PART A: SCIENTIFIC COUNCIL MEETING – 1-14 JUNE 2012

Contents

Scientific Council Participants during the June 2012 Meeting

SC Chairs and the SC Coordinator

Back: Neil Campbell (SC Coordinator), Don Stansbury (Canada, STACREC), Carsten Hvingel (Norway, SC Chair)
Front: Jean-Claude Mahé (EU-France, STACFIS), Margaret Treble (Canada, STACPUB), Gary Maillet (Canada, STACFEN)

REPORT OF SCIENTIFIC COUNCIL MEETING

1–14 JUNE 2012

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at Alderney Landing, Dartmouth, NS, Canada, during 1–14 June 2012, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), the European Union (France, Germany, Portugal, Spain and the United Kingdom), Japan, the Russian Federation, Ukraine and the United States of America. Observers from WWF and EAC were also present. 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.

The Council was called to order at 1000 hours on 1 June 2012. 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 Denmark (F&G), EU, Iceland, Japan and USA.

The opening session was adjourned at 1030 hours on 1 June 2012. 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 13 June 2012, the STACPUB report on 13 June 2012, the STACREC report on 13 June 2012, and the STACFIS report on 13 June 2012.

The concluding session was called to order at 0900 hours on 14 June 2012.

The Council considered and **adopted** the report the Scientific Council Report of this meeting of 1–14 June 2012. 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 1300 hours on 14 June 2012.

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

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

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

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 2011

VII.1.d) Special Request for Management Advice

v) Management Measures for blue whiting (item 11)

Scientific Council was requested to review the mesh size for blue whiting. Scientific Council **recommended** that *Division 3M should not be considered for a possible mesh size change*.

STATUS: There is nothing to report.

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 and to identify candidate 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*.

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 *an obituary be included in Volume. 44 of the Journal of the Northwest Atlantic Fishery Science for Spanish scientist, Dr. Laranneta, in English and Spanish*.

STACPUB **recommended** that the *Secretariat make further enquiries into how authorship is assigned (i.e. actual vs. corporate) when entering NAFO SC documents into the ASFA database in order to ensure that they can be located when searching using the actual authors name.*

STACPUB **recommended** that *digitizing the Sampling Yearbooks would be necessary, but not urgent*.

STACPUB **recommended** that *the Secretariat look to see if options for the current map projection are available and bring this to the next June meeting*.

STACPUB **recommended** that *a comprehensive and concise style sheet be followed for the Journal of Northwest Atlantic Fishery Science.*

STACPUB **recommended** that *the Secretariat initiate a review of the Scientific Council Reports format and to present to Scientific Council in September 2012 examples of format changes and information on whether a two volume approach would be a reasonable option to address concerns about the growing size of the Report.*

V. RESEARCH COORDINATION

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

There were no recommendations arising from STACREC.

VI. FISHERIES SCIENCE

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

There were no general recommendations arising from STACFIS. The Council endorsed recommendations specific to each stock and they are highlighted under the relevant stock considerations in the STACFIS report (Appendix IV).

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 19–26 October 2011. The Scientific Council provided scientific advice on northern shrimp stocks for 2013. Updated advice for 2013 will be provided at the Annual Meeting in 2012 through an interim monitoring report.

a) Request for Advice on TACs and Other Management Measures

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.

Scientific Council responded as follows:

Cod in Division 3M

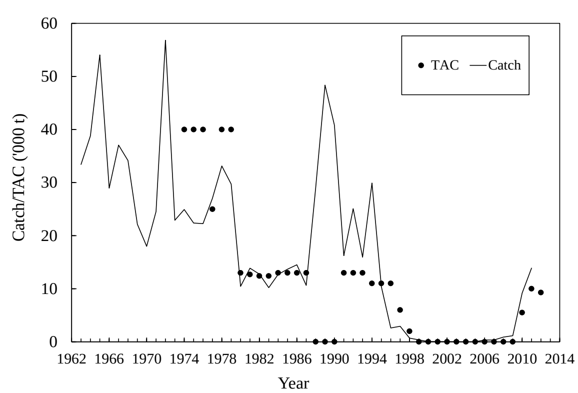
Recommendation: Scientific Council notes that under all the scenarios projected ($F_{0.1}$, F_{max} and F_{2011}) the probability of 2014 SSB being below B_{lim} is low (less than 5%). Estimated F_{2011} is more than twice F_{max}. In the short term the stock can sustain high values of F, however any fishing mortality over F_{max} will result in an overall loss in yield in the long term. Scientific Council considers that yields at $F_{statusquo}$ are not a viable option.

Background: The cod stock in Flemish Cap is considered to be a separate 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. Catches exceeded the TAC from 1988 to 1994. In 1999 the direct fishery was closed. The fishery was reopened in 2010 with 5 500 t TAC and a catch of 9 192 t was estimated by STACFIS. TAC for 2011 was set as 10 000 t. This year, STACFIS only had STATLANT 21A available as estimates of catches, which is inconsistent with the information used in previous assessments. The model used for the assessment of this stock estimated the 2011 catch to be 13 900 t. TAC for 2012 is 9 280 t.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2008	0.9	0.4	Ndf	ndf
2009	1.2	1.2	Ndf	ndf
2010	9.2	4.4	4.1	5.5
2011	13.9[1]	9.8	<10	10
2012			<=9.3	9.3

ndf: No directed fishing.
[1]Estimated by the assessment model.

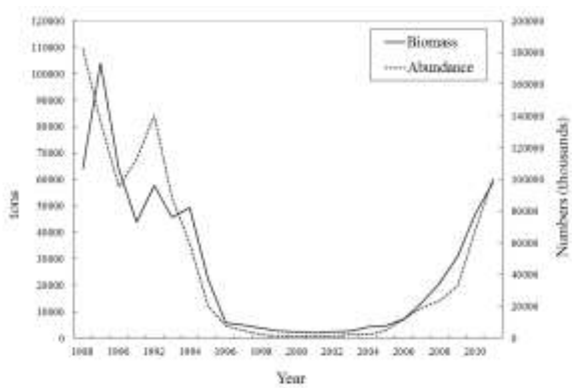


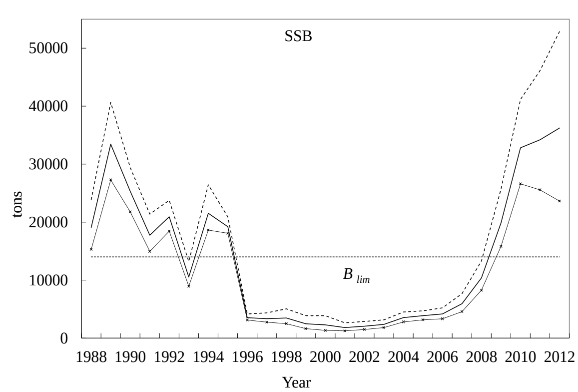
Data: For 2011, length sampling is available from Canada, EU-Estonia, EU-Lithuania, Norway, EU-Portugal, Russia, EU-Spain and EU-UK. Abundance at age indices were available from the EU bottom trawl survey since 1988, covering the whole distribution area of the stock. In 2009–2011 age-length keys from Portuguese catch were available. Maturity ogives are available from the EU survey for the entire period.

Assessment: An age-structured model was accepted to estimate the state of the stock.

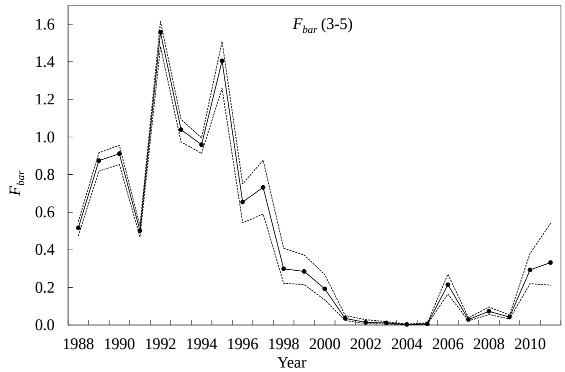
Total Biomass and Abundance: Estimated total biomass and abundance show an increasing trend since the mid-2000s. Both values are this year around the level of the early 90s.

SSB: Estimated median SSB has increased since 2005 to the highest value of the time series and is now well above B_{lim} (14 000 t). The big increase in the last three years is largely due to six abundant year classes, those of 2005–2010, and to their early maturity.



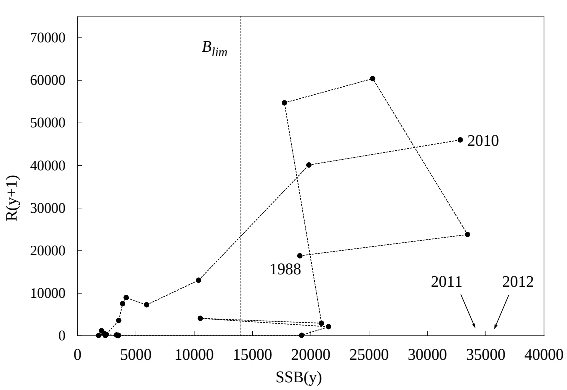


Fishing mortality: *F* increased in 2010 and 2011 with the opening of the fishery. F_{bar} in 2011 (0.339) was more than twice F_{max} (0.135).



Recruitment: After a series of recruitment failures between 1996 and 2004, recruitment at age 1 values in 2005–2011 are higher, especially the 2010 and 2011 values. There is a high uncertainty associated with those last values.

Reference Points: A spawning biomass of 14 000 t has been identified as B_{lim} for this stock. SSB is estimated to be well above B_{lim} in 2012.

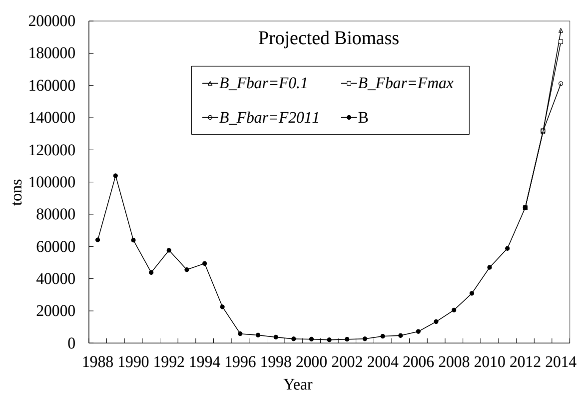


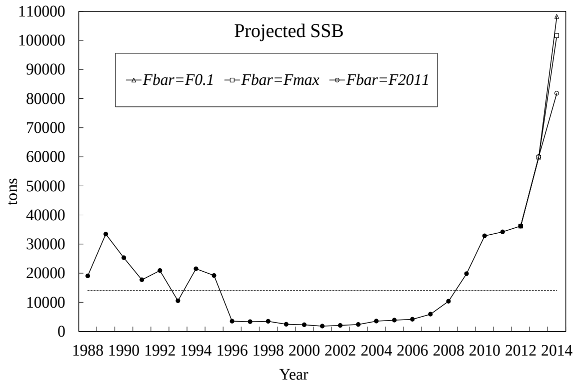
State of the Stock: SSB in 2011 is estimated to be well above B_{lim}. Recent recruitments are among the highest level of the time series, but these estimates are imprecise. Fishing mortality in 2011 is high, at the level of more than twice F_{max}.

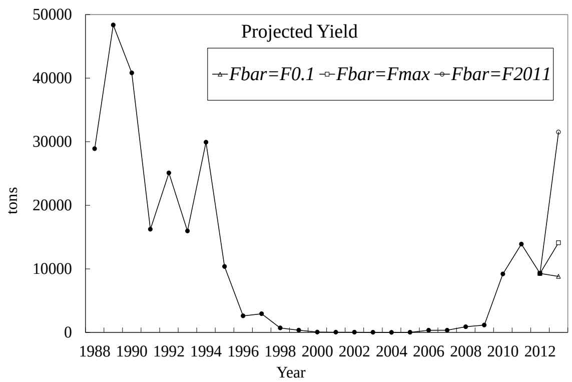
Stock Projections: Stochastic projections to 2014 were conducted for three fishing mortality scenarios: (1) $F_{bar}=F_{0.1}$ (median=0.08); (2) $F_{bar}=F_{max}$ (median=0.135); (3) $F_{bar}=F_{2011}$ (median=0.339). All scenarios assumed that the Yield for 2012 is the established TAC (9 280 t).

Under all scenarios there is a low probability (<5%) of SSB being below B_{lim}.

	Total Biomass		SSB		Yield	
	50%	5%–95%	50%	5%-95%	50%	5%-95%
$F_{bar}=F_{0.1}$ (median=0.080)						
2012	84107	57101-124148	36244	23632-52898	9280	
2013	131265	86966-205140	60023	40960-86763	8813	4329-17173
2014	194218	129002-303926	108249	71615-167444		
$F_{bar}=F_{max}$ (median=0.135)						
2012	84093	57195-124008	36180	23675-52880	9280	
2013	131836	87216-205249	59851	41007-86906	14113	7129-26507
2014	187176	122645-294501	101670	66422-158863		
$F_{bar}=F_{2011}$ (median=0.339)						
2012	84039	57066-123950	36168	23699-53154	9280	
2013	131711	87025-204072	60087	40793-86622	31517	18535-53190
2014	161107	103948-256003	81850	51353-131261		







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

As 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 the previous assessment, SSB for 2011 was estimated as 50 000 t. This is now revised to 34 000 t because of differences between the maturities assumed for 2011 in the previous assessment and the estimated maturities available this year.

The exploitation pattern in 2011 is much different than that of 2010. This sudden change, combined with changes in weight-at-age causes significant revisions and uncertainty in the estimated yield per recruit reference points.

Sources of Information: SCR Doc. 12/26, 35, 37; SCS Doc. 12/05, 06, 08, 09, 14.

Redfish in Divisions 3LN

Recommendation: Short term projections (median) of relative biomass, fishing mortality and catch, under $F_{statusquo}$ and a range of F_{msy} multipliers are presented below (*Status quo* catch is assumed for 2012):

Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
	B/Bmsy			
2012	1.470	**1.470**	1.470	1.470
2013	1.514	**1.514**	1.514	1.514
2014	1.554	**1.554**	1.528	1.478
2015	1.588	**1.589**	1.541	1.450
	F/Fmsy			
Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
2012	0.164	**0.164**	0.164	0.164
2013	0.170	**0.169**	0.337	0.675
2014	0.170	**0.169**	0.337	0.675
	Catch			
Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
2012	5768	**5768**	5768	5768
2013	6172	**6113**	12126	23830
2014	6346	**6287**	12277	23397

Although the stock has been increasing, this is a newly reopened fishery, and the response of the stock to fishing is uncertain.

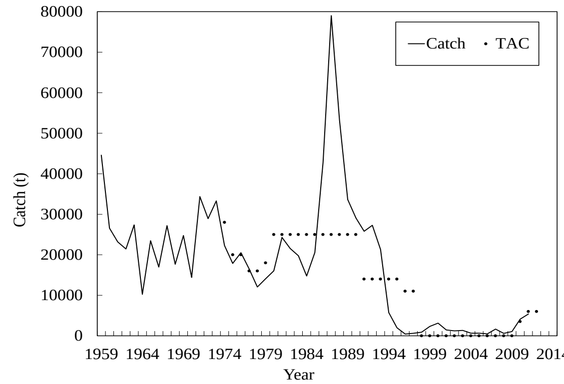
Scientific Council recommended that fishing mortality in 2013 and 2014 should be kept around the current level. Increases of F above $F_{statusquo}$ should be treated with caution.

Background: There are two species of redfish, *Sebastes mentella* and *Sebastes fasciatus*, which occur in Div. 3LN and are managed together as one management unit.

Fishery and Catches: Catches declined to low levels in the early 1990s and have since varied between 450 – 3 000 t. From 1998–2009 a moratorium was in place. Since 1998 catches were taken as bycatch primarily in Greenland halibut fisheries. With the reopening of the fishery in 2010 catches increased in 2010 and 2011 to 4 100 t and 5 395 t.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	1.1	0.3	ndf	ndf
2010	4.1	3.1	3.5	3.5
2011	5.4	5.4	6.0	6.0
2012			6.0	6.0

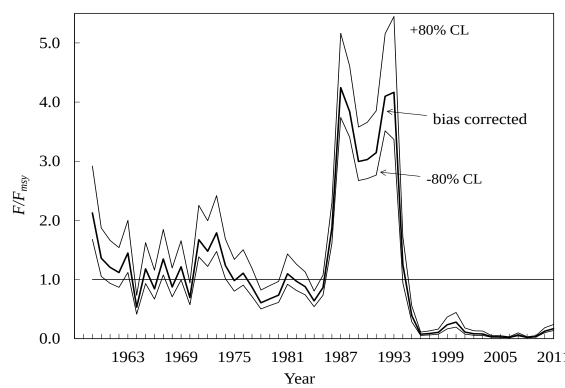
ndf No directed fishing



Data: Catch data since 1959 and data from surveys conducted by Canada, Russian Federation and EU-Spain were available. Length frequencies were available for both commercial catch and surveys.

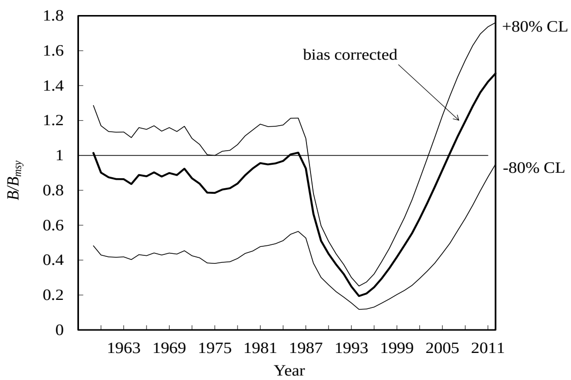
Assessment: An ASPIC model framework, was used to assess the status of the stock. This framework uses a surplus production model to describe stock dynamics.

Fishing Mortality: Fishing mortality has been low since 1995.

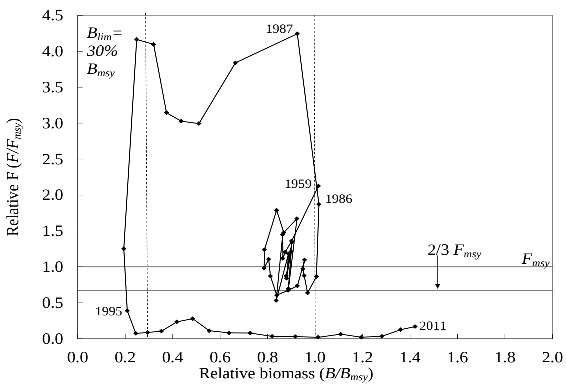


Recruitment: From commercial catch and Canadian survey length data there are signs of recent recruitment of above average year classes to the exploitable stock.

Biomass: Relative biomass was close to B_{msy} for most years up to 1987. Biomass decreased from 1987 to a minimum in 1994. During the moratorium years biomass increased and is now above B_{msy} .



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



Reference Points: The stock is estimated to be well above B_{lim} (30% B_{msy}) and fishing mortality is estimated to be well below F_{lim} (=F_{msy}).

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

The next assessment will be in 2014.

Sources of Information: SCR Doc. 12/14, 32; SCS Doc. 12/5, 6, 8, 9.

Thorny Skate in Divisions 3LNOPs

Recommendation: This stock has remained low since the mid-1990s. Catches in Div. 3LNO in excess of recent levels (2009–11 average = 4 700 t) will increase the risk of the stock failing to rebuild.

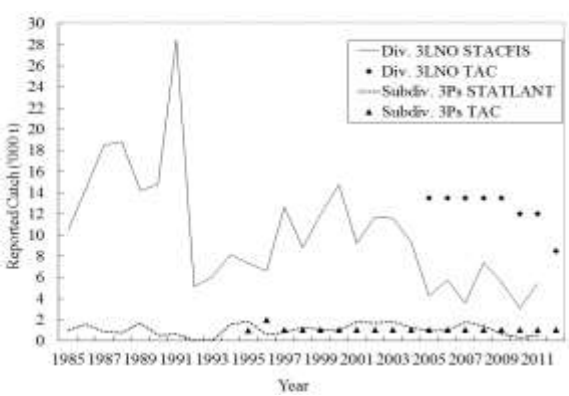
Background: Thorny Skate on the Grand Banks is managed as two units; Skate in Div. 3LNO is managed by NAFO and Skate in Subdiv. 3Ps is managed by Canada and France in their respective EEZs.

Fishery and Catches: Catches for NAFO Div. 3LNO increased in the mid-1980s with the commencement of a directed fishery for Thorny Skate. The main participants in this new fishery were EU-Spain, EU-Portugal, Russia, and Canada.

For 2010 and 2011, the TAC for Div. 3LNO was reduced to 12 000 t. The TAC was further reduced to 8 500 t for 2012. The TAC in Subdivision 3Ps is 1 050 t.

Catches are as follows:

	Catch (000 t)				TAC ('000 t)[1]
	Div.3LNO		Div. 3LNOPs		Div. 3LNO
	STACFIS	21	21		
2009	5.6	5.7	6.4		13.5
2010	3.1	5.4	5.7		12
2011	5.4	5.4	5.9		12
2012					8.5



There are substantial uncertainties concerning reported skate catches prior to 1996.

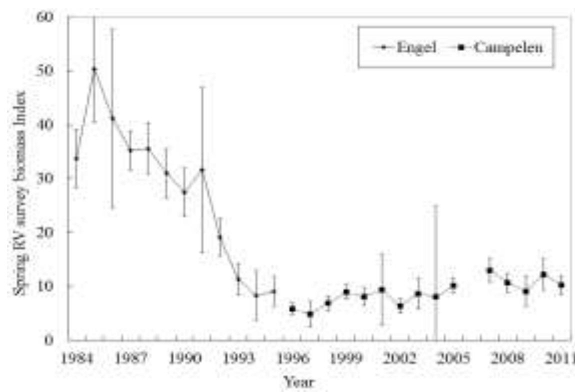
Data: Abundance and biomass indices were available from Canadian spring and autumn surveys since 1984.

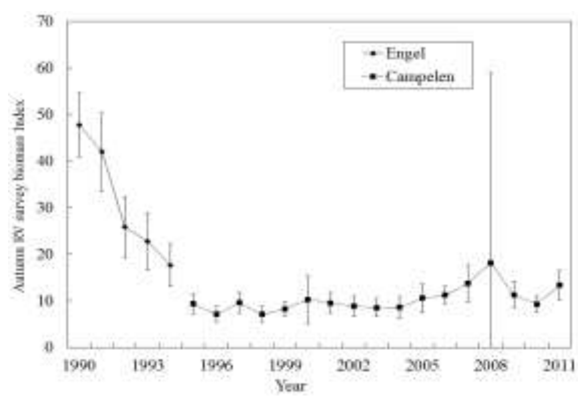
EU-Spain survey indices were available for the NAFO Regulatory Area of Div. 3NO (1997–2011). EU-Spain survey indices in the NRA of Div. 3L are available for 2003–2011.

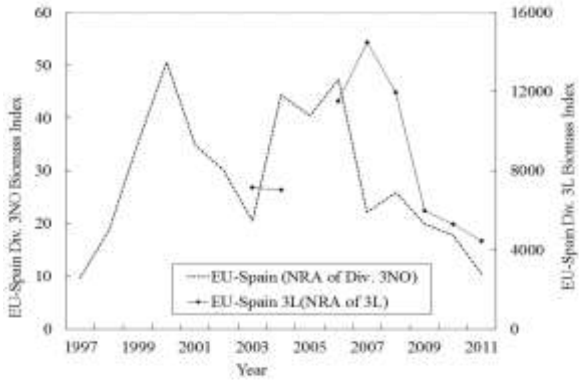
Commercial length frequencies were available for EU-Spain, EU-Portugal, Canada and Russia.

Assessment: No analytical assessment or risk analysis could be performed, therefore, only qualitative statements about risk can be provided.

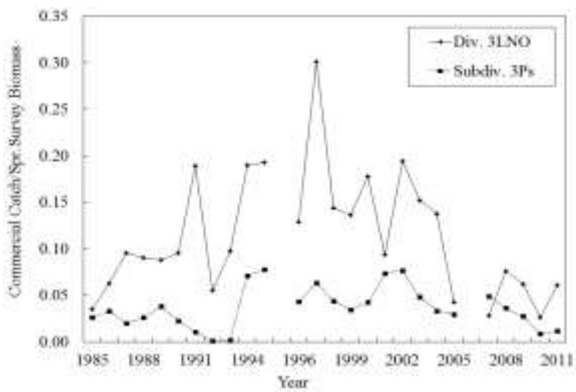
Biomass. The Canadian spring survey biomass indices fluctuated without trend prior to the mid-1980s then declined rapidly until the early-1990s. The Canadian spring Campelen series, 1996 to 2011, has been showing an increasing trend in biomass since 1997. While the Canadian autumn survey shows stability. Both EU-Spain surveys, which cover only the NRA have been in decline since 2007.



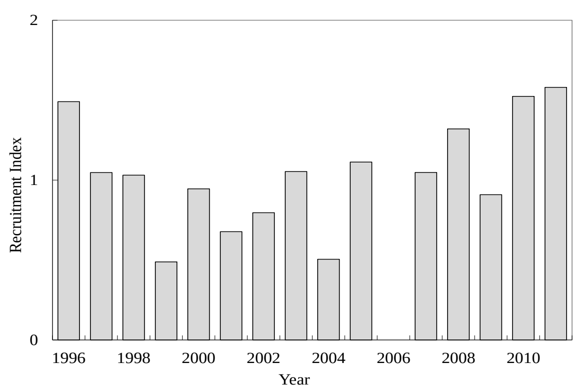




Fishing Mortality. A fishing mortality index (Catch/survey biomass from Canadian spring surveys for Div. 3LNO) has been low since 2005.



Recruitment: Recruitment index (Skate < 21cm) has been fluctuating without any clear trend from 1996–2009. The index in 2010 and 2011 is however 50% above average.



State of the Stock: This stock has remained at low levels since the mid-1990s, with low fishing mortality index since 2005. Recruitment index in 2010 and 2011 is 50% above average.

Reference Points: None defined.

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

The next assessment will be in 2014.

Sources of Information: (SCS Doc. 12/5, 8, 9; SCR Doc. 12/10, 15, 21, 28)

b) Monitoring of Stocks for which Multi-year Advice was Provided in 2010 or 2011

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

In 2010: 3-year advice was provided for 2011, 2012 and 2013 for Cod in Div. 3NO, Redfish in Div. 3O, Witch flounder in Div. 2J+3KL and Northern shortfinned squid in SA 3+4.

In 2011 3-year advice was provided for 2012, 2013 and 2014 American plaice in Div. 3M, Witch flounder in Div. 3NO and 2-year advice was provided for 2012 and 2013 for Redfish in Div. 3M, Yellowtail flounder in Div. 3LNO, Capelin in Div. 3NO and White hake in Div. 3NOPs.

The Scientific Council reviewed the status of the ten stocks (interim monitoring) at this June 2012 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. 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 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 Northern shortfinned 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 000t.

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

Recommendation for American plaice in Div. 3M: (2011) 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.

Recommendation for Witch flounder in Div. 3NO: (2011) 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.

Recommendation for Redfish in Div. 3M: (2011) 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.

Recommendation for Yellowtail flounder in Div. 3LNO: (2011) 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}.

Recommendation for Capelin in Div. 3NO: (2011) No directed fishery on capelin in Div. 3NO in 2012–2013.

Recommendation for White hake in Div. 3NOPs: (2011) 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.

c) Special Requests for Management Advice

i) Computation of harvest control rule and advice on exceptional circumstances in Greenland halibut in Subarea 2 and Divisions 3KLMNO (Item 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.

Scientific Council responded:

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.*

As per the HCR adopted by the Fisheries Commission, survey slopes were computed using the most recent five years of survey data (2007–2011) and are illustrated in Fig. 1. The data series included in the HCR computation are the Canadian Fall Divs. 2J3K index ("F2J3K"), the Canadian Spring Divs. 3LNO index ("S3LNO"), and the EU Flemish Cap index covering depths from 0–1400m ("EU1400"). Averaging the individual survey slopes yields *slope*= -0.1099. The TAC in 2012 is 16 326 t. Applying the harvest control rule, 16326*[1+2*(-0.1099)] = 12 739 t. However, as this change exceeds 5%, the HCR constraint is activated and TAC_{2013} = 0.95*16326 = **15 510 t**.

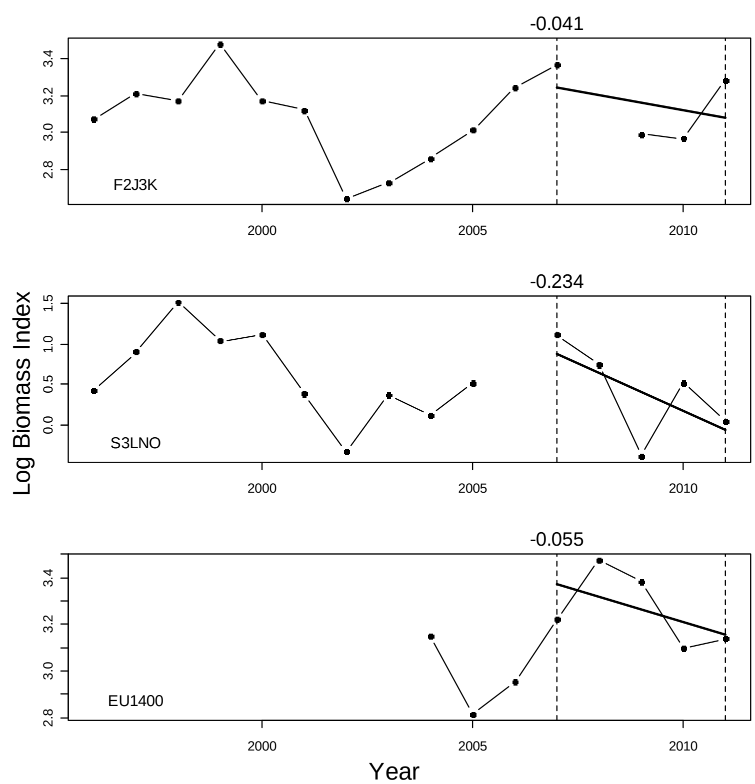


Fig. 1. Survey slopes used in computation of Greenland halibut harvest control rule.

b) Advise on whether or not an exceptional circumstance is occurring.

Defining Exceptional Circumstances in the context of the Greenland halibut MSE

Scientific Council advises that "Exceptional Circumstances" (EC) occur when a resource moves outside the range of parameters compatible with the various scenarios considered in the MSE simulation testing, on which selection of the management strategy for that resource was founded. If Scientific Council determined that "Exceptional Circumstances" are occurring, then a review and possible revision of the harvest control rule by Fisheries Commission, as outlined by the FC Working Group on MSE (FC Doc. 11/08), may be necessary.

In providing advice to Fisheries Commission, Scientific Council will compare the annual observations of the primary indicators, catch and survey biomass indices (age aggregated), with the corresponding values produced by the operating models from the September 2010 Management Strategy Evaluation carried out by WGMSE (NAFO/FC Doc. 10/30; SCR Doc. 11/48, 11/76). In making this comparison, all the results from the XSA operating models (OMs) should be combined into a single distribution for each year and all the results from SCAA OMs into a separate single distribution for each year. If any of these values fall outside the 90% CIs for either the XSA-based distribution or the SCAA-based distribution then exceptional circumstances will be considered to have occurred.

Scientific Council notes that in 2014, there will be a full review of the MSE. This work should be carried out within SC because it requires scientific peer review. The review of the MSE will necessitate the availability of appropriate technical expertise within Scientific Council to carry out the work.

Any changes in management objectives or performance statistics need to be provided by Fisheries Commission well ahead of this review.

Advise on whether or not an exceptional circumstance is occurring.

Annual comparisons of the "primary" indicators – catch and survey indices – are required to determine whether or not Exceptional Circumstances are occurring.

STACFIS catch estimates for 2011 are not available. Therefore, SC cannot compare observed catches to the simulated distributions, and is unable to determine if exceptional circumstances with respect to catches are occurring. SC notes the management strategy for Greenland halibut assumed that the simulated catches would exactly equal the TACs generated from the HCR. The 90% confidence intervals for the simulated 2011 catches range from 16 625 to 18 059 t in XSA based OMs and in SCAA based OMs, from 17 182 to 17 182 t.

For the three surveys used in the HCR, the 2011 observed values were compared with composite distributions of simulated surveys for both: i) SCAA-based OMs and ii) XSA-based operating models. Out of the six comparisons possible (three surveys; two distributions), there was one case for which the observed survey index *exceeded* the 95th percentile. According to the definition of EC, such situations constitute an exceptional circumstance.

Scientific Council advises that exceptional circumstances *are* presently occurring; but that having one survey above the simulated distributions from one suite of operating models does not constitute a conservation concern.

ii) Mid-water trawl fishery mesh size for redfish in Div. 3LN (Item 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.

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 present.

iii) Review and Update Reference points for Div. 3LNO American plaice, Div. 3NO cod (Item 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. Bisr) in the NAFO precautionary approach framework to delineate an additional zone between Blim and Bmsy as proposed by the working group

b) Taking into consideration the new reference point Bisr, provide advice on an updating NAFO PA framework and provide a description for each zone.

c) Provide advice on an appropriate selection of the Bisr value for Div. 3NO cod and Div. 3 LNO American plaice.

Scientific Council responded:

In 2011 Scientific Council had advised that B_{buf} was not required because both Div. 3LNO American plaice and Div. 3NO cod have analyses of the probability that biomass is below B_{lim}. However an additional zone between B_{lim} and B_{msy} in the NAFO Precautionary Approach Framework could be considered.

Providing advice on a new intermediate reference point and selecting an appropriate level depends on the purpose and on the properties that such a reference point would have. The purpose of the proposed B_{isr} is not clear to Scientific Council. If the purpose is to serve as a 'milestone' for the Fisheries Commission to track rebuilding, then the reference point can have any value that the Fisheries Commission wishes. If the purpose of the B_{isr} is to mark the beginning of the safe zone, or to mark an SSB above which h there is a high probability of being above Blim, or if the purpose is to mark any zone for which there would be some change in an HCR, then analyses as to the appropriate level would need to be conducted. Scientific Council can not advise on particular levels until it is clear as to the purpose of B_{isr}.

Scientific Council also can not advise on updating the NAFO PA framework as it also depends on the purpose of the B_{isr}. Scientific Council recommends that this exercise be conducted jointly with the Fisheries Commission. Therefore, the Scientific Council chair will contact the Fisheries Commission chair about the possibility of forming a joint working group to re-evaluate the NAFO PA framework. Scientific Council members of this group would bring work peer reviewed by Scientific Council to the discussions.

d) Review B_{msy} and F_{msy} provided in 2011 for both stocks and quantify uncertainty surrounding these estimates.

Scientific Council responded that for Div. 3NO cod:

Scientific Council notes that the approach used in estimation of the maximum sustainable yield (MSY) reference points approved last year may not be advisable in the case of Div. 3NO cod due to the high uncertainty in the stock-recruit relationship for this stock. Scientific Council recommends the use of proxies based on the yield per recruit (YPR) and spawner per recruit (SPR) to estimate the reference points for cod in Div. 3NO.

Using this approach Scientific Council estimated the YPR and SPR reference points with uncertainty for Div. 3NO cod. The proxies for the limit references points estimated through YPR were very similar to the F_{msy} estimated last year based on Loess smoother applied to log-transformed recruitment values from the VPA and the current B_{lim}. However, the B_{msy} estimated based on the YPR was different to the B_{msy} estimated last year.

Scientific Council noted that the level of B_{msy} estimated from YPR-SPR depends on assumptions about the level of recruitment. Scientific Council concluded that more research about the possibility of changes in productivity is needed to better estimate this reference point. Scientific Council noted that the actual biomass level of the Div. 3NO cod is far below any reasonable level of B_{msy}.

For Div. 3LNO American plaice:

For Div. 3LNO American plaice Bayesian surplus production models were fit to catch and research survey data and the results compared to the results for MSY reference points derived from Loess smoother applied to log-transformed recruitment values from the American plaice VPA assessment. Although the absolute values of F_{msy} and B_{msy} derived from these two different methods are not directly comparable the ratio of Biomass to B_{msy} (B_{ratio}) and Fishing mortality to F_{msy} (F_{ratio}) can be compared. Trends in these metrics from the different models were very similar over time, particularly B_{ratio}. All models show that current biomass is well below B_{msy}. The results of the Bayesian surplus production models support the MSY reference points derived by Scientific Council in 2011.

iv) Review of rebuilding plans for American plaice in Div. 3LNO and Cod in Div. 3NO (Item 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 B_{lim}.

Scientific Council responded to this request in conjunction with the following request.

v) Evaluation of the proposed harvest control rule for American plaice in Div. 3LNO and Cod in Div. 3NO (Item 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 B_{lim} 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 B_{lim}.

Harvest Control Rule:
a) When SSB is below Blim:
i. no directed fishing, and
ii. bycatch should be restricted to unavoidable bycatch 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.

Scientific Council responded to item 7 and 8 together.

For Div. 3NO cod:

Scientific Council notes that testing of the rebuilding plan and alternative HCR for Div. 3NO cod was not possible at this time. The stock recruit relationship of Div. 3NO is poorly defined and the use of parametric relationships is not warranted. The MSY reference points may be revised in the near future. The current stock status of Div. 3NO cod is such that it is well below B_{lim} and very far from any reasonable level of B_{msy}.

For Div. 3LNO American plaice:

The alternative HCR for Div. 3LNO American plaice was tested by simulation. This testing did not constitute a full management strategy evaluation and Scientific Council advises that such a process should be conducted. The simulation testing that was done indicates that this rule works reasonably well as a management strategy, although the time to reach the various reference points/milestones is long. The median time to reach B_{lim} is 2022, to reach the proposed value of B_{isr} is 2036 and to reach B_{msy} is greater than 2060.

Results of simulations testing the alternative HCR for Div. 3LNO American plaice

	5 years	10 years	15 years
SSB growth	$pSSB_{5years}>SSB_{1year}=0.80$	$pSSB_{10years}>SSB_{5years}=0.80$	$pSSB_{15years}>SSB_{10years}=0.93$
p SSB > B_{lim}	0	0.25	0.79
Median SSB	38 340	43 712	56 507
Median catch	4 446	4 991	8 221

Scientific Council notes that for Div. 3LNO American plaice the alternative HCR described in the Fisheries Commission request item 8 meets most of the requirements that are laid out in the conservation and rebuilding plan for that stock. It is a much simpler rule that is easier to apply than the current rebuilding plan. The rules described in the current rebuilding plan often mix performance statistics with HCR. In addition some of the rules are complicated and performance statistics vague. Therefore Scientific Council advises that the alternative HCR described in item 8 be considered for adoption for Div. 3LNO American Plaice.

For both Div. 3LNO American plaice and 3NO cod, Scientific Council responded:

It is not expected that Div. 3LNO American plaice and 3NO cod will reach B_{lim} in the short term. This gives time for the Scientific Council to cooperate with the Fisheries Commission and perform a full management strategy evaluation before the opening of any directed fisheries. Scientific Council highlights that such a process entails substantial workload and will require close dialogue between Scientific Council and Fisheries Commission.

vi) Full assessment of Div. 3LNO American plaice in accordance with the rebuilding plan (Item 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.

Scientific Council responded:

American plaice in Div. 3LNO

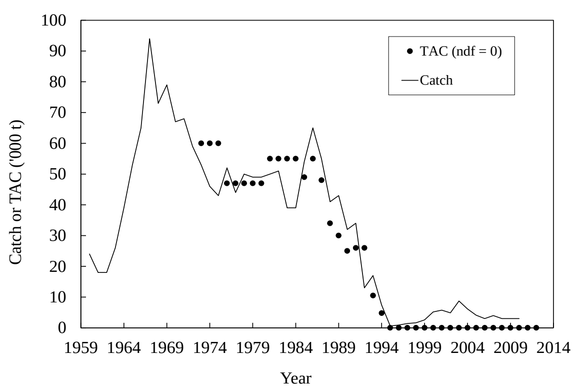
Recommendation: SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11). Scientific Council therefore recommended that in accordance with the rebuilding plan, there should be no directed fishing on American plaice in Div. 3LNO in 2013 and 2014. Bycatches of American plaice should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directing for other species.

