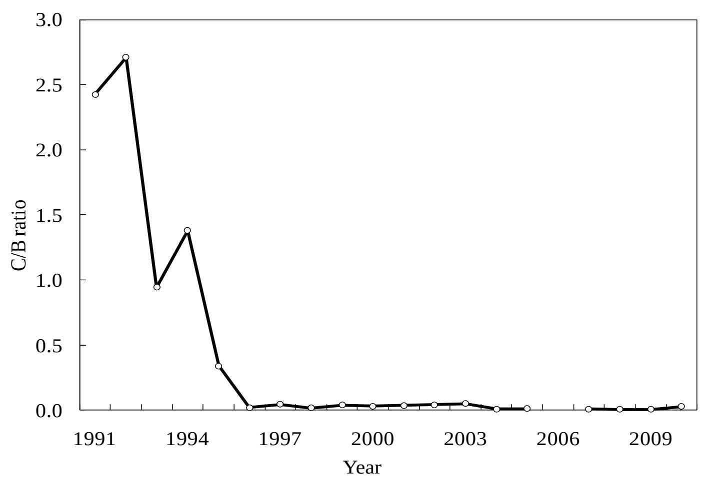


Fig. 10.3. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (1991-2010).

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.

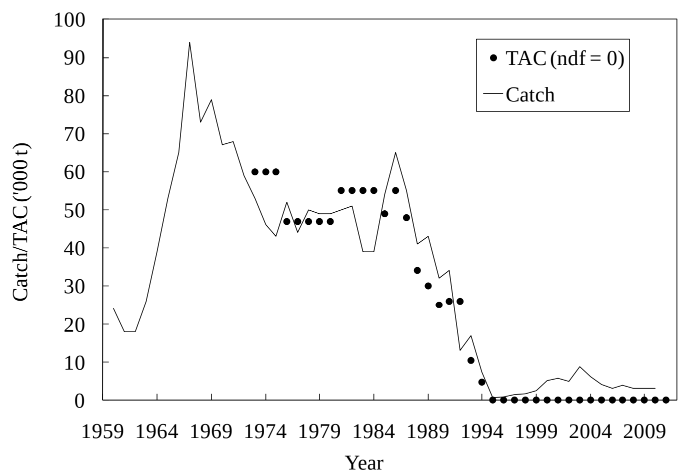


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

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.

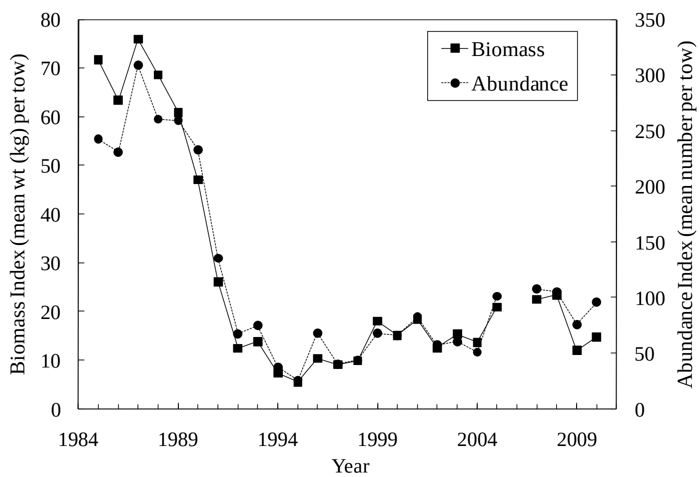


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys (Data prior to 1996 are Campelen equivalents and since then are Campelen).

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.

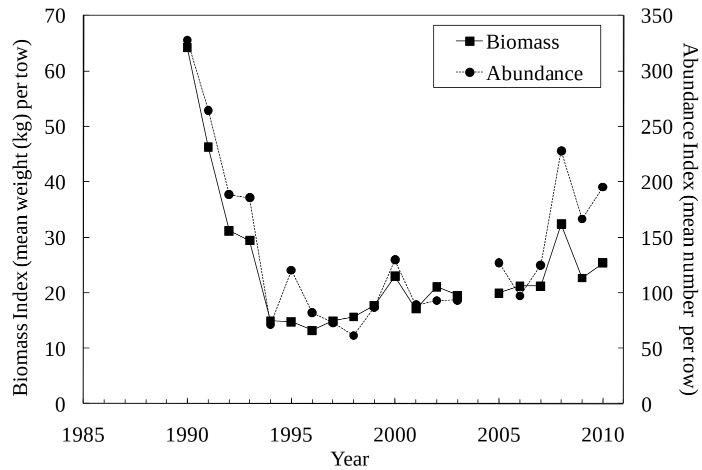


Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys (Data prior to 1995 are Campelen equivalents and since then are Campelen).

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).

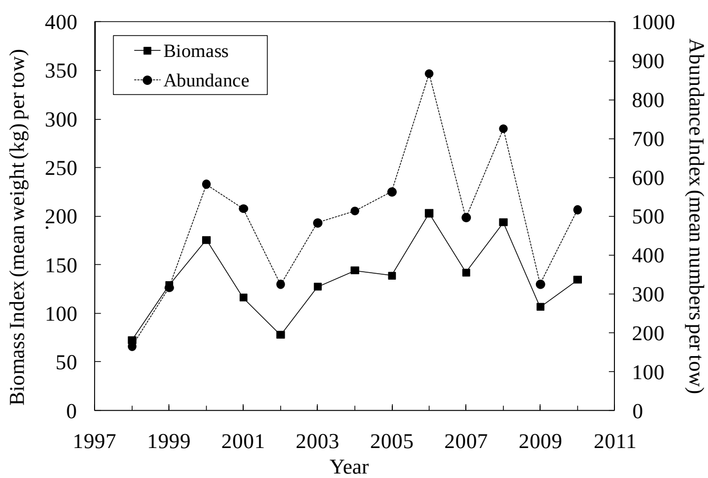


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from the EU-Spain Div. 3NO survey (Data prior to 2001 are Campelen equivalents and since then are Campelen).

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).

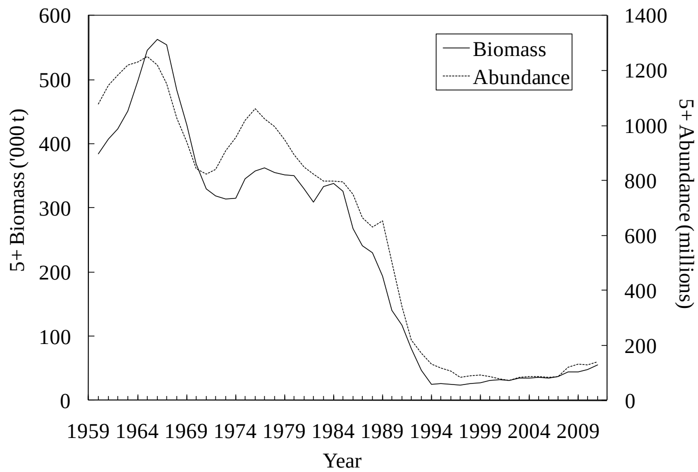


Fig. 11.5. American plaice in Div. 3LNO: population abundance and biomass from VPA

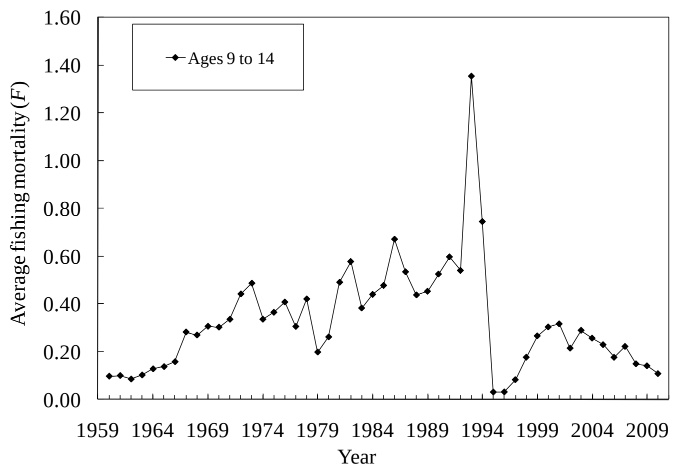


Fig. 11.6. American plaice in Div. 3LNO: average fishing mortality from VPA.

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.

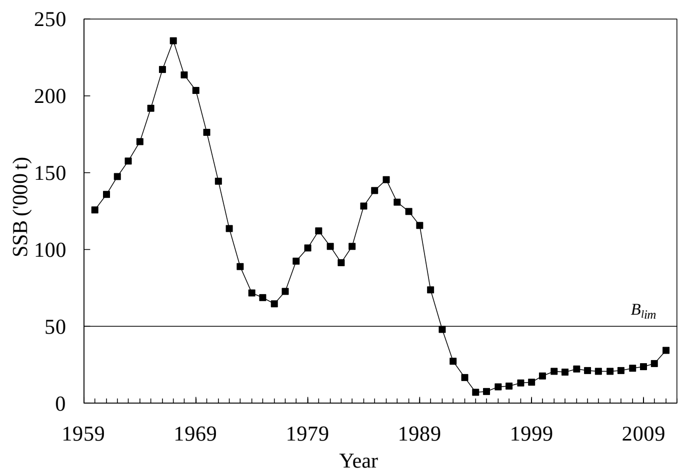


Fig. 11.7. American plaice in Div. 3LNO: spawning stock biomass from VPA.

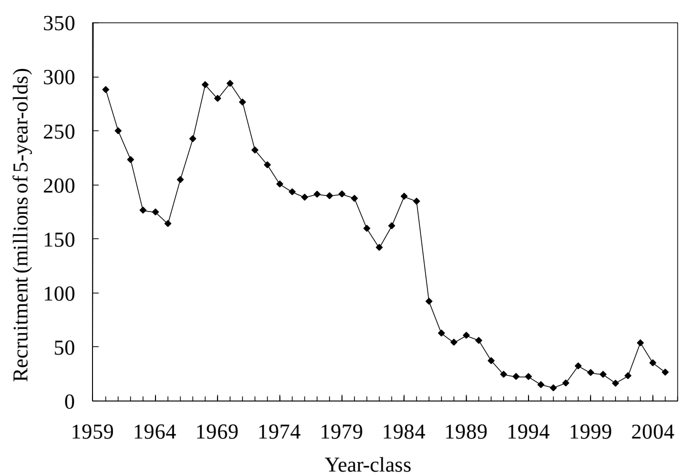


Fig. 11.8. American plaice in Div. 3LNO: recruits (at age 5) from VPA.

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.

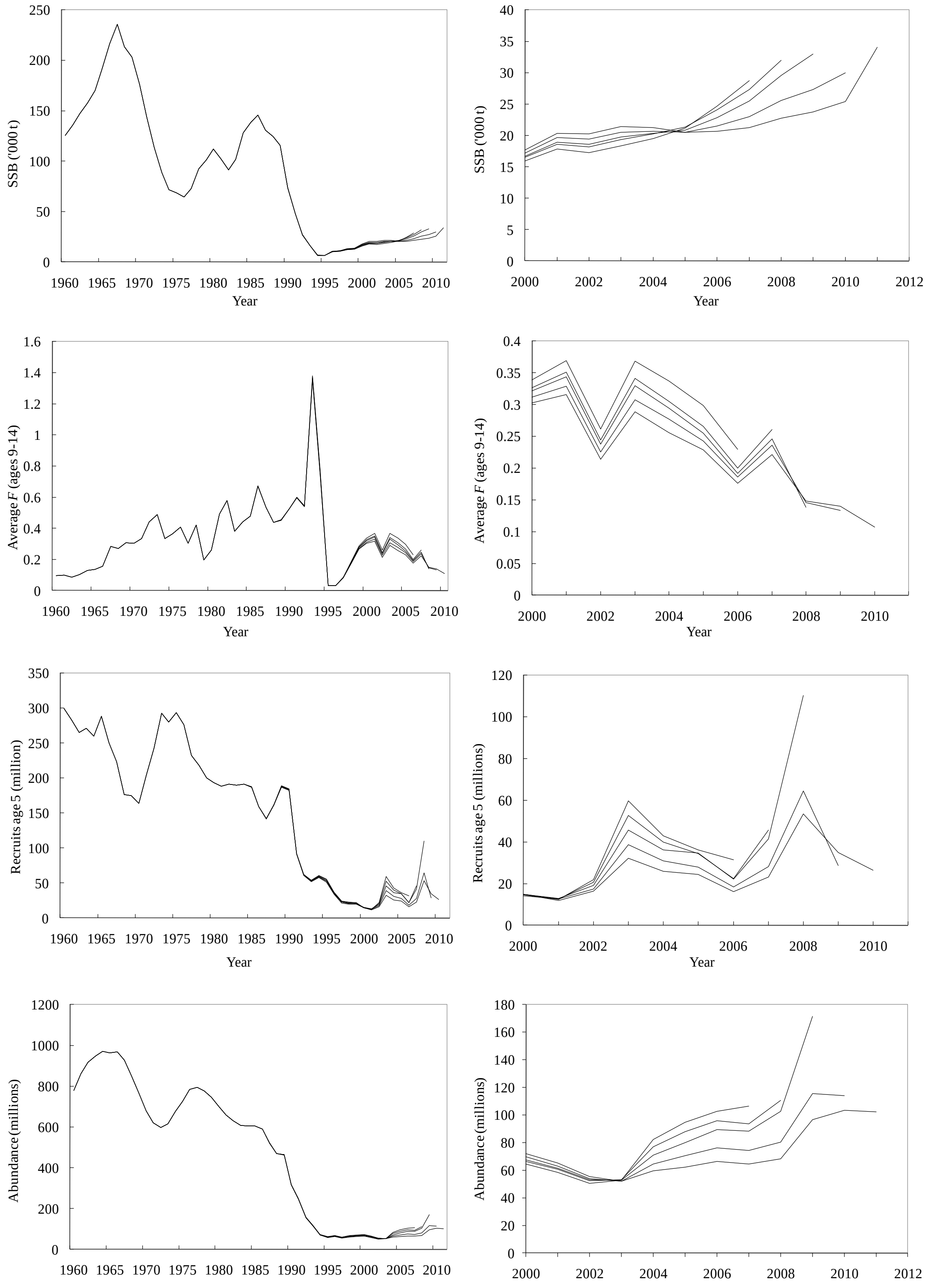


Fig 11.9 American plaice in Div. 3LNO: retrospective analysis of SSB, average *F* (ages 9-14), recruitment (age 5) and 6+ population numbers.

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).

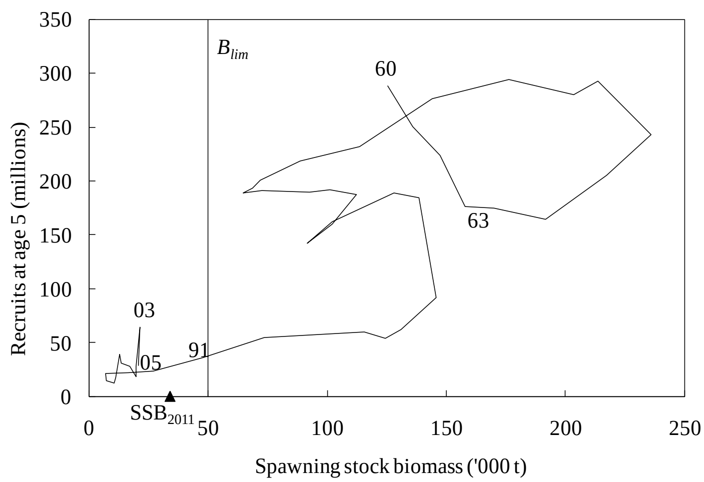


Fig. 11.10. American plaice in Div. 3LNO: stock recruit scatter. The vertical line is B_{lim}.

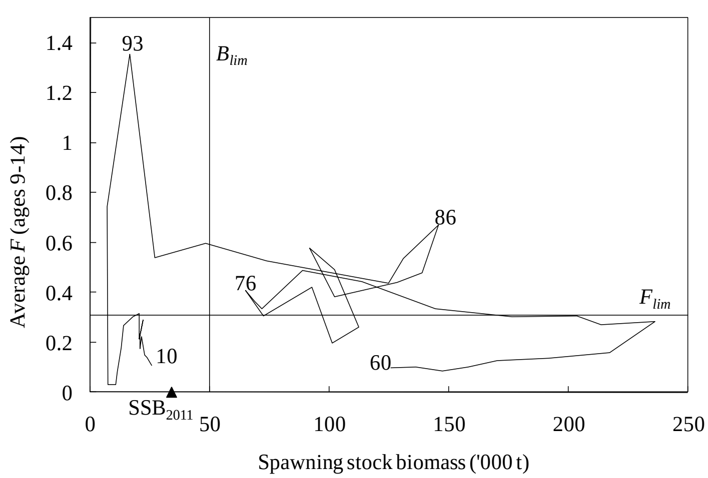


Fig. 11.11. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework.

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.

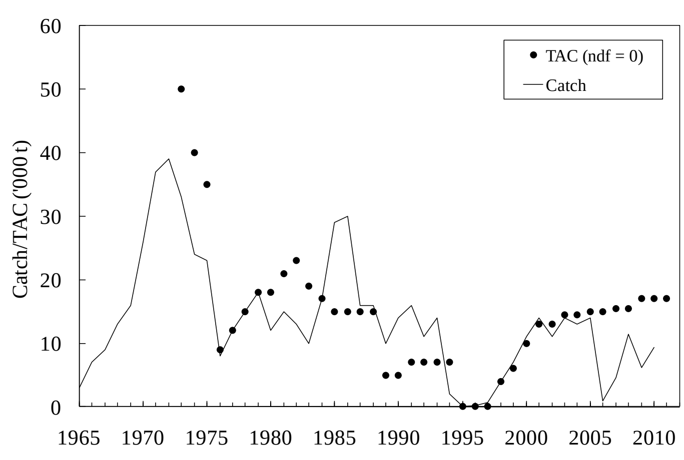


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

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.

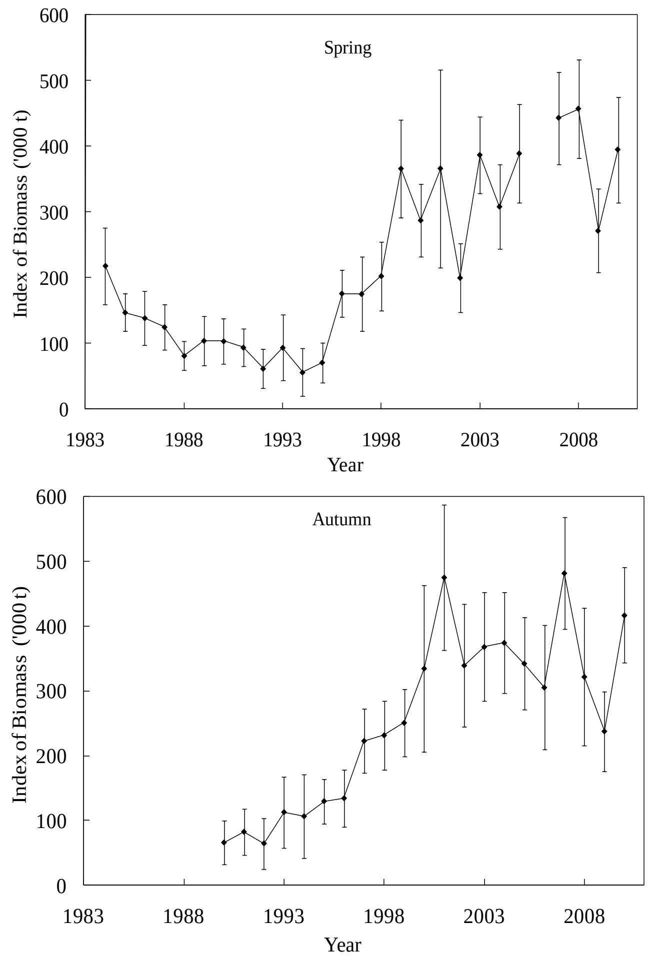


Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx 95% confidence intervals, from Canadian spring and autumn surveys. Values are Campelen units or, prior to autumn 1995, Campelen equivalent units.

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).

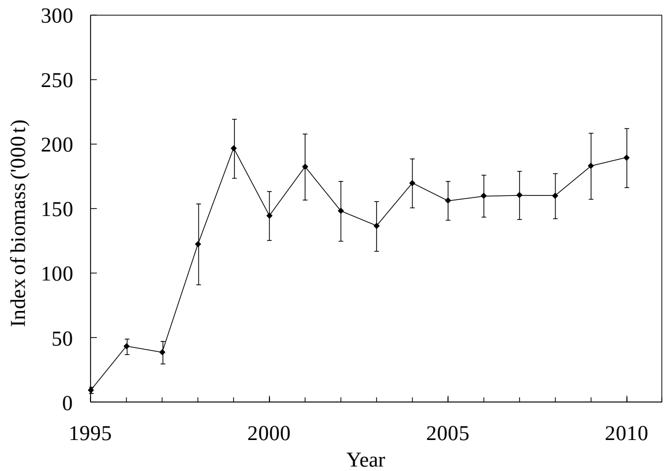


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the EU-Spain spring surveys in the Regulatory Area of Div. 3NO ±1SD. Values are Campelen units or, prior to 2001, Campelen equivalent units.

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.

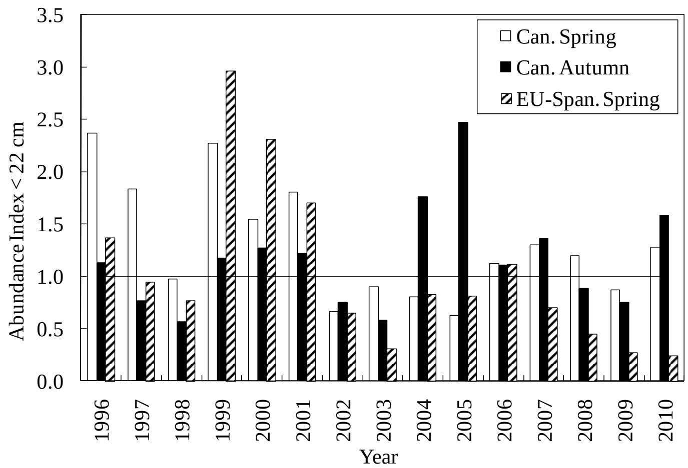


Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile length index estimated from 1996 to 2010 annual spring and autumn surveys by Canada (Can.) and annual spring surveys by EU-Spain (EU-Span.).

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).

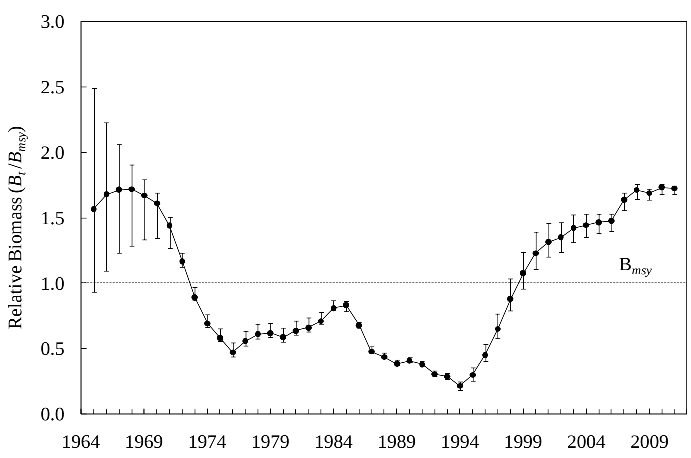


Fig. 12.5. Yellowtail flounder in Div. 3LNO: bias corrected relative biomass trends with approximate 80% confidence intervals.

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}.

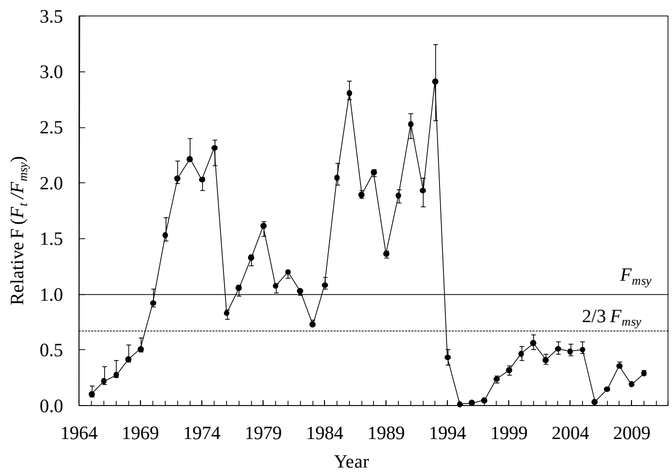


Fig. 12.6. Yellowtail flounder in Div. 3LNO: bias corrected relative fishing mortality trends with approximate 80% confidence intervals.

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.

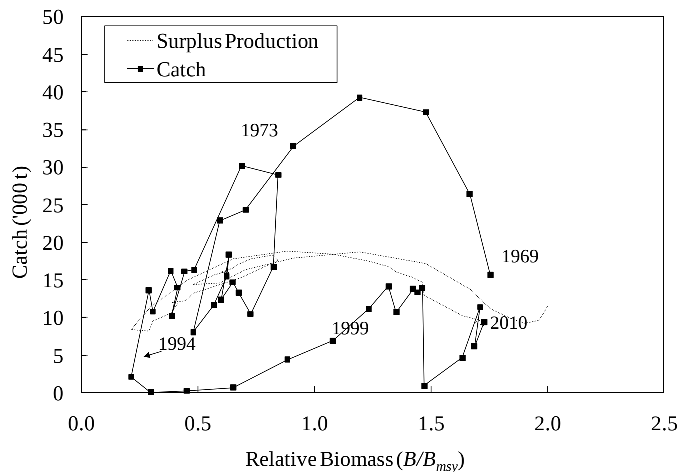


Fig. 12.7. Yellowtail flounder in Div. 3LNO: catch trajectory.

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

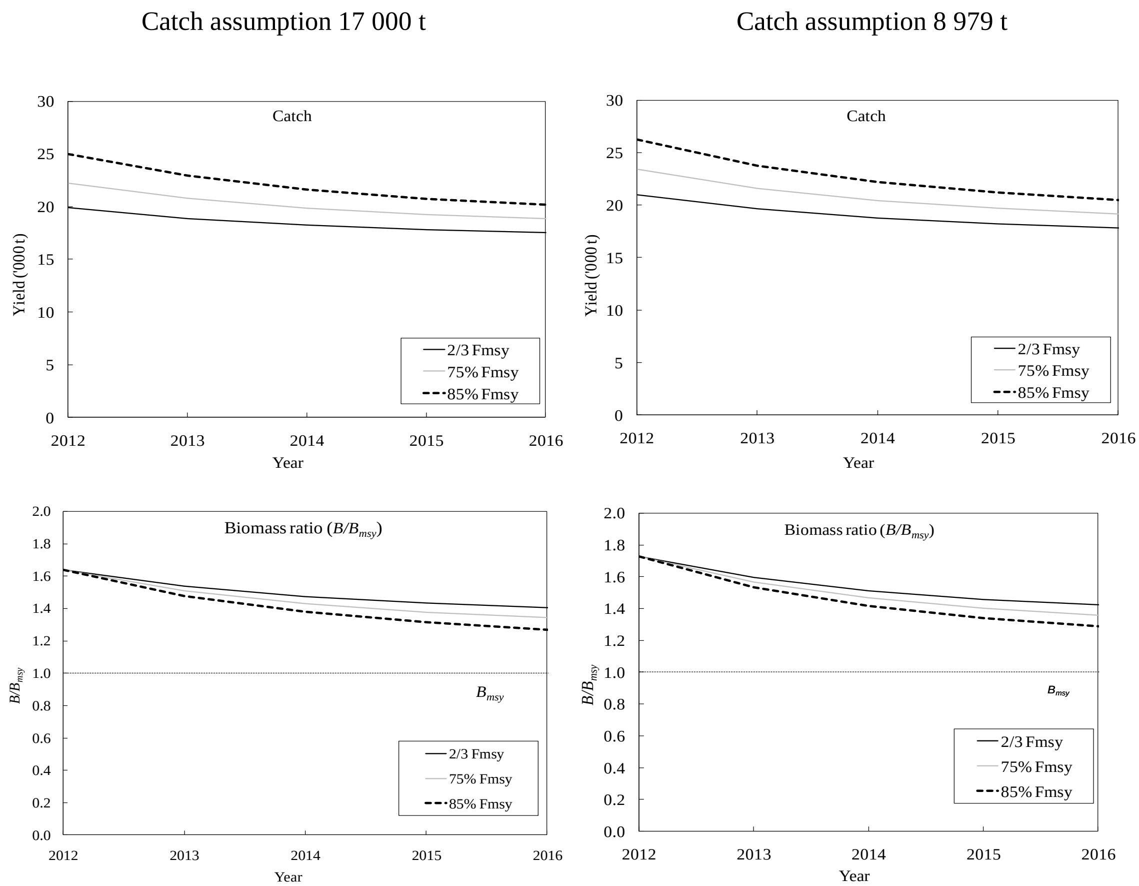


Fig. 12.8. Yellowtail flounder in Div. 3LNO: medium term projections for two catch scenarios and at three levels of F (2/3 F_{msy}, 75% and 85% F_{msy}). Top panels show projected catch and lower panels are projected relative biomass ratios (B/B_{msy}). Results are median values derived from ASPIC bootstrap 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.

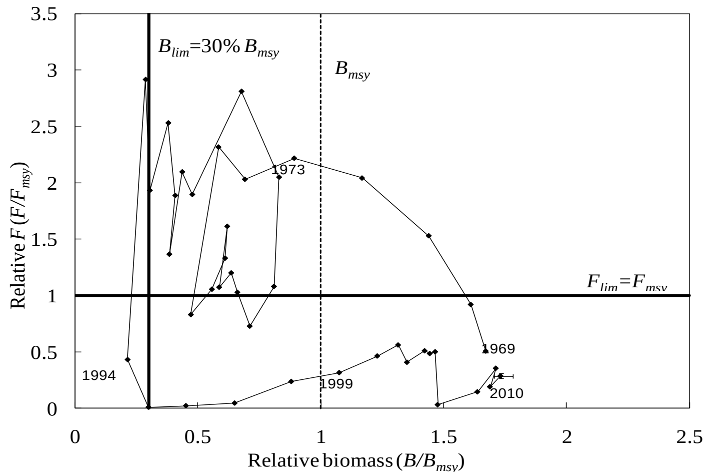


Fig. 12.9. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in the surplus production analysis, under a precautionary approach framework.

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.

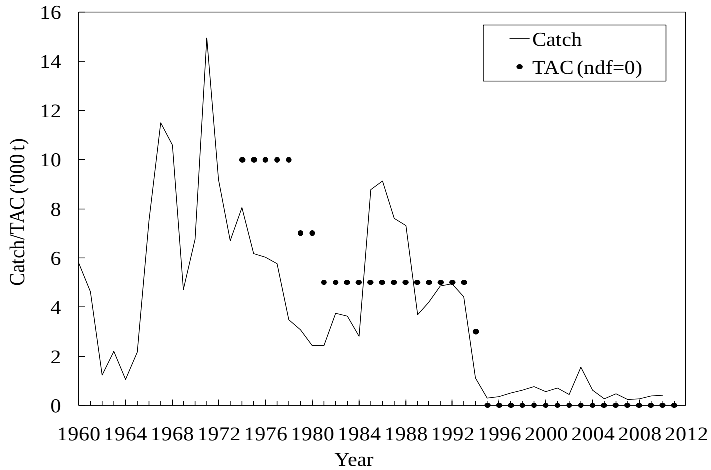


Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as TAC = 0.

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.

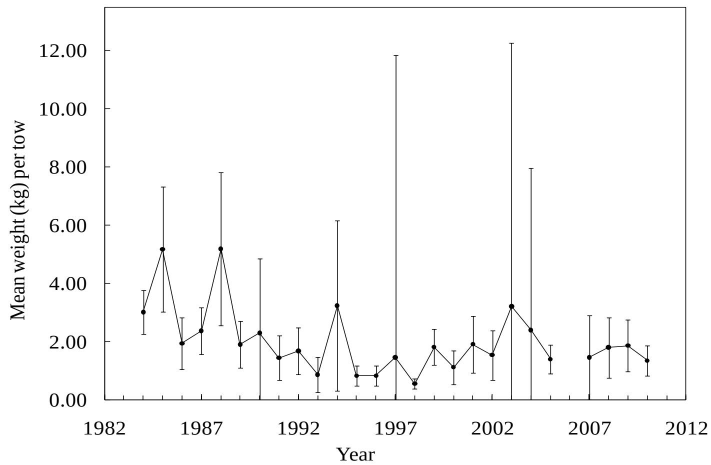


Fig. 13.2. Witch flounder in Div. 3NO: mean weights per tow from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units.

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.

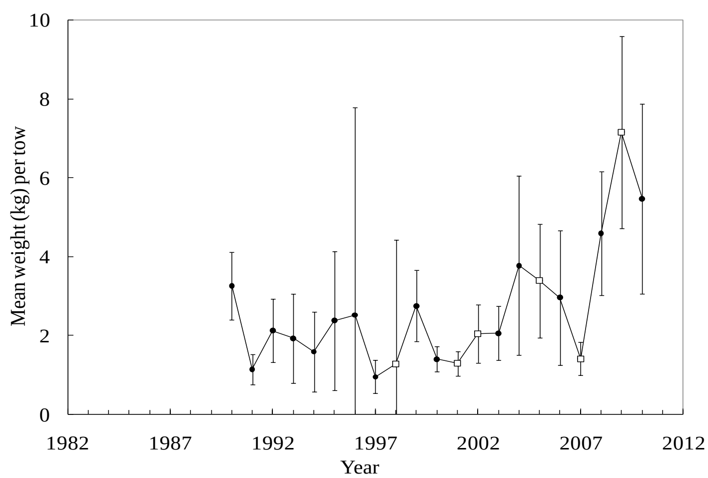


Fig. 13.3. Witch flounder in Div. 3NO: mean weights per tow from Canadian autumn surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols refer to years in which more than 50% of the deep water (> 730 m) strata were covered 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.

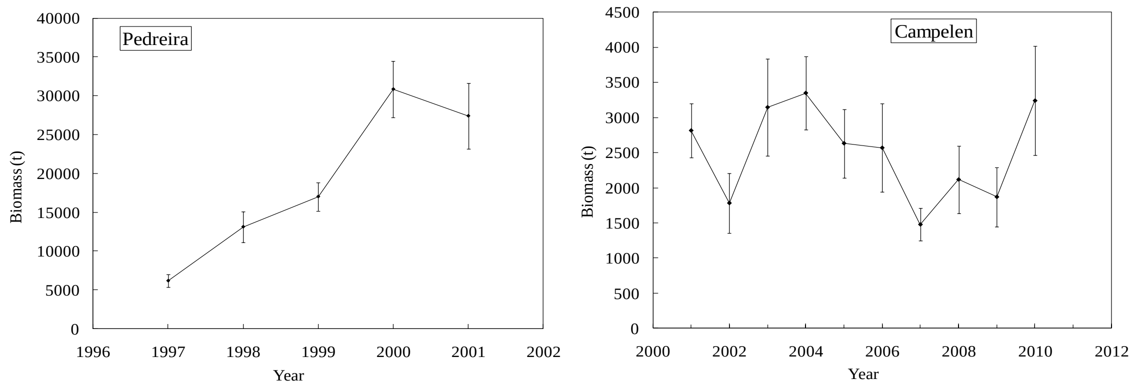


Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from EU-Spain Div. 3NO surveys (± 1 standard deviation). Data from 1997-2001 is in Pedreira units; data from 2001-2010 are Campelen units. Both values are present for 2001.

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).

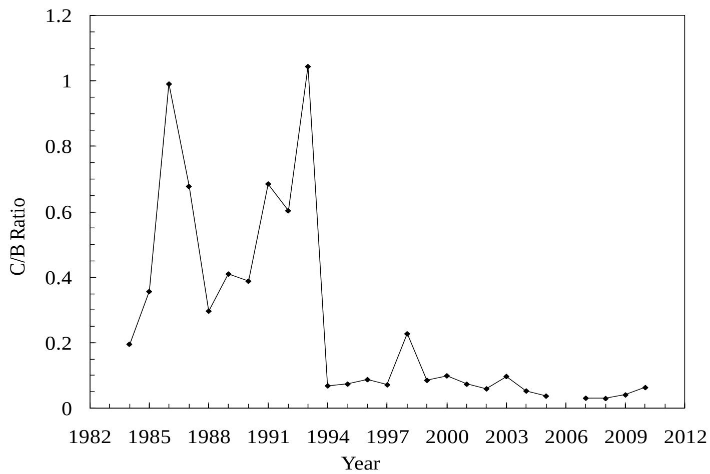


Fig. 13.5. Witch flounder in Div. 3NO: Catch divided by biomass estimates from the Canadian spring survey, 1984-2010.

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

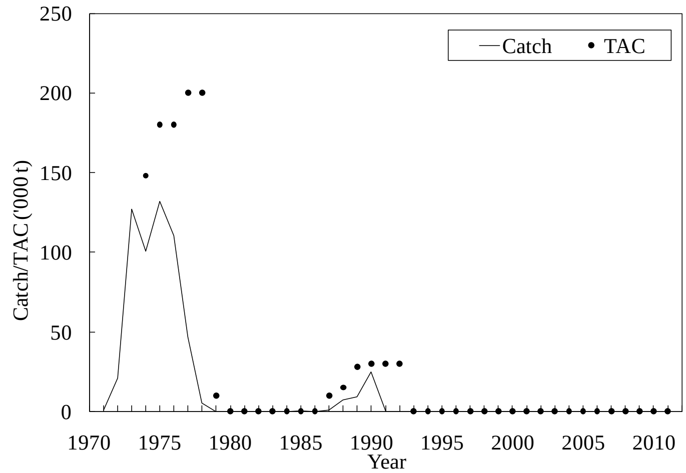


Fig. 14.1. Capelin in Div. 3NO: catches and TACs (ndf = 0).

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.

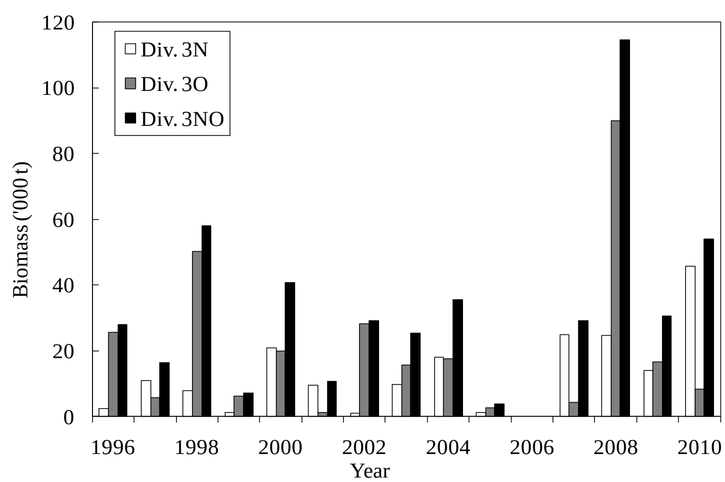


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates from Canadian spring surveys in 1996-2010.

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.

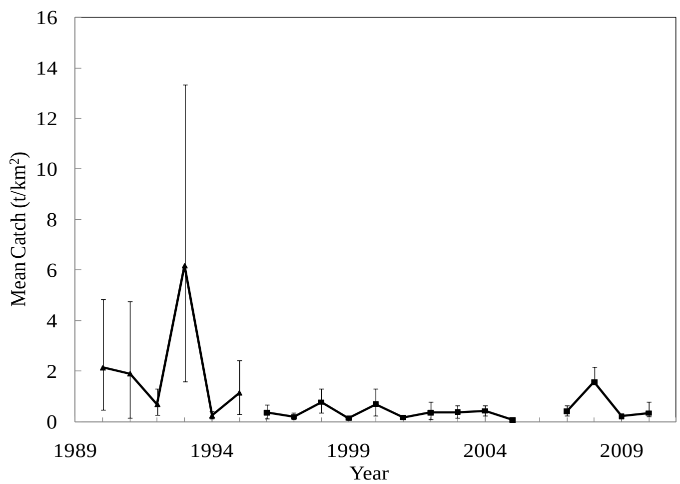


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km^2) from Canadian spring surveys in 1996-2010. Estimates prior to 1996 are from Engel and from 1996-2010 are from Campelen. Survey in 2006 was incomplete.

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

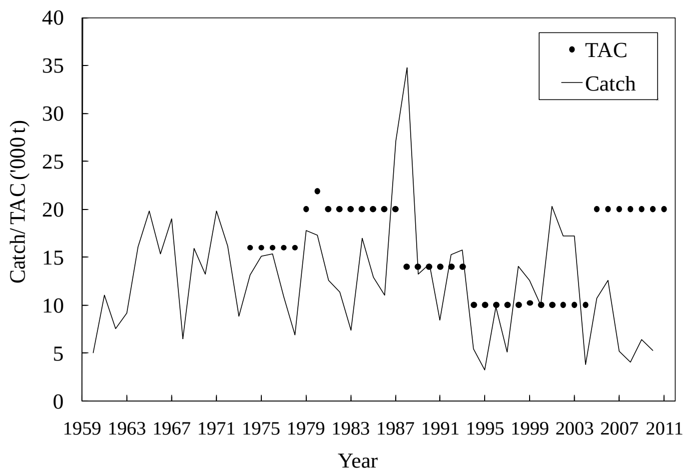


Fig. 15.1. Redfish in Div. 3O: catches and TACs. The TAC for 1997-2004 applied only within the Canadian EEZ.

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.

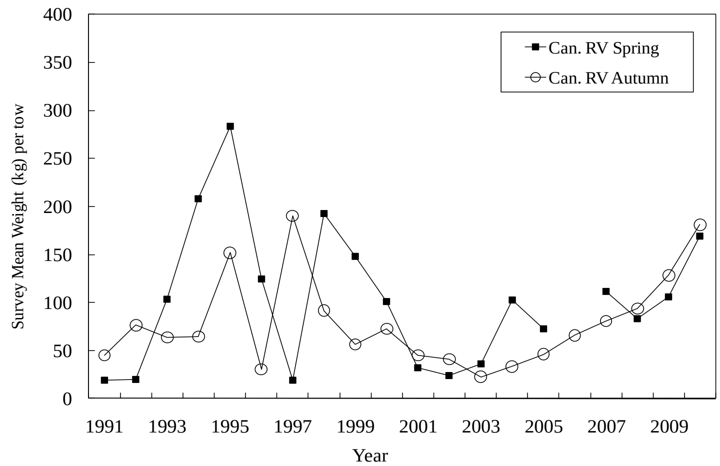


Fig. 15.2. Redfish in Div. 3O: Mean weight (kg.) per tow from Canadian surveys in Div. 3O (Campelen equivalent estimates prior to autumn 1995; error around estimates not plotted in order to visualize trend).

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)

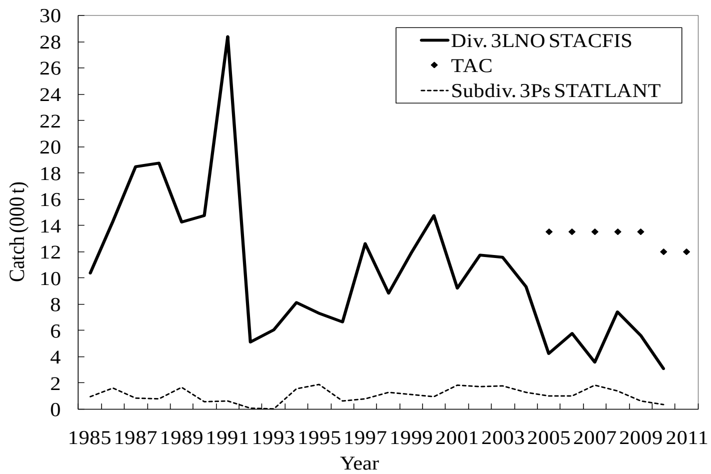


Fig. 16.1. Thorny skate catch in Div. 3LNO and Subdiv. 3Ps and TAC.

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).

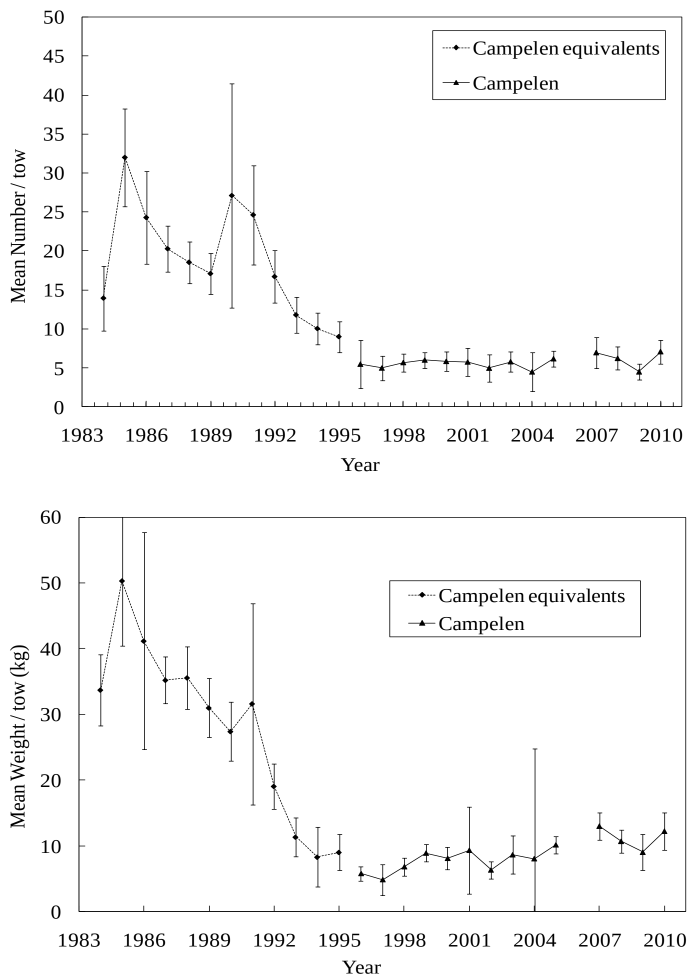
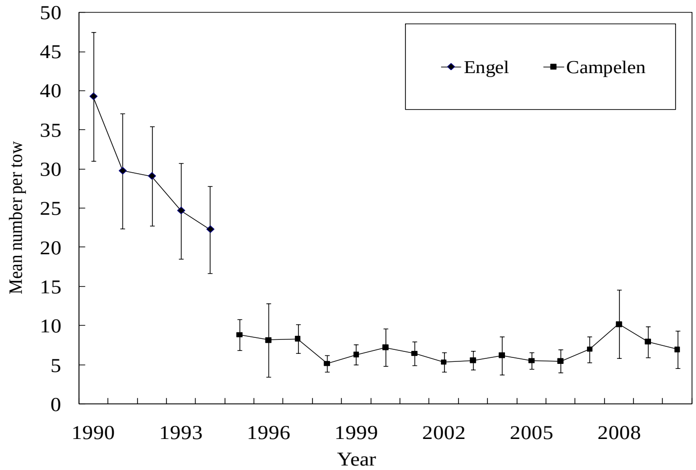


Fig. 16.2. Thorny skate in Div. 3LNOPs, 1984-2010: estimates of Campelen-equivalent and Campelen mean numbers (Upper panel) and mean weights (Lower panel) per tow from Canadian spring surveys. Survey in 2006 was incomplete.

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.



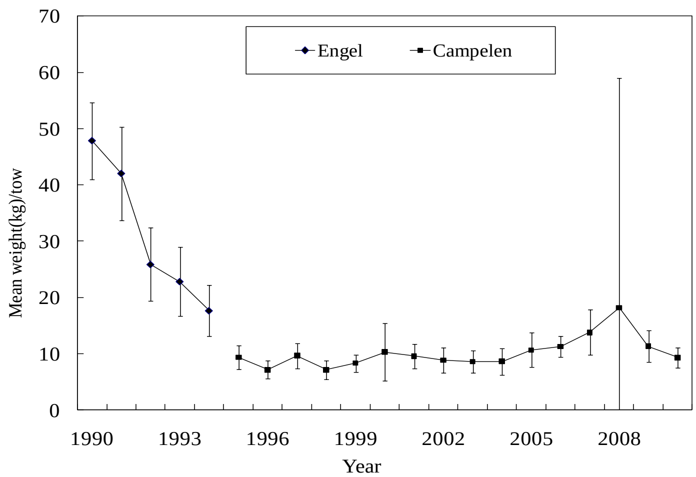


Fig. 16.3. Thorny skate in Div. 3LNO, 1990-2010: estimates of mean numbers and mean weights per tow (unconverted) from Canadian autumn surveys. Note that Engel data in 1990-1994 and Campelen data in 1995-2010 are not directly comparable.

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.

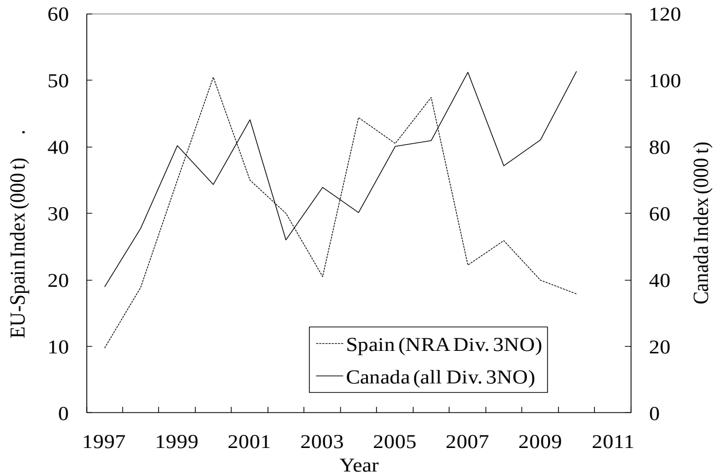


Fig. 16.4. Thorny skate in Div. 3NO: estimates of biomass from EU-Spain spring surveys and Canadian RV spring surveys from 1997-2010.

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	

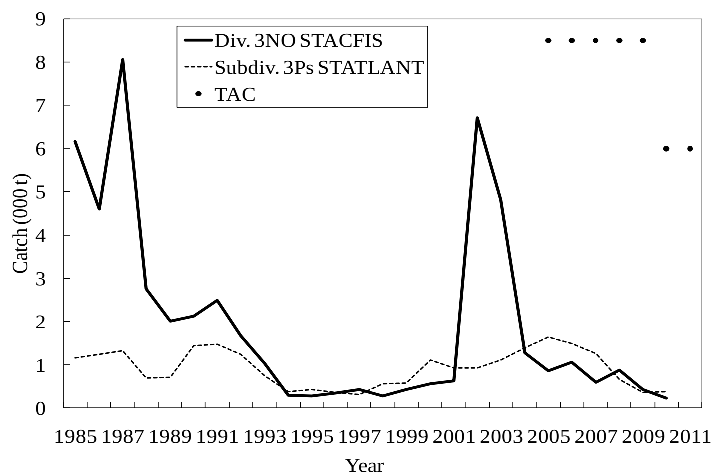


Fig. 17.1. White hake in Div. 3NO and Subdiv. 3Ps: Total catch of white hake in NAFO Div. 3NO (STACFIS) and Subdivision 3Ps (STATLANT21). The Total Allowable Catch (TAC) for Div. 3NO is indicated on the graph.

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.

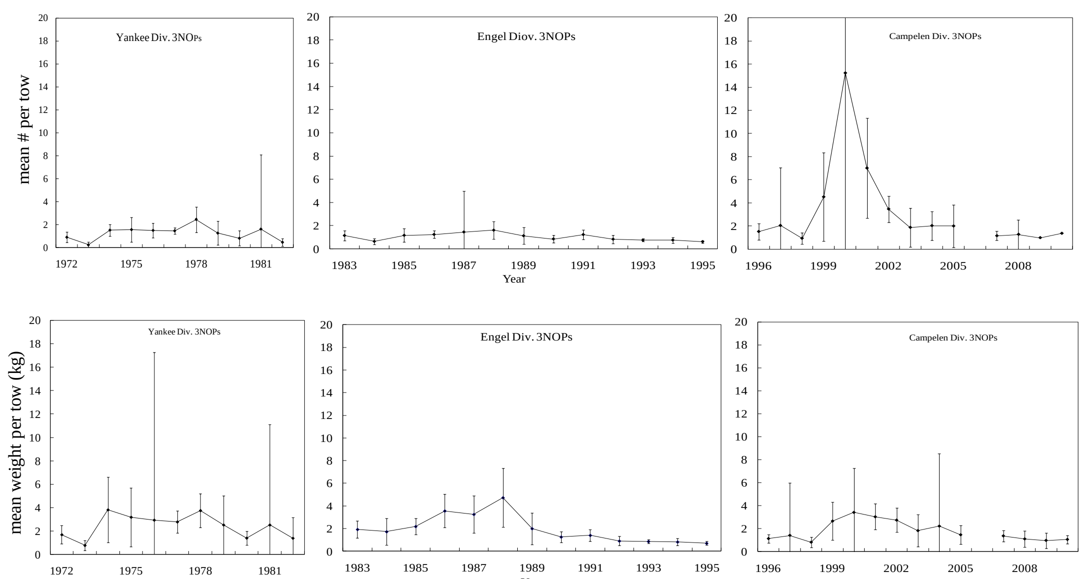
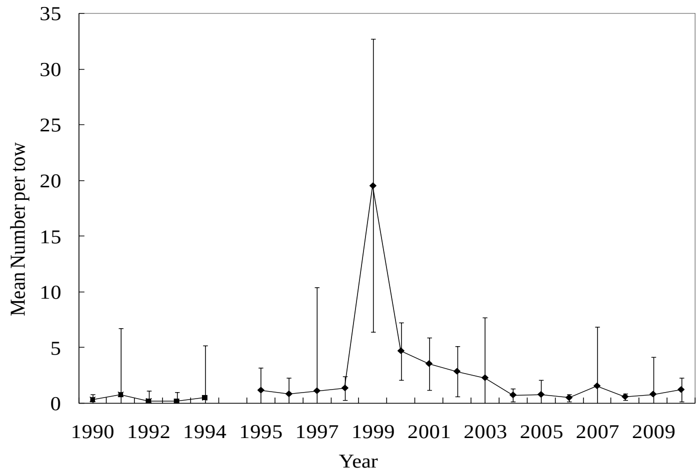


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: mean number and mean weight per tow from Canadian spring research surveys, 1972-2010. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. The Yankee, Engel, and Campelen time series are not standardized, and are thus presented on separate panels.



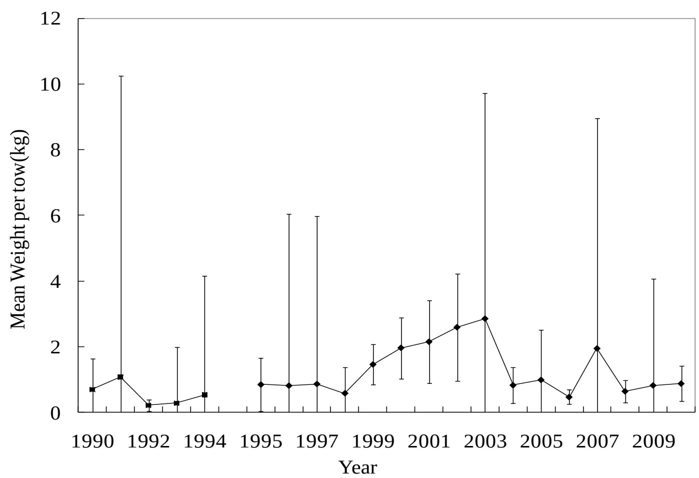


Fig. 17.2b White hake in Div. 3NO: mean numbers (upper Panel) and mean weights (lower Panel) per tow from Canadian autumn surveys, 1990-2010. The Engel (■, 1990-1994) and Campelen (♦, 1995-2010) time series are not standardized.

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).

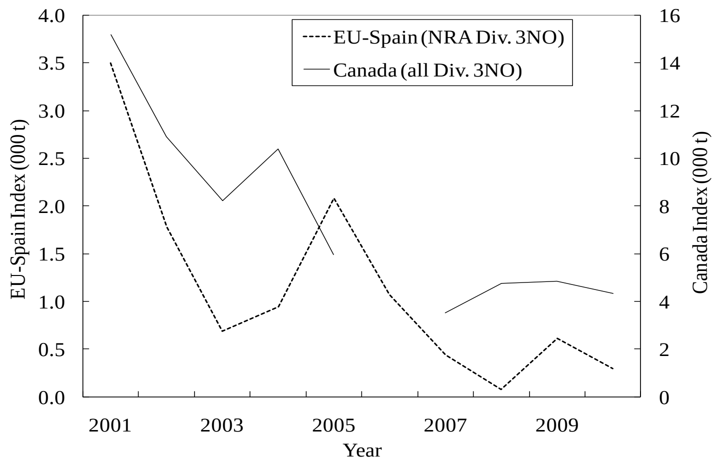


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from EU-Spain Campelen spring surveys in 2001-2010 compared to Canadian spring survey indices in all of Div. 3NO. Estimates from 2006 Canadian survey are not shown, since survey coverage in that year was incomplete.

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).

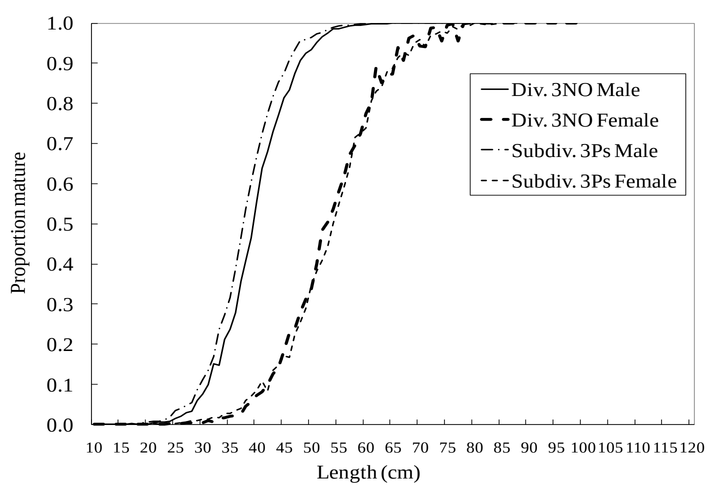
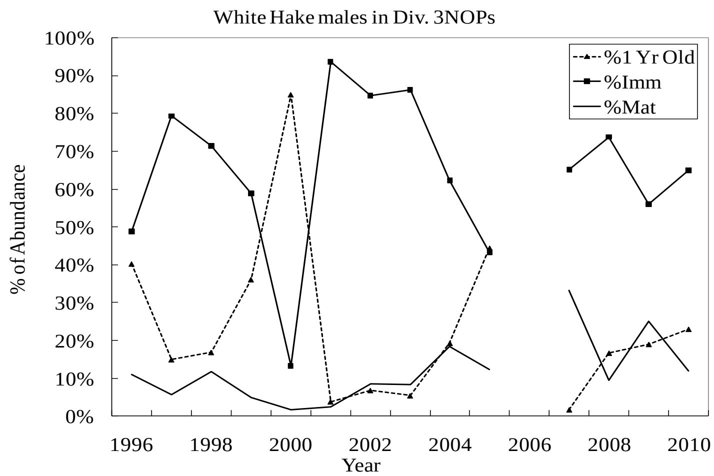


Fig. 17.4. White hake in Div. 3NO and Subdiv. 3Ps: ogives calculated for each sex from Canadian spring surveys and averaged over 1996-2010.

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.



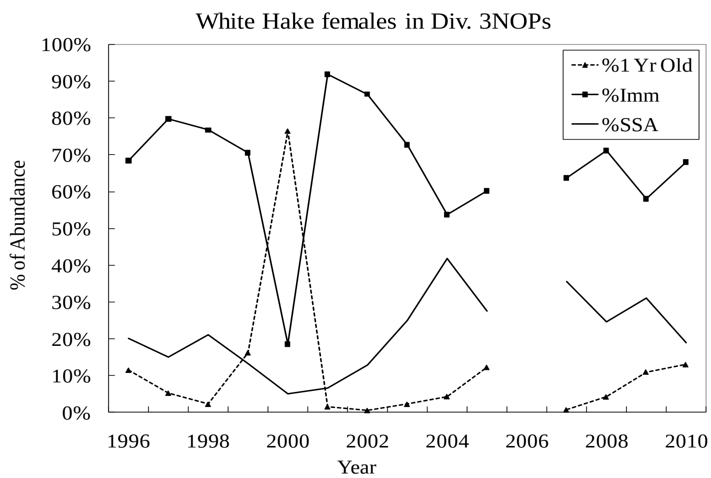


Fig. 17.5. White hake in Div. 3NO and Subdiv. 3Ps: Proportion of stages in terms of abundance by sex from Canadian Campelen spring survey data in 1996-2010. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

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.

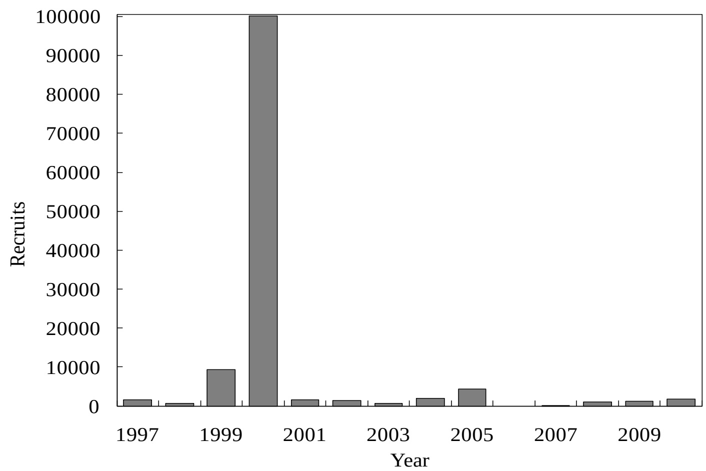


Fig. 17.6. White hake in Div. 3NO and Subdiv. 3Ps: recruits from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2010. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

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.

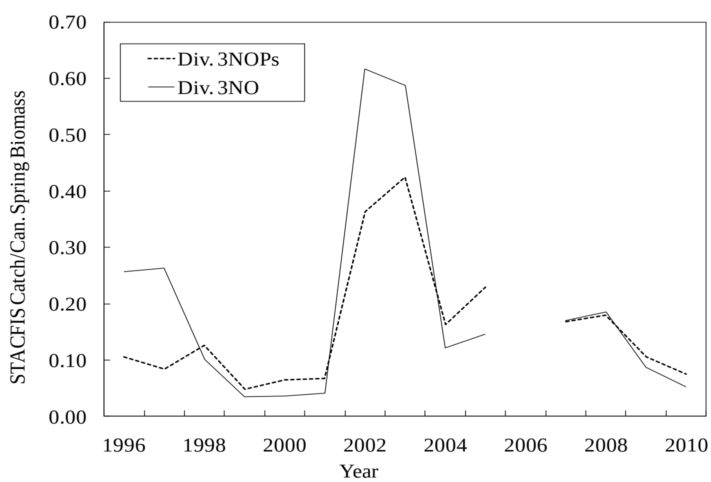


Fig. 17.7. White hake in Div. 3NO and Subdiv. 3Ps: estimates of relative *F* from STACFIS agreed commercial catches/Canadian spring survey biomass (1996-2010). Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

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^{o}-4^{o}C and salinities in the range of 34-34.75. On average bottom temperatures remain <0^{o}C over most of the northern Grand Banks but increase to 1-4^{o}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^{o}C) except for the shallow inshore regions where they are mainly <0^{o}C. In the deeper waters of the Flemish Pass and across the Flemish Cap bottom temperatures generally range from 3-4^{o}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

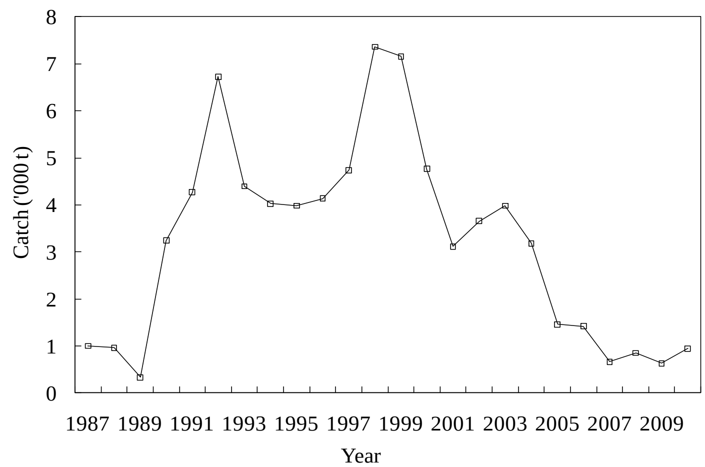


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

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).