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. This year, STACFIS only had STATLANT 21A available as estimates of catches in 2011. The inconsistency between the information available to produce catch figures used in the previous years' assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessment for this stock.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	3.0	1.8	ndf	ndf
2010	2.9	2.0	ndf	ndf
2011	na	1.2	ndf	ndf
2012			ndf	ndf

ndf No directed fishing;
na Not available.



Data: Biomass and abundance data were available from: annual Canadian spring (1985–2011) and autumn (1990–2011) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995–2011). Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2011.

Assessment: Since STACFIS was not able to estimate total catch, the analytical assessment using the ADAPTive framework could not be updated in 2012.

During the previous assessment in 2011, Scientific Council concluded that:

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 at the start of 2011 was 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: During the previous assessment in 2011, Scientific Council concluded that: 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. The 2012 assessment does not indicate a change in the status of the stock, based on last year's analytical model and the 2011 survey results.

Reference Points: Based on the 2011 assessment the biomass for this stock is estimated to be below B_{lim} (50 000 t) and fishing mortality in 2010 was below F_{lim} (0.3).

Short Term Considerations: Simulations were carried out in 2011 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).

SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11).

	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			

Special Comment: Given the low probability of reaching B_{lim} in the short term, Scientific Council plans to conduct the next full assessment of this stock in 2014.

Sources of Information: SCS Doc. 12/4, 5, 8, 9, 14; SCR Doc. 12/6, 12, 17, 33, 34.

vii) Examine links between decline of shrimp and recovery of cod and reduction of redfish in Div. 3M (Item 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 Scientific Council 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.

Analysis of common trends in the biomass trajectories of main demersal species in the Flemish Cap ecosystem indicates that the environment, trophic interactions, and fisheries are important drivers of their dynamics.

General analyses of fish stomachs show an increasing proportion of shrimp in the diets of most fish species since the mid to late 1990s, and a more recent increase of redfish in the diet of large predatory fishes since early 2000s. This trend is observed throughout the Flemish Cap fish community and indicates that any specific impact of cod on redfish and shrimp is part of a broader trend towards the consumption of these two components of the fish community.

Specific studies estimating redfish consumption by cod indicate that redfish is an important prey for cod, and that the level of consumption increased significantly in recent years. When compared with redfish stock sizes, the trend of redfish consumption by cod translates into an important increase in predation mortality for redfish since the middle 2000s. If reduction in redfish consumption by cod occurs, it may not trigger an immediate surge in redfish; other factors beyond reduced predation mortality by cod (in particular low fishing mortality and good recruitment conditions), are likely needed to generate an increase in the redfish stock.

An exploratory three-species model was used to investigate the joint dynamics of cod, redfish and shrimp in the Flemish Cap, and to explore the plausibility of producing a combined MSY for these three species.

Model results suggested that, in unexploited conditions, cod would be expected to be a highly dominant component of the system, and high shrimp stock sizes, like the ones observed in the mid-late 1990s, would not be a stable feature in the Flemish Cap. Different MSY scenarios were explored, including the maximization of combined yields for the three species (MS), as well as three single species scenarios where fishing rates were set to maximize the yield of each one of the individual species (SS Cod, SS Redfish, and SS Shrimp). Results from these explorations indicated that simultaneously achieving the yields produced by single species MSY scenarios is not possible; if such "parallel single-species MSY" strategy is implement in the model, significantly lower yields than the ones from each individual single species MSY scenario are obtained. Overall, achieving high yields for the fish species implies low levels of shrimp biomass, while maximizing shrimp yields would require accepting significantly lower levels of cod and redfish biomass. To a lesser degree, trade-offs are also expected between cod and redfish (Fig. 2).

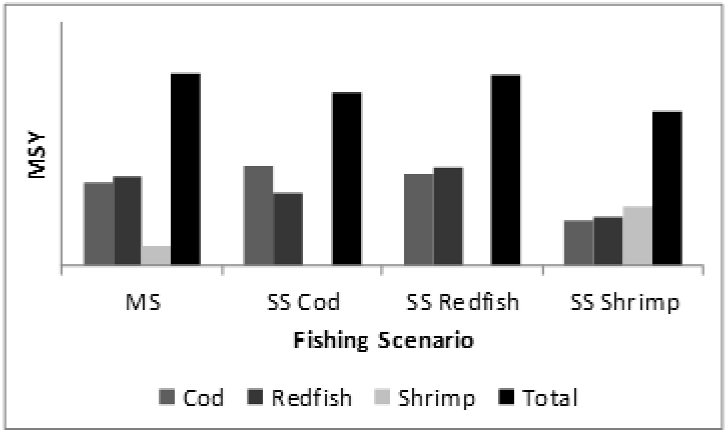


Fig. 2. Illustrative comparison of the MSY for each species and combined under each one of the four MSY scenarios explored.

This exploratory analysis indicates that important trophodynamic connections exist among these three species, hence maximizing yields requires addressing the trade-offs emerging from these interactions.

viii) Definition of MSY reference points and a prospective harvest control rule for cod in Div. 3M (Item 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 B_{msy} under different scenarios, consistent with the proposed HCR.

Scientific Council has been unable to make any progress towards answering this request at this time.

ix) Review of bycatch information (Item 12)

The Fisheries Commission requested:

Scientific Council is asked to provide, where available, qualitative and quantitative information including possible comparisons on bycatches of various species in directed fisheries on stocks under NAFO management.

The Scientific Council responded:

The Scientific Council is unable to make comparisons amongst fisheries because the information was not provided in a standardized way, including a common context for meaning of ‘directed’ fishery. For some fleets this was taken to be the main species sought, for others it was main species in the catch. The council also notes that Secretariat could provide additional information to Fisheries Commission via a tabulation of STATLANT 21 data.

Information on bycatch available to the 2012 Scientific Council meeting included analysis of logbook data or observer data. This is presented in summary form by stock area and/or Division in the format it was provided to the meeting. For brevity, only key bycatch species are listed individually and others may be aggregated at a higher taxonomic category. The calculation of bycatch percentage was by weight, and, for each species in relation to the total catch in accordance with the NAFO CEM except where specified.

Canada (N) fisheries (based on logbooks, the following tables are for all gears, does not include discards, and records are aggregated under the context of “directed” being the main species sought):

Bycatch in Canada (N) Greenland Halibut directed fisheries generally has been low throughout the stock area (< 2%) over the past five years. The area of highest bycatch percentage was realized in 3L in 2007 for Atlantic Cod being near 13%, then declined thereafter to <1% by 2010. The following tables list bycatch over the past 5 years:

Greenland Halibut SA2+3KLMNO		Catch (t)					% of Total Catch (within each Area)				
Area	Species	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
2G	Greenland Halibut	3	10	49	31		100.0%	100.0%	100.0%	100.0%	
2H	Greenland Halibut	122	158	99	30	87	100.0%	100.0%	100.0%	100.0%	100.0%
2J	Greenland Halibut	2385	2465	1576	2893	1818	97.7%	99.1%	99.7%	98.0%	96.8%
	Plaice	20	9	2		4	0.8%	0.3%	0.1%		0.2%
	Redfish	9	8	1	5	18	0.4%	0.3%	0.0%	0.2%	1.0%
	Roughhead Gren	10	2		6	1	0.4%	0.1%		0.2%	0.1%
	Skate NS	1					0.0%				
	Witch	16	5	2	47	37	0.7%	0.2%	0.1%	1.6%	2.0%
3K	Greenland Halibut	1446	1408	3018	2267	2589	97.3%	98.9%	97.6%	92.5%	93.5%
	Plaice		1	5	21	13		0.1%	0.2%	0.9%	0.5%
	Redfish	14	12	27	56	55	1.0%	0.9%	0.9%	2.3%	2.0%
	Roughhead Gren	22	2	7	23	62	1.5%	0.2%	0.2%	1.0%	2.2%
	Skate NS	2		1	3	2	0.1%		0.0%	0.1%	0.1%
	Witch	2	1	35	79	47	0.1%	0.0%	1.1%	3.2%	1.7%
3L	Cod	157	67	26	11		13.2%	9.4%	2.4%	0.8%	
	Greenland Halibut	1006	637	1006	1287	1635	84.7%	89.9%	95.5%	92.8%	93.4%
	Non Groundfish	1					0.1%				
	Plaice	11	2	4	31	11	0.9%	0.3%	0.4%	2.2%	0.6%
	Redfish	3	1	6	11	13	0.3%	0.2%	0.5%	0.8%	0.7%
	Roughhead Gren	5	1	4	12	50	0.5%	0.1%	0.4%	0.8%	2.8%
	Skate NS	1	1		2		0.1%	0.1%		0.1%	
	Witch	4		8	33	35	0.4%		0.7%	2.4%	2.0%
	Yellowtail					7					0.4%
3N	Plaice					1					8.7%
	Yellowtail					12					91.3%
3O	Greenland Halibut	89					96.8%				
	Halibut	3					3.2%				
	Monkfish				4					74.0%	
	Skate NS				1					26.0%	

The Canadian yellowtail flounder directed fishery generally has the highest incidence of bycatch of Canadian fisheries. Over the past five years, the principal bycatch species has been American Plaice which has been under moratorium since 1995. The percentage of bycatch has as ranged from a high of 19.5% (Div. 3N in 2009) to 6.4% (Div. 3N in 2008) and has been generally declining in each Division over the past 5 years. Bycatch percentage of other species has generally been less than 1% with the exception of Atlantic cod in particular for Div 3O which has ranged from 1% to 5% as indicated in the table below:

Yellowtail Flounder 3LNO		Catch (t)					% of Total Catch (within each Area)				
Area	Species	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
3L	Cod		3					0.24%			
	Haddock					1					0.44%
	Plaice	1	124	20	10	11	13.45%	11.18%	8.14%	8.42%	6.65%
	Yellowtail	5	985	224	113	159	86.55%	88.59%	91.86%	91.58%	92.91%
3N	Cod	37	85	15	63	28	1.61%	1.13%	0.37%	0.97%	0.89%
	Haddock	2			20	30	0.07%			0.31%	0.95%
	Halibut		2	1	6	4		0.03%	0.03%	0.09%	0.13%
	Plaice	187	486	785	814	279	8.22%	6.43%	19.49%	12.52%	8.77%
	White Hake				1					0.01%	
	Witch	3	14	1	15	2	0.12%	0.19%	0.04%	0.22%	0.05%
	Yellowtail	2053	6976	3228	5584	2838	89.98%	92.23%	80.08%	85.87%	89.21%
3O	Cod	69	73	115	36	7	3.58%	2.80%	4.77%	1.31%	0.63%
	Haddock			26	4	11			1.10%	0.14%	1.01%
	Halibut			1	1	1			0.03%	0.03%	0.12%
	Plaice	232	264	267	299	81	12.03%	10.10%	11.10%	10.92%	7.77%
	Witch	13	25	39	25	9	0.67%	0.94%	1.62%	0.90%	0.88%
	Yellowtail	1615	2249	1958	2372	930	83.72%	86.16%	81.38%	86.70%	89.59%

The white hake directed fishery has been declining over the past five years and skates species have been the principal bycatch species ranging from 0.5% in 2007 to 19.2% in 2011. There are a variety of other species taken in the fishery that generally have accounted for less than 4% as bycatch.

White Hake in 3NO		Catch (t)					% of Total Catch (within each Area)				
Division	Species	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
3N	Cod		1					0.1%			
	Greenland Halibut		2					0.2%			
	Halibut		3					0.3%			
	Skate NS		11					1.2%			
3O	Cod	3	25	6		1	0.7%	2.6%	1.4%		1.1%
	Cusk			2	1				0.5%	0.5%	0.0%
	Greenland Halibut		5					0.5%			
	Haddock	2	33	17	1		0.5%	3.4%	3.9%	0.5%	
	Halibut	6	11	11	7	2	1.3%	1.2%	2.7%	3.9%	3.0%
	Monkfish	12	7	3	11	1	2.6%	0.8%	0.8%	6.2%	2.1%
	Plaice		1					0.1%			
	Pollock	8	2		5		1.7%	0.2%		2.7%	
	Skate NS	2	155	49	1	12	0.5%	16.3%	11.6%	0.6%	19.2%
	White Hake	440	691	334	158	49	92.7%	73.1%	79.2%	85.6%	74.7%

Redfish directed fisheries in Div. 3L only landed 100 t in 2010 and the largest bycatch was Greenland halibut at 7.5%. In 2011, the directed fisheries increased to 1 950 t with the largest bycatch being American plaice at 70 t (~3%). In Div. 3O, redfish directed catch has declined from 1,100 t in 2007 to less than 200 t per year thereafter. Bycatch has been generally low (<4%).

Redfish in Div. 3LN		Catch (t)		% of Total Catch (within each Area)	
Area	Species	2010	2011	2010	2011
3L	Cod		2		0.1%
	Greenland Halibut	8	27	7.5%	1.3%
	Halibut		9		0.4%
	Plaice	1	67	0.4%	3.2%
	Redfish	102	1947	91.0%	93.9%
	Witch	1	23	1.1%	1.1%
3L Total		112	2074	100%	100%

Redfish in Div. 3O		Catch (t)					% of Total Catch (within each Area)				
Area	Species	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
3O	Cod	12	23				1.1%	9.3%			
	Haddock	23	9				2.1%	3.8%			
	Halibut	2	1	1			0.2%	0.3%	0.3%		
	Monkfish	1	2				0.1%	0.7%			
	Pollock	8					0.7%				
	Redfish	1054	202	256	42	97	94.6%	81.3%	99.3%	98.6%	100.0%
	Skate NS	1			1		0.1%			1.4%	
	White Hake	8	5	1			0.7%	2.0%	0.5%		
	Witch	5	7				0.5%	2.6%			
3O Total		1115	249	258	42	97	100.0%	100.0%	100.0%	100.0%	100.0%

The skate directed fishery was sparse in Div. 3LNO from 2007 onward with the exception of 2009 when 320 t was taken. In that year, most of the catch came from Div. 3O and Haddock (14.4%) and White hake (9.5%) were the major bycatch species.

Skate in 3LNO

Area	Species	Catch (t) 2007	2008	2009	2010	% of Total Catch (within each Area) 2007	2008	2009	2010
3L	Greenland Halibut		1				29.1%	0.0%	0.0%
	Halibut		2	3			38.5%	12.8%	0.0%
	Skate NS		2	19	10		32.4%	87.2%	100.0%
3N	Halibut			3				74.9%	
	Skate NS			1				25.1%	
3O	Cod	4	15	12		4.3%	75.2%	2.8%	
	Haddock	3		60		3.2%		14.4%	
	Halibut	1		5		1.6%		1.3%	
	Monkfish	2				2.6%		0.0%	
	Skate NS	35	5	301		36.7%	24.8%	72.0%	
	White Hake	49		40		51.5%		9.5%	

The only other directed fishery by Canada within the Regulatory Area was in Div. 3L for shrimp. There was zero bycatch reported from this fishery.

EU-Portugal fisheries: Based on scientific observer data from two of the 11 trawlers operating in the NAFO area from the Portuguese fleet, suggests the majority of the fishing effort was directed towards redfish, Greenland halibut and Atlantic cod. However, the observed CPUE data presented does not have a tabulation of associated effort and cannot be used as an indicator of the amount of directed effort spent by this fleet on each correspondent month and Division. The table below lists some general results:

Portuguese trawl fishery bycatch by Division, Month, and Depth for 2011.

DIVISION	TARGET SPECIES	MONTH	DEPTH RANGE (m) MIN.	MAX.	MAIN BYCATCH SPECIES	%	WITCH FLOUNDER BYCATCH (%)	TOTAL BYCATCH (%)
3M	COD	FEB-MAR	342	519	RED	2.1- 4.4	0.0	6.2
3M	COD	MAY-JUN	237	494	RED	9.3-31.8	0.0	10.9-38.1
3M	COD	AUG-OCT	205	610	RED	34.6-43.9	0.0	34.0-48.3
3M	RED	MAY-OCT	209	737	COD	23.1-49.1	0.0	23.6-58.0
3M	GHL	MAR-SEP	685	1540	RHG	13.4-18.8	0.0	17.2-26.1
3M	GHL	OCT	1042	1151	RHG	25.9	0.0	27.7
3M	RHG	OCT	1140	1151	GHL	51.0	0.0	55.4
3M	SKA	MAY	295	298	RED	39.2	0.0	73.5
3L	GHL	FEB-MAY	1149	1465	RHG	6.3-18.5	0.0	6.3-19.7
3L	GHL	AUG-NOV	886	1506	RHG	13.2-20.7	0.0	16.6-21.7
3N	GHL	FEB	798	844	WIT	38.8	38.8	56.2
3L	RED	AUG	342	549	COD	49.6	0.0	50.0
3N	RED	FEB-JUN	165	836	COD	6.9-11.6	0.0	7.9-13.1
3N	RED	JUN	165	700	COD	11.6	0.0	13.1
3N	RED	OCT	92	347	COD	37.8	0.0	52.4
3O	RED	MAY	107	530	SKA	13.9	8.2	47.7
3O	RED	JUN	197	700	COD	14.2	9.2	51.4
3O	RED	AUG	315	531	GHL	0.2	0.0	0.4
3L	RHG	SEP-OCT	1215	1491	GHL	45.8-54.0	0.0	48.6-56.6
3O	HKW	MAY	120	134	SKA	24.0	10.1	92.5
3O	HKW	JUN	197	700	RED	21.4	18.8	89.4
3O	SKA	MAY-JUN	107	700	RED	21.3-21.4	13.6-18.8	73.4-88.7

EU-Spain fisheries: Information based on the NAFO and Spanish Scientific Observers was available to characterize the different Spanish fisheries in NAFO Subarea 3 during the period 2005–2011 base on the gear used by the fleet, depth and catch composition and listing the 3-alpha NAFO code to identify species. Scientific Council noted that this analysis is the more complete available regarding the by catch in different fisheries because is based on the total catch (discards included) and have a complete description of the catch composition.

About 79% of the total Spanish effort in NAFO Subarea 3 was carried out with demersal 130 mm mesh size gear in Div. 3LMNO. Based on biological information of the depth distribution of the target species it was decided three different depth strata: less than 200 m, between 200–600 m and more than 600 m.

More than 600 meters depth: In Divisions 3LMNO was carried out the 91% of the effort with demersal 130 mm mesh size gear. The target species of this fishery was the Greenland halibut (86%) and the main bycatch species of this fishery were the roughhead grenadier (4%) and the redfish (2%). Catch composition (%) by Division of the hauls carried out by demersal 130 mm gear in depth strata more than 600 m were the following:

Species	3L	3M	3N	3O	3LMNO
GHL	91%	80%	66%	68%	86%
RHG	3%	7%	5%	8%	4%
RED	1%	3%	5%	0%	2%
PLA	1%	0%	5%	2%	1%
RNG	1%	3%	0%	1%	1%
WIT	0%	1%	6%	5%	1%
SKA	1%	1%	2%	1%	1%
GDE	1%	1%	0%	1%	1%
COD	0%	0%	6%	0%	1%
CAT	1%	1%	0%	0%	1%
NZB	0%	0%	1%	2%	1%
ANT	0%	1%	1%	2%	1%
GSK	0%	0%	0%	0%	0%
HKW	0%	0%	0%	1%	0%
CFB	0%	0%	0%	8%	0%
YEL	0%	0%	1%	0%	0%
GPE	0%	0%	0%	0%	0%
HAL	0%	0%	0%	1%	0%

In the 200–600 m strata: Only the 8% of the effort was made with demersal 130 mm mesh size gear, mainly in Div. 3O and 3M. The target species in this fishery was the redfish with the 80% of the catch weight and the main bycatch species were Greenland halibut (4%), American plaice (4%), cod (3%) and witch flounder (3%). Catch composition (%) by Division of the hauls carried out by demersal 130 mm gear in depth strata more 200–600 m were the following:

Species	3M	3N	3O	3LMNO
RED	61%	78%	84%	80%
GHL	23%	7%	0%	4%
PLA	0%	3%	5%	4%
COD	9%	1%	2%	3%
WIT	0%	1%	3%	3%
SKA	4%	1%	1%	1%
YEL	0%	6%	0%	1%
DGH	0%	0%	1%	1%
SQI	0%	0%	1%	1%
HKW	0%	0%	1%	0%
RGH	1%	1%	0%	0%
CAT	0%	0%	0%	0%
HAL	0%	0%	0%	0%
GSK	0%	2%	0%	0%

Less than 200 m: A very small part of the effort (1%) was carried out with demersal 130 mm mesh size in Div. 3NO. Catch composition shows that this effort form part of a mix fishery with different catch composition in Div. 3N (56% American plaice, 26% yellowtail flounder, 10% cod and 6% skates) than in Div. 3O (57% redfish, 14% American plaice, 12% skates and 7% witch flounder). Catch composition (%) by Division of the hauls carried out by demersal 130 mm gear in depth strata less than 200 m were the following:

Species	3N	3O	3NO
PLA	56%	14%	47%
YEL	26%	3%	21%
RED	0%	57%	13%
COD	10%	3%	8%
SKA	6%	12%	7%
WIT	1%	7%	2%
HKW	0%	1%	0%
CAT	0%	0%	0%
GHL	0%	1%	0%

With 280 mm mesh size: About 16% of the Spanish effort in the 2005–2011 period was carried out in Div. 3NO at less than 200 m depth. The target species were the skates (63%) with American plaice (19%), yellowtail flounder (10%) and cod (6%) as main bycatch species. Catch composition (%) by Division of the hauls carried out by the Spanish fleet with 280 mm. mesh size gear were the following:

Species	3N	3O	3NO
SKA	63%	61%	63%
PLA	19%	15%	19%
YEL	10%	10%	10%
COD	6%	3%	6%
CUX	1%	0%	1%
WIT	0%	6%	0%
ANG	0%	1%	0%
RED	0%	3%	0%

With 40 mm mesh size: About 5% of the total Spanish effort was carried out in depth between 300–500 m of the Divisions 3LM. The target species of this fishery was the shrimp with 98% of the catches and only a 2% of redfish as bycatch. Catch composition (%) by Division of the hauls carried out by the Spanish fleet with 40 mm. mesh size gear were the following:

Species	3L	3M	3LM
PRA	100%	97%	98%
RED	0%	3%	2%

About 1% of the total Spanish effort in 2010–2011 was carry out in Div. 3M at depth between 150–550 m targeting cod with a gear with 130 mm mesh size. The target species of this fishery was cod with 92% of the catches in weight and the most important species in the by catch was redfish with a 7% of the catches. Catch composition (%)of the hauls carried out by the Spanish fleet with 130 mm. cod mesh size gear were the following:

Species	Div. 3M
COD	92%
RED	7%

Russian fisheries: Information on bycatch was only available for the 2011 fisheries. In the directed Greenland Halibut fisheries in Div. 3LMNO, deep-sea redfish (4%), northern wolfish (2%) and roughhead grenadier (2%) comprised the majority of bycatch. The following table outlines all species:

Greenland halibut Divs. 3LMNO		Catch, t	% of total catch
Area	Species	2011	2011
3LMNO	American plaice	3	0.2
	Greenland halibut	1620	94.1
	Northern wolffish	30	1.7
	Redfish	19	1.1
	Roughhead grenadier	30	1.7
	Roundnose grenadier	12	0.7
	White hake	4	0.2
	Witch flounder	4	0.2
	Total	1722	99.9

Notable bycatches on the redfish fishery in 2011 included 153 t of cod in Div. 3M and 21 t of cod in Div. 3LN. The following table lists percentages of the total catch in the directed redfish fishery:

Redfish Divs. 3LMNO		Catch, t	% of total catch
Area	Species	2011	2011
3LN	American plaice	1	0.1
	Cod	21	1.2
	Greenland halibut	3	0.2
	Northern wolffish	1	0.1
	Redfish	1676	98.4
	Witch flounder	1	0.1
		1703	100.1
3M	Cod	153	9.1
	Greenland halibut	3	0.2
	Redfish	1522	90.5
	Witch flounder	4	0.2
		1682	100
3O	American plaice	3	0.5
	Cod	9	1.5
	Greenland halibut	1	0.2
	Redfish	573	97.4
	White hake	2	0.3
		588	99.9

The directed cod fishery in Div. 3M had about 51 t of redfish as bycatch:

Cod Div. 3M		Catch, t	% of total catch
Area	Species	2011	2011
3M	Cod	502	90.8
	Redfish	51	9.2
		553	100

Estonian fleet: Observer information was available from the Estonian finfish fisheries where kept and discarded weights were recorded. This data was not provided by directed fishery but supplementary information suggests finfish fisheries in Div. 3L were directing for Greenland halibut. However, supplementary information for Div. 3M, Div. 3N and Div. 3O was not available by directed fishery. Nevertheless, a breakdown of species catch as a proportion of total catch by Division provides an indication of bycatch levels in these areas.

The principal bycatch of the directed Greenland halibut fishery in Div. 3L was roughhead grenadier at 24%. Other species were invaluably less than 2%. In Division 3M, redfish accounted for 74% of the total catch with Greenland halibut, Atlantic cod and roughhead grenadier representing about 9%, 9% and 5% of the total catch. Given there are also directed fisheries included in this total, these would represent an upper level for these species. In Div. 3N and Div. 3O, redfish was the primary catch, with other species ranging from 0% to about 13% for skate in Div. 3N.

x) Trends in biomass and state of the stock for cod in Div. 2J+3KL (Item 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.

An update of the status of the northern (Div. 2J+3KL) cod stock was presented based on the most recent information in the Canadian Science Advisory Secretariat Science Report. This stock update was based mainly on data from a time series (1983–2011) of catch rate information from Canadian stratified random research vessel (RV) bottom-trawl surveys conducted during autumn, and from tagging results. The spawning stock biomass index from the RV survey has been low for several years since the 1992 moratorium, but increased slightly during 2005–08 due to a reduction in mortality rates. The increasing trend has not persisted and the three most recent values of this index (2009–2011) show no major changes. In 2010, the stock was 90% below the LRP based on survey index values and modeled estimates. The SSB index value from the 2011 survey indicates that the stock has shown no significant improvement and remains well below the LRP.

Tagging results indicate that current levels of removals have resulted in low exploitation rates; however, total mortality rates increased to approximately 50% per year in 2009–11. At current levels of recruitment and survival prospects for further stock growth are poor and the stock will not reach the LRP in the short term.

xi) Variability in indicators of stock status and recruitment for Witch flounder in Div. 3NO (Item 14)

Taking note that recent point estimates for Div. 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 about 50% higher than in 1994.

Scientific Council notes that the biomass index from the 2011 Canadian autumn survey was lower than the 2008–10 values and in the range of the 2004–06 values. There is no trend in the Canadian spring survey data since 2004.

a) What are the relative strengths and weaknesses of all the indices of abundance of witch?

For the Canadian spring surveys, depths greater than 731 m are not surveyed, and there is evidence that at least some witch are in deep water in the early spring, related to spawning. So it is possible that these fish would not be found in the spring survey in some years. The Canadian autumn survey has covered 731 – 1462 m in some years, but a high proportion of witch flounder is not found at those depths at that time of year. Ideally, there would be some deep coverage in the spring survey rather than the autumn. The EU-Spanish survey of the NRA does cover greater depths, but only surveys part of the witch distribution, and very little of Div. 3O. The Canadian autumn survey probably has the best chance of being an index of total stock abundance or biomass, particularly in years where deep sets are done, although even those deep sets are probably not critical to the index, at least in recent years.

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?

This is most likely to be due to different distribution of witch in spring vs. autumn, for biological reasons (i.e. spawning). Witch flounder are not likely to be distributed in the same areas in all seasons, for a number of reasons, including environmental. Scientific Council considered the issue of depth distribution of this stock in its 2008 and 2011 assessments, and has noted on several previous occasions that some variation in survey indices is likely due to distributional shifts between deeper smaller strata and larger shallower strata. It appears that more witch flounder are in shallow water in fall compared to spring, and more are in deeper water in spring, likely related to spawning

c) How might the confidence intervals around the point estimates over the time series affect the interpretations of stock trend and current status?

If the same population is sampled on numerous occasions and interval estimates are made on each occasion the resulting intervals would bracket the true population parameter in approximately 95% of the cases. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter. Therefore when variance in the survey results is large, the confidence intervals are wide, and the "statistical confidence" in the mean value and related trend is reduced. Very wide CI's are caused by 1 or more large catches, much larger than mean values, which greatly increase the variance around the estimates of abundance and biomass, and may obscure the trend in the mean values.

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?

Relative body condition was calculated for each year to determine if there have been any trends over time. Data were available for 1979, 1984, 1990, 1993, 1994 and 1997 – 2011. A length vs. body weight regression was fit using all data. The condition index is then the observed body weight of a fish divided by the body weight predicted from the length weight regression for a fish of that length. Relative body condition for each year was estimated using a generalized linear model with an identity link and a gamma error, with year as a class variable. Multiple comparisons were also conducted.

There was significant interannual variation in relative condition (χ^2=132.2, df=18, $p<0.001$). In general condition was higher in the first 3 years of the time series, lower in 1993–1994 and 1997–2003 and low again from 2009–2011 (Fig. 3). Relative condition was not significantly different among 1979, 1984 and 1990. Condition in these three years was significantly higher than most years until 2004. Condition in 2004 and in most years until 2008 was not significantly different from the first 3 years of the time series. Condition in 2008–2011 was significantly lower than these first 3 years (except for 2011 and 1979).

Condition was lower in most years for which data were available after 1990, except for 1997 and 2004 – 2008. The lack of data in years prior to 1990 means that there is limited information on condition in the period prior to the decline in stock size. Decreases in condition can be associated with stock decline if natural mortality has increased due to poor condition. However, the opposite can be true if there is a density dependent effect. Lower population size can lead to an increase in resources available to the remaining individuals and therefore an increase in condition.

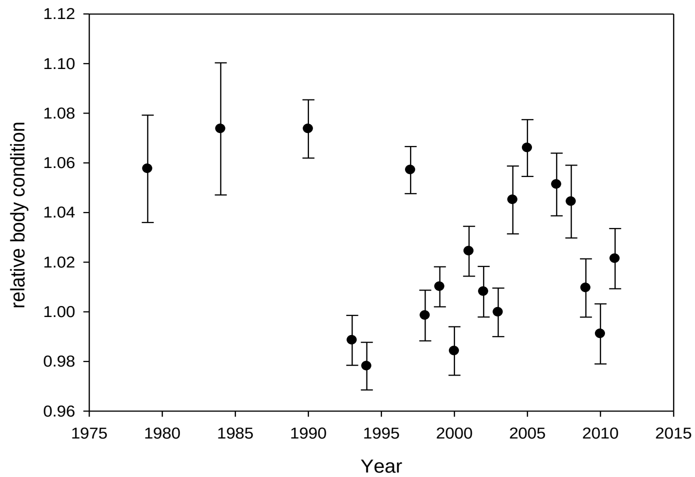


Fig. 3. Relative condition (+ standard error) from spring research vessel survey data for witch flounder in NAFO Div. 3NO.

No other analyses of changes in natural mortality have been carried out at this time. Scientific Council is unable to determine if changes in natural mortality have occurred.

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?

Scientific Council expects there to be size-dependent catchability. But overall, within a survey series, this should not be a factor, i.e. there are no expectations that size-dependent catchability has changed in the years after the introduction to the Canadian survey series of the Campelen trawl in 1995. The same trawl gear is used in spring and fall surveys, so there should be no gear related differences in size-dependent catchability between these two surveys.

Scientific Council noted there is a recommendation for additional work related to this issue: "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." Analysis has begun on this, but there is no progress to report yet.

f) What might be reasonable options for reference point proxies, with associated rationale, including those based on one or a combination of survey indices?

Scientific Council has made some attempts in the past at producing limit reference points. In 1998, Scientific Council looked at some analyses based on a Schaefer model and also on yield- and spawner per recruit, but did not establish any reference points based on this work. More recently, Scientific Council reviewed some analyses to see if proxies for B_{lim} could be established. The conclusions were that it was difficult to do because the survey series that provide biomass estimates cover different time periods and areas, and are highly variable, with trends in biomass or abundance that are less clear than for other stocks (e.g. Div. 2J3KL witch). As well, the highest observed biomass estimates are in the early part of the longer time series, when the survey covered less of the entire stock area. As a result, B_{lim} may be underestimated using a method that ties B_{lim} to a percentage of the maximum survey value (e.g. the 85% decline proxy used for some stocks), and therefore using this proxy for B_{lim} may not be appropriate for Div. 3NO witch. It is not clear that the same approach used for Div. 2J3KL witch flounder to estimate B_{lim} from survey data, by adjusting the older values in the time series, can be applied to Div. 3NO witch, but this should be investigated further, as should other proxies.

xii) Detailed list of VME Indicator species (Item 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.

Over 500 benthic invertebrate megafaunal taxa caught in research vessel surveys in the NRA were classified initially into broad taxonomic groupings and considered by experts against the life history and functional significance criteria in Table 1, which are drawn from the FAO Guidelines for identifying vulnerable marine ecosystems. In addition to the coral and sponge taxa that have previously been addressed three different groups emerged as potential indicators of VMEs: crinoids, erect bryozoans and large sea squirts.

Based on data from Spanish/EU groundfish surveys (2007 – 2010 period), rock dredge samples (NEREIDA Project) and preliminary analysis of images from the NEREIDA-Canadian photographic surveys (2009–2010) no rare/endemic species have been identified in the NRA. NEREIDA data are currently being analyzed and new information may emerge in the coming years to revise these lists.

For each VME indicator species group it is the dense aggregations (beds/fields) that are considered to be VME in order to establish functional significance. Many are associated with one another and so encounter protocols are at the aggregate level. A list of all VME indicator species known from the NRA is provided in Table 1. For each VME indicator species group it is the dense aggregations (beds/fields) that are considered to be VME in order to establish functional significance. Many are associated with one another and so encounter protocols are at the aggregate level. See the NAFO coral and sponge guides for identification.

In addition, seamounts, canyon heads, spawning areas and knolls which are listed in the FAO Guidelines and are included as VME elements are listed in Table 2. New additions to the Fogo Seamounts as well as canyon and slope elements have been identified through the NEREIDA program (see response to Request 18). Scientific Council previously highlighted the SE Shoal as a VME element containing unique spawning grounds for capelin, marine mammal feeding grounds, long-lived and relict bivalve populations in sandy shoal habitats. Similarly, Beothuk Knoll was highlighted as having large gorgonian corals and an area where very large sponge catches (> 1000 kg) have been reported.

Table 1. List of structure-forming benthic VME indicator species (benthic invertebrates) in the NAFO Regulatory Area.

Benthic Invertebrate VME Indicator Species			
Common name of taxonomic group	Known Taxon	Family	Phyllum
Large-sized sponges			Porifera
	Iophon piceum	Acarnidae	
	Stelletta normani	Ancorinidae	
	Stelletta sp.	Ancorinidae	
	Stryphnus ponderosus	Ancorinidae	
	Axinella sp.	Axinellidae	
	Phakellia sp.	Axinellidae	
	Esperiopsis villosa	Esperiopsidae	
	Geodia barretti	Geodiidae	
	Geodia macandrewii	Geodiidae	
	Geodia phlegraei	Geodiidae	
	Mycale (Mycale) lingua	Mycalidae	
	Thenea muricata	Pachastrellidae	
	Polymastia spp.	Polymastiidae	
	Weberella bursa	Polymastiidae	
	Weberella sp.	Polymastiidae	
	Asconema foliatum	Rossellidae	

	Craniella cranium	Tetillidae	
Stony corals (known seamount species may not occur in abundance in the NRA)	*Lophelia pertusa* *Solenosmilia variabilis* *Enallopsammia rostrata* *Madrepora oculata*	Caryophylliidae Caryophylliidae Dendrophylliidae Oculinidae	Cnidaria
Small gorgonian corals	*Anthothela grandiflora* *Chrysogorgia* sp. *Radicipes gracilis* *Metallogorgia melanotrichos* *Acanella arbuscula* *Acanella eburnea* *Swiftia* sp. *Narella laxa*	Anthothelidae Chrysogorgiidae Chrysogorgiidae Chrysogorgiidae Isididae Isididae Plexauridae Primnoidae	Cnidaria
Large gorgonian corals	*Acanthogorgia armata* *Iridogorgia* sp. *Corallium bathyrubrum* *Corallium bayeri* *Keratoisis ornata* *Keratoisis* sp. *Lepidisis* sp. *Paragorgia arborea* *Paragorgia johnsoni* *Paramuricea grandis* *Paramuricea placomus* *Paramuricea* spp. *Placogorgia* sp. *Placogorgia terceira* *Calyptrophora* sp. *Parastenella atlantica* *Primnoa resedaeformis* *Thouarella grasshoffi*	Acanthogorgiidae Chrysogorgiidae Coralliidae Coralliidae Isididae Isididae Isididae Paragorgiidae Paragorgiidae Plexauridae Plexauridae Plexauridae Plexauridae Plexauridae Primnoidae Primnoidae Primnoidae Primnoidae	Cnidaria
Sea pens	*Anthoptilum grandiflorum* *Funiculina quadrangularis* *Halipteris* cf. *christii* *Halipteris finmarchica* *Halipteris* sp. *Kophobelemnon stelliferum* *Pennatula aculeata* *Pennatula grandis* *Pennatula* sp. *Distichoptilum gracile* *Protoptilum* sp. *Umbellula lindahli* *Virgularia* cf. *mirabilis*	Anthoptilidae Funiculinidae Halipteridae Halipteridae Halipteridae Kophobelemnidae Pennatulidae Pennatulidae Pennatulidae Protoptilidae Protoptilidae Umbellulidae Virgulariidae	Cnidaria
Tube-dwelling anemones	*Pachycerianthus borealis*	Cerianthidae	Cnidaria
Erect bryozoans	*Eucratea loricata*	Eucrateidae	Bryozoa

Sea lilies (Crinoids)	*Trichometra cubensis* *Conocrinus lofotensis* *Gephyrocrinus grimaldii*	Antedonidae Bourgueticrinidae Hyocrinidae	Echinodermata
Sea squirts	*Boltenia ovifera* *Halocynthia aurantium*	Pyuridae Pyuridae	Chordata

Table 2. List of VME indicator elements known to occur in the NAFO Regulatory Area.

Physical VME indicator elements	
Seamounts	Fogo Seamounts (Div. 3O, 4Vs) Newfoundland Seamounts (Div. 3MN) Corner Rise Seamounts (Div. 6GH) New England Seamounts (Div. 6EF)
Canyons	Shelf-indenting canyon; Tail of the Grand Bank (Div. 3N) Canyons with head > 400 m depth; South of Flemish Cap and Tail of the Grand Bank (Div. 3MN) Canyons with heads > 200 m depth; Tail of the Grand Bank (Div. 3O)
Knolls	Orphan Knoll (Div. 3K) Beothuk Knoll (Div. 3 LMN)
Southeast Shoal	Tail of the Grand Bank Spawning grounds (Div. 3N)
Steep flanks > 6.4º	South and Southeast of Flemish Cap. (Div. 3 LM)

xiii) GIS modeling of sponge encounters using VMS data (Item 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 modeling 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).

The GIS model was refined to include 2010 VMS fishing effort data to generate realistic commercial trawl bycatch estimates for sponge and sea pens. Scientific Council notes the great value that the 2010 VMS data has added to the GIS modeling work and, in particular, to the estimation of biologically-based encounter thresholds. Scientific Council requests that all VMS be made available to update the model and to apply the procedure to estimate encounter thresholds for small and large gorgonian VME indicator species (see response to Request 17 below).

Model Developments

The model was used to identify when a commercial vessel has encountered an aggregation of VME indicator species using data from research vessels and simulated commercial trawl hauls. Simulated hauls are required as the actual fishery is not conducted in VME areas; however the representativeness of the simulated effort has now been checked and improved through use of the VMS data. For both sponges (Fig. 4) and sea pens (Fig. 5) the biomass layers derived from research vessel data and simulated commercial trawls were similar and identified the same high density locations for each VME.

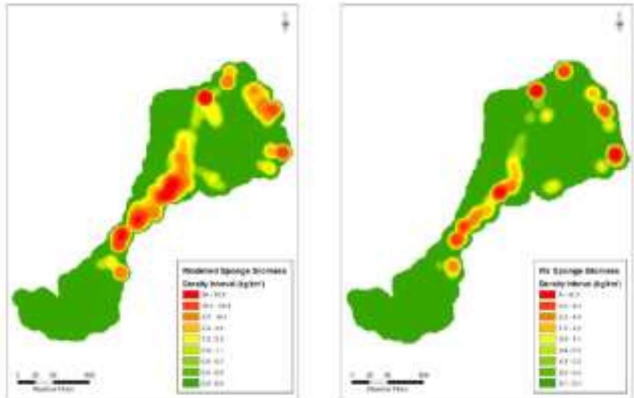


Fig. 4. Sponge biomass (kg/km^2) in the NRA estimated from simulated commercial trawls with random start locations and orientation (left) and from Spanish/EU research vessel catches (right). Note that absolute density values cannot be compared between the two areas due to the different sampling methods.

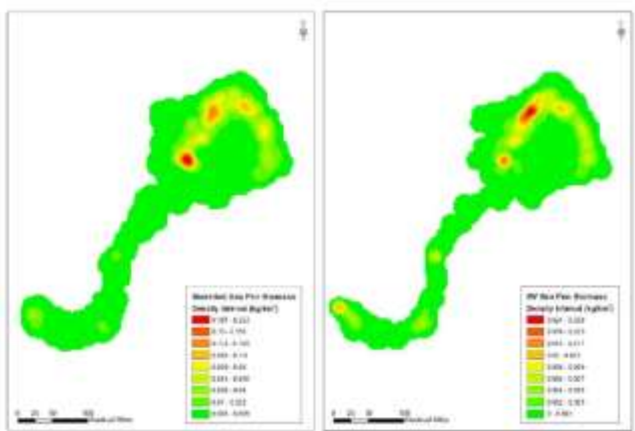
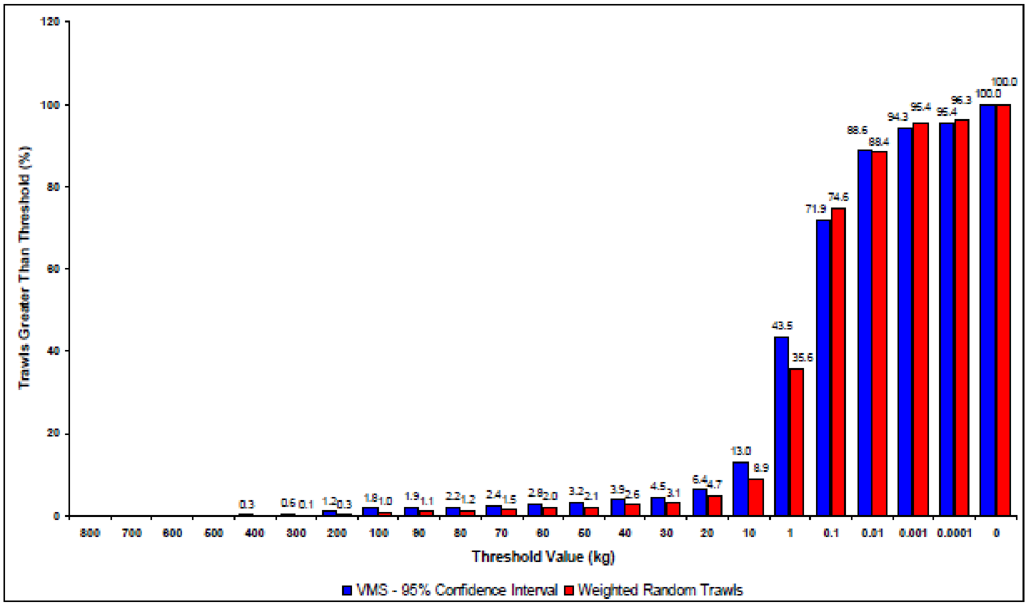


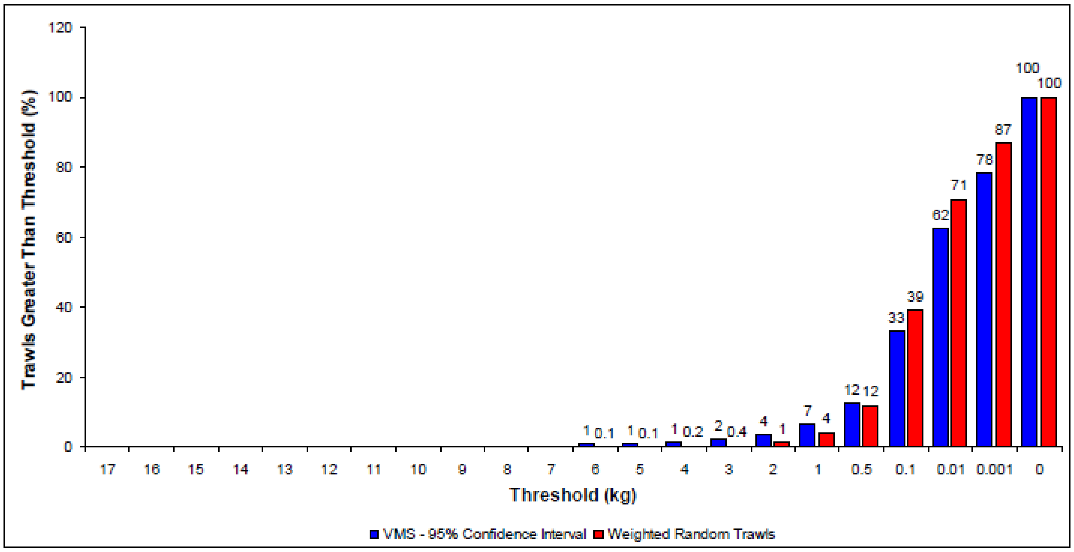
Fig. 5. Sea pen biomass (kg/km2) in the NRA estimated from simulated commercial trawls with random start locations and orientation (left) and from Spanish/EU research vessel catches (right). Note that absolute density values cannot be compared between the two areas due to the different sampling methods.

Commercial fishing tracks derived from VMS data were compared with the simulated commercial fishing tracks by randomly selecting 2000 of the former from within the 95% confidence interval of the trawl distances and comparing the catch at various thresholds with 2000 of the simulated commercial trawls (all 13.8 nm straight lines – the median of the 2010 VMS trawl distance – randomly placed and oriented in the direction of maximum effort). Both sponges (Fig. 6) and sea pens (Fig. 7) produced similar distribution patterns between the actual and simulated fishing bycatch. Figure 3 shows that if a 300 kg encounter threshold (see response to Request 17 below) were in place in 2010 that approximately 0.6% of the 2010 VMS-derived trawls would have met this threshold. Similarly for the sea pens, a 7 kg encounter threshold would have affected approximately 0.4% of VMS-derived trawls.



	95% C.I. VMS Fishing Tracks		Weighted Random Simulation Trawls	
Threshold	Count Above Threshold	% > Threshold	Count Above Threshold	% > Threshold
800	0	0.0	0	0.0
700	0	0.0	0	0.0
600	1	0.0	0	0.0
500	0	0.0	0	0.0
400	5	0.3	0	0.0
300	11	0.6	1	0.1
200	23	1.2	5	0.3
100	35	1.8	19	1.0
90	38	1.9	22	1.1
80	44	2.2	24	1.2
70	48	2.4	29	1.5
60	55	2.8	39	2.0
50	63	3.2	41	2.1
40	78	3.9	52	2.6
30	89	4.5	62	3.1
20	127	6.4	94	4.7
10	260	13.0	178	8.9
1	869	43.5	712	35.6
0.1	1437	71.9	1492	74.6
0.01	1771	88.6	1767	88.4
0.001	1886	94.3	1908	95.4
0.0001	1907	95.4	1926	96.3
0	2000	100.0	2000	100.0

Fig. 6. Number and percentage of vessels catching sponge at various encounter threshold levels between 2000 randomly selected trawls within the 95% confidence interval of the 2010 VMS fishing track distance (blue) and 2000 simulated straight line trawls of 13. 8 nm and weighted in the direction of maximum fishing effort (red). The 300 kg encounter threshold is indicated in grey in the associated table.



Threshold	95% C.I. VMS Fishing Tracks		Weighted Random 13.8 nm Simulation Trawls	
	Count Above Threshold	% > Threshold	Count Above Threshold	% > Threshold
17	1	0	0	0.0
16	2	0.1	0	0.0
15	5	0.3	1	0.1
14	6	0.3	1	0.1
13	6	0.3	1	0.1
12	6	0.3	1	0.1
11	6	0.3	1	0.1
10	6	0.3	1	0.1
9	8	0.4	1	0.1
8	8	0.4	1	0.1
7	8	0.4	1	0.1
6	15	0.8	1	0.1
5	17	0.9	2	0.1
4	26	1.3	4	0.2
3	41	2.1	7	0.4
2	72	3.6	27	1
1	129	6.5	81	4
0.5	247	12.4	238	12
0.1	662	33.1	779	39
0.01	1245	62.3	1413	71
0.001	1560	78	1736	87
0	2000	100	2000	100

Fig. 7. Number and percentage of vessels catching sea pens at various encounter threshold levels between 2000 randomly selected trawls within the 95% confidence interval of the 2010 VMS fishing track distance (blue) and 2000 simulated straight line trawls of 13.8 nm and weighted in the direction of maximum fishing effort (red). The 7 kg encounter threshold is indicated in grey in the associated table.

The estimated area of sponge and sea pen habitat affected by trawling are illustrated in Fig. 8 and Fig. 9. The red bars mark areas of rapid change in habitat area and indicate potential thresholds for moving out of the VME habitats: ≥ 4000 kg/tow, ≥ 300kg/tow and ≥ 40 kg/tow for sponge grounds and ≥ 7 kg/tow sea pen habitats. For sponges (Fig. 4) the analyses distinguished between two types of VME sponge grounds (those dominated by *Geodia* spp. and those by *Asconema* spp.). The potential threshold of 40 kg/tow of sponge was cross referenced to physical specimens from areas where such catches were located and shown to be produced in some cases from non-VME sponges. Therefore this threshold was not considered as a potential VME indicator level.

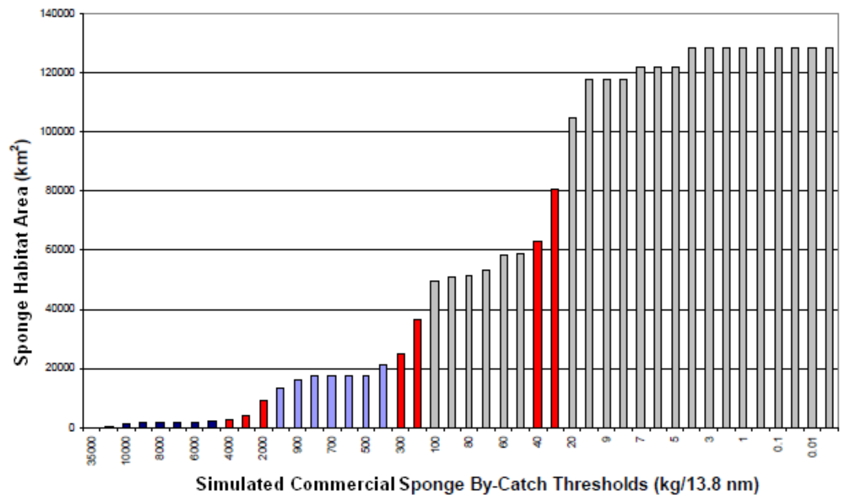


Fig. 8. Sponge habitat area occupied by successive commercial catch thresholds. Red bars indicate the levels where the greatest difference in area occupied occurred between successive catch weight values (greater than 1.3 times the area of the previous threshold). Dark blue bars correspond to the core of the *Geodia*-dominated sponge grounds. Light blue bars correspond to the VME sponge grounds for both *Geodia* -and *Asconema*-dominated habitats.

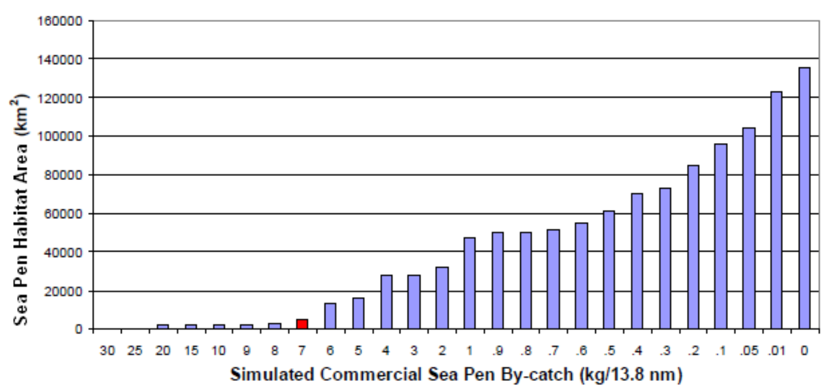


Fig. 9. Sea pen habitat area occupied by successive commercial catch thresholds. Red bars indicate the level where the greatest difference in area occupied occurred between successive catch weight values (≥ 7 kg).

xiv) Encounter thresholds and move on rules (Item 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) the exploratory fishing area of sea mounts as applicable.

Scientific Council responded:

Candidate biologically-based encounter thresholds were established for sea pens and sponge grounds using GIS methodology applied to research vessel survey data (see response to Request 16). Similar analyses for small and large gorgonian corals and other VME indicators have not yet been performed.

Candidate move-on rules for the different groups of VME indicators were based on information on their spatial distribution. Such information was available for area 1 and parts of area 2 of the request but not for area 3. Therefore the move-on rules presented here are not applicable to the sea mounts. Scientific Council recognizes that these move-on rules are complex and unlikely to be put in practice. In the NAFO Regulatory Area fishing often takes place very close to VME areas and the proposed move-on rules in some cases could effectively remove the vessel from target species fishing ground.

Sponges

Scientific Council recommends 300 kg of sponge per commercial tow (based on the median tow length of 13.8 nm as determined from 2010 VMS data, see answer to request 16 above) as the encounter threshold for sponge grounds.

Sponge grounds are localized in narrow bands along the slope of the Grand Bank and Flemish Cap and their distribution extends to deep waters. Scientific Council therefore considers move-on rules for the slope areas that require the vessel to move to shallower areas will provide the highest likelihood of movement out of sponge grounds.

Sponge grounds occur at different depths in different areas. Different rules could therefore apply based on location (see Fig. 10 for the location of slope areas corresponding to Table 3 and following text). The move-on rule would require the vessel to move from its position to shallow water ≤ 700 m in Slope Area 1, to ≤ 1000 m in Slope Area 2, to ≤ 950 m in Slope Area 3, to ≤ 1050 m in Slope Area 4 or to ≤ 1250 m in the Sackville Spur Area 5 (Table 3). If one rule were to be implemented for all areas it would be: the vessel is required to move to shallower water ≤ 700m. The maximum move-on distance in the NRA (from 2000 m) would be 18.1 km or 9.8 nm in the shortest direction of shallower water. This would occur in Slope Area 1.

Table 3. Minimum and maximum depth ranges for sponge grounds on the continental slopes of the NRA with a maximum move-on distance based on average slope and a starting point of 2000 m, the maximum depth of the sponge grounds.

Slope Area	Shallow End of Sponge Depth Range (m)	Average Slope over Depth Range of Sponge Grounds	Estimated Maximum Distance to Move (nm)
1) Area 1	700	4.112	9.8
2) Beothuk Knoll	1000	5.011	6.2
3) SE Flemish Cap	950	4.198	7.7
4) E Flemish Cap	1050	3.861	7.6
5) Sackville Spur	1250	3.516	6.6

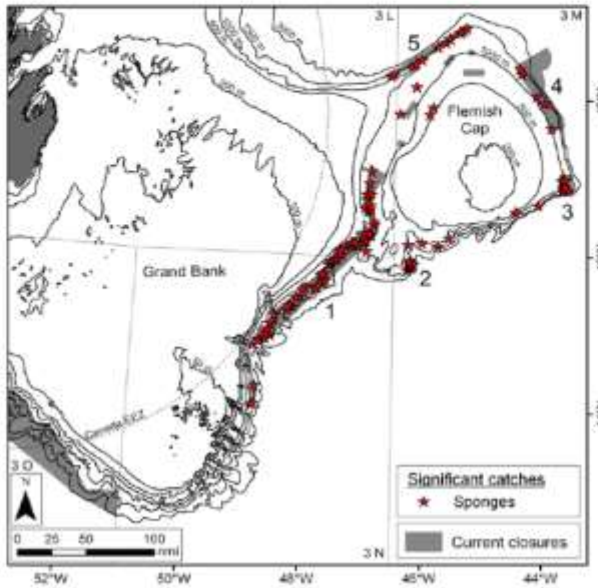


Fig. 10. Map of all significant research vessel trawl sponge catches (> 75 kg) based on Spanish/EU and Canadian bottom trawl groundfish surveys. All areas currently closed to protect significant concentrations of corals and sponges in the Divisions 3LMNO of the NRA are indicated. The numbers 1–5 indicate the areas with large sponge catches evaluated in Table 3.

Sea pens

Scientific Council recommends 7 kg of sea pens per commercial tow (based on the median tow length of 13.8 nm as determined from 2010 VMS data, see answer to request 16 above) as the encounter threshold for sea pen fields.

As for sponge grounds, Scientific Council recommends that potential move-on rules for sea pens should include the requirement to move towards shallower waters.

Scientific Council estimated that the area-specific maximum distance a vessel would have to move after an encounter (shallower direction) would range from 2.4 to 10.7 nm (Table 4). However some of the 2010 VMS fishing tracks are very close to the sea pen fields and so these move-on distances could remove vessels from fishing grounds in some cases.

Table 4. Distance from the center of each sea pen habitat area to the leading edge as illustrated in Fig. 11. (note area 1 was too small for these calculations).

Polygon Number (Fig. 11)	**Distance from Centre to Shallow Leading Edge (nm)**
2	6.9
3	2.4
4	6.6
5	10.7
6	9.9
7	6.8

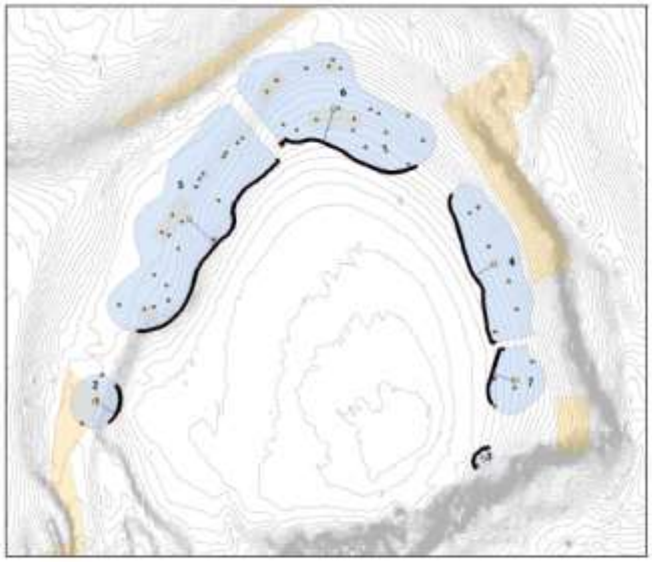


Fig. 11. Location of significant area polygons for sea pens. For each the centroid was calculated (yellow circle) and the distance to the closest edge in shallower water was determined.

Scientific Council notes that the encounter thresholds are a very useful tool to identify VMEs in areas where there is little survey information and the fishing activity is the main source of data. This applies especially to new fishing areas outside of the fishing footprint. However, as the locations of the benthic VMEs become increasingly well-defined in the NRA to support informed management through closed areas the need to implement encounter protocols gradually become redundant. Scientific Council considers a management through the closing of areas with significant concentrations of VME is the most effective measure for protecting VMEs in the NRA as it would avoid issues associated with the implementation of complex move-on rules.

In the NRA there is good annual survey coverage of the area and all of the VME locations identified to date have been defined based on survey data. Scientific Council considers that the survey information is the best source of reliable information to refine the VME locations in the NRA and recommends that the Contracting Parties continue to support all of the scientific surveys which collect these data. Further, new information from the NEREIDA research project has supported the selection of those areas and has provided new information for areas not well covered by the survey, particularly in deeper waters, on rough bottoms and on steep slopes. Scientific Council considers that as the locations of the benthic VMEs become increasingly well-defined through these efforts, appropriate closed areas put in place, and reassessed through the annual surveys, then the need to implement commercial fisheries encounter protocols in the NRA diminishes.

xv) Mapping of VME indicator species and elements (Item 18)

Fisheries Commission requested:

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".

Scientific Council responded:

Overview maps of the established VME indicator species (sponges and corals - Fig. 12 and Fig. 13) and VME elements were produced based on survey data (Fig. 14 and Fig. 15). VME densities and precise spatial location or extent are not detailed and only the start positions of significant concentrations (as previously determined from research vessel surveys using quantitative methods) are mapped. Should a more precise level of mapping of those data be required the start and end positions of the trawls can be provided. Scientific Council recognizes the occurrence of high densities of sponge and large gorgonian coral in areas adjacent to existing fishery closed areas in the NAFO Div. 3LMNO encountered by survey trawls in 2008, 2009 and 2010.

Threshold levels have not been established for the new VME indicator species groups (see response to Request 15). Spanish/EU groundfish survey bycatch data (2007–2010) revealed 50 records of *Boltenia ovifera* (large sea squirts) from the Tail of the Grand Bank between 50 and 320 m depth. More than 75 % of the catches were lower than 1 kg and 10 individuals; however a catch of 4.55 kg (65 individuals) was recorded at 200 m depth. The larger catch of *B. ovifera* which may constitute the location of a VME indicated by this species was found at: 43°21'50.4''N 49°25'19.2''W (start of tow) 43°23'09''N 49°24'17.4''W (end of tow) (Fig. 15). For the crinoids the most important concentrations were observed through video images in the 2010 NEREIDA-Canadian camera surveys along the East of Flemish Cap where high densities of the stalked crinoids *Gephyrocrinus grimaldii* were observed together with several structure-forming sponges inside the closed area. Information from the NEREIDA surveys can be added to these maps when the data are fully processed. Information on new potential VME elements is presented (Fig. 15). Black corals are recognized as occurring throughout the North Atlantic at low density. Although they cannot be considered unique or rare, Scientific Council considers, based on their extreme longevity, that they be included when considering closed area boundaries.

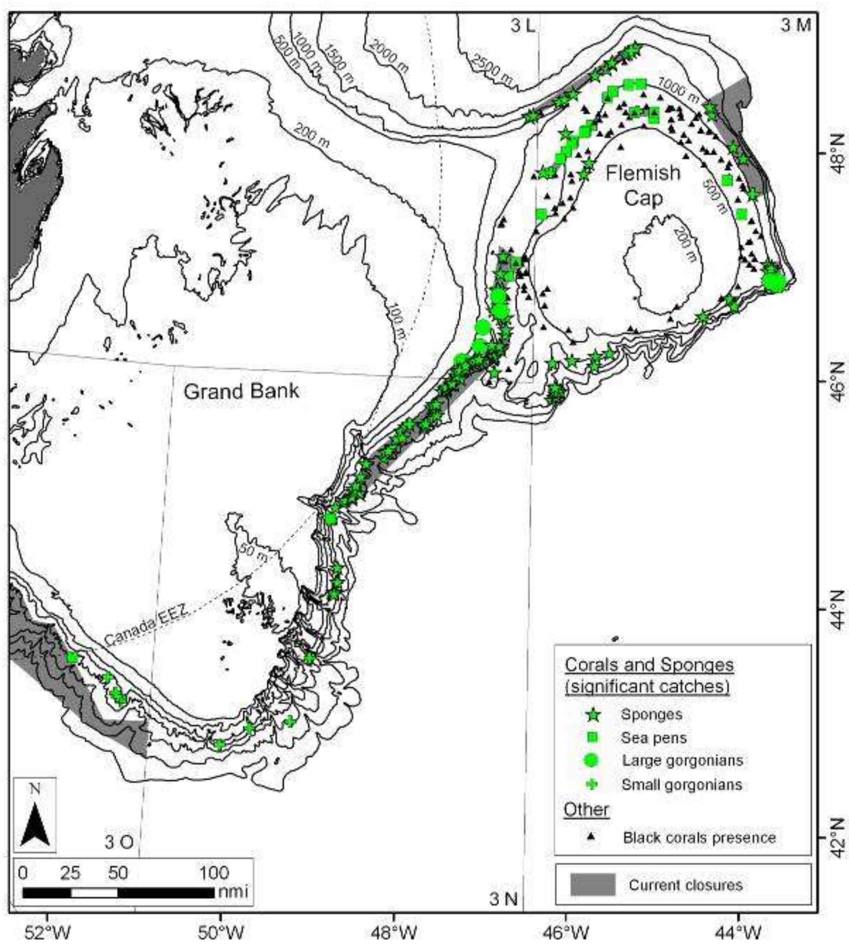


Fig. 12. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch.

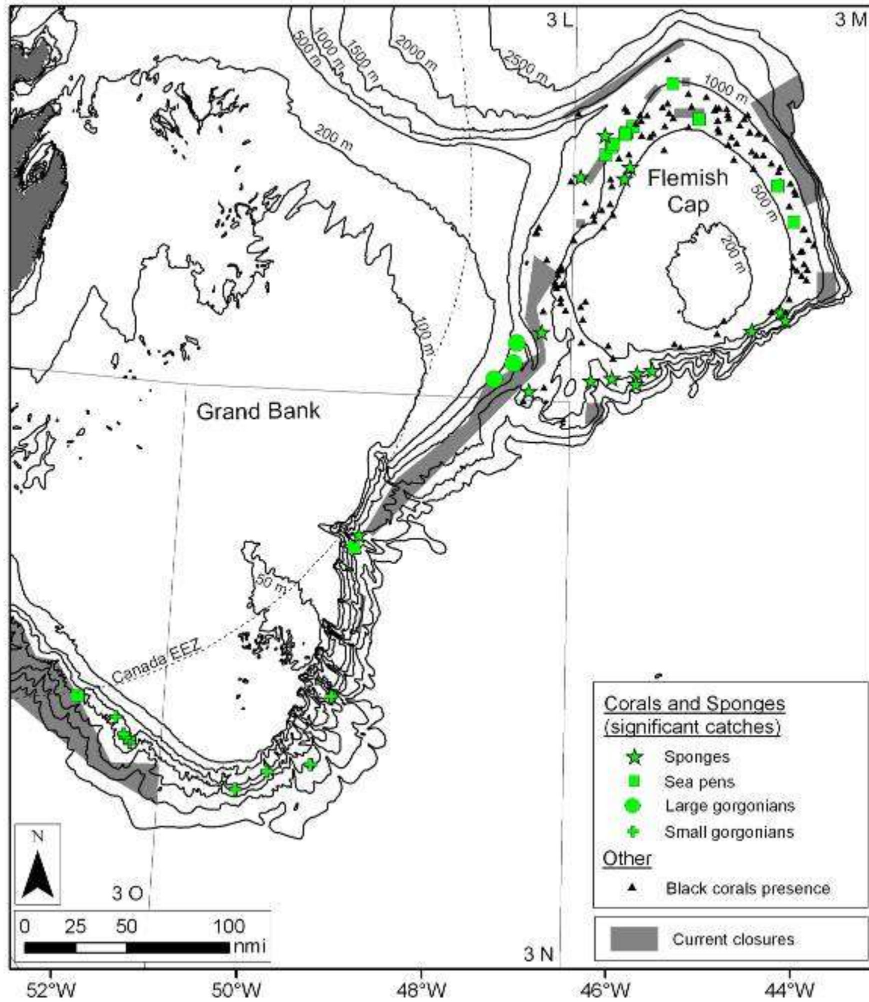


Fig. 13. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch. Data inside closed areas are excluded.

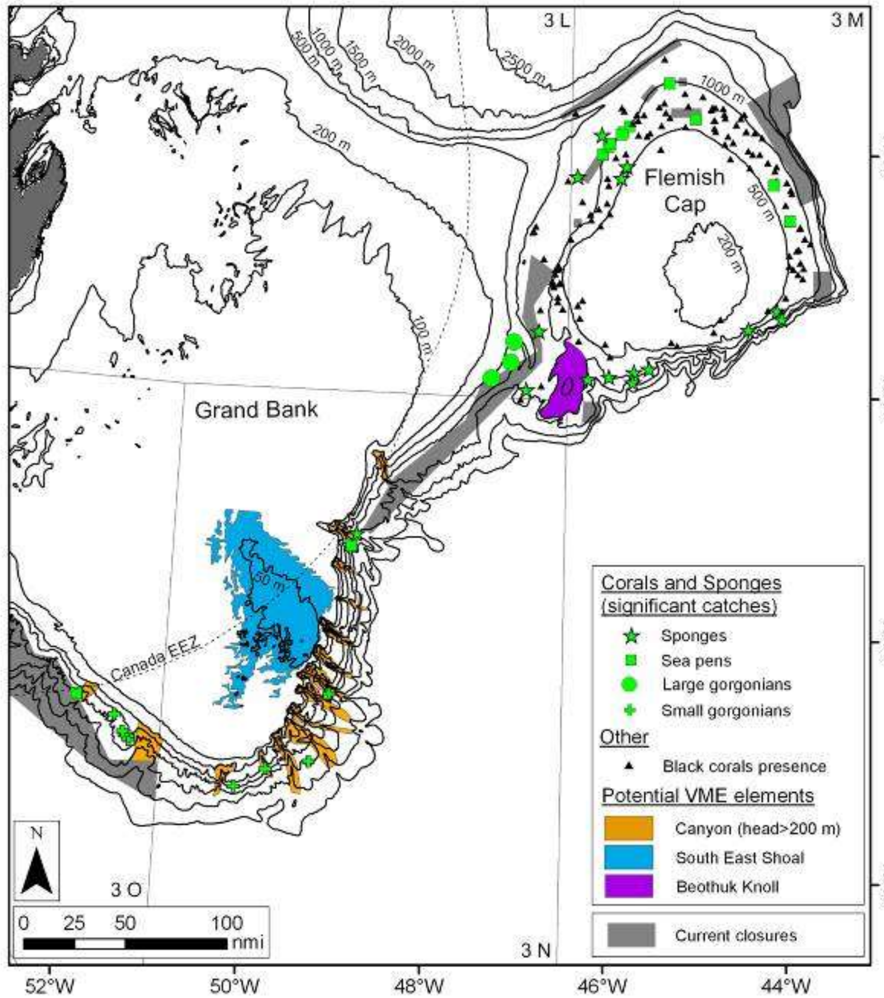


Fig. 14. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch (data inside closed areas are excluded) and location of VME elements such as the South East Shoal, Beothuk Knoll and the canyon heads.

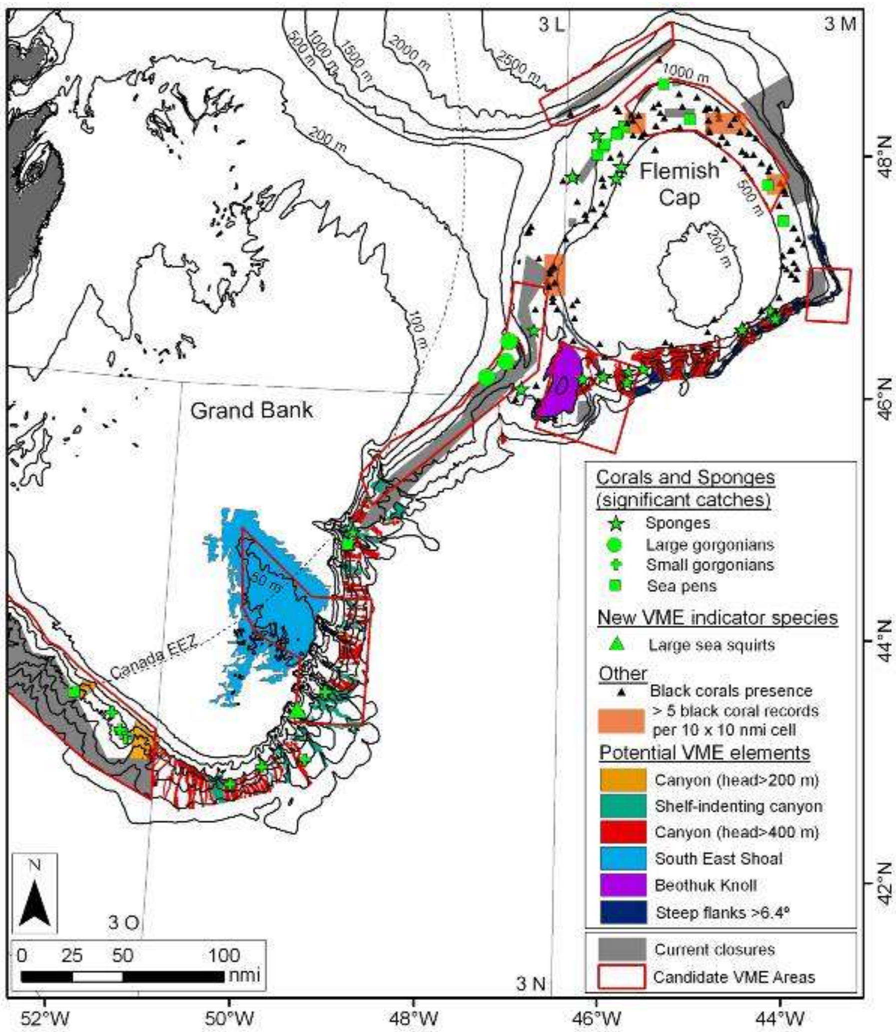


Fig. 15. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch (data inside closed areas are excluded) and location of all VME elements including potential VME elements (see response to Request 15 above), that is, canyon heads, slopes etc., and candidate VME areas. In addition to the location of all black coral records, areas where more than 5 research vessel trawls containing black coral were found in a 10x10 nm cell overlain on the NRA, are highlighted.

xvi) Development of a work plan for reassessment of VMEs (Item 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 Ecosystems 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 work plan for completing the initial reassessment and identifying the resources and information to do so.

Scientific Council noted that the request directs the responsibility for the fisheries assessments to Scientific Council, in collaboration with the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems. The components of an assessment of bottom fishing have already been defined, based on advice from Scientific

Council, and are contained in the NCEM (Chapter II, Article 19, plus Annex I.E). These requirements include not only an evaluation of fisheries impacts on VMEs, but also the management of the fisheries themselves and the assessment of their sustainability.

Scientific Council noted that many of the elements required for a fisheries assessment in the NCEM are also included in its “Roadmap for the development of an ecosystem approach to fisheries for NAFO” (“Roadmap to EAF”). Therefore, SC proposes the structure of fisheries assessment to be completed by 2016 to be organized in such a way that it would directly map onto the “Roadmap to EAF”. Fig. 16 shows a schematic structure of a) how the fisheries assessments could be organized (inside rectangle in Fig. 16), and b) how it can be made into a process to make operational the “Roadmap to EAF”.

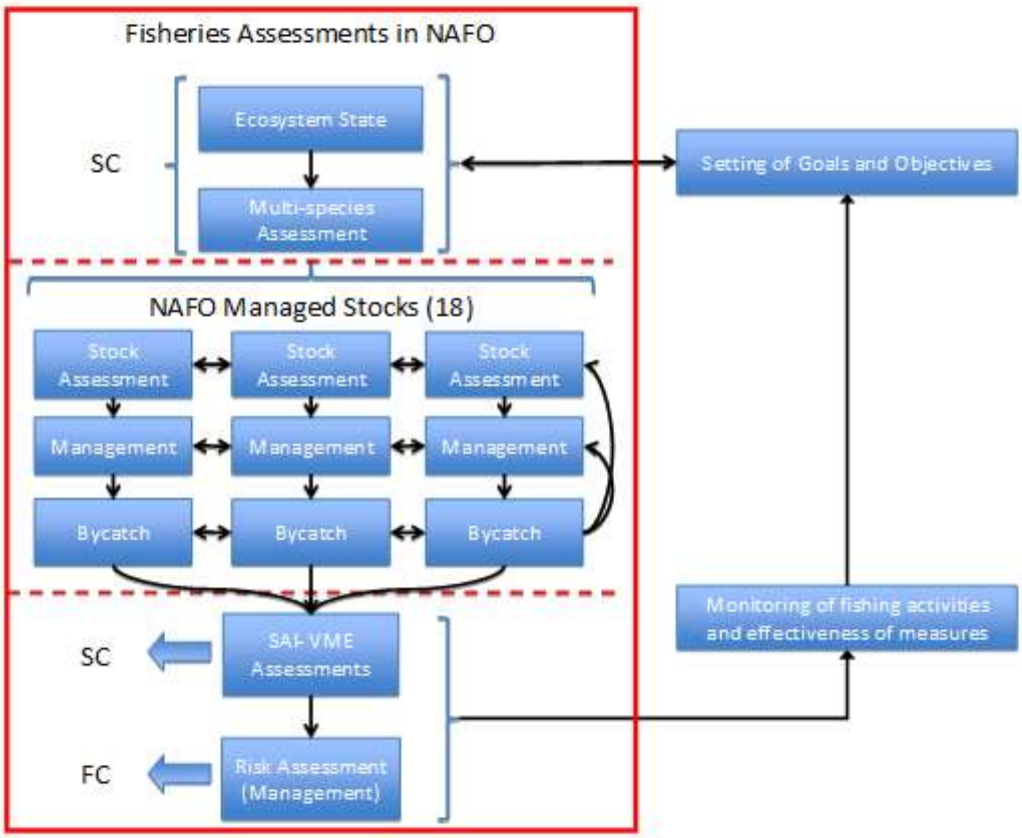


Fig. 16. Schematic representation of the structure and content of SC proposal to develop fisheries assessments. The red rectangle indicates the structure and content for the fisheries assessments themselves, while the boxes outside represent processes/mechanisms to be implemented to transform the static description of the fisheries assessment into a dynamic process to make operational the “Roadmap to EAF”. (SAI – significant adverse impact; VME – vulnerable marine ecosystem).

Under this framework, there would be one assessment per ecosystem; in practice for the NRA this would likely mean one for Flemish Cap and one for the Grand Bank (with linkages to the northern NL shelf).

Scientific Council advises that a number of data sources and human resources are necessary to complete the assessments. These include:

- Contracting Parties should submit data from commercial catch, including directed species, bycatch, discards, and catches of VME indicator species, on a tow-by-tow basis.

- Accurate and ongoing maps of fishing effort in the NRA (VMS data from NAFO). This requires making VMS data available to SC in a timely fashion without an explicit FC request (i.e. change in the NCEM needed – Article 26, para. 10.d). A major improvement in data quality would be achieved if the catch information could be linked to the VMS data for the specific tow.

- Maintain or enhance research vessel information and surveys (e.g. benthic surveys, multispecies trawl surveys, oceanographic surveys). Maintaining support for programs currently providing complementary ecosystem data and analyses will also be critical.

- Human resources will also be needed to complete the work required for fisheries assessments. It is vital that CPs consider the workloads involved in the assessment process and commit to providing these resources. It is to be expected that additional resources will be needed leading to the completion of fisheries assessments in 2016 (e.g. ad hoc meetings, additional travel, contracting/hiring people, etc.).

Scientific Council encourages further discussion of the proposed Scientific Council EAF framework with Fisheries Commission and/or the FC WGFMS-VME as soon as possible; noting that implementation of this approach will require considerable planning, resources, and data. This will also highlight the need for explicit and detailed objectives and goals as part of the management process.

2. Coastal States

a) Request by Canada and Denmark (Greenland) for Advice on Management in 2013 (Annexes 2 and 3)

i) Greenland halibut in Div. 0B + Div. 1C–F

The Council, is requested 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 2013, and to specifically advise on appropriate Total Allowable Catch levels for 2013, 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:

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

Recommendation: Div. 0A+1AB: Considering the increases in TAC from 4 000 t in 2000 to 13 000 t in 2006, 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 2013 remain unchanged and should not exceed 13 000 t.