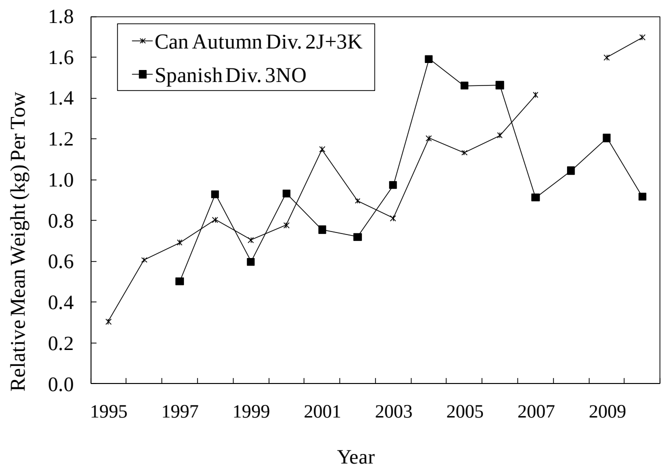


Fig. 18.2. Roughhead grenadier in Subareas 2+3: Relative (to the mean) mean weight per tow from the Canadian autumn (Div. 2J+3K) survey and Spanish Div. 3NO survey.

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.

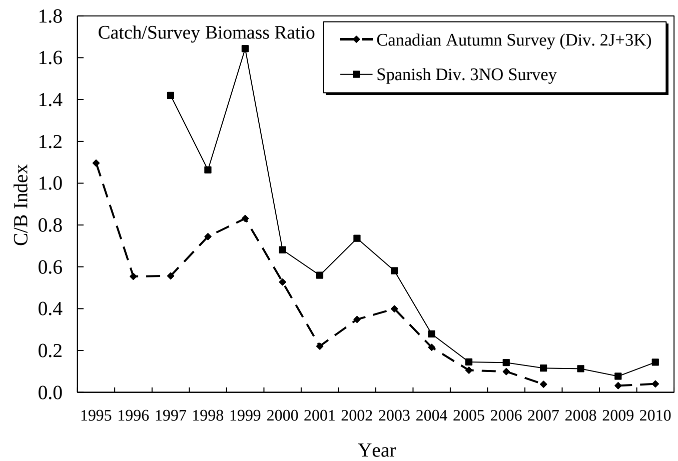


Fig. 18.3. Roughhead grenadier in Subareas 2+3: The catch/biomass (C/B) ratios from the Canadian autumn (Div. 2J+3K) survey and Spanish Div. 3NO survey.

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.

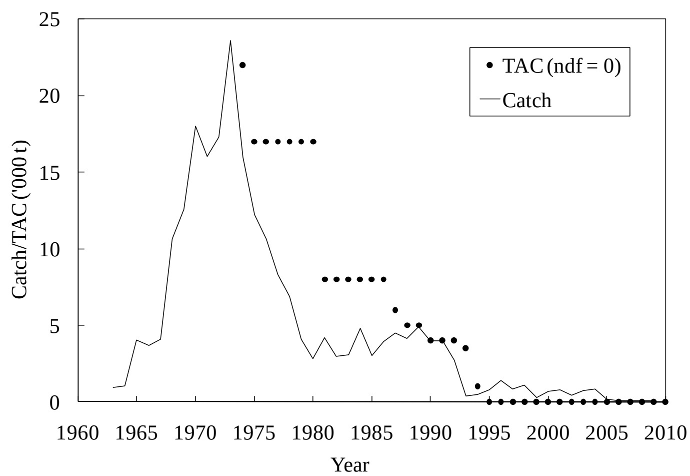


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

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.

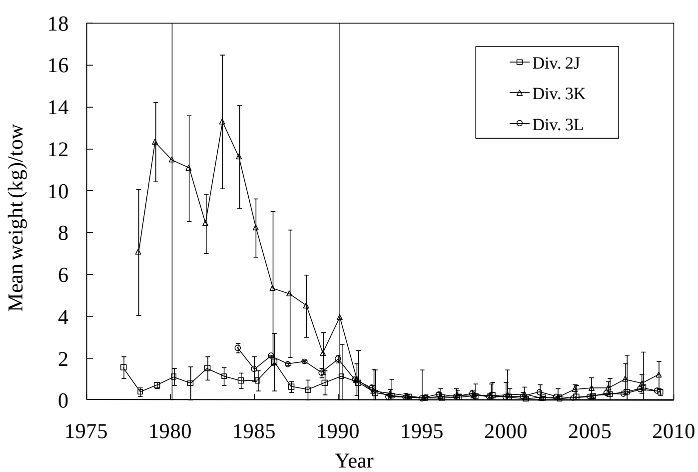


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: mean weights (kg) per tow (with 95% confidence limits) from Canadian autumn surveys. Values are Campelen units or, prior to 1995, Campelen equivalent units.

Distributions of witch flounder in the Canadian autumn survey for 2010 was similar to previous surveys and are shown in Fig 19.3.

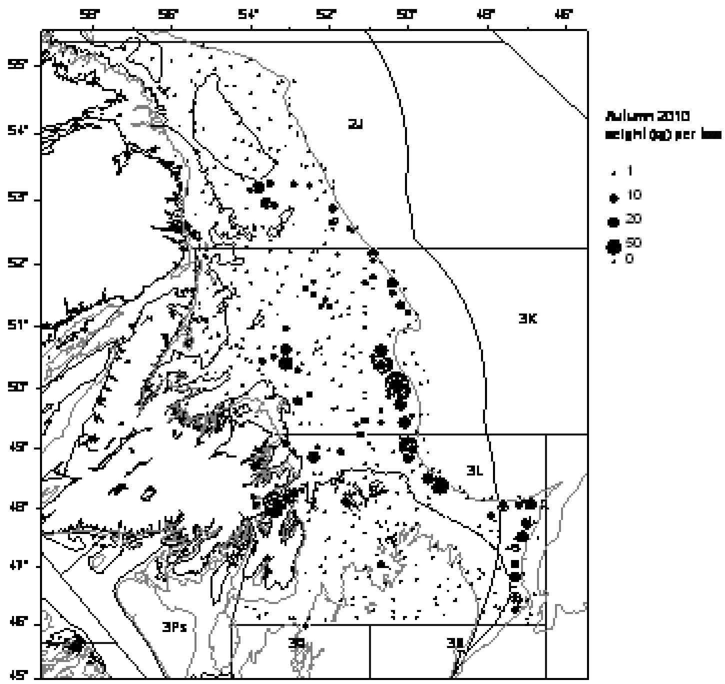


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per tow from the Canadian autumn survey in 2010.

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.

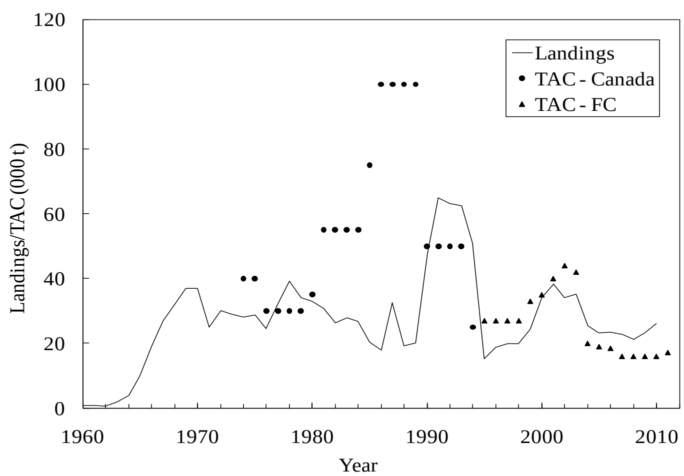


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

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).

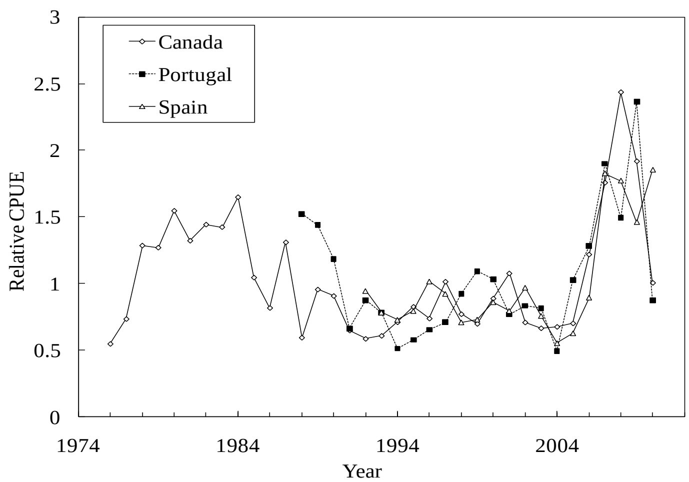


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2010 average.)

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.

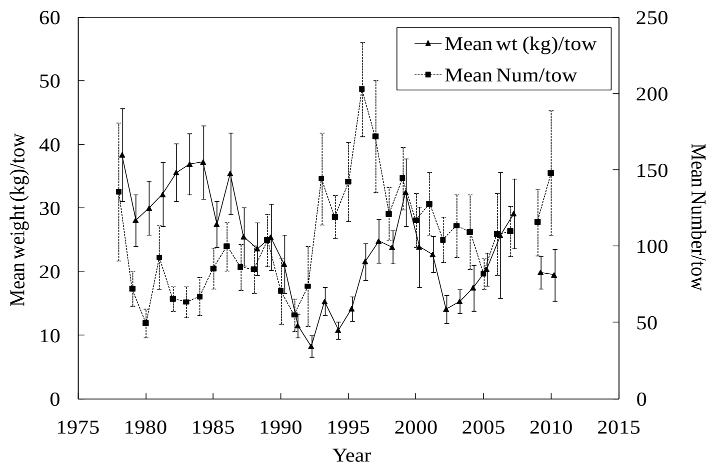


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

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.

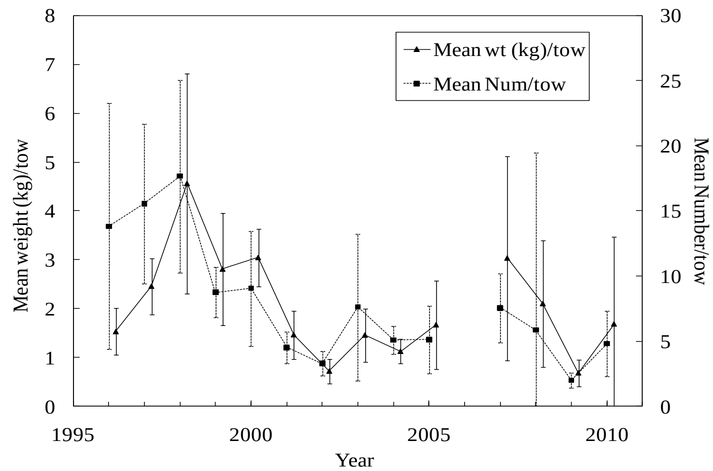


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (mean weight; mean number-per-tow with 95% CI) from Canadian spring surveys in Div. 3LNO.

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.

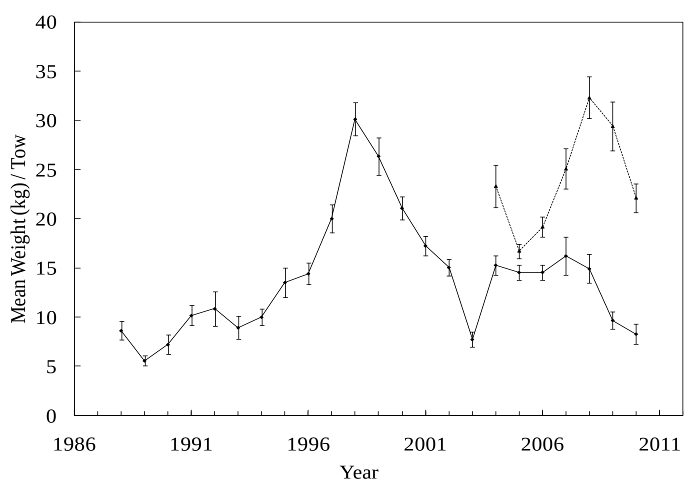


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (mean catch per tow ± 1 S.E.) from EU summer surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

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.

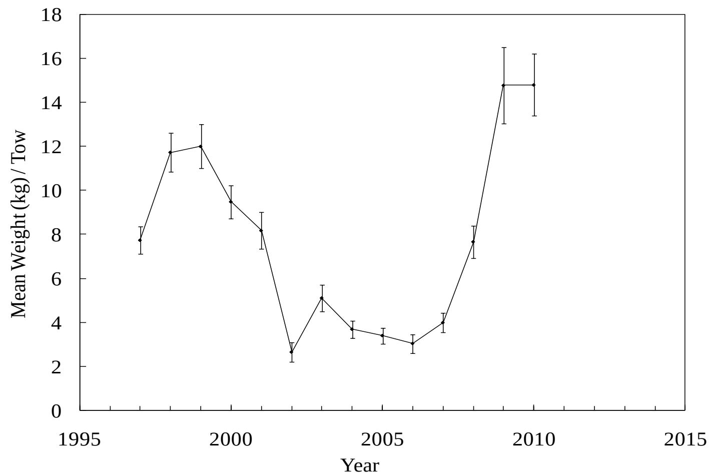


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in the NRA of Div. 3NO.

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.

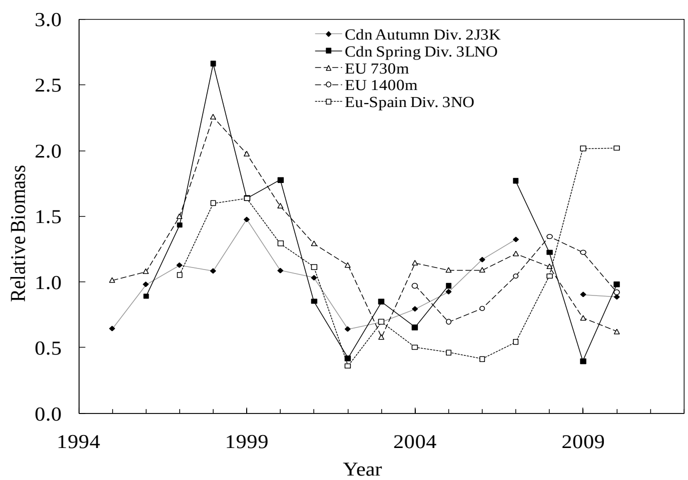


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices from Canadian autumn surveys in Div 2J+3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and EU-Spain surveys of the NRA of Div. 3NO. Each series is scaled to its 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 ($F_{5\text{-}10}$) exceeding 0.70. $F_{5\text{-}10}$ increased over 1995-2003 with increasing catch, but declined after 2003 under the Fisheries Commission rebuilding plan. $F_{5\text{-}10}$ 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.

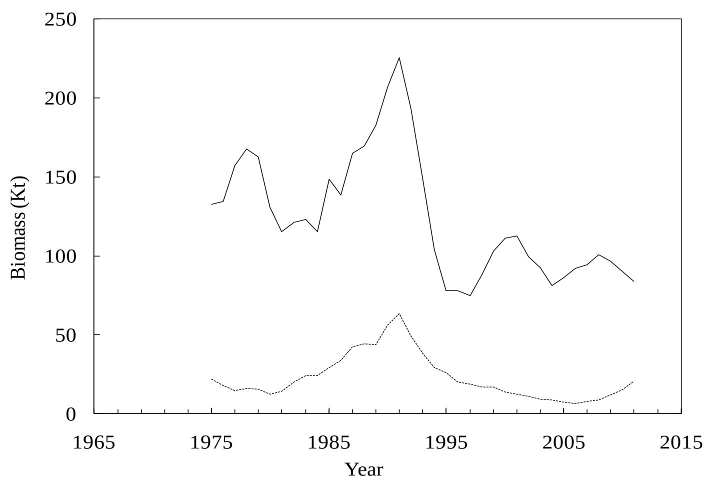


Fig. 20.8. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated exploitable (5+ biomass; solid line) and 10+ biomass (dashed line) from XSA.

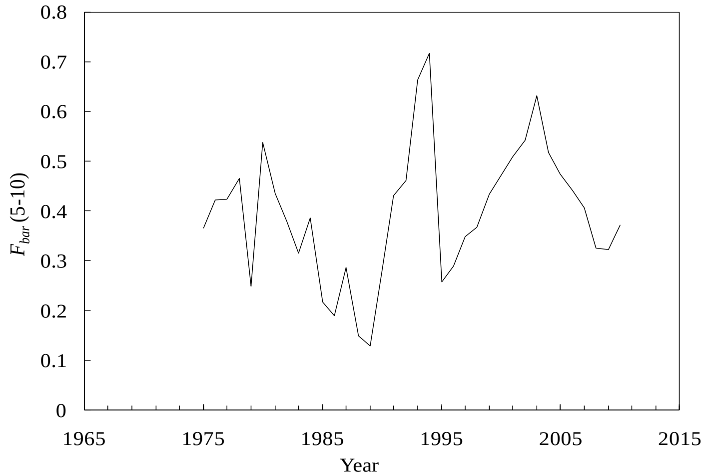


Fig. 20.9. Greenland halibut in Subarea 2 + Div. 3KLMNO: Estimated fishing mortality (averaged over ages 5-10) from XSA.

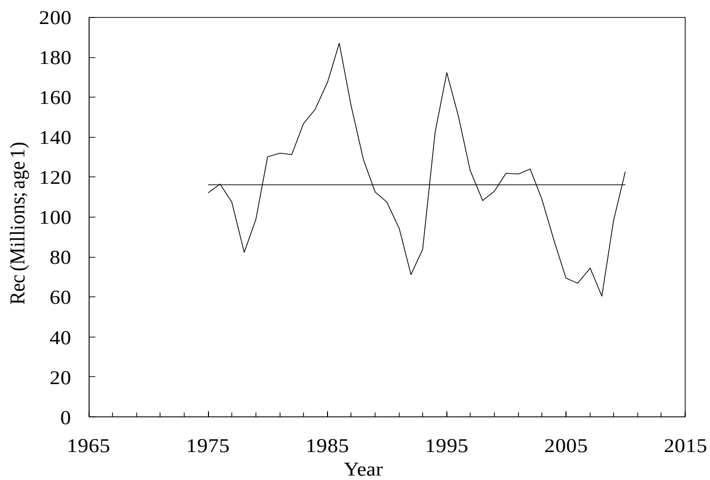


Fig. 20.10. Greenland halibut in Subarea 2 + Div. 3KLMNO: estimated recruitment at age 1 from XSA. Horizontal reference line indicates mean recruitment.

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.

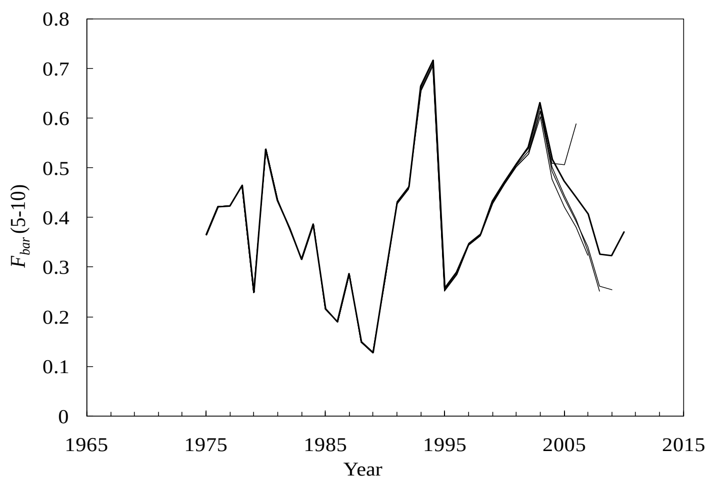


Fig. 20.12. Greenland halibut in Subarea 2 + Div. 3KLMNO: XSA retrospective analysis; average fishing mortality at ages 5-10.

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.

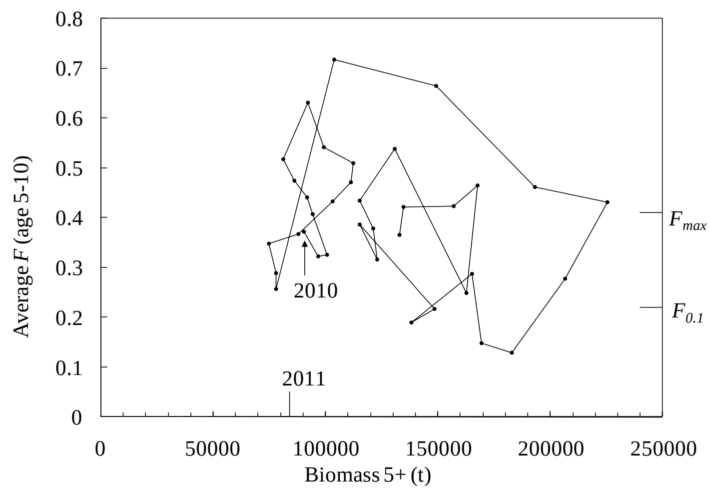


Figure 20.14. Greenland halibut in Subarea 2 + Div. 3KLMNO: Stock trajectory in relation to yield per recruit reference points. The 2011 estimate of biomass (84 000 t) is indicated on the biomass axis.

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

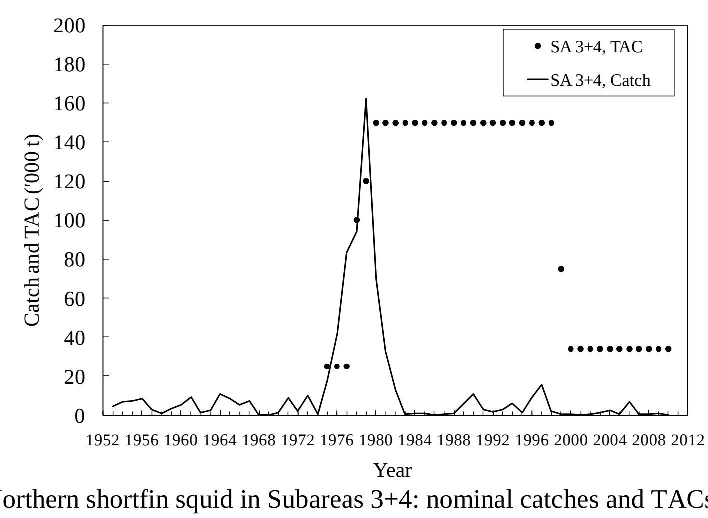


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

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.

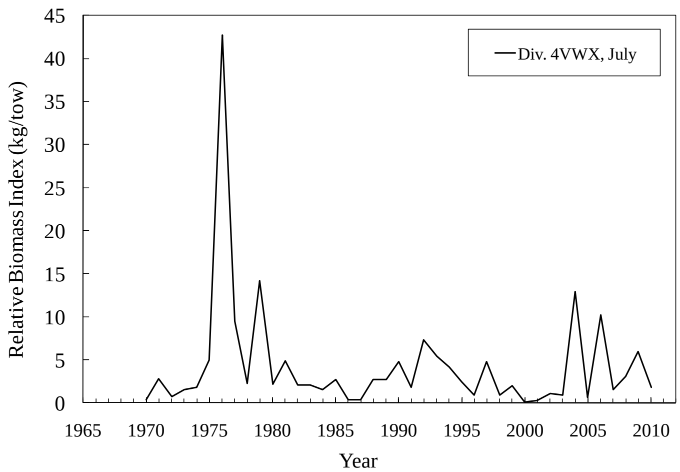


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices from the July survey in Div. 4VWX.

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.

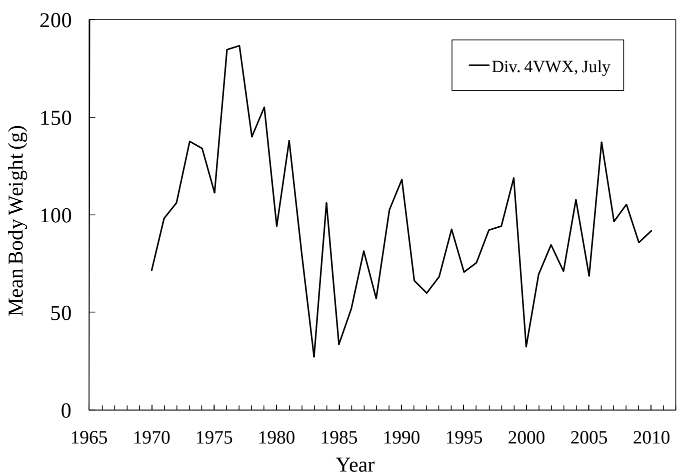


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX.

Catch/biomass ratios (relative fishing mortality indices) have been very low since 2001(Fig. 21.4).

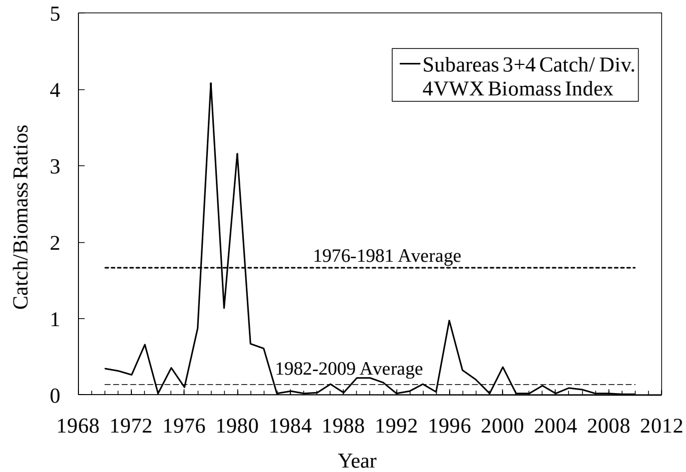


Fig. 21.4. Northern shortfin squid in Subareas 3+4: Catch/Biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index) for Northern shortfin squid in Subareas 3+4.

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.

PART B: SCIENTIFIC COUNCIL MEETING 1-12 SEPTEMBER 2011

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REPORT OF SCIENTIFIC COUNCIL MEETING

1-12 September 2011

Chair: Ricardo Alpoim Rapporteur: Neil Campbell

I. PLENARY SESSION

Noting the concerns expressed by the Chair of Fisheries Commission at the NAFO Annual Meeting, September 2010, regarding the timing of availability for advice on shrimp stocks, the Scientific Council met by correspondence via SharePoint and WebEx video conference during 1-12 September 2011 to address the Fisheries Commission requests and update advice on NAFO Div. 3LN and Div. 3M shrimp stocks for 2012. Representatives and participants attended from Canada, European Union (Estonia, Portugal and Spain) and Norway. The Scientific Council Coordinator was in attendance. Although only two NAFO stocks were under discussion, ICES members of NIPAG were invited by the Chair to participate in this meeting. No applications were received from observers to attend this meeting.

The provisional agenda was circulated to Contracting Parties by email on 20 July 2011 and posted on the SharePoint site. The report for this meeting was developed throughout the course of the meeting and was available on the SharePoint report area for comment.

The SharePoint site for this meeting was opened on 1 September 2011. Access to the SharePoint site, and hence participation in the meeting, was given to members of Scientific Council Executive and Members nominated by Contracting Parties. The Chair asked Representatives to post any comments on the agenda by 5 September. Participants were also asked to upload relevant documents to the SharePoint site and to discuss these documents on the discussion area. The opening session of the WebEx meeting of Council was called to order on at 0900 ADT on 9 September 2011. The report was adopted on 13 September 2011

The Chair welcomed all participants to this meeting by correspondence, noted this was the second time Scientific Council had convened in this manner and expressed his hopes that this form of meeting does not jeopardize the discussion and agreement that Scientific Council has in its' meetings of a more traditional form.

The Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Representatives, Advisers and Experts, are given in Appendices III, IV and V, respectively.

II. 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 I.

III. SPECIAL REQUESTS FROM THE FISHERIES COMMISSION

1. From September 2010

a) Update on Advice for Northern Shrimp In Div. 3M (Item 1)

The Fisheries Commission with the concurrence of the Coastal State as regards to the stocks below which occur within its jurisdiction ("Fisheries Commission") requests that the Scientific Council provide advice in advance of the 2011 Annual Meeting, for the management of Northern shrimp in Div. 3M, 3LNO in 2012.

Noting that Scientific Council will meet in October of 2010 for 2012 TAC advice, Fisheries Commission requests the Scientific Council to update its advice on shrimp stocks in 2011 for 2012 TAC.

Fisheries Commission further requests that SC provide advice in accordance to Annex 1.

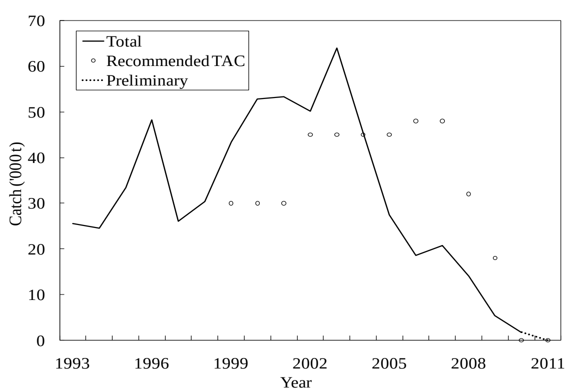
Northern Shrimp in Div. 3M

Background: The shrimp fishery in Div. 3M began in 1993. Initial catch rates were favourable and, shortly thereafter, vessels from several nations joined. The number of vessels participating in the fishery has decreased by more than 60% since 2004 to 13 vessels.

Fishery and catches: The stock is under effort regulation. The effort allocations were reduced to 50% in 2010 and there was no directed fishing in 2011 (moratorium for 2011). Catches are expected to decline close to zero in 2011. Recent catches were as follows:

	Catch ('000 t)		TAC ('000 t)	Effort[2] (days)
Year	STACFIS	21A	Recom-mended	Agreed
2006	18	15.2	48	10555
2007	21	17.6	48	10555
2008	13	13.4	17-32	10555
2009	5	5.3	18-27	10555
2010	2	1.9	ndf	5277
2011	0[1]		ndf	0

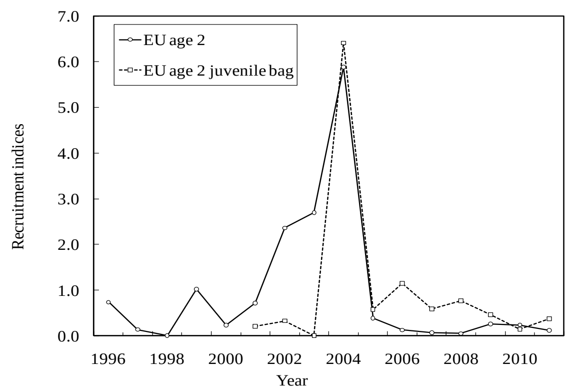
[1] Preliminary to September, 2011
[2] Effort regulated
ndf - no directed fishery



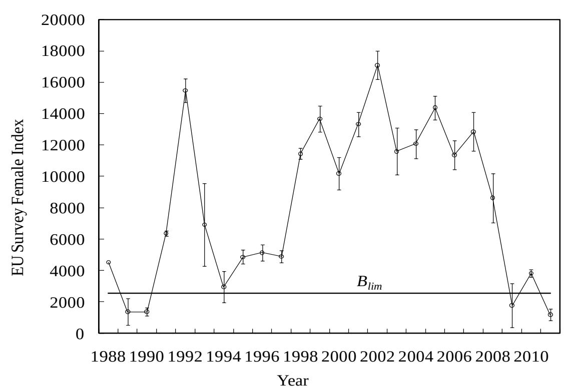
Data: Catch, effort and biological data were available from several Contracting Parties. Time series of size and sex composition data were available mainly from two countries between 1993 and 2005 and survey indices were available from EU research surveys (1988-2011). Catch data were updated for 2010. Reliable catch and effort data were not available for 2010 and there is no directed fishing for 2011. Therefore the standardized CPUE series was not updated to 2010.

Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

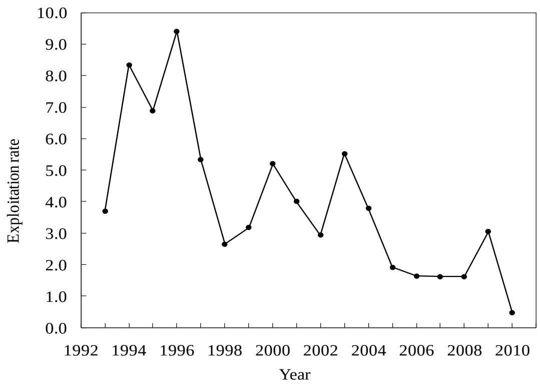
Recruitment: All year-classes after the 2002 cohort (i.e. age 2 in 2004) have been weak.



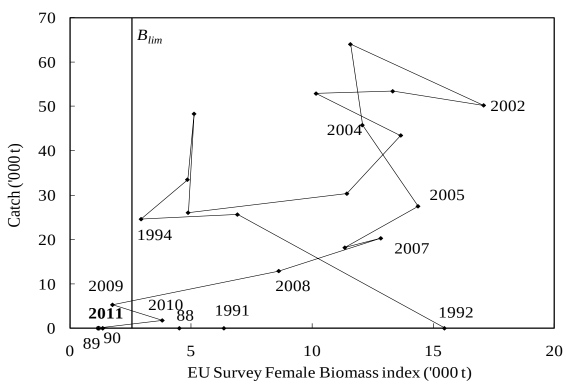
SSB: The survey index of female biomass increased from 1997 to 1998 and fluctuated without trend between 1998 and 2007. Since 2007 the survey index decreased and in 2011 it was the lowest in the survey series, well below B_{lim}.



Exploitation rate: From 2005 to 2008 exploitation rates (nominal catch divided by the EU survey biomass index of the same year) remained stable at relatively low values and increased in 2009 due to low levels of the stock estimated from the EU survey that year. The low catches recorded in 2010 caused the decline of the exploitation rate to the lowest levels (0.5).



State of the Stock: In 2009 the female biomass was below B_{lim}, increasing slightly above B_{lim} in 2010 and it was again well below B_{lim} in 2011. Due to the continued poor recruitment, there are serious concerns that the stock will remain at low levels.



Reference Points: Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim}, for Div. 3M shrimp, 2 600 t of female survey biomass. The female biomass index was below B_{lim} in 2009, it was slightly above it in 2010 and it is again well below B_{lim} in 2011. It is not possible to calculate a limit reference point for fishing mortality.

Recommendations: The 2011 survey biomass index indicates the stock is below the B_{lim} proxy and remains in a state of impaired recruitment. To favor future recruitment and stock recovery, Scientific Council recommends that the fishing mortality for 2012 be set as close to zero as possible.

Special comments: Scientific Council notes that there are indications of factors other than fishery that may be involved in the current decline of the stock.

The next assessment will be in October 2011.

Sources of Information: SCR Doc. 11/045

b) Update on Advice for Northern Shrimp in Div. 3LNO (Item 1)

The Fisheries Commission with the concurrence of the Coastal State as regards to the stocks below which occur within its jurisdiction ("Fisheries Commission") requests that the Scientific Council provide advice in advance of the 2011 Annual Meeting, for the management of Northern shrimp in Div. 3M, 3LNO in 2012.

Noting that Scientific Council will meet in October of 2010 for 2012 TAC advice, Fisheries Commission requests the Scientific Council to update its advice on shrimp stocks in 2011 for 2012 TAC.

Fisheries Commission further requests that SC provide advice in accordance to Annex 1.

Northern Shrimp in Div. 3LNO

Background: Most of this stock is located in Div. 3L and exploratory fishing began there in 1993. The stock came under TAC regulation in 2000, and fishing has been restricted to Div. 3L.

Fishery and catches: Several countries participated in the fishery in 2011. The use of a sorting grid to reduce bycatches of fish is mandatory for all fleets in the fishery. Recent catches from the stock are as follows:

	Catch ('000 t)		TAC ('000 t)	
Year	NIPAG	21A	Recom-mended	Agreed
2007	24	21	22	22[1]
2008	28	25	25	25[1]
2009	28	26	25	30[1]
2010	21	20	See footnote [2]	30[1]
2011	11[3]		<17[4]	19[1]
2012				17[5]

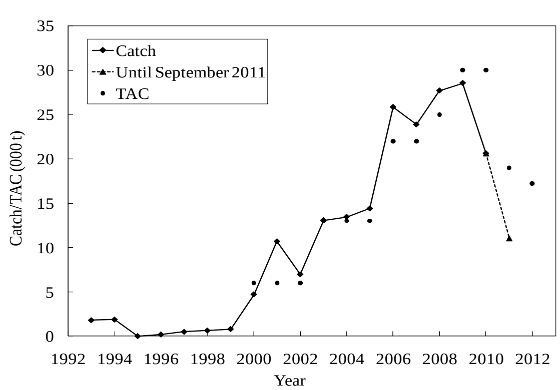
[1] Denmark (in respect of Faroes and Greenland) did not agree to the quotas of 144 t (2003–2005), 245 t (2006–2007), 278 t (2008), or 334 t (2009) and set their own quota of 1 344 t (2003–2005), 2 274 t (2006–2008) and 3 106 t (2009). The 2010 autonomous quota for Greenland was set at 532 t, while the Faroes did not set an autonomous quota for 2010. In 2011, Denmark (in respect of Greenland and Faroes) set an autonomous quota of 1 985 t. These increases are not included in the table.

[2] The recent exploitation rates of about 14% may be too high. Scientific Council therefore urges caution in the exploitation of the stock and considers that exploitation rates should not be raised, but kept below recent levels.

[3] STACFIS estimated catches to September 2011.

[4] In September 2010 SC considered that TAC options at 14% exploitation rate or higher to be associated with a relatively high risk of continued stock decline.

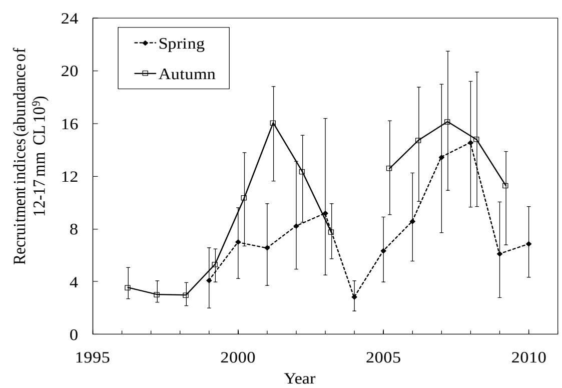
[5] This TAC will be reviewed based on available SC advice. (FC Doc. 11/1)



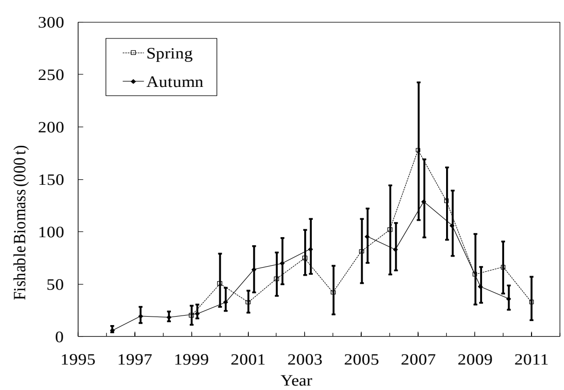
Data: Effort data were not updated. Biomass indices were available from research surveys conducted in Div. 3LNO during spring (1999 to 2011) and autumn (1996 to 2010). The Canadian survey in autumn 2004 was incomplete.

Assessment: Analytical assessment methods have not been established for this stock. Evaluation of the status of the stock is based upon interpretation of commercial fishery and research survey data.

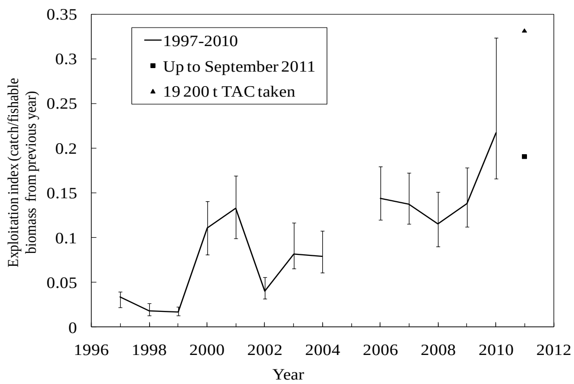
Recruitment: Recruitment indices from 2006 – 2008 were among the highest in the spring and autumn time series. The spring index decreased to near the mean in 2009 remaining near that level in 2010. The autumn recruitment index also declined in 2009. These indices were not updated.



Biomass: Spring and autumn biomass indices generally increased, to record levels by 2007, but decreased substantially by 2010. The spring biomass indices declined further in 2011.

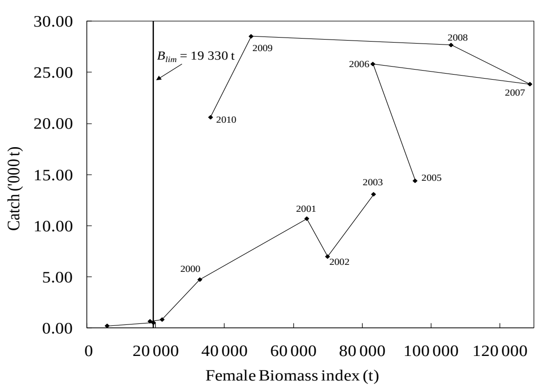


Fishing mortality: The index of exploitation has remained below 0.15 until 2009 but has since increased.



State of the Stock: Biomass levels peaked in 2007, but have since decreased substantially through to spring 2011. The female biomass index is estimated to be above B_{lim}. However, the decreased levels of biomass over the past seven consecutive Canadian surveys are a reason for concern.

Precautionary Approach Reference Points: Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} (approximately 19 000 t) for northern shrimp in Div. 3LNO (SCS Doc. 04/12). Currently, the female biomass index is estimated to be above but nearing B_{lim}. It is not possible to calculate a limit reference point for fishing mortality. A safe zone has not been determined in the precautionary approach for this stock.



Recommendation: Based on the average fishable biomass the following table shows catch levels at various exploitation rates in 2012:

5.00%	3 346 t
10.00%	6 691 t
14.00%	9 367 t
25.41%	17 000 t
28.69%	19 200 t
44.84%	30 000 t

Exploitation rates over the period 2006–2009 have been near 14% and were followed by stock decline. Scientific Council considers TAC options involving exploitation rates of 14% or higher to be associated with a relatively high risk of continued stock decline. TACs lower than that will tend to reduce this risk in proportion to the reduction in the exploitation rate. Scientific Council recommended that the TAC for 2012 be less than 9 350 t. Scientific Council is not able to quantify the absolute magnitude of the risk.

Special Comment: The next assessment will be in October 2011.

Sources of Information: SCR Doc. 11/46

c) Update on PA Reference Points for shrimp in Div. 3LNO (Item 3)

With respect to Northern shrimp (Pandalus borealis) in Div. 3LNO, noting the NAFO Framework for Precautionary Approach and recognizing the desire to demonstrate NAFO's commitment to applying the precautionary approach, Fisheries Commission requests the Scientific Council to:

a) identify F_{msy}

b) identify B_{msy}

c) provide advice on the appropriate selection of an upper reference point for biomass (e.g. Bbuf)

Scientific Council responded:

This request was also addressed to Scientific Council in 2009 (NAFO *Sci. Coun. Rep*., 2009, p 232). Scientific Council has been working to provide values for these reference points. Appropriate models have not yet been developed to a point where they have been accepted as a basis for the determination of reference points. Scientific Council is still unable to provide appropriate reference pointes to address this request. This request is therefore deferred to the October 2011 meeting of Scientific Council for further consideration.

d) Updates on Distribution of shrimp in Div. 3LNO (Item 4)

The Scientific Council is requested to provide updated information on the proportion of the 3LNO shrimp stock that occurs in 3NO.

Over the entire history of the Canadian surveys, at least 90% of the shrimp biomass has been recorded in Div. 3L.

Table 1. Shrimp biomass distribution in Canadian autumn surveys, 1996 – 2010.

Season	Year	Division	Biomass estimate (t)	% biomass in 3L
Autumn	1996	3L	23 056	92.71
Autumn	1997	3L	43 695	98.64
Autumn	1998	3L	56 381	92.26
Autumn	1999	3L	54 871	99.27
Autumn	2000	3L	106 519	98.88
Autumn	2001	3L	215 153	99.21
Autumn	2002	3L	189 077	97.97
Autumn	2003	3L	186 459	97.01
Autumn	2004	3L	???	???
Autumn	2005	3L	222 704	99.37
Autumn	2006	3L	215 153	99.21
Autumn	2007	3L	273 346	98.48
Autumn	2008	3L	247 874	98.76
Autumn	2009	3L	117 594	98.65
Autumn	2010	3L	74 503	99.20

Table 2. Shrimp biomass distribution in Canadian spring surveys, 1996 – 2011.

Season	Year	Division	Biomass estimate (t)	% biomass in 3L
Spring	1999	3L	47 823	96.15
Spring	2000	3L	109 439	95.94
Spring	2001	3L	83 262	97.07
Spring	2002	3L	128 971	95.74
Spring	2003	3L	166 525	97.52
Spring	2004	3L	92 626	98.40
Spring	2005	3L	134 106	99.85
Spring	2006	3L	180 620	???
Spring	2007	3L	284 018	97.75
Spring	2008	3L	224 114	99.73
Spring	2009	3L	110 949	97.96
Spring	2010	3L	130 683	99.31
Spring	2011	3L	69 469	99.42

e) Updates on Effect of 5 000 t catch on shrimp abundance in Div. 3M (item 5)

With respect to 3M shrimp, the Scientific Council estimated in 2009 a proxy for B_{lim} as 85% decline from the maximum observed index levels, this is 2600 t of female biomass. In 2009 the Scientific Council estimated biomass to be below B_{lim} and recommended fishing mortality to be set as close to zero as possible.

In 2009 estimated catches reached 5000 t. The Fisheries Commission decided on a 50% effort reduction in 2010 and provisional estimated catches up to September 2010 reached 1000 t. In its 2010 advice, the Scientific Council estimated biomass to be above B_{lim}, but reiterated its previous advice to set fishing mortality as close to zero as possible. The Fisheries Commission requests the Scientific Council to evaluate if the current level of catches is compatible with stock recovery, given that improvements in biomass levels were observed through current level of catches.

Scientific Council responded:

The biomass estimated in 2011 was the lowest recorded in the EU survey series and well below B_{lim}. All year classes after 2002 (i.e. age 2 in 2004) have been weak and there is no signs of change in this situation.

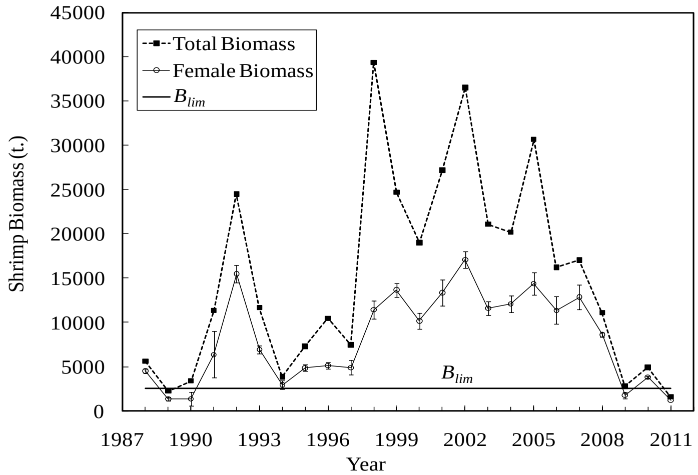


Fig. 1. Total and female biomass indexes of shrimp in EU summer survey series 1989-2011.

Catches in 2010 were around 1766 t and there was no rebuilding of the stock. In 2011 it is again in the collapsed zone. At this time here are therefore no indications that the level of catches for 2010 and zero catches for 2011will promote stock recovery

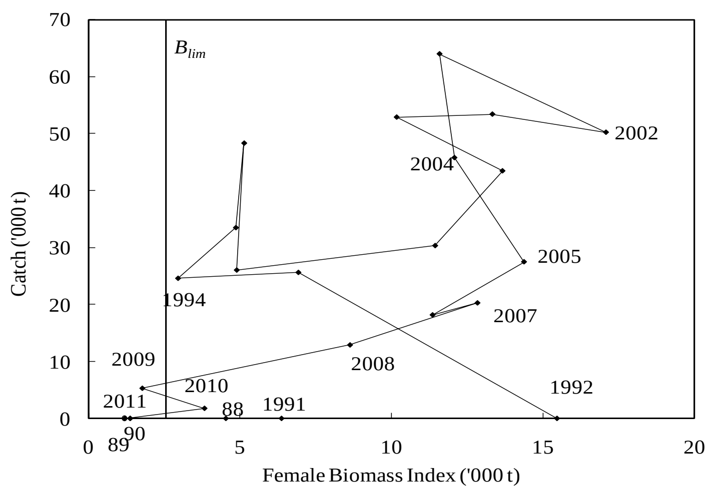


Fig. 2. Catch plotted against female biomass index from EU survey. Line denoting B_{lim} is drawn where biomass is 85% lower than the maximum point in 2002. Due to moratorium on shrimp fishery the expected catch in 2011 is 0 t.

This unflattering situation advises the maintenance of a moratorium on the shrimp fishery in Div. 3M until stock recovery signs appear.

IV. ADOPTION OF REPORT

The draft report of this meeting was circulated by email to participants and adopted. The report was adopted in full on 13 September 2011.

V. ADJOURNMENT

The meeting was adjourned by the Chair of Scientific Council after the report was adopted. Participants and the NAFO Secretariat were thanked for their contributions.

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

Chair: Joanne Morgan Rapporteur: Various

The Committee met by correspondence during 1-12 September 2011 via SharePoint and with a WebEx conference to consider the various items on its Agenda on 9 September 2011. Representatives attended from Canada, Denmark (with respect to Greenland), European Union (Estonia, Portugal and Spain) and Norway. The Scientific Council Coordinator was in attendance.

1. Opening

The Chair, Joanne Morgan, opened the meeting by welcoming participants. The provisional agenda was reviewed and adopted, and a plan of work developed for the meeting.

2. Interim Monitoring Updates

STACFIS was asked to update the assessments of Northern shrimp in Div. 3M and Northern shrimp in Div. 3LNO that had been reviewed at the meeting of NIPAG in October 2010.

a) Northern Shrimp (*Pandalus borealis*) in Div. 3M

(SCR 11/45)

Interim Monitoring Report

a) Introduction

The fishery on this stock is managed by effort regulation. Full assessments of this stock are based on the review of series of indices of survey biomass, CPUE, recruitment potential (numbers at age 2), and catch. All year classes after 2002 have been weak. The indices of female biomass in the July 2009-2011 surveys indicated a sharp decline and that the stock was below B_{lim} in 2009 and 2011 *i.e*., had entered the collapse zone defined by the NAFO PA framework. Scientific Council recommended in October 2010 that the fishing mortality be set as close to zero as possible in 2011 and 2012. In 2011 there was no directed fishing on shrimp in Div. 3M stock.

Updated catches in 2010 were 1 766 t. In 2011 there were no catches due to the moratorium.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	45 000	45 000	45 000	48 000	48 000	17 000-32 000[1]	18 000-27 000[2]	0	0
STATLANT 21	62 761	45 842	27 651	15 191	17 642	11 671	5 374	1 975	0[3]
NIPAG	63 970	45 757	27 479	18 162	20 741	12 889	5 429	1 766	

[1] SC recommended that exploitation level for 2008 should not exceed the 2005 and 2006 levels (17 000 to 32 000 t).
[2] SC recommended that exploitation level for 2009 should not exceed levels that have occurred since 2005 (18 000 to 27 000 t).
[3] Preliminary catches from circular letters, to September 2011.

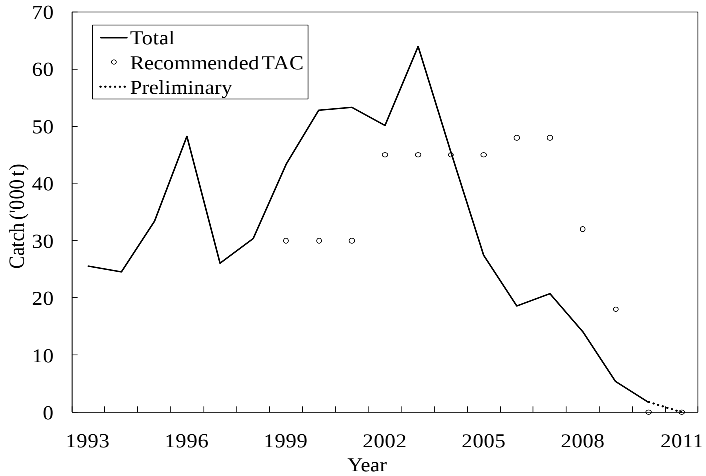


Fig. 1.1. Northern Shrimp in Div. 3M: Trends in catch (t) and TAC recommended over the period 1993-2011.

b) Data

The interim monitoring report was based on updates of total and female survey biomass, and recruitment indices with 2011 values. Surveys use a Lofoten trawl with 35-mm codend mesh, but fitted with a juvenile bag with 10-mm mesh.

c) Results

CPUE data. CPUE data was not updated at this time.

Research survey data. The survey index of female and total biomass increased from 1997 to 1998 and fluctuated without trend between 1998 and 2007. Since 2007 the survey indexes decreased and in 2011 they were the lowest in the survey series, well below B_{lim}.

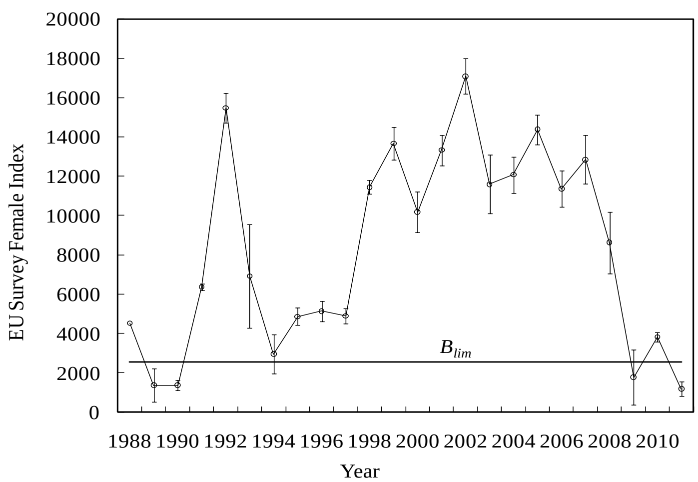


Fig. 1.2. Northern Shrimp in Division 3M: EU Survey index of female biomass, 1988 – 2011.

Recruitment: All year classes after the 2002 cohort (i.e. age 2 in 2004) have been weak.

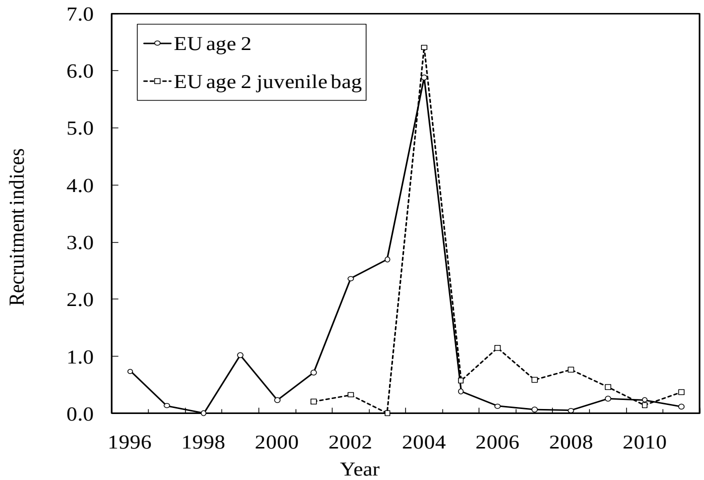


Fig. 1.3. Northern Shrimp in Division 3M: Abundance indexes at age 2 obtained in EU Flemish Cap surveys from Lofoten gear (black line) and Juvenile bag (dotted line). Each series was standardized to its mean.

Exploitation Rate: From 2005 to 2008 exploitation rates (nominal catch divided by the EU survey biomass index of the same year) remained stable at relatively low values and increased in 2009 due to low levels of the stock estimated from the UE survey that year. The low catches recorded in 2010 caused the decline of the exploitation rate to the lowest levels (0.5).

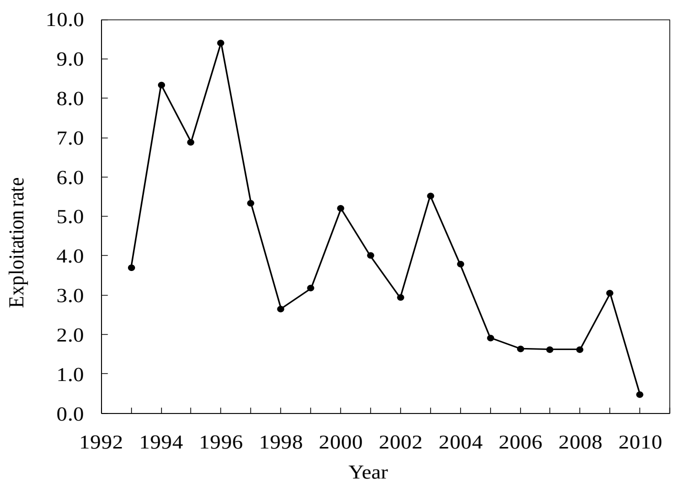


Figure 1.4. Exploitation rates as nominal catch divided by the EU survey biomass index of the same year.

Reference Points: Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim}, for Div. 3M shrimp, 2 600 t of female survey biomass. The female biomass index was below B_{lim} in 2009, it was slightly above it in 2010 and it is again well below B_{lim} in 2011. It is not possible to calculate a limit reference point for fishing mortality.

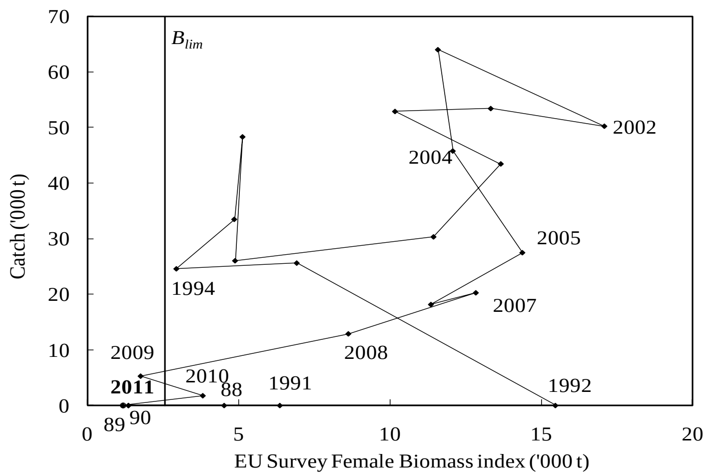


Fig. 1.5. Northern Shrimp in Division 3M: Catch plotted against female biomass index from EU survey. Line denoting B_{lim} is drawn where biomass is 85% lower than the maximum point in 2002. Due to moratorium on shrimp fishery the expected catch in 2011 is 0 t.

Ecosystem considerations: The decline of shrimp biomass in recent years is likely associated with the increase of the cod stock experienced in the last years.

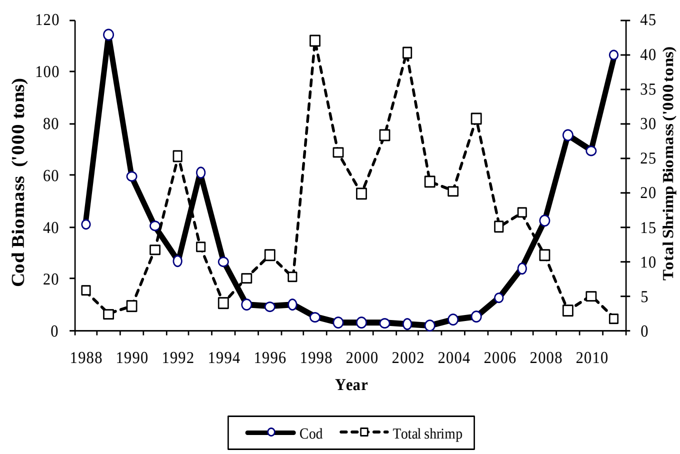


Fig. 1.6. Northern Shrimp in Division 3M: EU survey cod biomass (gross solid line) and total shrimp biomass (dashed line) in the years 1988-2011 on Flemish Cap.

STACFIS concluded that the information available does not change the perception of a significant decline in stock biomass and the stock is below B_{lim}. Due to continued low recruitment there are serious concerns that the stock will remain at low levels.

b) Northern Shrimp (*Pandalus borealis*) in Div. 3LNO

(SCR Doc. 11/46)

a) Introduction

This shrimp stock is distributed around the edge of the Grand Bank mainly in Div. 3L. The fishery began in 1993 and came under TAC control in 2000 with a 6000 t TAC and fishing restricted to Div. 3L. Annual TACs were raised several times between 2000 and 2009 reaching a level of 30 000 t for 2009 and 2010 before decreasing to 19 200 t in 2011 and 17 000 t in 2012. A total catch of 11 041 t was taken up to September 2011 (Fig. 2.1).

Recent catches and TACs (t) for shrimp in Div. 3LNO (total) are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC as set by FC	13 000[1]	13 000[1]	13 000[1]	22 000[1]	22 000[1]	25 000[1]	30 000[1]	30 000[1]	19 200	17 000[3]
STAT-LANT 21	11 917	12 051	13 574	21 284	21 120	24 758	25 621	19 726		
NIPAG	13 069	13 452	14 389	25 831	23 859	27 691	28 544	20 612	11 041[2]	

[1] Denmark (in respect of Faroes and Greenland) did not agree to the quotas of 144 t (2003–2005), 245 t (2006–2007), 278 t (2008), or 334 t (2009) and set their own quota of 1 344 t (2003–2005), 2 274 t (2006–2008) and 3 106 t (2009). The 2010 autonomous quota for Greenland was set at 532 t, while the Faroes did not set an autonomous quota for 2010. In 2011, Denmark (in respect of Greenland and Faroes) set an autonomous quota of 1 985 t. These increases are not included in the table.
[2] STACFIS estimated catches to September 2011.
[3] For 2012 TAC will be reduced to 17 000 t. This TAC will be reviewed based on available SC advice. (FC Doc. 11/1)

Since this stock came under TAC regulation, Canada has been allocated 83% of the TAC. This allocation is split between a small-vessel (less than 500 GT and less than 65 ft) and a large-vessel fleet. By September 2011, the small- and large-vessel fleets had taken 6 388 t and 2 423 t of shrimp respectively in Div. 3L. In all years, most of the Canadian catch occurred along the northeast slope in Div. 3L. The annual quota within the NAFO Regulatory Area (NRA) is 17% of the total TAC.