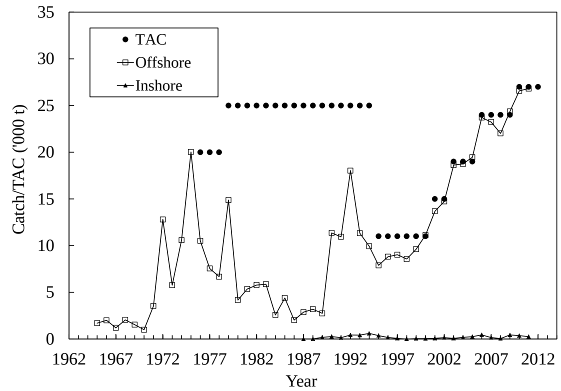
Div. 0B+1C–F: TAC was increased in 2010. The biomass and CPUE indices have been relatively stable. An increase in TAC of 10% or 15% will lead to an increase in Fr (index of fishing mortality) to above the long term mean, therefore an increase in TAC at this time could pose a risk to the sub-stock. Scientific Council advises that there is a low risk to the Greenland halibut in Div. 0B and Div. 1C–F if the TAC for 2013 remains unchanged and should not exceed 14 000 t.

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 tons 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. Catches were at the 2010 level in 2011.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recc.	Agreed
2009	25	25	24[1]	24
2010	27	27	27[1]	27
2011	27	27	27[1]	27
2012			27[1]	27

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

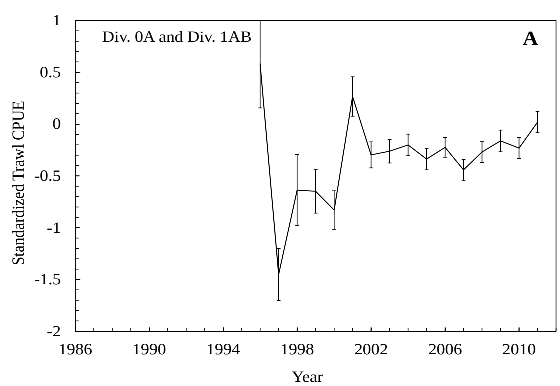


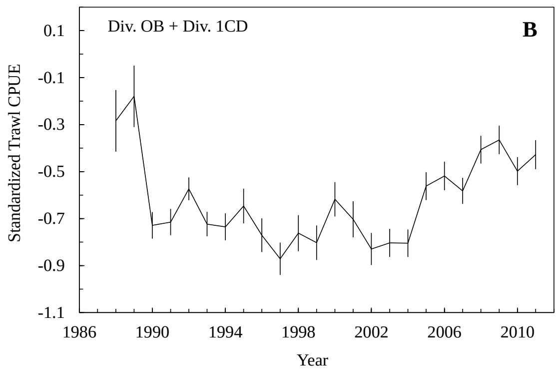
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2011 were available from Div. 0B and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A–F from 1989–2011.

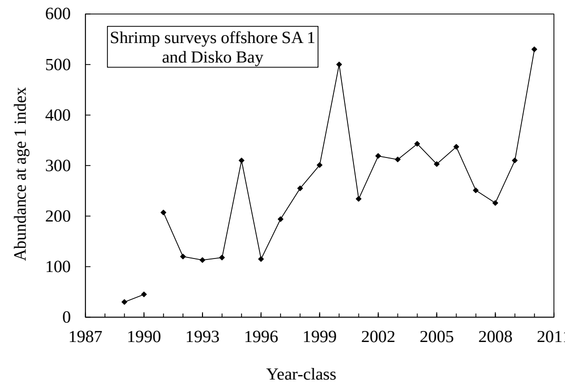
Assessment: No analytical assessment or risk analysis could be performed, therefore only qualitative statements on risk can be provided.

Commercial CPUE indices. Combined standardized catch rates in Div. 0A and Div. 1AB have been stable during 2002–2011.

The combined Div. 0B and 1CD standardized catch rates have been stable from 2002 to 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 increased again in 2011 and is among the highest in the time series.

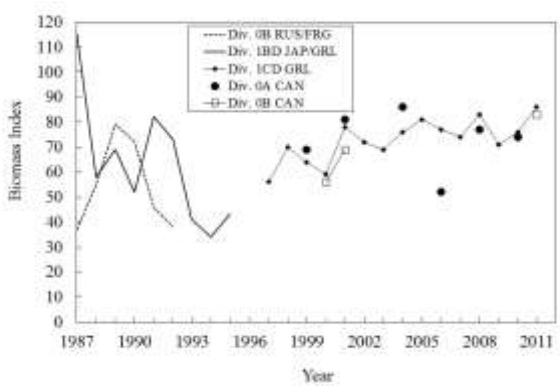






Biomass: The survey biomass index in Div. 0B has increased compared to previous years (2000 and 2001) and was at same level as in Div. 1CD.

The survey biomass index in Div. 1CD has increased gradually over the fourteen year time series and was the highest observed in 2011.



Recruitment: The abundance of the 2000 and 2010 year-classes at age 1 in the entire area covered by the Greenland shrimp survey were the highest in the time series, while the 2002–2006 and 2009 year-classes were above average. The recruitment of the 2007 – 2010 year-class in the offshore nursery area (Div. 1A (South of 70°37.5'N) - Div. 1B) was below average.

Fishing Mortality: Level not known.

State of the Stock: Div. 0A+1AB: Length compositions in the catches have been stable in recent years. Standardized catch rates 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 and Div. 0B has shown an increasing trend. In Div. 1CD the abundance increased between 1997 and 2001 and has been relatively stable since 2002. In Div. 0B the abundance was lower than in 2001 but higher than in 2000.

CPUE indices in Div. 0B and 1CD have shown an increasing trend since 2004, decreased between 2009 and 2010, increased again in 2011 and is among the highest in the time series.

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

Special Comments: A quantitative assessment of risk at various catch options is not possible for this stock. An approach using *F* ratio was used. It was noted that the method is very sensitive to annual changes in biomass estimates and the method is only meaningful if changes in *F* and biomass are considered over a range of years. Scientific Council recommended that the method should be investigated further.

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 Div. 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 2013.

Sources of Information: SCR Doc. 12/3, 16, 23, 31; SCS Doc. 12/5, 10, 13, 14.

ii) Pandalus borealis in Subareas 0 and 1

Scientific Council deferred addressing this request to the September meeting.

b) Request by Denmark (Greenland) for Advice on Management in 2013 (Annex 3)

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

For Roundnose grenadier in Subarea 0 + 1 advice was in 2011 given for 2012-2014. Denmark (on behalf of Greenland) requests the Scientific Council to continue to monitor the status of Roundnose grenadier in Subareas 0 and 1 annually and, should significant changes in the stock status be observed (e.g. from surveys), the Scientific Council is requested to provide updated advice as appropriate.

The Scientific Council reviewed the status of this stock at the June 2012 meeting. Despite the fact that the biomass has almost doubled compared to 2010 the biomass in 2011 is still at the very low level seen since 1993, and there is no reason to consider that the status of the stock has changed. Therefore, Scientific Council has not changed its advice for 2013 that there should be no directed fishing for roundnose grenadier in SA 0+1 and that catches should be restricted to bycatches in fisheries targeting other species

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

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

Advice for golden redfish (Sebastes marinus), demersal deep-sea redfish (Sebastes mentella), American plaice (Hippoglossoides platessoides), Atlantic wolffish (Anarhichas lupus), spotted wolffish (A. minor) in Subarea 1 was in 2011 given for 2012–2014. Denmark (on behalf of Greenland) requests the Scientific Council to continue to monitor the status of these species annually, and should significant change in stock status be observed, the Scientific Council is requested to provide updated advice as appropriate.

Scientific Council responded that, based on the available data there is no indication of any change in the status of these stocks.

These stocks will next be assessed in 2014.

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

Advice for Greenland halibut in Division 1A inshore was given in 2010 for 2011–2012. Denmark (on behalf of Greenland), requests the Scientific Council for advice on Greenland halibut in Division 1A (inshore) for 2013–2014.

Scientific Council responded:

Greenland halibut in Division 1A (inshore)

Recommendation:

Disko Bay: The status of the stock is unclear. Scientific Council therefore recommended that catches in 2013 and 2014 should not exceed 8 000 t/year.

Uummannaq: The status of the stock is unclear. Catches have been around 6 000 t annually over the past twenty years. Scientific Council therefore recommended that the TAC should not exceed 6 000 t for 2013 and 2014.

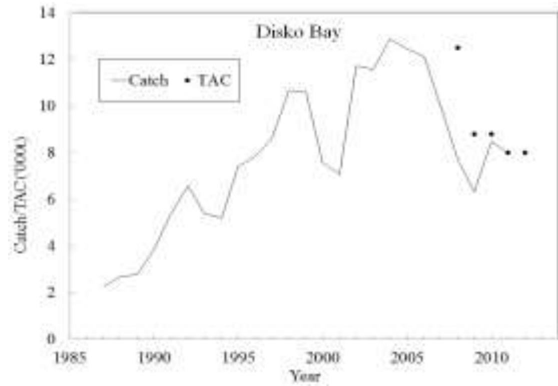
Upernavik: The status of the stock is unclear. Catches have increased substantially since 2002. Scientific Council therefore recommended that there should be no increase in catches beyond the 2009-11 average (6 300 t) in 2013 and 2014.

Background: The inshore stocks of Greenland halibut in Subarea 1 are believed to be dependent on recruitment from the offshore spawning stocks in the Davis strait. Little migration out of the inshore areas and between areas has been observed and a separate TAC is set for each area.

Fisheries and catches: Total landings for division 1A inshore were less than 500 t/yr. until 1955, less than 2 000 t/yr. until 1975, less than 5 000 t/yr. until 1985, less than 10 000 t/yr. until 1991 and finally peaked at 25 000 t in 1998. Since then landings have decreased, but remained around 20 000 t/yr. for the 3 areas combined.

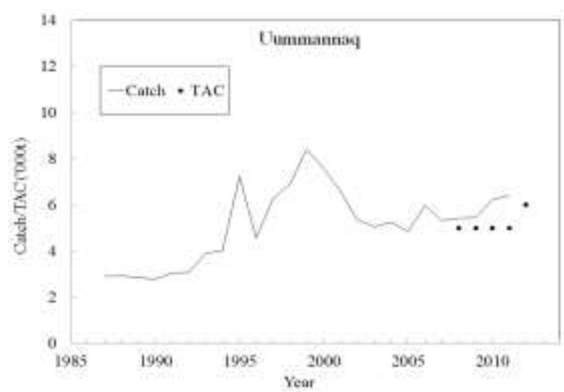
***Disko Bay**:* Landings increased from about 2 000 t in the mid 1980s and peaked in 2004 with more than 12 000 t. From 2006 landings decreased and in 2009 only 6 300 t was landed. However, in 2010 landings increased to 8 500 t and in 2011 8 000 t were landed.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	6.3	-	8.8	8.8
2010	8.5	-	8.8	8.8
2011	8.0	-	8.0	8.0
2012			8.0	8.0



Uummannaq: landings increased from a level of 3 000 t in the mid 1980's and peaked in 1999 at a level of more than 8 000 t. Landings then decreased and from 2002 were at a level of 5 000 to 6 000 t. In 2011, 6 400 t was landed, which is an increase compared to recent years.

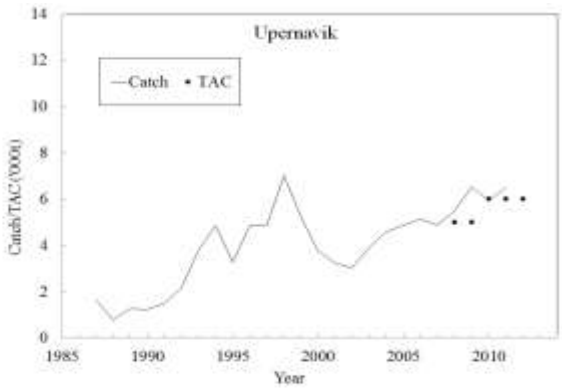
	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	5.5	-	5.0	5.0
2010	6.2	-	5.0	5.0
2011	6.4	-	5.0	5.0
2012			5.0	6.0



Upernavik: landings increased from the mid-1980s and peaked in 1998 at a level of 7 000 t. This was followed by a period of decreasing landings, but since 2002 catches have increased and 6 500 t were landed in 2011.

	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	6.5	-	na	5.0
2010	5.9	-	na	6.0
2011	6.5	-	na	6.0
2012			na	6.0

na - no advice



Data: ***All areas***: Length frequencies from factory landings were available from all areas from both the summer longline fishery, the winter longline and the winter gillnet fishery. A standardized CPUE series based on logbooks provided by vessels larger than 30 ft. was initiated in 2011. However, just as in 2011 the 2012 analysis only explained 22 to 27 % of the variability in the data. The 2006 and 2012 logbooks were excluded from the analysis, since few logbooks were available from 2006 and from the first months of 2012 and these estimates can hardly be regarded representative. Also the CPUE series does not account for effect of fishing ground within the area and shifts in the distribution could also cause the increasing or decreasing trends.

Disko Bay: A CPUE index and an NPUE index was derived from the Disko Bay Gillnet survey. The survey targets the pre-fishery recruits between 35 and 50 cm.

Abundance and biomass indices were derived from the Greenland shrimp fish trawl survey.

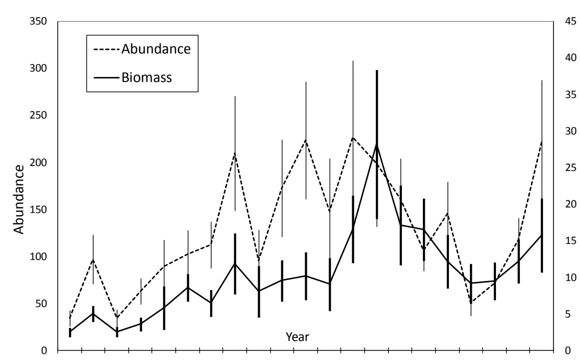
Assessment: No analytical assessment could be performed.

Disko Bay: *Mean length:* Mean length in landings, decreased after 2001 in both the summer and the winter fishery, and have decreased to the lowest value observed in the time series in 2010 and 2011. However, the average length in the winter fishery has increased in 2012 and the apparent detachment of the summer and winter fishery mean length series could indicate a redistribution of the stock or strong incoming year classes. The winter fishery in the Disko Bay is highly dependent on ice coverage and access to the inner parts of the Kangia icefjord where larger fish are accessible at greater depths, leading to the large difference in summer and winter fishery average length. The winter fishery in 2011 was characterized by poor sea ice coverage, and the fishery took place at the summer fishing grounds longer than usually.

Commercial CPUE: The standardized logbook CPUE index decreased from 2007 to 2011.

Survey CPUE: In the Disko Bay gillnet survey both CPUE and NPUE decreased in 2006 and 2007, but the 2008 and 2010 gillnet CPUE and NPUE estimates were at average levels. The 2011 gillnet survey CPUE and NPUE indices were the highest recorded for individuals < 50 cm, but also for all sizes. The increase in 2011 NPUEs is seen to derive mainly from the northern area off Torssukateq, while at the main fishing grounds at Kangia, the NPUEs have remained low. The high numbers of larger fish in 2011 seem not to have any origin in the previous years estimated populations. This may either be due to migration of the larger fish in the area or may simply reflect the uncertainty of the estimates.

Survey biomass: The Greenland Shrimp Fish trawl survey biomass and abundance indices decreased from 2004, but stabilized in 2008 and 2009 and increased in 2010 and 2011. The 2011 abundance index reached the highest value recorded, mainly caused by a strong 2009 year-class and a very strong 2010 year-class.



Uummannaq: *Mean length*: Mean length in the landings has decreased slightly in the summer fishery since 2004 and the winter fishery since 2007. However, the mean length in the winter fishery landings increased in 2012. *Commercial CPUE*: The standardized CPUE index increased from 2007 to 2011.

Upernavik: *Mean length*: Mean length in landings has been stable since 1999, except for a decrease in the 2010 and 2011 summer fishery. However, the mean length in the winter fishery landings of 2012 increased compared to the 2011 winter fishery and is at about the average of the recent 5 years.

Commercial CPUE: The standardized CPUE index decreased from 2007 to 2011.

State of the stock:

Disko Bay**:** The persistent decrease in mean length in the summer and winter fishery landings from 2001 to 2007 indicated a fishery dependent on incoming year-classes entering the fishery. However, the recent increase in the mean lengths in the winter fishery and the apparent detachment of the summer and winter fishery mean length series, along with the increasing indices in the Gillnet survey could also indicate some recovery. The decreasing logbook CPUE index may indicate a decreasing stock, but the index should be interpreted with caution, since little variance is explained and only part of the landings are covered in the logbooks. The recent increasing biomass and abundance indices in the Greenland shrimp fish trawl survey indicate good recruitment in 2010 and 2011.

Uummannaq**:** The slowly decreasing trend in mean length in the landings since 2004 could indicate large new incoming year-classes or a decreasing stock. The increasing logbook CPUE index may indicate an increasing stock, but the index should however be interpreted with caution as little variance is explained and only part of the landings are covered by logbooks.

Upernavik: Mean length in the commercial landings was stable from 1999 to 2009, but decreased slightly in 2010 and 2011. However the mean length in the 2012 winter fishery is at the same levels as in the past decade. The decreasing logbook CPUE index may indicate a decreasing stock, but the index should be interpreted with some caution since little variance is explained and only part of the landings are covered by the logbooks.

Reference Points: Could not be determined for any of the stocks.

Special Comments: The stocks are believed not to contribute to the spawning stock in Davis Strait, and no significant spawning has been observed in the areas, hence the stocks are dependent on recruitment from offshore spawning areas.

Sources of Information: SCR Doc. 11/43 12/16 36 SCS Doc. 12/10

VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

1. Scientific Council, September 2012

Scientific Council noted that the Annual Meeting will be held 17–21 September 2012 in St Petersburg, Russia. There will be a meeting by Sharepoint and WebEx in advance of this to update advice on shrimp stocks between 27 August – 10 September 2012, with a WebEx conference to be held on 7 September 2012.

2. Scientific Council, October 2012

Scientific Council noted the Scientific Council/NIPAG meeting will be held in Tromsø, Norway, 17 – 24 October, 2012.

3. Scientific Council, June 2013

Scientific Council agreed that its June meeting will be held on 7 – 20 June, 2013, at the Alderney Landing, Dartmouth, Nova Scotia, Canada.

4. Scientific Council, September 2013

Scientific Council noted that the Annual meeting will be held during 23 – 27 September at the Westin Hotel, Halifax, Nova Scotia, Canada, unless an invitation to host the meeting is extended by a Contracting Party.

5. Scientific Council, October 2013

Scientific Council noted the discussions being held by the NIPAG group regarding moving their meeting to late August/early September in order to reduce duplication of efforts and to produce more timely advice on shrimp stocks. This matter will be discussed in greater detail at the October meeting.

6. NAFO/ICES Joint Groups

a) NIPAG, 2012

Scientific Council noted the Scientific Council/NIPAG meeting will be held in Tromsø, Norway, 17 – 24 October, 2012.

b) NIPAG, 2013

The need to hold a NIPAG meeting and potential dates will be determined at the October meeting this year.

c) WGDEC, 2013

The Working Group on Deepwater Ecosystems will meet at the ICES Headquarters, Copenhagen, Denmark, during 25 – 29 March, 2013.

d) WGHARP

Scientific Council noted that WGHARP is scheduled to meet again during 2013.

7. Scientific Council Working Groups

a) WGEAFM

The Working Group on the Ecosystem Approach to Fisheries Management will meet at the NAFO Secretariat, Dartmouth, Nova Scotia, Canada, during 21 – 30 November, 2012.

b) WGRP

The Working Group on Reproductive Potential plan to meet in conjunction with the Gadoid symposium, St Andrews, New Brunswick, Canada, 16 – 18 October, 2013.

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Topics for Future Special Sessions

a) Joint ICES – NAFO Gadoid Symposium

At the ICES Annual Science Conference in September, 2011, approval was given to hold an ICES symposium entitled "Gadoid Fisheries: The Ecology and Management of Rebuilding" with E. Trippel (Canada) and F. Köster (Denmark) as co-conveners. The symposium will take place from October 15–18, 2013 in St. Andrews, Canada. Co-convener E. Trippel presented the following information to NAFO Scientific Council in order to seek co-sponsorship by NAFO for this symposium. The response from the Scientific Council was positive and agreed that given the topic area they would be in support of co-sponsorship. The requests from NAFO included membership on the Scientific Steering Committee and some financial support for travel for invited speakers to attend the meeting.

Rationale: Not since the early 1990s has there been international symposia dedicated to the biology and ecology of Atlantic cod (St. John's, Canada and Reykjavik, Iceland). In 2006, a Wakefield sponsored symposium on the resiliency of gadoid stocks to fishing and climate change was held in Anchorage, Alaska, with the program heavily focused on North Pacific gadoids (Pacific cod and walleye pollock). In 2009, an ICES/PICES/UNCOVER symposium on rebuilding depleted fish stocks - biology, ecology, social science and management strategies was held in Röstock addressing mechanisms of fish stock recovery and how to best implement stock recovery plans. The suggested symposium will go beyond these earlier symposia by contrasting gadoid stock dynamics in different ecosystems on both sides of the Atlantic, identifying not only ecological settings and management actions leading to recovery, but also considering management plans after and in the absence of rebuilding, acknowledging explicitly environmental change and species interactions.

NAFO is invited to co-sponsor this symposium as the scope and aims of the meeting are in line with the scientific advice sought by NAFO Scientific Council.

The aim of this Symposium is to (i) address the historical dynamics and current status of gadoid stocks in the North Atlantic, (ii) present new scientific findings on the biology and ecology of these species that can be used to improve fisheries management, (iii) link biological changes to environmental changes that can be used to forecast changes in species distribution and productivity related to climate change, (iv) present and appraise the effectiveness of management actions before, during and after recovery, and (v) discuss and document appropriate management strategies and re-opening criteria for recently rebuilt stocks.

Contrasting the recovery and non-recovery pattern observed among gadoid stocks across the Atlantic provides an opportunity to gain a better understanding of the important biological, ecological and anthropogenic factors and conditions driving gadoid population dynamics. Although collectively known as gadoids - cod, haddock, pollock and hake differ significantly in key biological attributes that may influence stock management advice through implementation of suitable fishery reference points, harvest levels, closed areas and seasons, and fishing gear.

Presentations are encouraged on biological (e.g., physiology, genetics, growth, reproduction, survival), ecological (e.g., distribution, abundance, behaviour, predator-prey interactions), and bio-physical (e.g., transport, climate forcing, coupled models) processes as well as among stock and among-gadoid species comparisons and fishery management strategies that aid in sustainable resource use.

Scientific Steering Committee: A Steering/Organizing Committee has been partly developed by the Conveners in consultation with ICES.

To date, the Scientific Steering Committee consists of Jason Link (USA), Olav Kjesbu (Norway), Doug Swain (Canada), and Jonna Tomkiewicz (Denmark). The NAFO Secretariat would be contacted to nominate additional members in order to assist the Conveners in planning the Symposium. In consultation with the Conveners, ICES/NAFO Secretariats will solicit appropriate co-sponsorship from other international organizations if deemed necessary.

Resource requirements: There will be significant resource requirements, most of which will be met by the imposition of a Conference Fee. ICES is asked to cover the publication of a special issue of the *ICES Journal of Marine Science*.

Participants: This Symposium will attract a diverse community of biologists and scientists from ICES and NAFO, as well as those from other organizations and countries concerned by the effects of exploitation on sustainable fisheries in the oceans.

The venue in Canada favours a strong participation of North American countries which largely are continuing to experience poor gadoid resources - some of which are designated as 'threatened' or 'endangered' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), though it is anticipated that the participant base will be broad and comprised of a number of ICES and NAFO countries with significant gadoid resources (e.g., EU, Scandinavia, Russia) as well as scientists studying North Pacific gadoids. A mix of scientists having different experiences with gadoid resiliency and ecosystem-based knowledge will be desirable. Representatives of fishermen's associations and other NGOs will also be encouraged to attend.

Secretariat facilities: The ICES Secretariat will be involved, as usual, in general professional and Secretariat support, and the Secretariat, as usual, should provide direct assistance during the Symposium. Support from the NAFO Secretariat for assistance in preparation and during the Symposium would also be appreciated.

Financial: Financial support from ICES of 15 000 euros was provided. This amount will be dedicated to fund travel and subsistence of keynote speakers and others that may be selected, and to support early career scientists. In addition, the attendance of one or two ICES Secretariat staff at the Symposium, and the presence of the General Secretary/President will place a financial burden on the Secretariat. Fisheries and Oceans Canada will also provide financial support. It is requested that NAFO also provide some financial support to assist with participant travel expenses.

Publication of proceedings: The conveners plan to use the *ICES Journal of Marine Science* for the proceedings. The volume is expected to exceed 200 pages. The conveners will act as Guest Editors of the proceedings.

Scientific Council considered that they would like to support this conference, and an item was added to the budget working paper to reflect this support.

b) World Conference on Stock Assessment Methods, Boston, 16 – 18 July 2013

Scientific Council was informed of a conference resulting from the SISAM Initiative which Scientific Council has been involved with since its inception, and which NAFO has been invited to co-sponsor. This conference will be held at the Boston Seaport during 16 – 18 July, 2013. The conference will provide a forum for presentations and workshops on the application of stock assessment methods. It will consider single stock approaches for data rich and poor stocks, and also multispecies and ecosystem based approaches. It is being organized by researchers from a range of scientific institutions and RFMOs across the world.

The objectives of the conference are to:

- explore the merits of available assessment methods for providing fisheries management advice
- explore model performance across a range of factors through participatory workshops
- consider how to determine the most appropriate method for individual cases

- inform and educate about the range of available stock assessment methods
- facilitate comparisons between methods through access to test data sets
- generate ideas for the features of next generation assessment models

Highlights of the symposium will be published in the ICES Journal of Marine Science.

Scientific Council considered that they would like to support this conference. An item was added to the budget working paper to reflect this support, and the Secretariat was asked to contact the organizing committee to discuss further details.

c) Chilean Observer Conference

Scientific Council was informed of an invitation to support the 7th International Fisheries Observer and Monitoring Conference, organized by the Instituto de Fomento Pesquero (Institute for Fisheries Development, IFOP), to be held during April 8– 12, 2013 in Viña del Mar, Chile. The objectives of the conference are to bring together principal fishing countries to exchange knowledge and experiences of researchers, practitioners and policy makers in the field of fisheries observation and data collection.

Scientific Council considered that this fell outside the core area of Scientific Council's work and they would be unable to support this conference.

d) Ecosystem Effects of Bottom Fishing

Scientific Council was given advanced notice of a conference to be held in June 2014 in Tromsø, Norway, on the ecological effects of bottom fishing. This event is currently supported by ICES and the Norwegian government. Scientific Council was in favor of supporting this event and the matter would be taken into account during budgeting and scheduling of meetings for 2014.

X. MEETING REPORTS

1. Working Group on EAFM, December 2011

The Scientific Council Working Group on Ecosystem Approaches to Fisheries Management (WGEAFM), met at the NAFO Headquarters, Dartmouth, Canada, from November 30 to December 10, 2011. The final report of this meeting is available as SCS Doc. 11/22 at the NAFO website.

WGEAFM currently operates within a set of long-term Themes and Terms of Reference (ToR) which 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).

WGEAFM also provided guidance to Scientific Council on 6 Fisheries Commission requests involving ecosystem-related issues (FC Requests # 10, 15–19). These Fisheries Commission requests were integrated into the long-term ToRs.

The final form of the ToRs addressed at the 4th WGEAFM meeting were:

Theme 1: Spatial considerations

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

ToR 1.1. Update on NEREIDA-related analyses and results.

ToR 1.2. [FC Request # 15] Produce a detailed list of VME indicator species and possibly other VME elements.

ToR 1.3. [FC Request # 18] Development of 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.

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

ToR 2.1. [Roadmap to EAF] Update on ecoregion analyses (Scotian Shelf).

ToR 2.2. [Roadmap to EAF] Development of framework for an integrated ecoregion analysis for the entire Northwest Atlantic.

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.

ToR 3.1. [Roadmap to EAF] Initiate the evaluation of fisheries production potential at the ecosystem level by considering a) Fisheries Production Potential Models, b) other models/approaches, and c) other research that can be of relevance to understand the ecosystem productivity of NAFO ecosystems.

ToR 3.2. [FC Request # 10] Provide an explanation on the possible connection between the recent decline of the shrimp stock, the recovery of the cod stock, and the reduction of the redfish stock in the Flemish Cap ecosystem, as well as advice on the feasibility and the manner by which these three species could be maintained at levels capable of producing a combined maximum sustainable yield.

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 4.1. [FC Requests # 16 & 17]. Implement and/or further refine the existing GIS simulation/modelling framework, in conjunction with the VMS data supplied by the NAFO Secretariat [FC Request #16], to make recommendations on 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.

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

ToR 5.1. [FC Request # 19] In preparation for the reassessment of NAFO bottom fisheries by 2016 and every 5 years thereafter, develop a work plan for completing the initial reassessment and identifying the resources and information to do so.

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.

Since all special requests were merged into the previous ToRs, no specific topic was tabled under this ToR.

In addressing ToR 1, WGEAFM discussed recent advances emerging from the ongoing analysis of NEREIDA samples. These results are starting to show and document clear differences in the benthic communities in an out some of the closed areas; this type of work is expected to continue. WGEAFM also review new information on the distribution of corals and sponges, and recommended to Scientific Council to consider this information for the possible designation of new closed areas adjacent to existing ones. Along this line, WGEAFM recommended Scientific Council to consider strategies to mitigate the impact of scientific surveys inside the closed areas. The WG also developed lists of potential VME-indicator species and elements, as well as corresponding maps, to serve as basis for Scientific Council discussion of FC Requests 15 and 18.

In addressing ToR 2, WGEAFM further advance the delineation of ecoregions and ecosystem-level units in the NW Atlantic, starting to explore the temporal variability of ecoregions in the Scotian Shelf, and developing a plan for an integrative ecoregion analysis at the entire Northwest Atlantic scale. This large scale ecoregion analysis involve the standardization and integration of several regional databases during 2012, a working meeting in October 2013, and a presentation of the results at the 2013 WGEAFM meeting. This work is being coordinated and supported by an ongoing DFO International Governance Strategy (IGS) project.

In addressing ToR 3, WGEAFM advanced in the study and modeling of fisheries production at the ecosystem level through an exploratory implementation of Fisheries Production Potential (FPP) models for the Newfoundland-Labrador (NL) and Scotian shelves, and the Flemish Cap, the development of aggregate biomass production models for the NL shelf and Flemish Cap, and the estimation of total food consumption by harp seals in Div. 2J3KL. The initial results from the FPP models were considered promising, but it was recognized that further work is required before these models are ready for practical application in these ecosystem units; plans to continue this work are in place, but are dependent on securing the necessary funding. The aggregate biomass models captured reasonably well the general trends in these ecosystems; these results also hinted to the importance of environmental (bottom-up) drivers in the overall biomass trends at the ecosystem level. The estimations of total food consumption by harp seals also provided important information to understand the overall productivity of the NL system. It is expected that, as work continues, results from these research activities would be integrated to provide operational estimates of system-level fisheries production. The interactions among cod, redfish and shrimp in the Flemish Cap were also addressed under this ToR through analyses of common trends in species survey biomasses and diets, estimations of redfish consumption by cod, and the implementation of a preliminary 3-species model. Results from these studies are put forward for the Scientific Council discussion of Fisheries Commission Request 10.

In addressing ToR 4, WGEAFM further developed the GIS modeling approach used in previous analyses of thresholds for encounter protocols; the current version of the model used actual VMS data to incorporate realistic fishing effort, and used this updated model to produce new estimates of thresholds for sponges and seapens. It also explored options for move-on rules. Results from these analyses are put forward for the Scientific Council discussion of Fisheries Commission Requests 16 and 17.

In addressing ToR 5, WGEAFM discussed the implications and needs associated with the reassessment of all NAFO fisheries by 2016, and every 5 years thereafter. In this context, WGEAFM noted that this requirement changes the way in which fisheries assessments were considered within NAFO; now the onus of producing fisheries assessments is put on Scientific Council and Working Group of Fisheries Managers and Scientists (WGFMS) as opposed to Contracting Parties. It was noted that the requirements of fisheries assessments can be mapped onto the general structure of the "Roadmap to EAF", and based on these similarities, WGEAFM proposed a possible way forward for developing fisheries assessments which could also be used as a template for the operational implementation of the "Roadmap to EAF". WGEAFM also discussed the data and resources needed to do the fisheries assessments by 2016, and noted that additional resources are expected to be required to meet this deadline. WGEAFM, mindful that it was the first group within NAFO discussing this topic, developed its proposal as a starting point for a broader discussion. The outcome of this ToR is put forward for the Scientific Council discussion of Fisheries Commission Request 19.

WGEAFM also discussed next step and future activities. In this context, the WG recognized that NAFO SC working groups do not have a regulated schedule for the replacement/renewal of their chairs. Current WGEAFM co-chairs, Mariano Koen-Alonso (Canada) and Andrew Kenny (UK), were elected to those positions at the 1st WGEAFM meeting (26–30 May, 2008, Dartmouth, Canada). Since more than 3 years have elapsed since their initial designation, WGEAFM reviewed the co-chairs situation and proposed to renew the incumbent appointments.

It was proposed that the 5th WGEAFM meeting take place 21-30 November, 2012 at the NAFO Secretariat in Dartmouth, NS, Canada, and that it 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 5th 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 updates from the NEREIDA project, as well as other surveys, will become available; these new studies will be presented and discussed under this ToR. Other elements to be discussed may include modeling VME distribution using habitat characteristics, as well as analyses of distribution of benthic communities.

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

It is expected that updated analyses considering temporal variability of ecoregions will be presented and discussed under this ToR. Advances on the integration of databases for the Northwest Atlantic integrated ecoregion analysis are also expected to be discussed here.

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

It is expected to continue working on Fisheries Production Potential (FPP) models, as well as modeling of multispecies systems, and estimations of food consumption.

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

It is expected that work under this ToR would include a literature review on parameterizations for SAI analyses, as well as a brainstorming session on the details and caveats of using VMS data for SAI analysis.

In addition to the work focused on the ToRs indicated above, WGEAFM would also be expected to allocate 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 welcomed the progress made by WGEAFM, and approved the plans for the next meeting 21 – 30 November, 2012 at the NAFO Headquarters.

Scientific Council noted the issue raised by the working group regarding the activities of research vessels within closed areas. Consequently, information was examined from Canadian surveys on the location of survey trawl sets relative to 12 closed areas in the NRA. The seamount closures were excluded, as no trawl surveys operate in these areas. Scientific Council noted that although surveys are exempt from the closed area provisions in the NCEM (Article 4, paragraph 1), this is an issue that required some consideration. Existing trawl surveys operate inside closed areas only when sets are placed there randomly as part of the survey design.

The analysis showed that there are 46 survey strata in Divisions 3LMNO that intersect with one or more of the closed zones, and that there are some strata which have 100% of the survey area inside a closed area. Thus there would be impacts on survey design and comparability of results if all closed areas were to be excluded from trawl surveys.

Scientific Council recognizes that while some scientific sampling is needed in all areas in the NRA to gather the information necessary for informed management, the issue of conducting trawl survey sets in the closed areas is a potential problem. There are consequences to survey designs of not surveying in the closed areas, as well as consequences to coral and sponge of surveying in these areas. Scientific Council considered some options, in addition to status quo and no surveying in closed areas entirely, and briefly discussed the pros and cons of each. Some of the options were surveying in closed areas less frequently, only surveying in select locations in the closed areas such as previously trawled grounds where VME indicator species are known to be below a threshold, or establishing a process requiring application and approval to survey in the closed areas.

Scientific Council **recommended** that *before design of survey sampling schemes are changed, more work be conducted in order to examine the trade-off between scientific sampling needs and potential impact on VMEs.*

2. Ad hoc Working Group on Exceptional Circumstances, Jan-Mar 2012

(SCS Doc. 12/02)

The *Ad hoc* Working Group on Exceptional Circumstances met by SharePoint and WebEx between January and March 2012 to consider the implications of exceptional circumstances in the Greenland halibut MSE. The group concluded that exceptional circumstances occur when a resource moves outside the range of parameters compatible with the various scenarios considered in the MSE simulation testing, on which selection of the management strategy for that resource was founded. If Scientific Council determined that "Exceptional Circumstances" are occurring, then a review and possible revision of the harvest control rule by Fisheries Commission, as outlined by the FC Working Group on MSE (FC Doc. 11/08), may be necessary.

3. Report from WGDEC, Mar 2012

(SCS Doc. 12/18)

The ICES – NAFO Working Group on Deepwater Ecology met during 26 – 30 March, 2011, at the ICES Headquarters, Copenhagen, Denmark, under the chairmanship of Francis Neat, (Marine Scotland - Science, Aberdeen, UK). The group had not received any requests for advice from NAFO, but had a number of terms of reference pertaining to the pending review of bottom-fishing regulations in NEAFC. The texts of these requests are available in the full report of the group.

ToR (a) was a standing request for advice to update records of deep-water vulnerable marine ecosystems (VMEs) in the North Atlantic and where appropriate advice 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, habitat modelling and seabed imagery surveys were available In the NE Atlantic new evidence came from video transects, side-scan sonar surveys, and trawl bycatch of coral from Rockall Bank. For the NW Rockall closure, these data largely support WGDEC's 2011 advice for boundary revision, with the exception that WGDEC advises a much reduced reopening of the south west corner of the current NEAFC because corals have since been found there. New trawl bycatch data from south-west Rockall suggest the presence of VMEs outside the current NEAFC closures in this area. Two options for greater protection of VMEs in this area are presented. New data from observers on long-line and trawler vessels operating in the Hatton bank suggest areas of deep-sea sponge aggregations and other VMEs that should be protected. Four closure boundary revision options are presented. Long-line records and high resolution multibeam imagery of Edora's bank (south-west of Hatton bank) suggest it is likely to contain concentrations of VMEs and thus a precautionary closure around the base of the bank is suggested. New data from the Whittard Canyon in the Bay of Biscay was available and this area is highlighted as an important area for VMEs that requires closer attention and consideration for protection. New records for the Norwegian Sea area are presented. New records of VME indicator species were obtained from the Josephine seamount (a NEAFC existing fishing area and an OSPAR MPA site) and attention is drawn to this area. In the Northwest Atlantic, new data were available from observers on trawlers suggesting the presence of VMEs in areas currently open to bottom to the east and west of Greenland.

To address ToR (b) a review was made of different species and habitats considered as potential VMEs in the NAFO and CCAMLAR regulatory areas. It was concluded that WGDEC should consider rarity or uniqueness more in its assessment of VMEs. Of particular significance for WGDEC to consider in more detail are the communities found around hydrothermal vents and seeps.

For ToR (c) a brief review was made of how indicators of biodiversity have been developed in the NAFO regulatory area. Methods for survey data, e.g. trawl bycatch or video transects, that allow quantification of the spatial distribution coral beds and sponge grounds may be used a proxies for monitoring biodiversity.

For ToR (d) there was a clear message that seamounts are not now generally considered to be sites of endemic species, but may nevertheless have faunal communities that are ecologically distinct. Alternative management advice for seamount fisheries is given as part of ToR e (iii).

To address ToR e (i), theoretical assumptions underlying VME distribution were considered in relation to empirical evidence from cumulative bycatch curves for VME species. As so little is known about VME distribution and patchiness, it is concluded that a 50 % reduction in the threshold to 30 kg coral and 400 kg sponges would be an ecologically broader and more realistic indicator of a VME encounter. A further suggestion is made to account for cumulative encounters below threshold levels, e.g. 2 bycatch events of 15 kg of corals in the same area is considered to be equivalent to a 30 kg threshold that triggers a move-on.

In ToR e (ii) the move-on rule is discussed in relation the different habitat types, fishing gear types and whether fishing is occurring in new or existing fishing areas. The move on rule is more appropriate for existing fishing areas, but less so in new fishing areas; moving off or away from a readily identified geo-morphological feature (such as distinctive outcrops, banks, ridges) may be a more effective means of avoiding further impacts on VME communities than moving a minimum distance. The move-on rule is not considered to be appropriate for seamount fisheries.