The use of a sorting grid to reduce bycatches of fish is mandatory for all fleets in the fishery. The sorting grid cannot have a bar spacing greater than 22 mm.

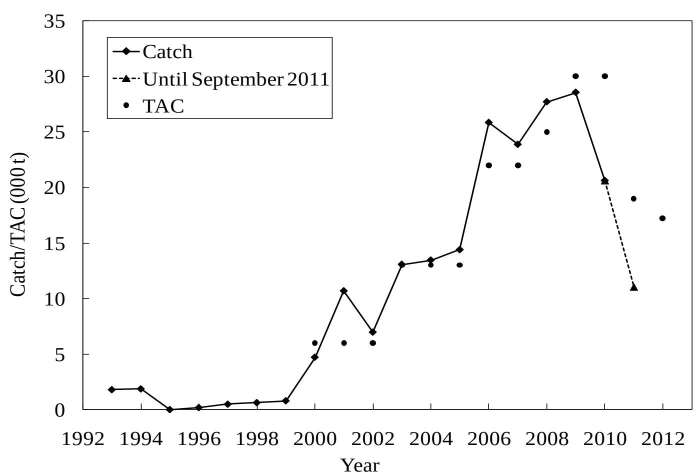


Fig. 2.1. Northern Shrimp in Div. 3LNO: catches (to September 2011) and TAC as set by Fisheries Commission.

b) Input Data

i) Commercial fishery data

Effort and CPUE. No updated information at this time.

Catch composition. No updated information at this time.

ii) Research survey data

Canadian multi-species trawl survey. Canada has conducted stratified-random surveys in Div. 3LNO, using a Campelen 1800 shrimp trawl, from which shrimp data is available for spring (1999–2011) and autumn (1996–2010). The autumn survey in 2004 was incomplete and therefore of limited use for the assessment.

Spanish multi-species trawl survey. No updated information at this time.

Biomass. In Canadian surveys, over 90% of the biomass was found in Div. 3L, distributed mainly along the northeast slope in depths from 185 to 550 m. There was an overall increase in the both spring and autumn indices to 2007 after which they decreased by about 75% to 2011 (Fig. 2.2). Confidence intervals from the spring surveys are usually broader than from the autumn surveys.

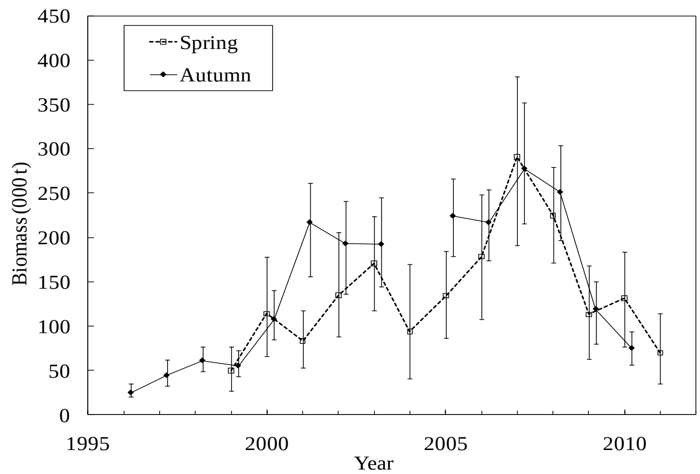


Fig. 2.2. Northern Shrimp in Div. 3LNO: biomass index estimates from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Stock composition. No updated information at this time.

Female Biomass (SSB) indices. The autumn Div. 3LNO female biomass index showed an increasing trend to 2007 but decreased 72% by 2010. The spring SSB index decreased by 82% between 2007 and 2011 (Fig. 2.3).

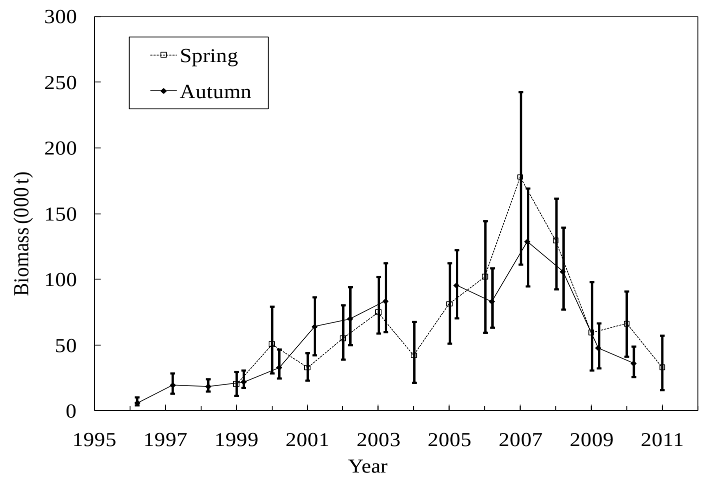


Fig. 2.3. Northern Shrimp in Div. 3LNO: Female biomass indices from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Recruitment indices. No updated information at this time.

Fishable biomass and exploitation indices. There had been an increasing trend in Canadian spring and autumn survey fishable biomass indices (shrimp >17 mm carapace length) until 2007. The autumn fishable biomass showed an increasing trend until 2007 then decreased by 76% through to 2010. Similarly, the spring fishable biomass index increased to 2007 but has since decreased by 79 % through to 2011 (Fig. 2.4).

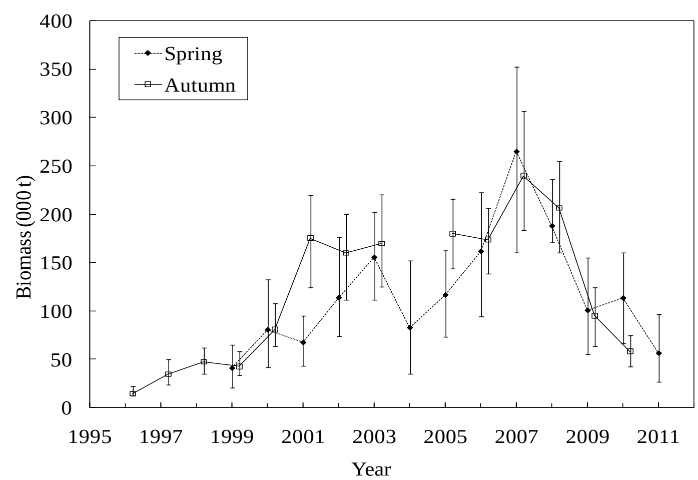


Fig. 2.4. Shrimp in Div. 3LNO: fishable biomass index. Bars indicate 95% confidence limits.

An index of exploitation was derived by dividing the catch in a given year by the fishable biomass index from the previous autumn survey. The catch series was updated in the 2011 analysis. The exploitation index has been below 0.15 until 2010 when it increased to 0.22. By September 2011, the 2011 exploitation rate index was 0.19. Based upon the autumn 2010 fishable biomass of 57 900 t, if the entire 19 200 t quota was to be taken, the exploitation rate index would increase to 0.33 (Fig. 2.5).

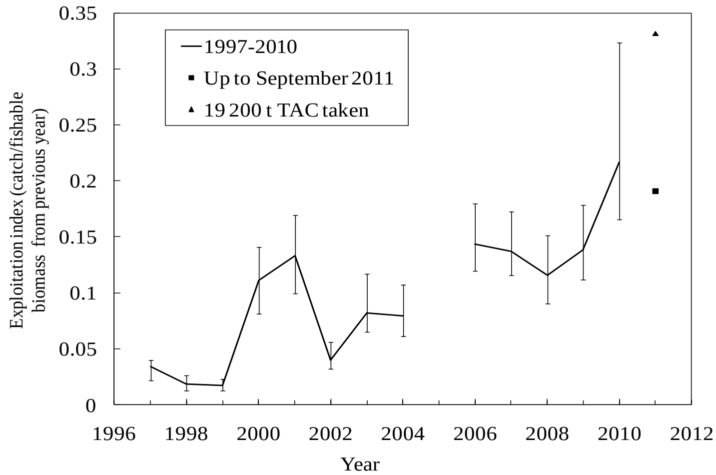


Fig. 2.5. Shrimp in Div. 3LNO: exploitation rates calculated as year's catch divided by the previous year's autumn fishable biomass index. The 2011 exploitation rate index is based upon incomplete catch data. Bars indicate 95% confidence limits.

c) Assessment Results

Recruitment. Recruitment indices from 2006-2008 were among the highest in the spring and autumn time series. The spring index decreased to near the mean in 2009, remaining near that level in 2010. The autumn recruitment index also declined in 2009. There was no updated information at this time.

Biomass. Spring and autumn biomass indices generally increased, to record levels by 2007, but decreased substantially by 2010. The spring biomass indices declined further in 2011.

Exploitation. The index of exploitation has remained below 0.15 until 2009 but has since increased.

State of the Stock. Biomass levels peaked in 2007, but have since decreased substantially through to spring 2011. The female biomass index is estimated to be above B_{lim}. However, the decreased levels of biomass over the past seven consecutive Canadian surveys are a reason for concern.

Inverse variance weighted average fishable biomass was calculated from the four most recent Canadian research surveys into 3LNO.

Variance weighting factor = fishable biomass/(measure of variance)^2÷Σ fishable biomass/(measure of variance)^2

Survey	Fishable biomass (t)	Fishable biomass – lower 95% C.I.= measure of variance	Fishable biomass/(measure of variance^2)	1/measure of variance^2	Variance weighting factor
Autumn 2009	95 042	31 301	9.70035E-05	1.02E-09	0.150
Spring 2010	113 366	47 108	5.10845E-05	4.51E-10	0.067
Autumn 2010	57 891	15 464	0.000242071	4.18E-09	0.617
Spring 2011	56 280	29 852	6.31567E-05	1.12E-09	0.166
Grand total			4.53315E-04	6.775E-09	1.00

Inverse variance weighted average fishable biomass = 4.53315E-04/6.775E-09

= 66 911 t

The inverse variance weighted average fishable biomass of the four most recent surveys is calculated to be 66 911 t. Based on this value, the following table shows exploitation rates at various catch levels in 2012:

TACs options at various percent exploitation rates (catch/fishable biomass)

Inverse variance weighted average fishable biomass	5.00%	10.00%	14.00%	25.41%	28.69%
66 911 t	3 346	6 691	9 367	17 000	19 200

At TACs of 17 000 t and above, the exploitation rate is estimated to be 25% or higher, which is well beyond the range of exploitation rates previously seen in this fishery. Given recent declines in stock biomass, catches at this level are likely to result in further declines.

Exploitation rates over the period 2006 – 2008 had been near 14% and were followed by stock decline.

d) Precautionary Approach Reference Points

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} (approximately 19 000 t) for northern shrimp in Div. 3LNO (SCS Doc. 04/12). Currently, the female biomass index is estimated to be above but nearing B_{lim} (Fig. 2.6). It is not possible to calculate a limit reference point for fishing mortality. A safe zone has not been determined in the precautionary approach for this stock.

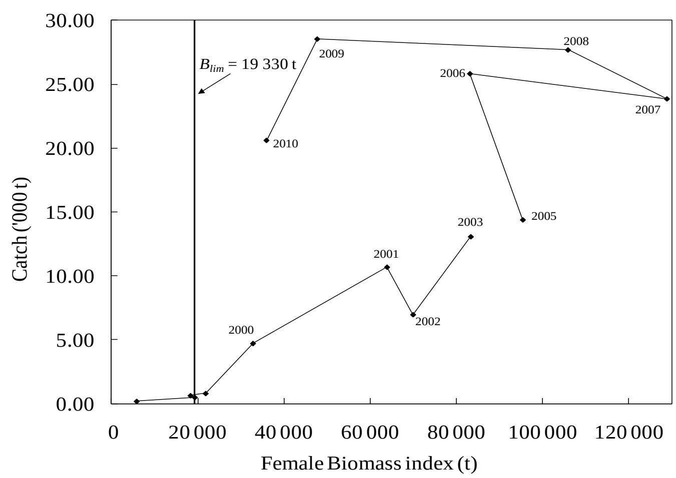


Fig. 2.6. Shrimp in Div. 3LNO: Catch against female biomass index from Canadian autumn survey. Line denoting B_{lim} (approximately 19,000 t) is drawn where female biomass is 85% lower than the maximum point in 2007.

e) Research Recommendations

STACFIS **recommended** that *the biomass of Northern shrimp in Div. 3LNO be examined in relation to biomass of other species in the same area.*

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Scientific Council Meeting Participants September 2011

Back room (left to right): Antonio Vázquez, Carsten Hvingel, Don Stansbury, Bill Brodie, Joanne Morgan, Mariano Koen-Alonso, Estelle Couture, Neil Campbell, Herlé Goraguer, Enrique de Cardenas, Ilya Skryabin, Ivan Tretiakov, Alexander Fomin, Vladimir Babayan, Javier Murillo, Barb Marshall

Front Row: Janice Ryan, Kathy Sosebee, Dave Orr, Jean-Claude Mahé, Diana Gonzalez-Troncoso, Fernando Gonzalez, Mar Sacau, Silver Sirp, Vladimir Rikhter, Ricardo Alpoim

Joanne Morgan (STACFIS Chair), Carsten Hvingel (STACREC Chair), Ricardo Alpoim (SC Chair), Vladimir Rikhter, Neil Campbell (SC Coordinator)

REPORT OF SCIENTIFIC COUNCIL MEETING

19-23 September 2011

Chair: Ricardo Alpoim Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at the Westin Hotel, Halifax, Nova Scotia, Canada, during 19-23 September 2011, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal and Spain), France (with respect to St. Pierre et Miquelon), Norway, Russian Federation and USA. The Executive Secretary and Scientific Council Coordinator were in attendance.

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

The opening session of the Council was called to order at 0900 hours on 19 September 2011.

The Chair welcomed participants to the 33rd Annual Meeting.

The Provisional Agenda was adopted with minor additions. The Council appointed Neil Campbell, the Scientific Council Coordinator, as rapporteur.

The Chair welcomed the Ecology Action Centre, the International Coalition of Fisheries Associations, the Atlantic Canada Chapter, Sierra Club Canada, and the World Wildlife Fund, as observers to this annual meeting.

The Council and its Standing Committees met through 19-23 September 2011 to address various items in its agenda. The Council considered and adopted the reports of the STACFIS and STACREC Standing Committees on 23 September 2011. The final session was called to order at 0915 hours on 23 September 2011. The Scientific Council then considered and adopted its report of this meeting. The meeting was adjourned at 0930 hours on 23 September 2011.

The Reports of the Standing Committees as adopted by the Council are appended as follows: Appendix I - Report of Standing Committee on Research Coordination (STACREC), and Appendix II - Report of Standing Committee on Fisheries Science (STACFIS).

The Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Representatives, Advisers and Experts, are given in Appendices III, IV, and VI, respectively.

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS

From Scientific Council Meeting, 3-16 June 2010

VII. Other Matters

1.d.v. Management measures for blue whiting

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.*

STATUS: This recommendation was presented to Fisheries Commission by the Scientific Council Chair.

III. 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 at Appendix I.

IV. 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 II.

V. SPECIAL REQUESTS FROM THE FISHERIES COMMISSION

1. *Ad hoc* Requests from Current Meeting

The following requests were received during the current meeting. Scientific Council noted that these responses are only for the clarification of the advice and do not in any way alter or change the advice published in the previous reports of the Scientific Council.

Question 1

Is the advice for shrimp in Div. 3M and Div. 3L based on single stock considerations or does it also take into account the ecosystem bearing in mind increasing abundance of shrimp predator species.

Response:

At the present time, we do not have models that explicitly incorporate ecosystem interactions affecting shrimp stocks, although efforts are being made in that direction. However, the current advice for shrimp in Div. 3M and Div. 3L is based on empirical indices of stock status, and hence, they implicitly capture the effects of ecosystem processes on the trajectories of shrimp stocks.

Question 2

Can the Scientific Council comment on the fact that the biomass of shrimp Div. 3M has declined to levels before B_{lim} following the closure of the fishery this year. What measures would the Scientific Council recommend in order to restore shrimp Div. 3M and Div. 3L stocks to MSY level by 2015 (Johannesburg commitment).

Response:

In the absence of a fishery, the fluctuations in a stock depend alone on the balance between recruitment and natural mortality. Recruitment in Div. 3M shrimp has varied at a low level since 2004 and such variation alone could result in the variations observed in the stock. Natural mortality – although not quantified – is considered to vary over time and would therefore also contribute to this variability. It is also important to bear in mind that, given the fact that both Div. 3M and Div. 3LNO shrimp stock trajectories are assessed using survey indices, any impact of a Div. 3M moratorium on recruitment, if occurs, will only be expected to be seen four years after its implementation. Also, changes in survey indices should only be interpreted in the context of the trend that they define; a single high or low value in a given year by itself is not sufficient to secure any conclusion. Regarding measures that would restore shrimp stocks to MSY levels, two things can be highlighted. First, the only variable affecting shrimp stocks that we can actually manage is the fishery, therefore, the recommendation would be to keep the Div. 3M moratorium in place and maintain catches in Div. 3LNO to the level recommended by the scientific advice. Secondly, we do not have models for these stocks, and hence, we cannot calculate MSY.

Question 3

Scientific Council has estimated TAC overruns of more than 60% for 2010 catches of Div. 3M cod and SA 2 + Div. 3KLMNO Greenland halibut. This is of concern, and we would like to know if there have been any recent changes in the Scientific Council estimation procedure?

Response:

Scientific Council employed the same methods for catch estimation in 2011 as in recent years. An *ad hoc* working group deliberated on catch estimates before the meeting, thereby enabling finfish catch estimates by stock, Division and Contracting Party to be available before the June Scientific Council meeting commenced. This working group considered various sources of information including reported catches. The accuracy of officially reported provisional statistics remains questionable.

Question 4

With respect to Div. 3M cod, Scientific Council is requested provide short term projection (2012-2014) of spawning biomass, fishing mortality and yield for four alternative scenarios of total removals in 2012: 11 000 t, 12 000 t, 13 000 t and 14 000 t and with constant fishing mortality (F of 2012) afterwards. Provide also a risk analysis with associated probabilities of spawning biomass falling below B_{lim}, fishing mortality increasing above F_{max} (proxy of F_{lim}) and probability of reaching B_{msy} in 2012-2014.

Response:

Scientific Council strongly reiterates its advice that catches in 2012 should not exceed the level of $F_{0.1}$ (9 280 t).

Scientific Council has made the projections suggested by the Fisheries Commission and the results are shown in the Table below. These results are based on the same assumptions presented in the June 2011 Scientific Council report, in particular that in 2011 the catch will be equal to the approved TAC (10 000 t) and that the biological parameters observed will be the same as those in the period 2008-2010. In the case that these assumptions will not be met, results could be different. If the TAC in 2011 is overshot and/or the mean weights decrease, the resulting F will be higher than the presented ones.

	Total Biomass			SSB			F_{bar}			Yield		
Yield 2012 = 11 000 t												
	5%	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**
2012	64733	95662	143429	46331	65072	90765	0.0854	0.1548	0.2738		11000	
2013	74606	120741	201974	62378	92439	143147	0.0854	0.1548	0.2738	8133	14966	28036
2014	82794	149395	274971	69986	117041	209580	0.0854	0.1548	0.2738	8064	16893	36080
Yield 2012 = 12 000 t												
	Total Biomass			**SSB**			F_{bar}			**Yield**		
	5%	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**
2012	64113	95556	143663	46185	65162	90602	0.0932	0.1702	0.3064		12000	
2013	73160	119010	200998	61254	91080	143337	0.0932	0.1702	0.3064	8840	16128	30741
2014	80211	145211	273239	67176	113945	205480	0.0932	0.1702	0.3064	8639	17777	38306
Yield 2012 = 13 000 t												
	Total Biomass			**SSB**			F_{bar}			**Yield**		
	5%	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**
2012	64342	94714	145919	46239	65021	91510	0.1004	0.1847	0.3338		13000	
2013	72226	117075	202179	60433	89376	140723	0.1004	0.1847	0.3338	9416	16919	32601
2014	77187	143439	268284	64944	109709	200940	0.1004	0.1847	0.3338	9049	18763	40706
Yield 2012 = 14 000 t												
	Total Biomass			**SSB**			F_{bar}			**Yield**		
	5%	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**	**5%**	**50%**	**95%**
2012	64588	95355	142588	46420	65010	90914	0.1103	0.2006	0.3617		14000	
2013	70968	116081	196972	59458	88283	139989	0.1103	0.2006	0.3617	9884	18159	34383
2014	75440	140013	257859	62601	107600	193208	0.1103	0.2006	0.3617	9517	19824	41617

The results of these projections were used by Scientific Council to estimate the probabilities requested by the Fisheries Commission and are shown in the Table below.

	TAC2012							
	11 000		12 000		13 000		14 000	
	$P(F_{bar}>F_{max})$	$P(SSB<B_{lim})$	$P(F_{bar}>F_{max})$	$P(SSB<B_{lim})$	$P(F_{bar}>F_{max})$	$P(SSB<B_{lim})$	$P(F_{bar}>F_{max})$	$P(SSB<B_{lim})$
2012	0.1870	<0.05	0.2782	<0.05	0.3614	<0.05	0.4494	<0.05
2013	0.1870	<0.05	0.2782	<0.05	0.3614	<0.05	0.4494	<0.05
2014	0.1870	<0.05	0.2782	<0.05	0.3614	<0.05	0.4494	<0.05

It was not possible to calculate B_{msy} during this meeting, so Scientific Council is unable to answer the final part of this request at present.

VI. MEETING REPORTS

1. Fisheries Commission WGFMS-CPRS

This Fisheries Commission Working Group met at the Cambridge Suites Hotel, Halifax, Canada, during 26-28 June 2011, was chaired by Jean-Claude Mahé (EU-France) and vice-chaired by Morley Knight (Canada). The Scientific Council was advised of progress in this group by the Chair in his presentation of the report to Fisheries Commission.

2. Fisheries Commission WGFMS-VME

This Fisheries Commission Working Group met at the Cambridge Suites Hotel, Halifax, Canada, during 29-30 June 2011, and was chaired by Bill Brodie (Canada). The Scientific Council was advised of progress in this group during the Chair's presentation of the report to Fisheries Commission.

3. Fisheries Commission WGMSE

This Fisheries Commission Working Group met by Webex on 7 September 2011, co-chaired by Sylvie Lapointe (Canada) and Antonio Vázquez (EU-Spain). The Scientific Council was notified of developments in this group during the Co-Chair's presentation of the report to Fisheries Commission.

4. WGHARP

The ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP) met during 15-19 August 2011 at the British Sea Mammal Research Unit (SMRU) at the Scottish Oceanographic Institute, University of St. Andrews, Scotland. The WG received presentations related to catch (mortality) estimates, abundance estimates, and biological parameters of White Sea/Barents Sea, Greenland Sea and Northwest Atlantic Ocean harp and hooded seal stocks, and provided updated catch options for northeast Atlantic harp and hooded seals in response to a September 2010 request from Norway. The WG also responded to a request from NAFO to consider the impacts of the increasing northwest Atlantic harp seals on the number of seals near Greenland. The WG then acted on requests from the ICES Directorate and the EU to consider issues related to Ecosystem Based Management and Marine Spatial Planning. The WG concluded their meeting on 19 August. In attendance were scientists representing Canada (2), Greenland (1), Norway (3), Russia (2), and United States (1), as well as the SMRU (3).

A survey of the White Sea/Barents Sea harp seal stock during 20-23 March 2010, and resulted in an estimate of 163 032 pups (SE = 33 342). The WG agreed that the survey appeared to have been carried out very well. The WG discussed several hypotheses to explain the reduced pup production since 2004 including unobserved mortality of adults ca. 2004, high mortality of neonates prior to the aerial surveys, or declines in fecundity (i.e. pup production). The most parsimonious explanation for the continued low count of pups in surveys in both good and bad ice years appears to be a decline in fecundity given the lack of evidence for a significant adult mortality event. This is significant because fecundity can be explored as part of the population modelling effort. The existing NE model could not account for the precipitous decline in pup production after 2003 with a fixed fecundity and maturity. Because of this, the NE model was considered inappropriate to provide catch options (as in the WG's 2009 meeting). A revised NE model with time-varying maturity and condition varying fecundity (i.e., as animal conditions improves, fecundity improves) provided a good fit to the observed pup counts. However, this model was considered preliminary and not ready at this time to be applied. A modified version of the existing NE model with time-varying maturity and fecundity provided a transitional model form, and was considered to be an appropriate temporary analytic tool. This model provided a 2011 population estimate of 1 364 700 total animals (SE = 68 503). Using this approach, the WG estimated that the sustainable catch for the White Sea/Barents Sea harp seal stock should be 26 535 seals (including 19 795 pups and 6 740 1+ animals) or 15 827 1+animals (with no harvest of pups).

With respect to the Greenland Sea harp seal stock, no new data have been collected since 2009, but the recent series of catch and reproductive data leads the WG to still consider the stock to be data rich with abundance greater than N_{70}. Therefore, it is appropriate to use a population model to estimate abundance and evaluate catch options. All model runs seem to indicate a substantial increase in the population abundance from the 1970s to the present. All model predictions indicate an increase in the abundance of 1+ animals on a 10 year scale, ranging from an increase of 31% - 49%, assuming no hunt. Using the NE model with time varying reproductive parameters, a 2011 abundance of 553 100 1+ animals and 96 470 pups are obtained. A 95% confidence interval for the 1+ population is (286 480 – 819 720). Total 2011 abundance of harp seals in the Greenland Sea is estimated to be 649 570 (379 031 – 920 101). The estimate provided by the modified model is lower than estimates provided by the original NE model. Based on the modified model's results, the WG suggests that sustainable catches are 25,410 animals (of which 63.4% are pups) or 16,737 (100% 1+ animals). An annual catch level of 35,000 (assuming 63.4% pups) or 25 000 (assuming 100% 1+ animals) would reduce the population to 70% of current level with 80% probability over a 10-year period.

The March-April 2007 Norwegian survey of hooded seal pup production in the Greenland Sea produced an estimate of 16 140 pups (SE = 2 140). This estimate is not significantly different from the estimate obtained with comparable methodology in the Greenland Sea in 2005, but is considerably lower than the 1997 estimate. The model developed for the 2011 assessment is similar to the model assessing the abundance of the Barents Sea / White Sea harp seal population, modified to incorporate historical maturity curves and historical pregnancy rates. The available historical data on pregnancy rates were considered unreliable. Hence, the model was run for a range of pregnancy rates, in addition to a run using the original model assuming constant reproductive data. All model runs indicate a population currently well below N_{30} (30% of largest observed population size). Following the Precautionary harvest strategy previously developed by WGHARP, catches should not occur for populations below N_{30}. Therefore, WGHARP suggests no catches are sustainable from the Greenland Sea hooded seal stock.

Historically the abundance of seals in Greenland waters was positively associated with increases in the harp seal population. Since 2000, it appears that ecological and hydrographical changes may have changed this relationship, and possibly led to decreases in the local abundance of harp seals in some areas. As a result, the positively correlated relationship between increases in the NWA harp seal population and the proportion of seals summering off Greenland no longer appear to exist. There are insufficient data available at this time to determine the reason for the change in the relationship.

At the request of the Marine Strategy Directive Framework Steering Group (MSFDSG) and the Strategic Initiative on Area Based Science and Management (SIASM), the WGHARP identified and described the work streams of relevance to the European Commission`s eleven descriptors with particular emphasis on linkages that between living marine resources (rather than fish stocks alone) and ecosystem/environmental monitoring and assessments.

The WG noted that that many of the principles identified in the European Commission's request for advice on the Descriptors should be extended to all upper trophic level marine species, including harp and hooded seals. Other marine taxa including other marine mammals, marine birds and marine turtles should also be considered as part of this exercise. An almost singular advantage of harp and hooded seals is that their population abundance, catch history, distribution, condition (including life history parameters), and ecological relationships are better understood than most other North Atlantic Ocean upper trophic level taxa. Similar data are also available for a few other species (e.g., United Kingdom grey seals, Baltic Sea/North Sea harbour seals). As key components of their ecosystems, it is important to consider these species, particularly because they can provide excellent indicators of ecosystem status.

The SIASM report identifies a number of spatial planning and data needs that can be supported by data available on harp and hooded seals including abundance, changes in reproductive parameters, change in growth rates and condition, changes in distribution, and changes in diets. Data are also available on several of the other themes of information requested.

Finally, WGHARP members suggest that ICES and its WGs are structured to provide advice that is easily incorporated into the policy or planning advice, therefore the WG does not understand the intent of statements within the report suggesting the contrary. WGHARP also felt that it was not the role of scientists to advocate for particular outcomes. It is the role of managers and stakeholders to identify clear objectives and questions, and for scientists to provide an analysis of the likely outcomes. Managers and stakeholders will then be able to make decisions based on the best available analyses. It is also the role of scientists to identify the uncertainty, but managers must take into account this uncertainty and its implications when making decisions.

The report of this group is available on the ICES website. This will be presented in full at the Scientific Council meeting, June 2012.

5. Meetings Attended by the Secretariat

a) Aquatic Sciences and Fisheries Abstract (ASFA) Board Meeting

The ASFA Board Meeting, Guayaquil, Ecuador, 5-9 September 2011 was attended by Alexis Pacey, Publications Manager, NAFO Secretariat. Scientific Council noted the report of the meeting provided by Alexis and deferred the matter for consideration at the next STACPUB meeting. Scientific Council voiced its support for the continued existence of ASFA and the involvement of NAFO in the organization.

b) Fifth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences

George Campanis attended the Fifth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences in Wellington, New Zealand, 22-26 August. George presented information on the use of VMS data to support management decisions in the NAFO Regulatory Area. Due to unforeseen circumstances George was unable to present his report to Scientific Council and this will be deferred to the October meeting.

c) ICES Study Group on Vessel Monitoring System Data (SGVMS)

At its June meeting, Scientific Council noted the invitation from the Chair to participate in the ICES Study Group on VMS Data, and recommended that the Scientific Council Coordinator attend this meeting. Due to the scheduling of the *ad hoc* Shrimp advice correspondence/Webex meeting, attendance of the SC Coordinator was not possible. The report of the study group will be available in due course. The next meeting of the group will be in Aberdeen, UK, in September 2012.

d) UN Workshop on the implementation of United Nations General Assembly (UNGA) Resolutions 61/105 and 64/7

The NAFO Executive Secretary, Vladimir Shibanov, attended the UN Workshop on the implementation of UNGA Resolutions 61/105 and 64/7, 15-16 September 2011, New York, USA. He was invited to represent NAFO on two panels, “Panel 3: Experience of RFMOs in addressing the impacts of bottom fisheries on vulnerable marine ecosystems and the long-term sustainability of deep-sea fish stocks”, and “Panel 4: Actions taken by States and RFMOs to implement paragraphs 84 and 87 of resolution 61/105 and paragraphs 122 and 123 of resolution 64/72.”. He presented information on NAFOs activities to protect VMEs, and a made a presentation and information paper on the “Experiences of NAFO in collection, exchange and dissemination of scientific and technical data and information”.

The main issue arising from this meeting was that of impact assessments and fishing plans, which have been submitted to NAFO and reviewed by Scientific Council as far as they were able, at a number of meetings. NAFO has considered these documents from Contracting Parties to be confidential and only required for exploratory fisheries, however non-governmental organizations took the view that these documents should be made publically available and the exercise carried out for existing fisheries as well.

e) Environmental, Biological Significant Areas Workshop: NE Atlantic (Oslo Paris Convention/North East Atlantic Fisheries Commission/Convention on Biological Diversity)

NAFO was invited to attend the OSPAR/NEAFC/CBD Workshop on Identification of Environmental, Biological Significant Areas (EBSAs), Port-Cros, France, 8-9 September 2011. The Chair of Scientific Council together with the Executive Secretary considered it important for NAFO to have a view of this workshop, however it fell at a busy time for the NAFO Secretariat and it was suggested that a member of Scientific Council attend as an NAFO SC Observer. Dr Andrew Kenny was due to be attending a meeting in France around this time and the decision was taken by the Scientific Council Executive Committee to support his travel and subsistence costs so that he could change his travel plans and represent Scientific Council at this meeting.

Background material on the Convention on Biological Diversity (CBD) process was presented, specifically progress towards delivering the COP10 objectives. COP10 Target 11, which relates to establishing a network of Marine Protected Areas (MPAs), should be implemented in the high seas by 2012. It was noted, however, that progress has been slow in designating high seas MPAs. By contrast EBSA designation is a scientific and technical exercise which makes it distinct from MPA designations. EBSA designation requires a repository of information supported by training manuals to be established, this will utilize a new prototype information system (see http://ebsa.cbd.int/). These regional workshops, of which the NE Atlantic is the first, will collate evidence on EBSAs and submit to UN via COP Process for formal adoption of candidate EBSAs. The NE Atlantic is a test case region, to be followed by south Pacific and the south Atlantic. Other global regions then expected to follow.

Odd Aksel (Norway) made a presentation on behalf of NEAFC whose mandate is to manage most fisheries outside EEZ in the NEAFC regulatory area, except for large pelagic species which are assessed by ICCAT. The RFMO regulatory areas are large, however the fishing areas (waters shallower than 2000m) are relatively small. There has been a steady transition in the NEAFC Regulatory Area from the pre-1970's unregulated fisheries, to the present day regulation of fishing activities. NEAFC also recognizes that fish stocks are significant functional element of ecosystems and therefore all aspects of marine ecosystems are of interest to NEAFC activities. NEAFC relies heavily on ICES for scientific advice. They have introduced effort restrictions, TACs, VMS monitoring, a gillnet ban in waters greater than 200m depth, and the red-listing of species. Motivation for all of these measures is to reduce the incentive to fish unsustainably. There are a further 3 measures providing ecosystem protection, **i** closed areas, **ii**. VME encounter protocols within existing fishing areas which can trigger a move-on rule, **iii**. moving into new fishing areas (for this it requires exploratory fishing plan with observers). The existing fishing footprint is only part of the potential fishing area in NEAFC. Existing fishing areas south of Iceland cover only 0.9% of total regulatory area of which 7.3% is MPA. The IUCN MPA *categories list* is being applied, which defines a hierarchy of protection. Existing NEAFC closures satisfy EBSA criteria, but NEAFC has not discussed putting forward MPA as EBSAs and some OSPAR MPAs were not closed by NEAFC (e.g. Josephine Sea Mount). NEAFC welcomes the science based proposals being tabled, but ICES should have a role in reviewing the proposals.

A series of presentations on the candidate EBSAs were then made.

Josephine Seamount Complex EBSA. The first ever seamount discovered by a science expedition in 1869 is located between Portugal and Madeira. It is one of the Lusitanian horseshoe chain of seamounts which occur between 170m to 3 700m in depth. The seamount chain acts as stepping stone for coastal fishes and sea turtles migrating between the Atlantic and Mediterranean and is an important area for corals and deepwater sharks, which are already subjected to significant fishing. In 2009 it was designated part of the Portuguese extended continental shelf. It was designated an MPA on 12 April 2011. CBD EBSA Criteria assessed the presence of VME species and habitats (high), biological productivity (high), diversity (some), representativeness (high). Not all criteria come out as high, but it was still designated MPA and is being considered as an EBSA.

Bird Life International IBA candidate EBSA This presentation detailed four candidate EBSA areas as important bird areas (IBAs) and a further five candidate EBSAs, two of which have their western boundary at the limit of the OSPAR/NEAFC area (in the Labrador and Newfoundland Basins). These areas include several IUCN Red list species whose presence is an important criteria for the site designations.

Rockall and Hatton Bank EBSA. The banks and basin have large habitat heterogeneity. Type and abundance of life changes with depth, food availability changes with depth, the organisms adapt to this limitation by growing more slowly have reduced metabolism and are not resilient as populations. General acceptance of proposal, but discussions and some disagreement about the shape and area of the proposed EBSA – this was a general issue, not just specific to Hatton Bank EBSA. What defines the boundaries of EBSAs this was not at all clear, but one suggestion which seemed to have some support from OSPAR was to set a bathymetric limit of 3 000m within the original Hatton EBSA proposal. This was examined and was considered to be appropriate with the North and Eastern limits defined by the limits of the EEZ. The resulting polygon has a more realistic appearance.

Charlie Gibbs North (fracture zone) and Sub Polar Front. Representativeness (high), productivity (high), biogeographic importance (high), deep water sponge and coral communities including deep water sharks, high proportion of VME species. Habitat structural complexity (high). There is a large amount of evidence obtained from MARECO project. The definition of the area should be driven by location of sub-polar front mixing zone – so propose three areas along MAR, south and north of mixing zone and then the area of the fracture zone where mixing takes place between N and S.

Arctic High Seas and Arctic Domain EBSAs. 2 proposals, North and South of Svalbard, respectively. Productivity (high), significant area for deepwater formation and hence supports vital ocean processes, it brings in pelagic features into an EBSA. The Arctic High Seas area is fully covered by winter sea ice, but this is expected to change significantly due to loss of summer sea ice conditions and therefore it requires special consideration and future assessment.

Jake Rice documented the historical development of VME & EBSAs. It was noted that under CBD criteria Annex 1 COP XI/20 the focus is on protecting the habitats which support associated vulnerable and endangered species, so it is not the species *per se* which are protected, but their habitats. Jake made a useful comparison of the FAO (VME) and CBD (EBSA) criteria, noting that the FAO approach appealed to the fisheries management community, whereas the CBD approach appealed to the conservation biology community. Overall though the criteria are very similar, although there is more emphasis in the FAO VME criteria on habitat structure forming species. The fact that both sets of criteria are similar is to be expected since they have common roots in their development arising from the WSSD in 2002. However, the implementation route taken by each policy is different. For example, the FAO pathway (under UNGA 61/105) has moved the focus from the comprehensive application of the Ecosystem Approach to Fisheries, to that of identifying and protecting VMEs as a component of implementing EAF. There has been some difficulty in interpreting "significant concentrations" of vulnerable species which has impeded progress on the identification of VMEs in many RFMOs. It was also noted that a process of coordination is required between the CBD and FAO 'special area' designations and that this would be the main subject of a forthcoming joint FAO and CBD GEF proposal.

It is envisaged that the evidence in support of EBSA nomination will be made available in order to feed into a number of NEAFC, CBD and OSPAR meetings later in 2011. A final report of proposed Candidate EBSAs for the NE Atlantic will be provided in January 2012.

Scientific Council welcomed the report and thanked Andrew for representing them at this meeting. It was noted that much of the work required to categorize an area as an ESBA may have already been completed in previous exercises and that if such an initiative was enacted within the NAFO Regulatory Area proper attention should be paid to avoiding the duplication of efforts. Scientific Council noted their continued interest in this process and asked the Secretariat to monitor the situation and advise the Council of any further developments.

VII. REVIEW OF FUTURE MEETING ARRANGEMENTS

1. Scientific Council, October 2011

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

2. Scientific Council, June 2012

Scientific Council agreed that its June meeting will be held on 1-14 June 2012 at the Alderney Landing, Dartmouth, NS, Canada.

3. Scientific Council, September 2012

Scientific Council noted that the Annual Meeting will be held on 17-21 September 2012. The meeting will be in St. Petersburg, Russia.

4. 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. The dates will be decided at the 2011 meeting.

5. Scientific Council, June 2013

Scientific Council agreed that its June meeting will be held during 7-20 June 2013 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada, or as decided at the 2012 meeting.

6. Scientific Council Working Groups

a) WGEAFM, December 2011

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

7. ICES/NAFO Joint Groups

a) NIPAG, October 2011

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

b) WGDEC, March 2012

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

c) NIPAG, October 2012

The dates and venue of this NIPAG meeting will be decided at the October 2011 meeting.

d) WGHARP, August 2013

The Working Group on Harp and Hooded Seals (WGHARP) (Chair: Mike Hammill) will meet for 4-5 days during August 2013 at a venue to be decided at a later date.

VIII. FUTURE SPECIAL SESSIONS

1. Topics for Future Special Sessions

Scientific Council was made aware of two possible future special sessions. Both of these would be held in 2013.

a) *Gadoid Fisheries: Biology, Ecology and Management*. Gadoids remain one of the key groups of demersal fishes in the North Atlantic. Recently marked improvements in population sizes have occurred in a number of gadoid stocks spanning their geographic distributions. These include cod in the Northeast Atlantic, Baltic Sea, NAFO Div. 3M and haddock of Georges Bank and SW Nova Scotia. Many other stocks remain depleted. Given the commercial value of these fishes, a symposium is proposed that would bring together scientists to present empirical data and theories to explain the varied recovery rates of gadoid stocks, the efficacy of recovery actions and discuss management strategies under and after rebuilding. This event would be held in late June 2013, in St. Andrews, Canada.

b) *Strategic Initiative on Stock Assessment Methods (SISAM).* NAFO has been involved with the ICES Strategic Initiative on Stock Assessment Methods since its inception in 2010, and supported the attendance of Brian Healey at a workshop organized under this initiative. The NAFO Secretariat has been informed of developments by the chair of the Steering Committee. The current plan is to hold a conference on stock assessment methods in Boston, USA, in early 2013.

Scientific Council noted this and asked the Secretariat to monitor the situation and inform Scientific Council of any further information which is received.

IX. OTHER MATTERS

1. Review and comment on the scientific aspects of Annex 4 and Annex 5 of NAFO/FC Doc. 11/4 (Report of the Fisheries Commission Working Group of Fishery Managers and Scientists on Conservation Plans and Rebuilding Strategies (WGFMS-CPRS))

Scientific Council was pleased to be informed of the work of the Fisheries Commission WG of Fisheries Managers and Scientists on Conservation Plans and Rebuilding Strategies (WGFMS-CPRS). Council noted that the interim rebuilding plans for Div. 3NO cod and Div. 3LNO American plaice produced by this WG were a step forward. However, Council also noted that there are still some issues with these plans, particularly that they are not fully specified. Council would be pleased to be engaged in improving these rebuilding plans.

2. Matters arising from Fisheries Commission Working Group on Management Strategy Evaluation for Greenland Halibut

At previous meetings Scientific Council has voiced its concerns that it is unable to adequately evaluate whether exceptional circumstances were occurring, due to issues with availability of results of one suite of models used. Two working papers were presented to Scientific Council to frame discussion on the scope of the "Exceptional Circumstances" provisions. The secondary indicators of stock status (exploitable biomass, fishing mortality and recruitment) are derived from the models. Primary indicators (catches and survey trends) are independent of models and should be used to determine whether exceptional circumstances are in effect in the first instance. It was proposed that an *ad hoc* working group be established to collect the required data and provide further guidance on how to determine if exceptional circumstances are in effect. This group should report to Scientific Council by 1 April 2012, would be coordinated by Peter Shelton and tentative membership would include Brian Healey, Fernando Gonzalez, Ricardo Alpoim, Jean-Claude Mahé and Carsten Hvingel.

3. Coastal State Request by Greenland on Harp seals (deferred from September 2010)

In response to a request from Greenland, the NAFO Scientific Council requested that the Joint ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP) "*Evaluate how a projected increase in the total population of Northwest Atlantic harp seals might affect the proportion of animals summering in Greenland"* during their biennial meeting held in August 2011. The response from WGHARP is contained in their report (ICES 2011).

Harp seals from both the Northwest Atlantic and Greenland Sea populations are found along the coast of Greenland. Because of their much larger population and migration patterns, the vast majority of seals that occur in Greenland waters are from the Northwest Atlantic population (NWA). Seals from this population are seasonal migrants, giving birth on the pack ice off southern Labrador and in the Gulf of St. Lawrence each spring. During the summer, NWA harp seals feed in the eastern Canadian archipelago and along the coast from west and southwest Greenland. Some harp seals remain in the Arctic throughout the year.

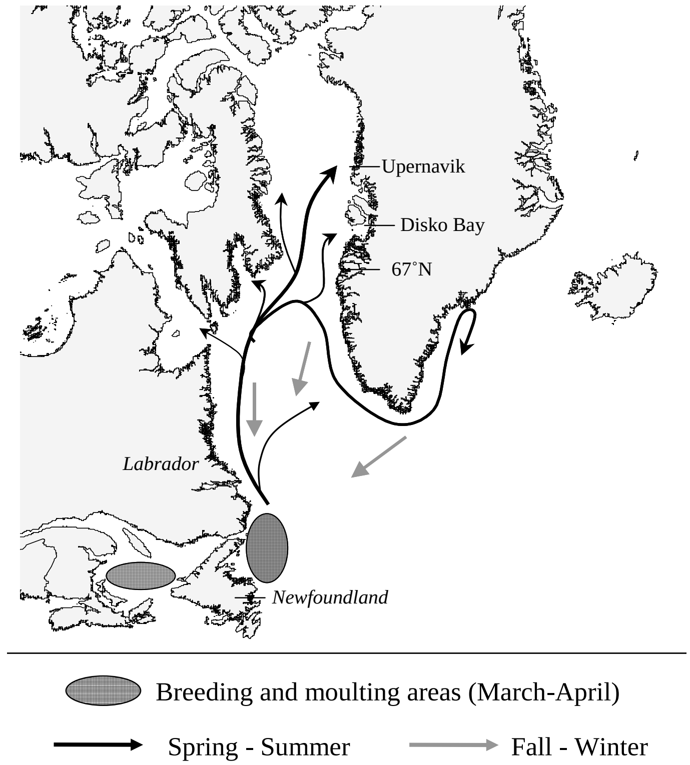


Figure 1. Distribution of Northwest Atlantic harp seals.

In Greenland waters there are no direct measurements of harp seal abundance, or of the proportion of the total population that occurs there. However, there are catch statistics from an unrestricted seal hunt which may reflect abundance along the Greenland coast.

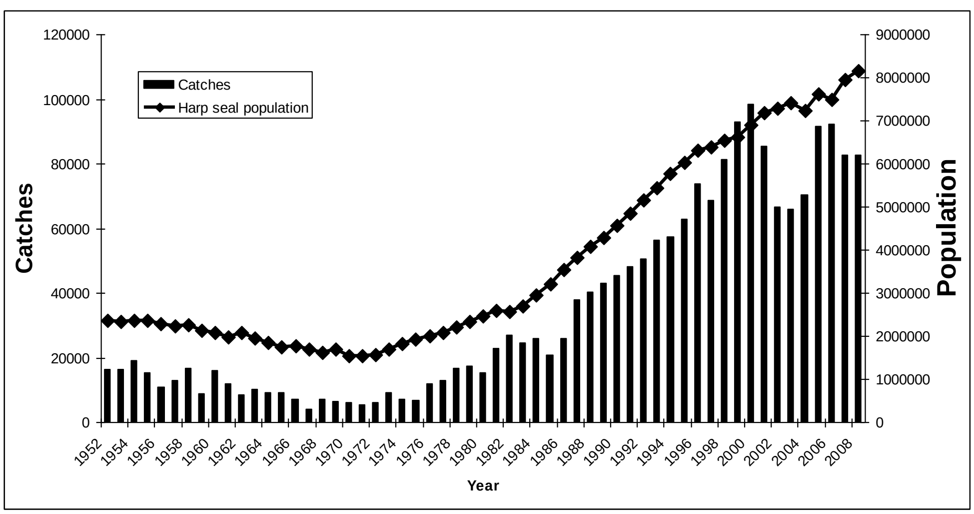
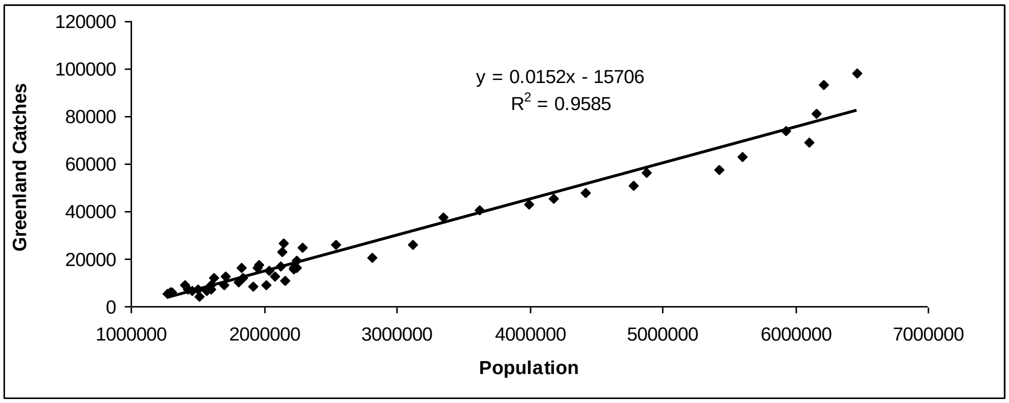


Figure 2. Estimated abundance of Northwest Atlantic harp seals and catches of NWA harp seals in Greenland.

The data show a strong correlation between estimates of total population size and Greenland catches until approximately the year 2000 (Fig 2, 3 top). After 2000, however, the relationship between catches and abundance broke down (Fig 3 bottom). This suggests that fairly precise predictions of seal abundance (using catch numbers as a proxy) could have been calculated from the total population size prior to 2000. After 2000, however, additional variables (e.g. changes in sea ice extent) may have affected the distribution and local abundance of harps in Greenland waters. The change in this relationship is particularly obvious in catches that occurred south of 67^0 N. However, it is also possible that changes in hunting effort during the latest decade may also have contributed to the perception of a decline in Greenland waters.



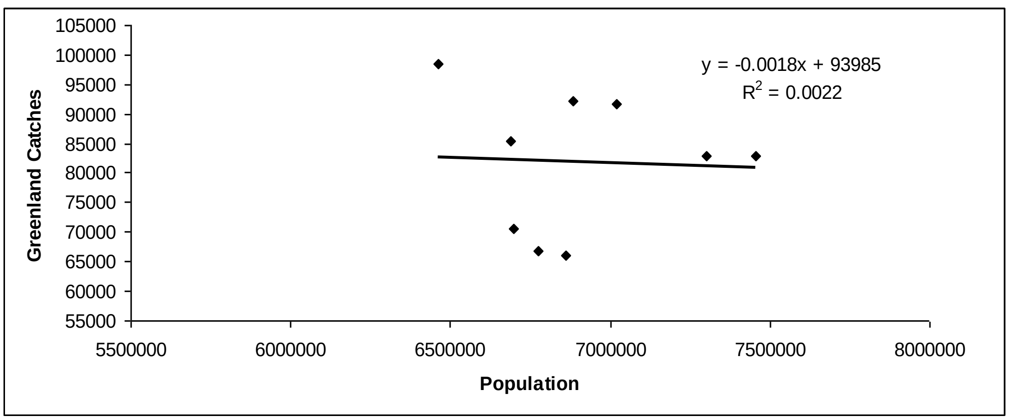


Figure 3. Relationship between estimates of NWA harp seal abundance and catches in Greenland from 1952 – 2000 (top) and from 2000-2008 (bottom).

Appropriate estimates of abundance in Greenland need to be developed to discriminate between actual and perceived changes in abundance. A time-series of surveys on seal abundance in Greenland waters would be one possibility. Seals will have to be surveyed at various times a year for a number of years. Such a model will, however, not be reliable to describe the period before the time-series began. The NWA harp seal population is believed to be approaching carrying capacity and it is uncertain whether the distribution of the seals in the years to come is predictable based on hind-cast analysis. Such analyses will, however, be important to describe how distribution patterns change as the population and the environment change.

Alternatively, a proxy of relative seal abundance (does abundance increase or decrease) might be found by selecting catch data from settlements where changes in hunting effort are likely to have been relatively small.

Ultimately, the historical abundance of seals in Greenland waters was positively associated with increases in the total (NWA) harp seal population. Since 2000, it appears that ecological and hydrographical changes may have changed this relationship, and possibly led to local changes in abundance, particularly in southwest Greenland. However, there are insufficient data available at this time to adequately analyze the latter.

References:

ICES, 2011. Report of the Working group on Harp and Hooded Seals (WGHARP), 15-19 August 2011, St. Andrews, Scotland, UK. ICES CM 2011/ACOM:22. 68 pp.

4. Future Research on Mesh Sizes for Redfish in Div. 3LN

Scientific Council received a presentation on observations made by a PINRO observer onboard a Russian pelagic side-trawler fishing for pelagic Redfish in Div. 3LN with a cod-end mesh size of 130mm.

The net was fitted with a catch sensor which triggered the hauling of the net when the weight of fish in the net reached 50 t, the catch was then pumped aboard from the cod-end. Large losses were observed through the meshes of the net as it was hauled in and whilst it was being pumped. Eventually, 18 t were pumped on board, the rest being lost. Mean size in the catch was 23.1 cm. The conclusion was made that two-thirds of the pelagic redfish entering the net are lost, and that fish escaping in this manner are dead or dying. Scientific Council were informed of plan to continue further research at PINRO to prevent catch losses by researching trawl selectivity using a 90mm mesh for this fishery in Div. 3LN.

Scientific Council asked if the total weight in the net is an issue in determining the rate of catch loss; noted the alternative methods available to prevent small fish entering the net in the first place and suggested the use of a twin trawl or randomizing the choice of mesh size used for each tow to obtain the most valuable data possible. The Scientific Council Chair thanked the presenter and suggested that it would be useful to receive comprehensive information on length frequency of the catch and any information on by-catch species when these results are presented in full.

5. FAO VME Database Meeting, December 2011

NAFO was approached regarding participation in an upcoming FAO Workshop for the development of a database for vulnerable marine ecosystems (VMEs).

The need for a global database on VMEs is underlined in the FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas, and the database concept was presented during the 2010 FAO Workshop on the Implementation of the International Guidelines for the Management of Deep-sea Fisheries in the High Seas - Challenges and Ways Forward, held in Busan, Republic of Korea from 10-12 May 2010.

NAFO was asked to appoint appropriate persons to attend and contribute to the workshop. The Chair noted that there are a number of NAFO Secretariat Staff members who are involved into the processes related to VMEs, and who would be in Rome at a meeting concurrent with this one, but felt that Scientific Council would benefit from involvement in this initiative in its own right. A number of scientists connected to NAFO work were included on the distribution list for this invitation and it was decided that they would be approached by the Secretariat and invited to observe the meeting on behalf of Scientific Council if they plan to attend.

6. Access to VMS data

Data access issues were brought forward to Scientific Council by the WGEAFM co-chair. These issues arose when WGEAFM scientists requested access to VMS data held at the NAFO Secretariat. Even though NAFO Secretariat staff and WGEAFM scientists achieved an agreement on how the data should be handled to prevent any disclosure of confidential information to the scientific team, the constraints imposed by the current CEM provisions pertaining VMS data requires that any data released by the Secretariat should be linked to an explicit request by Fisheries Commission, and can only be provided in a summary form.

Modern technologies, like VMS, have emerged as powerful tools for improving management and enforcement practices, but they also provide an important source of information that, as recent work by WGEAFM and Scientific Council has shown, can be used for scientific analyses that can improve the advice that Scientific Council gives to Fisheries Commission. In this context, and in full consideration of the privacy and confidentiality requirements associated with the use of VMS and other types of data that may be available via the NAFO Secretariat, Scientific Council **recommended** *Fisheries Commission to modify the language contained in the current CEM so to allow the NAFO Secretariat to release these types of data to Scientific Council, with the provision that the data must be completely anonymized before its release to Scientific Council, and that it should only be used for analyses pertaining questions posed by NAFO constituent bodies*.

7. Items arising from the NAFO Performance Assessment report

Scientific Council considered the recommendations forwarded from General Council. The Executive Committee will reflect on these and agree how best to implement any recommendations in advance of the June meeting. The Secretariat will assist with this process by extracting the background information upon which each recommendation has been made from the body of the Performance Assessment report. Scientific Council noted the recommendations which will be addressed by the General Council Working Group.

8. Change in NAFO Representation at WGDEC

Dr Ellen Kenchington (Canada) has represented NAFO Scientific Council at the ICES/NAFO Working Group on Deepwater Ecology (WGDEC) since its establishment in 2007. Dr Kenchington has asked to be replaced in this role. The Chair of Scientific Council thanked Ellen for the excellent job she had performed. These thoughts were echoed by members of Scientific Council, who noted the important work carried out by this group, which has been picked up and incorporated in to other NAFO groups. Scientific Council felt that it was important to have continuing representation in this working group, and a decision was made that the Secretariat would approach Odd Aksel Bergstad (Norway) to inquire as to whether he would be willing to take up this role.

9. Presentation of Scientific Merit Award to Dr V. Rikhter

At its June 2011 meeting, Scientific Council endorsed the award of a Scientific Merit Award to Dr. Vladimir Rikhter in recognition of his extensive career studying the fishery resources of the Northwestern Atlantic Ocean and the leadership he displayed within NAFO, acting as Chair of both STACPUB and Scientific Council.

Dr Rikhter made a presentation on the history of fisheries research in the northwest Atlantic carried out by his institute the text of which can be found in Annex 1. Dr Rikhter humbly praised the many colleagues he worked with over the years at both ICNAF and NAFO who he believed also deserved recognition, and highlighted that such research is still ongoing by a current generation of researchers.

Dr Rikhter was presented with his certificate and a bound volume of over eighty papers which he had published via NAFO by the Chair of Scientific Council, who wished him a long and happy retirement.

10. Awards to Outgoing Chairs

The Chair of Scientific Council thanked the outgoing chairs, Carsten Hvingel (STACREC) and Joanne Morgan (STACFIS) for all their hard work over the past years and wished them the best of luck in their future and presented them with Scientific Council Merit Awards. Scientific Council also recognized Ricardo Alpoim for the guidance and leadership displayed during the course of his tenure as Chair. Ricardo was presented with a Merit Award by the Scientific Council Coordinator, on behalf of the NAFO Scientific Council, President and Executive Secretary.

X. ADOPTION OF REPORTS

1. Committee Reports of STACREC and STACFIS

The Council reviewed and adopted the Reports of the Standing Committees (STACREC and STACFIS).

2. Report of Scientific Council

The Council at its concluding session on 23 September 2011 considered and adopted its own report.

XII. ADJOURNMENT

There being no other business, the meeting was adjourned at 0930 hours on 23 September 2011.

ANNEX 1. VALEDICTORY SPEECH BY DR V. RIKHTER: A BRIEF OVERVIEW OF RESEARCH ACTIVITIES CONDUCTED BY ATLANTNIRO IN THE NORTHWEST ATLANTIC.

First of all, I would like to thank NAFO research community for appreciating so highly my contribution to the activities of this Organization and for their kind invitation to participate in the present meeting and to share with you my inevitably nostalgic and at times subjective memories and impressions of the previous work. I would also like to express my opinion, in this case an objective one, that there are many more scientists among ICNAF-NAFO veterans who deserve such kind of reward probably even more than your humble servant. I hope this opinion will be accepted by the Scientific Council.

Let me now move on to the memories. The history of research conducted by AtlantNIRO in the Northwest Atlantic (NWA) began in 1959, when a relevant laboratory hadn't been founded at the institute yet. However, considering a rapidly growing interest to this area on the part of foreign, as well as Soviet, fishermen, a decision was made to start studying fishery resources there by arranging the first research and exploratory expedition. Search for commercial fish aggregations was carried out in the waters of West Greenland and Canada from the northern part of Davis Strait to the southern point of Grand Banks in October-November 1959. The search resulted in locating aggregations of cod, redfish, haddock, flatfish, and some other species. A vast body of data was collected on their biology and distribution. Later on, by decision of the Ministry of Fisheries of the USSR, the northern areas of NWA (waters of Greenland, Labrador, Newfoundland, Flemish Cap Bank) had been excluded from the AtlantNIRO scope of activity and their research had been transferred to the authority of the Polar Institute (PINRO). This means that colleagues of mine from the North also have a lot to say about research activity of their Institute in this area.

In subsequent years the intensity of AtlantNIRO research in close co-operation with Fishing Scouting Service carried out on the Nova Scotia shelf, Georges Bank and the USA shelf up to approximately 35ºN (north latitude), had been snowballing. In 1960 two expeditions were organized which resulted in locating of considerable aggregations of Atlantic herring on Browns Bank, Georges Bank and on Banquerau Bank. A new form of collecting biological material started to be introduced, when the data was collected by scientific observers, as they are called today, on fishing vessels. In February-March 1960, I had to familiarize myself with this kind of job being part of a group of 3 members from AtlantNIRO on a vessel, carrying out fishing of cod in divisions 2J3Kl.

In 1961 a momentous event took place at the Institute. A laboratory of Northwest Atlantic was founded under the direction of Dr. Noskov. Already in the first years of the laboratory's work he began to put into practice the idea of a ecosystem approach to studies of living resources of the Northwest Atlantic, being perhaps ahead of his time. In line with this idea the laboratory was divided into sector of stock assessment and sector of ecological research. Anticipating the sequence of events, one could say that the appropriateness of such a structure was well-founded, and that was confirmed later on, when we started co-operating with scientists from the U.S.

In 1961-1966 research carried out by AtlantNIRO was aimed at studying species which were new to Soviet fisheries: these are, primarily, Atlantic herring, silver hake, red hake, Atlantic mackerel, argentine, and some other of fish. The most important tasks were to study their habitat, biology and population dynamics to provide evaluation and prognosis of stocks status as well as allowable catches of the above mentioned species for the coming years.

Since the end of the 1960s, ecosystem approach had been pivotal in studying living resources of NWA at the laboratory. Emphasis was made on studies of food and food relations of dominant species of fish and invertebrates. Attempts had been made to assess the role of sea birds in the mortality of fish from natural causes. However, those experiments were not developed further. Within the framework of ecosystem approach emphasis was placed on research whose primary goal was to study conditions for formation of commercial fish aggregations with further displacement of focus towards revealing environmental factors, determining year-class strength of the most important species.

Considerable effort was put into studying life cycle of Atlantic herring at Georges Bank. Within the program aimed at studying its reproduction, benthic surveys with a dredge was carried out. As a result, mass spawn sites at the sea bottom as well as spawning period were established. Based on the data obtained, it became possible to assess tentatively spawning biomass of herring in the aforementioned area. Decrease in stock of this species gave a stimulus for intensification of research on other items of Soviet fisheries such as silver hake, red hake, argentine and squid.

On the whole, in the 1960s, the targets of Soviet fisheries were dozens of fish species and there is no need to innumerate all of them. However, it is worth mentioning rather an exotic for NWA species such as Atlantic saury which in 1969 became an object of joint research by both AtlantNIRO and fish scouting service. Based on the results of the first experimental expeditions at Scotian shelf and Georges Bank, commercial fishing of this species using electric light was soon organized.

At this point the description of the first stage of the AtlantNIRO research in the NWA can be completed. That was the time of the "younger years" of the Institute which coincided with the exploration of a totally new to the Soviet fisheries area of the Atlantic. At that stage there was no question about any international co-operation, but, obviously, that situation couldn't go on for a long time considering rapid development of foreign fishery in the vicinity of the U.S. and Canada shores. In 1966 ICNAF received the first documents prepared by AtlantNIRO.

However, a much more significant event was an agreement signed by the USSR and USA on joint research in the waters from Nova Scotia in the north to Cape Hatteras in the south. Within the framework of this agreement the first expedition headed by Dr. Noskov was carried out. The period of active co-operation between scientists from AtlantNIRO and North-East Fisheries Center continued from 1967 till 1980. Over this period 14 expeditions aimed at implementation of a joint program were organized on our part only. A significant achievement of both Soviet and American scientists was development of the program of ecosystem research, which was put to evaluation test at Georges Bank and in adjacent waters of the eastern coast of the USA. One could probably state that at that time, ecological surveys of such scope and at such level had not been conducted in any other area of the World Ocean.

The results obtained had made a considerable contribution to our knowledge of living resources in NWA. One can confidently state that the entire scientific international community benefited from the Soviet-American co-operation. In the opinion of Robert White, administrator of the National Oceanic and Atmospheric Administration (NOAA), the USSR-USA joint research had served as a model for developing ICNAF programs on coordinated surveys in this area. On the whole, in the course of the program over 70 scientists and technicians from AtlantNIRO took part in sea expeditions. Processing of the data collected during expeditions at sea was no less important integral part of the program. Highly qualified specialists on fish feeding and ageing, on ichthyo- and zooplankton were required. Such specialists got selected for NWA laboratory at that time, which enabled us to cope with all challenges arising in the process of bilateral co-operation and to implement the program in compliance with ecosystem focus of the laboratory's research.

The introduction of 200-mile economic zones by the USA and Canada can be rightfully regarded as the beginning of a new era in fishery and research in NWA. The USA practically closed down their zone for foreign fisheries which led first to reduction and then to almost total termination of the co-operation between AtlantNIRO and American Center in 1980. In the following years the exchange of publications still continued and a number of small-scale joint projects were carried out aimed at reconstructing the history of the Soviet fishery in the NWA and compiling electronic database including data accumulated during the stage of active co-operation. The outcome of one of such projects was the book entitled "From Cape Hatteras to Cabot Strait: the History of the Soviet Fishery on the Atlantic Continental Shelf of the United States and Canada", written by Dr. Chuksin, scientist from AtlantNIRO.

In the 1970s, alongside with the Soviet-American co-operation, direct contacts between AtlantNIRO and ICNAF Scientific Committee (STACRES) were established and began to develop. At that time annual submission of biological data, prepared in compliance with ICNAF standards and participation of AtlantNIRO scientists in various STACRES activities (annual, special meetings, working groups) got started. That period (1973-1979) had been quite strenuous for ICNAF scientists. Beginning with 1973 a period of transition from qualitative to quantitative methods of fish stocks assessment and prospective catches began. About 50 stock units were subject to investigation. Later on the number had gone up to about 60 units. Opposing views of the parties on the issues of stock and TAC value of some principal objects of fisheries had led to lengthy discussions. To the best of my knowledge, it was Dr. Edwards who first called this opposition of views "biopolitics". I can't help giving you a rather typical and probably the most vivid example of such a discussion related to the topic. As you know, in the first half of the 1970s, Atlantic mackerel from subareas 4-5 and statistical area 6 was one of the main objects of fishery for a number of countries including the USSR. Before establishing a 200-mile zone by the U.S., we had the last opportunity for fishing it in 1977. A special meeting had to make a decision concerning the TAC size in that year. It should be mentioned that according to American scientists, the stocks of Atlantic mackerel had decreased by mid 1970s. Based on this data, the U.S. delegation made a suggestion to reduce TAC to zero in 1977. It should be noted that in 1976 the TAC for mackerel made up 310 thousand tons. In turn, scientists from Poland, GDR, Bulgaria and the USSR presented a joint document, where they were trying to justify the TAC size for 1977 around 200 thousand tons. At that time it was quite a normal situation that our delegation got a directive from the Ministry of Fisheries to achieve this value of TAC. Considering the persistence with which our American colleagues were trying to pass their suggestion, one could get the impression that they also had a similar directive. A heated discussion broke out. And at this point it is worth recalling an ancient wisdom, which says that the truth is always born in a dispute and is usually halfway between two extremes. And it seems that ICNAF took seriously this ancient wisdom and defined TAC for 1977 in the size of 105 thousand tons. Similar situations, though less dramatic ones, took place for some other species of fish. I'd like to point out that at the STACRES level, representatives from different countries almost always managed to reach a compromise though from time to time a special opinion had to be recorded. In my opinion, biopolitics had in some extent positive impact on scientists, making them carry out additional research and present more conclusive arguments in support of their views and position of their country.

Considerable efforts were contributed also to exploration of commercial resources on the shelf of Nova Scotia, where till 1977 the main object of Soviet fishing had been silver hake, argentine, Atlantic herring, redfish, haddock and shortfin squid. In the following years only hake and squid remained available for foreign fishing. In 1973-1979 the results of research conducted by AtlantNIRO were submitted yearly to ICNAF in the form of research documents and in the aforementioned period over 70 papers were prepared.

In 1977 a period of long-lasting co-operation between the Soviet and Canadian scientists began and it was mainly aimed at in-depth study of silver hake biology and population dynamics on the Nova Scotia shelf. From 1977 till 1991 within the framework of a joint program 17 pelagic trawl surveys of silver hake juveniles were carried out with participation of Canadian scientists on the AtlantNIRO vessels. As a result, the scientists obtained a representative series of data on distribution, numbers of juveniles and conditions affecting year-class size of the species at early development stages. As for the studies of the population dynamics, the focus was made on determining factors affecting fluctuations in year-class abundance. In 1992, the long-term observations were discontinued due to the circumstances beyond the scientists' control. However, in 1993-1996 joint surveys were resumed on a Canadian vessel.

The co-operation with Canadian scientists, just like previously with American ones, had been terminated due to external factors, although, fortunately, that didn't happen too soon. In my opinion, on the whole, the specified goals had been achieved in both cases. As for the results of co-operation proper, in many respects they have preserved their applicability and can still serve as landmarks for planning some future, for example, ecosystem research in the NAFO area.

The intensity of the Soviet research in NWA experienced a considerable decrease after the introduction of 200-mile zones by the USA and Canada, which was directly connected to dramatic reduction of availability of the area to foreign fishery. The number of scientific and scouting expeditions dropped sharply. However, if we look at the number of research documents (over 80) prepared for the Scientific Council in 1980-1989, we will find that this decade turned out to be a quite productive one for the AtlantNIRO scientists. Though AtlantNIRO research activities were restricted mainly to the Nova Scotia shelf, it was this factor that enabled scientists to focus their efforts on in-depth studies of two species – silver hake and shortfin squid, which formed the basis of the Soviet fishing in this area. Research conducted within the framework of bilateral co-operation and the program of the Institute and collecting of biological samples from commercial catches contributed to the multifaceted character of the data.

In the 1980s, the Nova Scotia shelf started to lose its attractiveness for the Soviet fishery despite relatively good hake catches during this period, because of the exploration of other objects of fishery (horse mackerel in the southeast of the Pacific, pelagic redfish in the Irminger Sea) which began in the first half of the 1980s. In relation to this fact, re-distribution of scientific efforts inevitably started which led to liquidation of the Laboratory of Northwest Atlantic in 1987. There remained only a small group of specialists who continued the research. Thanks to their efforts and at the commission of the Scientific Council a paper on silver hake of the Nova Scotia shelf was prepared, where an attempt was made to elucidate all aspects of life cycle of the species. The quality of the work had been considerably improved thanks to the comments made by Dr. Halliday, to whom all the authors would like once again to express their profound gratitude.

The period of relatively active research carried out by AtlantNIRO in NWA continued till 1997 when the program of joint research ceased to exist. In the 1990s, another 47 research documents were prepared and most of them in the first half of the period. It comes as no surprise that the topic of those documents mainly was hake from the Nova Scotia shelf.

And this completes the history of AtlantNIRO research in the NWA. In the subsequent years the co-operation between the Institute and NAFO took the form of yearly (until 2009) presentations of the national report sections to the Secretariat with information on available oceanographic data on the area of Nova Scotia and individual research documents. The AtlantNIRO representatives stopped participating in meetings of the Scientific Council after 2004.

In conclusion I would like to present you some figures which don't require any comments. During the period between 1959 and 1991 inclusive, AtlantNIRO and fish scouting service carried out about 190 scientific and scouting expeditions in the NWA. The first publications by scientists from AtlantNIRO on research results in this area began to come out in 1963. By now about 200 publications have come out in various journals and over 250 have been presented to ICNAF and NAFO in the form of research and summary documents. And finally, my colleague Dr. Sigayev is finishing his monograph "The dynamics of hydrological fronts in the Northwest Atlantic and its impact on the ecosystem of shelf waters of New England and Nova Scotia", which will probably be submitted to the publisher next year. As we can see, the general line of research of the former Laboratory of NWA has had its worthy extension.

Now I would like to finish my presentation at this optimistic note. Thank you very much for your attention!

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

Chair: Carsten Hvingel Rapporteur: Barbara Marshall

The Committee met at the Westin Hotel, Halifax, Nova Scotia, Canada, during 20 September 2011, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal and Spain), France (with respect to St. Pierre et Miquelon), Norway, Russian Federation and USA. The Scientific Council Coordinator was in attendance.

1. Opening

The Chair opened the meeting and welcomed everyone. He especially welcomed the incoming Chair Don Stansbury and wished him well in his new role. Barbara Marshall was appointed the Rapporteur.

2. Fisheries Statistics

a) Progress Reports on Secretariat Activities

A proposal is being submitted to STACFAD to create a Data Manager position in the Secretariat. This position would then become responsible for the STATLANT database which is presently managed by the Fisheries Commission Coordinator.

The NAFO website is currently being redesigned and the new pages will feature a Data tab on the front page. This will contain links to the STATLANT, GIS and other data held by NAFO.

b) Review of STATLANT 21

All 21B submissions were made in a timely matter and the situation with some non-submissions of 21A data noted in June has been rectified.

3. Research Activities

a) Surveys Planned for 2010 and Early-2011

Designated Experts were requested to check and update the information contained in SCS Doc. 11/18.

4. External Cooperation

a) ICES Strategic Initiative on Stock Assessment Methods (SISAM)

A symposium will be held in 2013 in Boston. A funding request will be presented to NAFO and Scientific Council members are encouraged to attend. More information will be available at a later date.

5. Review of Recommendations

From the June Meeting:

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: No progress has been made at this time. This will be reviewed again next year.

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: No progress has been made at this time. This will be reviewed again next year.

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.*

STATUS: No progress reported.

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.*

STATUS: This recommendation was endorsed by the Scientific Council and presented to the Fisheries Commission for action.

6. Other Matters

a) Review of SCR and SCS Documents

No documents were reviewed during this meeting.

b) Other Business

Carsten Hvingel was thanked for his work as Chair and his contributions to the Executive Committee were appreciated.

The meeting was adjourned at 1530 on 20 September 2011.

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

Chair : Joanne Morgan Rapporteur: Various

The Committee met at the Westin Hotel, Halifax, Nova Scotia, Canada, during 19-21 September 2011, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal and Spain), France (with respect to St. Pierre et Miquelon), Norway, Russian Federation and USA. The Scientific Council Coordinator was in attendance.

1. Opening

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

2. Any matter outstanding from the WebEx SC Meeting, 1 - 12 September 2011

a) Northern Shrimp in Div. 3M and Div. 3LNO

The Chair informed the meeting that the assessments for Div. 3M and Div. 3LNO Northern shrimp had been updated during a SharePoint and Webex meeting of STACFIS. The assessments were completed at that time and there were no outstanding issues.

3. Nomination of Designated Experts

There are likely to be some changes in Designated Experts for stocks over the next year. The current list of Designated Experts is given below and will be nominated again. The relevant institutes will be contacted to confirm the Designated Experts.

The nominated Designated Experts for 2012 are:

From the Science Branch, Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans, P. O. Box 5667, St. John's, NL, Canada A1C 5X1, Canada (Fax: + 709-772-4188)

Cod in Div. 3NO	Don Power	Tel: +1 709-772-4935	don.power@dfo-mpo.gc.ca
Redfish Div. 3O	Don Power	Tel: +1 709-772-4935	don.power@dfo-mpo.gc.ca
American Plaice in Div. 3LNO	Rick Rideout	Tel: +1 709-772-6975	rick.rideout@dfo-mpo.gc.ca
Witch flounder in Div. 3NO	Bill Brodie	Tel: +1 709-772-3288	bill.brodie@dfo-mpo.gc.ca
Witch flounder in Div. 2J+3KL	Dawn Maddock Parsons	Tel: +1 709-772-2495	dawn.parsons@dfo-mpo.gc.ca
Yellowtail flounder in Div. 3LNO	Dawn Maddock Parsons	Tel: +1 709-772-2495	dawn.parsons@dfo-mpo.gc.ca
Greenland halibut in SA 2+3KLMNO	Brian Healey	Tel: +1 709-772-8674	brian.healey@dfo-mpo.gc.ca
Northern shrimp in Div. 3LNO	David Orr	Tel: +1 709-772-7343	david.orr@dfo-mpo.gc.ca
Thorny skate in Div. 3LNO	Mark Simpson	Tel: +1 709-772-4148	mark.r.simpson@dfo-mpo.gc.ca
White hake in Div. 3NO	Mark Simpson	Tel: +1 709-772-4148	mark.r.simpson@dfo-mpo.gc.ca

From the Instituto Español de Oceanografia, Aptdo 1552, E-36200 Vigo (Pontevedra), Spain (Fax: +34 986 49 2351)

Roughhead grenadier in SA 2+3	Fernando Gonzalez-Costas	Tel: +34 986 49 2111	fernando.gonzalez@vi.ieo.es
Roundnose grenadier in SA 2+3	Fernando Gonzalez-Costas	Tel: +34 986 49 2111	fernando.gonzalez@vi.ieo.es
Cod in Div. 3M	Diana Gonzalez-Troncoso	Tel: +34 986 49 2111	diana.gonzalez@vi.ieo.es
Shrimp in Div. 3M	Jose Miguel Casas Sanchez	Tel: +34 986 49 2111	mikel.casas@vi.ieo.es

From the Instituto Nacional de Recursos Biológicos (INRB/IPIMAR), Av. de Brasilia, 1449-006 Lisbon, Portugal (Fax: +351 21 301 5948)

American plaice in Div. 3M	Ricardo Alpoim	Tel: +351 21 302 7000	ralpoim@ipimar.pt
Redfish in Div. 3M	Antonio Avila de Melo	Tel: +351 21 302 7000	amelo@ipimar.pt
Redfish in Div. 3LN	Antonio Avila de Melo	Tel: +351 21 302 7000	amelo@ipimar.pt

From the Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk, Greenland (Fax: +299 36 1212)

Redfish in SA1	Rasmus Nygaard	Tel: +299 36 1200	rany@natur.gl
Other Finfish in SA1	Rasmus Nygaard	Tel: +299 36 1200	rany@natur.gl
Greenland halibut in Div. 1A	Rasmus Nygaard h	Tel: +299 36 1200	rany@natur.gl
Northern shrimp in SA 0+1	Michael Kingsley	Tel: +299 36 1200	mcsk@natur.gl
Northern shrimp in Denmark Strait	Nanette Hammeken	Tel: +299 36 1200	nanette@natur.gl

From the Danish Institute for Fisheries Research, Charlottenlund Slot, DK-2920, Charlottenlund, Denmark (Fax: +45 33 96 33 33)

Roundnose grenadier in SA 0+1	Ole Jørgensen	Tel: +45 33 96 33 00	olj@dfu.min.dk
Greenland halibut in SA 0+1	Ole Jørgensen	Tel: +45 33 96 33 00	olj@dfu.min.dk

From Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk, 183763, Russia (Fax: +7 8152 47 3331)

Capelin in Div. 3NO	Ivan Tretiakov	Tel: +7 8152 450568	tis@pinro.ru

From National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543

Northern Shortfin Squid in SA 3 & 4	Lisa Hendrickson	Tel: +1 508 495-2285	lisa.hendrickson@noaa.gov

4. Other Matters

a) Review of SCR and SCS Documents

There were no papers presented to STACFIS.

b) Other Business

There being no other business 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 1615 on 21 September.

PART D: SCIENTIFIC COUNCIL MEETING 19-26 OCTOBER 2011

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PARTICIPANTS

Back row: Neil Campbell (NAFO Secretariat), José Miguel Casas, Peter Shelton, Tim Siferd, Mats Ulmestrand, Carsten Hvingel (Chair Scientific Council; Co-Chair NIPAG)

Middle back row: Michael Kingsley, Silver Sirp, Bill Brodie, Jean-Claude Mahé (Co-Chair NIPAG), Don Stansbury,

Front row: Sten Munch-Petersen, Guldborg Søvik, Sergey Bakanev, Dave Orr, Helle Siegstad, Barb Marshall (NAFO Secretariat).

Report of Scientific Council Meeting

19-26 October 2011

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at the NAFO Headquarters, Dartmouth, NS, Canada, during 19-26 October 2011, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), European Union (Denmark, Estonia, France, Portugal and Spain), Norway and Russia. The Scientific Council Coordinator, Neil Campbell, was in attendance.

The opening session of the Council was called to order at 0930 hours on 19 October 2011.

The Chair welcomed representatives, advisers and experts to the opening session of Scientific Council. The Chair noted that the primary reason for this meeting was to provide advice on shrimp stocks based on the assessments provided by the joint NAFO/ICES *Pandalus* Assessment Group (NIPAG). ICES members of NIPAG were granted observer status at the Scientific Council meeting, and the Chair wished all NIPAG members a productive and successful meeting.

The Scientific Council Coordinator, Neil Campbell, was appointed Rapporteur.

This opening session was adjourned at 1000 hours. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda.

The concluding session was convened at 0900 hours on 26 October 2011. The Council then considered and adopted Sections III.1–4 of the “Report of the NAFO/ICES *Pandalus* Assessment Group” (NAFO SCS Doc. 11/20, ICES CM 2011/ACOM:14). The Council, having considered the results of the assessments of the NAFO stocks, provided advice and recommendations and noted the requests of the Fisheries Commission and Coastal States had been addressed. The Council then considered and adopted its own report of the 19-26 October 2011 meeting.

The meeting adjourned at 1300 hours on 26 October 2011.

The revised Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Representatives, Advisers and Experts, are given in Appendix I, II and III, respectively.

II. REVIEW OF RECOMMENDATIONS IN 2010

Scientific Council Meeting, 3-16 June 2011

III. NAFO/ICES *PANDALUS* ASSESSMENT GROUP

NIPAG has assessed four stocks of relevance to NAFO: Northern shrimp in Div. 3M, Northern shrimp in Div. 3LNO, Northern shrimp in Subareas 0 and 1, and Northern shrimp in Denmark Strait and off East Greenland. The Scientific Council summary sheets and conclusions for these stocks are presented in Section IV of this report. The recommendations to Fisheries Commission, with respect to stock advice, appear in the summary sheets. The full NIPAG report is available in NAFO SCS Doc. 11/20 and ICES CM 2011/ACOM:14

IV. FORMULATION OF ADVICE (SEE ANNEXES 1, 2 AND 3)

1. Request from Fisheries Commission

The Fisheries Commission Request for Advice from the September 2011 meeting (Annex 1d) for shrimp in Div. 3M and Div. 3LNO regarding stock assessment (Item 1) is given, respectively, under IV.1.a and IV.1.b below.

The Request for Advice on the identification of PA reference points (Item 3), is given under IV.1.c below.

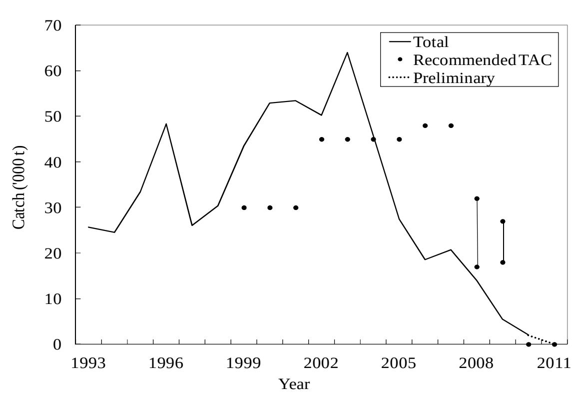
a) Northern shrimp in Div. 3M

Background: The shrimp fishery in Div. 3M is now under moratorium. This fishery began in 1993. Initial catch rates were favorable and, shortly thereafter, vessels from several nations joined. Catches peaked at over 60 000 t in 2003 and declined thereafter.

Fishery and Catches: The stock is under effort regulation. The effort allocations were reduced by 50% in 2010 and a moratorium was imposed in 2011. Catches are expected to be close to zero in 2011. Recent catches were as follows:

	Catch ('000 t)		TAC ('000 t)	Effort[3] (days)
Year	NIPAG	STATLANT 21	Recommended	Agreed
2006	19	15	48	10555
2007	21	18	48	10555
2008	14	12	17-32	10555
2009	5	5[1]	18-27	10555
2010	2	2[1]	ndf	5277
2011	0[2]		ndf	0

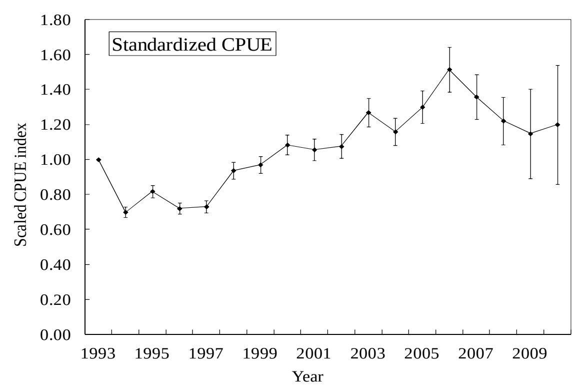
[1] Provisional.
[2] Preliminary to October, 2011
[3] This stock is effort regulated
ndf- no directed fishery



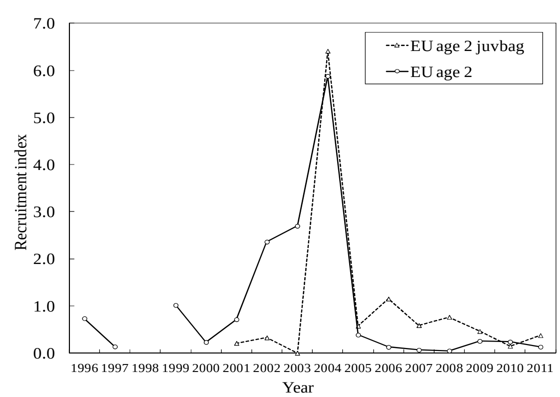
Data: Catch, effort and biological data were available from several Contracting Parties. Time series of size and sex composition data were available mainly from two countries between 1993 and 2005 and survey indices were available from EU research surveys (1988-2011). The standardized CPUE series was updated for 2010.

Assessment: No analytical assessment is available and fishing mortality is unknown. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

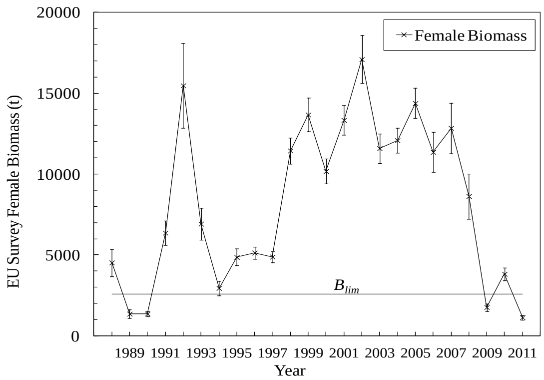
CPUE: The CPUE index from the commercial fishery showed increasing trends from 1996 to 2006. This index has decreased from 2006 to 2010



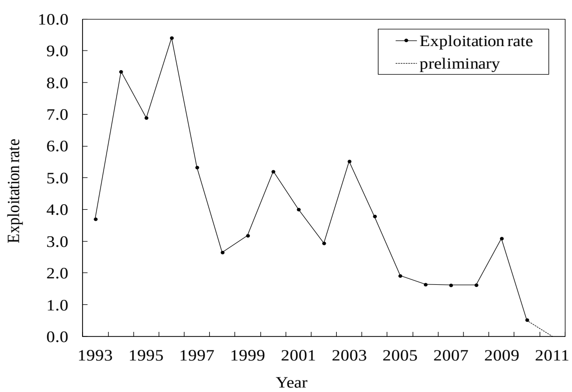
Recruitment: Indices of age 2 abundance have been week since 2002



SSB: The survey female biomass index was at a high level from 1998 to 2007, and has declined to its lowest level in 2011.

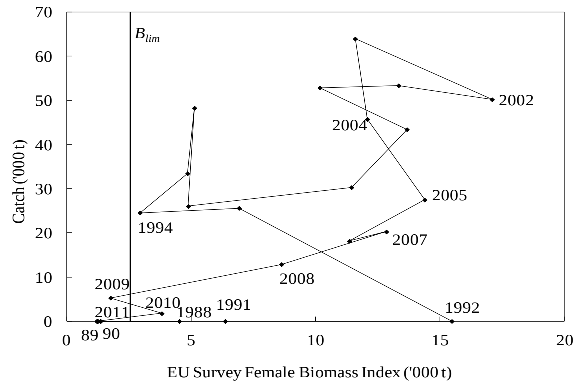


Exploitation rate: From 2005 to 2008 exploitation rates (nominal catch divided by the EU survey biomass index of the same year) remained stable at relatively low values and increased in 2009. Because catches in 2010 were low, while the female biomass estimate increased slightly, the exploitation rate declined to its lowest observed level.



State of the Stock: In 2009 the female biomass index was below B_{lim}, it was slightly above it in 2010 and it is again well below B_{lim} in 2011. Due to the continued poor recruitment, there are serious concerns that the stock will remain at low levels.

Reference Points: Scientific Council considers that the point at which a valid index of stock size has declined by 85% from its maximum observed level provides a proxy for B_{lim}. This is 2 564 t for northern shrimp in Div. 3M. The index in 2011 is below B_{lim}. It is not possible to caluculate a limit reference point for fishing mortality.



Recommendation: The 2011 survey biomass index indicates the stock is below the B_{lim} proxy and remains in a state of impaired recruitment. Scientific Council recommends that the fishing mortality for 2013 be set as close to zero as possible.

Special Comments: Scientific Council notes that there are indications of factors other than fishery that may be involved in the current decline of the stock.

This advice will be reviewed based on updated information in September 2012 when results from the summer survey are available.

Sources of Information: SCS Doc. 04/12, SCR Doc. 04/77, 11/59, 11/60, 11/62

b) Northern shrimp in Div. 3LNO

Background: Most of this stock is located in Div. 3L and exploratory fishing began there in 1993. The stock came under TAC regulation in 2000, and fishing has been restricted to Div. 3L.

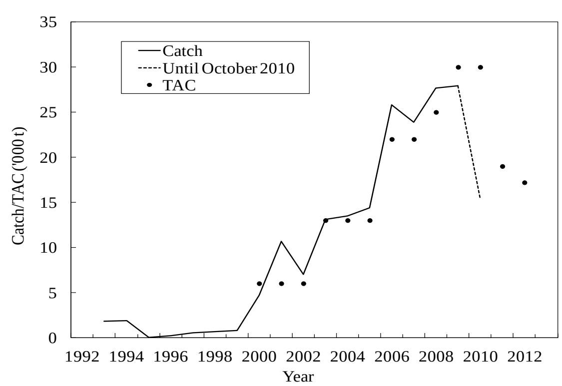
Fishery and catches: Several countries participated in the fishery in 2011. The use of a sorting grid to reduce bycatches of fish is mandatory for all fleets in the fishery. Recent catches from the stock are as follows:

	Catch (´000 t)		TAC ('000 t)	
Year	NIPAG	21A	Recommended	Agreed
2007	24	21	22	22[1]
2008	28	25	25	25[1]
2009	28	26	25	30[1]
2010	21	20	See footnote [2]	30[1]
2011	11[3]		<17	19[1]
2012			<9.35	12
2013				9

[1] Denmark with respect to Faroes and Greenland did not agree to the 2003 – 2011 quotas and have set autonomous TACs since 2003. These increases are not included in the table.

[2] The recent exploitation rates of about 14% may be too high. Scientific Council therefore urges caution in the exploitation of the stock and considers that exploitation rates should not be raised, but kept below recent levels.

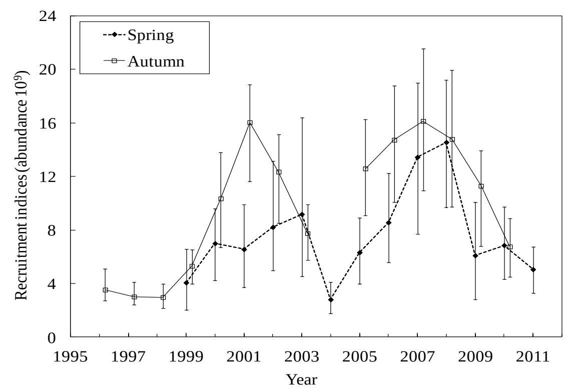
[3] NIPAG estimated catches to October 2011.



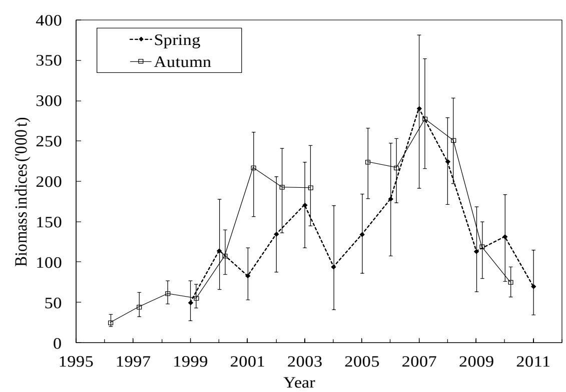
Data: Catch, effort and biological data were available from the commercial fishery. Biomass indices were available from research surveys conducted in Div. 3LNO during spring (1999 to 2011) and autumn (1996 to 2010). The Canadian survey in autumn 2004 was incomplete.

Assessment: Analytical assessment methods have not been established for this stock. Evaluation of the status of the stock is based upon interpretation of commercial fishery and research survey data.

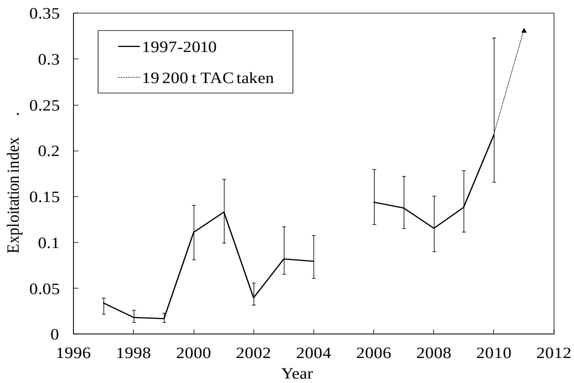
Recruitment: Recruitment indices from 2006 – 2008 were among the highest in the spring and autumn time series but have decreased since and are now below the long-term mean.



Biomass: Spring and autumn biomass indices generally increased, to record levels by 2007, but decreased substantially by 2010. The spring biomass indices remained at a low level in 2011.

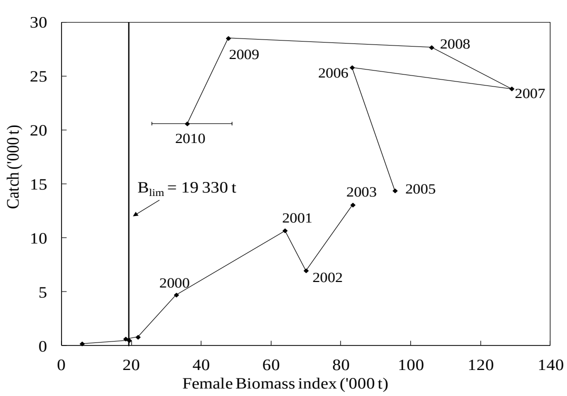


Exploitation rate: The index of exploitation remained below 0.15 through 2009 however it has since increased. If the entire TAC for 2011 is taken, it will be above 0.30. If the 12 000 t TAC is taken in 2012, the predicted exploitation rate is 0.20.



State of the Stock: Biomass levels peaked in 2007 then decreased substantially through to spring 2011. The female biomass index is estimated to be above B_{lim} (19 300 t). A continuous decrease of biomass in the past four years is a reason for concern. The predicted autumn 2011 female biomass index is 27 600 t – a decline of 23% from 2010. Given the level of uncertainty attached to survey estimates, there is a slight risk of the female biomass index being below B_{lim} by the end of 2011.

Precautionary Approach Reference Points: Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} (19 330 t) for northern shrimp in Div. 3LNO (SCS Doc. 04/12). Currently, the female biomass index is estimated to be above but nearing B_{lim}. It is not possible to calculate a limit reference point for fishing mortality. A "safe zone" has not been determined in the precautionary approach for this stock.



Recommendation: Based on the average fishable biomass for the last three surveys and predicted autumn 2011 survey, the following table shows catch levels at various exploitation rates in 2013:

5.0%	3 059 t
10.0%	6 119 t
14.0%	8 566 t
15.3%	9 350 t[1]

[1] FC TAC for 2013

Exploitation rates over the period 2006–2009 have been near 14% and were followed by stock decline. Scientific Council considers TAC options involving exploitation rates of 14% or higher to be associated with a relatively high risk of continued stock decline. TACs lower than that will tend to reduce this risk in proportion to the reduction in the exploitation rate. Scientific Council recommended that the TAC for 2013 be less than 8 600 t. Scientific Council is not able to quantify the absolute magnitude of the risk.

Special Comments: Scientific Council notes that the stock has declined since 2007 and the female biomass at the end of 2011 is predicted to be close to B_{lim}. If the decline continues, the exploitation rates predicted in the above table will be underestimated.

In order to reduce the risk of the stock falling below B_{lim} in the near future it will be advisable to exercise caution in setting TACs

This assessment will be updated in September 2012.

Sources of Information: SCR Doc. 11/13, 46, 49, 59, 61; SCS Doc. 04/12.

c) PA Reference points for shrimp in Div. 3LNO

With respect to Northern shrimp (Pandalus borealis) in Div. 3LNO, noting the NAFO Framework for Precautionary Approach and recognizing the desire to demonstrate NAFO's commitment to applying the precautionary approach, Fisheries Commission requests the Scientific Council to:

identify F_{msy}
identify B_{msy}
provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf} *)*

Scientific Council responded:

Current scientific advice for the management of Div. 3LNO shrimp is based on the relationship between trends in research vessel survey indices and the commercial landings. There is no accepted assessment model. 15% of the highest survey observation of female biomass (SSB) is currently accepted as a proxy for B_{lim}. There is no current proxy for F_{lim}. Fisheries Commission has requested advice on the identification of F_{msy}, B_{msy} and advice on the appropriate selection of an upper reference point for biomass. Such advice is best provided using an accepted assessment model fit to the data. Progress has been made in fitting surplus production models using both maximum likelihood and Bayesian approaches. The Bayesian model will be further refined and presented in 2012 as a potential assessment model for the stock.

2. Requests from Coastal States

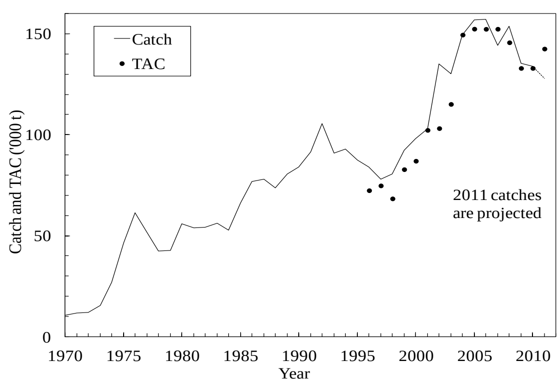
a) Northern shrimp in Subareas 0 and 1

Background: The shrimp stock off West Greenland is distributed in Subarea 1 and Div. 0A east of 60°30'W. A small-scale inshore fishery began in SA 1 in the 1930s. Since 1969 an offshore fishery has developed.

Fishery and Catches: The fishery is prosecuted mostly by Greenland in SA 1 and Canada in Div. 0A. Canada did not fish in 2008 and fished little in 2009, but has since resumed fishing. Recent catches are:

	Catch ('000 t)		TAC ('000 t)	
Year	NIPAG	STATLANT 21	Advised	Actual[2]
2008	152.9	148.6	130	145.7
2009	135.5	133.5[1]	110	133.0
2010	134.0	134.0[1]	110	133.0
2011	126.0[3]		120	142.6

[1] Provisional.
[2] Total of TACs set by Greenland and Canada.
[3] Predicted to year end by industry observers.



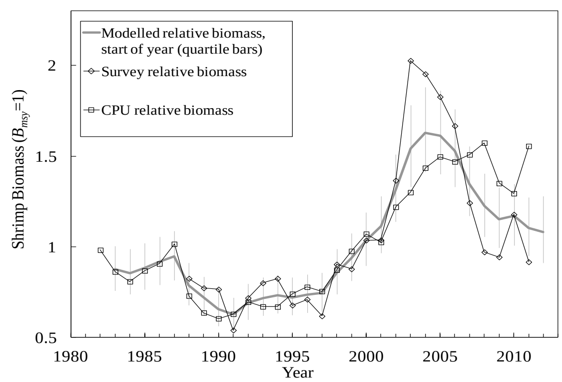
Data: Catch, effort, and position data were available from all vessels. Series of biomass and recruitment indices and size- and sex-composition data were available from research surveys. Series of cod biomass and cod consumption were also available.

Assessment: An analytical assessment framework was used to describe stock dynamics in terms of biomass (B) and mortality (Z) relative to biological reference points.

The model used was a stochastic version of a surplus production model including an explicit term for predation by Atlantic cod, stated in a state-space framework and fitted by Bayesian methods. *MSY* (Maximum Sustainable Yield) defines maximum production, and B_{msy} is the biomass level giving *MSY*.

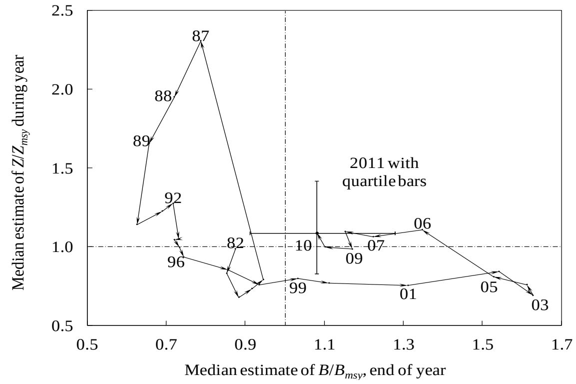
A precautionary limit reference point for stock biomass (B_{lim}) is 30% of B_{msy} and the limit reference point for mortality (Z_{lim}) is Z_{msy}. Recent CPUE values have stayed high, while the area fished has contracted and survey biomass indices have decreased, and the index is now considered to be of questionable reliability. Therefore in the 2011 assessment, the model accepted was modified from that used in foregoing years to give equal weight to CPUE and survey indices of biomass. The resulting median estimate of *MSY* was 135 000 t/yr.

Indices of how widely the stock and the fishery were distributed were calculated from catch positions in the fishery and the survey.

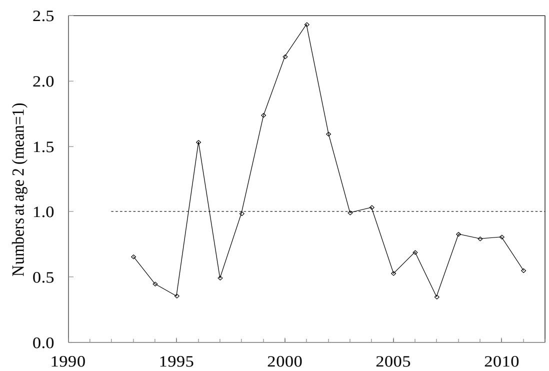


Biomass. A stock-dynamic model showed a maximum biomass at the end of 2003, with a continuing decline since; the probability that biomass will be below B_{msy} at the end of 2011 with projected catches at 126 000 t was estimated at 38% and risk of its being below B_{lim} at less than 1%.

Mortality. The mortality caused by fishing and cod predation (Z) is estimated to have stayed below the upper limit reference (Z_{msy}) from 1996 to 2005, but is now estimated to have averaged 6% over the limit value since 2006. With catches projected at 126 000 t the risk that total mortality in 2011 would exceed Z_{msy} was estimated at about 59%. Atlantic cod is widely distributed on the West Greenland shrimp grounds in 2011 and predation is expected to remain high



Recruitment. The stock structure in 2011 is deficient in shrimps of intermediate size 15–22 mm CPL, presaging poor short-term recruitment to both the fishable and spawning stocks; numbers at age 2 in 2011 are at 55% of the series mean, so medium-term recruitment is also expected to be poor.



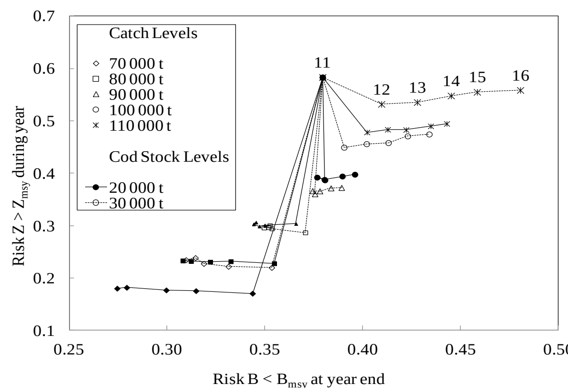
State of the Stock. Modelled biomass is estimated to have been declining since 2004. At the end of 2011 biomass is projected to remain slightly above B_{msy}. Total mortality for the year is projected to exceed Z_{msy}. Recruitment to the fishable stock, in both the short and the medium term, is expected to be low.

Short-term predictions: Estimated risks for 2012 with an "effective" (the amount of cod biomass overlapping the shrimp biomass) 20 000 t cod stock are:

20 000 t cod	Catch option ('000 t)						
Risk of end 2012 (%)	60	70	80	90	100	110	120
falling below B_{msy}	33.1	34.4	35.5	37.5	38.1	40.2	41.3
falling below B_{lim}	<1	<1	<1	<1	<1	<1	<1
exceeding Z_{msy}	13.4	17.0	22.7	30.7	38.7	47.8	55.1

Medium-term Predictions: Predicted probabilities of transgressing precautionary limits after 3 years in the fishery for Northern Shrimp on the West Greenland shelf with 'effective' cod stocks assumed at 20 000 t (20kt) and 30 000 t(30kt) were estimated at:

	Prob. biomass $< B_{MSY}$ (%)		Prob. biomass $<B_{lim}$ (%)		Prob. mort. $> Z_{msy}$ (%)	
Catch (Kt/yr)	20 Kt	30 Kt	20 Kt	30 Kt	20 Kt	30 Kt
60	27.4	29.2	1.6	2.0	14.0	18.4
70	30.0	31.9	1.5	2.1	17.7	22.7
80	32.2	34.9	1.6	2.2	22.7	29.0
90	36.1	38.8	1.8	2.3	30.7	37.2
100	38.0	41.3	1.8	2.4	38.8	45.8
110	42.2	44.5	1.8	2.4	48.3	54.8
120	44.6	47.8	1.8	2.6	56.2	61.8



Recommendation: Recent catch levels are not estimated to be sustainable. Scientific Council therefore recommends that catches in 2012 should be reduced substantially.

The risk of exceeding Z_{msy} at a catch level of 90 000 t with an effective cod stock at the 2011 level in 2012 is estimated to be around 31%. Scientific Council notes that this risk is higher than was recommended in previous assessments. This is because model results indicate a stationary stock above B_{msy} at this risk level of exceeding Z_{msy}. Scientific Council therefore recommends that catches in 2012 should not exceed 90 000 t.

Special Comments: Scientific Council were not in a position to predict the cod stock so assumed that the cod stock in 2012 would be at the same level as 2011 in its analysis. Should the cod stock increase beyond this assumption catches may have to be decreased further.

Sources of Information: SCR Docs 04/75, 04/76, 08/62, 11/50, 11/51, 11/52, 11/55, 11/57, 11/58, SCS Doc. 04/12.

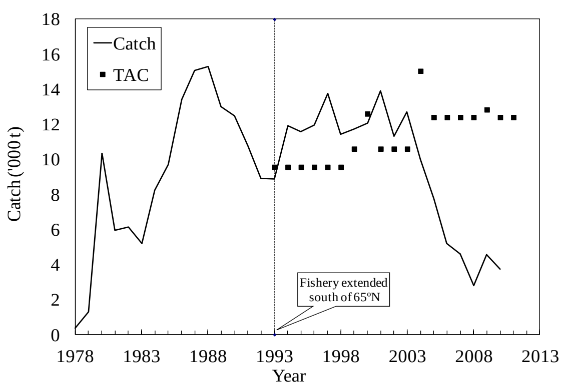
b) Northern shrimp in Denmark Strait and off East Greenland

Background: The fishery began in 1978 in areas north of 65°N in Denmark Strait, where it occurs on both sides of the midline between Greenland and Iceland. Areas south of 65°N in Greenlandic waters have been exploited since 1993. Until 2005 catches in the area south of 65°N accounted for 50 - 60% of the total catch but since 2006 catches in the southern area accounted for 25% or less of the total catch.

Fishery and Catches: Two nations participated in the fishery in 2011. Catches in the Iceland EEZ decreased from 2002-2005 and since 2006 no catches have been taken. Recent catches and recommended TACs are as follows:

	Catch ('000 t)	TAC ('000 t)		
Year	NIPAG	Recom-mended	Greenland EEZ	Iceland EEZ[1]
2007	4.6	12.4	12.4	
2008	2.8	12.4	12.4	
2009	4.6	12.4	12.8	
2010	3.7	12.4	11.8	
2011	1.1[2]	12.4	11.8	

[1] Fishery unregulated in Icelandic EEZ;
[2] Catch till October 2011.

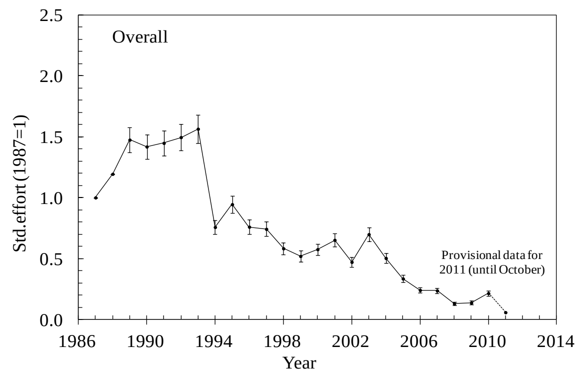


Data: Catch and effort data were available from trawlers of several nations. Annual surveys have been conducted since 2008.

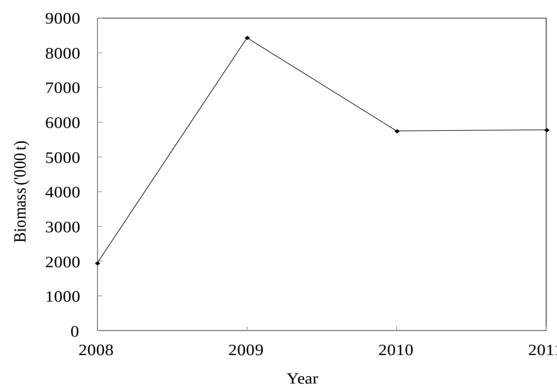
Assessment: No analytical assessment is available. Evaluation of the status of the stock is based on analysis of commercial fishery data and survey data.

Recruitment: No recruitment estimates were available.

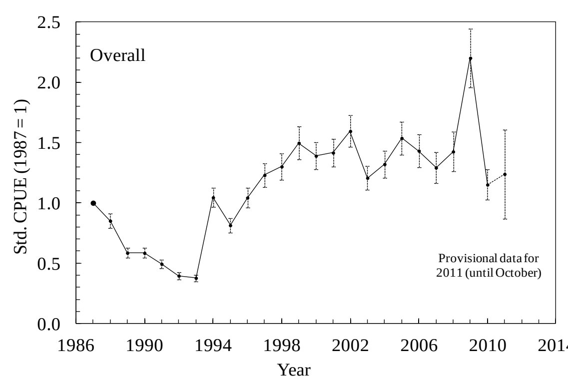
Exploitation rate: Since the mid 1990s exploitation rate index (standardized effort) has decreased, reaching the lowest levels seen in the time series from 2008 - 2011.



Biomass: The biomass index from 2008-2011 varied greatly with no clear trend.



CPUE: Combined standardized catch-rate index for the total area decreased steadily from 1987 to 1993, showed an increase to a relatively high level in 1998, and has fluctuated around this level since. There are concerns as to whether the 2009 value properly reflects the state of the stock.



State of the Stock: The stock biomass is believed to be at a relatively high level, and to have been there since 1998.

Recommendation: Scientific Council finds no basis to change its previous advice and recommends that catches should remain below 12 400 t in 2012.

Special Comments: The predominant fleet, accounting for 40% of total catch, has decreased their effort in recent years, which gives some uncertainty as to whether recent index values are a true reflection of the stock biomass. This decrease may be related to the economics of the fishery.

Sources of Information: SCR Doc. 03/74, 11/56, 11/54.

c) Audit of management plan for Northern Shrimp fishery to the west of Greenland

Scientific Council considered a request from the Government of Greenland to:

'audit 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.'

and further

'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 Bmsy, Blim and Zmsy as soon as the limits of the biomass is exceeded.'

The 'management plan' referred to is a management plan for the fishery for Northern Shrimp that was adopted by the Greenland Self-Government in July 2010. The request made to Scientific Council is not specific about what is to be understood by 'audit'. Scientific Council will find it helpful if the Government of Greenland consults the Greenland Institute of Natural Resources or other experts with a view to more exactly defining its requirement.

Scientific Council observes, however, that a full evaluation of a complete set of fishery management procedures (a 'Management Strategy Evaluation', or MSE) is normally based on a set of linked simulation models, all complex, and is too big a task to be undertaken in the course of a Scientific Council meeting. A full MSE can be expected to take two to three years to complete and to require several meetings and workshops.

d) Stock status of *P. montagui* in Subareas 0-1

(SCR Doc. 11/070 and 11/053)

The Scientific Council was 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.*

Information was available from logbooks in the fishery for *P. borealis* and from the annual West Greenland trawl survey.

Overall, *P. montagui* appears to occur at a density of the order of 1% of that of *P. borealis.* Its distribution is different: it is relatively rare north of the northern margin of Store Hellefiskebanke, and south of that limit it occurs in shallower water than *P. borealis*, possibly associated with a greater tolerance for colder water. Its distribution is more localised than that of *P. borealis*, and although it is seldom caught as clean catches but almost always associated with *borealis* there are known to the industry small areas where catches of *montagui*, sometimes large, can dependably be made.

Logging of catches of *P. montagui* is irregular. Vessels of the coastal fleet fishing bulk shrimps for processing in Greenland undoubtedly catch *montagui* from time to time; the catch composition is estimated by sampling at the point of sale and the price adjusted accordingly. However, this fleet component records practically no *montagui* in logbooks, logging all catches as 'PR99'—i.e. bulk shrimp. Offshore trawlers are more apt to log catches of *montagui*, but it is impossible to be certain that records are complete.

Some owners avoid catching *montagui* completely, others have customers that will accept it. It appears that some vessels will occasionally target *montagui*, especially when short of quota for fishing *borealis*, and they sometimes record catch sequences, including repeated large catches of *montagui*, that are not consistent with sustained efforts to avoid it. In all fleet segments weights of *montagui* are not withdrawn from quotas, which apply to *borealis* only. The fishery for *montagui* is therefore only indirectly regulated, by the species's being less acceptable to the markets and by its being almost always mixed with *borealis*, which is quota-restricted.

The only fishery-independent information on *montagui* is that available from the West Greenland trawl survey executed annually by the Greenland Institute of Natural Resources. The survey has never had the investigation of *P. montagui* among its design objectives, and effort is allocated principally according to the distribution of *P. borealis.* Given the localised and shallow-water distribution of *montagui*, catches of *montagui* in the survey are therefore sporadic and survey results an inaccurate measure of trends in biomass. Scientific Council does not think that biomass indices from the trawl survey as at present conducted constitute a satisfactory means of determining whether the stock of *P. montagui* is within safe biological limits. Scientific Council recommends, however, that the Greenland Institute of Natural Resources should analyse the results of previous surveys to find out whether, or how, it might be possible to alter the basis on which the survey is designed to improve its usefulness for monitoring the state of the stock of *P. montagui.*

Scientific Council concluded that it cannot now formulate advice on whether the stock of *Pandalus montagui* is within safe biological limits.

Scientific Council considered the following as possible measures that might be applied in the fishery for *P. borealis* to afford some protection to the stock of *P. montagui*, without suggesting that they exhaust the possibilities:

- require the reliable logging of catches of *P. montagui* and make the records available to fishery scientists and managers.

Scientific Council considers this measure to be indispensable and a necessary precursor to any other measure.

- Impose a shallow limit on fishing for *P. borealis* of *for example* 170 m on the West Greenland coast between *for example* 60°45'N (approximately the latitude of Kap Desolation) and 68°15'N (approx. the latitude of the northern edge of Store Hellefiskebanke).

This would give a measure of protection to *P. montagui*, given its distribution in shallower water than that preferred by *borealis*, and would in some measure also benefit the stock of *P. borealis* by preferentially protecting the smaller sizes. This restriction would apply to all fleet components.

- Apply the present bycatch regulations, which require fishing to be moved by a regulated distance if a bycatch limit is exceeded, to *P. montagui.*

This measure would greatly protect *P. montagui* given that no licenses are issued for any fishery on it. However, it would also thereby forgo the commercial benefits of the catches now being taken.

- Impose limits on catches of *P. montagui* separate from those enacted for *P. borealis;*

Catch limits on *P. montagui* might be called 'bycatch limits', implying catches under licences for *P. borealis*, or 'TACs', implying that licences would be issued for fishing *montagui*, but either way it would become necessary to assess the status of the stock of *montagui* and to decide on catch limits that would protect the stock without unnecessary restriction on the fishery for *borealis*. Data sources, assessment methods and forecasting techniques are lacking and would have to be developed.

- Manage a joint fishery for the two species;

This implies that licences would be issued and TACs and quotas set for the two species without distinction. Stock assessments and advice would be provided for the two species as a joint stock, although some level of separate evaluation would probably also be necessary to ensure that neither was over-exploited. This management would look much like the present, except that catches of *montagui* would be withdrawn from quotas. Such a management regime might be expected to provide considerable protection for *montagui*, as it would be withdrawn from quotas on the same footing as *borealis* in spite of its lower market value.

Scientific Council has not considered all the implications of these different possibilities and does not at the present time recommend all or any for implementation, with the exception of the first *i.e.* the accurate recording of catches. Scientific Council considers that reliable and accessible catch records are a *sine qua non* even for attempting to evaluate the effects of different management options, let alone developing the methods and procedures necessary for implementing any of them.

V. OTHER MATTERS

1. SC/NIPAG Meeting, October 2012

The Scientific Council agreed that the dates and venue of the next Scientific Council / NIPAG meeting will be 17-24 October 2012 at the Institute of Marine Research, Tromsø (IMR), Norway.

2. SC/NIPAG Meeting, October 2013

Scientific Council noted the proposed change in timing of the annual meeting in 2013, the duplication of effort which occurs for the NAFO Div. 3M and Div. 3LNO stocks when updates to advice are produced intersessionally and the time-lag between assessments and the implementation of advice based on them. Scientific Council resolved to consider holding the Scientific Council / NIPAG meeting prior to the annual meeting in future, and to reflect upon this matter in more detail at the 2012 meeting.

3. Topics for Future Special Sessions

There are no special sessions planned for 2012, and no proposals were received from this meeting. Scientific Council were updated regarding the two sessions discussed at the September 2011 SC meeting (*Gadoid Fisheries: Biology, Ecology and Management; Strategic Initiative on Stock Assessment Methods*) which are scheduled for 2013.

4. Items arising from the NAFO Performance Assessment

Scientific Council members who were not present at the September meeting were given a chance to review the NAFO Performance Assessment. Further discussion of the issue was deferred until the meeting in June 2012.

5. Other Business

Scientific Council noted that an ICES benchmark assessment workshop will be held in spring 2012, and will address the assessment of *Pandalus* in the Skagerrak and Norwegian Deeps. Further information will be available on the ICES website.

Scientific Council reviewed a working paper on Lithuanian research in the shrimp fishery in ICES Subarea I and II. The author requested Scientific Council discuss the sharing of biological data collection duties. Scientific Council noted that at present demographic information from the fishery is not used in the assessment of shrimp in this area, however it is a useful component in the assessment of other shrimp stocks. Notwithstanding, Scientific Council considered that the proper place to raise this discussion could be the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (PGCCDBS), or in the relevant Regional Coordination Meeting.

VI. ADOPTION OF SCIENTIFIC COUNCIL AND NIPAG REPORTS

The Council at its session on 26 October 2011 considered and adopted Sections III.1-4 of the "Report of the NAFO/ICES *Pandalus* Assessment Group" (SCS Doc. 11/20, ICES CM 2011/ACOM:14). The Council then considered and adopted its own report of the 19-26 October 2011 meeting.

VII. ADJOURNMENT

The Chair thanked the participants for their hard work and contribution to the success of this meeting, and welcomed the peer review and constructive comments received in formulating the scientific advice. The Chair thanked the Scientific Council Coordinator, Neil Campbell, for his support during the meeting. The Chair then thanked the ICES and NAFO Secretariats for their support and NAFO for hosting the Scientific Council and NIPAG meetings. All participants were then wished a safe journey home and the meeting was adjourned at 1230 hours.

APPENDIX 1 - STOCKS ASSESSED BY NIPAG

Co-Chairs: Jean-Claude Mahé and Carsten Hvingel Rapporteurs: Various

I. OPENING

The NAFO/ICES *Pandalus* Assessment Group (NIPAG) met at the NAFO Headquarters, Dartmouth, NS, Canada, during 19-26 October 2011 to review stock assessments referred to it by the Scientific Council of NAFO and by the ICES Advisory Committee. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Denmark, Estonia, and Spain), Norway, Russian Federation and Sweden.

II. GENERAL REVIEW

1. Review of Research Recommendations in 2010

These are given under each stock in the "stock assessments" section of this report.

2. Review of Catches

Catches and catch histories were reviewed on a stock-by-stock basis in connection with each stock.

III. STOCK ASSESSMENTS

1. Northern Shrimp on Flemish Cap (NAFO Div. 3M)

SCS Doc 04/12; SCR 04/77, 11/13, 11/59, 11/60, and 11/62

Environmental Overview

The water masses characteristic of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water, generally warmer and saltier than the sub-polar 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.

a) Introduction

The shrimp fishery in Div. 3M began in 1993. Initial catch rates were favorable and, shortly thereafter, vessels from several nations joined. The number of vessels participating in the fishery has decreased by more than 60% since 2004 to 13 vessels in 2010.

Catches peaked at 64 000 t in 2003 (Fig. 1.1). Since then catches have been lower, declining to 5 400 t in 2009. and 2 000 t in 2010. Information from the fishing industry suggests that catch rates, fuel prices, and low market prices for shrimp might have affected the participation in this fishery in recent years. Due to a moratorium, there was no shrimp fishing in Div. 3M during 2011.

NIPAG is concerned about suspected misreporting of catches since 2005, where catches from Div. 3L were reported as from Div. 3M.

Recent catches and TACs (t) are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	45 000	45 000	45 000	48 000	48 000	17 000-32 000[1]	18 000-27 000[2]	0	0
STATLANT 21	62 761	45 842	27 651	15 191	17 642	11 671	5 374	1 975	0[3]
NIPAG	63 970	45 757	27 479	18 595[4]	20 741	13985[4]	5 448[4]	1 988[4]	

[1] SC recommended that exploitation level for 2008 should not exceed the 2005 and 2006 levels (17 000 to 32 000 t).
[2] SC recommended that exploitation level for 2009 should not exceed the levels that have occurred since 2005 (18 000 to 27 000 t).
[3] Preliminary catches from circular letters, to October 2011
[4] Catches revised in 2011

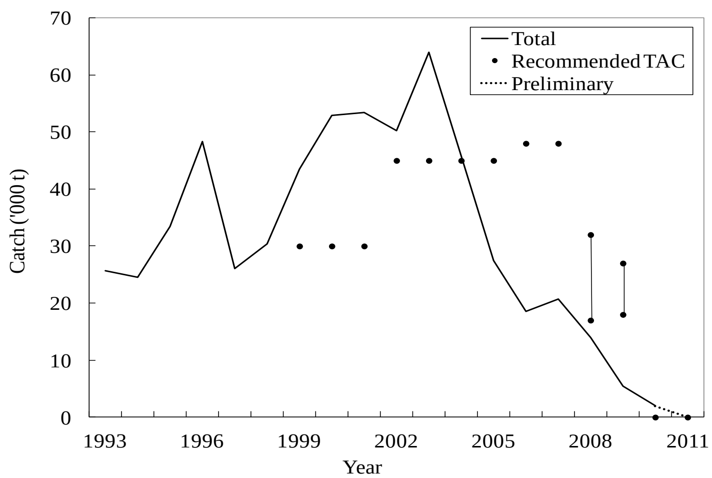


Fig. 1.1. Shrimp in Div. 3M: Catches (t) of shrimp on Flemish Cap and TACs recommended in the period 1993-2011. Due to a moratorium, the shrimp catch is expected to be zero in 2011.

b) Input Data

i) Commercial fishery data

Effort and CPUE. Logbook and/or observer data were available from Canadian, Greenlandic, Icelandic, Faroese, Norwegian, Russian, Estonian and Spanish vessels. From this information one international CPUE database for Div. 3M was constructed. There have been concerns that, since 2005, the reporting of some Div. 3L catches as coming from Div. 3M were affecting the CPUE data for some fleets. In order to avoid the uncertainty around the catch rate standardization model used for Div. 3M, all trips from 2005 to 2010 where fishing occurred in both Div. 3M and Div. 3L were eliminated and a standardized CPUE series was produced for 1993 to 2010. CPUE gradually increased from the mid-1990s to 2006. In 2007, 2008 and 2009 the standardized CPUE declined. In 2010 the CPUE seems to stabilize at 2008-2009 levels, however due to the scanty observations in 2009 and 2010 (only Spanish data were available) there is considerable uncertainty regarding these years. Effort levels have recently been low and NIPAG was concerned that the CPUE may not reflect the stock status in the same way as at higher levels of effort.

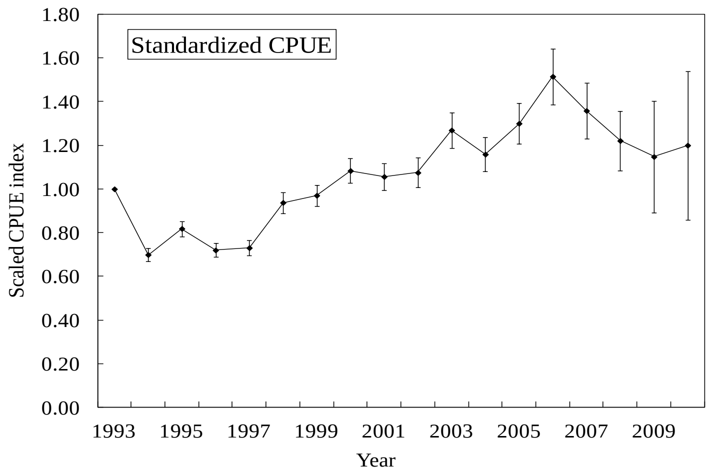


Fig. 1.2. Shrimp in Div. 3M: Standardized CPUE of shrimp on Flemish Cap, 1993-2010 (±1 SE).

Biological data. The age and sex composition was assessed from commercial samples obtained from Iceland from 2003 to 2005 and from Canada, Greenland, Russia and Estonia in previous years. For these years number/hour caught per age-class was calculated for each year by applying a weight/age relationship and age proportions in the catches to the annual standardized CPUE data. From 2006 the samples obtained from the fishery have been insufficient to assess the age of the catches and so was not possible to estimate the disaggregated CPUE (number/hour or kg/hour) by age and sex since 2006 to the present.

ii) Research survey data

Stratified-random surveys have been conducted on Flemish Cap by the EU in July from 1988 to 2011, using a Lofoten trawl. A new vessel was introduced in 2003 which continued to use the same trawl employed since 1988. In addition, there were differences in cod-end mesh sizes utilized in the 1994 and 1998 surveys that have likely resulted in biased estimates of total survey biomass. Nevertheless, for this assessment, the series prior to 2003 were converted into comparable units with the new vessel based on the methodology accepted by STACFIS in 2004 (NAFO 2004 SC Rep., SCR Doc. 04/77). The index was stable at a high level from 1998 to 2007. Since then the survey biomass index declined and in 2011 was the lowest in the survey series, well below B_{lim} (Fig. 1.3).