For ToR e (iii) WGDEC discussed alternative management options to encounter thresholds and move-on rules. Technical conservation measures that lessen seabed impact are discussed and are certainly to be encouraged, but WGDEC's main conclusion is the best solution is to invest heavily in high technology monitoring of the fishery and mapping of the habitat so as to avoid impacting VMEs as much as possible. For seamounts fisheries in particular this should be an unconditional requirement in their regulation.

ToR e (iv) discusses uncertainty in our state of knowledge of VME occurrence and how different sources of information are to be interpreted at different geographical scales. In particular the outputs of habitat suitability models are discussed. Where there are unequivocal occurrences of VMEs in the NEAFC RA, e.g. visual validations of *Lophelia pertusa* reefs, there have been closures to bottom fisheries enforced.

For ToR (f) the NAFO observer guides for corals and sponges were reviewed and an analysis was made of how appropriate these guides would be for the NEAFC RA. While the guides are seen as very useful and there is some overlap between species in the NAFO and NEAFC RAs there was consensus that separate guides would be needed for the NEAFC area, especially in the case of the sponges. Advice is presented on which key species such a report should focus on.

Recommendations to ICES

1) WGDEC recommends that recent (post 2009) VMS data is provided to ICES in advance of the 2013 WGDEC meeting. Notable areas of interest include fisheries in the Rockall-Hatton area, all seamounts, the mid-Atlantic ridge, and the continental slope (including the Bay of Biscay). All form of identification of vessel or nationality should be removed from the data. For the data to be useful, however, WGDEC will need;

i. the data resolved at the finest possible temporal and spatial scale;

ii. information on gear type;

iii. information that links the VMS data to log book records.

2) WGDEC recommends that ICES SGVMS considers a means of processing the VMS data so that fishing effort maps can be readily made.

3) WGDEC recommends that NEAFC consider whether log-book records of encounters with VME indicator species (below current thresholds) could be made available to the group for purposes of assessing VME indicator bycatch frequency and distribution.

4. WGRP

(SCS Doc 12/16)

Over the past year, Working Group members worked inter-sessionally by correspondence and *ad-hoc* meetings at other scientific fora to address the ToRs approved by Scientific Council. The EU COST Research Network Action Fish Reproduction and Fisheries (FRESH) (Coordinator: Fran Saborido-Rey, Spain) was successfully completed in June, 2011. Many initiated activities in support of the NAFO WG on Reproductive Potential were carried forward over the past year. This enabled the development of collaborations among scientists that benefited addressing NAFO ToRs, avoided duplication of effort between the two groups, and brought more results to the attention of Scientific Council.

5. WGHARP

(SCS Doc. 12/17)

The Scientific Council noted the important work carried out by the ICES – NAFO Working Group on Harp and Hooded Seals over many years. Although there have been no specific requests for advice from Fisheries Commission to this group in recent years, there have been a number from Coastal States. The Scientific Council also noted that there are a considerable number of questions remaining about the impact of marine mammals on fish stocks. Some of these questions were addressed at the two symposia NAFO organized, in cooperation with ICES and the North Atlantic Marine Mammal Commission (NAMMCO), on the role of marine mammals in the ecosystem. Continued progress on these issues requires the collaboration of marine mammal and fishery scientists, along with ecosystem modelers.

Scientific Council noted the concerns expressed by the working group chair regarding the position of seals in NAFO, given the wording of the new Convention, particularly change in the scope of jurisdiction of the organization from *"fishery resources of the Convention Area, with the following exceptions: salmon, tunas and marlins, cetacean stocks managed by the International Whaling Commission … and sedentary species of the Continental Shelf"*, to one which defines "*fishery resources*" specifically as *"all fish, molluscs and crustaceans within the Convention Area".*

Scientific Council further noted the wording of Article VII, paragraph 9 (b) of the new convention, which states that *"the Scientific Council may cooperate with any public or private organization sharing similar objectives".* Given this flexibility to cooperate with other organizations with similar objectives, Scientific Council endorsed the continued participation of NAFO in a joint working group with ICES, NAMMCO and/or other bodies, addressing fisheries interactions with seals.

6. WGNARS

The ICES Working Group on the Northwest Atlantic Regional Sea (WGNARS) met at the Waquoit Bay National Estuarine Research Reserve in Falmouth, MA, USA, on March 6-8, 2012. The meeting was chaired by Steve Cadrin (USA), and Catherine Johnson (Canada), and Mariano Koen-Alonso (Canada) attended as NAFO WGEAFM co-chair. The full report of this meeting will soon be available at the ICES website.

The overarching objective of ICES WGNARS is to develop an Integrated Ecosystem Assessment (IEA) of the Northwest Atlantic region to support ecosystem approaches to science and management. The work of WGNARS is structured around a triad of drivers which define the overall spatial, ecological, and socio-economic scope of IEA development. This triad includes 1) human drivers (e.g. fishing, contaminants), 2) internal drivers (e.g. trophodynamics, biodiversity), and 3) external drivers (e.g. climate, oceanography).

The work at the 3rd ICES WGNARS meeting was organized into four sessions focused on a) indicators and thresholds, b) biological−physical interactions, c) habitat and spatial planning, and d) socio−economics. Through these sessions, WGNARS addressed the triad of drivers, but also included a place−based perspective and interactions across spatial scales.

The session on indicators and thresholds reviewed work towards developing integrated ecosystem indicators that could be used to evaluate management objectives, and discussed the relative merits of empirically vs theoretically derived thresholds. Based on this work, a set of principles for IEA indicator development was proposed.

The session on biological−physical interactions focused on integrating information on climate−driven environmental change in the NW Atlantic, the responses by lower trophic level, and how this understanding can be used for developing indicators for the pelagic habitat. Advances in ocean observing infrastructure across the NW Atlantic was also discussed in this session.

The session on habitat and spatial planning discussed how to identify critical habitat scales needed to link habitat effects on individuals and groups, the role of spatio-temporal habitat dynamics on system-wide production, resilience and aggregate ecosystem indicators, as well as the integration of dynamic pelagic processes with static seabed features to define ocean habitats.

The session on socio-economic aspects provided an avenue for discussing the role of social science in the development of a regional IEAs; this included ideas on how to incorporate human dimensions into ecosystem based management, experiences from ongoing work on defining social and economic performance measures and indicators to evaluate fisheries management outcomes, and modeling frameworks to integrate ecological and economic considerations.

WGNARS highlighted the scoping of objectives with stakeholders, the development of management thresholds, and the evaluation of performance indicators against ecosystem drivers as priorities for the coming years. This WG will direct its work during 2013-2015 towards developing an initial integrated assessment; however, it recognized that differences in governance and capacity across NW Atlantic regions would limit what can be accomplish in certain areas. Fostering coordination among NW Atlantic regions, other ICES regional seas programs, as well as with NAFO WGEAFM, are an integral component of WGNARS plan to move forward. As part of this process, the WG meetings will expand from 3 to 5 days of duration.

The next ICES WGNARS meeting is tentatively scheduled for January 28 to February 1, 2013, in Dartmouth, NS, Canada, and it will be co-chaired by Sara Gaichas (USA) and Catherine Johnson (Canada). The proposed terms of reference for this meeting are:

a) Continue to develop the scientific support for an integrated assessment of the Northwest Atlantic region to support ecosystem approaches to science and management;

b) Review and summarize previous scoping exercises in integrated ecosystem assessment or similar initiatives for management objectives and socio−economic utilities. Identify next steps for refining goals for an IEA for the Northwest Atlantic as well as for vetting core indicators with relevant stakeholders (federal and regional governments, coastal communities, fishers, etc.).

c) Evaluate risk of various multi−sector ocean−uses impacts facing the Northwest Atlantic to assess relative susceptibilities;

d) Evaluate indicator performance with respect to important ecosystem drivers, emphasizing responses relative to candidate thresholds;

e) Review and report on the work of other integrated ecosystem assessment activities in ICES, NAFO and elsewhere.

Following with current practices, it is expected that at least one of the NAFO WGEAFM co-chairs will be attending to this meeting.

7. Meetings Attended by the Secretariat

a) GIS Symposium

George Campanis (IT Manager, NAFO Secretariat) was invited to attend 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. In particular, he presented the methods used to delineate NAFO's fishing footprint, and how VMS data are being used to model bycatch thresholds for the management of VME species in the NRA.

The symposium was attended by GIS experts from 13 different countries and two RFMO's (NAFO, IATTC). The symposium allowed NAFO to showcase some accomplishments achieved by utilizing GIS and VMS data to aid fisheries managers and scientists in their work. Although the symposium was attended by a somewhat broad group of individuals e.g. mariculture specialists, statisticians, biologists, GIS software developers etc., it allowed the Secretariat to build capacity by comparing spatial analysis methods and techniques amongst participants and by forging contacts with like-minded GIS experts.

Some useful knowledge gained during the symposium includes: online presentation of spatial and temporal data using free and open sourced tools; integrating R and ESRI ArcGIS; and using software that allows for 4D presentation of data (Eonfusion).

Some NAFO scientists have expressed an interest in the possibility for NAFO to host the 6th GIS Symposium in Dartmouth. Given the progress that NAFO are making in using GIS to define ecoregions and bycatch thresholds for coral and sponges, this may well be a worthwhile and mutually beneficial endeavor.

b) FAO VME Database Workshop

The FAO Workshop for the development of a database for vulnerable marine ecosystems (VMEs) was held in Rome, Italy, 7 – 9 December 2011. The workshop was attended by several RFMOs, the fishing industry and various national agencies. The Fisheries Commission Coordinator (Ricardo Federizon) and the Information Officer (Barbara Marshall) represented the NAFO Secretariat. The workshop discussed the requirements for a global database information system on VMEs and associated areas in the high seas deepwater areas. This information system is specified in the UNGA resolution 61/105.

The VME database will capture information on VMEs and associated areas which have been identified by RFMOs and VME-related data form areas which are not presently covered under the jurisdiction of a RFMO/A. The VME database would assist in outreach, transparency and global awareness, as well as provide comparative regional information on VMEs and management approaches.

The attending agencies and organizations, NAFO included, have indicated their interest in participating in the project. There were discussions about adopting the “FIRMS model” in the implementation of the project.

The Secretariat and Canada (Ellen Kenchington *et al*.) have been developing a case study. Included is information on the history, development and regulation of VMEs as well as scientific information and interesting graphical shows of specific scientific information. It may be possible to also use this information on the NAFO website.

c) CWP

The Coordinating Working Party on Fishery Statistics (CWP) Inter-sessional Fishery Group Meeting was held in Rome, Italy, 14–16 December 2011. The Fisheries Commission Coordinator (Ricardo Federizon) and the Information Officer (Barbara Marshall) represented the NAFO Secretariat. The meeting focused on the review of the progress of the update and revision of the CWP Handbook of Fishery Statistical Standards which was first published in 1990. At the CWP-23 Meeting held in Hobart Australia in February 2010, various sections of the Handbook were assigned to CWP members for revision and update. CCAMLR and NAFO were identified and assigned to draft a new section on ecosystem monitoring for the Handbook.

A draft outline of the ecosystem monitoring section was developed at the meeting. It was based on the case studies of CCAMLR and NAFO prepared jointly by Dr. Ramm (CCAMLR) and Dr. Federizon (NAFO). The meeting agreed with the time table for the development of the Handbook. It is envisioned that the final version of the Handbook will be adopted at CWP-24 Meeting in February 2013.

d) FIRMS

The meeting of the Fisheries Resources Monitoring System (FIRMS) Steering Committee was held 12–13, 16 Dec in Rome. It was attended by Barbara Marshall and Ricardo Federizon. NAFO is well established in FIRMS but have recently begun to submit Fisheries information. The Partnership Agreement will be revised by GC this year. There were a few items that NAFO will be collaborating on in the upcoming months including developing some new thematic fact sheets and creating PR materials for FIRMS. Barb was nominated for Vice-Chair of the FIRMS Steering Committee. The next meeting will be held in conjunction with the CWP in Feb 2012, venue not yet confirmed.

e) Science Sustainability Forum

The Science Sustainability Forum held 29 February–2 March in Washington, DC, brought together scientists and those that elaborate scientific information and many of the USA seafood retail buyers. Barbara Marshall attended the Forum representing FIRMS.

The main questions raised were what exactly is sustainability and where can reliable information on the status of certain species be found. The Forum focused on looking at various types of information from different sources (mostly US and international) and counting on the reliability of the sources to judge the quality of the information.

Many of the seafood buyers were confused by the scientific lingo that described stock status. A point was made that communications and public relations are specialized professions and that scientists are not trained in these techniques. One presentation noted that scientists should not be communicating scientific information any more than PR specialists should be conducting stock assessments!

The presentations made were informative to the buyers and some of the international information like FIRMS was not well known.

The next steps for the Forum will be to work with a PR firm to prepare information in a more public friendly way. Some specific projects were identified as well and these include requesting FAO/FIRMS to take over the management of the RAM Legacy Database (http://ramlegacy.marinebiodiversity.ca/ram-legacy-stock-assessment-database). This will includes some support funding as well.

f) World Fisheries Congress

Neil Campbell (SC Coordinator) and Ricardo Federizon (FC Coordinator) attended the World Fisheries Congress at the Edinburgh International Conference Center, 7–11 May, 2012, where they presented information on NAFO's management measures in place for the conservation and management of deep water fish, and on NAFO's institutional structures which enable closer working of managers and scientists. This meeting also provided the opportunity to hold discussions and gather information of use to Scientific Council, regarding an upcoming stock assessment conference, and on a global research network on climate change, both of which are detailed elsewhere in this report.

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. Performance Assessment Recommendations to Scientific Council

Scientific Council noted the performance assessment recommendations directed specifically to the Scientific Council. SC has made some attempts to make its advice clearer and easier to read. Further progress on this matter can best be made through dialogue with Fisheries Commission and Coastal States regarding their needs. Scientific Council deferred further discussion on this matter until the September meeting.

2. Issues Arising from the GC Working Group on the Plan of Action

Scientific Council considered the report of the GC Working Group. Of particular note was the invitation to hold a joint meeting of the Scientific Council and Fisheries Commission at the forthcoming Annual Meeting. Scientific Council felt that discussions on a number of issues would be of benefit to NAFO and welcomed this initiative.

3. General Plan of Work for September 2012 Annual Meeting

Other than the prospective joint meeting of Fisheries Commission and Scientific Council, no new issues were raised that will affect the regular work plan for the September meeting.

4. Other Matters

a) ICES Greenland Halibut Benchmark Process

NAFO was contacted by the ICES Secretariat and informed of the potential for a "benchmark" assessment workshop on Greenland halibut stocks, to take place in autumn 2013. An invitation to participate in this exercise was extended to members of Scientific Council. Greenland halibut stocks in NAFO are currently managed under the auspices of the management strategy, and this process is not necessarily compatible with the ICES benchmarking process. While recognizing this difference, Scientific Council felt that it would be beneficial to participate in the process, in order to keep abreast of best practice and explore different methods used in Greenland halibut assessments. A benchmark process would require some preparatory work by designated experts in order to deliver the best outcomes. The SC Chair agreed to contact ICES to discuss the issue further.

b) ICES Request regarding SA 1 (inshore) cod

Scientific Council was informed of a communication from ICES regarding the provision of advice on Cod in ICES Subarea XIV – NAFO Subarea 1. The latest advice is that this stock should be managed as two components; one in

ICES Div. XIV and the offshore part of NAFO SA 1, the other in inshore waters of SA 1. ICES were unsure of the protocol regarding advising on a stock wholly within the NAFO Convention Area. Scientific Council noted this request and were agreeable for ICES to continue providing advice for this stock in the current manner.

XII. OTHER MATTERS

1. Designated Experts

The list of Designated Experts will be confirmed at the September meeting.

2. Stock Assessment Spreadsheets

It is requested that the stock assessment spreadsheets be submitted to the Secretariat as soon after this June meeting as possible. The importance of this was reiterated by STACREC.

3. Meeting Highlights for the NAFO Website

The Chairs of each Committee submitted highlights of the meeting to the Secretariat. This information will be uploaded to the NAFO website after the meeting.

4. Scientific Merit Awards

No nominations were received.

5. Budget Items

The budget for the current year 2012 was presented to Scientific Council.

The 2013 budget was discussed by Scientific Council and will be presented to STACFAD in September 2012 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.

6. Other Business

a) Quality of catch information for assessments

Scientific Council noted the concerns expressed by STACFIS regarding the quality of catch data available to perform assessments.

Contracting Parties have the responsibility to report accurate catches to NAFO via STATLANT 21 submissions, and Scientific Council has the responsibility to “compile” these catches for NAFO. Scientific Council considered that it is not its responsibility to provide the best catch figures, nevertheless Scientific Council requests clarification on which NAFO body is responsible for validating the quality of the STATLANT catch figures submitted, to enable the Scientific Council to carry out assessments in a timely manner. If it is the job of Scientific Council, Scientific Council recognizes that the availability of more information will improve the catch quality, for example inspection reports, daily catch reports and VMS data, may be required for this task.

Scientific Council **recommended** that *General Council clarify the responsibilities of NAFO bodies and Contracting Parties with respect to determining the quality of STATLANT 21 data.*

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 and the Alderney Landing for the excellent facilities. There being no other business the meeting was adjourned at 1300 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 Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 4 and 13 June 2012, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Greenland), European Union (France, Germany, Portugal, Estonia, Latvia, Lithuania and Spain), Japan, Russian Federation and USA.

Highlights of Climate and Environmental Conditions in the NAFO Convention Area for 2011

- The North Atlantic Oscillation index (NAO), a key indicator of climate conditions over the North Atlantic was negative resulting in weak arctic air outflow and warmer air temperatures during winter 2010/2011 over the NAFO Convention Area.

- In contrast, annual temperature over Southwest Greenland waters was slightly below normal in 2011, reflecting lower mean air temperatures than normal from spring onwards.

- The Labrador Sea experienced warm winter surface air temperatures from approximately 6°C above normal in the northern region near Davis Strait to about 2°C above normal in the southeastern Labrador Sea in 2011.

- Sea surface temperature anomaly was more than +5°C in the Labrador Sea during the winter of 2011 but close to normal throughout the remainder of the year.

- In 2011, wintertime convection in the Labrador Sea was limited to the upper 200 m of the water column, which is very similar to that observed in 2010 and well below normal.

- Sea ice anomalies in the Labrador Sea were negative (below 50% of normal) in January 2011 and remained well below the long-term means for the remainder of the ice season.

- The above normal air temperatures experienced over Newfoundland and Labrador in 2010 decreased significantly in 2011, but remained above normal by <1 Standard Deviation (SD).

- The annual sea ice extent on the NL Shelf remained below normal for the 16th consecutive year reaching a record low in 2011.

- Only three icebergs were detected south of 48^{o}N on the Northern Grand Bank, compared to one in 2010, substantially fewer than the 1981-2010 mean of 767.

- Annual water column averaged temperature at Station 27 off southeastern Newfoundland increased to a record high in 2011 at 3 SD above the long-term mean.

- Station 27 annual bottom temperatures (176 m) were also at a record high at 3.4 SD (1.3°C) above normal.

- Near-surface summer temperatures in the inshore regions along the east coast of Newfoundland were 1-2 SD below normal.

- The annual stratification index at Station 27 decreased to 2 SD below normal, the lowest since 1980.

- The area of the cold intermediate layer (CIL) water mass (<0°C) on the eastern Newfoundland Shelf was at a record low value at 2 SD below normal.

- Spring bottom temperatures across the Div. 3Ps-3LNO region were at a record high in 2011 at about 2 SD above normal.

- Autumn bottom temperatures in Div. 2J and 3K were also at a record high value, at 2 and 2.7 SD above normal, respectively.
- A composite climate index derived from 27 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 and 2011 to the 2nd and 4th highest, respectively, indicating warmer than normal conditions throughout the region.
- Air temperatures on the Scotian Shelf and adjacent offshore areas remained above normal by 1-2 SD but decreased over 2010 values.
- Ice coverage and volume on the Scotian Shelf was the third lowest in the 43 year long record in 2011.
- The climate index, a composite of 18 selected, normalized time series, averaged +0.9 SD with 17 of the 18 variables more than 0.5 SD above normal in 2011.
- Bottom temperatures were above normal in 2011 with anomalies for NAFO Div. 4Vn, 4Vs, 4W, 4X of +0.7°C (+1.6 SD), +0.8°C (1.1 SD), +0.3°C (+0.3 SD), and +0.5°C (+0.6 SD) respectively.
- The volume of the CIL on the Scotian Shelf, defined as waters with temperatures <4^{o}C, was 0.6 SD less than the long-term mean in 2011 and similar to that observed in the previous two years.
- Stratification on the Scotian Shelf in 2011 weakened significantly compared to 2010; obtaining a value near that seen in 2002 and a record low since 1986.
- Nitrate inventories were generally above normal within the upper 50m from the Grand Banks extending down to the Scotian Shelf, with near-normal levels observed in the northeast Newfoundland Shelf and southern Labrador Shelf in 2011.
- In contrast, deeper inventories of nitrate that represent the main limiting nutrient for the following year showed a large reduction in 2011 across the region.
- Seasonal monitoring of ocean sections and coastal stations, which provide information throughout the water column, revealed enhanced phytoplankton standing stocks along the eastern and central Scotian Shelf in 2011.
- Coherent trends in the time series of composite satellite indices from 1998 to 2011 were observed between the northern and southern Subareas which suggest the importance of large-scale physical forcing.
- Enhanced abundance of large and small copepods as well as total copepod zooplankton was observed for the northern Subareas in 2011 with 1 to >2 SD above normal, in contrast to 1 to 3 SD below normal across the Scotian Shelf.
- The zooplankton dry weight anomalies were generally below normal across NAFO Subareas 2 to 4 in 2011.

1. Opening

The Chair opened the meeting by welcoming participants to this June 2012 Meeting of STACFEN.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 12/02, 12/04, 12/07, 12/08, 12/09, 12/13, 12/18, 12/29, and SCS Doc. 12/07, 12/09, 12/10, 12/13, 12/14.

2. Appointment of Rapporteur

Eugene Colbourne (Canada) was appointed rapporteur.

3. Adoption of the Agenda

The provisional agenda was adopted with no further modifications.

4. Review of Recommendations in 2011

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

STATUS: Although there were no specific requests from Scientific Council, the Committee has prepared new environmental composite time series in development for use in the STACFIS Report this year that will be more fully addressed in recommendation # 3.

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

STATUS: An invited speaker was supported in 2012 along with a number of interdisciplinary presentations on environmental regulation of resource populations and to address a broader array of ecosystem components and database tools.

STACFEN **recommended** *development of annual time series of environmental composite indices to complement environmental information provided to STACFIS for the Subareas of interest which include SA 0-1, SA3 – Div. 3M, SA3 and Div. 3LNO, and widely distributed stocks SA 2-4*.

STATUS: The Committee will provide an update for the composite environmental time series for each of the NAFO Subareas of interest for inclusion in the STACFIS Report.

STACFEN **recommended** that *the appearance of good year classes that were observed in 2010 (specifically cod on the Flemish Cap (3M) and on the Scotian Shelf be explored in relation to environmental indices and ocean climate conditions*.

STATUS: No progress was reported at this June assessment meeting.

5. Invited Speaker

The Chair introduced this year's invited speaker Dr. Alida Bundy. Dr. Bundy is a Research Scientist with Fisheries and Oceans, Canada at the Bedford Institute of Oceanography. She has a variety of interests that focus on the preservation of biodiversity of our oceans. Her research interests include the impact of fishing on marine ecosystems, the structure and functioning of ecosystems, ecosystem-based management and ecosystem based indicators of fishing impacts, development of assessment methods for data-poor fisheries, adaptive management of fisheries and interdisciplinary approaches to fisheries science.

The following is an abstract of her presentation entitled “Environmental change, fisheries and trophodynamics in the Northwest Atlantic: far out and zoomed in”.

The presentation explored the relative effects of environment, fishing and trophic interactions on northwest Atlantic marine ecosystems using a variety of approaches including empirical analysis and ecosystem modeling techniques. Review of previous studies across a number of different spatial and temporal scales revealed the importance of both climate and fishing exploitation and importantly the interaction among a variety of external drivers. A number of implications were raised for fisheries management issues based on findings including:

- Similar trends and patterns were observed for a number of different stocks across NW Atlantic

- Results illustrate important role of environment of ecosystem dynamics, in addition to fishing exploitation and tropho-dynamic interactions

- With climate change, we can expect stronger environmental effects
- Serious implications for stocks with decreased biomass, condition, reduced age structure and recruitment and therefore resilience to change
- Fisheries assessments must account for environmental, climate change and the broader ecosystem
- Failing that fisheries assessments must be extremely cautious and manage well below the usual precautionary reference points

The invited lecture presented by Dr. Bundy was well received by Scientific Council and stimulated discussion on the response of ecosystems to climate change. The use of ecosystem models of differing complexity was presented to investigate ecosystem dynamics and functioning. In addition, the implication of change in structure and energy flow of ecosystems for harvest rates and management strategies was addressed.

6. Integrated Science Data Management (ISDM) Report for 2011

(SCR Doc. 12/13)

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. A review of the ISDM Report for 2011 was presented in **SCR Doc. 12/13**. 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 2012 required the submission to ISDM of a completed oceanographic inventory form for data collected in 2011, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2011. The data of highest priority are those from the standard sections and stations. 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 2011 are included. This report will also provide an update on other ISDM activities during 2011. 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 Report for 2011:

The following is the inventory of oceanographic data obtained by ISDM during 2011 and updates on other activities in the area.

i) Hydrographic Data Collected in 2011

Data from 1179 oceanographic stations collected in the NAFO area received in delayed mode by ISDM in 2011 have been archived. A total of 279,186 stations were received through the GTSPP (Global Temperature and Salinity Profile Programme) and have been archived.

ii) Historical Hydrographic Data Holdings

Data from 5260 oceanographic stations collected prior to 2011 were obtained and processed during 2011.

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 2011, ISDM received surface temperature and salinity data from 1270 discrete stations.

iv) Drifting Buoy Data

A total of 162 drift-buoy tracks within NAFO waters were received by ISDM during 2011 representing 364,648 buoy messages.

v) Wave Data

During 2011, 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 2011.

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 96 tide and water level gauges were processed during 2011 with 26 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 2011, the Bedford Institute of Oceanography (BIO) recovered and processed data from 7 current meters instruments in the NAFO area. An additional 29 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.

7. 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 2011 was presented in **SCR Doc. 12/02, 12/08** and **SCS Doc. 12/10, 12/13**. In winter 2010/11, the North Atlantic Oscillation (NAO) index was negative describing weakening westerlies over the North Atlantic Ocean. Often this results in warmer conditions over the West Greenland region which was also the case for this winter. The air temperature was higher than normal during winter – especially over the Davis Strait. Time series of mid-June temperatures on top of Fylla Bank show temperatures 0.4°C above average conditions in 2011 and the salinity was 0.2 above average. The presence of Irminger Water in the West Greenland waters was high in 2011. Pure Irminger Water (waters of Atlantic origin) could be traced north to the Maniitsoq section and modified Irminger Water further north to the Sisimiut section. The mean (400–600 m) temperature and salinity was high over the Southwest Greenland Shelf Break. After one single year of decrease, the bottom temperature and salinity off Ilulissat in the Disko Bay has increased again to high values comparable with values observed before mid-1990's. The annual mean air temperature at Nuuk Weather Station was -1.13°C, down from the historic high value observed in the previous year and similar to conditions in 2009. The uppermost layer of the Cape Desolation Station 3 in fall 2011 was occupied by relative fresh surface Polar Water in contrast to the previous two years when no Polar Water was observed there. The water temperature between 100 and 700 m depth was warmer than its long-term mean, and thus continued the series of 'warmer than normal' years started in 1998. Fyllas Bank Station 4 was characterized in fall 2011 by a negative potential temperature anomaly within the uppermost 50 to 100 m and a positive temperature anomaly between 100 and 700 meter water depth. The salinity of Irminger Sea Water at Station 4 was slightly above its long term mean.

Subareas 1 and 2. A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2011 was presented in **SCR Doc. 12/18**. Following the trend of the last three years, the Labrador Sea experienced warm winter surface air temperatures in 2011; temperatures ranged from approximately 6°C above normal in the northern region near Davis Strait to about 2°C above normal in the southeastern Labrador Sea. Sea surface temperature anomaly was more than 5°C in the Labrador Sea during the winter of 2011 but close to normal throughout the remainder of the year. In 2011, wintertime convection was limited to the upper 200 m of the water column, which is very similar to that observed in 2010. Sea ice anomalies were very negative (below 50% of normal) in January 2011 and remained well below the normal long-term mean for the rest of the winter. 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. A strong contrast is observed between the Atlantic Zone Off-Shelf Monitoring Program (AZOMP) 1994 and 2011 surveys of temperature, salinity, density and dissolved oxygen.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador (NL) Region during 2011 was presented in **SCR Doc. 12/09** and **SCS Doc. 12/14**.

The NAO index, is a key indicator of climate conditions on the Newfoundland and Labrador Shelf, and after reaching a record low in 2010, remained in the negative phase in 2011. As a result, arctic air outflow to the Newfoundland and Labrador Region remained weak resulting in warmer conditions in most areas in 2011. Annual air temperatures remained above normal at Labrador by 0.7 SD (0.9°C at Cartwright) and at Newfoundland by 0.6 SD (0.5°C at St. John's) but declined significantly from the record highs of 2010. The annual sea ice extent on the NL Shelf remained below normal for the 16th consecutive year reaching a record low in 2011. As a result of these and other factors, local water temperatures on the NL Shelf remained above normal, setting new record highs in some 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 from 2009-2011. At a standard coastal monitoring site off eastern Newfoundland (Station 27), the depth-averaged annual water temperature increased to a record high in 2011 at 3 SD above the long-term mean. Annual surface temperatures at Station 27 were above normal by 0.6 SD (0.4°C) while bottom temperatures (176 m) were at a record high at 3.4 SD (1.3°C) above normal. The annual depth-averaged salinities at Station 27 were below normal for the 3rd consecutive year. The annual stratification index at Station 27 decreased to 2 SD below normal, the lowest since 1980. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland Shelf (Bonavista Section) during the summer of 2011 was at a record low value at 2 SD below normal, implying warm conditions, while off southern Labrador it was the 4th lowest at 1.5 SD below normal. On the Grand Bank the CIL area was the second lowest on record. The volume of CIL (<0°C) water on the NL shelf during the fall was below normal (4th lowest since 1980) for the 17th consecutive year. Average temperatures along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. All spring bottom temperature measurements in NAFO Divs. 3Ps and 3LNO during 2011 were above 0°C and up to 1°-2°C higher than normal. The gridded average bottom temperature across the 3Ps-3LNO region was at a record high. During the fall, bottom temperatures in Div. 2J and 3K were also at a record high value, at 2 and 2.7 SD above normal, respectively, and in 3LNO they were 1.8 SD above normal. Generally, bottom temperatures were about 1°-2°C above normal in most regions, with very limited areas of the bottom covered by <0°C water. A composite climate index derived from 27 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 and 2011 to the 2nd and 4th highest, respectively, indicating warmer than normal conditions throughout the region.

An investigation of the biological and chemical oceanographic conditions in subareas 2 to 5 in 2011 was presented in **SCR Doc. 12/07.** Biological and chemical variables collected in 2011 from coastal high frequency monitoring stations, semi-annual oceanographic transects, and ships of opportunity ranging from the Labrador-Newfoundland and Grand Banks (Subareas 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 2011 Atlantic Zone Monitoring Program (AZMP). In general, nitrate inventories in NAFO Subareas 2 and 3 were above normal within the upper 50m, consistent with data further south in Subareas 4 in 2011. In contrast, the deeper inventories of nitrate that represent the main limiting nutrient for the subsequent year showed a large reduction in 2011 across the entire zone compared to previous years. The nutrient anomaly and composite time series for the NAFO Subareas show large interannual and spatial variability throughout the 13-year record. Ship-based observations of phytoplankton standing stock along ocean transects, which provides sub-surface information, revealed enhanced levels along the eastern and central Scotian Shelf while the Newfoundland and Labrador Shelf had lower chlorophyll *a* inventories in 2011. The duration of the spring bloom was mostly reduced along the northwest Atlantic in 2011 with few exceptions. The timing of the spring bloom varied across the NAFO Subareas with near-normal conditions in the northern areas (Div. 2J, 3K), delayed blooms across the northern Grand Bank (Div. 3L-3M), to earlier blooms observed from the southern Grand Banks to the central Scotian Shelf (Div. 3L to 4W) in 2011. Enhanced abundances of large and small copepods as well as total copepod zooplankton were observed for the northern Subareas in 2011 with 1 to 2 standard deviation units above normal in the 13-year time series. Negative trends in abundance of these same functional zooplankton groups were observed across the Scotian Shelf in 2011 on the order of 1 to 3 standard deviation units below normal. The zooplankton dry weight anomalies were below normal across NAFO Subareas 2 to 4 in 2011. This was particularly apparent across the Scotian Shelf with large negative anomalies. The composite indices summing each of the zooplankton abundance indices across the NAFO Subareas revealed some contrasting patterns during the available time series.

Subarea 4. A description of environmental information collected on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas during 2011 was presented in **SCR Doc. 12/04**. A review of the 2011 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 +0.9 SD with 17 of the 18 variables more than 0.5 SD above normal; compared to the other 42 years, 2011 ranks as the 6th warmest. The anomalies did not show a strong spatial variation. Bottom temperatures were above normal with anomalies for NAFO areas 4Vn, 4Vs, 4W, 4X of +0.7°C (+1.6 SD), +0.8°C (1.1 SD), +0.3°C (+0.3 SD), and +0.5°C (+0.6 SD) respectively. Compared to 2010, bottom temperatures increased in areas 4Vn, 4Vs and 4X by 0.5, 0.4 and 0.1°C; temperatures decreased by 0.3°C in area 4W.

Subareas 4-6. Several on-going oceanographic, plankton and benthic studies conducted by the Northeast Fisheries Science Centre (NEFSC) in NAFO Subareas 4 through 6 presented in **SCS Doc. 12/07**. A total of 1839 CTD (conductivity, temperature, depth) profiles were collected and processed on Northeast Fisheries Science Center (NEFSC) cruises during 2011. Of these 1810 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. Additional water temperature measurements from the EMOLT (see emolt.org) project from 60 fixed stations around the Gulf of Maine and southern New England Shelf revealed that 2011 was one of the warmest years in the last decade. During 2011, zooplankton community distribution and abundance were monitored on five surveys using 575 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.

8. Interdisciplinary Studies

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

The following interdisciplinary studies were presented at the June 2012 Meeting along with relevant abstracts:

"***Environmental regulation of capelin in the Northwest Atlantic***", by Alejandro D. Buren, Mariano Koen-Alonso, Pierre Pepin, Fran Mowbray, Brian Nakashima, Garry Stenson, Neil Ollerhead, William Montevecchi.

During the early 1990s the Northwest Atlantic underwent extensive ecosystem changes. In the case of capelin, these changes included a major reduction in acoustic offshore abundance estimates, reduced size and age at maturity, reduced somatic condition and delayed spawning. Invoking metabolic reasoning, the timing of spawning has been explained by a combination of fish length and temperature conditions during February to June, while the drivers modulating the biomass trajectory have remained elusive. The initiation of the spring bloom in the Newfoundland Shelf is determined by light availability and seasonal sea ice dynamics. Using data from 1980-2010, we study the relationship between sea ice, capelin biomass and timing of spawning to explore the hypothesis that capelin dynamics are environmentally regulated through food availability. We found that simple models with a break in 1991 and sea ice as a modulator accounted for 75% of the variability in peak spawning date and more than 90% of the variability in capelin biomass. We predicted biomass levels during the 1970s and found good agreement with estimates based on advisory models of sequential capelin abundance. Our results support the hypothesis that bottom-up control mechanisms may be at play. Given capelin's role as key forage species in this ecosystem, these findings are particularly relevant as they provide an avenue to explore the potential impacts of climate change on ecosystem productivity.

Activities by the *"**Ocean Tracking Network**"* in the North West Atlantic was presented by Robert M. Branton, Dalhousie University, Halifax Canada. The Ocean Tracking Network (OTN) at Dalhousie University, originally conceived in 2006 by Ron O'Dor, senior scientist for the Census of Marine Life to unite physical oceanographers and animal trackers on a global scale began its formal operation as a Global Ocean Observing System project in 2010. This presentation includes descriptions of basic ocean tracking field operations and data management practices with special attention to recent developments in the North West Atlantic as well as linkages with the Ocean Biogeographic Information System at Rutgers University. Major research themes in the OTN include biology and behavior of migrating marine life; ocean physics modeling, potential impacts of ocean climate, resource management, and international social and legal framework for the oceans. A number of different invertebrate, fish, and marine mammals are currently being investigated which include American eel, American lobster, American shad, anadromous brook charr (trout), Atlantic bluefin tuna, Atlantic cod - Morue de l'Atlantique, Atlantic salmon, Atlantic sturgeon, brook trout, Greenland shark, grey seal, rainbow trout, spiny dogfish, and striped bass. The web site contains detailed information regarding OTN and additional resource links (see http://oceantrackingnetwork.org/)

An investigation of seabird monitoring and research in the northwest Atlantic was presented in **SCR Doc. 12/29**. The east coast of Canada supports millions of seabirds that are an integral part of the marine ecosystem. The Canadian Wildlife Service (CWS) of Environment Canada collects data on their offshore distribution and abundance in order to identify and minimize the impacts of human activities on birds at sea. Since 2006, almost 100,000 km of ocean track has been surveyed in Atlantic Canada and the Gulf of St. Lawrence, and over 120,000 birds have been sighted. These data provide critical up-to-date information for environmental assessments related to offshore developments, emergency response related to oil spills, risk assessments, marine protected area planning, and other management and conservation initiatives. In 2005, CWS reinvigorated the pelagic seabird monitoring program with the goal of identifying and minimizing the impacts of human activities on birds in the marine environment. Since 2005, a scientifically rigorous protocol for collecting data at sea and a sophisticated geodatabase have been developed, relationships with industry and DFO to support offshore seabird observers have been established, and almost 100,000 km of ocean track have been surveyed by CWS trained observers. These data are now being used to identify conservation issues and potential threats to birds in their marine environment.

A presentation entitled: *"**OBIS - A Valuable Resource for NW Atlantic Fisheries Science**"*, was presented by Robert M. Branton, Mary Kennedy and Tana Worcester, OBIS Canada. The Ocean Biogeographic Information System (OBIS) can provide a wealth of data for use in understanding species and ecosystems as well as monitoring, evaluating and forecasting changes in our oceans (particularly stocks which straddle international borders).OBIS datasets will facilitate integration of marine biodiversity data within an international and national framework of data standards and protocols. It will also provide access to highly distributed data sets from a multitude of partners in areas of interest to regional groups such as temporal coverage (time series datasets), geographic coverage, and taxonomic coverage (phytoplankton, zooplankton, fish, birds, mammals).OBIS will enable scientists to study biodiversity at both national and global scales, facilitating research in areas such as ecosystem based management, species at risk, or invasive species which are best examined within the context of global biodiversity changes. OBIS directly relates to efforts to identify biodiversity hotspots and large-scale ecological patterns. The web site contains detailed information regarding OBIS and additional resource links (see http://www.iobis.org/).

9. 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. The climate summary will be updated by the NAFO Secretariat on an annual basis with contributions from each contracting country. Information for 2011 are available from Subareas 1, West Greenland , Subareas 2-3, Grand Banks and Labrador Sea / Shelf , Subareas 4-5, Scotian Shelf and Gulf of Maine , and Subareas 5-6, Georges Bank and Gulf of Maine.

10. The Formulation of Recommendations Based on Environmental Conditions

STACFEN **recommended** *input from Scientific Council for development of new time series and data products and to identify candidate 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*.

11. National Representatives

Currently, the National Representatives for hydrographic data submissions are: E. Valdes (Cuba), S. Demargerie (Canada), E. Buch (Denmark), J.-C Mahé, (France), F. Nast (Germany), **Vacant** (Japan), H. Sagen (Norway), J. Janusz (Poland), **Vacant** (Portugal), M. J. Garcia (Spain), B. F. Prischepa (Russia), L. J. Rickards (United Kingdom), and K. J. Schnebele (USA; retired). Contact information for newly appointed National Representatives to be forwarded to the NAFO Secretariat.