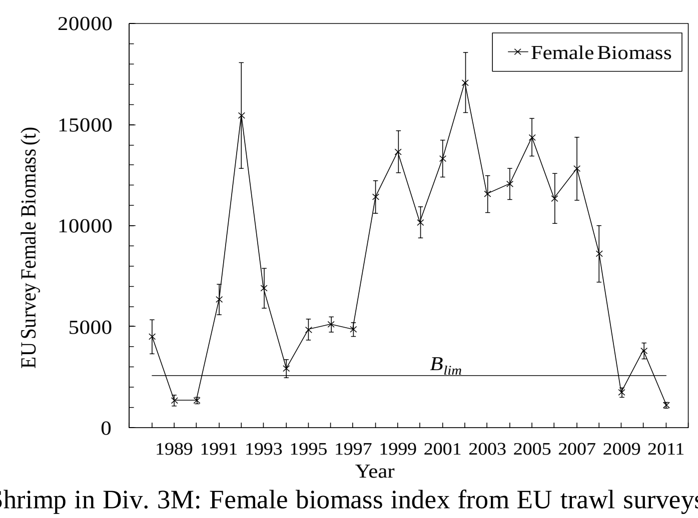


Fig. 1.3. Shrimp in Div. 3M: Female biomass index from EU trawl surveys, 1988-2011. Error bars are 1 std. err.

iii) Recruitment indices

EU bottom trawl surveys. From 1988 to 1995 shrimp at age 2 and younger were not captured by the survey. Beginning in 1996 the presence of this component increased in the surveys and it is believed that the introduction of the new vessel in 2003 greatly improved the catchability of age 2 shrimp due to technological advances in maintaining consistent performance of the fishing gear. In addition, since 2001, a small mesh juvenile bag was also attached to the net which was designed to provide an index of juvenile shrimp smaller than that typically retained by the survey codend. Both EU-survey indices show an exceptionally large 2002 year-class and very weak 2003-2009 year-classes (Fig. 1.4).

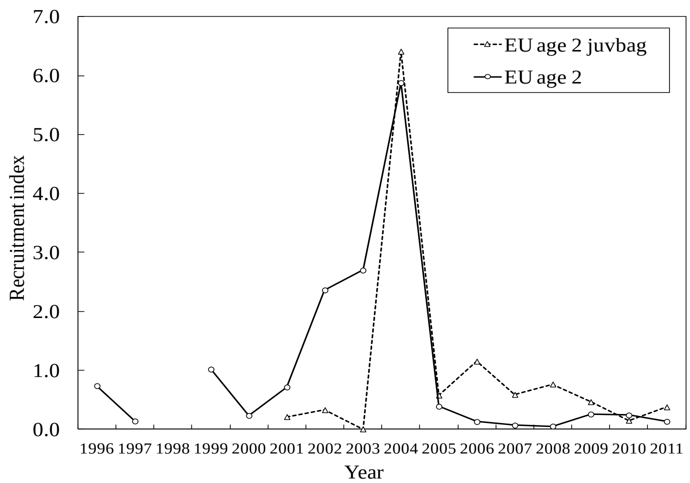


Fig. 1.4. Shrimp in Div. 3M: Abundance indices at age 2 from the EU survey. Each series was standardized to its mean. The 1998 value is not shown due to bias caused by the use of a smaller cod-end mesh size (25 mm.) in that year.

iv) Exploitation index

An index of exploitation was derived by dividing the nominal catch in a given year by the biomass index from the EU survey in the same year (Fig. 1.5). This was high in the years 1994-1997 when biomass was generally lower. From 2005 to 2008 exploitation indices remained stable at relatively low values and increased in 2009, as a consequence of decrease in the biomass estimated that year. The exploitation rate in 2010 was the lowest observed in the series as a result of the very low catches and the small increase in the biomass index estimated that year. The expected exploitation rate in 2011 will be zero or very close to zero due to the moratorium for this fishery.

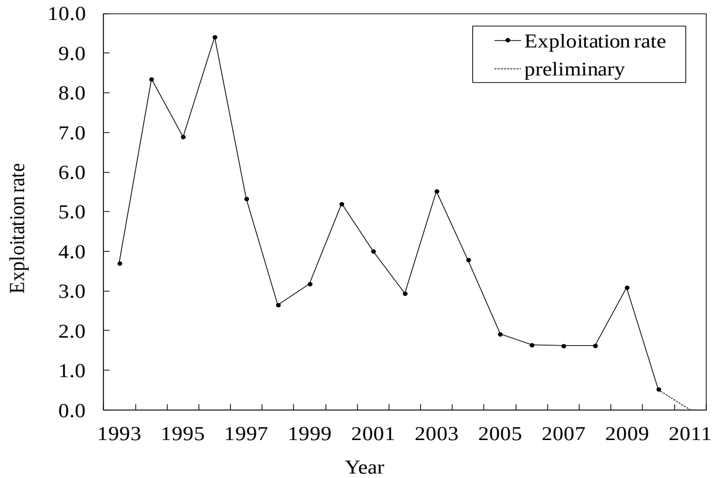


Fig. 1.5. Exploitation rate of shrimp in Div. 3M (catch divided by the EU survey biomass index of the same year).

c) Assessment Results

Commercial CPUE index. The CPUE index from the commercial fishery showed increasing trends from 1996 to 2006. This CPUE index has decreased from 2006 to 2010.

SSB. The survey female biomass index was at a high level from 1998 to 2007, and has declined to its lowest level in 2011.

Recruitment. Indices of age 2 abundance have been weak since 2002.

Exploitation rate. From 2005 to 2008 exploitation rates (nominal catch divided by the EU survey biomass index of the same year) remained stable at relatively low values and increased in 2009. Because catches in 2010 were low, while the female biomass estimate increased slightly, the exploitation rate declined to its lowest observed level.

State of the Stock. In 2009 the female biomass index was below B_{lim}, it was slightly above it in 2010 and it is again well below B_{lim} in 2011. Due to the continued poor recruitment, there are serious concerns that the stock will remain at low levels.

d) Precautionary Approach

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim}, 2 564 t for northern shrimp in Div. 3M (SCS Doc. 04/12). The index in 2011 is below B_{lim}. It is not possible to caluculate a limit reference point for fishing mortality (Fig. 1.6).

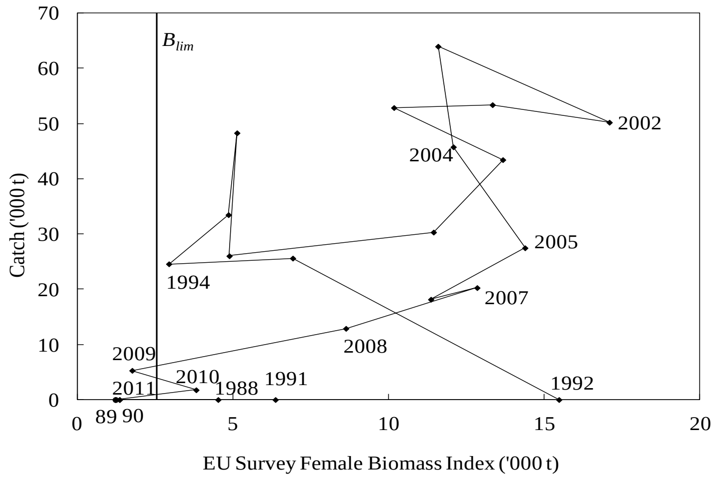


Fig. 1.6. Shrimp in Div. 3M: Catch plotted against female biomass index from EU survey. Line denoting Blim is drawn where biomass is 85% lower than the maximum point in 2002. Due to the moratorium on shrimp fishing the expected catch in 2011 is 0 t.

e) Ecosystem considerations

The drastic decline of shrimp biomass in 2009 and 2011 years coincided with the increase of the cod stock in recent years (SCR Doc. 11/62) (Fig. 1.7).

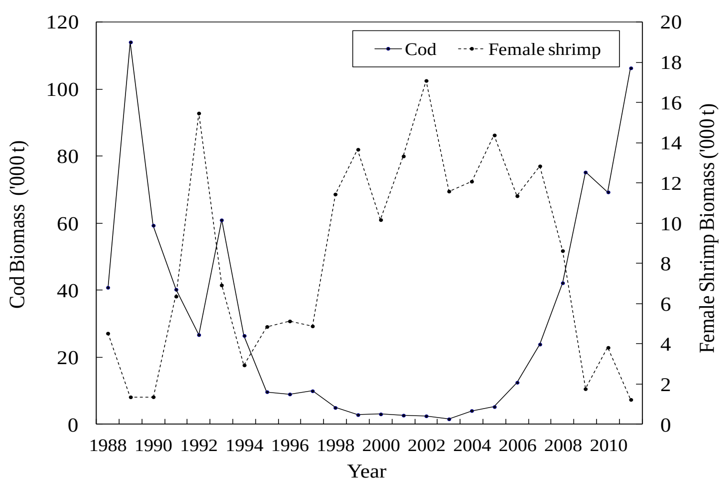


Fig. 1.7. Shrimp in Div. 3M: Cod and female shrimp biomass from EU trawl surveys, 1988-2011.

f) Review of Research Recommendations made in 2010

NIPAG **recommended** that *biological and CPUE data from all fleets fishing for shrimp in the area, be submitted to Designated Experts by 1 September 2011.*

STATUS: Data from 2010 year were submitted by this deadline.

NIPAG **recommended** that *for northern shrimp in Division 3M investigations be conducted into methods for demographic analyses of fishery CPUE.*

STATUS: In 2011 began the moratorium for shrimp fishery and no commercial sampling was possible.

Sources of Information: SCS Doc 04/12 , SCR Doc. 04/77, 11/ 13, 11/59, 11/60, 11/62.

2. Northern Shrimp (Div. 3LNO)

(SCR Doc. 11/13, 49, 59, 61)

Environmental Overview

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.

a) Introduction

This shrimp stock is distributed around the edge of the Grand Bank mainly in Div. 3L. The fishery began in 1993 and came under TAC control in 2000 with a 6000 t TAC and fishing restricted to Div. 3L. Annual TACs were raised several times between 2000 and 2009 reaching a level of 30 000 t for 2009 and 2010 before decreasing to 19 200 t in 2011, 12 000 t in 2012 and 9 350 t in 2013. A total catch of 11 434 t was taken by October 2011 (Fig. 2.1).

Recent catches and TACs (t) for shrimp in Div. 3LNO (total) are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC as set by FC	13 000[1]	13 000[1]	13 000[1]	22 000[1]	22 000[1]	25 000[1]	30 000[1]	30 000[1]	19 200[1]	12 000[1]
STATLANT 21	11 917	12 051	13 574	21 284	21 120	24 758[2]	25 621[2]	19 726[2]		
NIPAG	13 069	13 452	14 389	25 831	23 859	27 691	28 544[3]	21,187[2,3]	11 434[4]	

[1] Denmark with respect to Faroes and Greenland did not agree to the 2003 – 2011 quotas and have set autonomous TAC since 2003. These increases are not included in the table.
[2] Provisional catches.
[3] Revised in 2011.
[4] Estimated catches to October 2011.

Since this stock came under TAC regulation, Canada has been allocated 83% of the TAC. This allocation is split between a small-vessel (less than 500 GT and less than 65 ft) and a large-vessel fleet. By October 2011, the small- and large-vessel fleets had taken 6 506 t and 2 439 t of shrimp respectively in Div. 3L. In all years, most of the Canadian catch occurred along the northeast slope in Div. 3L. The annual quota within the NAFO Regulatory Area (NRA) is 17% of the total TAC.

The use of a sorting grid to reduce bycatches of fish is mandatory for all fleets in the fishery. The sorting grid cannot have a bar spacing greater than 22 mm.

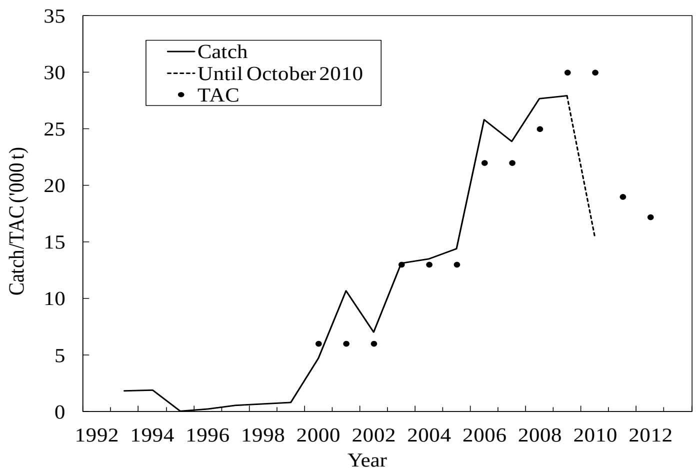


Fig. 2.1. Shrimp in Div. 3LNO: catches (to October 2011) and TAC as set by Fisheries Commission.

b) Input Data

i) Commercial fishery data

Effort and CPUE. Catch and effort data have been available from vessel logbooks and observer records since 2000. Data for the time series have been updated for these analyses. CPUE models were standardized to 2000 values rather than the last year of the fishery as had been done in previous years. The 2011 index for each of the large and small vessel CPUEs were significantly lower than the long term mean and were similar to the 2000 values for their respective series (Fig. 2.2).

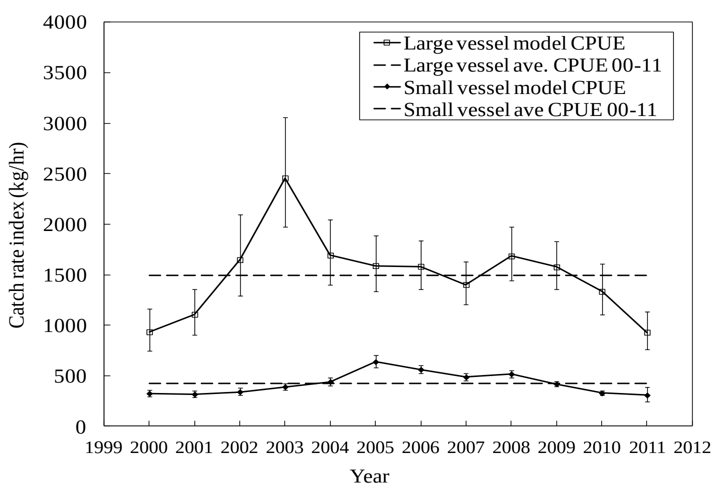


Fig. 2.2. Shrimp in Div. 3LNO: Standardized CPUE for the Canadian large-vessel (>500 t) and small-vessel (≤500 t; LOA<65') fleets fishing shrimp in Div. 3L within the Canadian EEZ.

Logbook data were available for the shrimp fishery within the NRA, in 2011, but this came from only Estonia. The data was insufficient to produce a standardized CPUE model.

Catch composition. Length compositions were derived from Canadian observer datasets from 2001 to 2010. Catches appeared to be represented by a broad range of size groups of both males and females. No new data were available from the 2011 fishery.

ii) Research survey data

Canadian multi-species trawl survey. Canada has conducted stratified-random surveys in Div. 3LNO, using a Campelen 1800 shrimp trawl, from which shrimp data is available for spring (1999–2011) and autumn (1996–2010). The autumn survey in 2004 was incomplete and therefore of limited use for the assessment.

Spanish multi-species trawl survey. EU-Spain has been conducting a spring stratified-random survey in Div. 3NO within the NRA since 1995; the survey has been extended to include the NRA in Div. 3L since 2003. From 2001 onwards data were collected with a Campelen 1800 trawl. There was no Spanish survey in 2005 in Div. 3L.

Biomass. In Canadian surveys, over 90% of the biomass was found in Div. 3L, distributed mainly along the northeast slope in depths from 185 to 550 m. There was an overall increase in the both spring and autumn indices to 2007 after which they decreased by about 75% to 2011 (Fig. 2.3). Confidence intervals from the spring surveys are usually broader than from the autumn surveys.

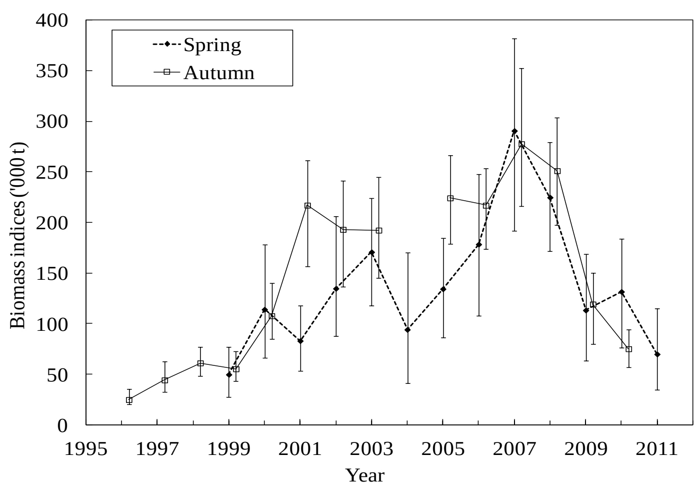


Fig. 2.3. Shrimp in Div. 3LNO: biomass index estimates from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Spanish survey biomass indices for Div. 3L, within the NRA, increased from 2003 to 2008 followed by an 83% decrease by 2011 (Fig. 2.4).

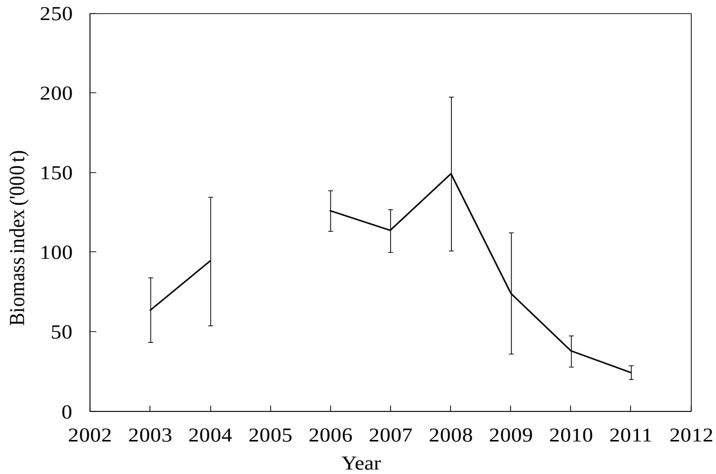


Fig. 2.4. Shrimp in Div. 3LNO: biomass index estimates from EU - Spanish multi-species surveys (± 1 s.e.) in the 3L NRA.

Female Biomass (SSB) indices. The autumn 3LNO female biomass index showed an increasing trend to 2007 but decreased 72% by 2010. The spring SSB index decreased by 82% between 2007 and 2011 (Fig. 2.5).

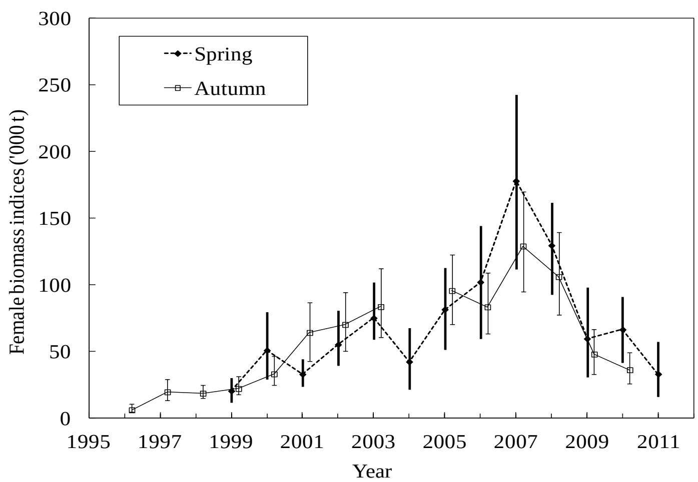


Fig. 2.5. Shrimp in Div. 3LNO: Female biomass indices from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

The Canadian autumn 2011 bottom trawl survey was ongoing while this meeting was taking place therefore the previous autumn female spawning stock biomass (SSB) index was regressed upon the spring female SSB index to predict an autumn 2011 female SSB index of 27 600 t.

Stock composition. The autumn surveys showed an increasing trend in the abundance of female (transitionals + females) shrimp up to 2007 and remained high in 2008 then decreased by 65% through to 2010. Similarly, spring female abundance series increased until 2007, remained high in 2008 then decreased by 74% through to 2011. Male autumn abundance index peaked in 2001 and remained high until 2008 before decreasing by 69% by 2010. The spring male abundance index followed trends similar to their respective female index (Fig. 2.6).

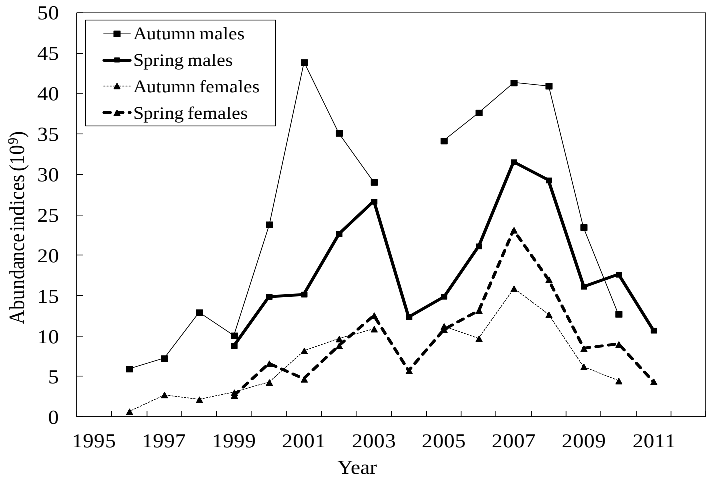


Fig. 2.6. Shrimp in Div. 3LNO: Abundance indices of male and female shrimp within Div. 3LNO as estimated from Canadian multi-species survey data.

Both males and females showed a broad distribution of lengths in recent surveys indicating the presence of more than one year class. It is worth reiterating that since 2008 the abundances at all length classes were greatly reduced from those found in previous Canadian surveys (Fig. 2.7).

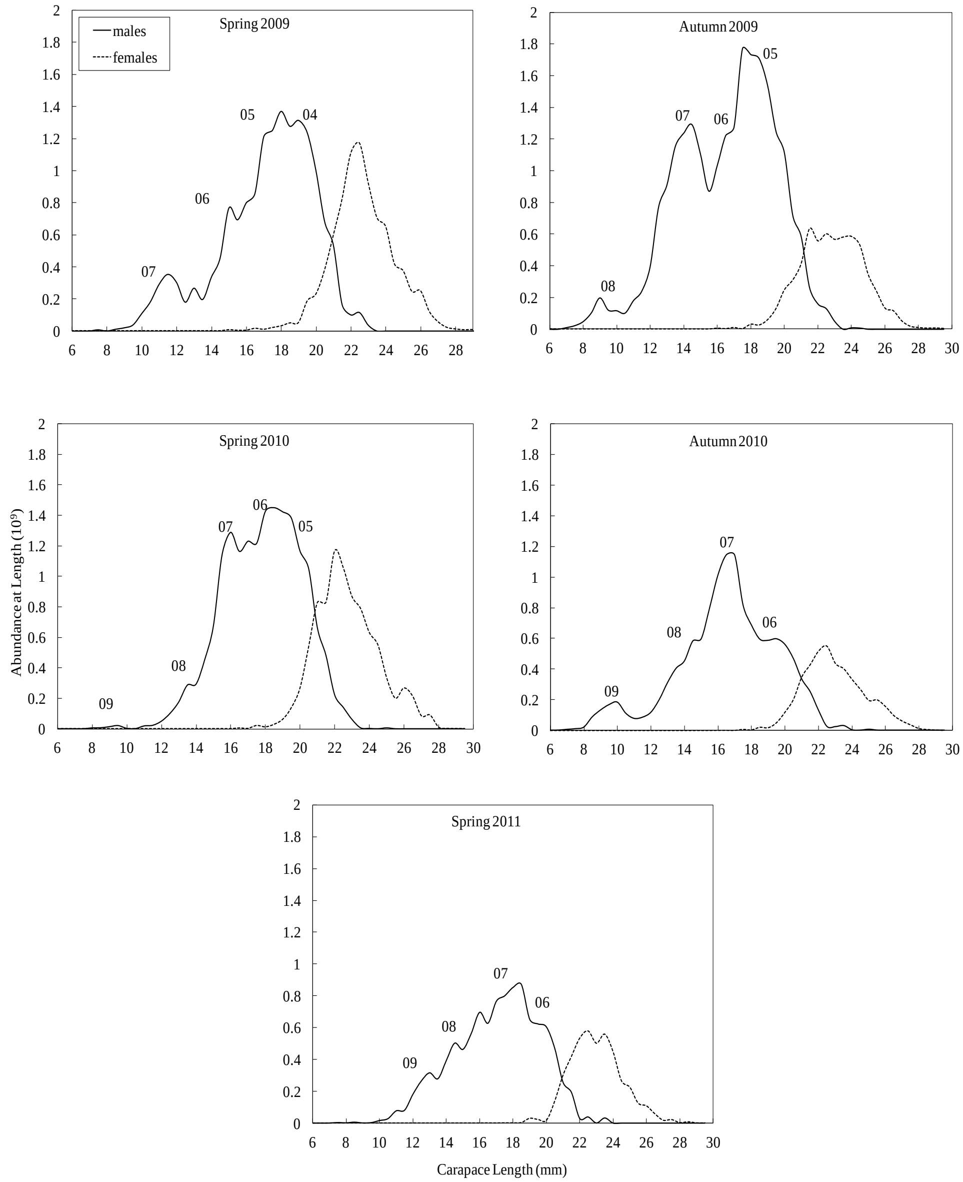


Fig. 2.7. Shrimp in Div. 3LNO: abundance at length for northern shrimp estimated from Canadian multi-species survey data. Numbers within charts denote year-classes.

Recruitment indices. The recruitment indices were based upon abundances of all shrimp with carapace lengths of 12 – 17 mm from Canadian survey data. The 2006 – 2008 recruitment indices were among the highest in both spring and autumn time series. The spring and autumn indices decreased to near their respective series means in 2009 then decreased further through to spring 2011 (Fig. 2.8).

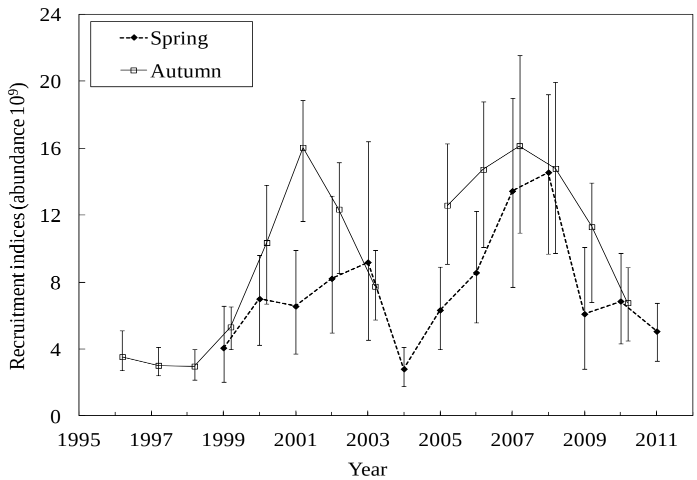


Fig. 2.8. Shrimp in Div. 3LNO: Recruitment indices derived from abundances of all shrimp with 12 – 17 mm carapace lengths from Canadian spring and autumn bottom trawl survey (1996–2011) data.

Fishable biomass and exploitation indices. There had been an increasing trend in Canadian spring and autumn survey fishable biomass indices (shrimp >17 mm carapace length) until 2007. The autumn fishable biomass showed an increasing trend until 2007 then decreased by 76% through to 2010. Similarly, the spring fishable biomass index increased to 2007 but has since decreased by 79 % through to 2011 (Fig. 2.9).

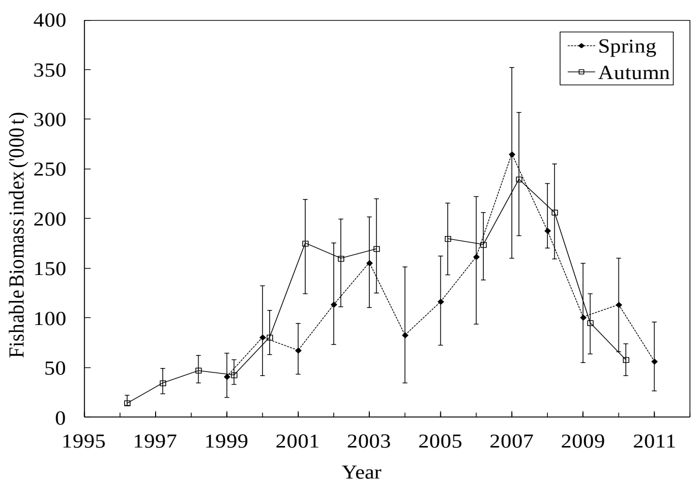


Fig. 2.9. Shrimp in Div. 3LNO: fishable biomass index. Bars indicate 95% confidence limits.

An index of exploitation was derived by dividing the catch in a given year by the fishable biomass index from the previous autumn survey. The catch series was updated in the 2011 analysis. The exploitation index has been below 0.15 until 2010 when it increased to 0.22. By October 2011, the 2011 exploitation rate index was 0.20. Based upon the autumn 2010 fishable biomass of 57 900 t, if the entire 19 200 t quota was to be taken, the exploitation rate index would increase to 0.33 (Fig. 2.10).

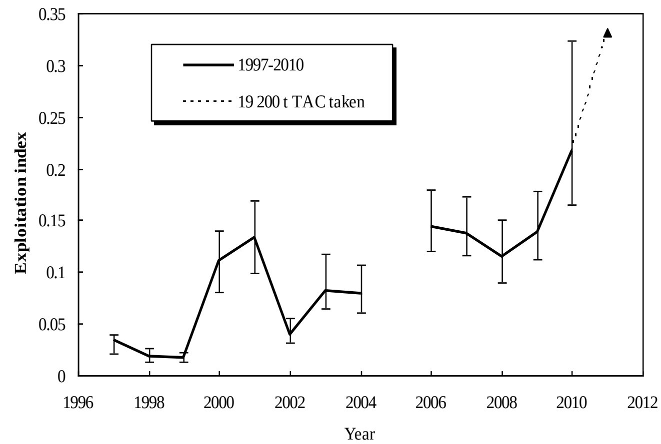


Fig. 2.10. Shrimp in Div. 3LNO: exploitation rates calculated as year’s catch divided by the previous year's autumn fishable biomass index. The 2011 point is based upon the assumption that the full TAC will be taken. Bars indicate 95% confidence limits.

The Canadian autumn 2011 bottom trawl survey was ongoing while this meeting was taking place therefore the previous autumn fishable biomass index was regressed upon the spring fishable biomass index to predict an autumn 2011 fishable biomass index of 59 900 t. At TAC’s accepted in Fisheries Commission for 2012 (12 000 t) and 2013 (9 350 t), assuming the fishable biomass index remains at 59 900 t, the projected exploitation rates would be19.61 % and 15.28 % respectively.

A TAC recommendation was determined using the inverse variance weighted fishable biomass from the latest three survey and predicted index values.

Variance weighting factor = fishable biomass/(measure of variance)^2÷Σ fishable biomass/(measure of variance)^2

Survey	Fishable biomass (t)	Fishable biomass - lower 95% C.I.= measure of variance	Fishable biomass/ (measure of variance^2)	1/measure of variance^2	Variance weighting factor
spring 2010	113,366	47,108	5.10845E-05	4.50617E-10	0.050
autumn 2010	57,891	15,464	2.42071E-04	4.18149E-09	0.463
spring 2011	56,280	29,852	6.31567E-05	1.12218E-09	0.124
predicted autumn 2011	59,900	17,473	1.96187E-04	3.27524E-09	0.363
Grand total			5.52499E-04	9.02953E-09	1.000

Inverse variance weighted average fishable biomass = 5.52499E-04/9.02953E-09

= 61 188 t

The inverse variance weighted average fishable biomass is calculated to be 61 188 t. Based upon this value, the following table provides exploitation rates at various catch levels for 2013:

TAC options at various percent exploitation rates (catch/ inverse variance weighted fishable biomass):

Inverse variance weighted average fishable biomass	5.00%	10.00%	14.00%
61 188	3 059	6 119	8 566

c) Assessment Results

Recruitment. Recruitment indices from 2006 – 2008 were among the highest in the spring and autumn time series but have decreased since and are now below the long-term mean.

Biomass. Spring and autumn biomass indices generally increased, to record levels by 2007, but decreased substantially by 2010. The spring biomass indices remained at a low level in 2011.

Exploitation. The index of exploitation remained below 0.15 through 2009 however it has since increased. If the entire TAC for 2011 is taken, it will be above 0.30. If the 12 000 t TAC is taken in 2012, the predicted exploitation rate is 0.20.

State of the Stock. Biomass levels peaked in 2007 then decreased substantially through to spring 2011. The female biomass index is estimated to be above B_{lim} (19 300 t). A continuous decrease of biomass in the past four years is a reason for concern. The predicted autumn 2011 female biomass index is 27 600 t – a decline of 23% from 2010. Given the level of uncertainty attached to survey estimates, there is a slight risk of the female biomass index being below B_{lim} by the end of 2011. If the 12 000 t TAC is taken in 2012, the predicted exploitation rate is 0.20.

d) Precautionary Approach Reference Points

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} (19 330 t) for northern shrimp in Div. 3LNO (SCS Doc. 04/12). Currently, the female biomass index is estimated to be above but nearing B_{lim} (Fig. 2.11). It is not possible to calculate a limit reference point for fishing mortality. A "safe zone" has not been determined in the precautionary approach for this stock.

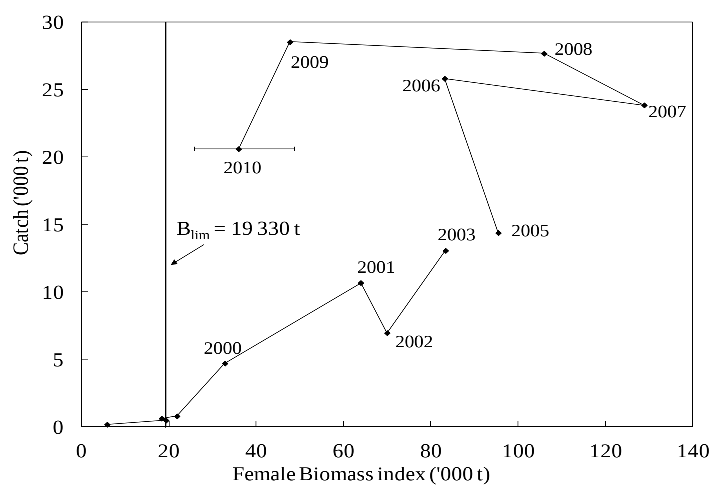


Fig. 2.11. Shrimp in Div. 3LNO: Catch against female biomass index from Canadian autumn survey. Line denoting B_{lim} (approximately 19,000 t) is drawn where female biomass is 85% lower than the maximum point in 2007. The bar on the 2010 data point indicates the 95% confidence limit.

e) Review of Research Recommendations

2010 NIPAG recommendations for research pertaining to Northern shrimp in Div. 3LNO:

- *biological and CPUE data from all fleets fishing for shrimp in the area be submitted to the Designated Expert, in the standard format, by 1 September 2011.*

STATUS: NIPAG drew attention to the late and inadequate submission of this information by a number of Contracting Parties, and reiterated its recommendations for improvements.

- *NIPAG recommended that research continue into fitting production models to data for northern shrimp in Div. 3LNO including studies of stock structure.*

STATUS: Work is ongoing on this topic. [See other studies]

- *Continued investigation of stock assessment models for Pandalus borealis in NAFO Div. 3LNO. This may help provide estimations of B_{msy} and F_{msy}.*

STATUS: Work is ongoing on this topic. [See other studies]

NIPAG recommendations for Northern shrimp in Div. 3LNO:

- *biological and CPUE data from all fleets fishing for shrimp in the area be submitted to the Designated Expert, in the standard format, by 1 September 2012.*

- *NIPAG recommended that research continue into fitting production models to data for northern shrimp in Div. 3LNO including studies of stock structure and continued investigation of stock assessment models for Pandalus borealis in NAFO Div. 3LNO. This may help provide estimations of B_{MSY} and F_{MSY}.*

g) Other studies

Assessment models and reference points for Div. 3LNO shrimp. Current scientific advice for the management of Div. 3LNO shrimp is based on the relationship between trends in research vessel survey indices and the commercial landings. There is no accepted assessment model. 15% of the highest survey observation of female biomass (SSB) is currently accepted as a proxy for B_{lim}. There is no current proxy for F_{lim}. Fisheries Commission has requested advice on the identification of F_{msy}, B_{msy} and advice on the appropriate selection of an upper reference point for biomass. Such advice is best provided using an accepted assessment model fit to the data. Progress has been made in fitting surplus production models using both maximum likelihood and Bayesian approaches. The Bayesian model will be further refined and presented in 2012 as a potential assessment model for the stock.

3. Northern shrimp (Subareas 0 and 1)

(SCR Docs 04/75, 04/76, 08/62, 11/50, 11/51, 11/52, 11/55, 11/57, 11/58, SCS Doc. 04/12)

a) Introduction

The shrimp stock off West Greenland is distributed mainly in NAFO Subarea 1 (Greenland EEZ), but a small part of the habitat, and of the stock, intrudes into the eastern edge of Div. 0A (Canadian EEZ). Canada has defined ‘Shrimp Fishing Area 1’ (Canadian SFA1), to be the part of Div. 0A lying east of 60°30'W, i.e. east of the deepest water in this part of Davis Strait.

The stock is assessed as a single population. The Greenland fishery exploits the stock in Subarea 1 (Div. 1A–1F). Since 1981 the Canadian fishery has been limited to Div. 0A.

Three fleets, one from Canada and two from Greenland (offshore and coastal) have participated in the fishery since the late 1970s. The Canadian fleet and the Greenland offshore fleet have been restricted by areas and quotas since 1977. The Greenland coastal fleet has privileged access to inshore areas (primarily Disko Bay and Vaigat in the north, and Julianehåb Bay in the south). Coastal licences were originally given only to vessels under 80 tons, but in recent years much larger vessels have entered the coastal fishery. The coastal fishery was unrestricted until January 1997, when quota regulation was imposed. Greenland allocates a quota to EU vessels in Subarea 1; this quota is usually fished by a single vessel which for analyses is treated as part of the Greenland offshore fleet. Mesh size is at least 44 mm in Greenland, 40 mm in Canada. Sorting grids to reduce bycatch of fish are required in both of the Greenland fleets and in the Canadian fleet. Discarding of shrimps is prohibited.

The TAC advised for the entire stock for 2004–2007 was 130 000 t, reduced for 2008–2010 to 110 000 t but increased again for 2011 to 120 000 t. Greenland set a TAC for Subarea 1 for 2007 of 134 000 t, of which 74 100 t was allocated to the offshore fleet, 55 900 t to the coastal and 4000 t to EU vessels; these allocations were reduced for 2008 to 70 281, 53 019 and 4000 t (total 127 300 t) and for 2009 further to 59 025, 51 545 and 4000 t (total 114 570 t). This total TAC was kept for 2010, but following the increase in the advice the allocations were increased for 2011 to 68 400, 51 600 and 4000 t. Canada enacted TACs for SFA1 of 18 417 t for 2007–2010, increased to 18 597 t for 2011 (SCR Doc. 11/51).

Greenland requires that logbooks should record catch live weight. For shrimps sold to on-shore processing plants, a former allowance for crushed and broken shrimps in reckoning quota draw-downs was abolished in 2011 to bring the total catch live weight into closer agreement with the enacted TAC. However, the coastal fleet catching bulk shrimps does not log catch weights of *P. montagui* separately from *borealis;* weights are estimated by catch sampling at the point of sale and the price adjusted accordingly, but the weight of *montagui* is not deducted from the quota (SCR Doc. 11/53). Logbook-recorded catches can therefore still legally exceed quotas.

The table of recent catches was updated (SCR Doc. 11/51). Total catch increased from about 10 000 t in the early 1970s to more than 105 000 t in 1992 (Fig. 3.1). Moves by the Greenlandic authorities to reduce effort, as well as fishing opportunities elsewhere for the Canadian fleet, caused catches to decrease to about 80 000 t by 1998. Total catches then increased to over 155 000 t in 2005 and 2006. Total catch for 2008 at 152 749 t was more than 20 000 t higher than the projection, based on the first six months' data, used in the 2008 assessment; the 2009 total catch was also underestimated, by 26 000 t, for the 2009 assessment. Therefore the 2011 projection of total catch has been based not on projection formulas but on estimates provided by industry observers, as was done in 2010.

Recent catches, projected catches for 2011 and recommended and enacted TACs (t) for Northern Shrimp in Div. 0A east of 60°30'W and in Subarea 1 are as follows:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TAC										
Advised	85 000	100 000	130 000	130 000	130 000	130 000	110 000	110 000	110 000	120 000
Enacted	103 190	115 167	149 519	152 452	152 380	152 417	145 717	132 987	132 987	142 597
Catches (NIPAG)										
SA 1	128 925[1]	123 036[1]	142 311	149 978	153 188	142 245	153 889	135 029	135 029	*124 000*[2]
SA 0A	6247	7137	7021	6921	4127	1945	0	429	5882	*2000*[2]
TOTAL SA1–Div.0A	135 172	130 173	149 332	156 899	157 315	144 190	152 749	135 458	133 986	*126 000*
STATLANT 21A										
SA 1	103 645	78 436	142 311	149 978	153 188	142 245	148 550	133 561[3]	123 228[3]	
Div. 0A	6053	2170	6861	6410	3788	1878	0	429[3]	5206[3]	

[1] Catches before 2004 corrected for underreporting
[2] Total catches for the year as predicted by industry observers.
[3] Provisional

Until 1988 the fishing grounds in Div. 1B were the most important. The offshore fishery subsequently expanded southward, and after 1990 catches in Divs 1C–D, taken together, began to exceed those in Div. 1B. However, since about 1996 catch and effort in southern West Greenland have continually decreased, and since 2008 effort in Div. 1F has been virtually nil (SCR Doc. 11/52).

The Canadian catch in SFA1 was stable at 6000 to 7000 t in 2002–2005, about 4–5% of the total catch, but in 2006 was only 4100 t and in 2007 less than 2000 t. In 2008 there was no fishing and in 2009 very little. In 2010 5 vessels fished and catches were average, but in 2011 fishing has been difficult and catches are expected to be lower.

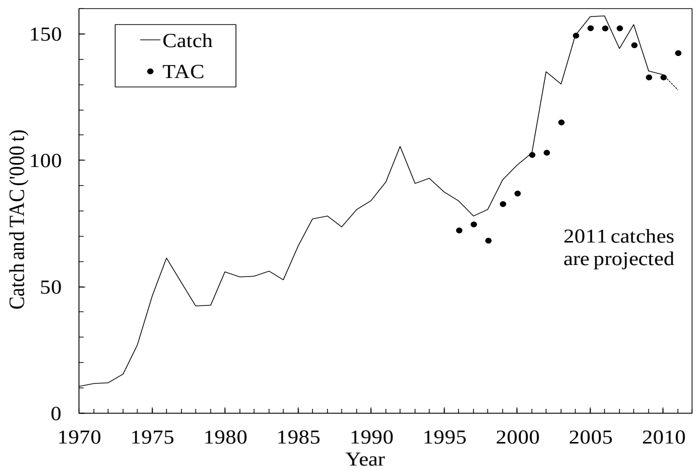


Fig. 3.1. Shrimp in Subarea 1 and Canadian SFA1: enacted TACs and total catches (2011 predicted for the year).

b) Input Data

i) Fishery data

Fishing effort and CPUE. Catch and effort data from the fishery were available from logbooks from Canadian vessels fishing in Canadian SFA 1 and from Greenland logbooks for Subarea 1 (SCR Doc. 11/52). In recent years both the distribution of the Greenland fishery and fishing power have changed significantly: for example, larger vessels have been allowed in coastal areas; the coastal fleet has fished outside Disko Bay; the offshore fleet now commonly uses double trawls; and the previously rigid division between the offshore and coastal quotas has been relaxed and quota transfers are now allowed. A change in legislation effective since 2004 requiring logbooks to record catch live weight in place of a previous practice of under-reporting would, by increasing the recorded catch weights, have increased apparent CPUEs since 2004; this discontinuity in the CPUE data was corrected in 2008.

CPUEs were standardised by linearised multiplicative models including terms for vessel effect, month, year, and statistical area; the fitted year effects were considered to be series of annual indices of total stock biomass. Series for the Greenland fishery after the end of the 1980s were divided into 2 fleets, a coastal and an offshore; for those ships of the present offshore fleet that use double trawls, only double-trawl data was used. A series for 1976–1990 was constructed for the KGH (Kongelige Grønlandske Handel) fleet of sister trawlers and a series for 1987–2007 and 2010 for the Canadian fleet fishing in SFA1. The CPUE indices from the Greenland coastal and the Greenland offshore fleets remained closely in step from 1988 to 2004 (Fig. 3.2), then diverged more from each other in 2005 and 2007, but in 2008–2011 their trajectories have again agreed. CPUE in the Canadian fishery in SFA1 has always varied more from year to year and has never stayed closely in step with the Greenland fleets, although over time its overall trend has been similar and it has also increased between the 1990s and the most recent values.

The four CPUE series were unified in a separate step to produce a single series that was input to the assessment model. This all-fleet standardised CPUE was variable, but on average moderately high, from 1976 through 1987, but then fell to lower levels until about 1997, after which it increased markedly to plateau in 2004–07 at about twice its 1997 value (Fig. 3.2). A lower value for 2008 based, in that year, on part-year's data was not confirmed when the full year's data was analysed in 2009, but values for 2009 and 2010 were both consecutively lower. However, this trend was not continued by the part-year value for 2011, which has returned to the levels of 2005–08 (SCR Doc. 11/52).

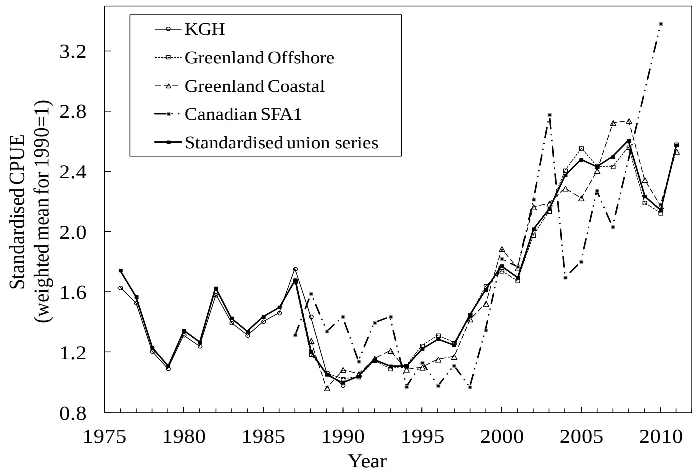


Fig. 3.2. Shrimp in Subarea 1 and Canadian SFA 1: standardised CPUE index series 1976–2010.

The distribution of catch and effort among NAFO Divisions was summarised using Simpson's diversity index to calculate an 'effective' number of Divisions being fished as an index of how widely the fishery is distributed (Fig 3.3). (In interpreting the index, it should be remembered that NAFO Divisions in Subarea 1, designed for the management of groundfish fisheries, are of unequal size with respect to shrimp grounds, and those recently abandoned by the fishery are the smaller ones.) The fishery area has contracted and continues to do so; NIPAG has for some years been concerned for effects of this contraction on the relationship between CPUE and stock biomass, and in particular that relative to earlier years biomass might be overestimated by recent CPUE values.

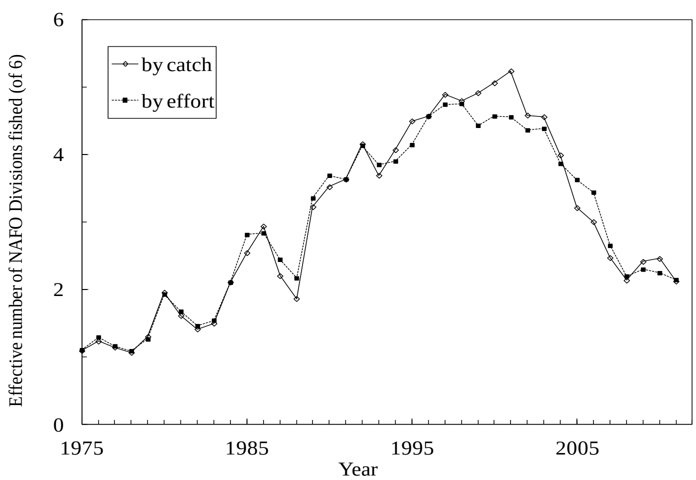


Fig. 3.3. Shrimp in Subarea 1 and Canadian SFA1: indices for the distribution of the Greenland fishery among NAFO Divisions in 1975–2011.

From the end of the 1980s there was a significant expansion of the fishery southwards and in 1996–98 areas south of Holsteinsborg Deep (66°00'N) accounted for 65% of the catch. The effective number of Divisions being fished peaked at about 4.5–5 in 1995–2003. Since then the range of the fishery has contracted northwards and the effective number of Divisions being fished has decreased. Since 2007 the areas south of Holsteinsborg Deep have yielded only about 10% of the catch, and Julianehåb Bay no longer supports a fishery.

Catch composition. There is no biological sampling program from the fishery that is adequate to provide catch composition data to the assessment.

ii) Research survey data

Greenland trawl survey. Stratified semi-systematic trawl surveys designed primarily to estimate shrimp stock biomass have been conducted since 1988 in offshore areas and since 1991 also inshore in Subarea 1 (SCR Doc. 11/55). From 1993, the survey was extended southwards into Div. 1E and 1F. A cod-end liner of 22 mm stretched mesh has been used since 1993. From its inception until 1998 the survey only used 60-min. tows, but since 2005, after several years of investigations into shorter tow durations, all tows have lasted 15 min. In 2005 the *Skjervøy 3000* survey trawl used since 1988 was replaced by a *Cosmos 2000* with rock-hopper ground gear, calibration trials were conducted, and the earlier data was adjusted.

The survey average bottom temperature increased from about 1.7°C in 1990–93 to about 3.1°C in 1997–20011 (SCR Doc. 11/55). About 80% of the survey biomass estimate is in water 200–400 m deep. In the early 1990s, about ¾ of this was deeper than 300 m, but after about 1995 this proportion decreased and since about 2001 has been about ¼, and most of the biomass has been in water 200–300 m deep (SCR Doc. 11/55). The proportion of survey biomass in Div. 1E–F has decreased in recent years and the distribution of survey biomass, like that of the fishery, has become more concentrated and more northerly.

Biomass. The survey index of total biomass remained fairly stable from 1988 to 1997 (c.v. 18%, downward trend 4%/yr). It then increased by, on average, 19%/yr until 2003, when it reached 316% of the 1997 value. Subsequent values were consecutively lower, by 2008–2009 less than half the 2003 maximum (Fig. 3.4) and 9% below the series mean. In 2010 the survey biomass index increased by nearly 24%, but in 2011 it returned to below the 2009 level[3] (SCR Doc. 11/55).

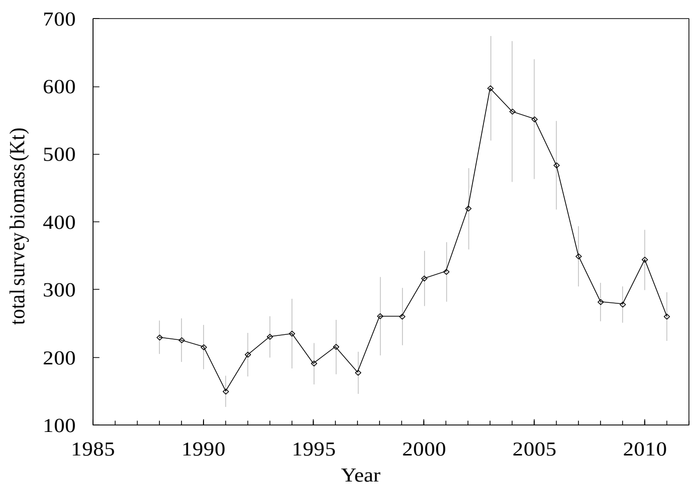


Fig. 3.4. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey indices of total stock biomass 1988–2011 (SCR Doc. 11/55) (error bars 1 s.e.)

Length and sex composition (SCR 11/55). In 2008 modes at 12 mm and 15 mm CL could be observed suggesting two- and three-year-olds; the two-year-old class in particular appeared stronger than in 2007. The 2009 distribution of lengths appeared very similar to that for 2008; cohorts could be distinguished at 11–13 mm and at 15.5–18 mm. The supposed 2-year-old class appears to have numbered about the same in 2009 and 2010 as in 2008, but in 2011 numbers 68% of the 2008–10 mean and 55% of the series mean (Fig. 3.5).

Estimated numbers of males and females in 2009 - 41.5 and 12.2×10^9 - were close to those for 2008 and still below their series means. In 2010 the number of males was about 40% higher at 56.2×10^9 while the number of females increased by only about 16% to 14.4×10^9; in 2011 total numbers at 49.8×10^9 are 30% less than in 2010, but

[3] area C and sub-stratum W1-4 were not surveyed in 2011 owing to sea ice. They provide on average about 3½% of the survey biomass.

almost all the decrease is in numbers of males, while females remain at 96% of the 2010 number. In 2011 the stock is estimated to have its highest-ever proportion of females both by number (26%) and by weight (43%), but to be short of shrimps at 15–22 mm CPL. The fishable proportion is estimated at 91.4%, close to its average level.

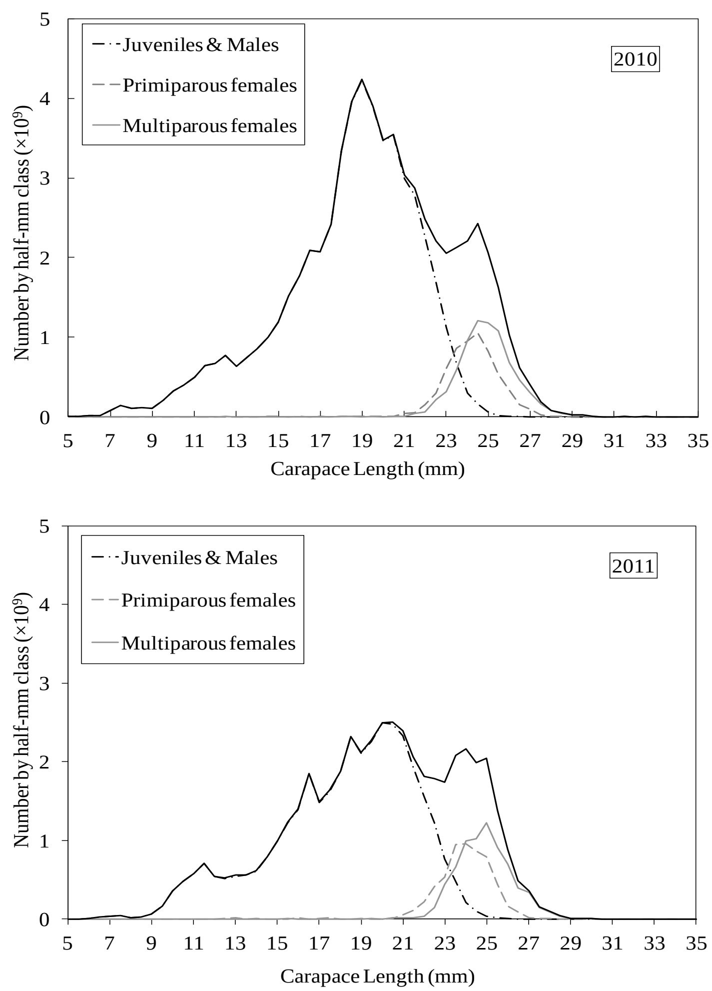


Fig. 3.5. Northern Shrimp in Subarea 1 and Canadian SFA 1: length frequencies in the West Greenland trawl survey in 2010–2011.

Recruitment Index. The number at age 2 is a predictor of fishable biomass 2–4 years later (SCR Doc. 03/76). This recruitment index was high in 2001, but decreased continually to 2007. From 2008 to 2010 estimated numbers at age 2 were higher than in 2007 and about stable near 78% of the series mean, but in 2011 decreased to 55% of the mean. A relative lack of shrimps at 15–22 mm CPL in 2011 presages poor immediate recruitment to both the fishable and the spawning stocks.

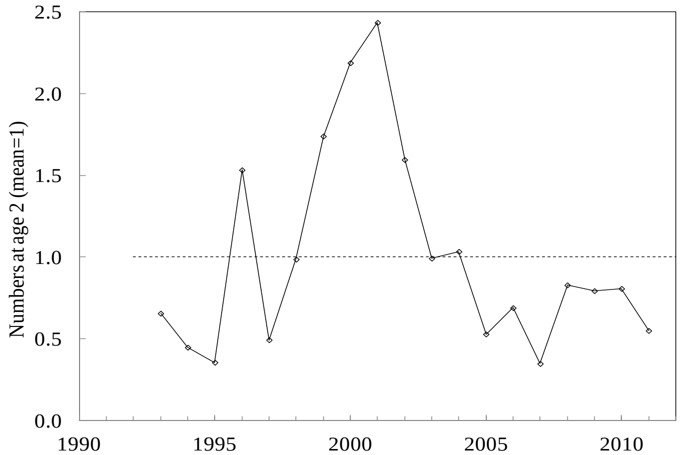


Fig. 3.6. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey index of numbers at age 2, 1993–2011.

iii) Predation index

Estimates of cod biomass from the German groundfish survey at West Greenland are used in the assessment of shrimp in SA 1 and in Div. 0A east of 60°30′W, but the results from the German survey for the current year are not available in time for the assessment. Although the West Greenland trawl survey is not primarily directed towards groundfish, the cod biomass index it produces for West Greenland offshore waters is well correlated with that from the German groundfish survey (r^2 = 0.86). The index of cod biomass is adjusted by a measure of the overlap between the stocks of cod and shrimp in order to arrive at an index of 'effective' cod biomass, which is entered in the assessment model. In recent years cod stocks have fluctuated, and a great increase in biomass in 2006–07 was short-lived (Fig. 3.7). In 2011 cod was widely distributed along the West Greenland shelf and the index of overlap between the distributions of cod and shrimp increased to 88.8%, so although the cod biomass was not very large, the effective biomass as a predator on shrimps increased to 21.8 Kt, a value of the same order as those of 2006–07 when the biomass was much greater but the overlap less (SCR Doc. 11/50).

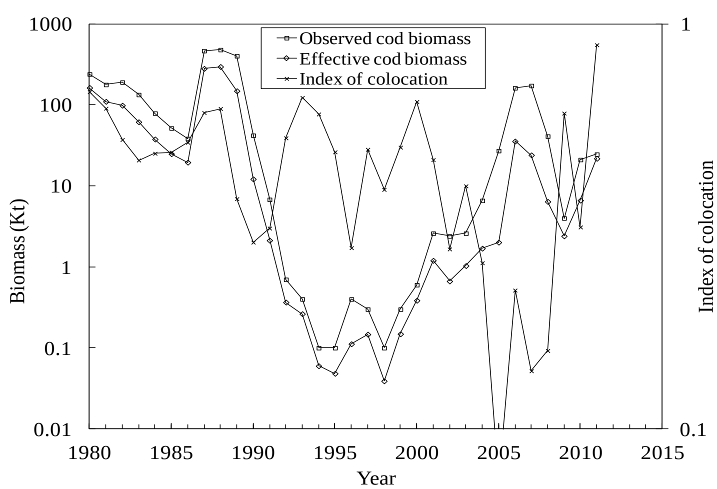


Fig. 3.7. Indices of the biomass of Atlantic cod, including its index of colocation with the stock of Northern shrimp, 1980–2011

c) Results of the Assessment

i) Estimation of Parameters

A Schaefer surplus-production model of population dynamics was fitted to series of CPUE, catch, and survey biomass indices (SCR Doc. 11/58). The model included a term for predation by Atlantic cod and the series of 'effective' cod biomass values was included in the input data. Total catches for 2011 were assumed to be 126 000 t.

After discussion by NIPAG, a model was accepted for the assessment in 2011 that was modified from that used in the foregoing years. The model has in the past consistently estimated a biomass trajectory that has closely followed the CPUE series while largely ignoring the survey series, apparently because such a trajectory, avoiding the large excursions of the survey series, could be fitted better to the assumed stock-dynamic model. NIPAG has been concerned that CPUE might not reliably index biomass if the amplitude of the fishery changes — contracts — as it has been doing in recent years. For 2011 the previously accepted assessment model was therefore constrained to fit the biomass trajectory at least as closely to the survey index as to the CPUE index: i.e. the survey CV should be no greater than the CPUE CV. The model was run with data series shortened to 30 years to speed up the running; the effect of shortening the data series was checked and found not significant.

The result of fitting this model was a biomass trajectory that tracked between the survey index and the CPUE index; the survey CV was estimated at 13% and that of the CPUE at 15%. The process error and the error associated with the predation term both increased considerably, so predictions became more uncertain. The biomass is now considered to have decreased, as the survey index did, between 2003 and 2011 under the influence of the high catches of 2004–2008, instead of staying high like the CPUE index. In consequence, the model estimates the MSY lower than in previous assessments, at 135 Kt/yr.

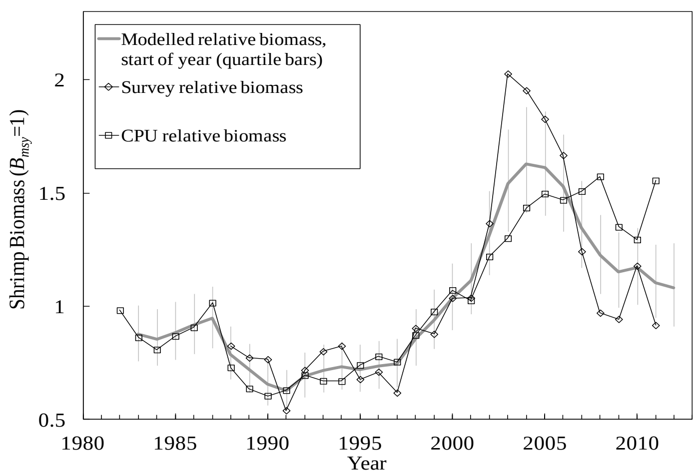


Fig. 3.8: Northern Shrimp in SA 1 and Canadian SFA1: trajectory of the median estimate of relative stock biomass at start of year 1983–2012, with median CPUE and survey indices; 30 years' data with constrained CVs.

Estimates of stock-dynamic and fit parameters from fitting a Schaefer stock-production model, with constrained CVs, to 30 years' data on the West Greenland stock of the northern shrimp in 2011, with median values from 2010 assessment:

	2011 assessment						2010 assessment
	Mean	S.D.	25%	Median	75%	Est. Mode	Median
Max.sustainable yield	142	60	114	135	160	122	147
B/Bmsy, end current year (proj.)	1.11	0.29	0.91	1.08	1.28	1.03	1.16
Z/Zmsy, current year (proj.)	—	—	0.84	1.11	1.44	—	0.92
Carrying capacity	3716	3406	1873	2725	4375	743	2123
Max. sustainable yield ratio (%)	10.9	6.0	6.5	10.3	14.6	9.2	13.9
Survey catchability (%)	22.6	14.4	11.7	19.6	30.2	13.6	28.0
CV of process (%)	11.4	2.6	9.5	11.1	12.9	10.5	8.9
CV of survey fit (%)	13.2	1.7	12.0	13.1	14.3	12.8	20.5
CV of CPUE fit (%)	15.3	2.1	13.7	15.0	16.5	14.4	3.6

ii) Assessment Summary

Recruitment. The stock structure in 2011 is deficient in shrimps of intermediate size 15–22 mm CPL, presaging poor short-term recruitment to both the fishable and spawning stocks; numbers at age 2 in 2011 have declined from the level of the 3 foregoing years to 55% of the series mean, so medium-term recruitment is also expected to be poor.

Biomass. A stock-dynamic model showed a maximum biomass at end 2003 with a continuing decline since; the probability that biomass will be below B_{msy} at end 2011 with projected catches at 126 000 t was estimated at 38%; of its being below B_{lim} at less than 1%.

Mortality. The mortality caused by fishing and cod predation (Z) is estimated to have stayed below the upper limit reference (Z_{msy}) from 1996 to 2005, but is now estimated to have averaged 6% over the limit value since 2006. With catches projected at 126 000 t the risk that total mortality in 2011 would exceed Z_{msy} was estimated at about 59%. Atlantic cod is widely distributed on the West Greenland shrimp grounds in 2011 and predation is expected to remain high.

State of the Stock. Modelled biomass is estimated to have been declining since 2004. At the end of 2011 biomass is projected to be still slightly above B_{msy}.Total mortality is projected to exceed Z_{msy}. Recruitment to the fishable stock, in both the short and the medium term, is expected to be low.

d) Precautionary Approach

The fitted trajectory of stock biomass showed that the stock had been below its MSY level until the late 1990s, with mortalities mostly near the MSY mortality level except for an episode of high mortality associated with a short-lived resurgence of cod in the late 1980s. In the mid-1990s, with cod stocks at low levels, biomass started to increase at low mortalities to reach about 1.6 times B_{msy} in 2003–05. Recent increases in the cod stock coupled with high catches have been associated with higher mortalities and continuing decline in the modelled biomass, although the biomass is still estimated above B_{msy}.

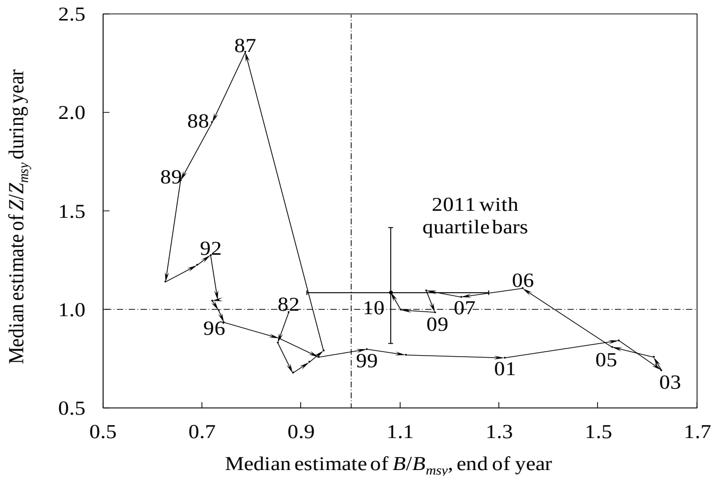


Fig. 3.9. Shrimp in SA 1 and Canadian SFA1: trajectory of past relative biomass and relative mortality.

e) Projections

Predicted probabilities of transgressing precautionary limits in 2012 (risk table) under seven catch options and subject to predation by a cod stock with an effective biomass of 20 000 t:

20 000 t cod	Catch option ('000 t)						
Risk of:	60	70	80	90	100	110	120
falling below B_{msy} end 2012 (%)	33.1	34.4	35.5	37.5	38.1	40.2	41.3
falling below B_{lim} end 2012 (%)	<1	<1	<1	<1	<1	<1	<1
exceeding Z_{msy} during 2012 (%)	13.4	17.0	22.7	30.7	38.7	47.8	55.1

In the medium term, with a 20 000 t effective biomass of cod, model results estimate catches of 100 000 t/yr to be associated with a stationary stock, above B_{msy}, and with mortality below Z_{msy}. At 30 000 t effective cod biomass, annual catches of 100 000 t are predicted to cause the stock status to deteriorate slowly.

Predicted probabilities of transgressing precautionary limits after 3 years in the fishery for Northern Shrimp on the West Greenland shelf with ‘effective’ cod stocks assumed at 20 000 t and 30 000 t.

Catch (Kt/yr)	Prob. biomass < B_{msy} (%)		Prob. biomass<B_{lim} (%)		Prob. mort > Z_{msy} (%)	
	20 Kt	30 Kt	20 Kt	30 Kt	20 Kt	30 Kt
60	27.4	29.2	1.5	2.0	14.0	18.4
70	30.0	31.9	1.5	2.1	17.7	22.7
80	32.2	34.9	1.6	2.2	22.7	29.0
90	36.1	38.8	1.8	2.3	30.7	37.2
100	38.0	41.3	1.8	2.4	38.8	45.8
110	42.2	44.5	1.8	2.4	48.3	54.8
120	44.6	47.8	1.8	2.6	56.2	61.8

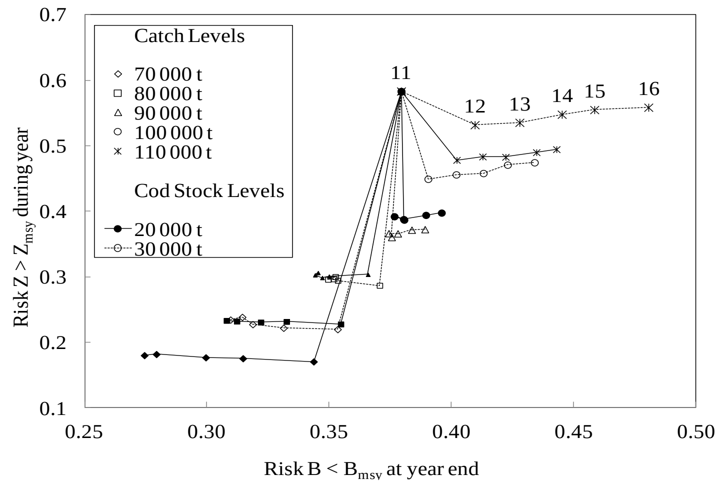


Fig. 3.10. Shrimp in SA 1 and Canadian SFA1: Risks of transgressing mortality and biomass precautionary limits for catches at 70 000–110 000 t projected over five years with an ‘effective’ cod stock assumed at 20 000 or 30 000 t.

Medium-term predictions were summarised by plotting the risk of exceeding Z_{msy} against the risk of falling below B_{msy} over 5 years for 5 catch levels, considering also two possible levels for the ‘effective’ cod stock (Fig. 3.9). The immediate biomass risk is relatively insensitive to catch level but changes with time, upwards or downwards depending on catch level and cod-stock level; the mortality risk depends immediately upon the assumed future catch and cod-stock levels, but changes little with time. A 10 000 t change in the cod stock is practically equivalent to a 10 000 t change in catch. For catches of 70 000 t to 90 000 t the mortality risk is 17–37% and nearly constant over the projection period, while the biomass risk decreases as the stock is projected to grow. At a catch level of 100 000 t the stock is nearly stationary above B_{msy} if the effective cod stock is assumed near 20 000 t, but if the cod stock increases to an effective biomass of 30 000 t catches of 100 000 t/yr are predicted to be associated with a decreasing biomass.

f) Review of Research Recommendations

NIPAG **recommended** in 2010 that, for shrimp off West Greenland (NAFO Subareas 0 and 1):

- *the estimate of the biomass of Atlantic cod from the W. Greenland trawl survey should be explicitly included in the stock-production model used for the assessment;*

STATUS: no progress has been made on this recommendation.

- *estimating weight-length curves from length-sample data alone, and using them for partitioning the estimated stock biomass, should be further compared with the method based on weighing individuals and its usefulness and reliability further evaluated.*

STATUS: this method of estimating weight-length curves was not further investigated in 2011. Instead, the procedure that relies on weighing and measuring individuals was developed further to ensure better agreement between the overall biomass estimate and the aggregate of sex- and length-class weights.

- *numbers at length for all the components of the stock identified by modal analysis should be tabulated, to allow confirmation that they tally to the estimated survey total numbers at length;*

STATUS: correction factors, based on survey total numbers, were applied to the numbers at length output by the modal analysis (CMIX) for the stock components identified to bring their sum into agreement with survey totals.

- *demographic analyses of past survey data should be thoroughly revised, including adjustment for the 2005 gear change, with a view to obtaining a consistent series.*

STATUS: demographic analyses, including calculations of numbers and biomasses by sex and length class and modal analyses to estimate numbers in age classes, were revised for past surveys back to 2005. It was concluded that no adjustment for the gear change was necessary.

4. Northern shrimp (in Denmark Strait and off East Greenland)

(SCR Doc. 03/74, 11/54, 11/56)

a) Introduction

Northern shrimp off East Greenland in ICES Div. XIVb and Va is assessed as a single population. The fishery started in 1978 and, until 1993, occurred primarily in the area of Stredebank and Dohrnbank as well as on the slopes of Storfjord Deep, from approximately 65°N to 68°N and between 26°W and 34°W.

In 1993 a new fishery began in areas south of 65°N down to Cape Farewell. From 1996 to 2005 catches in this area accounted for 50 - 60% of the total catch. In 2006 and 2007 catches in the southern area only accounted for 25% of the total catch. Since 2008 about 10% of the total catch has been taken in the southern area.

A multinational fleet exploits the stock. During the recent ten years, vessels from Greenland, EU-Denmark, the Faroe Islands and Norway have fished in the Greenland EEZ. Only Icelandic vessels are allowed to fish in the Icelandic EEZ. At any time access to these fishing grounds depends strongly on ice conditions.

In the Greenland EEZ, the minimum permitted mesh size in the cod-end is 44 mm, and the fishery is managed by catch quotas allocated to national fleets. In the Icelandic EEZ, the mesh size is 40 mm and there are no catch limits. In both EEZs, sorting grids with 22-mm bar spacing to reduce by-catch of fish are mandatory. Discarding of shrimp is prohibited in both areas.

As the fishery developed, catches increased rapidly to more than 15 000 t in 1987-88, but declined thereafter to about 9000 t in 1992-93. Following the extension of the fishery south of 65°N catches increased again reaching 11 900 t in 1994. From 1994 to 2003 catches fluctuated between 11 500 and 14 000 t (Fig. 4.1). Since 2004 the catches decreased continually from 10 000 t to between 2 000 - 4 000 t in the most recent years. In 2011 total catches are expected to decrease even further. Catches in the Iceland EEZ decreased from 2002-2005 and since 2006 no catches have been taken.

Recent recommended and actual TACs (t) and nominal catches are as follows:

	2002[1]	2003[1]	2004	2005	2006	2007	2008	2009	2010	2011[2]
Recommended TAC, total area	9600	9600	12400	12400	12400	12400	12400	12400	12400	12400
Actual TAC, Greenland	10600	10600	15043	12400	12400	12400	12400	12835	11835	11835
North of 65°N, Greenland EEZ	4113	5480	4654	3987	3887	3314	2529	3945	3313	1048
North of 65°N, Iceland EEZ	1231	703	411	29	0	0	0	0	0	0
North of 65°N, total	5344	6183	5065	4016	3887	3314	2529	3945	3313	1048
South of 65°N, Greenland EEZ	5985	6522	4951	3737	1302	1286	266	610	413	0
TOTAL NIPAG	11329	12705	10016	7753	5189	4600	2794	4555	3727	1048

[1] Estimates corrected for “overpacking”.
[2] Catches until October 2011

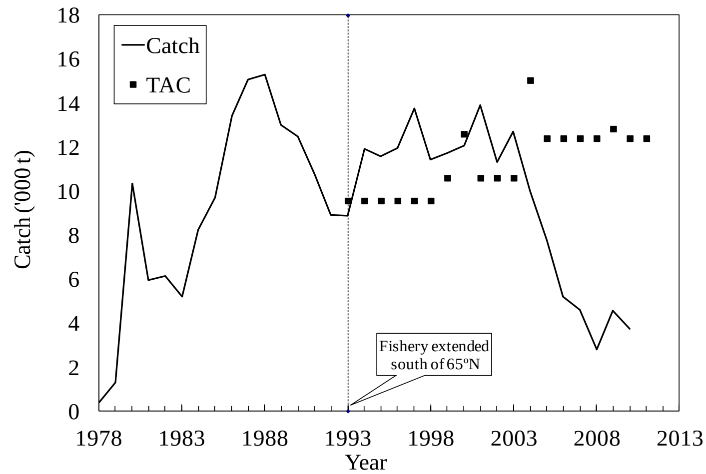


Fig. 4.1. Shrimp in Denmark Strait and off East Greenland: Total catches.

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Data on catch and effort (hours fished) on a haul by haul basis from logbooks from Greenland, Iceland, Faroe Islands and EU-Denmark since 1980, from Norway since 2000 and from EU-France for the years 1980 to 1991 are used . Until 2005, the Norwegian fishery data was not reported in a compatible format and were not included in the standardized catch rates calculations. In 2006 an evaluation of the Norwegian logbook data from the period 2000 to 2006 was made and since then these data have been included in the standardized catch rate calculations. Since 2004 more than 60% of all hauls were performed with double trawl and the 2011 assessment included both single and double trawl in the standardized catch rate calculations.

Catches and corresponding effort are compiled by year for two areas, one area north of 65°N and one south thereof. Standardised Catch-Per-Unit-Effort (CPUE) was calculated and applied to the total catch of the year to estimate the total annual standardised effort. Catches in the Greenland EEZ are corrected for "overpacking" (SCR Doc. 03/74).

The Greenlandic fishing fleet, catching 40% of the total catch from 1998 to 2005 and between 0% and 30% from 2006, has decreased its effort in recent years, and this creates some uncertainty as to whether recent values of the indices accurately reflect the stock biomass. There could be several reasons for decreasing effort, some possibly related to the economics of the fishery. The fishing opportunities off West Greenland seem to have been adequate in recent years and the fishing grounds off East Greenland are for several reasons a less desirable fishing area. Even though both effort and catches in East Greenland have declined, the catch rates (CPUE's) are still high; however, this could be partly because the fleet can concentrate effort in areas of high densities of sought-after size classes of shrimp.

North of 65°N standardized catch rates based on logbook data from Danish, Faroese, Greenlandic, Norwegian and Icelandic vessels declined continuously from 1987 to 1993 but showed a significant increase between 1993 and 1994. Since then rates have varied but shown a slightly increasing trend until 2008. From 2008 to 2009 the catch rate increased by 50%. In 2010 and 2011 the catch rate went down to the level seen in the period from 2004-2008 (Fig. 4.2).

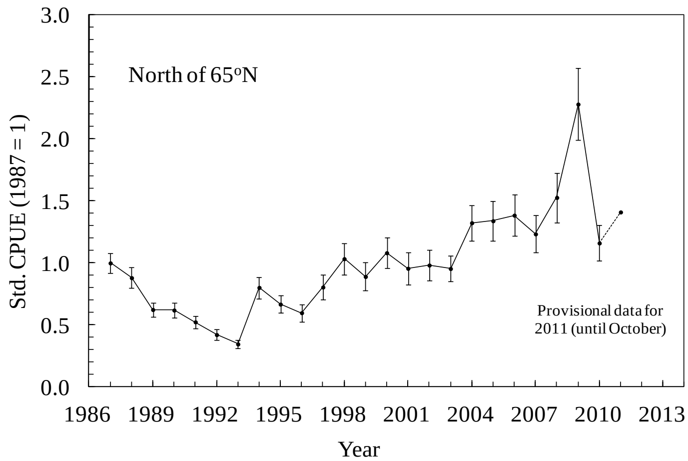


Fig. 4.2. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1987 = 1) with ±1 SE calculated from logbook data from Danish, Faeroese, Greenland, Icelandic and Norwegian vessels fishing north of 65°N.

In the southern area a standardized catch rate series from the same fleets, except the Icelandic, increased until 1999, and varied around this level until 2008. The catch rate increased in 2009 by 25%, then decreased to levels seen in the late-1990s (Fig. 4.3). No fishing has been conducted in the southern area in 2011.

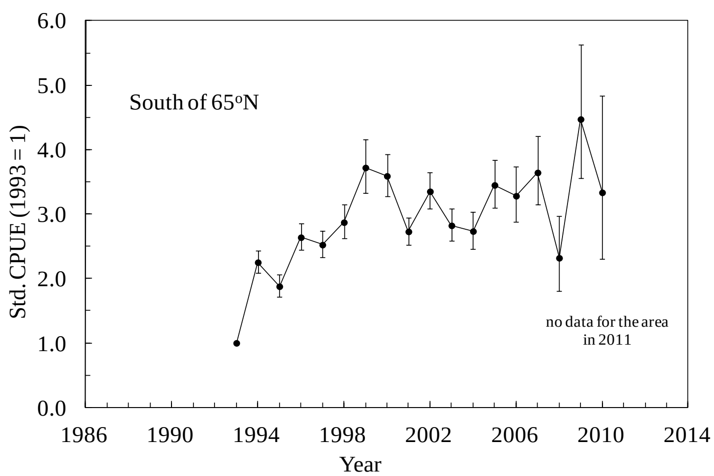


Fig. 4.3. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1993 = 1) with ±1 SE calculated from logbook data from Danish, Faeroese, Greenland and Norwegian vessels fishing south of 65°N.

The combined standardized catch rate index for the total area decreased steadily from 1987 to 1993, and then showed an increasing trend until the beginning of the 2000s. The index stayed at or around this level until 2008, but nearly doubled in 2009. In 2010 and 2011 the combined standardized catch rate index decreased to the level seen at the beginning of the 2000s (Fig. 4.4).

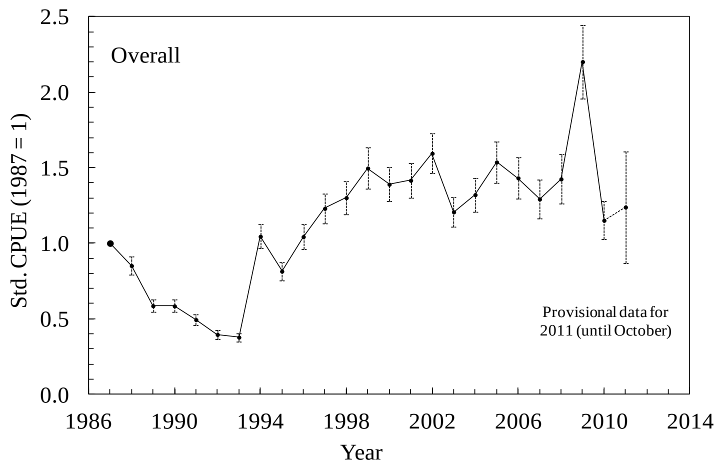


Fig. 4.4. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE-indices (1987 = 1) with ± 1 SE combined for the total area.

Standardized effort indices (catch divided by standardized CPUE) as a proxy for exploitation rate for the total area shows a decreasing trend since 1993. Recent levels are the lowest of the time series (Fig. 4.5).

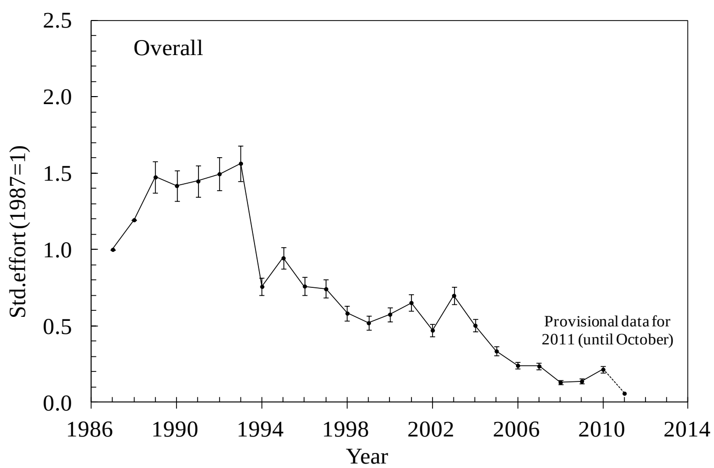


Fig. 4.5. Shrimp in Denmark Strait and off East Greenland: annual standardized effort indices, as a proxy for exploitation rate (± 1 SE; 1987 = 1), combined for the total area.

ii) Biological data

There are no biological data available from the commercial fishery.

iii) Research survey data

Stratified-random trawl surveys has been conducted to assess the stock status of northern shrimp in the East Greenland area since 2008 (SCR Doc. 11/56). The main objectives were to obtain indices for stock biomass, abundance, recruitment and demographic composition. The area was also surveyed in 1985-1988 (Norwegian survey) and in 1989-1996 (Greenlandic survey). The historic survey is not directly comparably with the recent survey due to different area cover, survey technique and trawling gear. However, the 1989-1996 survey estimated biomass and abundance at the same level as the 2008-2011 survey. The two Greenlandic surveys also showed similar overall size distributions. Absence of the smaller male and juvenile shrimp in the survey area stresses that the total area of distribution and recruitment patterns of the stock are still unknown.

Biomass estimate. The biomass estimates (t) for the entire survey area are:

Year	Biomass	+/-	Error C.V. (%)
2008	1953	1764	90.32
2009	8446	3852	45.61
2010	5758	3928	68.22
2011	5789	2760	47.68

The surveys conducted since 2008 shows that the shrimp stock is concentrated in the area North of 65°N.

Stock composition. The total number of shrimp for 2008, 2009, 2010 and 2011 was estimated to 206, 909, 525 and 514 million respectively (Fig 4.6). Between 2009 and 2011 female abundance was roughly 200 million, however the abundance of males declined from around 700 million in 2009 to 300 million in 2010 and remained near that level in 2011 (Fig 4.6).

The demography in East Greenland shows a lack of males smaller than 20 mm CL (Fig. 4.7), which means that no recruitment index is available.

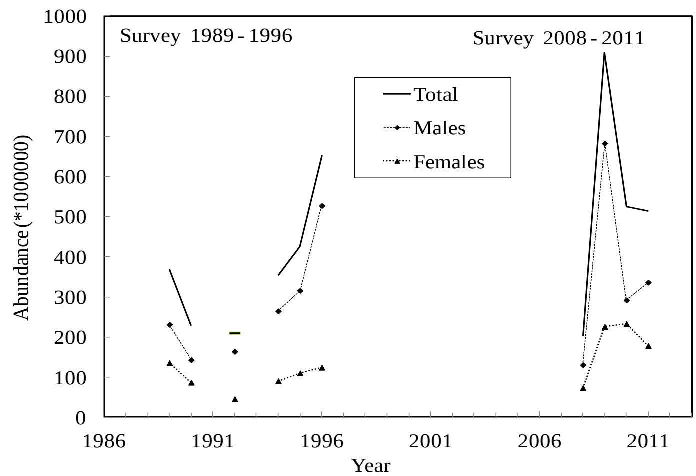


Fig. 4.6. Shrimp in Denmark Strait and off East Greenland. Abundance of males and females in two different surveys series from 1989-1995 and 2008-2011 for the areas North of 65°N.

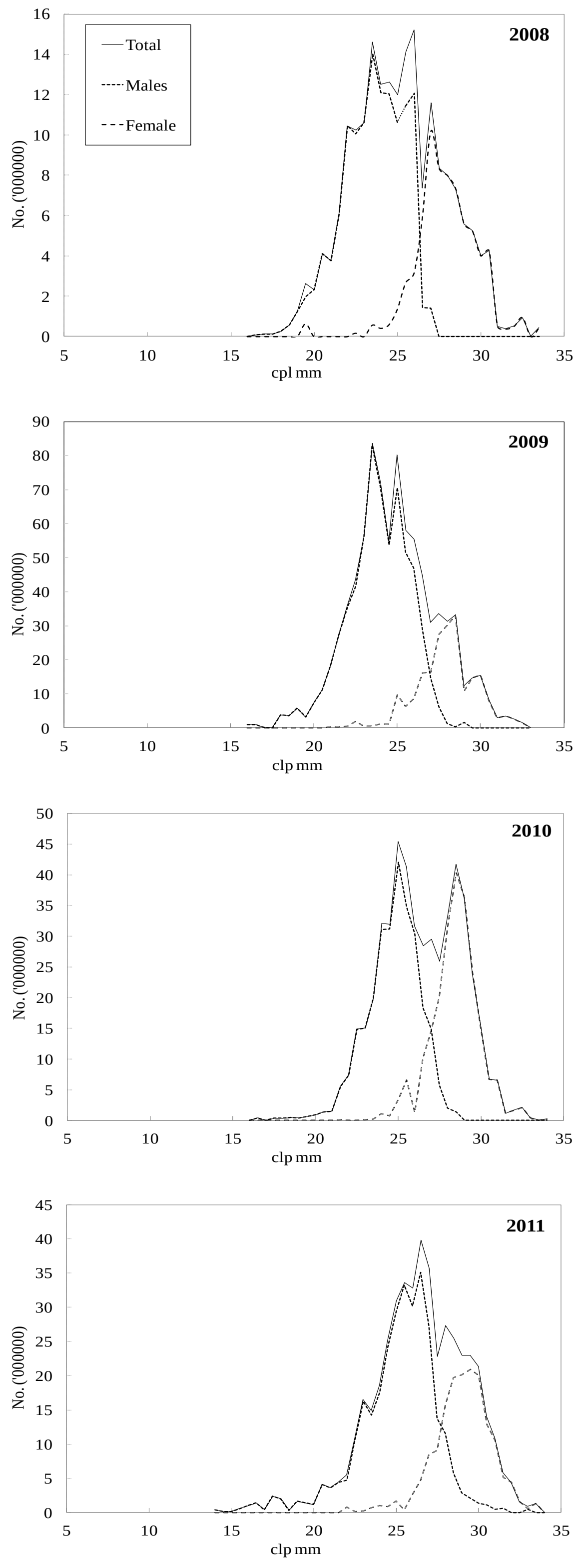


Fig.4.7. Shrimp in Denmark Strait and off East Greenland. Numbers of shrimp by length group (CL)in the total survey area in 2008 - 2011 based on pooling of samples weighted by catch and stratum area.

c) Assessment Results

CPUE. Combined standardized catch-rate index for the total area decreased steadily from 1987 to 1993, showed an increase to a relatively high level in 1998, and has fluctuated around this level since. There are concerns as to whether the 2009 value properly reflects the state of the stock.

Recruitment. No recruitment estimates were available.

Biomass. The biomass index from 2008-2011 varied greatly with no clear trend.

Exploitation rate. Since the mid 1990s exploitation rate index (standardized effort) has decreased, reaching the lowest levels seen in the time series from 2008 - 2011.

State of the Stock. The stock biomass is believed to be at a relatively high level, and to have been there since 1998.

5. Northern shrimp in Skagerrak and Norwegian Deep (ICES Div. IIIa and IVa East) – ICES Stock

(SCR Docs. 11/64, 11/67, 11/68, 11/69)

a) Introduction

The shrimp in the northern part of ICES Div. IIIa (Skagerrak) and the eastern part of Div. IVa (Norwegian Deep) is assessed as one stock and is exploited by Norway, Denmark and Sweden. The Norwegian and Swedish fisheries began at the end of the 19th century, while the Danish fishery started in the 1930s. All fisheries expanded significantly in the early 1960s. By 1970 the landings had reached 5 000 t and in 1981 they exceeded 10 000 t. Since 1992 the shrimp fishery has been regulated by a TAC, which was around 16 500 t in 2006-2009, but decreased to 14 558 t in 2010 and further to 12 380 t in 2011 (Fig. 5.1, Table 5.1). In recent years an increasing number of the Danish vessels have started boiling the shrimp on board and landing the product in Sweden to obtain a better price. In 2010 around 40% of Danish landings were boiled. Most of the Danish catches are, however, still landed fresh in home ports. In the Swedish and Norwegian fisheries approximately 50% of catches are boiled at sea, and almost all catches are landed in home ports. In 2010, more than 60% of total landings were boiled.

The overall TAC is shared according to historical landings, giving Norway 60%, Denmark 26%, and Sweden 14% in 2010 and 2011. The recommended TACs until 2002 were based on catch predictions. However, since 2003 when the cohort based analytical assessment was abandoned no catch predictions have been available, and the recommended TACs have been based on perceived stock development in relation to recent landings. The shrimp fishery is also regulated by mesh size (35 mm stretched), and by restrictions in the amount of landed bycatch. The use of Nordmøre selective grids with un-blocked fish openings reduces bycatch significantly (SCR Doc. 11/69) and is used by an increasing number of vessels in the Swedish fleet. However, at present it is mandatory only in Swedish national waters.

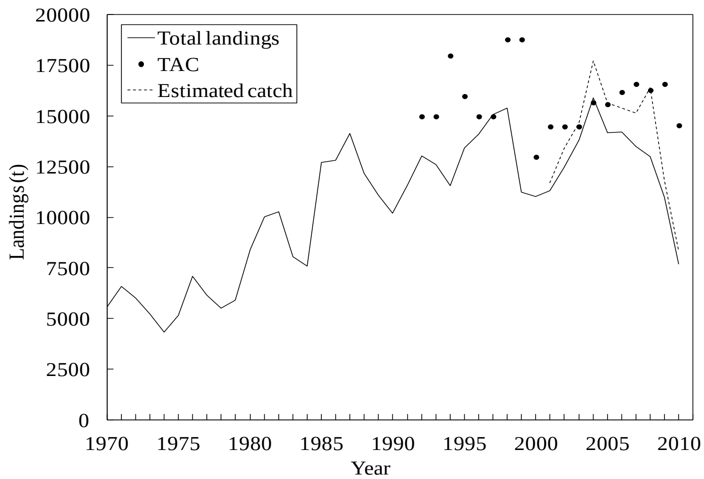


Fig. 5.1. Northern shrimp in Skagerrak and Norwegian Deep: TAC, total landings by all fleets, and total catch including estimated Swedish high-grading discards for 2001-2010, Norwegian discards for 2007-2010 and Danish discards for 2009-2010.

Total landings have varied between 10 000 and 16 000 t during the last 30 years. The Norwegian and Swedish boiled landings have been corrected for weight loss caused by boiling and raised by a factor of 1.13. Total catches are estimated as the sum of landings and discards and have varied between 11 000 and 18 000 t in 2001-2009, but decreased to around 8 300 t in 2010. In 2005 to 2008 the catches were around 15 000 to 16 000 t. The increase in total catches in 2008 compared with 2007 was due to the high estimates of Norwegian and Swedish discards in 2008. Danish and Norwegian landings have decreased since 2007, and in 2010 also the Swedish landings decreased (Table 5.1 and Fig. 5.1). Total landings in 2010 decreased by more than 3000 t compared with 2009.

Table 5.1. Northern shrimp in Skagerrak and Norwegian Deep: TACs, landings and estimated catches (t).

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Recommended TAC	11 500	13 400	12 600	14 700	15 300	13 000	14 000	14 000	15 000	15 000	13 000
Agreed TAC	13 000	14 500	14 500	14 500	15 690	15 600	16 200	16 600	16 300	16 600	14 558
Denmark	2 371	1 953	2 466	3 244	3 905	2 952	3 061	2 380	2 259	2 155	1 229
Norway	6 444	7 266	7 703	8 178	9 544	8 959	8 669	8 686	8 260	6 364	4 673
Sweden	2 225	2 108	2 301	2 389	2 464	2 257	2 488	2 445	2 479	2 483	1 781
Total landings	11 040	11 327	12 470	13 811	15 913	14 168	14 218	13 511	12 998	11 002	7 683
Est. Danish discards*										36	29
Est. Swedish high-grading		375	908	868	1 797	1 483	1 186	1 124	2 003	678	558
Est.Norwegian discards**								526	1 408	115	63
Est. total catch		11 702	13 378	14 679	17 710	15 651	15 404	15 161	16 409	11 824	8 334

* Collection of Danish discard data began in 2009
** Collection of Norwegian discard data began in 2007

The Danish and Norwegian fleets have undergone major restructuring in recent years. In Denmark, the number of vessels targeting shrimp has decreased from 191 in 1987 to 24 in 2006 and only 12 in 2010. It is mostly the small (< 24 m LOA) and less efficient trawlers which have left the fishery and in 2010 the Danish fleet consisted of vessels with an average length of 26 m (SCR Doc. 11/69). The efficiency of the fleet has also increased due to the introduction of twin trawl technology and increased trawl size.

In Norway the number of vessels participating in the shrimp fishery has decreased from 423 in 1995 to 227 in 2010. The number of smaller vessels (10-10.99 m LOA) has increased from the mid-1990s until present, while the number of larger vessels (11-20.99 m LOA) has decreased. The length group 10-10.99 m LOA has been the numerically dominant one since 2005 (39% of all vessels in 2010), owing to the fact that vessels < 11 m do not need a license to fish. Vessels ≥ 21 m LOA constitute only 9% of the fleet, which illustrates the difference between the Norwegian and Danish fleets. Twin trawl was introduced around 2002, and the use is increasing. In 2010 twin trawls are estimated to be in use by 40-50 Norwegian trawlers.

The Swedish specialized shrimp fleet (catch of shrimp ≥ 10 t/yr) has been around 40-50 vessels for the last decade and there has not been any major change in trawl size or trawl design according to the Swedish net manufacturer. In Sweden twin trawls have been in use since 2006 (5 vessels) and the use is increasing. In 2010 15 twin trawlers caught 38% of the Swedish shrimp landings (SCR Doc. 11/69).

Catch and discards. Discarding of shrimp may take place in two ways: 1) discards of shrimp <15 mm CL which are not marketable, and 2) high-grading discards of medium-sized and lower-value shrimp. In recent years the Swedish fishery has been constrained by the national quota, which has resulted in ‘high-grading’ of the catch by the Swedish fleet. The amount of high-grading and discards in the Swedish fisheries was estimated to around 678 t in 2009 and 558 t in 2010 based on comparison of length distributions in Swedish and Danish landings (Fig. 4 in SCR Doc. 11/67). The Danish length distribution for each year is scaled to fit the Swedish length distribution for the same year for the larger shrimp (≥21 mm CL). This correction assumes that there is no discarding of the most valuable larger shrimp and that Swedish and Danish fisheries are conducted on the same grounds and are using same mesh sizes and sorting sieves. The higher numbers in the Danish size groups <21 mm CL are compared to the Swedish numbers, and the differences are then multiplied with the mean weights of each size group. The sum of mean weights by size group is considered as the weight of the Swedish discarding due to high-grading.

The uncertainties in this estimation have increased in recent years due to changes in the Swedish fishing pattern. Swedish shrimp trawlers have been avoiding grounds with small size composition in the catch. There is also an increasing part that voluntarily use 45 mm mesh size instead of legislated 35 mm. There is also an at-sea-sampling programme giving size compositions of samples of the boiled, raw and discarded part of the catch. Unfortunately there are so far too few samples with the total weight of the discarded part to be used in an estimation of total Swedish discards from the at-sea-sampling.

Norwegian discards have since 2007 been estimated using the same method as described above (SCR Doc. 11/67). The length distributions of Norwegian unprocessed commercial catches are compared with those of Norwegian sorted landings. In 2010 Norwegian discards from Skagerrak was estimated to be 95 t. In 2010 discards from Skagerrak were also estimated applying the Danish discards-to-landings proportion to the Norwegian landings, yielding discards of 63 t. This figure was considered the most reliable one. Attempts to estimate discards from the Norwegian Deep were carried out for the first time in 2010, however these were unsuccessful. The Norwegian discards are probably mainly made up of non-marketable shrimp < 15 mm CL and shrimp of poor quality, but high-grading cannot be ruled out.

Bycatch and ecosystem effects. Shrimp fisheries in the North Sea and Skagerrak have by-catches of 10-30% (by weight) commercially valuable species (Table 5.2) even though regulations restrict the weights that may be landed. Since 1997, trawls used in Swedish national waters must be equipped with a Nordmøre grid, with bar spacing 19 mm, which excludes fish > 20 cm from the catch. Logbook information shows that landings delivered by vessels using this grid consist of 96-99% shrimp compared to only 70-90% in landings from trawls without grid (Table 5.2). In the area outside of Swedish national waters the grids are not mandatory, however, there has been an increase in their use, which accounted for 37% of Swedish shrimp landings in 2010.

The effects of shrimp fisheries on the North Sea ecosystem have not been the subject of special investigation. It is known that deep-sea species such as argentines, roundnose grenadier, rabbitfish, and sharks are frequently caught in shrimp trawls in the deeper parts of Skagerrak and the Norwegian Deep. However, no quantitative data on this mainly discarded catch component is available.

Table 5.2. Northern shrimp in Skagerrak and Norwegian Deep: Landings by the *Pandalus* fishery in 2010. Combined data from Danish and Swedish logbooks and Norwegian sale slips (t). The figures for cod and saithe for the trawl with grid is likely to be misreported landings.

	Sub-Div. IIIa, no grid		Sub-Div. IIIa, grid		Sub-Div. IVa East, no grid	
Species:	Total (t)	% of total catch	Total (t)	% of total catch	Total (t)	% of total catch
Pandalus	5026	77.3	364	96.2	1810	77.0
Norway lobster	45	0.7	2	0.6	25	1.0
Angler fish	56	0.9	0	0.0	67	2.8
Whiting	15	0.2	0	0.0	3	0.1
Haddock	41	0.6	0	0.0	19	0.8
Hake	22	0.3	0	0.1	35	1.5
Ling	41	0.6	0	0.0	34	1.4
Saithe	642	9.9	7	1.9	193	8.2
Witch flounder	59	0.9	0	0.1	2	0.1
Norway pout	0	0.0	0	0.0	0	0.0
Cod	382	5.9	2	0.7	70	3.0
Other market fish	168	2.6	2	0.4	93	3.9

b) Assessment Data

i) Commercial fishery data

LPUE The Danish catch and effort data from logbooks have been analyzed and standardized (SCR Doc. 08/75, 11/69) to provide indices of stock biomass. A GLM standardization of the LPUE series was performed on around 20 500 shrimp fishing trips conducted in the period 1987-2010:

$$\ln(\text{LPUE}) = \ln(\text{LPUEmean}) + \ln(\text{vessel}) + \ln(\text{area}) + \ln(\text{year}) + \ln(\text{season}) + \text{error}$$

where 'vessel' denotes the horse power of the individual vessels, 'year' covers the period 1987-2010, 'area' covers Norwegian Deep and Skagerrak, 'season', in this case quarter, covers possible seasonal variation, and the variance of the error term is assumed to be normally distributed.

In the standardization of the Norwegian LPUE (2000-2010) (SCR Doc. 11/68) a similar model was applied, but gear type (single and twin trawl) was also included as a variable:

$$\ln(\text{LPUE}) = \ln(\text{LPUEmean}) + \ln(\text{vessel}) + \ln(\text{area}) + \ln(\text{year}) + \ln(\text{month}) + \ln(\text{gear}) + \text{error}$$

Information on gear use recorded in Norwegian logbooks (single or twin trawl) was corrected by interviews with fishers. In 2010, catches recorded in logbooks only made up 8% and 9% of the respective landings in Divs. IIIa and IVa east. This is partly due to vessels <11 m not being required to fill in logbooks. Unfortunately data are lacking also for larger vessels.

Since the mid-1990s the Danish standardised LPUE has fluctuated without trends (Fig. 5.2). For the last decade the two time series show similar fluctuations, increasing from 2000 to 2004, decreasing in 2005 and then increasing again until 2007. Both LPUE indices have decreased since 2008.

The Swedish LPUE data were not used in the assessment (SCR Doc. 11/69) because of uncertainties caused by discarding due to high-grading and lack of information necessary for standardization.

In previous assessments harvest rates (H.R.) were estimated from landings and corresponding biomass indices from the Norwegian survey. Since the new survey only covers six years, time series of standardised effort indices (total landings/Danish and Norwegian standardised LPUE indices) have been estimated in addition to H.R. estimates for

2006-2010 (Fig. 5.3) Standardised effort seems to have been fluctuating without any clear trend since the mid-1990s indicating stability in the exploitation of the stock.

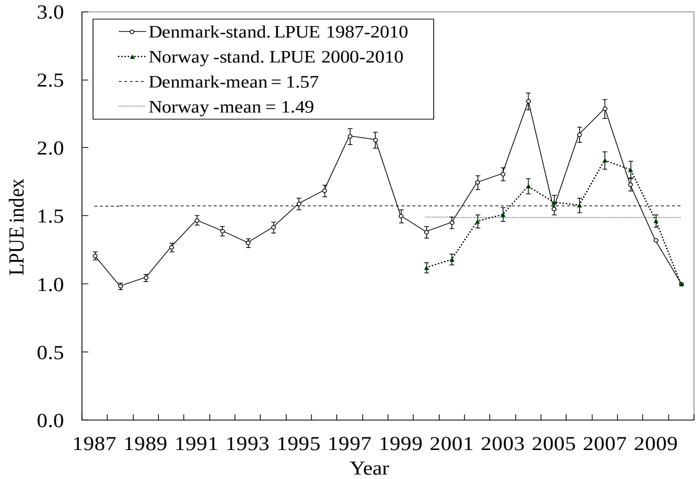


Fig. 5.2. Northern shrimp in Skagerrak and Norwegian Deep: Danish and Norwegian standardised LPUE until 2010.

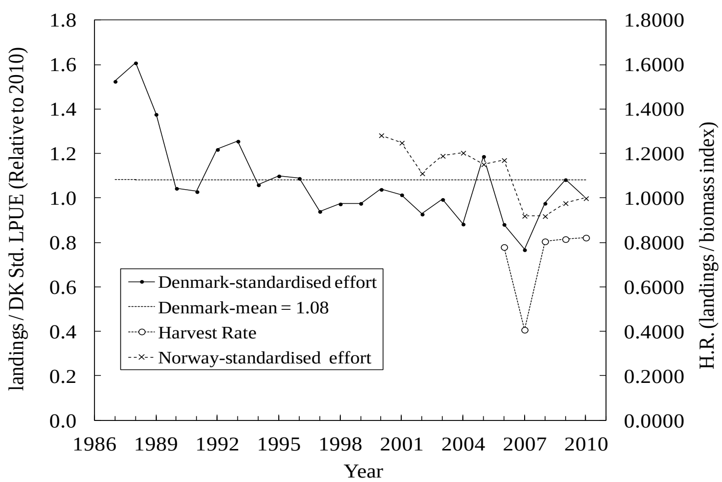


Fig. 5.3. Northern shrimp in Skagerrak and Norwegian Deep: Harvest rate (total landings/survey indices of biomass) and estimated standardised effort based on total landings and Danish and Norwegian standardised LPUE. Long term Danish mean = 1.08.

ii) Sampling of landings

Information on the size and subsequently age distribution of the landings are obtained by sampling the landings. The samples provide information on sex distribution and maturity (SCR Doc. 11/69). This substantial amount of information has not been used in the current assessments, but will be used in the up-coming benchmark analytical assessment in 2012.

iii) Survey data

The Norwegian shrimp survey went through large changes in the years 2003-06 with changes in vessel and timing (SCR Doc. 11/64) resulting in four different survey series, lasting from one to nineteen years. ICES (2004) strongly recommended the survey to be conducted in the 1st quarter as it gives good estimates of the 1-group (recruitment) and female biomass (SSB). Thus, a new time series at the most optimal time of year was established in 2006.

There was no trend in the annual survey biomass estimates from the mid 1990s to 2002, when the first series was discontinued (Fig. 5.4). In 2003 the survey was carried out using a different trawl in use only that year. The 2004 and 2005 mean values of a new biomass index series were not statistically different. In 2008 the index declined back to the 2006 level, and in 2009 and 2010 the index showed a further decline. In 2011 the biomass index is at the same low level as in 2010.

The abundance of age 1 shrimp in 2006 was equal to the abundance of age 1 shrimp in 2007. From 2007 to 2010 the recruitment (age 1) showed a steady decline to a low level of only 1/10 of the 2006 and 2007 indices (Fig 5.5). In 2011 recruitment increased compared with 2010, but the index is still the second lowest of the time series.

SSB (female biomass) has been calculated for the years 2006-2011 (Fig. 5.6). The index follows the overall biomass index, increasing from 2006 to 2007, then declining back to the 2006-level in 2008 and further declining in 2009 and 2010. In 2011 the SSB index is at the same low level as in 2010.

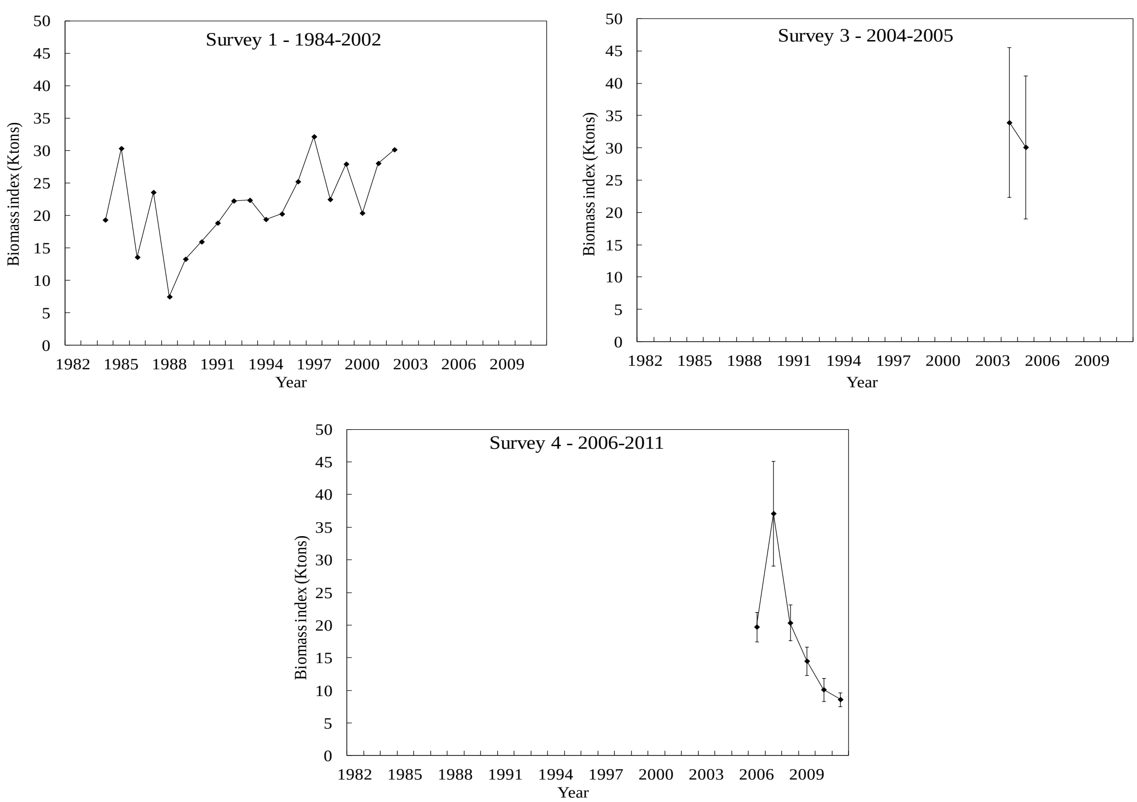
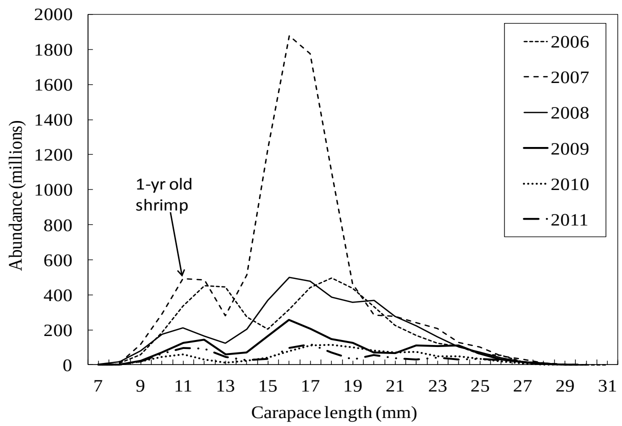


Fig. 5.4. Northern shrimp in Skagerrak and Norwegian Deep: Estimated survey biomass indices in 1984 to 2011. The four surveys are not calibrated to a common scale. Standard errors (error bars) have been calculated for the 2004-2011 surveys. Survey 1: October/November 1984-2002 with Campelen trawl; Survey 2: October/November 2003 with shrimp trawl 1420 (not shown); Survey 3: May/June 2004-2005 with Campelen trawl; Survey 4: January/February 2006-2011 with Campelen trawl.



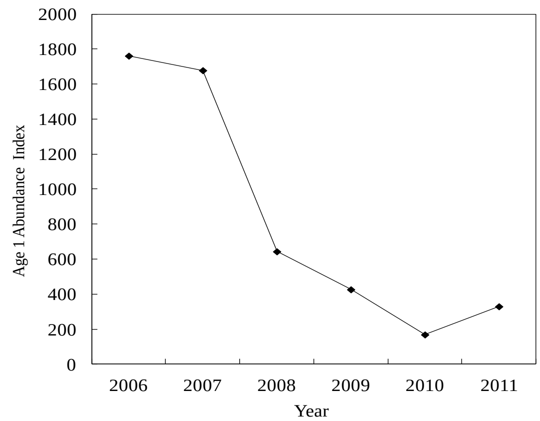


Fig. 5.5. Northern shrimp in Skagerrak and Norwegian Deep: Estimated length frequency distribution from the Norwegian shrimp surveys in 2006-2011, and recruitment indices from the same years. The recruitment index is calculated as the abundance of age 1 shrimp (the first mode, approx. 9-13mm, in the length frequency distribution).

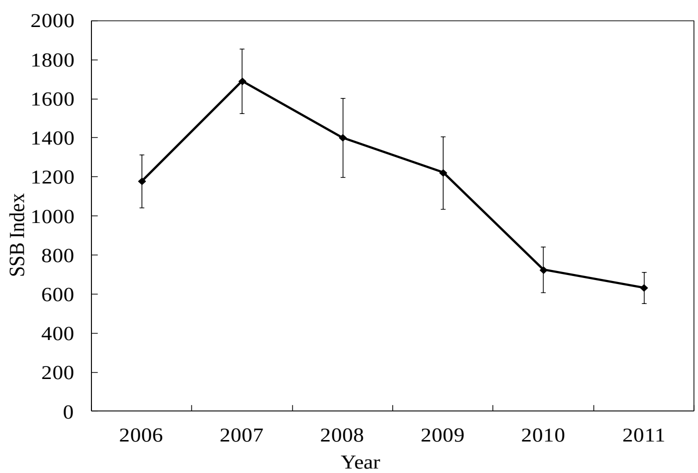


Fig. 5.6. Northern shrimp in Skagerrak and Norwegian Deep: SSB abundance from the Norwegian shrimp surveys in 2006-2011. The abundance index of the spawning stock is calculated as the abundance of females. Error bars are SE.

The large inter-annual variation in the predator biomass index is mainly due to variations in the saithe and roundnose grenadier indices. The sizes of these indices are heavily influenced by which stations are trawled as saithe is found on the shallowest stations and roundnose grenadier on the deepest ones. An index without these species is shown at the bottom of Table 5.3. The total index of shrimp predator biomass excluding saithe and roundnose grenadier has been at the same level during the 5 last years (Table 5.3).

Table 5.3**.** Northern shrimp in Skagerrak and Norwegian Deep: Estimated indices of predator biomass (catch in kg per towed nautical miles) from the Norwegian shrimp survey in 2006-2011.

Species	biomass index 2006	2007	2008	2009	2010	2011
Blue whiting	0.13	0.13	0.12	1.21	0.27	0.62
Saithe	7.33	39.75	208.32	53.89	18.53	7.52
Cod	0.51	1.28	0.78	2.01	1.79	1.66
Roundnose Grenadier	3.22	6.85	19.02	19.03	10.05	4.99
Rabbit fish	2.24	2.15	3.41	3.26	3.51	2.73
Haddock	0.97	4.21	1.85	3.18	3.46	5.82
Redfishes	0.18	0.40	0.26	0.43	0.80	1.02
Velvet Belly	1.31	2.58	1.95	2.42	2.52	1.47
Skates, Rays	0.41	0.95	0.64	0.17	0.60	0.88
Long Rough Dab	0.22	0.64	0.42	0.28	0.47	0.51
Hake	0.98	0.78	0.64	2.56	1.60	0.56
Angler	0.15	0.91	0.87	1.25	1.70	0.92
Witch	0.24	0.74	0.54	0.16	0.13	0.24
Dogfish	0.31	0.19	0.28	0.14	0.11	0.21
Black-mouthed dogfish	0.00	0.05	0.05	0.15	0.09	0.09
Whiting	0.00	0.05	0.05	0.15	0.09	3.07
Blue Ling	0	0	0	0	0	0
Ling	0.04	0.11	0.34	0.79	0.64	0.24
Fourbearded Rockling	0.06	0.14	0.04	0.03	0.05	0.03
Cusk	0.20	0	0.02	0.05	0.13	0.29
Halibut	0.08	0.07	3.88	0.09	0.20	0.05
Pollack	0.06	0.25	0.03	0.13	0.12	0.15
Greater Fork-beard	0	0	0	0.01	0.04	0.02
Total	18.99	63.19	244.81	94.26	49.23	33.09
Total (except saithe and roundnose grenadier)	8.44	16.59	17.47	21.34	20.65	20.58

c) Assessment Results

This year's assessment was based on evaluation of both Danish and Norwegian standardised LPUEs and standardised effort from the fishery in 1987-2010, and the survey indices of recruitment and biomass in 2006-2011.

LPUE: The standardised Danish and Norwegian LPUEs have shown similar fluctuations since 2000 (Fig. 5.2). Both indices have decreased since 2007, and are now below their respective long term means.

Recruitment: The recruitment index (age 1) decreased from 2007 to 2010. The 2011 index is around the level seen in the previous three years.

Survey biomass: The biomass index has decreased since 2007.

State of the stock: Indices of stock biomass indicate a decline from 2007 to 2011. The recruitment index has shown a declining trend since 2007, therefore recruitment to the fishable stock is expected to be low in 2012.

d) Biological Reference Points

No reference points were provided in this assessment.

e) Management Recommendations

NIPAG **recommended** that, *for shrimp in Skagerrak and Norwegian Deep:*

- *sorting grids or other means of facilitating the escape of fish should be implemented in this fishery.*
- *all Norwegian vessels should be required to complete and provide log books.*

f) Research Recommendations

NIPAG **recommended** that, *for shrimp in Skagerrak and Norwegian Deep:*

- *The Norwegian survey time series indices from 1984 - 2003 should be recalculated in order to provide confidence intervals and length frequency distributions.*

g) Research Recommendations from the 2008-2010 meetings

- *the Swedish effort data should be standardised*

STATUS: Work in progress. Process is delayed due to technical problems (lack of resources).

- *the Stochastic assessment model as described in SCR Doc.10/70 should be implemented and MSY reference points should be established.*

STATUS: A preliminary assessment using the model was presented to the NIPAG 2011 meeting. The input consists of length data both from commercial catches and surveys, and the preliminary results are promising (estimates of absolute stock size and fishing mortality). This modeling framework will be explored further and the results presented at the benchmark meeting.

- *A benchmark assessment is carried out before next NIPAG meeting as suggested by the 2009 Review Group.*

STATUS: Benchmark assessment scheduled in early 2012.

- *collaborative efforts should be made to standardise a means of predicting recruitment to the fishable stock.*

STATUS: No progress

- *the Norwegian shrimp survey should be continued on an annual basis*

STATUS: The survey will most likely be conducted annually.

- *Differences in recruitment and stock abundance between Skagerrak and the Norwegian Deep should be explored.*

STATUS: This forms part of the research projects described below

- *the ongoing genetic investigations to explore the relation/connection/mixing between the shrimp (stock units) in Skagerrak and the Norwegian Deep on the one hand and the Fladen Ground shrimp on the other hand should be continued until these relationships have been clarified.*

STATUS: A 3-year Norwegian-Swedish-Greenlandic project on shrimp genetics is financed from 2010 onwards (POPBOREALIS). The project’s main goal is to explore shrimp stock structure in the whole North Atlantic. Another 3-year Norwegian-Swedish-Danish project on shrimp genetics is financed from August 2010 onwards (Sustainable Fisheries in the Skagerrak). This project’s main goal is to explore shrimp stock structure in Skagerrak and surrounding fjords.

- *1) further development of the Bayesian stock production model presented in 2005 and 2) comparison with and exploration of other assessment models, e.g. new cohort based models, available for this shrimp stock should be carried out.*

STATUS: Work in progress

6. Northern Shrimp in Barents Sea and Svalbard area (ICES SA I and II) – ICES Stock

a) Introduction

Northern shrimp (*Pandalus borealis*) in the Barents Sea and in the Svalbard fishery protection zone (ICES Sub-areas I and II) is considered as one stock (Fig. 6.1). Norwegian and Russian vessels exploit the stock in the entire area, while vessels from other nations are restricted to the Svalbard fishery zone and in the “Loop Hole” (Fig. 6.1).

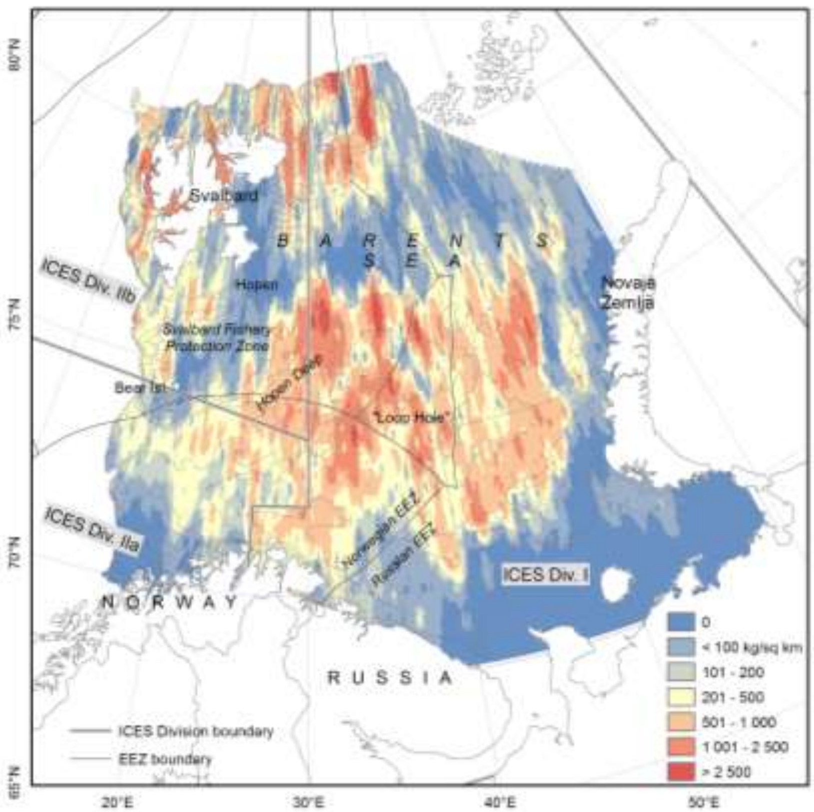


Fig. 6.1. Shrimp in the Barents Sea: stock distribution, mean density (kg/km^2), based on survey data 2000-2010.

Norwegian vessels initiated the fishery in 1970. As the fishery developed, vessels from several nations joined and the annual catch reached 128 000 t in 1984 (Fig. 6.2). From 2001 to 2010 catches have varied between 21 000 and 61 000 t/yr, about 75–93% of these were taken by Norwegian vessels and the rest by vessels from Russia, Iceland, Greenland and the EU (Table 6.1).

There is no TAC established for this stock. The fishery is partly regulated by effort control, and a partial TAC (Russian zone only). Licenses are required for the Russian and Norwegian vessels. The fishing activity of these license holders are constrained only by bycatch regulations whereas the activity of third country fleets operating in the Svalbard zone is also restricted by the number of effective fishing days and the number of vessels by country. The minimum stretched mesh size is 35 mm. Bycatch is limited by mandatory sorting grids and by the temporary closing of areas where excessive bycatch of juvenile cod, haddock, Greenland halibut, redfish or shrimp <15 mm CL is registered.

Catch. Overall catches have ranged from 5 000 to 128 000 t/yr (Fig. 6.2). The most recent peak was seen in 2000 at approximately 83 000 t. Catches thereafter declined to about 21 000 t in 2010 due to reduced profitability of the fishery (reduced shrimp prices and increased fuel prices). Based on information from the industry, catch statistics until August and the seasonal fishing pattern of the most recent years the 2011 catches are predicted to reach 23 000 t.

Table 6.1. Shrimp in ICES SA I and II: Recent catches (2001–2011) in metric tons, as used by NIPAG for the assessment.

	2001	2002	2003	2004	2005[1]	2006[1]	2007[1]	2008[1]	2009[1]	2010[1]	2011[2]
Recommended TAC	-	-	-	-	41 299[3]	40 000	50 000	50 000	50 000	50 000	60 000
Norway	43 031	48 799	34 172	35 918	36 943	27 351	25 509	20 953	19 769	16 779	18 000
Russia	5 846	3 790	2 186	1 170	933	0	9	371	0	0	0
Others	8 659	8 899	1 599	4 211	3 519	2 107	3 763	5 130	3 796	4 074	5 000
Total	57 536	61 488	37 957	41 299	41 395	29 458	29 281	26 454	23 565	20 853	23 000

[1] Minor revisions made in 2011;
[2] Catches projected to the end of the year;
[3] Should not exceed the 2004 catch level (ACFM, 2004).

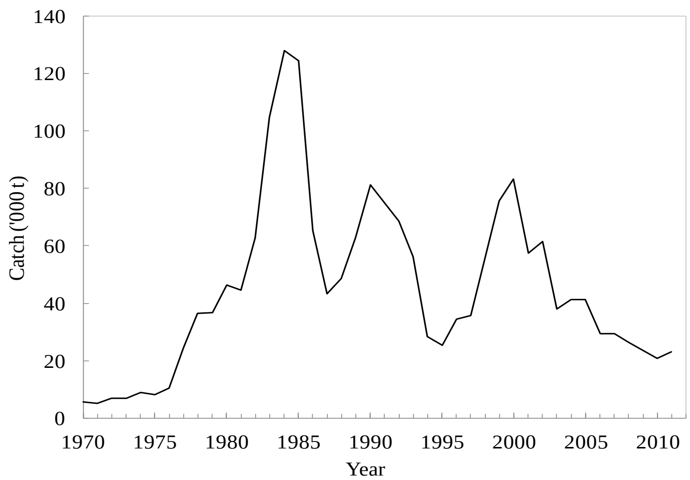


Fig. 6.2. Shrimp in ICES SA I and II: total catches 1970–2011 (2011 projected to the end of the year).

Discards and bycatch. Discard of shrimp cannot be quantified but is believed to be small as the fishery is not limited by quotas. Bycatch rates of other species are estimated from surveillance and research surveys and are corrected for differences in gear selection pattern (SCR Doc. 07/86). The bycatch rates in specific areas are then multiplied by the corresponding shrimp catch from logbooks to give the overall bycatch.

Since the introduction of the Nordmøre sorting grid in 1992, only small cod, haddock, Greenland halibut, and redfish in the 5–25 cm size range are caught as bycatch. The bycatch of small cod ranged between 2–67 million individuals/yr and redfish between 2–25 million individuals/yr since 1992, while 1–9 million haddock/yr and 0.5–14 million Greenland halibut/yr were registered in the period 2000–2004 (Fig. 6.3). In recent years there has been a decline in bycatch following a reduced effort in the shrimp fishery. Details of bycatch is reported in AFWG.

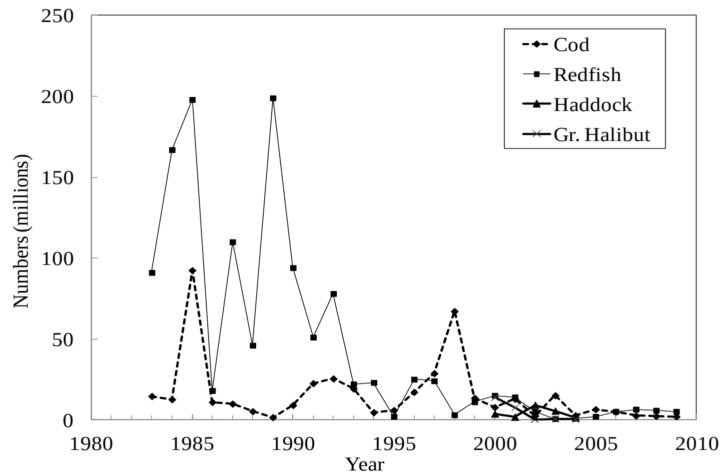


Fig. 6.3. Shrimp in ICES SA I and II: Estimated bycatch of cod, haddock, Greenland halibut and redfish in the Norwegian shrimp fishery (million individuals). No data available for 2010-11.