12. Other Matters

One of the sessions at the 6th Annual World Fisheries Congress in Edinburgh, Scotland during 7-11 May 2012 attended by NAFO Scientific Coordinator (Neil Campbell) discussed marine hotspots (see SCWP 12-10). The initiative is referred to as the Global Network of Marine Hotspots (GNMH). The criteria used to define these locations were related to the rate of ocean warming based on historical and projected rates. According to the criteria developed by the lead investigators, two of these regions fall within the NAFO NRA. The lead investigators of GNHN are seeking potential collaboration with fisheries scientists and oceanographers in the northwest Atlantic to contrast common features in these areas where ocean climate conditions are changing rapidly. This initiative began in 2010 and a global communication network was proposed to address consistency in approaches, sharing of regional knowledge and experience in hotspot areas to provide guidance on impacts, model validation, and adaptive planning to a variety of stakeholders. The Committee proposes to keep track of the progress of GNMH and appreciate the efforts of the NAFO Secretariat to bring this information forward to STACFEN.

13. 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 again to our invited speaker Dr. Alida Bundy (Bedford Institute of Oceanography, Fisheries and Oceans Canada), and contributions to the interdisciplinary session including Alejandro Buren (Memorial University), Carina Gjerdrum (Environment Canada), and Robert Branton (Dalhousie University).

The meeting was adjourned at 16:35 on 4 June 2012.

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

Chair: Margaret Treble Rapporteur: Alexis Pacey

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, NS, Canada, on the 2 and 13 June 2012, 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, Spain, Portugal, United Kingdom), Japan, Russian Federation, Ukraine, 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 distributed prior to the meeting was adopted with the addition of item 6a, ICNAF Document Digitization, and 6d, Size of the Scientific Council Reports.

4. Review of Recommendations in 2011

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

STATUS: This is in production as of early June 2012.

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

STATUS: This was completed and appears in the Scientific Council Reports 2011.

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.*

STATUS: This has been implemented.

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

STATUS: A DVD was produced containing all Scientific Council Reports, Scientific Council Research documents and Scientific Council Summary documents for 1979-2009. A small number of DVDs were produced and are available upon request.

5. Review of Publications

a) Annual Summary

i) Journal of Northwest Atlantic Fishery Science (JNAFS)

Volume 43, Regular issue, was printed in December 2011 and there were 200 copies made.

Volume 44, Regular issue has a total of seven papers that have been submitted for publication, one has been published (online) and the second one is in production. All others are in the review process. The paper edition will be printed in December 2012. A smaller print run of 165 copies will be printed.

STACPUB **recommended** that *an obituary be included in Volume. 44 of the Journal of the Northwest Atlantic Fishery Science for Spanish scientist, Dr. Laranneta, in English and Spanish*.

ii) NAFO Scientific Council Studies

Studies No. 44 (2012) has been submitted: *Report of the Workshop on Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species*.

iii) NAFO Scientific Council Reports

A total of 65 printed copies of the NAFO Scientific Council Reports 2011 (389 pages) were produced in April 2012.

iv) Progress report of meeting documentation CD

STACPUB was informed that: Approximately 25 copies of the Meeting Documentation CD 2011 were produced. The CD contains:

- GC/FC Proceedings 10-11
- GC/FC Report Sep 11
- SC Reports 2011
- NAFO Convention
- NCEM 2012
- Rules of Procedure
- Annual Report 2011
- Performance Review Report

The CD will no longer be placed in the back of Scientific Council Reports. The CDs will be made available to individuals who prefer this digital format and will be distributed to a mailing list consisting of Libraries and Institutes.

v) Historical Documentation DVD

A DVD containing SC Reports, SCS and SCR documents spanning the period 1979-2009 has been produced. An initial production run of 25 will be available. Additional copies can be produced as required.

***vi)* ASFA**

The 40th Annual Meeting of the Aquatic Sciences and Fisheries Abstracts (ASFA) took place from 5 to 9 September 2011 in Guayaquil, Ecuador. The Instituto Nacional de Pesca (INP) hosted the ASFA meeting with Pilar Solis, Director of INP, Mr. Nikita Gaibor (INP) chair of the ASFA meeting, and Dr. Richard Grainger, and Chief of the FAO service responsible for ASFA. The meeting was attended by Alexis Pacey, Publications Manager at the NAFO Secretariat and provided her with a good opportunity for training in ASFA and other aspects of document management.

A tour of the facilities at INP began the week long meeting. The meeting covered many topics ranging from software and technical information, ASFA partnership status, ASFA's publishing partner PROQuest, the ASFA trust fund, training activities and demos, new products, and discussion around the future direction of ASFA. The next meeting will be held in Galway, Ireland, 25-29 June, 2012.

During the 2011 meeting STACPUB raised some concern about the use of "corporate author" for some Scientific Council documents entered in the ASFA database. Some enquiries about the issue with ASFA were made and Scientific Council was informed that this term is part of the software package that ASFA uses for data entry and it cannot be changed. Some Scientific Council members noted that authorship entries for SC documents in ASFA are inconsistent (i.e. sometimes the authors name is included but sometimes it is not and the entry is anonymous or entered as a corporate author).

STACPUB **recommended** that the *Secretariat make further enquiries into how authorship is assigned (i.e. actual vs. corporate) when entering NAFO SC documents into the ASFA database in order to ensure that they can be located when searching using the actual authors name.*

The ASFA database of records that is hosted by PROQuest, has a new and updated platform as of January 2012. Most ASFA entries are up-to-date as of May 29, 2011, except for the following publications: Scientific Council Studies, NAFO Rules of Procedures & Financial Regulations and the NAFO Handbook. There are currently 11 active titles in the database.

6. Other Matters

a) Update on digitization of NAFO historical documents and ICNAF historical documents.

All historical NAFO publications and documents, including metadata, have been digitized and uploaded.

The importance of having the Scientific Council Reports available on-line was re-iterated, particularly now that Fisheries and Oceans Canada are planning to close most of their libraries. The development of a search tool should continue in order to fully realize the benefits of digitizing these documents.

The utility of scanning other publications such as the Statistical Bulletin, Sampling Yearbook and List of Fishing Vessels publications was discussed. It was suggested that only the Sampling Yearbook would need to be available in digital format because there are no other sources for some of these data (e.g. catch-at-age and length frequency).

STACPUB **recommended** that *digitizing the Sampling Yearbooks would be necessary, but not urgent*.

Most ICNAF publications have now been scanned. Scanning is in progress for the ICNAF meeting documents for the Commission as well as the science committees. Metadata will also be included in the database. The ICNAF documents will be accessible when the new NAFO public website is updated.

A summary of the history of ICNAF is being prepared and will be posted on-line once the new website is ready.

b) New cover designs for JNAFS

Alternative cover designs for the *Journal of the Northwest Atlantic Fishery Science* were presented to STACPUB. One suggestion was that a design that reflects the fish or fisheries within NAFO could be considered in a new design (e.g. pictures or illustrations of marine species that are under NAFO regulation). After some discussion it was decided that the current cover was preferred over the alternatives, but that it could possibly be improved with a better map on the front cover.

STACPUB **recommended** that *the Secretariat look to see if options for the current map projection are available and bring this to the next June meeting*.

c) Consistency of formatting styles in JNAFS

After reviewing the most recent Journal volume it was noted that there were conflicting editorial styles applied to the papers. It is suggested that the editorial style sheet be revised.

STACPUB **recommended** that *a comprehensive and concise style sheet be followed for the Journal of the Northwest Atlantic Fishery Science.*

d) Increasing size of the NAFO Scientific Council Reports

The size of the NAFO Scientific Council Reports has been growing. It is nearly 400 pages and will be difficult to bind if the size continues to increase. Many of the Fisheries Commission's requests for advice required detailed responses that have added to the size in recent years. Several suggestions were made by Scientific Council members to address this concern.

One suggestion was to divide the Scientific Council Reports into two volumes. Meeting results from June, September and October, Summary Sheets and advice could be included in one volume while the second volume would include the reports from the Standing Committees and possibly ad hoc working groups and other items.

STACPUB also discussed the possibility of re-formatting and/or re-organizing certain sections to make it easier for readers to find information. An effort could also be made to reduce repetition and to keep contributions to the report as succinct as possible.

STACPUB **recommended** that *the Secretariat initiate a review of the Scientific Reports format and to present to Scientific Council in September 2012 examples of format changes and information on whether a two volume approach would be a reasonable option to address concerns about the growing size of the Report.*

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 16:30 hours on 13 June 2011.

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

Chair: Don Stansbury Rapporteur: Barbara Marshall

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, NS, Canada, on various occasions throughout the meeting 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, Portugal and Spain), Russian Federation, Ukraine 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 1330 hours on 5 June 2012, welcomed all the participants and thanked the Secretariat for providing support for the meeting.

2. Appointment of Rapporteur

Barbara Marshall was appointed as rapporteur.

3. Review of Recommendations in 2011

From June 2011

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 was reported but it was agreed that this should be done. The Chair of STACREC will follow-up with Designated Experts during this June meeting to try to compile a table.

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 was reported and it was decided not to pursue this any further.

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: Bomb radiocarbon assay analysis of Greenland halibut otoliths from the SA 2+ Div. 3KLMNO stock has been initiated in order to validate age estimation. Currently age is estimated using surface read whole otoliths, but these are thought to be inaccurate for estimating age in Greenland halibut. Otoliths were sectioned and then assayed in order to determine the amount of ^{14}C in the cores. These values will be used to reconstruct a ^{14}C time series that will be compared to a reference chronology of ^{14}C for the North Atlantic (^{14}C increased in the world's oceans due to a rise in atmospheric radiocarbon during the 1950s and 1960s). All studies that have been done to date suggest that this method can confirm accuracy of an ageing technique to within 1–3 years. This technique is one of the most accurate methods currently available for validating ages of long-lived species. Preliminary results are not yet available but the final analysis will be presented at NAFO Scientific Council in 2013.

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: In September, this recommendation was endorsed by the Scientific Council and presented to the Fisheries Commission for action.

4. Fishery Statistics

a) Progress report on Secretariat activities in 2011/2012

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).

It was agreed that in the interest of compiling data on as fine a scale as possible, CAN-SF (Scotia-Fundy) and CAN-G (Gulf) would not be combined into CAN-M (Maritimes) as has been done in the past. New country codes could be assigned if necessary.

TABLE 1. Dates of receipt of STATLANT 21A and 21B reports for 2009–2011 up to 3 June 2012.

Country/Component	STATLANT 21A (deadline, 1 May)			STALANT 21B (deadline 31 August)		
	2009	2010	2011	2008	2009	2010
CAN-CA	31 Mar 10	31 Mar 11	24 Apr 12	31 Aug 09	30 Aug 10	8 Aug 11
CAN-M						
CAN-SF	14 May 10	28 Apr 11	14 May 12	29 Apr 11	21 May 10	10 June 11
CAN-G	2 Jun 10	29 Apr 11	29 Apr 12	6 Oct 09	1 Sep 2010	27 July 11
CAN-N	29 Apr 10	29 Apr 11	30 Mar 12	31 Aug 09	3 Sep 10	31 Aug 11
CAN-Q	11 Mar 11			11 Mar 11	11 Mar 11	
CUB			4 May 12			
E/EST	30 Apr 10	27 Apr11	17 May 12	4 Sep 09	26 Aug 10	31 Aug 11
E/DNK	24 May 10		18 May 12	25 May 09	24 May 10	
E/FRA-M			21 May 12			
E/DEU	27 Apr 10	28 Apr 11	26 Apr 12	21 Aug 09	31 Aug 10	23 Aug 11
E/LVA	2 Jun 10	14 Apr 11	17 May 12	3 Aug 09	2 Jun 10	16 Aug 11
E/LTU			2 May 12	22 Mar 11	22 Mar 11	
E/POL	22 Jul 10 (no fishing)		26 Apr 12 (no fishing)			
E/PRT	11 May 10	27 Apr 11	8 May 12 (revised 29 May 12)	31 Aug 09	31 Aug 10	31 Aug 11
E/ESP	3 Jun 10		30 May 12	2 Jun 09	3 Jun 10	11 May 11
E/GBR	2 Jun 10	1 Jun 11	26 Apr 12	1 Sep 09	2 Jun 10	16 Aug 11
FRO	1 Jun 10	6 May 11	30 Apr 12	16 Jul 09	1 Jun 10	6 May 11
GRL	28 Jun 10	27 Apr 11	19 Apr 12	23 Jun 10		29 Apr 11
ISL	9 Jun 10 (no fishing)	4 May 11	31 May 12			1 Sep 11
JPN			25 Apr 12 (no fishing)	10 Aug 09		
KOR						
NOR	15 Apr 10	28 Apr 11	27 Apr 12		31 Aug 10	19 Aug 11
RUS	3 Jun 10	27 Apr 11	29 Apr 12	9 Jul 09	21 Jun10 (Revised 13 Apr 11)	26 Jul 11
USA	26 May 10	16 May 11	21 May 12			
FRA-SP	2 Jun 10	29 Apr 11	14 May 12	11 May 09	1 Sep 10	4 Aug 11
UKR		20 Jan 11 (no fishing)				

5. Research Activities

a) Biological Sampling

i) Report on activities in 2011/2012

STACREC reviewed the list of Biological Sampling Data for 2011 (SCS Doc. 12/11) prepared by the Secretariat and noted that any updates will be inserted during the summer, prior to finalizing the SCS Document which will be finalized for the September 2012 Meeting.

ii) Report by National Representatives on commercial sampling conducted

Canada-Newfoundland (SCS Doc. 12/14, plus information in various SC 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 charr (SA 2), Atlantic cod (Div. 2GH, Div. 2J+3KL, Div. 3NO, Subdiv. 3Ps), American plaice (SA 2 + Div. 3K, Div. 3LNO, Subdiv. 3Ps), witch flounder (Div. 2J3KL, 3NO, 3Ps), yellowtail flounder (Div. 3LNO), redfish (Subarea 2 + Div. 3K, 3LN, 3O, Unit 2), northern shrimp (Subarea 2 + Div. 3KLMNO), Iceland scallop (Div. 2HJ, Div. 3LNO, Subdiv. 3Ps, Div. 4R), sea scallop (Div. 3L, Subdiv. 3Ps), snow crab (Div. 2J+3KLNO, Subdiv. 3Ps, Div. 4R), squid (SA 3), thorny skate (Div. 3LNOPs), white hake (Div. 3NOPs), lobster (SA 2+3+4), and capelin (SA 2 + Div. 3KL).

Denmark/Greenland. 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. 12/10). 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-Estonia (NAFO SCS Doc. 12/06): Specifically trained NAFO observers collected length, age and sex data for Greenland halibut (Div. 3LMN), Northern shrimp (Div. 3L), redfish (Div. 3MNO) and cod (Div. 3MNO).

EU-Portugal (NAFO SCS Doc. 12/08): Data on catch rates were obtained from trawl catches for redfish (Div. 3LMNO), Greenland halibut (Div. 3LMN), roughhead grenadier (Div. 3LM), skates (Div. 3MO), cod (Div. 3M) and white hake (Div. 3O). Data on length and age composition of the catch were obtained for 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), Cod (Div. 3LNO), thorny skate (Div. 3MNO), roughhead grenadier (Div. 3LM), witch flounder (Div. 3NO), white hake (Div. 3NO), Redfish *S. marinus* (Div. 3M) and Yellowtail flounder (Div. 3N).

EU-Spain (SCS Doc. 12/09): A total of 14 Spanish trawlers and 1 pair trawler operated in NAFO Regulatory Area, Div. 3LMNO, during 2011, amounting to 1,667 days (25,276 hours) of fishing effort. In 2011, Spanish effort increased 11% in this Area in relation with 2010 effort. Total catches for all species combined in Div. 3LMNO were 17,897 tons in 2011. IEO scientific observers were on board 336 fishing days that it means 20 % of the Spanish total effort. In 2011, they carried out 393 length samples of the most important species in the catches and 49,934 individuals of different species were measured. Besides these samples scientific observers collected biological samples for growth, age and maturity studies for the most important species in the catches.

Russian Federation (SCS Doc. 12/05): 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. 3LN, roundnose grenadier in Div. 3L, American plaice in Div. 3LMN, threebeard rockling in Div. 3L, witch flounder in Div. 3LNO, cod in Div. 3LMN, northern wolffish in Div. 3LN, black dogfish in Div. 3LN, thorny skate in Div. 3LMNO, white hake in Div. 3LN, marlin-spike grenadier in Div. 3LNO, Atlantic halibut in Div. 3LN, blue hake in Div. 3LN, deep-water redfish (*Sebastes mentella*) in Div. 3LMN, golden redfish (*Sebastes marinus*) in Div. 3LMNO and Acadian redfish (*Sebastes fasciatus*) in Div. 3LMNO.

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

The utility of this data was discussed and it was agreed that it is important and useful. Designated Experts were reminded to provide available data from commercial fisheries to the Secretariat. It was agreed to store the files on the meeting Sharepoint under a folder entitled “DATA”.

b) Biological Surveys

i) Review of survey activities in 2011 (by National Representatives and Designated Experts)

Canada: 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 2011 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2HJ3KLMNO (SCR 12/19). The spring survey in Div. 3LNOP was conducted from April to late June, and the portion in Div. 3LNO consisted of 490 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 564 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 2011, directed at a number of species using a variety of designs and fishing gears, were described in detail in various documents. Results from Canadian oceanographic surveys were discussed in detail in STACFEN.

Canada (Central and Arctic Region) conducted a survey in Div. 0B in 2011 (SCR Doc. 12/23) with the Greenland Institute of Natural Resources research vessel Pâmiut. The survey took place from September 23 to October 15 and consisted of 84 tows with the Alfredo trawl and 72 tows with the Cosmos trawl. Previous surveys in Div. 0B with this vessel and the Alfredo gear occurred in 2000 and 2001. Oceanographic variables (temperature, salinity and depth) were measured during each tow.

Denmark/Greenland: The West Greenland standard oceanographic stations were surveyed in 2011 as in previous years (SCR Doc. 12/02).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2011. In July-August 216 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.12/16).

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 1997-2011 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 2011 67 valid hauls were made. (SCR Doc. 12/03).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2011 the longline survey was conducted in Uummannaq and Upernavik.

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2011 a total of 50 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-Spain (SCS Doc. 12/09): The Spanish bottom trawl survey in NAFO Regulatory Area Div. 3NO was conducted from 5th to 24th of June 2011 on board the R/V *Vizconde de Eza*. The gear was a Campelen otter trawl with 20 mm mesh size in the cod-end. A total of 122 valid hauls and 121 hydrographic stations were taken within a depth range of 44-1450 m according to a stratified random design. Furthermore, a stratified sampling by length class and sex was used to sample gonads and otoliths of Atlantic cod, American plaice and Greenland halibut for histological maturity, fecundity and growth studies. The results of this 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, redfish, witch flounder, roughhead grenadier, thorny skate and white hake are presented as Scientific Council Research Documents. In addition, age distributions are presented for Greenland halibut, American plaice and Atlantic cod.

In 2003 it was decided to extend the Spanish 3NO survey toward Div. 3L (Flemish Pass). In 2011, 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 10th to 24th of August. 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 90 of which 89 were valid hauls. Survey results, including abundance indices and length distributions of the main commercial species, are presented as Scientific Council Research documents. Survey results for Div. 3LNO of the northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 11/61. Samples for histological (Greenland halibut, American plaice, roughhead grenadier) and aging (Greenland halibut, American plaice, roughhead grenadier and cod) studies were taken. Feeding studies on demersal species (*Synaphobrachus kaupi*, *Notacanthus chemnitzii*, *Hydrolagus affinis* and *Harriotta raleighana*) were performed and 307 stomach contents were analyzed in depths of 342 to 1419 m. Eighty-four hydrographic profile samplings were made in a depth range of 115–1445 m.

The EU Spain and Portugal bottom trawl survey in Flemish Cap (Div. 3M) (SCR Doc. 12/26) was carried out on board R/V *Vizconde de Eza* using the usual survey gear (Lofoten) from June 27th to August 9th 2011. The area surveyed was Flemish Cap Bank to depths up to 800 fathoms (1460 m) following the same procedure as in previous years. The number of hauls was 126 and five of them were nulls. This year only 30 of 32 strata were adequately sampled. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, roughhead grenadier and Greenland halibut are presented as Scientific Council Research documents. Flemish Cap survey results for northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 11/61. Samples for histological assessment of sexual maturity of cod, redfish, Greenland halibut and roughhead grenadier were taken. Oceanography studies continued to take place.

USA (SCS Doc. 12/07): 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 from four research surveys. These surveys included the spring and fall multispecies bottom trawl survey which cover NAFO areas 4-6, the scallop dredge survey which covers NAFO areas 5 and 6, and the northern shrimp trawl survey which covers NAFO Div. 5Y. Additionally, surveys were conducted in NAFO Areas 5 and 6 to monitor plankton, marine mammals, and herring. 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: decline in thorny skate biomass index to a record low value in 2011; descriptions of research on marine mammals and sharks; inventory of number of ages collected and 102,000 fish aged in 2011; continued observer coverage using At-Sea Monitors and Fisheries Observers; information on stock assessments and salmon; and information on cooperative research, including the analysis of the comparative study of two otter trawl sweeps and a new spiny dogfish tagging project.

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. 12/15)

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

A reward information poster prepared by Canada is to be circulated to Scientific Council members to ensure a wide distribution.

d) Other Research Activities

No other research activities were reported.

6. Review of SCR and SCS Documents

The following papers were presented to STACREC:

SCR Doc. 12/03 – O.A. Jørgensen - Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2011

SCR Doc. 12/06 - Esther Román, Ángeles Armesto and Diana González-Troncoso - Results for the Spanish Survey in the NAFO Regulatory Area of Division 3L for the period 2003-2011

SCR Doc. 12/10 - Esther Román, Concepción González-Iglesias 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 2003-2011

SCR Doc. 12/12 - Diana González-Troncoso, Esther Román and Xabier Paz - Results for Greenland halibut, American plaice and Atlantic cod of the Spanish survey in NAFO Div. 3NO for the period 1997-2011

SCR Doc. 12/14 - Diana González-Troncoso, Elena Guijarro-Garcia 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 Doc. 12/15 – Diana González-Troncoso, Elena Guijarro 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 Doc. 12.16 - Rasmus Nygaard and Ole A. Jørgensen - Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the GINR Shrimp Fish Survey, 1988-2011.

SCR Doc. 12/19 – B.P. Healey, W.B. Brodie, D.W. Ings, and D.J. Power - Performance and description of Canadian multi-species surveys in NAFO subarea 2 + Divisions 3KLMNO, with emphasis on 2009-2011

This paper updates basic survey performance statistics and documents the spatial coverage of the annual spring and autumn multi-species surveys conducted by the Department of Fisheries and Oceans, Newfoundland Region, over 2009-2011. Noteworthy issues include modifications to survey density, some prioritizing of survey efforts, and coverage shortfalls during fall surveys. Brief discussion of how these issues impact survey indices required for the assessments of various species is also provided.

SCR Doc. 12/022 - Valery V. Paramonov , Yu.V. Korzun, S.T. Rebik, and N. N Kukharev , On historical Experience of the Ukraine fishery in the Northwest Atlantic

This paper illustrated the historical presence of the Ukraine fleet in the NWA as part of the old Soviet Union and under flags of other countries prior to Ukraine's entrance into NAFO. Given this historical presence, the Ukraine fleets have established itself as a fishing country in Northwest Atlantic.

SCR Doc. 12/23 - M. A. Treble - Analysis of data from a trawl survey in NAFO Division 0B

SCR Doc. 12/25 - Adriana Nogueira Gassent, Xabier Paz and Diana González-Troncoso - Persistence and Variation on the Groundfish Assemblages on the Southern Grand Banks (NAFO Divisions 3NO): 2002-2011

Data from EU-Spain bottom trawl surveys in the NRA from 2002 to 2011 are analyzed to examine evolution patterns in the Southern of Grand Banks (NAFO Div. 3NO) groundfish assemblage structure in relation to depth. The 1160 hauls from the slope surveys span between 38 and 1460 m in depth. This focused on the 28 most abundant species, which make up 92.6 % of the catch in terms of biomass. The highest value of diversity is reached in the deeper assemblage, with H=2.23. Assemblage structure is strongly correlated with depth. Three main groups and five assemblages are identified. Cluster I (Shallow) comprises the strata with depths lesser than 300 m; cluster II (Intermediate) contains the depth strata between 301 and 1000 m and cluster III (Deep) the depth strata greater than 1001 m. Cluster I can be further subdivided into two sub-clusters. Cluster Ia comprises the strata with depth less than 150 m and cluster Ib the strata with depths between 151 and 300 m. Two sub-cluster are identified in cluster II: IIa contains depths between 301 m and 600 m and IIb depths between 601 and 1000 m. Despite dramatic changes in biomass and abundance of the species in the area, the boundaries and composition assemblages seem to be similar to the previous period. Although some changes are evident, the main ones are replacement of the dominant species in several assemblages and bathymetric range extension of distribution of some species. Yellowtail flounder (*Limanda ferruginea*) appears to be as the dominant species in shallow assemblages instead of Atlantic cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*), that were dominant in the period before the collapse in the area; in the intermediate assemblages redfish (*Sebastes* spp.) is the dominant species.

SCR Doc. 12/26 Antonio Vázquez - Results from Bottom Trawl Survey on Flemish Cap of July 2011

A stratified random bottom trawl survey on Flemish Cap was carried out on July - August 2011, covering the bank up to 1460 m depth (800 fathoms). The survey was carried out on board R/V Vizconde de Eza, using a Lofoten bottom trawl gear, and 128 haul were done, 79 of them in the region with less than 730 m depth. Survey results are presented and compared with results of previous surveys in the series since 1988. Biomass and abundance indices are provided for main commercial species, as well as age composition for cod, American plaice, Greenland halibut, and roughhead grenadier.

SCR Doc. 12/38 - V.I. Vinnichenko, K.Yu. Fomin, M. V. Pochtar - Some Results from Russian Studies on Diet of Redfishes (*Sebastes* spp.) and Cod (*Gadus morhua*) on the Flemish Cap

SCR Doc. 12/39 - Antonio Vázquez - On recruitment of the Flemish Cap cod stock

The possibility that the shrimp fishery in Flemish Cap has impeded survival of any good year class from 1993 to 2004 is analyzed. The bycatches were estimated to be low in that fishery. However, the effect of small mesh size cod-ends used in that fishery could produce escape mortality on fry cod, as well as an insignificant bycatch. The main support to this hypothesis is the concurrence of years the fleet was fishing shrimp and the occurrence of very poor year classes.

7. Other Matters

a) CWP Handbook

Unfortunately the CWP Handbook is not yet available for review.

b) 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”. In 2011, STACREC 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.

The Secretariat has begun the compilation of this and should have a draft ready to be reviewed in September.

c) Sampling Protocols

It was noted that in the past the sampling protocols were published in the Sampling Yearbook. Since this publication has been discontinued it was agreed that the protocols should be included in the annual List of Sampling Data document.

8. Adjournment

The Chair thanked the participants for their valuable contributions to the Committee. This year the committee met on two occasions to deal with late submissions. 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 1700 hours on 13 June 2012.

ANNEX 1. HISTORICAL CATCH DATA BY SPECIES AND DIVISION

Table 1a STACFIS catch ('000 t) estimates by NAFO Division and species from 2000 to 2011 where available.

Species	Year	2J	3K	3L	3M	3N	3O
American plaice	2000			0.53	0.13	4.06	0.27
	2001			1.06	0.15	3.48	1.03
	2002			0.74	0.13	2.18	1.94
	2003			0.22	0.13	1.13	0.75
	2004			1.12	0.08	3.53	1.52
	2005			0.66	0.05	2.59	0.85
	2006			0.07	0.05	2.56	0.19
	2007			0.23	0.08	2.75	0.62
	2008			0.29	0.07	1.70	0.53
	2009			0.06	0.07	2.33	0.63
	2010			0.06	0.06	2.39	0.44
	2011						
Capelin	2000					0	0
	2001					0	0
	2002					0	0
	2003					0	0
	2004					0	0
	2005					0	0
	2006					0	0
	2007					0	0
	2008					0	0
	2009					0	0
	2010					0	0
	2011					0	0
Cod	2000				0.06	0.10	0.11
	2001				0.04	0.64	0.67
	2002				0.03	0.43	1.76
	2003				0.01	1.36	2.92
	2004				0.05	0.41	0.53
	2005				0.02	0.37	0.36
	2006				0.34	0.44	0.12
	2007				0.30	0.48	0.30
	2008				0.90	0.60	0.32
	2009				1.16	0.65	0.43
	2010				9.19	0.81	0.14
	2011				13.90		

Species	Year	2J	3K	3L	3M	3N	3O
Redfish	2000			0.66	3.66	0.82	10.00
	2001			0.65	3.20	0.25	20.30
	2002			0.65	2.90	0.33	17.20
	2003			0.58	1.90	0.75	17.20
	2004			0.40	2.90	0.24	3.80
	2005			0.58	4.10	0.08	10.70
	2006			0.05	6.00	0.44	12.60
	2007			0.12	6.62	1.55	5.18
	2008			0.22	8.50	0.38	4.00
	2009			0.06	11.30	0.99	6.40
	2010			0.26	8.50	3.69	5.20
	2011						
Thorny skate	2000						
	2001						
	2002			1.20		8.32	2.00
	2003			1.32		10.26	1.97
	2004			0.77		7.74	0.82
	2005			0.41		2.99	0.81
	2006			0.15		5.00	0.59
	2007			0.15		2.97	0.47
	2008			0.13		6.89	0.39
	2009			0.08		3.76	0.63
	2010			0.10		2.72	0.33
	2011			0.10		5.06	0.23
White hake	2000						
	2001						
	2002					1.45	5.23
	2003					0.56	3.36
	2004					0.07	1.15
	2005					0.00	0.86
	2006					0.00	0.96
	2007					0.01	0.58
	2008					0.03	0.85
	2009					0.00	0.42
	2010					0.02	0.21
	2011					0.00	0.15

Species	Year	2J	3K	3L	3M	3N	3O
Witch flo.	2000	0.00	0.02	0.33	0.31	0.38	0.09
	2001	0.01	0.05	0.41		0.43	0.18
	2002	0.00	0.08	0.36	0.30	0.25	0.20
	2003	0.00	0.05	0.39		0.06	0.08
	2004	0.00	0.01	0.33	0.47	0.19	0.44
	2005	0.01	0.03	0.12	0.11	0.11	0.15
	2006	0.00	0.05	0.03	0.03	0.16	0.32
	2007	0.02	0.00	0.03		0.08	0.15
	2008	0.00	0.01	0.08	0.05	0.12	0.15
	2009	0.00	0.03	0.02		0.10	0.28
	2010	0.05	0.08	0.06		0.24	0.18
	2011	0.04	0.05	0.14		0.21	0.15
Yellow-tail flo.	2000			1.43		9.15	0.33
	2001			0.20		10.52	3.42
	2002			0.03		8.44	2.12
	2003			0.03		8.41	4.49
	2004			2.33		8.40	2.63
	2005			0.28		10.98	2.37
	2006			0.00		0.79	0.02
	2007			0.01		2.90	1.71
	2008			0.99		8.22	2.27
	2009			0.23		3.92	2.03
	2010			0.12		6.88	2.37
	2011			0.17		4.07	0.99

Table 1b STACFIS catch ('000 t) estimates for Greenland Halibut by NAFO Division from 2000 to 2011 where available.

Species	Year	0A	0B	1AB	1CD	2G	2H	2J	3K	3L	3M	3N	3O
Greenland Halibut	2000	0.00	5.44	0.10	5.63				5.85	18.98	4.18	3.09	0.95
	2001	3.07	5.03	0.58	5.08	0.06	0.25	1.03	4.00	21.08	6.08	4.07	0.70
	2002	3.56	3.91	2.05	5.36		0.38	1.04	2.90	21.45	5.20	2.65	0.31
	2003	4.14	5.06	4.01	5.49	0.26	1.89	0.74	2.86	16.30	4.56	4.84	0.41
	2004	3.75	5.77	3.91	5.50	0.15	1.05	0.89	1.84	12.75	4.84	3.36	0.45
	2005	4.21	5.79	4.04	5.68	0.04	0.38	1.72	3.01	11.55	4.53	1.48	0.39
	2006	6.63	5.59	6.22	5.72	0.10	0.40	0.45	3.88	12.80	2.98	0.51	0.10
	2007	6.17	5.32	6.30	5.60	0.00	0.12	2.39	1.46	13.02	3.53	1.49	0.17
	2008	5.26	5.18	6.24	5.80	0.01	0.16	2.43	1.71	11.04	4.55	0.98	0.07
	2009	6.63	5.62	6.74	5.67	0.05	0.10	1.56	3.02	12.41	4.22	0.83	0.27
	2010	6.39	6.84	6.46	7.25	0.03	0.03	2.89	2.27	15.95	3.37	1.56	0.07
	2011	6.26	6.87	6.47	7.22								

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

Chair: Jean-Claude Mahé Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, NS, Canada, from 1 to 14 June 2012, 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, Portugal and Spain), Japan, Russian Federation, Ukraine 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, Jean-Claude Mahé (EU-France), 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 2011

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 and the status presented in the relevant sections of the STACFIS report.

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 2011. STACFIS noted that an ad hoc working group had deliberated on catch estimates before the meeting and the conclusion were presented to STACFIS and discussed. NAFO Scientific Council (STACFIS) has estimated catch for its stock assessments for many years since the 1980s when large discrepancies were observed between various sources of catch information. The goal of this exercise was to use the best information available to provide the best possible assessments and advice. STACFIS has had available estimates from different sources, but not for all fleets or from all Contracting Parties. These various sources of data have repeatedly led STACFIS to the conclusion that catch estimates from STATLANT have been unreliable for a number of stocks. This year, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks. STACFIS notes that it does not have the information and time available to estimate catches during the June meeting and that if these problems continue in the future, the inconsistencies between catch data before and after 2011 will increase and the quality of the assessments will deteriorate. This will lead to greater uncertainty regarding the status of the stocks.

III. STOCK ASSESSMENTS

STOCKS OFF GREENLAND AND IN DAVIS STRAIT: SA0 AND SA1

Environmental Overview

(SCR Doc. 12/02, 12/08, 12/18, SCS Doc. 12/10, 12/13)

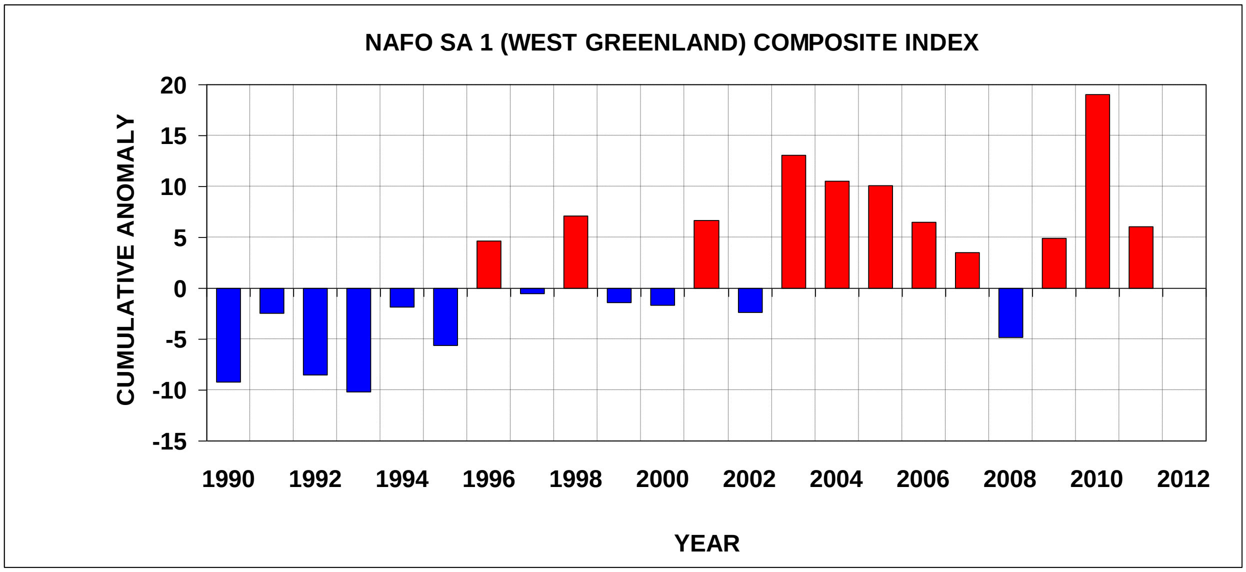


Fig. IV-1. Composite climate index for NAFO Subarea 1 (West Greenland) derived by summing the standardized anomalies of meteorological and ocean conditions.

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 northward flowing 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, temperature and salinity have become steadily 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.

The composite climate index in Subarea 1 has remained above normal in recent years (2009-2011) showing a peak in 2010 (Fig. IV-1). Cold, fresh conditions persisted in the early to mid-1990s followed by a general warming trend in the past decade with the exception of 2008. Time series of mid-June temperatures on top of Fylla Bank show temperature and salinity above average in 2011 at 0.4°C and 0.2, respectively. The presence of Irminger Water in the region was high in 2011 with pure Irminger Water (waters of Atlantic origin) traced as far north as the Maniitsoq section and modified Irminger Water further north to the Sisimiut section. The mean (400–600 m) temperature and salinity was high over the Southwest Greenland Shelf Break based on reported potential T/S properties compared to the long-term average.

The uppermost layer of the Cape Desolation Section in 2011 was occupied by relative fresh surface PW in contrast to the previous two years when this water mass was not detected. The water temperature between 100 and 700 m depth was warmer than its long-term mean, and thus continued the series of ‘warmer than normal’ years started in

1998. Fyllas Bank Section was characterized in 2011 by a negative temperature anomaly within the uppermost 50 to 100 m and a positive temperature anomaly between 100 and 700 m water depth. The salinity of Irminger Sea Water along this section was slightly above its long term mean.

Sea surface temperature anomaly was more than 5°C in the Labrador Sea during the winter of 2011 but close to normal throughout the remainder of the year. In 2011, wintertime convection was limited to the upper 200 m of the water column, which is very similar to that observed in 2010. While the upper layer (10-150m) in the Labrador Sea demonstrates a strong trend of increasing temperature since the mid-1990s, the trend in salinity is much weaker. In the layer impacted by convection (20-2000 m), there is a strong increasing trend in both temperature and salinity since the mid-1990s.

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

(SCR Doc. 12/03, 16, 23, 31; SCS Doc. 12/05, 10, 13, 14)

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 and remained at 26 800 t in 2011 (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 and 2012.

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 in 2010 and remained at 13 125 t in 2011.

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 6 300 t in 2011.

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. Catches remained at that level in 2011.

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 and remained at 6 500 t in 2011.