Environmental considerations. Temperatures in the Barents Sea have been high during the last nine years, mostly due to the inflow of warm water masses from the Norwegian Sea.

In 2011, temperatures close to the bottom were in general close to those in 2010, and still above the long-term mean by 0.2–0.7°C in most of the Barents Sea. Only small areas with temperatures below 1°C were observed. Shrimps were only caught in areas where bottom temperatures were above 0°C (Fig. 6.4). Highest shrimp densities were found between zero and 4°C, while the upper limit of temperature tolerance appeared to lie at about 6-8°C. The wedge of near-zero-degrees water observed in 2009 in the central Barents Sea, which appeared to have driven the distribution of shrimps more easterly, was less evident in 2010 - 11 (Fig. 6.4).

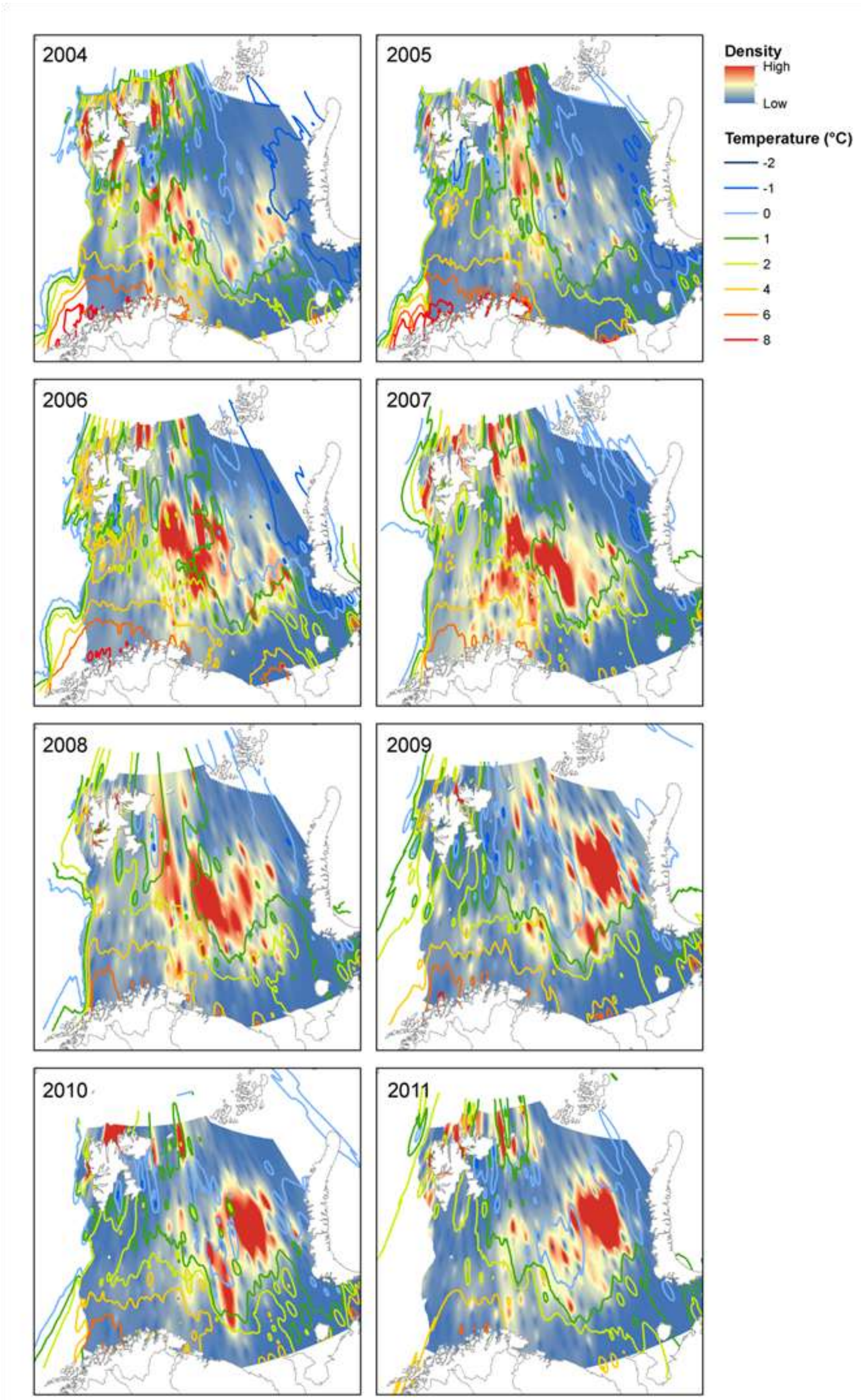


Fig. 6.4. Shrimp in ICES SA I and II: Bottom temperature contour overlays from the 2004 to 2011 ecosystem surveys on shrimp density distributions.

b) Input Data

i) Commercial fishery data

A major restructuring of the shrimp fishing fleet towards fewer and larger vessels has taken place since the mid-1990s. At that time an average vessel had around 1 000 HP; 10 years later this value had increased to more than

6 000 HP (Fig. 6.5). Until 1996 the fishery was conducted by using single trawls only. Double trawls were then introduced, and in 2002 approximately ⅔ of the total effort (trawl-time) spent was by using two trawls simultaneously. In 2000 a few vessels started to experiment with triple trawls: 58% of the effort in 2010 is accounted for by this fishing method (Fig. 6.6). An individual vessel may alternate between single and multiple trawling depending on what is appropriate on given fishing grounds.

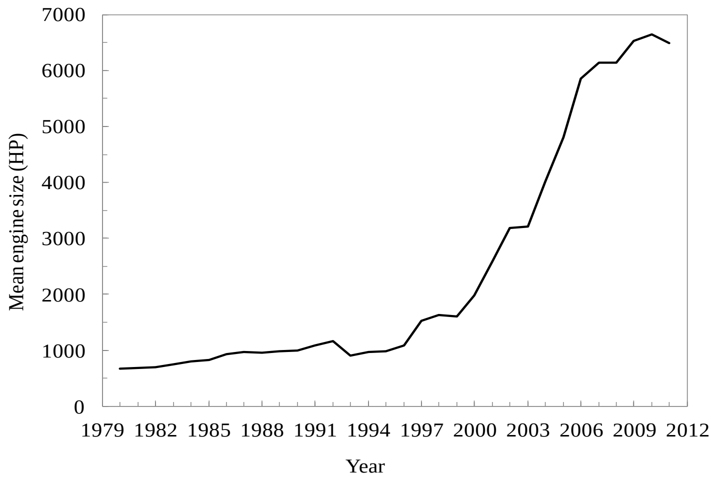


Fig. 6.5. Shrimp in ICES SA I and II: Mean engine power (HP) weighted by trawl-time, in the years 1980–2011.

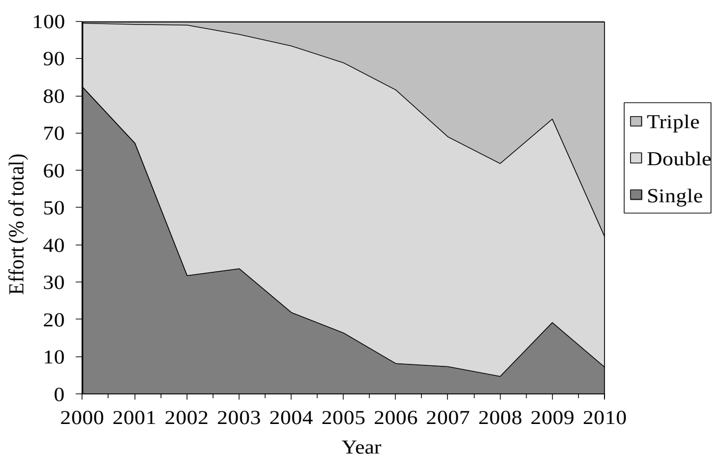


Fig. 6.6. Shrimp in ICES SA I and II: Percentage of total fishing effort spent by using single, double or triple trawls 2000–2010 (Norwegian data).

The fishery is conducted mainly in the central Barents Sea and on the Svalbard Shelf (Fig. 6.7). The fishery takes place throughout the year but may in some years be restricted by ice conditions. The lowest effort is generally seen in October through March, the highest in May to August.

Logbook data from 2009 to 2011 show decreased activity in the Hopen Deep, coupled with increased effort further east in international waters in the so-called “Loop Hole” (Fig 6.7). Information from the industry points to high densities of shrimp in the “Loop Hole” and closures in the traditional Hopen Deep fishing area due to high levels of juvenile redfish bycatch as the main reasons for the observed change in fishing pattern.

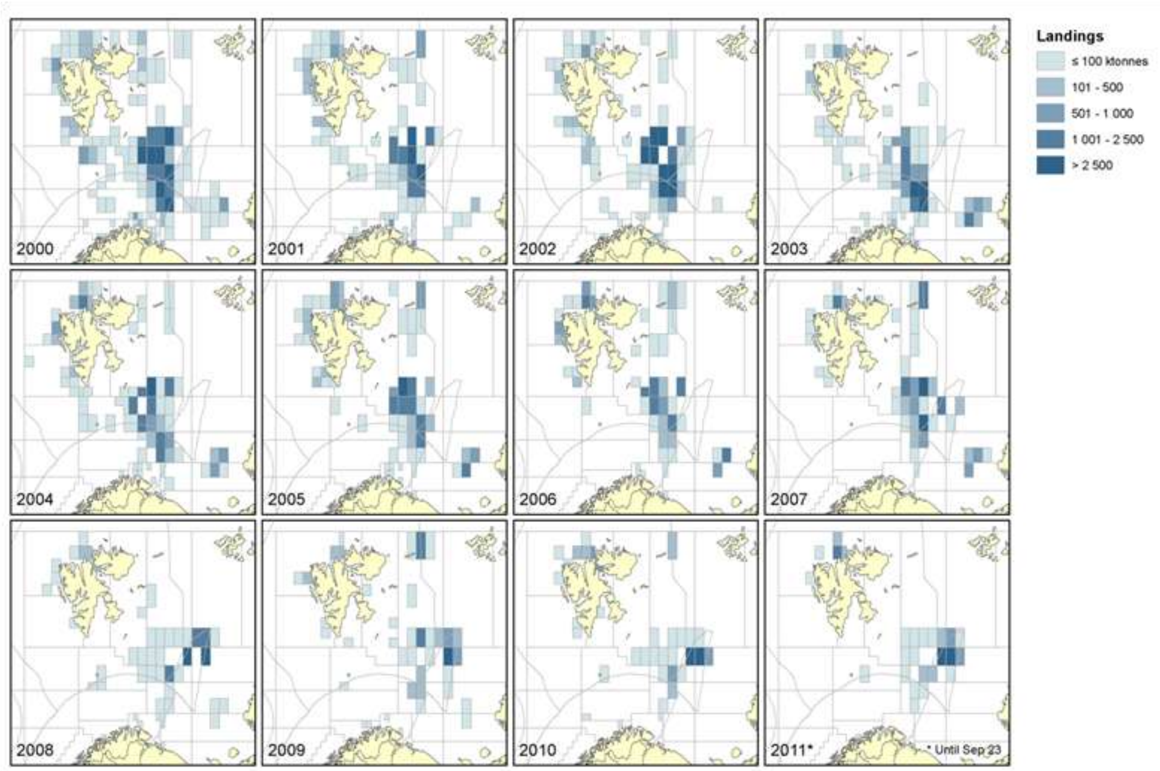


Fig. 6.7. Distribution of catches by Norwegian vessels 2000-2011 based on logbook information. (2011 only data until August)

Norwegian logbook data were used in a multiplicative model (GLM) to calculate standardized annual catch rate indices (SCR Doc. 11/66). A new index series based on individual vessels rather than vessel groups was introduced in 2008 (SCR Doc. 08/56) in order to take into account the changes observed in the fleet. The GLM model to derive the CPUE indices included the following variables: (1) vessel, (2) season (month), (3) area, and (4) gear type (single, double or triple trawl). The resulting series is assumed to be indicative of the biomass of shrimp ≥17 mm CL, *i.e*. females and older males.

The standardized CPUE declined by 60% from a maximum in 1984 to the lowest value of the time series in 1987 (Fig. 6.8). Since then it has showed an overall increasing trend. A new peak was reached in 2006. The 2007 to 2011 mean values have fluctuated 5-10% below the 2006-value, but are still above the average of the series. The standardized effort (Fig. 6.9) has shown a decreasing trend since 2000.

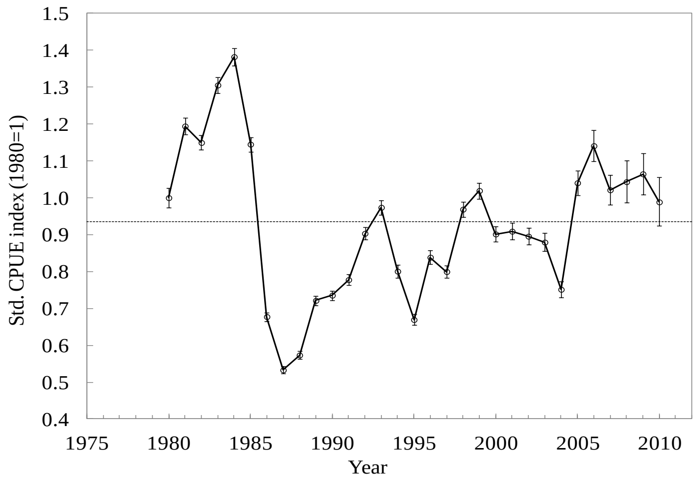


Fig. 6.8. Shrimp in ICES SA I and II: standardized CPUE based on Norwegian data. Error bars represent one standard error; dotted line is the overall mean of the series.

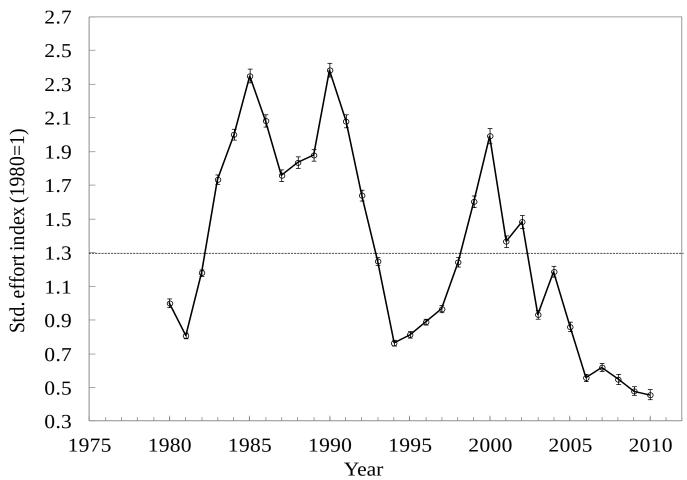


Fig. 6.9. Shrimp in ICES SA I and II: Standardized effort (Catch divided with standardized CPUE). Error bars represent one standard error; dotted line is the overall mean of the series.

ii) Research survey data

Russian and Norwegian shrimp surveys have been conducted in their respective EEZs of the Barents Sea since 1982 to assess the status of the northern shrimp stock (SCR Doc. 06/70, 07/75). The main objectives were to obtain indices for stock biomass, abundance, recruitment and demographic composition. In 2004, these surveys were replaced by the joint Norwegian-Russian "Ecosystem survey" which monitors shrimp along with a multitude of other ecosystem variables.

The Norwegian shrimp survey 1982–2004, covering the most important shrimp grounds for that period, and the Joint Russian - Norwegian Ecosystem survey 2004-present, covering the entire area, were used as input for the assessment model.

Biomass. The Biomass index of the Norwegian shrimp survey cycled with a period of approximately 7 years between 1982 and 2004 (Fig. 6.10). The Joint Russian - Norwegian Ecosystem survey has not been calibrated to the Norwegian shrimp survey. The estimate of mean biomass increased by about 66% from 2004 to 2006 and then decreased back to the 2004-value in 2008 (Fig. 6.10). The 2010 and 2011 values is back up close to that of 2006.

The geographical distribution of the stock in 2009-2011 is more easterly compared to that of the previous years (Fig. 6.11).

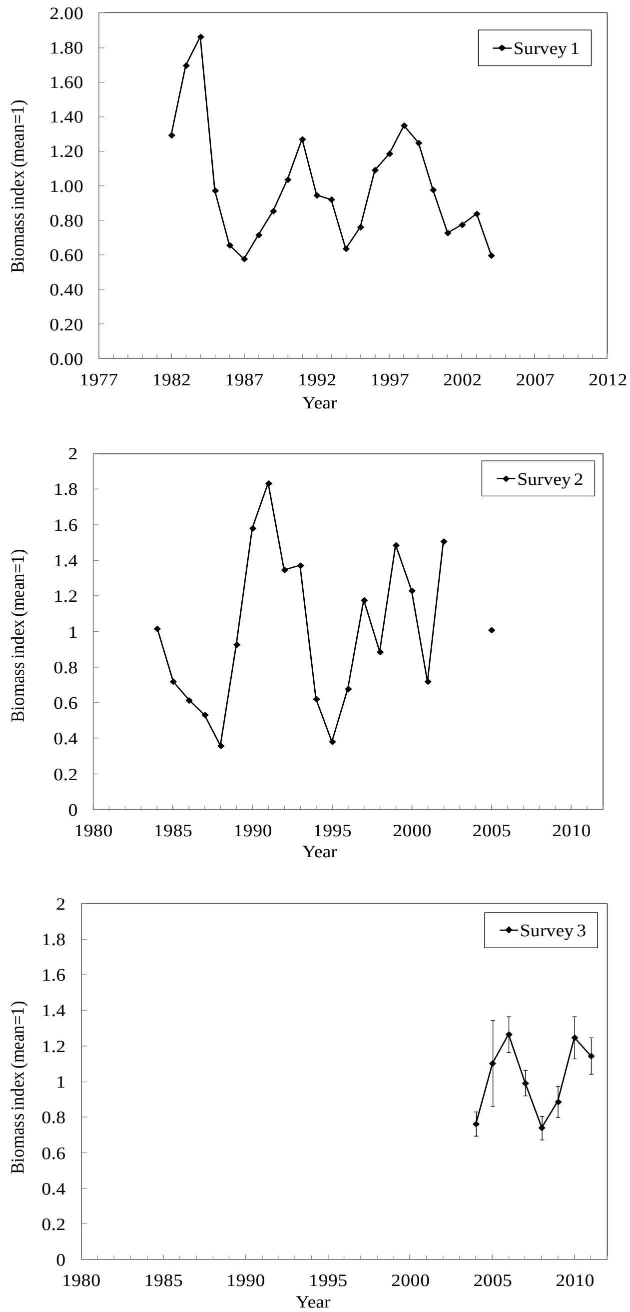


Fig. 6.10. Shrimp in ICES SA I and II: Indices of total stock biomass from the (1) 1982-2004 Norwegian shrimp survey, (2) the 1984-2005 Russian survey, and (3) the joint Russian-Norwegian ecosystem survey. Error bars represent one standard error.

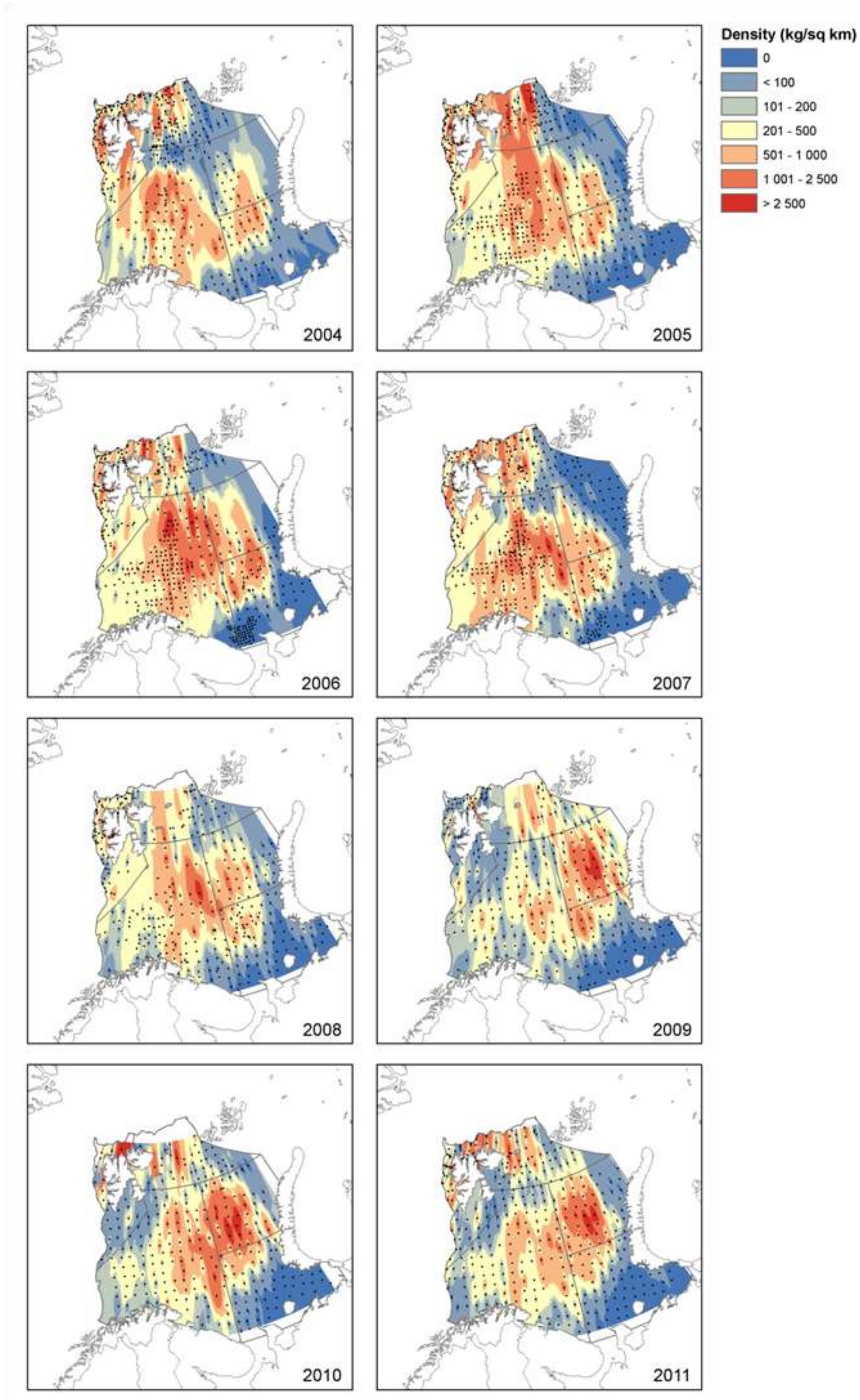


Fig. 6.11. Shrimp in ICES SA I and II: Shrimp density (kg/km^2) as calculated from the Ecosystem survey data 2004–2011).

Recruitment indices. Recruitment indices were derived from the overall size distributions based on Russian and Norwegian samples (SCR Doc. 11/63 and 11/65 respectively) as estimated abundance of shrimp at 13 to 16 mm CL. Shrimp at this size will probably enter the fishery in the following one to two years. The recruitment indices have decreased from 2004 to 2007-2008 but were higher in 2009 to 2011 (Fig. 6.12). The series based on Russian samples was updated in 2011.

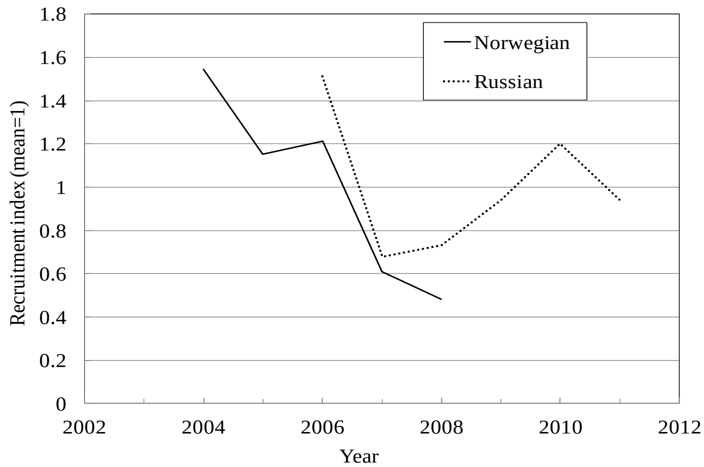


Fig. 6.12. Shrimp in ICES SA I and II: Indices of recruitment: abundance of shrimp at size 13–16 mm CL based on Norwegian survey samples 2004-2008 and Russian survey samples 2006-2011.

c) Estimation of Parameters

The modelling framework introduced in 2006 (Hvingel, 2006) was used for the assessment. Model settings were the same as ones used in previous years.

Within this model, parameters relevant for the assessment and management of the stock are estimated, based on a stochastic version of a surplus-production model. The model is formulated in a state-space framework and Bayesian methods are used to construct "posterior" likelihood distributions of the parameters (SCR Doc. 11/71).

The model synthesized information from input priors, three independent series of shrimp biomass indices and one series of shrimp catch. The three biomass indices were: a standardized series of annual commercial - vessel catch rates for 1980–2010 (Fig. 6.10, SCR Doc. 11/66); and trawl-survey biomass indices for 1982–2004 and for 2004–2010 (Fig, 6.10, SCR Doc. 07/75). These indices were scaled to true biomass by catchability parameters and lognormal observation errors were applied. Total reported catch in ICES Div. I and II 1970–2010 was used as yield data (Fig. 6.2, SCR Doc. 11/66). The fishery being without major discarding problems or variable misreporting, reported catches were entered into the model as error-free.

Absolute biomass estimates had relatively high variances. For management purposes, it was therefore desirable to work with biomass on a relative scale in order to cancel out the uncertainty of the "catchability" parameters (the parameters that scale absolute stock size). Biomass, *B,* was thus measured relative to the biomass that would yield Maximum Sustainable Yield, B_{msy}. The estimated fishing mortality, *F*, refers to the removal of biomass by fishing and is scaled to the fishing mortality at MSY, F_{msy}. The state equation describing stock dynamics took the form:

$$P_{t+1} = \left(P_t - \frac{C_t}{B_{MSY}} + \frac{2\,MSY\,P_t}{B_{MSY}}\left(1 - \frac{P_t}{2}\right)\right) \cdot \exp(\nu_t)$$

where P_t is the stock biomass relative to biomass at MSY ($P_t = B_t/B_{MSY}$) in year *t*. This frames the range of stock biomass on a relative scale where B_{MSY} = 1 and the carrying capacity (*K*) equals 2. The ‘process errors’, *v*, are normally, independently and identically distributed with mean 0 and variance σ_P^2 .

The observation equations had lognormal errors, ω, κ and ε , for the series of standardised CPUE ($CPUE_t$), Norwegian shrimp survey ($surv_R$) and joint ecosystem survey ($surv_E$) respectively giving:

$$CPUE_t = q_C B_{MSY} P_t \exp(\omega_t), \quad survR_t = q_R B_{MSY} P_t \exp(\kappa_t), \quad survE_t = q_E B_{MSY} P_t \exp(\varepsilon_t)$$

The observation error terms, ω, κ and ε are normally, independently and identically distributed with mean 0 and variance σ_C^2 , σ_R^2 and σ_E^2 respectively.

Summaries of the estimated posterior probability distributions of selected parameters are shown in Table 6.2. Values are similar to the ones estimated in the 2010 assessment.

Table 6.2. Shrimp in ICES SA I and II : Summary of parameter estimates: mean, standard deviation (sd) and 25, 50, and 75 percentiles of the posterior distribution of selected parameters (symbols are as in the text). *MSY* = Maximum Sustainable Yield (kt), *K* = carrying capacity, B_{msy} = biomass that produces MSY, *r* = intrinsic growth rate, *qC*, *qR* and *qE* are catchability parameters, P_0 = the 'initial" stock biomass in 1969, σ = CV of CPUE and surveys, and σ_p = the process error.

	Mean	Sd	25 %	Median	75 %
MSY (ktons)	246	183	112	195	329
K (ktons)	3196	1804	1849	2782	4100
R	0.32	0.16	0.21	0.31	0.42
q_R	0.14	0.11	0.07	0.11	0.18
q_E	0.20	0.15	0.10	0.16	0.25
q_C	5.1E-04	3.8E-04	2.5E-04	4.0E-04	6.3E-04
P_0	1.50	0.26	1.33	1.50	1.68
P_{2011}	2.02	0.54	1.68	1.98	2.31
σ_R	0.18	0.03	0.16	0.18	0.20
σ_E	0.17	0.04	0.14	0.16	0.19
σ_C	0.13	0.02	0.11	0.12	0.14
σ_P	0.19	0.03	0.17	0.19	0.21

Reference points. In 2009 ICES adopted a "Maximal Sustainable Yield (MSY) framework" (ACOM. ICES Advice, 2010. Book 1. Section 1.2) for deriving advice. There are now 3 reference points to be considered: F_{msy}, $B_{trigger}$ and B_{lim}. In the MSY management approach the F_{lim} is somewhat redundant, however, recent discussions on the setting of an F_{lim} reference can be found in the 2009 NIPAG report. F_{msy} and the probability of exceeding it can be estimated, as well as the risk of exceeding B_{lim} which is set at 30% B_{msy} (NIPAG, 2006), F_{lim} suggested to be 170% of F_{msy} (NIPAG, 2009) and $B_{trigger}$ set at 50% B_{msy} (NIPAG 2010).

d) Assessment Results

The results of this year's model run are similar to those of the previous years (model introduced in 2006).

Stock size and fishing mortality. Since the 1970s, the estimated median relative biomass (B/B_{msy}) has been above 1 (Fig. 6.13, upper panel) and the probability that it had been below B_{msy} was small for most years, *i.e.* it seems likely that the stock has been above B_{msy} since the start of the fishery.

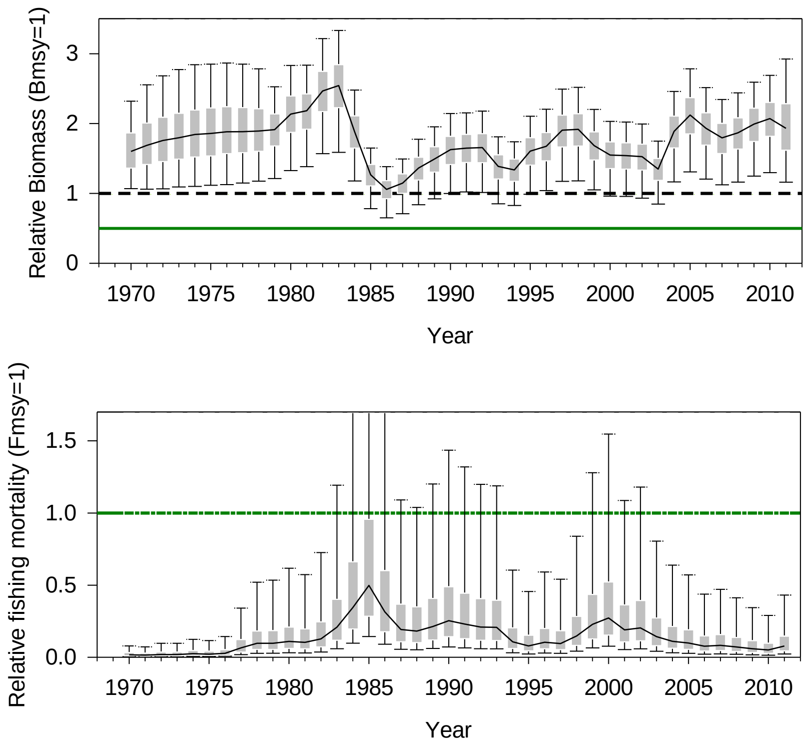


Fig. 6.13. Shrimp in ICES SA I and II: estimated relative biomass (B_t/B_{msy}) and fishing mortality (F_t/F_{msy}) for the years (t) 1970–2011. Boxes represent inter-quartile ranges and the solid black line at the (approximate) centre of each box is the median; the arms of each box extend to cover the central 95% of the distribution.

A steep decline in stock biomass was noted in the mid 1980s following some years with high catches and the median relative biomass went close to 1 (Fig. 6.13). Since the late 1990s the stock has varied with an overall increasing trend and reached a level estimated to be close to K in 2005. The estimated risk of stock biomass being below B_{MSY} in 2010 and 2011 was <2.5% (Table 6.3). The median relative fishing mortality (F/F_{MSY}) has been well below 1 throughout the series (Fig. 6.13). In 2010 and 2011 there is <1% risk of exceeding F_{MSY} (Table 6.3).

Table 6.3. Shrimp in ICES SA I and II: stock status for 2010 and predicted to the end of 2011 assuming a total catch of 23 ktons. (170% F_{MSY} = fishing mortality that corresponds to a B_{lim} at $0.3B_{MSY}$).

Status	2010	2011*
Risk of falling below B_{lim} ($0.3B_{MSY}$)	<1 %	<1 %
Risk of falling below B_{triq} ($0.5B_{MSY}$)	<1 %	<1 %
Risk of falling below B_{MSY}	1.7 %	2.1 %
Risk of exceeding F_{MSY}	<1 %	<1 %
Risk of exceeding $1.7F_{MSY}$	<1 %	<1 %
Stock size (B/B_{MSY}), median	2.07	1.98
Fishing mortality (F/F_{MSY}), median	0.05	0.06
Net Production (% of MSY)	-15 %	3 %

Estimated median biomass has been above $B_{trigger}$ and fishing mortality ratio has been below F_{msy} throughout the time series (Fig. 6.14). At the end of 2011 there is less than 1% risk that the stock would be below $B_{trigger}$, and that F_{msy} will be exceeded (Table 6.3).

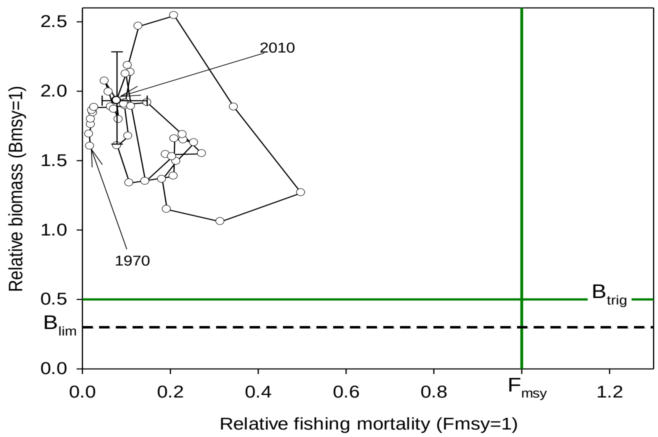


Fig. 6.14. Shrimp in ICES SA I and II: Estimated annual median biomass-ratio (B/B_{MSY}) and fishing mortality-ratio (F/F_{MSY}) 1970–2010. The reference points for stock biomass, B_{lim}, and fishing mortality, F_{MSY}, are indicated by the bold lines and $B_{trigger}$ is shown as black dashed line. Error bars on the 2010 value are inter-quartile range.

Predictions. Assuming a catch of 23 kt for 2011, catch options up to 60 kt for 2012 have a low risk (<5%) of exceeding F_{MSY} (Table 6.4) and is likely to maintain the stock at its current high level.

Table 6.4. Shrimp in ICES SA I and II: Predictions of risk and stock status associated with six optional catch levels for 2012. (170% F_{MSY} = fishing mortality that corresponds to a B_{lim} at $0.3B_{MSY}$).

Catch option 2012 (ktons)	30	40	50	60	70	90
Risk of falling below B_{lim} ($0.3B_{MSY}$)	<1 %	<1 %	<1 %	<1 %	<1 %	<1 %
Risk of falling below B_{trig} ($0.5B_{MSY}$)	<1 %	<1 %	<1 %	<1 %	<1 %	<1 %
Risk of falling below B_{MSY}	2.5 %	2.6 %	2.7 %	3.0 %	2.9 %	3.1 %
Risk of exceeding F_{MSY}	1.3 %	2.1 %	3.1 %	4.4 %	5.5 %	8.7 %
Risk of exceeding $1.7F_{MSY}$	<1 %	<1 %	1.4 %	1.8 %	2.5 %	3.7 %
Stock size (B/B_{MSY}), median	1.93	1.92	1.92	1.91	1.89	1.89
Fishing mortality (F/F_{MSY}),	0.08	0.11	0.13	0.16	0.19	0.24
Net Production (% of MSY)	13 %	15 %	16 %	18 %	21 %	21 %

The risks associated with ten-year projections of stock development assuming annual catch of 30 000 to 90 000 t were investigated (Fig. 6.15). For all options the risk of the stock falling below B_{MSY} in the short to medium term (1-5 years) is low (<10%) and all of these catch options result in a probability of less than 5% of going below $B_{trigger}$ over a 10 year period (Fig. 6.13). Catch options up to 60 000 t, have a low risk (<5%) of exceeding F_{MSY} in the short term (Fig. 6.14).

Taking 90 000 t/yr will increase the risk of going below B_{MSY} to more than 10% during the ten years of projection (Fig. 6.15). However, the risk of going below $B_{trigger}$ remains under 5%. The risk that catches of this magnitude will not be sustainable (*prob*($F > F_{MSY}$)) in the longer term increase as compared to the 60 000 t option but is still below 15% after ten years.

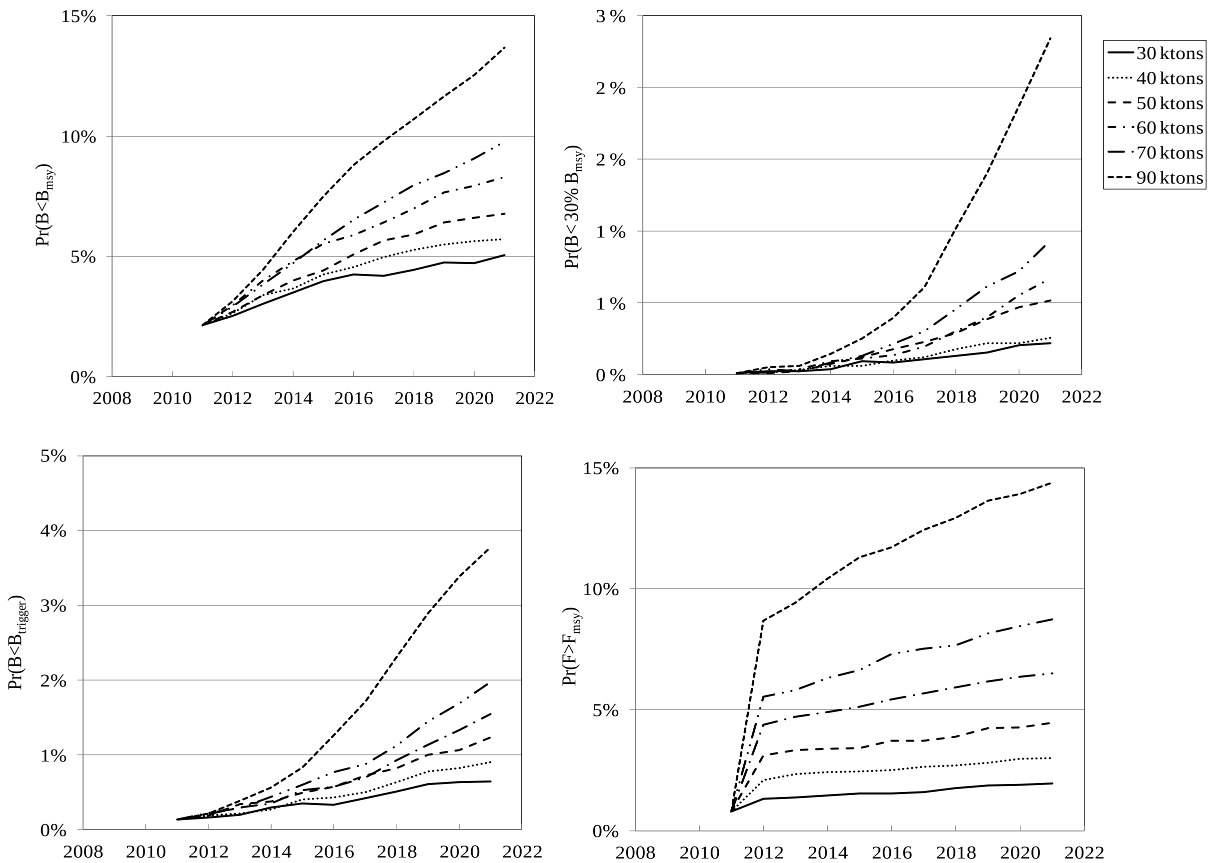


Fig. 6.15. Shrimp in ICES SA I and II: Projections of estimated risk of going below B_{MSY} and B_{lim} (top) and of going below $B_{trigger}$ and of exceeding F_{MSY} (bottom) given different catch options (see legend).

Yield predictions can be made for various levels of fishing mortalities (e.g. at target fishing mortality=F_{MSY}) but such estimates have high uncertainties as absolute biomass can only be estimated with relatively high variances (see section on “estimation of parameters”) and therefore such point estimates should be interpreted with caution. Instead we estimate yield at risk level of exceeding the target of F_{MSY} (Table 6.5) and managers may pick their preferred risk level from this.

Table 6.5. Shrimp in ICES SA I and II: Yield predictions (kt) at five risk levels of exceeding F_{msy}.

	Risk of exceeding F_{msy}				
Year	2.5 %	5 %	10 %	25 %	50 %
2012	43	68	98	181	321
2013	44	65	97	180	318
2014	42	62	91	165	286
2015	41	60	88	152	264
2016	39	58	84	142	247
2017	38	55	80	136	235
2018	38	53	76	130	229
2019	36	53	73	125	223
2020	36	51	71	121	216
2021	36	51	72	120	213

Additional considerations

Model performance. The model was able to produce good simulations of the observed data (Fig. 6.16). The observations did not lie in the extreme tails of their posterior distributions (Table 6.6.). The retrospective pattern of relative biomass series estimated by consecutively leaving out from 0 to 10 years of data did not reveal any problems with sensitivity of the model to particular years (Fig. 6.17).

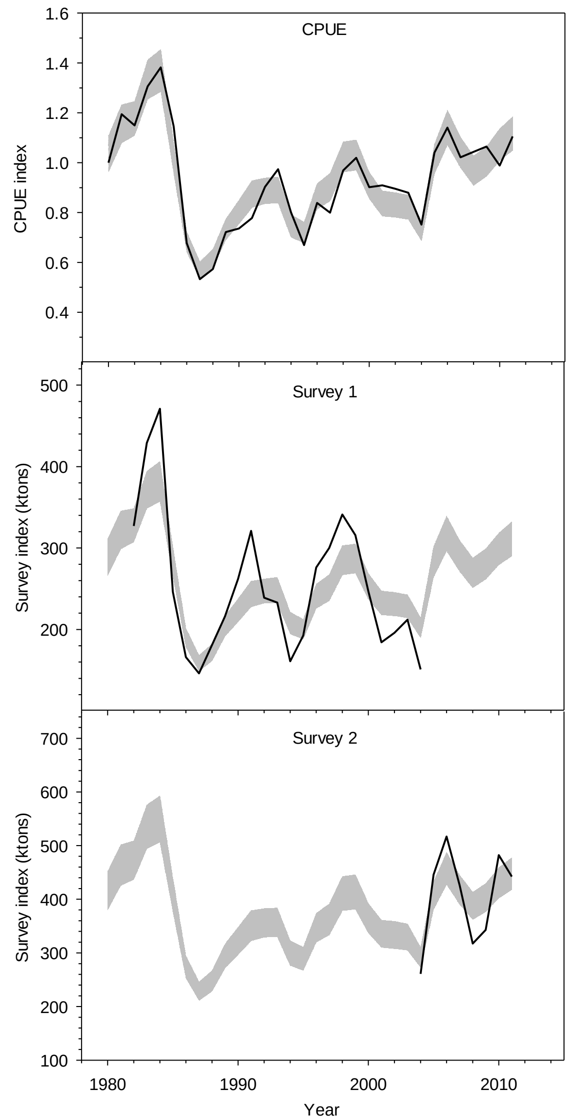


Fig. 6.16. Shrimp in ICES SA I and II: Observed (solid line) and estimated (shaded) series of the included biomass indices: the standardized catch-per-unit-effort (CPUE), the 1982–2004 shrimp survey (survey 1) and the joint Norwegian-Russian Ecosystem survey (survey 2). Grey shaded areas are the inter-quartile range of their posteriors.

Table 6.6. Model diagnostics: residuals (% of observed value) and probability of getting a more extreme observation (pr; pr=0.5 means the observations is in the center of its predicted distribution while values close to 1 or 0 means that it is in the tail).

	CPUE		Survey 1		Survey 2	
Year	resid (%)	pr	resid (%)	pr	resid (%)	pr
1980	3.99	0.42	-	-	-	-
1981	-2.97	0.59	-	-	-	-
1982	2.59	0.45	0.49	0.50	-	-
1983	2.27	0.45	-13.29	0.77	-	-
1984	-0.65	0.53	-18.82	0.85	-	-
1985	-11.02	0.79	15.35	0.25	-	-
1986	0.75	0.49	14.60	0.25	-	-
1987	7.03	0.33	8.82	0.35	-	-
1988	7.96	0.32	-4.82	0.60	-	-
1989	1.71	0.46	-5.32	0.62	-	-
1990	9.35	0.29	-14.45	0.79	-	-
1991	12.70	0.23	-23.93	0.92	-	-
1992	-1.55	0.55	3.59	0.43	-	-
1993	-8.43	0.73	6.62	0.38	-	-
1994	-6.75	0.69	29.21	0.11	-	-
1995	7.80	0.31	4.07	0.43	-	-
1996	3.24	0.44	-12.60	0.76	-	-
1997	13.09	0.22	-16.02	0.81	-	-
1998	5.87	0.37	-16.21	0.82	-	-
1999	1.39	0.47	-8.95	0.68	-	-
2000	0.96	0.48	2.57	0.45	-	-
2001	-7.89	0.71	26.73	0.13	-	-
2002	-7.14	0.70	18.23	0.21	-	-
2003	-6.46	0.68	8.02	0.36	-	-
2004	-3.13	0.59	34.20	0.07	11.89	0.29
2005	-2.28	0.56	-	-	-8.58	0.69
2006	0.21	0.50	-	-	-11.27	0.74
2007	2.10	0.45	-	-	-1.80	0.55
2008	-7.10	0.69	-	-	22.64	0.15
2009	-5.41	0.65	-	-	13.23	0.26
2010	8.69	0.30	-	-	-14.08	0.79
2011	-0.15	0.51	-	-	-2.65	0.57

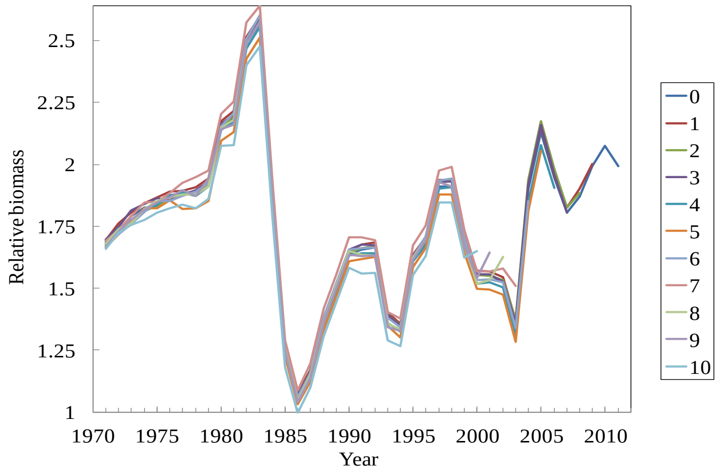


Fig. 6.17. Shrimp in ICES SA I and II: Retrospective plot of median relative biomass (B/B_{msy}). Relative biomass series are estimated by consecutively leaving out from 0 to 10 years of data.

Predation. Both stock development and the rate at which changes might take place can be affected by changes in predation, in particular by cod, which has been estimated to consume large amounts of shrimp. If predation on shrimp were to increase rapidly outside the range previously experienced by the shrimp stock within the modelled period (1970–2011), the shrimp stock might decrease in size more than the model results have indicated as likely. The cod stock has recently increased (AFWG, ICES). However, as the total predation depends on the abundance of cod, shrimp and also of other prey species (e.g. capelin) the likelihood of such large reductions is at present hard to quantify. Continuing investigations to include cod predation as an explicit effect in the assessment model has not so far been successful as it has not been possible to establish a relationship between shrimp/cod densities.

Recruitment/reaction time of the assessment model. The model used is best at describing trends in stock development but shows some inertia in its response to year-to-year changes. Large and sudden changes in recruitment may therefore not be fully captured in model predictions.

e) Summary

Mortality. The fishing mortality has been below F_{MSY} throughout the exploitation history of the stock. The risk that F will exceed F_{MSY} in 2011 is estimated to be less than 1%.

Biomass. The stock biomass estimates have been above B_{MSY} throughout the history of the fishery. Biomass at the end of 2011 is estimated to be well above $B_{trigger}$.

Recruitment. Recruitment indices, available only for part of the stock, decreased from 2004 to 2007-2008 but were higher in 2009 to 2011.

State of the Stock. The Stock is estimated to be close to the carrying capacity. The risk of stock biomass being below $B_{trigger}$ and fishing mortality above F_{MSY} at end 2011 is less than 1%.

Yield. A catch option of up to 60 000 t for 2012 would have less than 5% risk of exceeding F_{MSY}. Catch options up to 60 000 t/yr, have a low risk (<5%) of exceeding F_{MSY} in the coming 3 years.

f) Review of Recommendations from 2010

NIPAG **recommended** that, *for the shrimp stock in Barents Sea and Svalbard (ICES Div. I and II):*

- *Demographic information (length, sex and stage etc.) be collected also from the Norwegian part of* ***the Barents Sea ecosystem survey.***

STATUS: Data has been collected but no progress to date on its analysis.

- *Collaborative efforts should be made to standardize a means of predicting recruitment to the fishable stock.*

STATUS: No progress.

- *Work to include explicit information on recruitment in the assessment model should be continued.*

STATUS: Work ongoing.

g) Research Recommendations

There were no research recommendations.

Sources of Information: SCR Doc. 04/12, 06/64, 70; 07/75, 86; 08/56; 11/55, 65, 66, 71.

7. Northern shrimp in Fladen Ground (ICES Division IVa)

From the 1960s up to around 2000 a significant shrimp fishery exploited the shrimp stock on the Fladen Ground in the northern North Sea. A short description of the fishery is given, as a shrimp fishery could be resumed in this area in the future. The landings from the Fladen Ground have been recorded from 1972 (SCR Doc. 09/69, Table 9). Total reported landings since 1997 have fluctuated between zero in 2006 to above 4000 t (Table 6.1). The Danish fleet accounts for the majority of these landings, with the Scottish fleet landing a minor portion. The fishery took place mainly during the first half of the year, with the highest activity in the second quarter. Since 2006 no landings have been recorded from this stock.

Since 1998 landings have decreased steadily and since 2004 the Fladen Ground fishery has been virtually non-existent with total recorded landings being less than 25 t. Interview information from the fishing industry obtained in 2004 gives the explanation that this decline is caused by low shrimp abundance, low prices on the small shrimp which are characteristic of the Fladen Ground, and high fuel prices. This stock has not been surveyed for several years, and the decline in this fishery may reflect a decline in the stock.

Table 7.1. Northern shrimp in Fladen Ground: Landings of *Pandalus borealis* (t) from the Fladen Ground (ICES Div. IVa) estimated by NIPAG.

Country/Fleet	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Denmark	3 022	2 900	1 005	1 482	1 263	1 147	999	23	10	0	0	0	0	0
Norway	9	3	9		18	9	8	0	0	0	0	0	0	0
Sweden							1	0	0	0	0	0	0	0
UK (Scotland)	365	1 365	456	378	397	70		0	0	0	0	0	0	0
Total	3 396	4 268	1 470	1 860	1 678	1 226	1 008	23	10	0	0	0	0	0

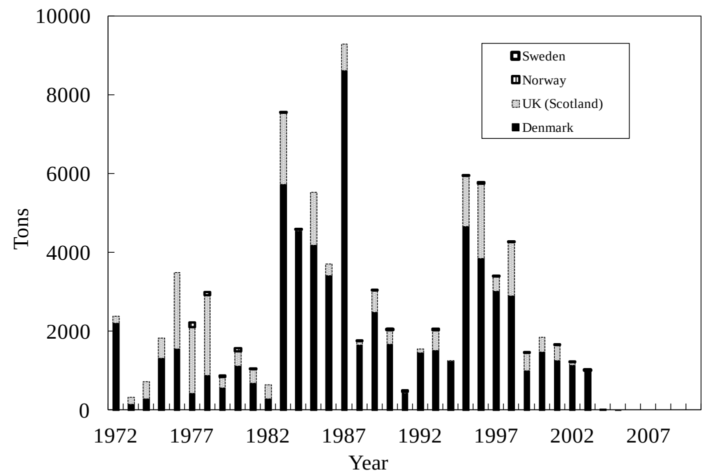


Fig. 7.1. Northern shrimp in Fladen Ground: Catches

IV. ADDITIONAL REQUESTS FROM FISHERIES COMMISSION - NAFO

1. PA reference points for shrimp in Div. 3LNO

This request was also addressed to Scientific Council in 2009 (NAFO Scientific Council Report., 2009, page 232). NIPAG has been working to provide values for these reference points. Appropriate models have not yet been developed to a point where they have been accepted as a basis for the determination of reference points, and so NIPAG is unable to provide appropriate reference points to address this request.

V. OTHER BUSINESS

There was no other business.

VI. ADJOURNMENT

The NIPAG meeting was adjourned at 1200 hours on 26 October 2011. The Co-Chairs thanked all participants, especially the designated experts and stock coordinators, for their hard work. The Co-Chairs thanked the NAFO and ICES Secretariats for all of their logistical support.

APPENDIX I. TECHNICAL MINUTES FROM THE REVIEW OF ICES STOCKS OF NAFO/ICES PANDALUS ASSESSMENT GROUP (NIPAG) (REPORT 2011)

26.10.2011. – 28.10-2011

By correspondence

Reviewers:

Max Cardinale, Lionel Pawlowski, and Tammo Bult (chair)

Chair WG- ICES Stocks: Carsten Hvingel

Secretariat: Barbara Schoute

General

The Review Group considered the following stocks:

Species	Stock name	Type assessment
pand-sknd	Northern shrimp (*Pandalus borealis*) in Division IIIa West and Division IVa East (Skagerrak and Norwegian Deeps)	Updated - advice
pand-barn	Northern Shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea)	Updated - advice
pand-flad	Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)	No assessment - Same advice as last year

The review group worked by correspondence. Each stock was revised by two reviewers and a final overall check was done by all.

General comments

The report is very well organized, easy to follow and to interpret. As in the previous years, the report refers several working documents important to clarify some issues. No Management consideration section is presented in each section as it was recommended last year by the RG.

The working group indicated that the timing of the review and advice drafting group, overlapping with the NIPAG meeting, does not improve the quality of the work. The RG agrees with comments from the working group that the timing of the work should be less constricted.

NORTHERN SHRIMP IN SKAGERRAK AND NORWEGIAN DEEPS (ICES DIV. IIIA WEST AND IVA EAST (REPORT SECTION 5)

1) **Assessment type: update,** trends in Danish and Norwegian LPUEs and from Norwegian shrimp survey

2) **Assessment**: no analytical assessment

3) **Forecast**: not performed

4) **Assessment model**: Standardized LPUE (GLM) and Stock size index from surveys (Stratified sampling including swept area)

5) **Consistency**: consistent with last year assessment.

6) **Stock status**: Biomass declining since 2007. Declining trends for recruitment from 2007 to 2010. 2011 is around the level seen in the previous 3 years. No reference points defined

7) **Man. Plan.**: None

General comments

A significant effort has made by the WG to deal with most of the comments made by the RG in previous years. As last year, the document is easy to follow. A recurring comment from last year is to replace for clarification the "in recent years" by an explicit indication of the period.

- Landings. The landings in 2010 are substantially lower than in 2009 (-3500t) with lower landings from Norway, Denmark and Sweden. While it is explained that Danish and Norwegian fleets have undergone major restructuring "in recent years" which probably explains why landings have decreased, it is not clear why Swedish landings are also lower. I am although wondering if 2010 data are preliminary or complete, or are there other explanation for the big drop observed for all countries ?

- Catch and discards. Some of the length distributions in doc 11/67 should probably be added into this section as there's a paragraph on length distribution but no figure in the report. As requested last year, there are now explanations about the uncertainties on discards and highgradings for Swedish and Norwegian fleets with clarification about the sources of those uncertainties. Absolute values of discard should be derived using annual discard data that should have been collected through the DCF framework at least for the Danish and Swedish fisheries. Since this has been pointed out also in previous report, the sampling should have been changed accordingly and therefore saying that few samples are taken is not acceptable.

- Commercial fishery data. As last year, some exploratory work would be interesting regarding the inclusion of swedish LPUEs or at least, the evaluation on how the level of uncertainty regarding high-grading affect those LPUEs. The Swedish LPUE data should be also modelled as those are an important part of the catch information in the area. This has been recommended now since several years but nothing has been done in that direction. Saying that the work is in progress is not acceptable anymore.

- The standardization procedures are now appropriate but I suggest that next time the working documents were the procedures are explained in details are included in the review process. The standardization is the most important part of this assessment (and also for the Barents Sea stock) and needs careful examination.

- Landings. As mentioned above, having length distribution, catch at age data year by year would be nice to have in the main body of the report.

- surveys. Confidence intervals are missing for survey 1. The text does not explain the increasing trend from 1988 to the mid 1990s.

Conclusions and recommendations

The stock follows the same trends as last year. All indicators suggest a declining biomass. Recruitment in 2011, although slightly higher than in 2010 is one of the lowest recruitment of the 2006-2011 time series.

Following the comments from the last 2 years, this stock is now scheduled for a benchmark in 2012 therefore it is assumed that data and methods will be revisited. There are some work in progress regarding Swedish effort data and a modeling framework.

NORTHERN SHRIMP IN BARENTS SEA AND SVALBARD AREA (ICES SUBAREAS I AND II (REPORT SECTION 6)

1) **Assessment type: Update**

2) **Assessment: accepted**

3) **Forecast: stochastic forecast (10 years)**

4) **Assessment model: Bayesian version of a surplus-production model:** Input commercial CPUE, two surveys CPUE and total catch

5) **Consistency: consistent with last year assessment.**

6) **Stock status: B>B_{lim} and F<F_{lim}** being F_{lim}=F_{msy} and B_{lim}=0.3B_{msy}, B is above B_{msy} with a high probability

7) **Man. Plan.: No management plan is a agreed for this stock.**

General comments

A significant effort has made by the WG to deal with most of the comments made by the RG in previous years. This section is also easy to follow.

Technical comments:

The major deficiencies in the assessment are:

The standardization procedure of the commercial CPUE time series is again poorly explained. The WG did not make any effort to explain this aspect in the 2010 and now in the 2011 report. This is unfortunate as it makes the work of RG basically an academic exercise. The major issues are:

1. It is not explained how the vessel effect is modeled, theoretically it should be swept area or at least HP that is usually a proxy of it
2. A GAM should because: month has a cyclic effect (month 12 closer to month 1 than to month 9) and this can be modeled in a GAM
3. The year effect should be modeled as smoother as the year before is correlated with the year after since the biomass is made by several year classes merged together
4. The shape of the effect of the predictors should be showed in the report
5. The error distribution used is not mentioned
6. The residuals should be formally analysed
7. A spatial predictor should be included

The surveys sampling strategy is not explained and it should at least briefly. Is survey design a random stratified? How the index is derived? This should be clearly explained. I suggest that the survey index is also derived using a standardization procedure (i.e. GAM) (see comments above).

How is the uncertainty in the catchability parameters included in the estimation of the TAC? As it stands now, the reader is left out with no information to judge this rather crucial step of the analysis.

It would be nice to have The modelling framework from (Hvingel, 2006) as an annex or a properly referenced document. This section refers to a set of working documents from previous years. Tracking down those documents across years is difficult and will certainly be more difficult in the future. The presentation of the model and rationales for using relative biomass are well explained.

Reference points: this model seems to fit well the new ICES approach and guidelines on biological reference points. $B_{trigger}$ is set at 0.50 times the B_{msy} and B_{lim} is set at 0.30 times the B_{msy}. Both seem to be rather low in my opinion. As the framework here is different from the standard ICES approach, I think that ACOM should spend some time to get an agreement about the validity of these reference points for Northern Shrimp in Barents Sea and Svalbard area (ICES Subareas I and II).

Results and forecasts are nicely presented. The summary section is very straightforward. It is worth noting that few assessments within ICES includes the probability of risk of being below or over reference points and there have been recurring discussions in some WG (e.g. WGMG) about how to include uncertainties into the advices.

Like last year retrospective plot are too thick to be able to see some trends. Considering the retrospective effects are only visible for a few years, having only the last 10-15 years shown should probably be enough.

Conclusions and recommendations:

The assessment is done according to the annex and can be accepted as basis for advice. There does not seem to be major issues regarding the assessment and the data used.

NORTHERN SHRIMP IN FLADEN GROUND (ICES DIVISION IVA) (REPORT SECTION 7)

Assessment type: no assessment

- No direct shrimp fishery since 2005.

Comments

The conclusive comment "This stock has not been surveyed for several years, and the decline in this fishery may reflect a decline in the stock" is quite strong considering there's actually no fishery, no survey. The decline of this fishery may have been caused by low abundances, low benefits (low prices and high cost of fuel) but the current status of the stock is rather unknown.

Conclusions and recommendations:

Except landings which have been null since 2005, no new data are available on this stock therefore the available information is inadequate to evaluate stock trends. The state of this stock is unknown.

Should the landings of this fishery be back to substantial levels, some data collection program should be implemented.

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AGENDA I - SCIENTIFIC COUNCIL MEETING, 3-16 JUNE 2011

I. Opening (Scientific Council Chair: Ricardo Alpoim)
   1. Appointment of Rapporteur
   2 Presentation and Report of Proxy Votes (by Executive Secretary)
   3. Adoption of Agenda
   4. Attendance of Observers
   5. Appointment of Designated Experts
   6. Plan of Work
   7. Housekeeping issues

II. Review of Scientific Council Recommendations in 2010

III. Fisheries Environment (STACFEN Chair: Gary Maillet)
   1. Opening
   2. Appointment of Rapporteur
   3. Review of Recommendations in 2010
   4. Invited speaker
   5. Integrated Science Data Management (ISDM) Report for 2010
   6. Review of the physical, biological and chemical environment in the NAFO Convention Area during 2010
   7. Interdisciplinary studies
   8. An update of the on-line annual ocean climate status summary for the NAFO Convention Area
   9. Environmental indices and links to year-class strength
   10. Formulation of recommendations based on environmental conditions during 2010
   11. Review of Symposium on "Hydrobiological and ecosystem variability in the ICES and NAFO area during the first decade of the XXI century”
   12. National Representatives
   13. Other Matters
   14. Adjournment

IV. Publications (STACPUB Chair: Margaret Treble)
   1. Opening
   2. Appointment of Rapporteur
   3. Adoption of Agenda
   4. Review of Recommendations in 2010
   5. Review of Publications
      a) Annual Summary
         i) Journal of Northwest Atlantic Fishery Science (JNAFS)
         ii) Scientific Council Studies
         iii) Scientific Council Reports
         iv) Progress Report on Meeting Documentation CD
   6. Other Matters
      a) Review of roles for Editors (General, Associate and Guest)
      b) JNAFS General Editor
      c) Update on digitization of NAFO historical documents
      d) Search function for NAFO documents, including DOIs and ASFA
      e) American Fisheries Society recommendation on revised naming convention
      f) Facebook and Twitter on the NAFO website?
      g) Website Update
   7. Adjournment

V. Research Coordination (STACREC Chair: Carsten Hvingel)
   1. Opening
   2. Appointment of Rapporteur
   3. Review of Previous Recommendations
   4. Fishery Statistics
      a) Progress report on Secretariat activities in 2010/2011
         i) STATLANT 21A and 21B
         ii) Labelling of STATLANT catch figures in catch tables

iii) Information collected by the Secretariat
iv) Codes for invertebrates
5. Research Activities
a) Biological sampling
i) Report on activities in 2010/2011
ii) Report by National Representatives on commercial sampling conducted
iii) Report on data availability for stock assessments (by Designated Experts)
b) Biological surveys
i) Review of survey activities in 2010 (by National Representatives and Designated Experts)
ii) Surveys planned for 2011 and early 2012
- The international bottom survey (organized by EU-Spain)
- Other surveys
c) Tagging activities
d) ICES GHL ageing workshop, Feb 2011
e) Other research activities
6. Data Sharing Arrangements
7. Observer program
8. Use of VMS data
a) Presentation of D-4 Science, FAO
9. Cooperation with other Organizations
a) TXOTX
10. Review of SCR and SCS Documents
11. Other Matters
a) Stock-by-stock Research Vessel Surveys Reported
12. Adjournment

VI. Fisheries Science (STACFIS Chair: Joanne Morgan)
1. Opening
2. General Review
a) Review of Recommendations in 2010
b) General Review of Catches and Fishing Activity
3. Stock Assessments
a) Certain Stocks in Subareas 2, 3 and 4; as Requested by the Fisheries Commission with the Concurrence of the Coastal States (Annex 1)
i) Thoroughly assessed stocks (Item 2, Annex 1):
- American plaice in Div. 3LNO
- Redfish in Div. 3M
- Cod in Div. 3M
- American plaice in Div. 3M
- Witch flounder in Div. 3NO
- Yellowtail flounder in Div. 3LNO
- Capelin in Div. 3NO
- White hake in Div. 3NO
ii) Monitored stocks[4] (Item 2, Annex 1):
- Cod in Div. 3NO
- Redfish in Div. 3LN
- Witch flounder in Div. 2J3KL
- Redfish in Div. 3O
- Thorny skate in Div. 3LNOPs
- Northern shortfin squid in SA3+4
b) Certain Stocks in Subareas 0 and 1, as Requested by Denmark (Greenland) (Annex 3):
i) Thoroughly assessed stocks
- Demersal redfish

[4] Monitored stocks to be provided in the agreed format (NAFO Sci. Coun. Rep., 2005, Part A, Appendix IV, 2.i)

- Greenland halibut in Div. 1A inshore

Other finfish (American plaice, Atlantic wolfish, spotted wolffish and thorny skate) in SA 1

Monitored stocks:

- Roundnose grenadier in SA0+1

c) Stocks Overlapping the Fishery Zones in Subareas 0 and 1, as Requested by Canada and by Denmark (Greenland) (Annexes 2 and 3 respectively):

i) Thoroughly assessed stocks:

- Greenland halibut in the offshore area of Divisions 0A+lAB and Divisions 0B+lC-F (Annex 2, Item 1-2; Annex 3, Item 3)

d) Other stocks:

i) Monitored stocks:

- Roughhead grenadier in SA 2+3

4. Stocks under a Management Strategy Evaluation (FC Item 6)
   a) Greenland halibut in SA 2 and Div. 3KLMNO
5. Other Matters
   a) FIRMS Classification for NAFO Stocks
   b) Other Business
6. Adjournment

VII. Management Advice and Responses to Special Requests

1. Fisheries Commission (Annex 1)
   a) Request for Advice on TACs and Other Management Measures for 2012 (Item 6)
      i) Greenland halibut in SA 2 and Div. 3KLMNO
   b) Request for Advice on TACs and Other Management Measures (Item 2, Annex 1))

      For 2012

      - Cod in Div. 3M

      For 2012 and 2013

      - American plaice in Div. 3LNO
      - Redfish in Div. 3M
      - Yellowtail flounder in Div. 3LNO
      - Capelin in Div. 3NO
      - White hake in Div. 3NO

      For 2012, 2013 and 2014

      - American plaice in Div. 3M
      - Witch flounder in Div. 3NO
   c) Monitoring of Stocks for which Multi-year Advice was provided in 2010 (Item 2)
      - Cod in Div. 3NO
      - Redfish in Div. 3LN
      - Witch flounder in Div. 2J3KL
      - Redfish in Div. 3O
      - Thorny skate in Div. 3LNOPs
      - Northern shortfin squid in SA3+4
   d) Special Requests for Management Advice
      i) Reference points for Div. 3LNO American plaice, Div. 3NO cod, and Div. 3LN redfish (Item 7)
      ii) S/R and B_{lim} for Div. 3NO cod (Item 8)
      iii) Capelin distribution in Div. 3L (Item 9)
      iv) Mid-water trawl mesh size for Div. 3LN redfish (Item 10)
      v) Management measures for blue whiting (Item 11)
      vi) Catch estimation for Div. 3LNO thorny skate (Item 12)
      vii) Protection of corals and sponges (Item 13)
      viii GIS framework and SASI model (Item 14)
      ix) Fishery impact assessments (Item 15)
      x) Reduction/elimination of scientific tasks of observers (Item [16])
2. Coastal States
   a) Request by Denmark (Greenland) for Advice on Management in 2012 (Annex 3A)

i) Roundnose grenadier in SA 0+1 (Item 1)
ii) Redfish and other finfish in SA 1 (Item 2)
iii) Greenland halibut in Div. 1A inshore (Item 4)
iv) West Greenland shrimp audit of management plan (Annex 3B: Item 1)
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)

b) Request by Canada and Denmark (Greenland) for Advice on Management in 2011 (Annexes 2 and 3)
i) Greenland halibut in SA 0+1 (Annex 2: Item 1 and 2; Annex 3: Item 3)

3. Scientific Advice from Council on its own Accord
a) Oceanic (pelagic) redfish
b) Roughhead grenadier in SA2+3 (monitor)

VIII. Review of Future Meetings Arrangements
1. Scientific Council, Sep 2011
2. Scientific Council, Oct 2011
3. Scientific Council, Jun 2012
4. Scientific Council, Sep 2012
5. Scientific Council, Oct/Nov 2012
6. ICES/NAFO Joint Groups
a) NIPAG, 19-26 Oct 2011
b) NIPAG, Oct/Nov 2012
7. WGEAFM
8. WGRP
9. WGHARP
10. WGDEC

IX. Arrangements for Special Sessions
1. Topics for future Special Sessions

X. Meeting Reports
1. Working Group on EAFM, Dec 2010
2. Working Group on Reproductive Potential, Mar 2010
3. Report from WGDEC, Feb-Mar 2011 (including NAFO request)
4. Meetings attended by the Secretariat: PICES, FAO By-catch
5. ICES - SISAM (Brian Healey)
6. ICES - WGNARS

XI. Review of Scientific Council Working Procedures/Protocol
1. Election of Chairs
2. General Plan of Work for September 2011 Annual Meeting
3. Timing of Advice
4. Other Matters

XII. Other Matters
1. Designated Experts
2. Sponsorship of "PICES/ICES/IOC Climate Change symposium sponsorship", May 2012
3. Stock Assessment spreadsheets
4. Fisheries Managers and Scientists Working Groups
4. Meeting Highlights for NAFO Website
5. Scientific Merit Awards
6. Budget items
7. Other Business

XIII. Adoption of Committee Reports
1. STACFEN
2. STACREC
3. STACPUB
4. STACFIS

XIV. Scientific Council Recommendations to General Council and Fisheries Commission

XV. Adoption of Scientific Council Report

XVI. Adjournment

AGENDA II– SCIENTIFIC COUNCIL MEETING, 1-12 SEPTEMBER 2011

I) Opening (Chair: Ricardo Alpoim)
   1. Appointment of Rapporteur
   2. Adoption of Agenda
   3. Attendance of Observers
   4. Plan of Work

II) Fisheries Science (STACFIS Chair: Joanne Morgan)
   1. Opening
   2. Interim Monitoring Updates
      a) Northern Shrimp in Div. 3M
      b) Northern Shrimp in Div. 3LNO

III) Special Requests from the Fisheries Commission
   1. From September 2010
      a) Update on Advice for Northern Shrimp in Division 3M (Item 1)
      b) Update on Advice for Northern Shrimp in Divisions 3LNO (Item 1)
      c) Update on PA Reference points for shrimp in Div. 3LNO (Item 3)
      d) Update on Distribution of shrimp in Div. 3LNO (Item 4)
      e) Update on Effect of 5 000 t catch on shrimp abundance in Div. 3M (Item 5)

IV) Adoption of Reports
   1. Committee Report of STACFIS
   2. Report of Scientific Council

V) Adjournment

AGENDA III-SCIENTIFIC COUNCIL MEETING 19-23 SEPTEMBER

I. Opening (Chair: Ricardo Alpoim)
   1. Appointment of Rapporteur
   2. Adoption of Agenda
   3. Attendance of Observers
   4. Plan of Work

II. Review of Scientific Council Recommendations

III. Research Coordination (STACREC Chair: Carsten Hvingel)
   1. Opening
   2. Fisheries Statistics
      a) Progress of Secretariat activities
      b) Review of STATLANT 21
   3. Research Activities
      a) Surveys planned for 2011 and early 2012
   4. External Cooperation
      a) ICES Strategic Initiative on Stock Assessment Methods (SISAM)
   5. Review of Recommendations
   6. Other Matters
      a) Review of SCR and SCS Documents
      b) Other Business

IV. Fisheries Science (STACFIS Chair: Joanne Morgan)
   1. Opening
   2. Any matter outstanding from the WebEx SC Meeting, 1 - 12 September 2011
      a) Northern Shrimp in Div. 3M and Div. 3LNO
   3. Nomination of Designated Experts
   4. Other Matters
      a) Review of SCR and SCS Documents
      b) Other Business

V. Special Requests from the Fisheries Commission
   1. Ad hoc requests from current meeting

VI. Meeting Reports
   1. FC WGFMS-CPRS
   2. FC WGFMS-VME
   3. FC WGMSE
   4. ICES/NAFO WGHARP
   5. Meetings attended by the Secretariat
      a) ASFA Board Meeting
      b) Fifth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences
      c) ICES SGVMS
      d) UN General Assembly Workshop on Implementaion of UNGA Resolutions 61/105 and 64/7
      e) NEAFC/OSPAR/CBD Workshop on Identification of Ecologically and Biologically Significant Areas

VII. Review of Future Meeting Arrangements
   1. Scientific Council, October 2011
   2. Scientific Council, June 2012
   3. Annual Meeting, September 2012
   4. Scientific Council, October 2012
   5. Scientific Council, June 2013
   6. Scientific Council Working Groups
      a) WGEAFM, December 2011
   7. ICES/NAFO Joint Groups
      a) NIPAG, October 2011
      b) WGDEC, March 2012
      c) NIPAG, October 2012

VIII. Future Special Sessions

1. Topics for future special sessions

IX. Other Matters
   1. Review and comment on the scientific aspects of Annex 4 and Annex 5 of NAFO/FC Doc. 11/4 (Report of the Fisheries Commission Working Group of Fishery Managers and Scientists on Conservation Plans and Rebuilding Strategies (WGFMS-CPRS))
   2. Matters arising from Fisheries Commission Working Group on Management Strategy Evaluation for Greenland Halibut
   3. Coastal State request by Greenland on Harp seals (deferred from September 2010)
   4. Future Research on Mesh Sizes for Redfish in Div. 3LN
   5. FAO VME Database Meeting, December 2011
   6. Items arising from the NAFO Performance Assessment report
   7. Access to VMS data
   8. Change in NAFO Representation at WGDEC
   9. Presentation of Scientific Merit Award to Dr V. Rikhter
   10. Awards to Outgoing Chairs

X. Adoption of Reports
   1. Committee Reports of STACREC and STACFIS
   2. Report of Scientific Council

XI. Adjournment

AGENDA IV- SCIENTIFIC COUNCIL MEETING - 19–26 OCTOBER 2011

I. Opening (Chair: Carsten Hvingel)

1. Appointment of Rapporteur
2. Adoption of Agenda[1]
3. Attendance of Observers
4. Plan of Work

II. Review of Recommendations in 2010 and in 2011

III. NAFO/ICES *Pandalus* Assessment Group

IV. Formulation of Advice (see Annexes 1–3 of Appendix I)

1. Request from Fisheries Commission (Items 3, 4 and 5 of Annex I)
   a) Northern shrimp (Div. 3M)
   b) Northern shrimp (Div. 3LNO)
   c) PA Reference points for shrimp in Div. 3LNO

2. Requests from Coastal States (Items 1 and 2 of Annex II, item 5 of Annex IIIa, Annex IIIb and IIIc)
   a) Northern shrimp (Subareas 0 and 1)
   b) Northern shrimp (in Denmark Strait and off East Greenland)
   c) Audit of management plan for Northern Shrimp fishery to the west of Greenland
   d) Stock status of *P. montagui* in Subareas 0-1

V. Other Matters

1. Meeting of October–November 2012
2. Meeting of October–November 2013
3. Topics for Future Special Sessions
4. Items arising from the NAFO Performance Assessment
5. Other Business

VI. Adoption of Scientific Council and NIPAG Reports

VII. Adjournment

[1] Agenda to include relevant outcomes of the Scientific Council 1-13 Meeting and the NAFO Annual Meeting on 19–23 September 2011.

AGENDA V - NIPAG MEETING 19-26 OCTOBER 2011

I. Opening (Co-chairs: Jean-Claude Mahé and Carsten Hvingel)

1. Appointment of Rapporteur
2. Adoption of Agenda[1]
3. Plan of Work

II. General Review

1. Review of Recommendations in 2009 and in 2010
2. Review of Catches

III. Stock Assessments

- Northern shrimp (Division 3M)
- Northern Shrimp (Divisions 3LNO)
- Northern shrimp (Subareas 0 and 1)
- Northern shrimp (in Denmark Strait and off East Greenland)
- Northern shrimp in Skagerrak and Norwegian Deep (ICES Divisions IIIa and IVa East)
- Northern Shrimp in Barents Sea and Svalbard area (ICES Sub-areas I & II)
- Northern shrimp in Fladen Ground (ICES Division IVa)

IV. Other Business

V. Adjournment

[1] Agenda to include relevant outcomes of the Scientific Council 1–12 Meeting and the NAFO Annual Meeting on 19–23 September 2011.

Annex I. Fisheries Commission Requests for Scientific Advice on Management Options in 2012 and Beyond of Certain Stocks in Subareas 2, 3 and 4 and Other Matters

1. The Fisheries Commission with the concurrence of the Coastal State as regards to the stocks below which occur within its jurisdiction ("Fisheries Commission") requests that the Scientific Council provide advice in advance of the 2011 Annual Meeting, for the management of Northern shrimp in Div. 3M, 3LNO in 2012.

Noting that Scientific Council will meet in October of 2010 for 2012 TAC advice, Fisheries Commission requests the Scientific Council to update its advice on shrimp stocks in 2011 for 2012 TAC.

Fisheries Commission further requests that SC provide advice in accordance to Annex 1a.

2. Fisheries Commission requests that the Scientific Council provide advice for the management of the fish stocks below according to the following assessment frequency (unless Fisheries Commission requests additional assessments):

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

To continue this schedule of assessments, the Scientific Council is requested to conduct the assessment of these stocks as follows:

In 2011, advice should be provided for 2012 and 2013 for American plaice in Div. 3LNO, yellowtail flounder in Div. 3LNO, redfish in Div. 3M, white hake in Div. 3NO and capelin in Div. 3NO and for 2012, 2013 and 2014 American plaice in Div. 3M and witch flounder in Div. 3NO.

In 2011, advice should be provided for 2012 for 3M cod.

Fisheries Commission requests that SC provide advice in accordance to Annex 1.

The Fisheries Commission also requests the Scientific Council to continue to monitor the status of all these stocks annually and, should a significant change be observed in stock status (e.g. from surveys) or in bycatches in other fisheries, provide updated advice as appropriate.

3. With respect to Northern shrimp (*Pandalus borealis*) in Div. 3LNO, noting the NAFO Framework for Precautionary Approach and recognizing the desire to demonstrate NAFO's commitment to applying the precautionary approach, Fisheries Commission requests the Scientific Council to:

identify F_{msy}
identify B_{msy}
provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf})

4. The Scientific Council is requested to provide updated information on the proportion of the 3LNO shrimp stock that occurs in 3NO.

5. With respect to 3M shrimp, the Scientific Council estimated in 2009 a proxy for B_{lim} as 85% decline from the maximum observed index levels, this is 2600 t of female biomass. In 2009 the Scientific Council estimated biomass to be below B_{lim} and recommended fishing mortality to be set as close to zero as possible.

In 2009 estimated catches reached 5000 t. The Fisheries Commission decided on a 50% effort reduction in 2010 and provisional estimated catches up to September 2010 reached 1000 t. In its 2010 advice, the Scientific Council estimated biomass to be above B_{lim}, but reiterated its previous advice to set fishing mortality as close to zero as possible. The Fisheries Commission requests the Scientific Council to evaluate if the current level of catches is compatible with stock recovery, given that improvements in biomass levels were observed through current level of catches.

6. 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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

ADDITIONAL REQUEST

[16]. Fisheries Commission requests the Scientific Council to evaluate any negative scientific impacts resulting from reduction.

Annex 1 – Additional guidance in regards to questions 1 and 2.

Mindful of the desire to move to a risk-based approach in the management of fish stocks, Fisheries Commission requests the Scientific Council to provide a range of management options as well as a risk analysis for each option as outlined in the provisions below, rather than a single TAC recommendation.

1. The Fisheries Commission request the Scientific Council to consider the following in assessing and projecting future stock levels for those stocks listed above. These evaluations should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, in determining its management of these stocks:

a) The preferred tool for the presentation of a synthetic view of the past dynamics of an exploited stock and its future development is a stock assessment model, whether age-based or age-aggregated.

b) For those stocks subject to analytical-type assessments, the status of the stocks should be reviewed and catch options evaluated in terms of their implications for fishable stock size in both the short and long term. As general reference points, the implications of fishing at $F_{0.1}$ and F_{2010} in 2012 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options.

c) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and catch options evaluated in the way described above to the extent possible. In this case, the level of fishing effort or fishing mortality (F) required to take two-thirds MSY catch in the long term should be calculated.

d) For those resources for which only general biological and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of management requirements for long-term sustainability and the advice provided should be consistent with the precautionary approach.

e) Spawning stock biomass levels considered necessary for maintenance of sustained recruitment should be recommended for each stock, defined in relation to both long-term productivity regimes, and current productivity regimes to the extent these may differ. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing reproductive potential of the stock, options should be offered that specifically respond to such concerns.

f) Information should be provided on stock size, spawning stock sizes, recruitment prospects, fishing mortality, catch rates and catches implied by these management strategies for the short and the long term in the following format:

I. For stocks for which analytical-type assessments are possible, graphs should be provided of all of the following for the longest time-period possible:

- historical yield and fishing mortality;
- spawning stock biomass and recruitment levels;
- catch options for the year 2012 and subsequent years over a range of fishing mortality rates (for as many years as the data allow)
- (F) at least from $F_{0.1}$ to F_{max};
- spawning stock biomass corresponding to each catch option;
- yield-per-recruit and spawning stock per recruit values for a range of fishing mortalities.

II. For stocks for which advice is based on general production models, the relevant graph of production as a function of fishing mortality rate or fishing effort should be provided. Age aggregated assessments should also provide graphs of all of the following for the longest time period possible:

- exploitable biomass (both absolute and relative to B_{MSY})
- yield/biomass ratio as a proxy for fishing mortality (both absolute and relative to F_{MSY})
- estimates of recruitment from surveys, if available.

III. Where analytical methods are not attempted, the following graphs should be presented, for one or several surveys, for the longest time-period possible:

- time trends of survey abundance estimates, over:
- an age or size range chosen to represent the spawning population
- an age or size-range chosen to represent the exploited population
- recruitment proxy or index for an age or size-range chosen to represent the recruiting population.
- fishing mortality proxy, such as the ratio of reported commercial catches to a measure of the exploited population.

For age-structured assessments, yield-per-recruit graphs and associated estimates of yield-per-recruit based reference points should be provided. In particular, the three reference points, actual F, $F_{0.1}$ and F_{max} should be shown.

2. Noting the Precautionary Approach Framework as endorsed by Fisheries Commission, the Fisheries Commission requests that the Scientific Council provide the following information for the 2011 Annual Meeting of the Fisheries Commission for all stocks under its responsibility requiring advice for 2012:

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

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

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

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

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

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

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

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

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

Annex II. Fisheries Commission Requests for Scientific Advice on Management Options in 2013 and Beyond of Certain Stocks in Subareas 2, 3 and 4 and Other Matters

1. The Fisheries Commission with the concurrence of the Coastal State as regards to the stocks below which occur within its jurisdiction (“Fisheries Commission”) requests that the Scientific Council provide advice in advance of the 2012 Annual Meeting, for the management of Northern shrimp in Div. 3M, 3LNO in 2013. The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation).

   Noting that Scientific Council will meet in October of 2011 for 2013 TAC advice, Fisheries Commission requests the Scientific Council to update its advice on shrimp stocks in 2012 for 2013 TAC.

   Fisheries Commission further requests that SC provide advice in accordance to Annex 1.

2. Fisheries Commission requests that the Scientific Council provide advice for the management of the fish stocks below according to the following assessment frequency (unless Fisheries Commission requests additional assessments):

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

   To continue this schedule of assessments, the Scientific Council is requested to conduct the assessment of these stocks as follows:

   In 2012, advice should be provided for 2013 and 2014 for Redfish in Div. 3LN and Thorny skate in Div. 3LNOPs and for 2013, 2014 and 2015 Northern shortfin squid in SA 3+4.

   In addition, advice should be provided in 2012 for cod Div. 3M.

   The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation). Additionally, Fisheries Commission requests that SC provide advice in accordance to Annex 1.

   The Fisheries Commission also requests the Scientific Council to continue to monitor the status of all these stocks annually and, should a significant change be observed in stock status (e.g. from surveys) or in bycatches in other fisheries, provide updated advice as appropriate.

3. With respect to Northern shrimp (*Pandalus borealis*) in Div. 3LNO, noting the NAFO Framework for Precautionary Approach and recognizing the desire to demonstrate NAFO’s commitment to applying the precautionary approach, Fisheries Commission requests the Scientific Council to:

   a) identify F_{msy}
   b) identify B_{msy}
   c) provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf})

4. 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) 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) Advise on whether or not an exceptional circumstance is occurring.

5. 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.

6. The Fisheries Commission adopted in September 2011, conservation plans and rebuilding strategies for 3NO cod and 3 LNO American plaice and "recognizing that further updates and development of the plans may be required to ensure that the long term objectives are met". The Fisheries Commission requests the Scientific Council to:
   a) Provide advice on the addition of a new intermediate reference point (i.e. B_{isr}) in the NAFO precautionary approach framework to delineate an additional zone between B_{lim} and B_{msy} as proposed by the proposed by the working group
   b) Taking into consideration the new reference point B_{isr}, provide advice on an updating NAFO PA framework and provide a description for each zone.
   c) Provide advice on an appropriate selection of the B_{isr} value for Div. 3NO cod and Div. 3 LNO American plaice.
   d) Review B_{msy} and F_{msy} provided in 2011 for both stocks and quantify uncertainty surrounding these estimates.

7. Fisheries Commission requests the Scientific Council to review the conservation and rebuilding plans of 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5). Through projections and a risk based approach, evaluate the performance of the present rebuilding plans in terms of expected time frames (5 / 10 / 15 years) and associated probabilities to reach indicated limit and target biomass levels and catches. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above Blim.

8. Fisheries Commission requests the Scientific Council to evaluate the Harvest Control Rule (HCR) indicated below as an alternative to the HCR of the 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4, item 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5, item 4) Conservation Plans and Rebuilding Strategies. Through projections and a risk based approach, evaluate the performance of this HCR in terms probabilities associated with maintaining Biomass above Blim and ensuring continuous SSB growth. SC should provide SSB and associated catch trajectories for 5 / 10 / 15 years. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above Blim.

   Harvest Control Rule:

   a) When SSB is below Blim:

   i. no directed fishing, and
   ii. by-catch should be restricted to unavoidable by-catch in fisheries directing for other species

   b) When SSB is above Blim:

   If P y+1 > 0.9 Then Fy+1 = F0.1 * Py+1

   Else

   Fy+1 = 0

   TACy+1 = B y+1 * Fy+1

Where:
Fy+1 = Fishing mortality to project catches for the following year.
Py+1 = Probability of projected Spawning Stock Biomass to be above Blim.
B y+1 = Exploitable biomass projected for the following year.

9. The Fisheries Commission requests the Scientific Council to conduct a full assessment of 3LNO American Plaice and provide advice in accordance to the rebuilding plan currently in place.

10. On the Flemish Cap, there seems to be a connection between the most recent decline of the shrimp stock, the recovery of the cod stock and the reduction of the redfish stock. The Fisheries Commission requests the Scientific Council to provide an explanation on the possible connection between these phenomena. It is also requested that SC advises on the feasibility and the manner by which these three species are maintained at levels capable of producing a combined maximum sustainable yield, in line with the objectives of the NAFO Convention.

11. Fisheries Commission requests the Scientific Council to define B_{msy} for cod in Division 3M and to propose a Harvest Control Rule (HCR) consistent with the NAFO Precautionary Approach Framework. It also requests the Scientific Council to define the estimated timeframe to reach Bmsy under different scenarios, consistent with the proposed HCR.

12. Scientific Council is asked to provide, where available, qualitative and quantitative information including possible comparisons on by-catches of various species in directed fisheries on stocks under NAFO management.

13. For the cod stock in Divisions 2J+3KL, the Scientific Council is requested to comment on the trends in biomass and state of the stock in the most recent Science Advisory Report from the Canadian Science Advisory Secretariat.

14. Taking note that recent point estimates for 3NO Witch flounder of the Canadian Autumn survey are 2-3 times higher than in 1994 when the moratorium was first implemented and are among the highest in the times series , and while more variable the recent point estimates of the Canadian Spring survey are abut 50% higher than in 1994:

    a) What are the relative strengths and weaknesses of all the indices of abundance of witch?
    b) What are plausible reasons for different abundance trends in the spring and autumn surveys of the SAME STRATA, and what are the rationales to support either set of results over the other?
    c) How might the confidence intervals around the point estimates over the time series affect the interpretations of stock trend and current status?
    d) What evidence exists (if any) to indicate whether any changes in natural mortality have occurred since the early 1990's, e.g. condition of the fish?
    e) Is it plausible there may be a different survey catchability for younger/smaller fish relative to older/larger fish (applicable to witch flounder), and how might this affect our interpretation of stock trends and status?
    f) What might be reasonable options for reference point proxies, with associated rationale, including those based on one or a combination of survey indices?

15. As per the recommendation outlined in the report of the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems adopted in September 2011, the Fisheries Commission requests the Scientific Council to produce a detailed list of VME indicator species and possibly other VME elements.

16. Given the progress made by Scientific Council on the development of the GIS model for the evaluation of bycatch thresholds for sponges as requested by Fisheries Commission in its 2010 Annual Meeting, and mindful of the need for further refining this modelling framework, as well as exploring its potential utility for its application to other VME-defining species, Fisheries Commission requests the Executive Secretary to provide to the Scientific Council anonymous VMS data in order to further develop the current sponge model as

requested by the Fisheries Commission in 2010 and to assess the feasibility of developing similar models for other VME-defining species(e.g. corals).

17. Fisheries Commission requests the Scientific Council to make recommendations for encounter thresholds and move on rules for groups of VME indicators including sea pens, small gorgonian corals, large gorgonian corals, sponge grounds and any other VME indicator species that meet the FAO Guidelines for VME and SAI. Consider thresholds for 1) inside the fishing footprint and outside of the closed areas and 2) outside the fishing footprint in the NRA, and 3) for the exploratory fishing area of seamounts if applicable.

18. Noting Article 4bis - Assessment of bottom fishing of the NAFO Conservation and Enforcement measures. " The Scientific Council, with the co-operation of Contracting Parties, shall identify, on the basis of best available scientific information, vulnerable marine ecosystems in the Regulatory Area and map sites where these vulnerable marine ecosystem are known to occur or likely to occur and provide such data and information to the Executive Secretary for circulation to all Contracting Parties".

    The Fisheries Commission requests the Scientific Council to produce a comprehensive map of the location of VME indicator species and elements in the NRA as defined in the FAO International Guidelines for the Management of Deep Sea Fisheries in the High Seas. This includes canyon heads and spawning grounds and any other VME not protected by the current closures to protect coral and sponge. This will be used by Contracting Parties to complete impact assessments

19. As stated in the "Reassessment of the Impact of NAFO Managed Fisheries on known or Likely Vulnerable Marine Ecosystems" (NAFO FC WP 11/24), the Scientific Council in collaboration with the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystem will conduct a reassessment of NAFO bottom fisheries by 2016 and every 5 years thereafter. In preparation for reassessments, the Fisheries Commission requests the Scientific Council to develop a workplan for completing the initial reassessment and identifying the resources and information to do so.

Annex1 – Additional guidance in regards to questions 1 and 2.

Mindful of the desire to move to a risk-based approach in the management of fish stocks, Fisheries Commission requests the Scientific Council to provide a range of management options as well as a risk analysis for each option as outlined in the provisions below, rather than a single TAC recommendation.

1. The Fisheries Commission request the Scientific Council to consider the following in assessing and projecting future stock levels for those stocks listed above. These evaluations should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, in determining its management of these stocks:

    a) The preferred tool for the presentation of a synthetic view of the past dynamics of an exploited stock and its future development is a stock assessment model, whether age-based or age-aggregated.

    b) For those stocks subject to analytical-type assessments, the status of the stocks should be reviewed and catch options evaluated in terms of their implications for fishable stock size in both the short and long term. As general reference points, the implications of fishing at $F_{0.1}$ and F_{2011} in 2013 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options.

    c) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and catch options evaluated in the way described above to the extent possible. In this case, the level of fishing effort or fishing mortality (F) required to take two-thirds MSY catch in the long term should be calculated.

    d) For those resources for which only general biological and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of management requirements for long-term sustainability and the advice provided should be consistent with the precautionary approach.

e) Spawning stock biomass levels considered necessary for maintenance of sustained recruitment should be recommended for each stock, defined in relation to both long-term productivity regimes, and current productivity regimes to the extent these may differ. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing reproductive potential of the stock, options should be offered that specifically respond to such concerns.

f) Information should be provided on stock size, spawning stock sizes, recruitment prospects, fishing mortality, catch rates and catches implied by these management strategies for the short and the long term in the following format:

I. For stocks for which analytical-type assessments are possible, graphs should be provided of all of the following for the longest time-period possible:

- historical yield and fishing mortality;
- spawning stock biomass and recruitment levels;
- catch options for the year 2013 and subsequent years over a range of fishing mortality rates (for as many years as the data allow)
- (F) at least from $F_{0.1}$ to F_{max};
- spawning stock biomass corresponding to each catch option;
- yield-per-recruit and spawning stock per recruit values for a range of fishing mortalities.

II. For stocks for which advice is based on general production models, the relevant graph of production as a function of fishing mortality rate or fishing effort should be provided. Age aggregated assessments should also provide graphs of all of the following for the longest time period possible:

- exploitable biomass (both absolute and relative to B_{MSY})
- yield/biomass ratio as a proxy for fishing mortality (both absolute and relative to F_{MSY})
- estimates of recruitment from surveys, if available.

III. Where analytical methods are not attempted, the following graphs should be presented, for one or several surveys, for the longest time-period possible:

- time trends of survey abundance estimates, over:
- an age or size range chosen to represent the spawning population
- an age or size-range chosen to represent the exploited population
- recruitment proxy or index for an age or size-range chosen to represent the recruiting population.
- fishing mortality proxy, such as the ratio of reported commercial catches to a measure of the exploited population.

For age-structured assessments, yield-per-recruit graphs and associated estimates of yield-per-recruit based reference points should be provided. In particular, the three reference points, actual F, $F_{0.1}$ and F_{max} should be shown.

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

a) the limit and precautionary reference points as described in Annex II of the UN Fisheries Agreement indicating areas of uncertainty (for those stocks for which precautionary reference points cannot be determined directly, proxies should be provided);
b) the stock biomass and fishing mortality trajectory over time overlaid on a plot of the PA Framework (for those stocks where biomass and/or fishing mortality cannot be determined directly, proxies should be used);
c) information regarding the current Zone the stock is within as well as proposals regarding possible harvest strategies which would move the resource to (or maintain it in) the Safe Zone, including medium term

considerations and associated risk or probabilities which will assist the Commission in developing the management strategies described in paragraphs 4 and 5 of Annex II in the Agreement.

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

   a) References to “risk” and to “risk analyses” should refer to estimated probabilities of stock population parameters falling outside biological reference points.
   b) Where reference points are proposed by the Scientific Council as indicators of biological risk, they should be accompanied by a description of the nature of the risk associated with crossing the reference point such as recruitment overfishing, impaired recruitment, etc.
   c) When a buffer reference point is identified in the absence of a risk evaluation in order to maintain a low probability that a stock, measured to be at the buffer reference point, may actually be at or beyond the limit reference point, the Scientific Council should explain the assumptions made about the uncertainty with which the stock is measured.
   d) Wherever possible, short and medium term consequences should be identified for various exploitation rates (including no fishing) in terms of yield, stability in yield from year to year, and the risk or probability of maintaining the stock within, or moving it to, the Safe Zone. Whenever possible, this information should be cast in terms of risk assessments relating fishing mortality rates to the trends in biomass (or spawning biomass), the risks of stock collapse and recruitment overfishing, as well as the risks of growth overfishing, and the consequences in terms of both short and long term yields.
   e) When providing risk estimates, it is very important that the time horizon be clearly spelled out. By way of consequence, risks should be expressed in timeframes of 5, 10 and 15 years (or more), or in terms of other appropriate year ranges depending on stock specific dynamics. Furthermore, in order to provide the Fisheries Commission with the information necessary to consider the balance between risks and yield levels, each harvesting strategy or risk scenario should include, for the selected year ranges, the risks and yields associated with various harvesting options in relation to B_{lim}.

Annex III. Canadian Request for Scientific Advice on Management in 2012 of Certain Stocks in Subareas 0 to 4.

1. Canada requests that the Scientific Council, at its meeting in advance of the 2011 Annual Meeting of NAFO, subject to the concurrence of Denmark (on behalf of Greenland), provide advice on the scientific basis for management in 2012 of the following stocks

Shrimp (Subareas 0 and 1)

Greenland halibut (Subareas 0 and 1)

The Scientific Council has noted previously that there is no biological basis for conducting separate assessments for Greenland halibut throughout Subareas 0-3, but has advised that separate TACs be maintained for different areas of the distribution of Greenland halibut. The Council is therefore, subject to the concurrence of Denmark (on behalf of Greenland) as regards Subarea 1, to provide an overall assessment of status and trends in the total stock area throughout its range and comment on its management in Subareas 0+1 for 2012, and to specifically:

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.

With respect to shrimp, it is recognized that the Council may, at its discretion, delay providing advice until later in the year, taking into account data availability, predictive capability, and the logistics of additional meetings.

2. Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for Shrimp and Greenland halibut in Subareas 0 and 1:

a) For those stocks subject to analytical-type assessments, the status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size in both the short and long term. The implications of no fishing as well as fishing at F0.1, and F2010 in 2012 and subsequent years should be evaluated in relation to precautionary reference points of both fishing mortality and spawning stock biomass. The present stock size and spawning stock size should be described in relation to those observed historically and those to be expected in the longer term under this range of fishing mortalities, and any other options Scientific Council feels worthy of consideration under the NAFO Precautionary Approach Framework.

b) Opinions of the Scientific Council should be expressed in regard to stock size, spawning stock sizes, recruitment prospects, catch rates and catches implied by these management strategies for the short and long term. Values of F corresponding to the reference points should be given. Uncertainties in the assessment should be evaluated and presented in the form of risk analyses related to B_{lim} (B_{buf}), and F_{lim} (F_{buf}), as per the NAFO Precautionary Approach Framework.

c) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and management options evaluated in the way described above to the extent possible. Management options should be within the NAFO Precautionary Approach Framework.

d) For those resources for which only general biological advice and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of the management requirements for long-term sustainability and management options evaluated in the way described above to the extent possible. Management options should be within the NAFO Precautionary Approach Framework.

I. Presentation of the results should include the following:

- For stocks for which analytical-type assessments are possible:
- A graph of historical yield and fishing mortality for the longest time period possible;
- A graph of spawning stock biomass and recruitment levels for the longest time period possible. The biomass graph should indicate the stock trajectory compared to B_{lim};

- Graphs and tables of catch options for the year 2012 and subsequent years over a range of fishing mortality rates (F) at least from F=0 to $F_{0.1}$ including risk analyses;
- Graphs and tables showing spawning stock biomass corresponding to each catch option including risk analyses;
- Graphs showing the yield-per-recruit and spawning stock per recruit values for a range of fishing mortalities.

II. For stocks for which advice is based on general production models, the relevant graph of production on fishing mortality rate or fishing effort.

In all cases, the reference points, F=0, actual F, and $F_{0.1}$ should be shown. As well, Scientific Council should provide the limit and precautionary reference points as described in the NAFO Precautionary Approach Framework, indicating areas of uncertainty (when reference points cannot be determined directly, proxies should be provided).

Annex IVa. Denmark (Greenland) Request for Scientific Advice on Management in 2012 of Certain Stocks in Subarea 0 and 1

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.

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.

3. Subject to the concurrence of Canada as regards Subarea 0+1, the Scientific Council is requested to provide advice on appropriate TAC levels for 2012 separately for Greenland halibut in 1) the offshore area of NAFO Subarea 0A+Divisions 1A Offshore + Divisions 1B and 2) NAFO Subarea 0B + Division 1C-1F. The Scientific Council is also asked to advice on any other management measures it deems appropriate to ensure the sustainability of these resources.

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.

5. Subject to the concurrence of Canada as regards Subarea 0+1, Denmark (on behalf of Greenland) further requests the Scientific Council of NAFO before December 2011 to provide advice on the scientific basis for management of Northern shrimp (*Pandalus borealis*) in Subarea 0 and 1 in 2012 for as many years ahead as data allows for.

Furthermore, the Council is in co-operation with ICES requested to provide advice on the scientific basis for management of Northern shrimp (*Pandalus borealis*) in Denmark Strait and adjacent waters east of southern Greenland in 2012 and as many years ahead as data allows for.

Annex IVb. Additional Request from Denmark (Greenland) for Audit of Management Plan for the Shrimp Fishery in West Greenland

Denmark, on behalf of Greenland, requests the Scientific Council to audit 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.*

Annex IVc. Additional Request from Denmark (Greenland) on Striped pink shrimp (*Pandalus montaguii*).

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.

Annex V. ICES ToRs for NIPAG

From 2010 ACOM and ACOM Expert Group ToR's

(http://www.ices.dk/iceswork/recs/2010%20Resolutions/ACOM%20EG%20ToRs%202011.pdf)

Generic ToRs for Regional and Species Working Groups

The following ToRs apply to: AFWG, HAWG, NWWG, NIPAG, WGWIDE, WGBAST, WGBFAS, WGNSSK, WGCSE, WGDEEP, WGHMM, WGEF and WGANSA.

The working group should focus on:

ToRs a) to g) for stocks that will have advice,
ToRs b) to f) and h) for stocks with same advice as last year.
ToRs b) to c) and f) for stocks with no advice.

a) Produce a first draft of the advice on the fish stocks and fisheries under considerations according to ACOM guidelines and implementing recommendations from WKMSYREF.

b) Update, quality check and report relevant data for the working group:

i) Load fisheries data on effort and catches (landings, discards, bycatch, including estimates of misreporting when appropriate) in the INTERCATCH database by fisheries/fleets. Data should be provided to the data coordinators at deadlines specified in the ToRs of the individual groups. Data submitted after the deadlines can be incorporated in the assessments at the discretion of the Expert Group chair;
ii) Abundance survey results;
iii) Environmental drivers.
iv) Propose specific actions to be taken to improve the quality of the data (including improvements in data collection).

c) Produce an overview of the sampling activities on a national basis based on the INTERCATCH database and report the use of InterCatch;

d) In cooperation with the Secretariat, update the description of major regulatory changes (technical measures, TACs, effort control and management plans) and comment on the potential effects of such changes including the effects of newly agreed management and recovery plans.

e) For each stock update the assessment by applying the agreed assessment method (analytical, forecast or trends indicators) as described in the stock annex. If no stock annex is available this should be prepared prior to the meeting.

f) Produce a brief report of the work carried out by the Working Group. This report should summarise for the stocks and fisheries where the item is relevant:

i) Input data (including information from the fishing industry and NGO that is pertinent to the assessments and projections);
ii) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information;
iii) Stock status and 2012 catch options;
iv) Historical performance of the assessment and brief description of quality issues with the assessment;
v) Mixed fisheries overview and considerations;
vi) Species interaction effects and ecosystem drivers;
vii) Ecosystem effects of fisheries;
viii) Effects of regulatory changes on the assessment or projections;

g) Where appropriate, check for the need to reopen the advice in autumn based on the new survey information and the guidelines in AGCREFA (2008 report).

h) For the stocks where the advice is marked 'collate data', available data should be collected and presented as far as possible. If information is available for more than or only part of the area, the header for the stock can be adapted (please discuss with the secretariat).

i) Identify elements of the EGs work that may help determine status for the 11 Descriptors set out in the Commission Decision (available at:

http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:232:0014:0024:EN:PDF;

j) Provide views on what good environmental status (GES) might be for those descriptors, including methods that could be used to determine status.

k) Take note of and comment on the Report of the Workshop on the Science for area based management: Coastal and Marine Spatial Planning in Practice (WKCMSP) http://www.ices.dk/reports/SSGHIE/2011/WKCMSP11.pdf

l) Provide information that could be used in setting pressure indicators that would complement biodiversity indicators currently being developed by the Strategic Initiative on Biodiversity Advice and Science (SIBAS). Particular consideration should be given to assessing the impacts of very large renewable energy plans with a view to identifying/predicting potentially catastrophic outcomes.

m) Identify spatially resolved data, for e.g. spawning grounds, fishery activity, habitats, etc. In the EG report please indicate how advice for this stock can be given in future; both what timing (data availibility over the year) and analytical / trends based assessment options are concerned.

A draft advice sheet should be produced that presents available information and informs about the status of the stock assessment possibilities.

LIST OF RESEARCH AND SUMMARY DOCUMENTS 2011

SCR Documents

Doc No.	Serial No	Author(s)	Title
SCR 11/001	N5876	Mads Hvid Ribergaard	Oceanographic Investigations off West Greenland 2010
SCR 11/002	N5877	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
SCR 11/003	N5878	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
SCR 11/004	N5882	Heino Fock and Christoph Stransky	Stock Abundance Indices and Length Compositions of Demersal Redfish and Other Finfish in NAFO Sub-area 1 and near bottom water temperature derived from the German bottom trawl survey 1982-2010
SCR 11/005	N5885	Diana González-Troncoso, Esther Román, Ana Gago and Xabier Paz	Results for Greenland halibut, American plaice and Atlantic cod of the Spanish survey in NAFO Div. 3NO for the period 1997-2010
SCR 11/006	N5886	Diana González-Troncoso, Concepción González and Xabier Paz	Yellowtail flounder, redfish (*Sebastes* spp) and Witch flounder indices from the Spanish Survey conducted in Divisions 3NO of the NAFO Regulatory Area
SCR 11/007	N5887	Diana González-Troncoso, Concepción González and Xabier Paz	Biomass and length distribution for Roughhead grenadier, Thorny skate and White hake from the surveys conducted by Spain in NAFO 3NO
SCR 11/008	N5888	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.
SCR 11/009	N5889	O.A. Jørgensen	Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2010
SCR 11/010	N5890	O.A. Jørgensen	Bottom trawl survey in Baffin Bay, NAFO Divisions 1A, 2010
SCR 11/011	N5893	I. Yashayaev and B.J.W. Greenan	Environmental conditions in the Labrador Sea in 2010
SCR 11/012	N5894	B. J. W. Greenan, I. Yashayaev, W. Li, Y. Geshelin, Z. Wang, J. W. Loder, E. J. H. Head, K. Azetsu-Scott and W. G. Harrison	Oceanographic Observations in Support of Defining Vulnerable Marine Ecosystems in the NAFO Regulatory Area
SCR 11/013	N5895	G. Maillet, P. Pepin , C. Johnson, G. Harrison, E. Head, J. Spry, K. Pauley, C. Caverhill, H. Maass, M. Kennedy, C. Porter, I. Yashayaeva, B. Casault, S. Fraser, T. Shears, G. Redmond	Biological and Chemical Oceanographic Conditions on the Newfoundland and Labrador Shelf, Grand Banks, Scotian Shelf, and the Gulf of Maine During 2010
SCR 11/014	N5896	B. Petrie, R. G. Pettipas and D. Hebert	Physical Oceanographic Conditions on the Scotian Shelf and in the eastern Gulf of Maine (NAFO areas 4V,W,X) during 2010
SCR 11/015	N5897	Bruce Bradshaw, Luc Bujold, Jenny Chiu and Matt Ohara	Integrated Science Data Management - NAFO Report 2010
SCR 11/016	N5898	E. B. Colbourne, J. Craig, C. Fitzpatrick, D. Senciall, P. Stead and W. Bailey	An Assessment of the Physical Oceanographic Environment on the Newfoundland and Labrador Shelf in NAFO Subareas 2 and 3 during 2010

SCR 11/017	N5900	M. A. Treble	Report on Greenland Halibut caught during the 2010 Trawl Survey in NAFO Division 0A
SCR 11/018	N5901	I.S. Tretyakov, I.A. Skryabin, S.A. Egorov	Capelin Stock Assessment in NAFO Divisions 3NO Based on Data from Trawl Surveys
SCR 11/019	N5902	Esther Román, Concepción González-Iglesias and Diana González-Troncoso	Results for the Spanish Survey in the NAFO Regulatory Area of Division 3L for the period 2003-2010
SCR 11/020	N5904	Esther Román, Ángeles Armesto and Diana González-Troncoso	Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2010
SCR 11/021	N5904	José Miguel Casas and Diana González-Troncoso	Results from Bottom Trawl Survey on Flemish Cap of June-July 2010
SCR 11/022	N5905	Simpson, Miri, and Mello	An Assessment of White Hake (*Urophycis tenuis*, Mitchill 1815) in NAFO Divisions 3N, 3O, and Subdivision 3Ps
SCR 11/023	N5906	Mónica Mandado Antonio Vázquez	On otoliths sampling
SCR 11/024	N5908	Rasmus Nygaard and Ole A. Jørgensen	Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the Greenland Shrimp Fish Survey, 1988-2010.
SCR 11/025	N5909	Rasmus Nygaard, Heino Fock and Christoph Stransky	Assessment of Other Finfish in NAFO Subarea 1
SCR 11/026	N5911	A. Ávila de Melo, F. Saborido-Rey, Diana González Troncoso, Maria Pochtar and R. Alpoim	An Assessment of Beaked Redfish (*S. mentella* and *S. fasciatus*) in NAFO Division 3M (With an Approach to the Likely Impact of Recent 3M Cod Growth on Redfish Natural Mortality)
SCR 11/027	N5912	O.A. Jørgensen	Assessment of the Greenland Halibut Stock Component in NAFO Subarea 0 + Division 1A Offshore + Divisions 1B-1F
SCR 11/028	N5913	Antonio Vázquez	Validation of Flemish Cap cod ageing
SCR 11/029	N5914	W. Brodie, D. Parsons, E. Murphy, and K. Dwyer	An assessment of the witch flounder resource in NAFO Divisions 3NO
SCR 11/030	N5915	A. Akimova	Hydrographic conditions off West Greenland in 2010 in context of interannual and long-term variability based on in situ and satellite observations
SCR 11/031	N5916	B. P. Healey	Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: Stock Trends based on annual Canadian Research Vessel survey results during 1978-2010.
SCR 11/032	N5917	R.M. Rideout, M.J. Morgan, D. Maddock Parsons, W.B. Brodie, B.P. Healey, D. Power and K.S. Dwyer	An assessment of American plaice in NAFO Div. 3LNO
SCR 11/033	N5918	Dawn Maddock Parsons, Joanne Morgan, Bill Brodie and Don Power	Assessment of NAFO Div. 3LNO Yellowtail Flounder
SCR 11/034	N5919	D. Maddock Parsons	Divisions 3LNO Yellowtail Flounder (*Limanda ferruginea*) in the 2009 and 2010 - Canadian Stratified Bottom Trawl Surveys
SCR 11/035	N5920	J.-C. Mahé	Greenland Halibut in NAFO Sub-area 2 & Divisions 3KLMNO – An update of Statistical Catch at Age Formulation to assess the Resource
SCR 11/036	N5921	B.P. Healey	An Assessment of Greenland Halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO

SCR 11/037	N5922	D. Maddock Parsons	Witch Flounder, American Plaice and Yellowtail Flounder in Canadian Spring and Autumn Surveys: Time Series Stock Distribution Maps
SCR 11/038	N5923	Diana González-Troncoso and Antonio Vázquez	Assessment of the Cod Stock in NAFO Division 3M
SCR 11/039	N5924	Peter A. Shelton and M. Joanne Morgan	Further considerations regarding reference points, harvest control rules and rebuilding strategies for 3LNO American plaice and 3NO cod
SCR 11/040	N5925	Rasmus Nygaard, Heino Fock and Christoph Stransky	Assessment of Demersal Redfish in NAFO Subarea 1
SCR 11/041	N5926	R. Alpoim and A. M. Ávila de Melo	An Assessment of American Plaice (*Hippoglossoides platessoides*) in NAFO Division 3M
SCR 11/042	N5927	Peter Shelton	Evolution and implementation of a management strategy for NAFO Subarea 2 and Divs. 3KLMNO Greenland halibut fishery
SCR 11/043	N5928	Rasmus Nygaard and Jesper Boje	Standardized logbooks from the inshore longline fishery on Greenland halibut in the inshore part of Div. 1A
SCR 11/044	N5929	Power	The Canadian fishery for Greenland halibut in SA 2 + Div. 3KLMNO, with emphasis on 2010
SCR 11/045	N5934	J.M. Casas Sánchez	Division 3M Northern shrimp (*Pandalus borealis*) – Interim Monitoring Update
SCR 11/046	N5935	D.C. Orr and D.J. Sullivan	Divisions 3LNO Northern Shrimp (*Pandalus borealis*) – Interim Monitoring Update
SCR 11/047	N5941	Diana González-Troncoso and Fernando González-Costas	New projections from the assessment of the Cod Stock in NAFO Division 3M
SCR 11/048	N5973	D S Butterworth and R A Rademeyer	On “Exceptional Circumstances” Provisions for the Management Strategy for the Greenland Halibut Stock in Subarea 2 + Divisions 3KLMNO based especially on Survey Results occurring Outside the Range Simulated
SCR 11/049	N5974	D.C. Orr and D.J. Sullivan	The 2011 assessment of the Northern Shrimp (*Pandalus borealis*, Kroyer) resource in NAFO Divisions 3LNO
SCR 11/050	N5975	Anja Retzel	A preliminary estimate of Atlantic cod (*Gadus morhua*) biomass in West Greenland offshore waters (NAFO Subarea 1) for 2011 and recent changes in the spatial overlap with Northern shrimp (*Pandalus borealis*)
SCR 11/051	N5976	Michael C.S. Kingsley	Catch Table Update for the West Greenland Shrimp Fishery
SCR 11/052	N5977	Michael C.S. Kingsley	The Fishery for Northern Shrimp (*Pandalus borealis*) off West Greenland, 1970–2011
SCR 11/053	N5978	Michael C.S. Kingsley	Pandalus montagui in the West Greenland shrimp fishery, 2001–2010.
SCR 11/054	N5979	Helle Siegstad	The Fishery for Northern Shrimp (*Pandalus borealis*) in Denmark Strait / off East Greenland – 2011
SCR 11/055	N5980	Kingsley, M.C.S, Helle Siegstad and Kai Wieland	The West Greenland trawl survey for *Pandalus borealis*, 2011, with reference to earlier results

SCR 11/056	N5981	Helle Siegstad	Results of the Greenland Bottom Trawl Survey for Northern shrimp (*Pandalus borealis*) Off East Greenland (ICES Subarea XIV b), 2008-2011
SCR 11/057	N5982	Michael C.S. Kingsley	Bycatch rates in the West Greenland shrimp fishery, 1975–2010
SCR 11/058	N5983	Michael C. S. Kingsley	A Provisional Assessment of the Shrimp Stock off West Greenland in 2011
SCR 11/059	N5984	J. M. Casas	The Spanish Shrimp Fishery on Flemish Cap (Division 3M) and Division 3L in 2010
SCR 11/060	N5985	J. M. Casas	Northern Shrimp (*Pandalus borealis*) on Flemish Cap Surveys 2011
SCR 11/061	N5986	J. M. Casas, E. Román, J. Teruel, E. Marull and G. Ramilo	Northern Shrimp (*Pandalus borealis*, Krøyer) from Spanish Bottom Trawl Survey 2011 in NAFO Div. 3LNO
SCR 11/062	N5987	J. M. Casas	Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2011
SCR 11/063	N5988	Bakanev S. V., Lubin P.A. and Zakharov D.V.	Results of Russian investigations of the northern shrimp in the Barents Sea in 2004-2011
SCR 11/064	N5989	G. Søvik and T. Thangstad	Results of the Norwegian Bottom Trawl Survey for Northern Shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east) in 2011
SCR 11/065	N5991	C. Hvingel, T. Thangstad and P. Lyubin	Research survey information regarding northern shrimp (*Pandalus borealis*) in the Barents Sea and Svalbard area 2004-2011
SCR 11/066	N5992	Carsten Hvingel and Trude Thangstad	The Norwegian fishery for northern shrimp (*Pandalus borealis*) in the Barents Sea and round Svalbard 1970-2011
SCR 11/067	N5993	Sten Munch-Petersen, Mats Ulmestrand, Guldborg Søvik and Ole Eigaard	Discarding in the shrimp fisheries in Skagerrak and the Norwegian Deep (ICES Divs. IIIa and IVa east)
SCR 11/068	N5994	G. Søvik and T. Thangstad	The Norwegian Fishery for Northern Shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east), 1970-2011
SCR 11/069	N5995	S. Munch-Petersen, O. Eigaard, G. Søvik and M. Ulmestrand	The Northern shrimp (*Pandalus borealis*) Stock in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa East) (ICES Divisions IIIa and IVa East)
SCR 11/070	N5996	H. Siegstad and N. Hammeken Arboe	Occurrence of Pandalus montagui in Trawl Survey Samples from NAFO Subareas 0+1.
SCR 11/071	N5997	Carsten Hvingel	Shrimp (*Pandalus borealis*) in the Barents Sea – stock assessment 2011
SCR 11/072	N6002	A. Cogswell, E. Kenchington, C. Lirette, J. Murillo Perez, G. Campanis, N. Campbell, N. Ollerhead	Layers Utilized by an ArcGIS model to Approximate Commercial Coral and Sponge Bycatch in the NAFO Regulatory Area

SCR 11/073	N6003	F.J. Murillo, E. Kenchington, M. Sacau, D.J.W. Piper, V. Wareham, A. Muñoz	New VME indicator species (excluding corals and sponges) and some potential VME elements of the NAFO Regulatory Area
SCR 11/074	N6004	F.J. Murillo, V. Wareham, M. Sacau, E. Román	New data on deep-water corals and large sponges from Spanish/EU and Canadian bottom trawl groundfish surveys in the NAFO Regulatory Area (Divs. 3LMNO): 2008-2010 period
SCR 11/075	N6005	E. Kenchington, F. J. Murillo, A. Cogswell, C. Lirette	Development of Encounter Protocols and Assessment of Significant Adverse Impact by Bottom Trawling for Sponge Grounds and Sea Pen Fields in the NAFO Regulatory Area
SCR 11/076	N6008	Peter Shelton and Brian Healey	Evaluating exceptional circumstances in the context of the Greenland halibut management strategy evaluation basedon the 2011 stock assessment
SCR 11/077	N60098	Perez, A.	Changes in feeding habits of the Flemish Cap demersal community

SCS Documents

SCS Doc. 11-01	N5873		FC Request for Advice
SCS Doc. 11-02	N5874		Greenland Request for Advice
SCS Doc. 11-03	N5875		Canada Request for Advice
SCS Doc. 11-04	N5880	R Statkus	Lithuania Research Report for 2010
SCS Doc. 11-05	N5881	J. Vargas, R. Alpoim, E. Santos and A. M. Ávila de Melo	Portuguese Research Report for 2010
SCS Doc. 11-06	N5883	H. O. Fock and A. Akimova	German Research Report for 2010
SCS Doc. 11-07	N5884	F. González-Costas, D. González-Troncoso, G. Ramilo, E. Román, J. Lorenzo, M. Casas, C. Gonzalez, A. Vázquez, and M. Sacau	Spanish Research Report for 2010
SCS Doc. 11-08	N5891	K.A. Sosebee	United States Research Report for 2010
SCS Doc. 11-09	N5899	D. Richards	Canadian Research Report for 2010 Newfoundland and Labrador Region
SCS Doc. 11-10	N5901	Greenland Institute of Natural Resources	Denmark/Greenland Research Report for 2010
SCS Doc. 11-11	N5902	I.A. Skryabin and M.V. Pochtar	Russian Research Report for 2010

SCS Doc. 11-12	N5903	NAFO Secretariat	Tagging
SCS Doc. 11-13	N5904	S.Sirp	Estonian Research Report for 2010
SCS Doc. 11-14	N5907	E.A. Trippel and M.J. Morgan	Report of the NAFO Scientific Council Working Group on Reproductive Potential
SCS Doc. 11-15	N5910	NAFO Secretariat	Inventory of Biological Sampling
SCS Doc. 11-16	N5930	NAFO	Report of the June Scientific Council Meeting
SCS Doc. 11/17	N5937	NAFO	Report of the Scientific Council, 1-12 September 2011
SCS Doc. 11-19	N5942	NAFO	Report of the Scientific Council, 19-23 September 2011
SCS Doc. 11/20	N5998	NAFO	NIPAG Report
SCS Doc. 11/21	N5999	NAFO	SC Report
SCS Doc. 11/22	N6006	NAFO	WGEAFM Report
SCS Doc. 11/23	N5939	NAFO Secretariat	Available Data from the Commercial Fisheries Related to Stock Assessment (2010) and Inventory of Biological Surveys
SCS Doc. 11/24	N6007	NAFO Secretariat	A Compilation of Research Vessel Surveys on a Stock-by-stock Basis

LIST OF REPRESENTATIVES, ADVISERS, EXPERTS AND OBSERVERS, 2011

A = SC Meeting 3-16 June 2011
B = SC Meeting 1-12 Sep 2011
C = SC Meeting 19-23 Sep 2011
D = SC and NIPAG Meeting 19-26 Oct 2011

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SCIENTIFIC COUNCIL MERIT AWARDS

Year	Recipient	Institute
2009	Ralph Mayo	NMFS, Woods Hole, MA, USA
2010	Dr Manfred Stein	Institut fur Seefischerei, Hamburg, Germany
2011	Dr. Vladimir Rikhter	AtlantNIRO, Kaliningrad, Russian Federation

LIST OF RECOMMENDATIONS IN 2011

Scientific Council 3-16 Jun 2011

VII. Management Advice and Responses to Special Requests

1. Fisheries Commission

v) Management measures for blue whiting(Item 11)

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.*

STACFEN

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.*

STACPUB

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

6) Other Matters

b) JNAFS General Editor

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.*

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

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.*

STACREC

3. Review of Previous Recommendations

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.

d) ICES GHL ageing workshop, February 2011

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.*

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.*

STACFIS

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.*

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

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.*

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

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.*

5. Other Finfish in SA 1

f) 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.*

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

i) Research recommendations

For cod in Div. 3M, STACFIS **recommended** that *an age reader comparison exercise be conducted.*

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

f) 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.*

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

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}.

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

d) Conclusions

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

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.*

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

d) 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

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.*

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

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.*

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

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

e) Research Recommendations

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.*

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

d) Research Recommendation

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

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

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.

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STACFIS

b) Northern Shrimp (*Pandalus borealis*) in Div. 3LNO

e) Research Recommendations

STACFIS **recommended** that *the biomass of Northern shrimp in Div. 3LNO be examined in relation to biomass of other species in the same area.*

Scientific Council 19-23 Sep 2011

IX. OTHER MATTERS

6. Access to VMS data

Data access issues were brought forward to Scientific Council by the WGEAFM co-chair. These issues arose when WGEAFM scientists requested access to VMS data held at the NAFO Secretariat. Even though NAFO Secretariat staff and WGEAFM scientists achieved an agreement on how the data should be handled to prevent any disclosure of confidential information to the scientific team, the constraints imposed by the current CEM provisions pertaining VMS data requires that any data released by the Secretariat should be linked to an explicit request by Fisheries Commission, and can only be provided in a summary form.

Modern technologies, like VMS, have emerged as powerful tools for improving management and enforcement practices, but they also provide an important source of information that, as recent work by WGEAFM and Scientific Council has shown, can be used for scientific analyses that can improve the advice that Scientific Council gives to Fisheries Commission. In this context, and in full consideration of the privacy and confidentiality requirements associated with the use of VMS and other types of data that may be available via the NAFO Secretariat, Scientific Council **recommended** *Fisheries Commission to modify the language contained in the current CEM so to allow the NAFO Secretariat to release these types of data to Scientific Council, with the provision that the data must be completely anonymized before its release to Scientific Council, and that it should only be used for analyses pertaining questions posed by NAFO constituent bodies*.

NIPAG 19-26 Oct 2011

2. Northern Shrimp (Div. 3LNO)

e) Review of Research Recommendations

2010 NIPAG recommendations for research pertaining to Northern shrimp in Div. 3LNO:

- *biological and CPUE data from all fleets fishing for shrimp in the area be submitted to the Designated Expert, in the standard format, by 1 September 2011.*

STATUS: NIPAG drew attention to the late and inadequate submission of this information by a number of Contracting Parties, and reiterated its recommendations for improvements.

NIPAG recommendations for Northern shrimp in Div. 3LNO:

- *biological and CPUE data from all fleets fishing for shrimp in the area be submitted to the Designated Expert, in the standard format, by 1 September 2012.*

- *NIPAG recommended that research continue into fitting production models to data for northern shrimp in Div. 3LNO including studies of stock structure and continued investigation of stock assessment models for Pandalus borealis in NAFO Div. 3LNO. This may help provide estimations of B_{MSY} and F_{MSY}.*

5. Northern shrimp in Skagerrak and Norwegian Deep (ICES Div. IIIa and IVa East) – ICES Stock

e) Management Recommendations

NIPAG **recommended** that, *for shrimp in Skagerrak and Norwegian Deep:*

- *sorting grids or other means of facilitating the escape of fish should be implemented in this fishery.*

- *all Norwegian vessels should be required to complete and provide log books.*

f) Research Recommendations

NIPAG **recommended** that, *for shrimp in Skagerrak and Norwegian Deep:*

- *The Norwegian survey time series indices from 1984 - 2003 should be recalculated in order to provide confidence intervals and length frequency distributions.*