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 2011, 2 119 t were taken by gillnet, 81 t by longline and 4 665 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 2011, trawlers caught 3 089 t and 2 909 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 and Faroe Islands, were also engaged in the fishery in the area in 2011. 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 253 t in 2011, 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 – 6 700 t in 2006-2011. 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:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	19	19	19	24	24	24	24	27	27	27
TAC	19	19	19	24	24	24	24	27	27	27
SA 0	9	10	10	12	11	11	12	13	13	
SA1 exl. Div. 1A inshore	10	10	10	12	12	12	12	14	14	
Total STATLANT 21 [1]	20[2]	19[3]	20[3]	24[3]	23[3]	22	25	27	27	
Total STACFIS	19	19	20	24	23	23	25	27	27	

1 Excluding inshore catches in Div.1A

2 Including 1 366 t reported by error from Div. 1A.

3 Excluding 2 000 - 4 300 t reported by error from Div. 1D.

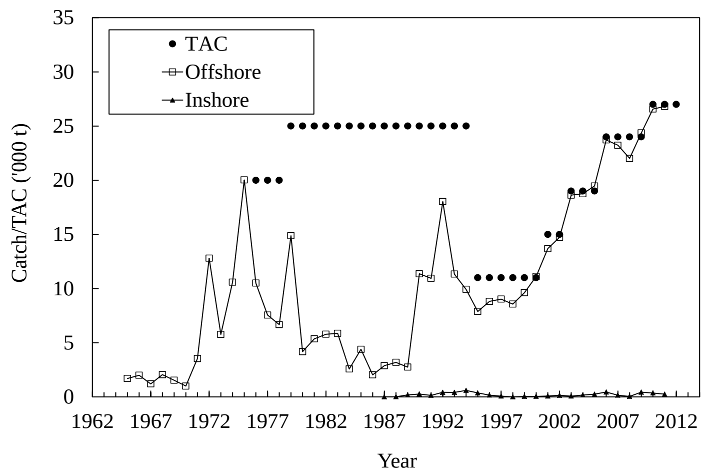


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

b) Input Data

i) Commercial fishery data

Information on length distribution was available from gill net and trawl fisheries in Div. 0A and 0B. The bulk of the catches in the gillnet fishery in Div. 0A were between 50 and 80 cm with a mode around 64 cm as in recent years. The length distributions in the single and twin trawl fishery in Div. 0A and 0B were very similar with modes around 49-51 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 47 cm and 49 cm in the Russian and Greenlandic trawl fishery, respectively. 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.

Standardized catch rates from Div. 0A declined slightly in 2007 but increased in 2008 and 2009, decreased in 2010 to increase again to the 2008-2009 level. Standardized trawl catch rates have been relatively stable over the past 10 years.

Standardized catch rates in Div. 1AB declined between 2006 and 2008 but have been increasing since then and were in 2011 the highest in the time series.

The combined Div. 0A+1AB standardized CPUE series has shown a slightly increasing trend since 2007, but has been relatively 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 then increased again in 2011.

Standardized catch rates in Div. 1CD decreased gradually from 1989-1997 but increased since then until 2008. In 2011 it increased further to the highest level seen since 1990, but has been relatively stable the last four 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 to increase again in 2011 and is among the highest in the time series. (Fig. 1.2).

Unstandardized catch rates from the gill net fishery in Div. 0A have been increasing since 2006 and in 2011 is the highest in the time series, dating back to 2004. Unstandardized catch rates from the gill net fishery in Div. 0B increased between 2007 and 2010 but decreased in 2011. The CPUE is, however, the second highest in the time series that dates back to 2003. (Fig. 1.3)

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, the catch rates should be interpreted with caution.

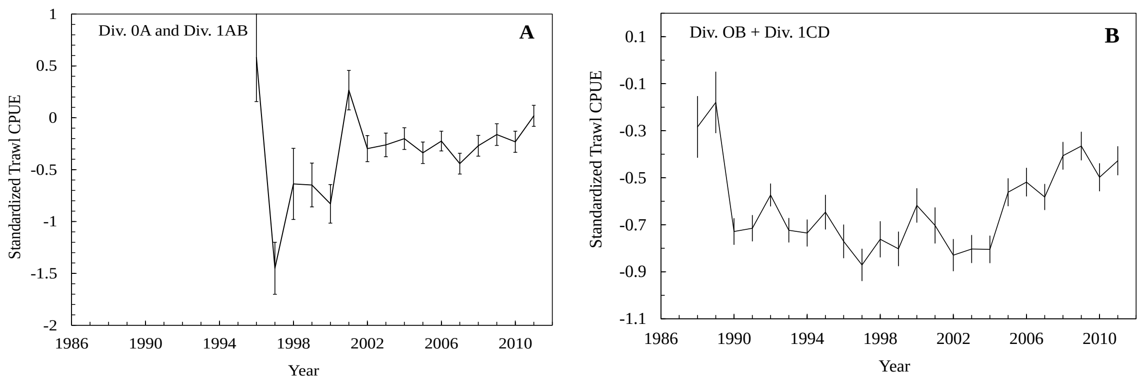


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawler CPUE from Div. 0A and Div. 1AB with ± S.E . B: Combined standardized trawler CPUE from Div. 0B and Div. 1CD with ± S.E.

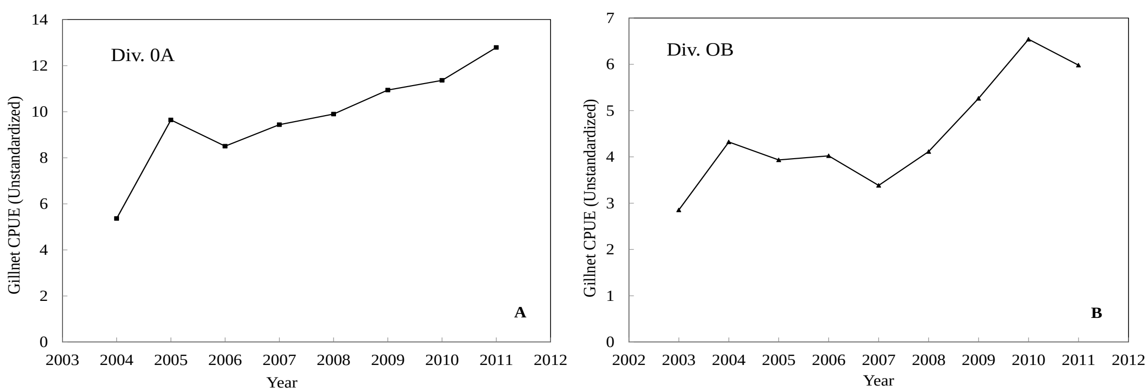


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Unstandardized gill net CPUE from Div. 0A. B: Unstandardized gill net CPUE from Div. 0B.

ii) Research survey data

Japan-Greenland and Greenland deep sea surveys in Div. 1CD. 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 is the highest in the time series in 2011. (Fig. 1.4). The abundance increased between 1997 and 2001 and has been relatively stable since 2002.

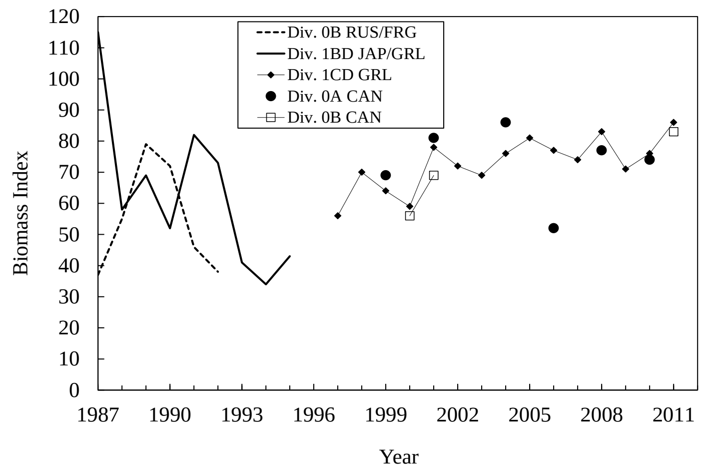


Fig. 1.4. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass indices from bottom trawl surveys. Note, incomplete coverage of the 2006 survey in Div. 0A and that survey indices from Div. 0A do not include surveys in the northern part in 2004 and 2010. Further, the survey indices from Div. 1A in 2001, 2004 and 2010 are not included.

Canada deep sea survey in Div. 0B. Division 0B was surveyed in 2012, the third time this area has been surveyed using M/Tr *Pâmiut*. Previous surveys were conducted in 2000 and 2001. Prior to this there had been a survey conducted in 1986 using the RV *Gadus Atlantica*. Biomass has increased compared to previous years. Abundance was lower than in 2001 but higher than in 2000. The length distribution had a single mode at 51 cm, an increase in modal length compared to 2001 (45 cm) and 2000 (42 cm).

Greenland shrimp survey in Div. 1A-1F. 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 index in the offshore area peaked in 2004. Since then offshore biomass decreased gradually until 2009 but increased again in 2010 and 2011 and the 2011 estimate is the third highest in the time series (Fig. 1.5). The biomass index and abundance index time series were recalculated in 2004 based on better depth information and new strata areas. The survey gear was changed in 2005, but the 2005-2011 figures are adjusted for that.

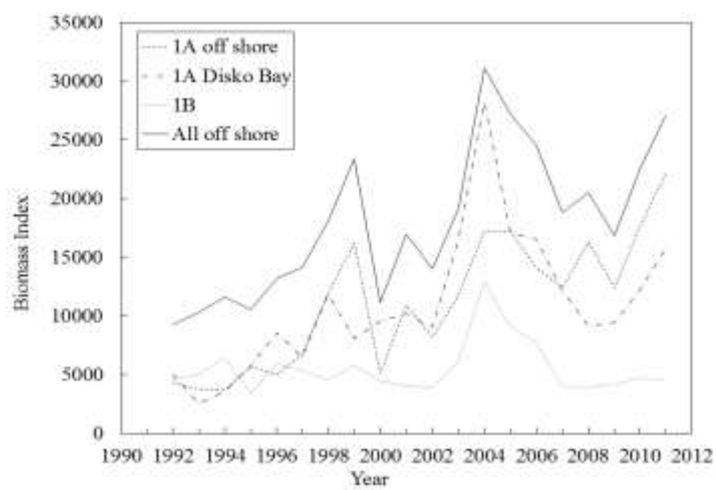


Fig. 1.5. Greenland halibut in Subareas 0+1: Biomass index from the Greenland shrimp survey by most important Divisions and in total offshore (including 1C-1F, which have little biomass). Div. Disko Bay is inshore .

The index of one-year-old fish in the total survey area including Disko Bay increased gradually from 1996 to a peak in the 2001 survey (2000 year class (Fig.1.6)). The index declined in 2002, increased in 2003 and has stayed at that level until 2007, but declined gradually in 2009. The index of one year olds increased in 2010 and again in 2011 to the highest level in the time series. The increase in recruitment in the total survey area between 2009 and 2011 was caused by an increase in recruitment in the inshore Disko Bay and Div. 1A north of 70° 37.5'N. The figures were recalculated in 2007, based on the new stratification, but it did not change the overall trends in the recruitment.

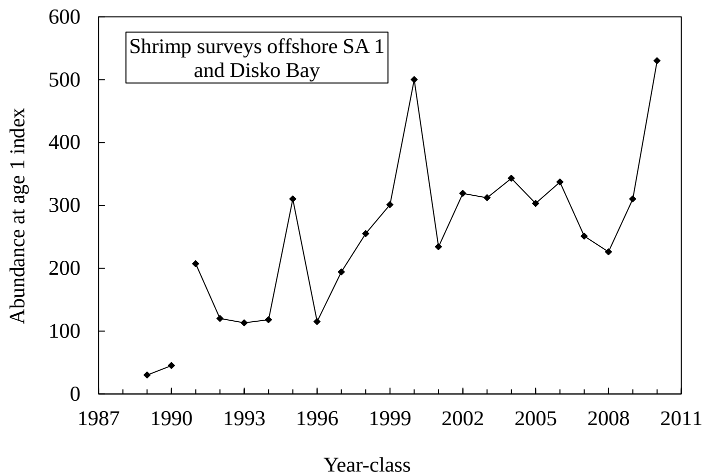


Fig. 1.6. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1).

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1A(south of 70°37.5'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 2010 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 2011 report) and the age reading procedure is currently under revision hence no age based analysis are presented.

An ASPIC was attempted again in 2012, 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 and since then catches increased gradually to 26 900 t in 2010 and remained at that level in 2011. The increase in catches was 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 indices from deep sea surveys in 2011 were available from Div. 0B and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2011.

Assessment: No analytical assessment could be performed.

Commercial CPUE indices. Combined standardized catch rates in Div. 0A and Div. 1AB have been stable during 2002-2011.

The combined Div. 0B and 1CD standardized catch rates have been stable from 2002 to 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 increased again in 2011 and is among the highest in the time series.

Biomass: The survey biomass index in Div. 0B has increased compared to previous years (2000 and 2001) and was at same level as in Div. 1CD.

The survey biomass index in Div. 1CD has increased gradually over the fourteen year time series and was the highest observed in 2011.

Recruitment: The abundance of the 2000 and 2010 year-classes at age 1 in the entire area covered by the Greenland shrimp survey were the highest in the time series, while the 2002-2006 and 2009 year-classes were above average. The recruitment of the 2007 - 2010 year-class in the offshore nursery area (Div. 1A (South of 70°37.5'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 and Div. 0B has shown an increasing trend. In Div. 1CD the abundance increased between 1997 and 2001 and has been relatively stable since 2002. In Div. 0B the abundance was lower than in 2001 but higher than in 2000. CPUE indices in Div. 0B and 1CD have shown an increasing trend since 2004, decreased between 2009 and 2010, increased again in 2011 and is among the highest in the time series.

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), 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.*

STATUS: Gill net data from Div. 0A and 0B from 2009, 2010 and 2011 have been acquired and were presented in 2012.

The next assessment will be in 2013.

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

(SCR Doc. 11/43 12/16 36 SCS Doc. 12/10)

a) Introduction

The inshore fishery for Greenland halibut developed in the beginning of the twentieth century, with the introduction of the longline around 1910. 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 are believed not to contribute to the spawning stock in Davis Strait, and no significant spawning has been observed in the areas, hence the stocks are dependent on recruitment from offshore spawning areas.

Fisheries and catches

Total landings for division 1A inshore were less than 500 t/yr. until 1955, less than 2 000 t/yr. until 1975 and less than 5 000 t/yr. until 1985, less than 10 000 t/yr. until 1991 and finally peaked at 25 000 t in 1998. Since then landings have decreased, but remained around 20 000 t/yr. for the 3 areas combined.

Disko Bay: Landings increased from about 2 000 t in the mid 1980's and peaked in 2004 with more than 12 000 t. From 2006 landings decreased and in 2009 only 6 300 t was landed. However, in 2010 landings increased again to 8 500 t and in 2011 8 000 t were landed (Table 2.1 and Fig 2.1, upper left)

Uummannaq: landings increased from a level of 3 000 t in the mid 1980's and peaked in 1999 at a level of more than 8 000 t. Landings then decreased and from 2002 were at a level of 5 000 to 6 000 t. In 2011, 6 400 t was landed, which is an increase compared to recent years (Table 2.1 and Fig 2.1, upper right).

***Upernavik*:** landings increased from the mid 1980's and peaked in 1998 at a level of 7 000 t. This was followed by a period of decreasing landings, but since 2002 catches have increased and in 2011 6 500 t were landed (Table 2.1 and Fig 2.1, lower).

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	7.9	na	ni	ni	ni	ni	8.8	8.8	8.0	8.0
Disko Bay – TAC						12.5	8.8	8.8	8.0	8.0
Disko Bay - Catch	11.6	12.9	12.5	12.1	10.0	7.7	6.3	8.5	8.0	
Recommended TAC	6.0	na	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Uummannaq - TAC						5.0	5.0	5.0	5.0	6.0
Uummannaq - Catch	5.0	5.2	4.9	6.0	5.3	5.4	5.5	6.2	6.4	
Recommended TAC	4.3	na	na	na	na	na	na	na	na	na
Upernavik - TAC						5.0	5.0	6.0	6.0	6.0
Upernavik - Catch	3.9	4.6	4.8	5.1	4.9	5.5	6.5	5.9	6.5	
Division 1A Unknown			0.8							
STACFIS Total	20.5	22.7	22.9	23.2	20.6	18.9	18.3	20.6	20.9	

na no advice
ni no increase in effort

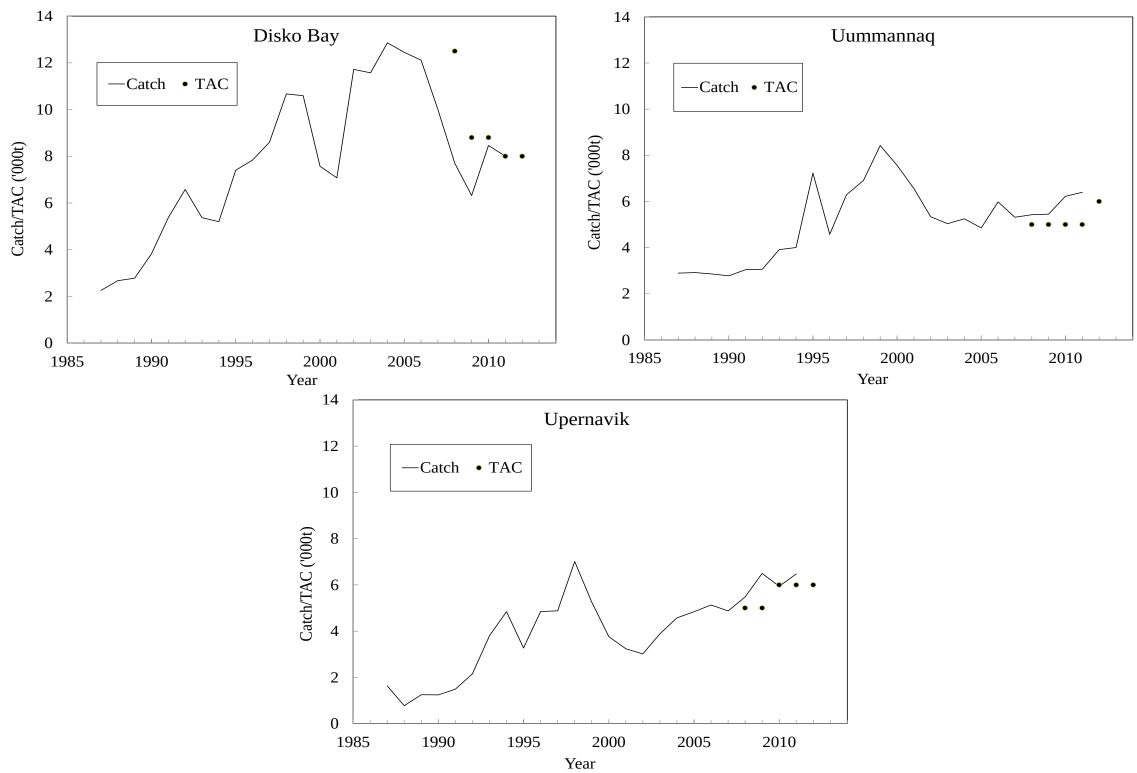


Fig 2.1. Greenland halibut in Div. 1A inshore: catches and TAC in Disko Bay, Uummannaq and Upernavik.

b) Data

i) Commercial fishery data

Length frequencies from factory landings were available from all areas from both the summer longline fishery and the winter longline and gillnet fishery. Logbooks have been mandatory for vessels above 30ft since 2008, but voluntary logbooks from 2006 and 2007 were also available. Age readings have been postponed since 2010, although otoliths have been 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 SA1 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.

c) Assessment

Mean length in the landings.

Disko Bay: Mean length in landings, decreased after 2001 in both the summer and the winter fishery, and have decreased to the lowest value observed in the time series in 2010 and 2011 (Fig 2.2 upper left). However, the average length in the winter fishery has increased in 2012 and the apparent detachment of the summer and winter fishery mean length series could indicate a redistribution of the stock or strong incoming year classes. The winter fishery in the Disko bay is highly dependent on ice coverage and access to the inner parts of the Kangia icefjord where larger fish are accessible at greater depths, leading to the large difference in summer and winter fishery average length. The winter fishery in 2011 was characterized by poor sea ice coverage, and the fishery took place at the summer fishing grounds longer than usually.

Uummannaq: Mean length in the landings have decreased slightly in the summer fishery since 2004 and the winter fishery since 2007 (Fig 2.2 upper right). However, the mean length in the winter fishery landings increased in 2012.

Upernavik: Mean length in landings have been stable since 1999, except for a decrease in the 2010 and 2011 summer fishery (Fig 2.2lower). However, the mean length in the winter fishery landings of 2012 increased compared to the 2011 winter fishery and is at about the average of the recent 5 years.

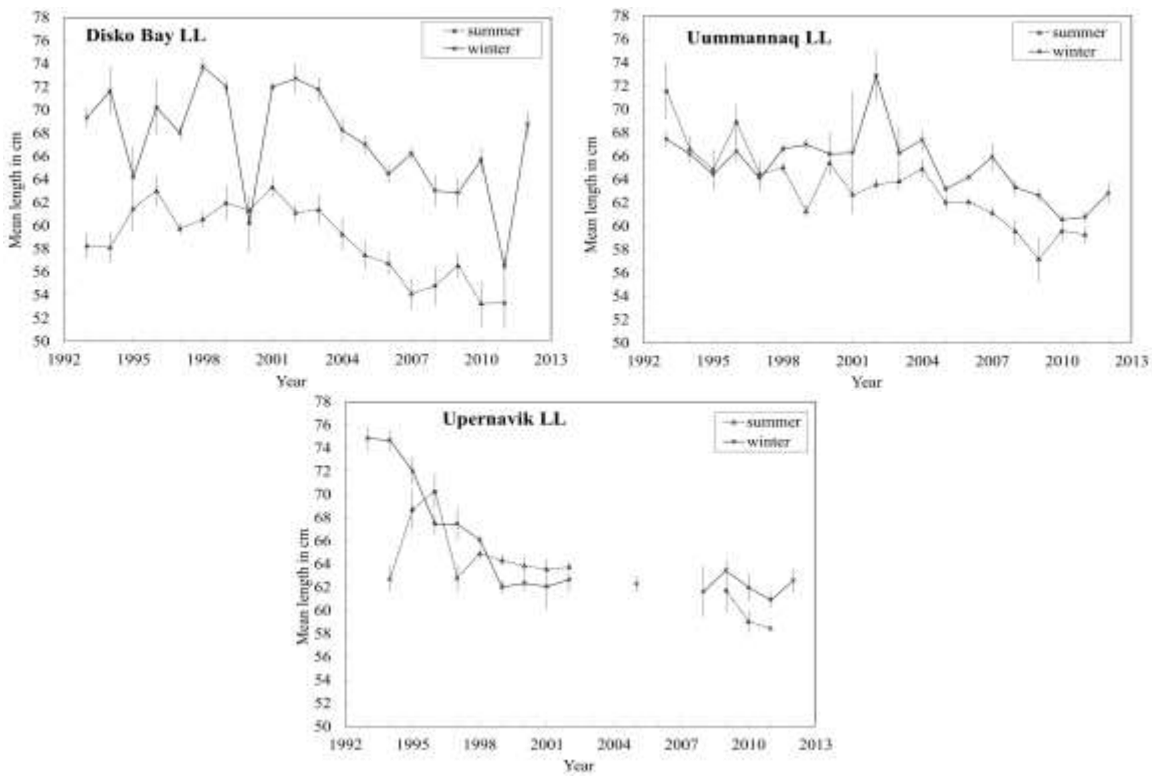


Fig. 2.2. Greenland halibut in Div. 1A inshore: Longline mean length in landings from Ilulissat, Uummannaq and Upernavik.

CPUE index.

A standardized CPUE series based on logbooks provided by vessels larger than 30 ft. was initiated in 2011 (Fig 2.3). However, just as in 2011 the 2012 analysis only explained 22 to 27 % of the variability in the data. The 2006 and 2012 logbooks were excluded from the analysis, since few logbooks were available from 2006 and from the first months of 2012, these estimates can hardly be regarded representative. Also the CPUE series does not account for effect of fishing ground within the area and shifts in the distribution could also cause the increasing or decreasing trends.

Disko Bay: The standardized CPUE indicates a decrease in CPUE in the Disko bay from 2007 to 2011 (Fig 2.3 upper left).

Uummannaq: The standardized CPUE indicates an increase in CPUE in Uummannaq from 2007 to 2011 (Fig 2.3 upper right).

Upernavik: The standardized CPUE indicates a decreasing CPUE in Upernavik from 2007 to 2011 (Fig 2.3 lower).

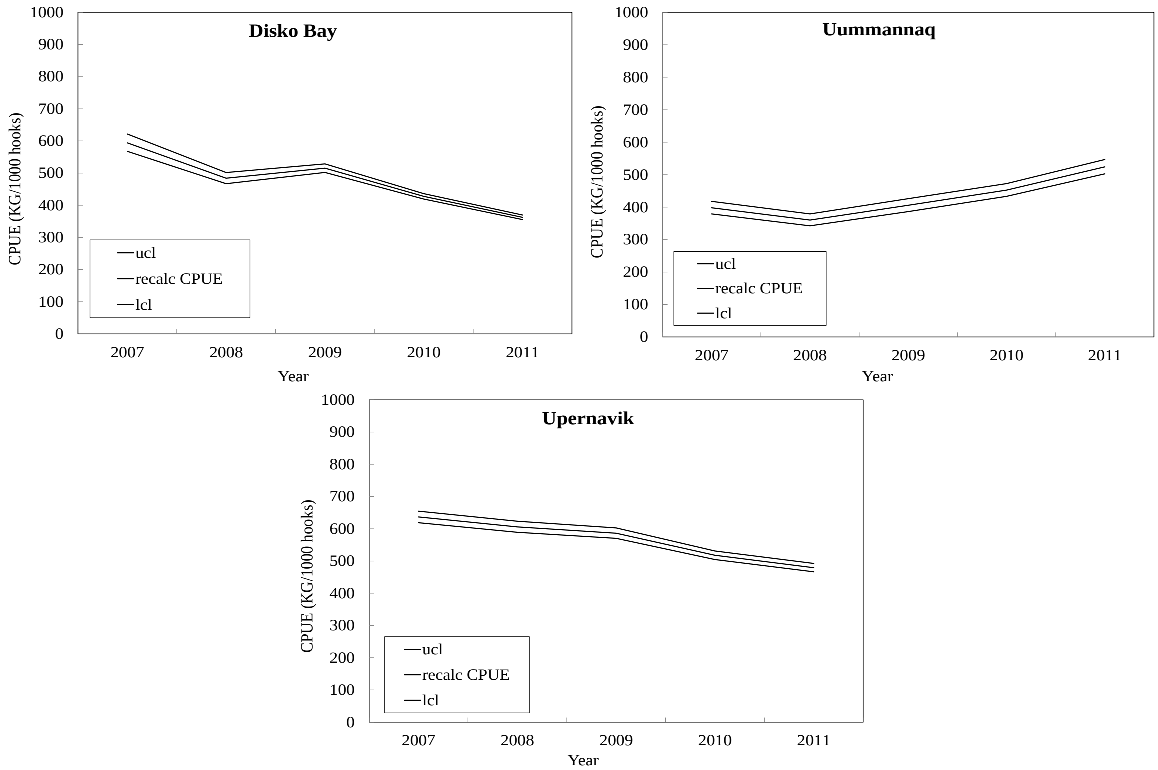


Fig. 2.3 Greenland halibut in Div. 1A inshore: LOGBOOK CPUE =overall mean + year + month + vessel +-1SE.

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 gillnet CPUE and NPUE estimates were at average levels. The 2011 gillnet survey CPUE (Fig 2.4 left) and NPUE (Fig 2.4 right) indices were the highest recorded for individuals < 50 cm, but also for all sizes (not shown). The increase in 2011 NPUEs is seen to derive mainly from the northern area off Torssukateq, while at the main fishing grounds at Kangia, the NPUEs have remained low. The high numbers of larger fish in 2011 seem not to have any origin in the previous years estimated populations. This may either be due to migration of the larger fish in the area or may simply reflect the uncertainty of the estimates.

The Greenland Shrimp Fish trawl survey also covers the Disko bay. The survey biomass and abundance indices decreased from 2004, but stabilized in 2008 and 2009 and increased in 2010 and 2011 (Fig 2.5). The 2011 abundance index reached the highest value recorded, mainly caused by a strong 2009 year-class and a very strong 2010 year-class.

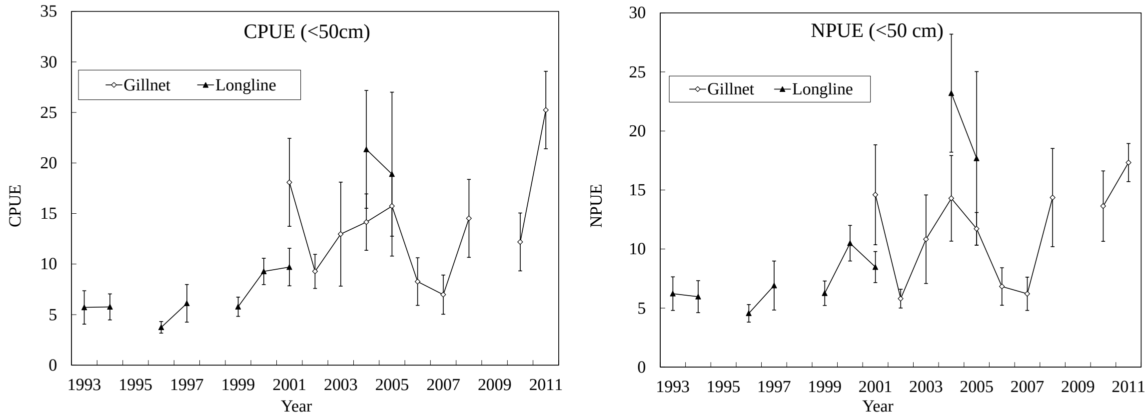


Fig. 2.4. Greenland halibut in Div. 1A inshore: Disko Bay gillnet survey CPUE and NPUE + 95% CI indicated.

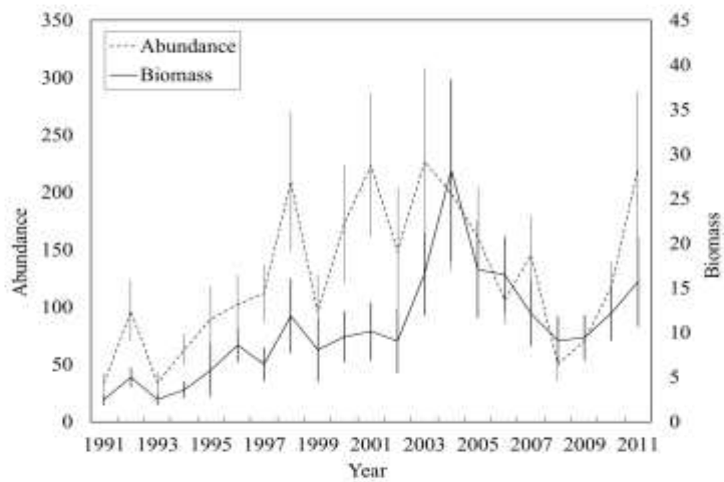


Fig. 2.5. Greenland halibut in Div. 1A inshore: Disko Bay abundance and biomass indices + 95% CI for Greenland halibut in the Greenland Shrimp Fish trawl survey.

d) Assessment results:

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

Fishing mortality: unknown for all of the stocks

Disko Bay: The persistent decrease in mean length in the summer and winter fishery landings from 2001 to 2007 indicated a fishery dependent on incoming year-classes entering the fishery. However, the recent increase in the mean lengths in the winter fishery and the apparent detachment of the summer and winter fishery mean length series, along with the increasing indices in the Gillnet survey could also indicate some recovery. The decreasing logbook CPUE index may indicate a decreasing stock, but the index should be interpreted with caution, since little variance is explained and only part of the landings are covered in the logbooks. The recent increasing biomass and abundance indices in the Greenland shrimp fish trawl survey indicate good recruitment in 2010 and 2011.

Uummannaq: The slowly decreasing trend in average length in the landings since 2004 could indicate large new incoming year-classes or a decreasing stock. The increasing logbook CPUE index may indicate an increasing stock, but the index should however be interpreted with caution as little variance is explained and only part of the landings are covered by logbooks.

Upernavik: Mean length in the commercial landings was stable from 1999 to 2009, but decreased slightly in 2010 and 2011. However the mean length in the 2012 winter fishery is at the same levels as in the past decade. The decreasing logbook CPUE index may indicate a decreasing stock, but the index should be interpreted with some caution since little variance is explained and only part of the landings are covered by the logbooks.

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

Interim monitoring report (SCR Doc. 12/03, SCS Doc. 12/10, 12/13)

a) Introduction

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is taken as bycatch in the Greenland halibut fishery. A total catch of 10 t was estimated for 2011. 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:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Agreed TAC	4.2	4.2	4.2	4.2						
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.04	0.02	0.01	0.02	0.01	0.00	0.00	0.03	0.00	
STACFIS Catch	0.04	0.02	0.01	0.02	0.03	0.00	0.00	0.03	0.01	

ndf : No directed fishing. No TAC set for 2007 – 2011.

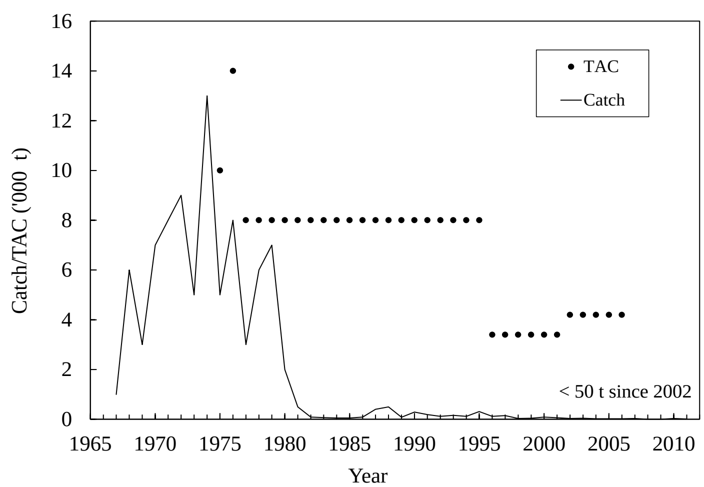


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2012

b) Data Overview

Research survey data

There has not been any survey that covers the entire area or the entire period which makes direct comparison between survey series difficult. In the period 1987-1995 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. The survey area was restratified and the biomasses recalculated in 1997. Russia has in the period 1986-1992 conducted surveys covering Div. 0B and Div. 1CD at depths down to 1 250 m until 1988 and down to 1 500 from then on. The surveys took place in October-

November. During 1997-2011 Greenland has conducted a survey in September - November covering Div. 1CD at depths between 400 and 1500 m.

Canada has conducted surveys in Div. 0B in 2000, 2001 and 2011 at depths down to 1500 m. Further Canada and Greenland have conducted a number of surveys in Div. 0A and Div. 1A since 1999 but roundnose grenadier has very seldom been observed in that area.

In the Greenland survey in Div. 1CD , the biomass index almost doubled between 2010 and 2011. Despite the increase the biomass is still at the very low level observed since 1993. Almost all the biomass was found in Div. 1D. 800-1400 m. The fish were generally small, between 4 and 8 cm pre anal fin length.

The Canadian surveys in Div. 0B in 2000 and 2001 also showed very low biomasses. The biomass was not calculated in 2011 but few Roundnose grenadiers were recorded.

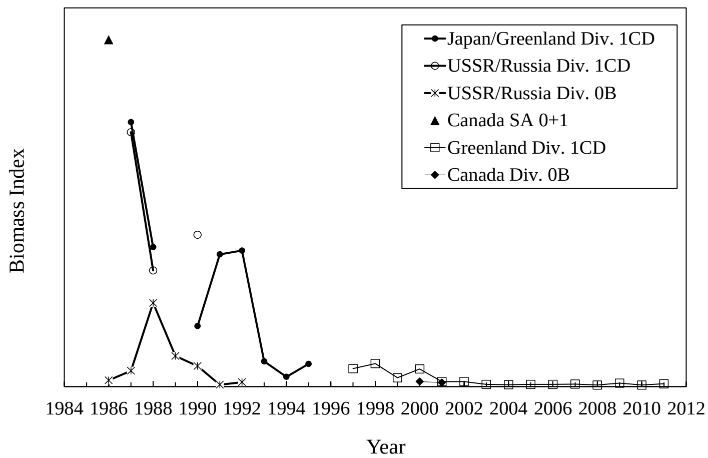


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/ Greenland, Canadian and Greenland surveys in Div. 0B and Div.

c) Conclusion

Despite the fact that the biomass has almost doubled compared to 2010 the biomass in 2011 is still at the very low level seen since 1993, and there is no reason to consider that the status of the stock has changed.

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

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

Interim Monitoring Report (SCR Doc. 07/88 12/03 05 16. SCS Doc. 12/10)

a) Introduction

There are two demersal redfish species of commercial importance in subarea 1, golden redfish (*Sebastes marinus*) and demersal 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.

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 2011, 182 t were reported to Greenland including 46 t reported as bycatch in the shrimp fishery (Fig 4.1). Recent catch figures 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 bycatch 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. A mixture of commercially sized Golden and deep-sea are taken as a bycatch in the inshore fishery, targeting Greenland halibut, cod and shrimp.

Recent catches ('000 t) are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC	8	1	1	1	1	1	1	1	1	1
STATLANT 21	0	0.3	0.2	0.4	0.3	0	0.02	0	0.2	
STACFIS	0.5	0.3	0.2	0.4	0.3	0.4	0.4	0.3	0.2	

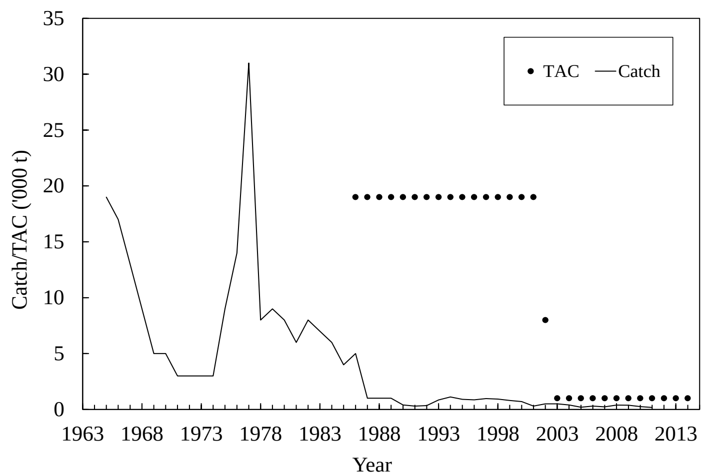


Fig. 4.1. Demersal redfish in Subarea 1: catches and TAC.

b) Data overview

i) Research survey data

Golden redfish (*Sebastes marinus*): The indices of the EU-Germany survey (Div. 1C-F) 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 and 2011 indices are the highest observed since 1986 (Fig 4.2).

Demersal deep-sea redfish (*Sebastes mentella*): The indices of the EU-Germany survey have fluctuated at a low level throughout the time series, but with very low values since 2007 (fig 4.3). The fluctuating trend could be caused by poor survey overlap with the depth distribution of the demersal deep-sea redfish stock. The joint Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (Div. 1CD, 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.

Juvenile redfish (both species combined): Abundance indices of juvenile redfish (both species combined) in the EU-Germany survey have been at a very low level since 2001 (Fig 4.4). Abundance indices of both redfish species combined in the Greenland Shrimp Fish (SFW) survey (Div. 1A-F) decreased during the 1990s and have remained at a low level since then (fig 4.4).

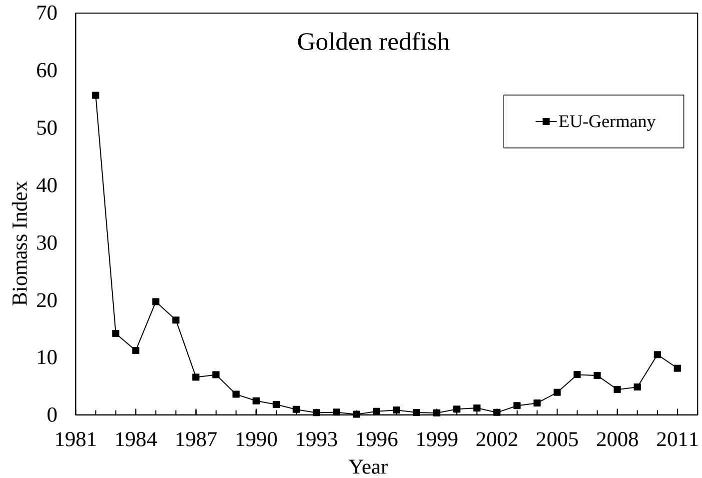


Fig. 4.2. Golden redfish in Subarea 1: redfish (≥17 cm) survey biomass indices derived from the EU-Germany survey.

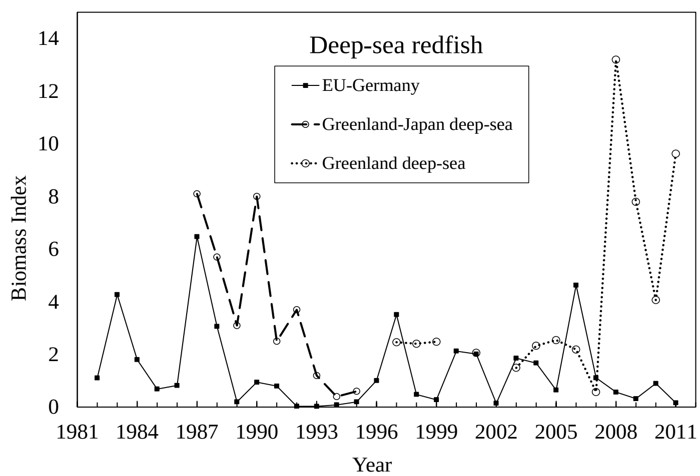


Fig. 4.3. Demersal deep-sea redfish in Subarea 1: (≥17 cm) survey biomass indices derived from the EU-Germany survey (Div. 1C-F) and from the joint Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (Div. 1CD, 1997-2011).

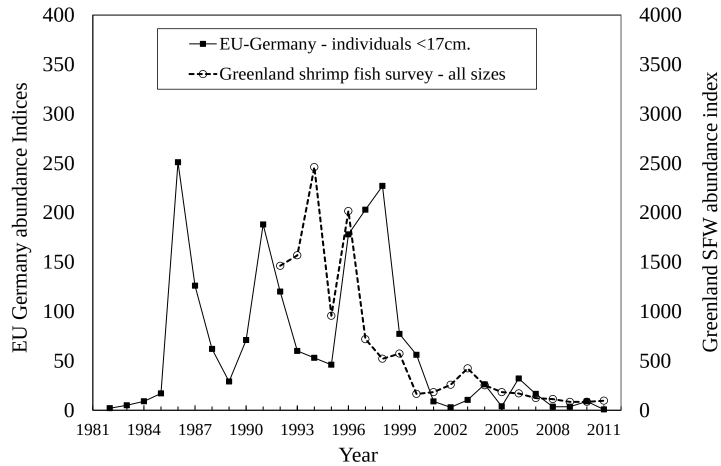


Fig. 4.4. Demersal redfish in Subarea 1: Juvenile deep-sea redfish and golden redfish combined survey abundance indices for EU-Germany survey (Div. 1C-F, individuals <17cm) and the Greenland Shrimp Fish survey (Div. 1A-F, all sizes and both species combined).

c) Conclusion

Based on the available data there is no indication of any change in the status of these stocks.

d) Research Recommendations

STACFIS **recommended** that *the species composition and quantity of redfish discarded in the shrimp fishery in SA 1 be further investigated*.

STATUS: No progress in 2011. This recommendation is reiterated.

This stock will next be assessed in 2014

5. Other Finfish in SA 1

Before 2012, Denmark (on behalf of Greenland) requested advice for Atlantic wolffish, spotted wolffish, American plaice and thorny skate in subarea 1 under the term “other finfish”. However, the request of 2012 no longer uses this term, but strictly requests advice by species, and no longer requests advice for thorny skate. Therefore, the STACFIS report has been updated and advice for Atlantic wolffish, spotted wolffish and American plaice can now be found under their common names in section 5a and 5b.

5a. Wolffish in Subarea 1

Interim monitoring report (SCR Doc. 07/88 12/05 16; SCS Doc. 12/10)

a) Introduction

Three species of wolffish exist in Subarea 1, Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*) and Northern wolffish (*Anarhichas denticulatus*). Only the two first are of commercial interest. Atlantic wolffish has its main distribution offshore and spotted wolffish is more connected to the fjord and coastal areas. In the past, these stocks have mainly been taken as a bycatch in the offshore fisheries targeting cod, Greenland halibut and shrimp, but a directed small-boat fishery exists in the West Greenlandic fjords almost exclusively taking spotted wolffish. 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).

i) Fishery and Catches

Catch statistics for wolffish species are combined, since no species-specific data are available from STATLANT, logbooks or factory landings reports. Catches of wolffish in SA1 were at a level around 5 000 t/yr. from 1960 to 1980 (Fig. 5a.1.). Catches then decreased to <100 t/yr. during the 1980s and remained low until 2002. 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 bycatch.

Recent nominal catches (t) for wolffish.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Atlantic wolffish recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
Spotted wolffish recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	na	na	na	na
STATLANT 21	306	313	524	764	880	1195	50	9	752	
STACFIS	393	313	515	764	880	1195	1175	1315	779	

ndf – No directed fishery
na – No advice

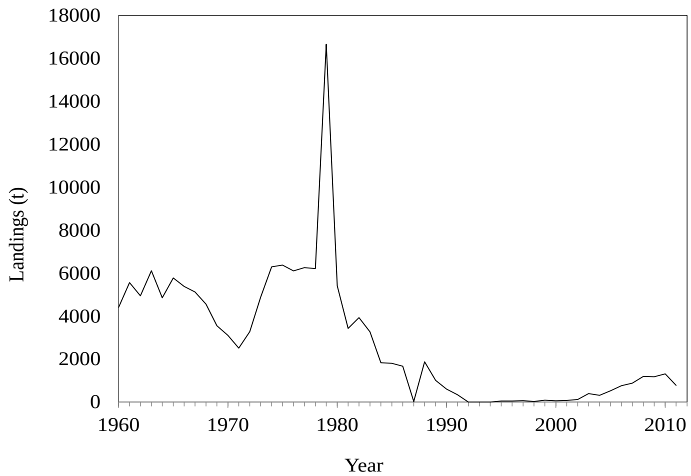


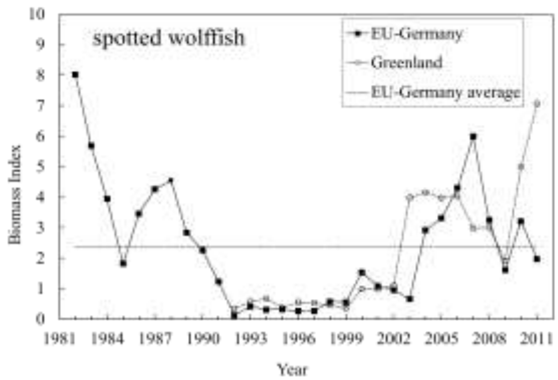
Fig 5a.1. Wolffish in Subarea 1: Catches of Atlantic wolffish and spotted wolffish in SA1 combined from 1960 to 2011.

b) Data Overview

i) Research survey data

Atlantic wolffish: Biomass indices decreased in the 1980s in the EU-Germany survey. From 2002 to 2005 biomass indices increased in both the EU-Germany survey and the Greenland shrimp fish survey to above average levels. After 2005 the biomass has shown a decreasing trend in both surveys (Fig. 5a.2.left). 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 survey, but increased in both the EU-Germany survey and the Greenland Shrimp fish surveys after 2000 to above average levels (Fig 5a.2.right). 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.



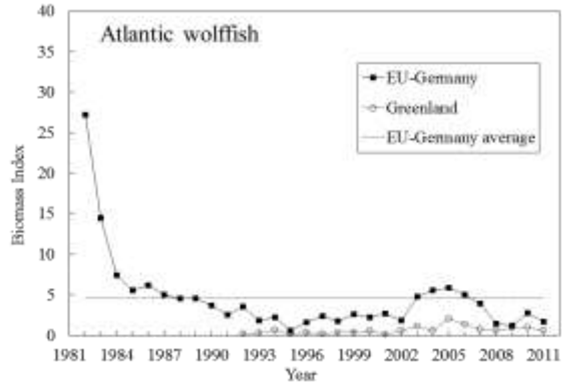


Fig. 5a.2. Wolffish in Subarea 1: wolffish survey biomass indices in SA1.

c) Conclusion

Based on available data, there is no indication of any change in the status of these stocks.

d) Research Recommendation

Noting the change in the request for other finfish STACFIS **recommended** that *the species composition and quantity of wolffish discarded in the shrimp fishery in SA1 be further investigated*.

STATUS: No progress

Noting the change in the request for other finfish STACFIS **recommended** that *the distribution of wolffish 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 and this recommendation is reiterated.

These stocks will next be assessed in 2014.

5b. American plaice (*Hippoglossoides platessoides*) in Subarea 1

Interim monitoring report (SCR Doc. 07/88 12/05 16; SCS Doc. 12/10)

a) Introduction

American plaice in subarea 1 have mainly been taken as a bycatch in fisheries targeting Cod, redfish and shrimp. 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).

i) Fishery and Catches

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 bycatches of American plaice in SA1, but American plaice may be part of the bycatch in other fisheries reported as “fish not specified”.

Recent catches (t) are:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
STATLANT 21	0	0	0	0	0	0	0	0	0	0
STACFIS	0	0	0	0	0	0	0	0	0	0

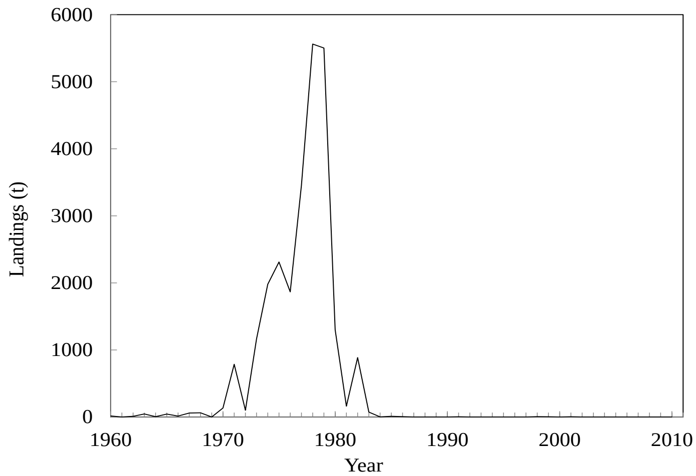


Fig 5b.1. American plaice in Subarea 1: Catches from 1960 to 2010.

b) Data

i) Research survey data

Biomass indices decreased in the 1980s in the EU-Germany survey (1C-F). From 2002 to 2005 biomass indices in both the EU-Germany survey and the Greenland shrimp fish survey (1A-F) increased, but indices have decreased since then. The general trend has however been increasing during the past decade (Fig. 5b.2). The stock is mainly composed of individuals less than 35 cm.

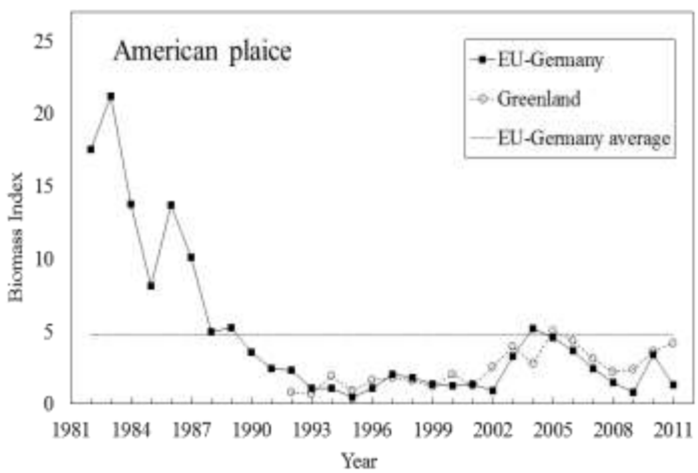


Fig. 5b.2. American plaice in Subarea 1: American plaice survey biomass indices in SA1.

c) Conclusion

Based on available data there is no indication of any change in the status of this stock.

d) Research Recommendation

STACFIS **recommended** that *the species composition and quantity of American plaice and other fish species discarded in the shrimp fishery in SA1 be further investigated.*

STATUS: No progress and this recommendation is reiterated.

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 bycatch*.

STATUS: No progress

These stocks will next be assessed in 2014

B. STOCKS ON THE FLEMISH CAP: SA 3 AND DIV. 3M

Environmental Overview

(SCR Doc. 12/07, 12/09, SCS Doc. 12/14)

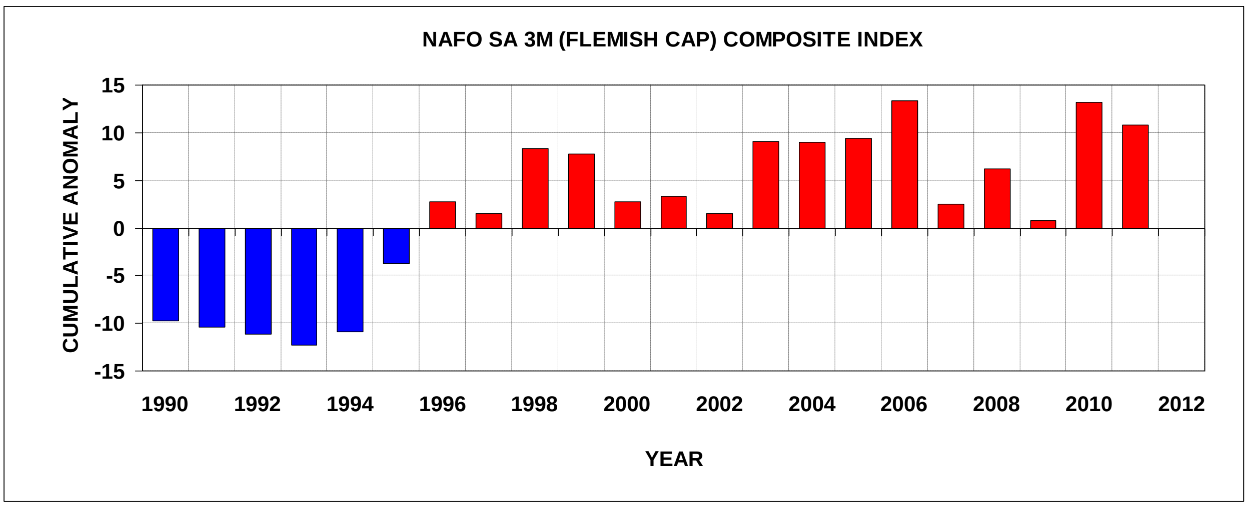


Fig. IV-2. Composite ocean climate index for NAFO Subarea 3 (SA3 Div. 3M) derived by summing the standardized anomalies.

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^{o}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.

The composite climate index in Subarea 3 (Div. 3M) has remained above normal in recent years (2009-2011) following a distinct warming trend since the mid-1990s (Fig. IV-2). Below normal climate conditions were again reflected in the early to mid-1990's period. Surface temperatures on the Flemish Cap were near normal in 2011 while near-bottom temperatures remained above normal by ~ 1 standard deviation (SD). Along the 47^{o}N section, the summer Cold-Intermediate Layer (CIL) area was above normal in 2009 but in 2010 it had decreased to the 2nd lowest value in the 61-year record after 1966 and remained nearly identical in 2011 implying warm conditions. The baroclinic transport in the offshore branch of the Labrador Current off the Grand Bank through the Flemish Pass increased from >2 SD below normal in 2008, varied about the mean for 2009 and 2010 and was near the long term mean in 2011.

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

(SCR Doc. 12/26, 12/37; SCS Doc. 12/05, 12/06, 12/08, 12/09, 12/14)

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 1 161 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. This year, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the precious years assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks. However, the model used for the assessment of this stock estimated the 2011 catch to be 13 900 t[1]. TAC for 2012 is 9 280 t.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	5.5	10	9.3
STATLANT 21	0.0	0.0	0.0	0.1	0.1	0.4	1.2	5.3	9.8	
STACFIS	0.0	0.0	0.0	0.3	0.3	0.9	1.2	9.2	13.9[1]	

ndf No directed fishery
[1] See estimation of parameters

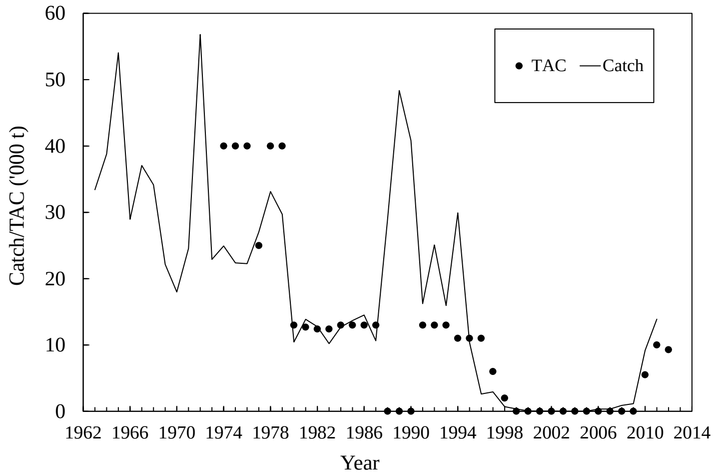


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch line includes estimates of misreported catches since 1988. No direct fishery is plotted as 0 TAC

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 2010-2011, whit the fishery opens, there was a good sampling level. There were length distributions for Canada, EU-Estonia, EU-Lithuania, Norway, EU-Portugal, Russia, EU-Spain and EU-UK. Spain had two types of vessels in 2011 for the fishery of Div. 3M cod, otter trawlers and paired trawlers. The mode for Portugal was 54 cm but 90 cm for UK . Lithuania, Estonia, Canada, Russia and Spain-otter trawlers mode ranges 57-63 cm. The mode for Spanish-paired trawlers was 84 cm. In 2009-2011 age-length keys from Portuguese catches were available. In 2009-2010 age 4 was the most abundant in the catch, whereas it was ages 7 and 8+ in 2011.

ii) Research survey data

Stratified-random bottom trawl surveys have been conducted by the EU (Spain and Portugal) 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 showed a general decline in biomass going from a peak value of 114 in 1989 to the lowest observed level of 1.6 in 2003. Biomass index increased since then, especially from 2006, reaching 106.2 in 2011 (Fig. 6.2). The growth of the strong year classes since 2005 has contributed to the increase in biomass.

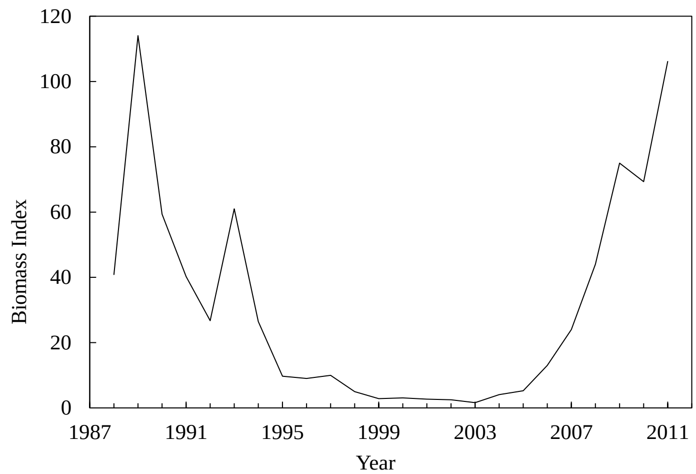


Fig. 6.2. Cod in Div. 3M: survey biomass estimates from EU-Flemish Cap survey

Abundance at age indices were available from the Flemish Cap survey. After several series of 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 2011 is by far the largest in the EU series (Fig. 6.3).

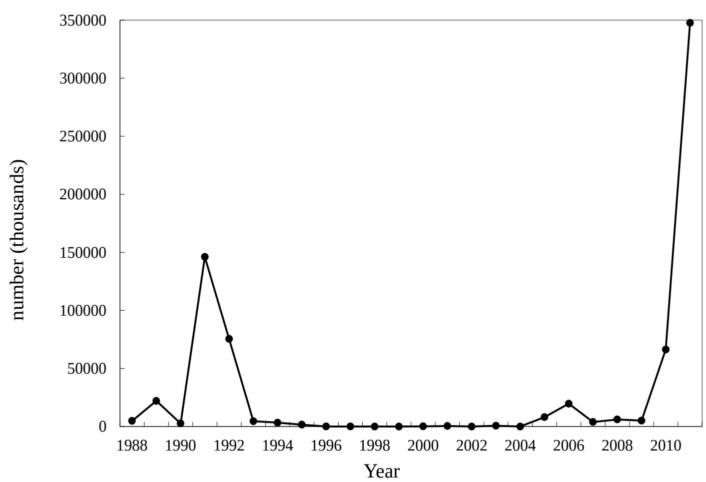


Fig. 6.3. Number at age 1 in the EU survey, 1988-2011

Additional survey information was available but not used in the assessment.

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, although in 2011 the mean weight of all the ages except 8+ decreased outstandingly with respect to the same ages in the 2009.

There are maturity information from the EU survey for 1990-1998, 2001-2006 and 2008-2011. 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. However, since 2005 it has been a slight increase in the A_{50}, mostly in 2011, reaching in this year a value of more than 4 years old.

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 1988-2011, except for 2002-2005, for which only total catch is available. As STACFIS was unable to estimate the catch in 2011 appropriately, a lognormal prior over this catch was set in the model with a median of 12 800 t and a 95% confidence interval of (9 905 t, 16 630 t). The value of the median is based on the 2010 STACFIS estimate raised by the ratio of 2011 over 2010 effort.

Tuning: numbers at age from the EU Flemish Cap survey data for 1988-2011

Ages: from 1 to 8+ in both cases

Catchability analysis: dependent on stock size for ages 1 to 2

Natural Mortality: M was set via a lognormal prior as last year assessment.

Maturity ogives: Modelled using a Bayesian framework and estimating the years with missing data from the years with data.

Additional 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.

The priors are defined as follows:

Input data	**Prior Model**	**Prior Parameters**
Total Catch 2011	$LN\left(median, sd\right)$	Median=9.46, sd=0.1313
Survivors(2011,a), a=1-7 Survivors(y,7), y=1988-2010	$LN\left(median = medrec \times e^{-medM - \sum_{age=1}^{a} medFsurv(age)}, cv = cvsurv\right)$	medrec=15000 medFsurv(1,…,7)={0.0001, 0.1, 0.5, 0.7, 0.7, 0.7, 0.7} cvsurv=1
F(y,a), a=1-7, y=2002-2005	$LN\left(median = medF(a),\ cv = cvF\right)$	medF=c(0.0001, 0.005, 0.01, 0.01, 0.01, 0.005, 0.005) cvsurv=0.7
Total Catch 2002-2005	$LN\left(median = CW_{\mathrm{mod}}(y),\ cv = cvCW\right)$	CW_{mod} is derived from the Baranov equation cvCW=0.05
Survey Indices (I)	$I(y) \sim LN\left(median = \mu(y,a),\ cv = \sqrt{e^{\frac{1}{\psi(a)}} - 1}\right)$ $\mu(y,a) = q(a)\left(N(y,a)\frac{e^{-\alpha Z(y,a)} - e^{-\beta Z(y,a)}}{(\beta-\alpha)Z(y,a)}\right)^{\gamma(a)}$ $\gamma(a)\begin{cases} \sim N(\text{mean}=1, \text{variance}=0.25),\ if\ a=1,2 \\ =1,\ if\ a \geq 3 \end{cases}$ $\log(q(a)) \sim N(\text{mean}=0, \text{variance}=5)$ $\psi(a) \sim gamma(shape=2, rate=0.07)$	I is the EU survey abundance index q is the survey catchability at age N is the commercial abundance index α = 0.5, β = 0.58 (survey made in July) Z is the total mortality
M	$M \sim LN(\text{median}, cv)$	Median=0.218, cv=0.3

d) Assessment Results

The 2011 catch posterior median, estimated by the model, is 13 900 t.

Note that estimates of SSB are available for 2012, whereas total biomass estimates are available to 2011 only. This difference arises because there are no age 1 recruitment estimates for 2012, 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 since the mid-2000s. Both values are this year around the level of the early 1990s (Fig. 6.4).

Spawning stock biomass: Estimated median SSB (Fig. 6.5) has increased since 2005 to the highest value of the time series and is now well above B_{lim} (14 000 t). The big increase in the last three years is largely due to six abundant year classes, those of 2005-2010, and to their early maturity.

As 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 the previous assessment, SSB for 2011 was estimated as 50 000 t. This is now revised to 34 000 t because of differences between the maturities assumed for 2011 in the previous assessment and the estimated maturities available this year (Fig. 6.5).

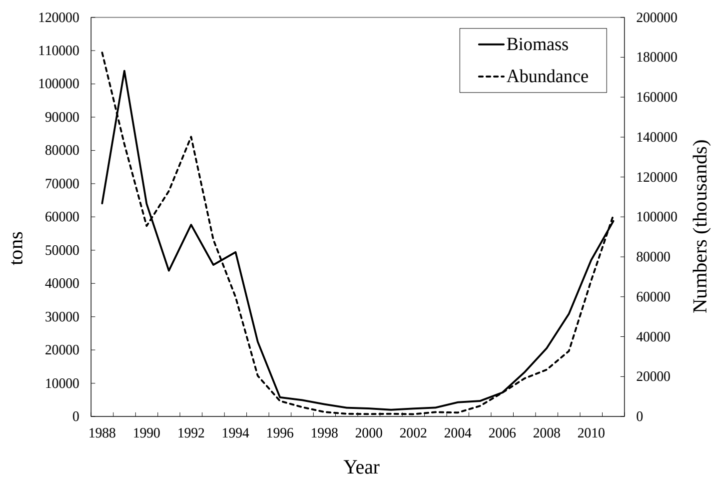


Fig. 6.4. Cod in Div. 3M: Biomass and abundance estimates for years 1988 to 2011

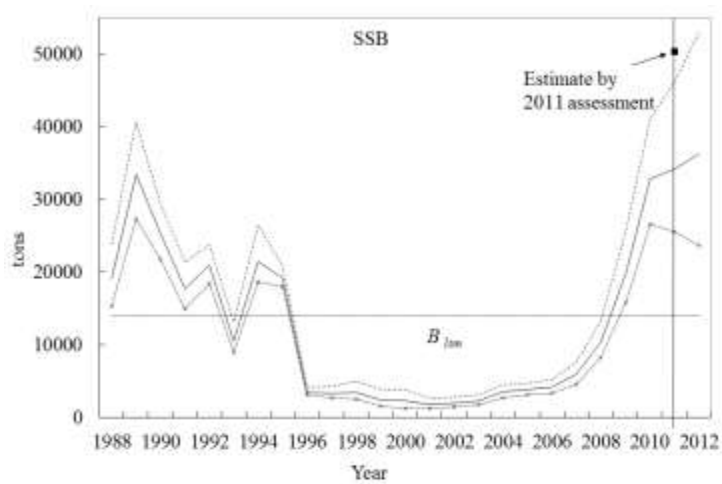


Fig. 6.5. Cod in Div. 3M: Median and 90% probability intervals SSB estimates for years 1988 to 2012. The horizontal dashed line is the B_{lim} level of 14 000 t. The point indicates the 2011 SSB as estimated by the 2011 assessment.

Recruitment: After a series of recruitment failures between 1996 and 2004, recruitment at age 1 values in 2005-2011 are higher, especially the 2010 and 2011 values (Fig. 6.6). There is a high uncertainty associated with those last values.

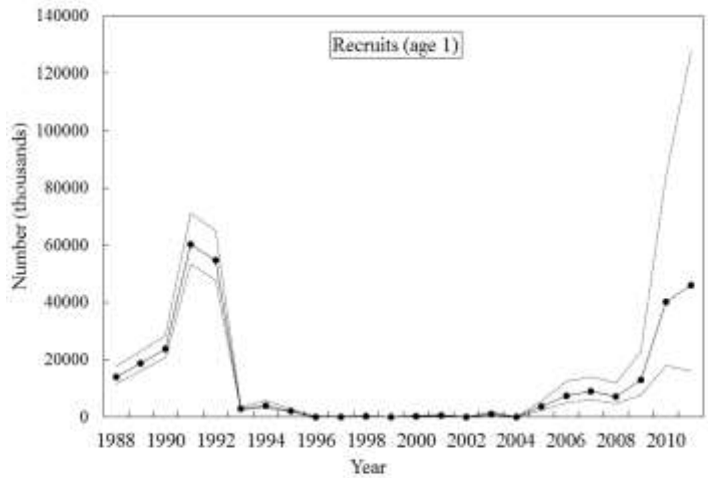


Fig. 6.6. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2011

Fishing mortality: *F* increased in 2010 and 2011 with the opening of the fishery (Fig. 6.7). F_{bar} in 2011 (0.339) was more than twice F_{max} (0.135).

Consistent with the changing age distribution in the catches of 2010 and 2011, the exploitation pattern in 2011 is much different than the 2010 estimate. In 2010, fishing mortality was relatively constant across ages 3-8+, but during 2011 the estimated fishing mortality on ages 6-8+ was almost double that on ages 3-5. This sudden change contributes to significant revisions in estimated yield-per-recruit reference points (Section g).

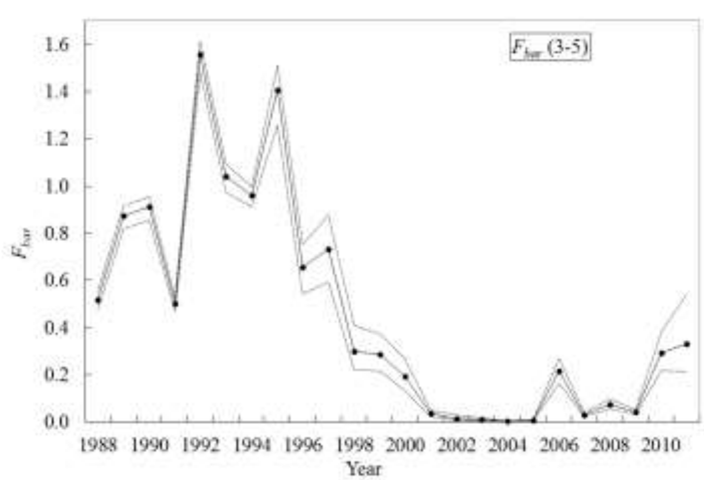


Fig. 6.7. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2011

Natural mortality: The posterior median of *M* estimated by the model (*M*=0.15) was considerably updated from the prior median (*M*=0.218).

e) Retrospective analysis

A six-year retrospective analysis with the Bayesian model was conducted by eliminating successive years of catch and survey data. Fig. 6.8 to 6.10 present the retrospective estimates of age 1 recruitment, SSB and F_{bar} at ages 3-5.

Retrospective analysis show a slight overestimation of recruitment in recent years except for 2009, that was underestimated (Fig. 6.8). SSB has been overestimated during the last three years (Fig. 6.9). Fishing mortality in recent years are consistent (Fig. 6.10).

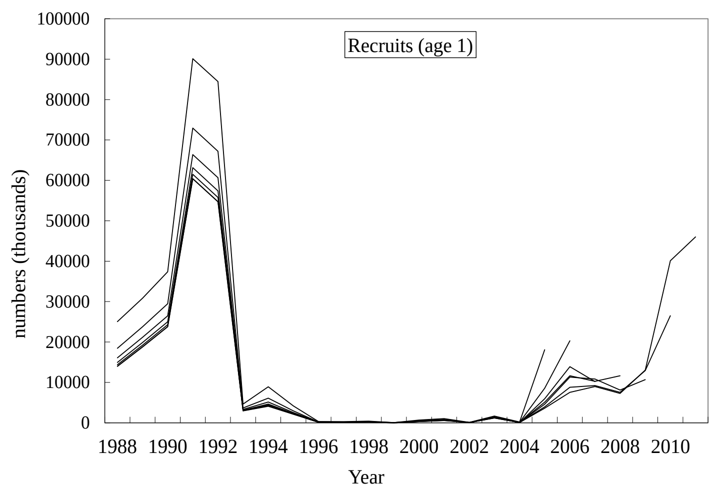


Fig. 6.8. Cod in Div. 3M: Retrospective results for recruitment

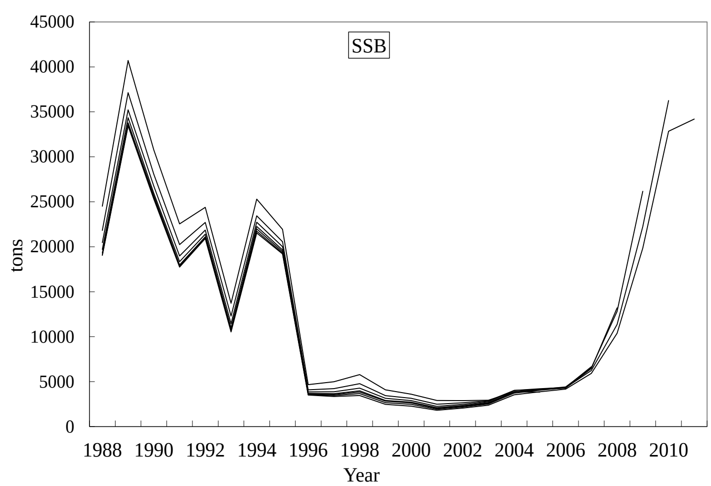


Fig. 6.9. Cod in Div. 3M: Retrospective results for SSB

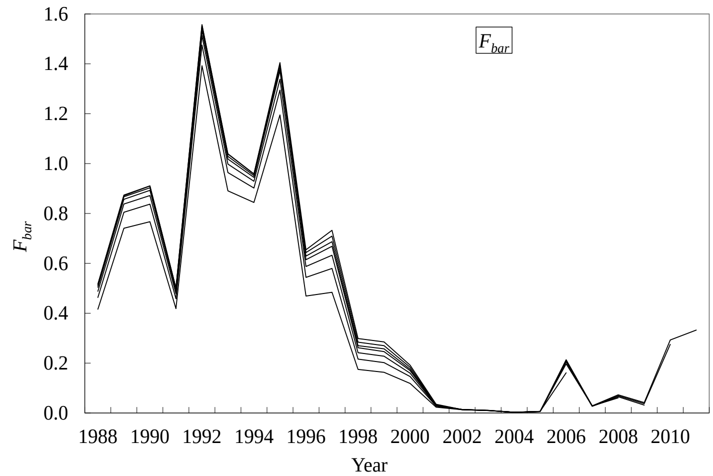


Fig. 6.10. Cod in Div. 3M: Retrospective results for F_{bar}.

f) State of the stock

SSB in 2011 is estimated to be well above B_{lim}. Recent recruitments are among the highest level of the time series, but these estimates are imprecise. Fishing mortality in 2011 is high, at the level of more than twice F_{max}.

g) Reference Points

STACFIS has previously estimated B_{lim} to be 14 000 t for this stock. SSB is well above B_{lim} in 2012. Fig. 6.11 shows a stock-recruitment plot. Fig. 6.12 shows a stock-F_{bar} plot.

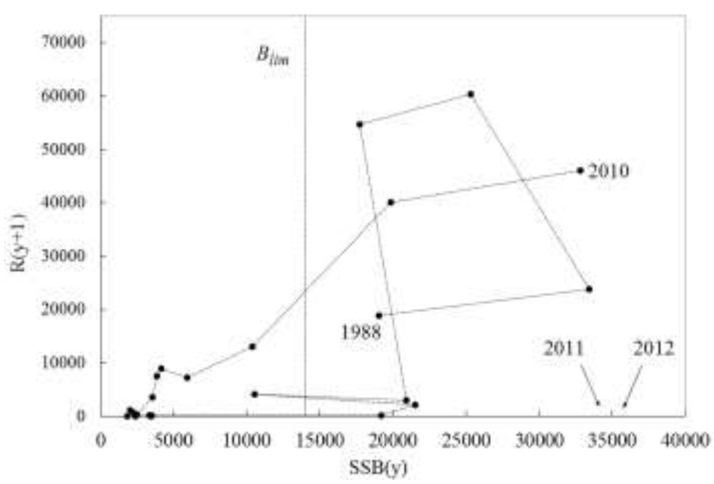


Fig. 6.11. Cod in Div. 3M: Stock-Recruitment (posterior medians) plot

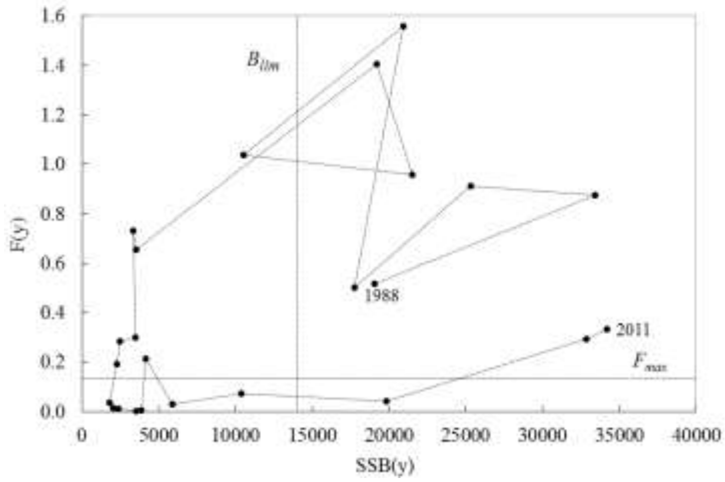


Fig. 6.12. Cod in Div. 3M: Stock-F_{bar}(3-5) (posterior medians) plot. B_{lim} and F_{max} are plotted in the graph.

Figure 6.13 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_{2011}. $F_{0.1}$ and F_{max} have been revised and they have changed substantially from last year's assessment due to the rapid changes in the values of the exploitation pattern and the biological parameters.

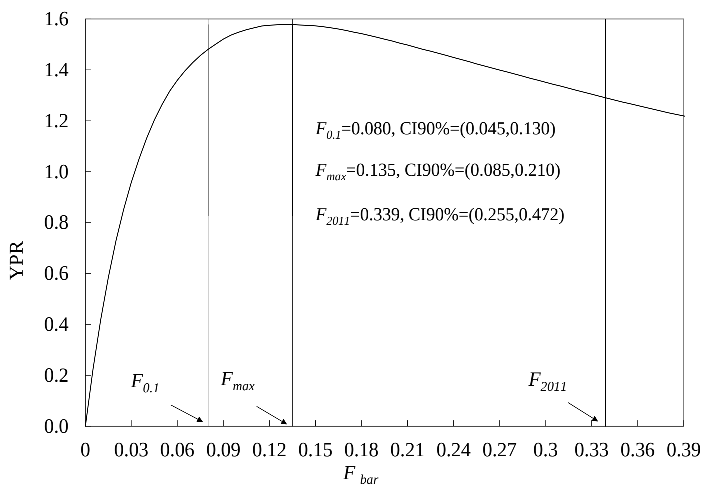


Fig. 6.13. Cod in Div. 3M: Bayesian Yield per recruit

h) Stock projections

Stochastic projections of the stock dynamics over a 3 year period (2013-2015) 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 2012: estimated from this assessment.

Recruitments for 2012-2015: Recruits per spawner were drawn randomly from the last seven years of the assessment (2005-2011), as these are the years in which recruitment has started to recover.

Maturity ogive: 2011 maturity ogive.

Natural mortality: 2011 natural mortality from the assessment results.

Weight-at-age in stock and weight-at-age in catch: 2011 weight-at-age in catch.

PR at age for 2012-2015: 2011 PR.

F_{bar}*(ages 3-5)*: Three scenarios were considered. All scenarios assumed that the Yield for 2012 is the established TAC (9 280 t):

(Scenario 1) $F_{bar}=F_{0.1}$ (median value = 0.08).

(Scenario 2) $F_{bar}=F_{max}$ (median value = 0.135).

(Scenario 3) $F_{bar}=F_{2011}$. (median value = 0.339).

Figures 6.14 to 6.16 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. 6.14 and 6.15). The removals associated with these F_{bar} levels are lower than those in the period before 1995 (Fig. 6.16).

Under all scenarios there is a very low probability (<5%) of SSB being below B_{lim}.

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=0.080)									
2012	57101	84107	124148	23632	36244	52898		9280	
2013	86966	131265	205140	40960	60023	86763	4329	8813	17173
2014	129002	194218	303926	71615	108249	167444			
$F_{bar}=F_{max}$ (median=0.135)									
2012	57195	84093	124008	23675	36180	52880		9280	
2013	87216	131836	205249	41007	59851	86906	7129	14113	26507
2014	122645	187176	294501	66422	101670	158863			
$F_{bar}=F_{2011}$ (median=0.339)									
2012	57066	84039	123950	23699	36168	53154		9280	
2013	87025	131711	204072	40793	60087	86622	18535	31517	53190
2014	103948	161107	256003	51353	81850	131261			

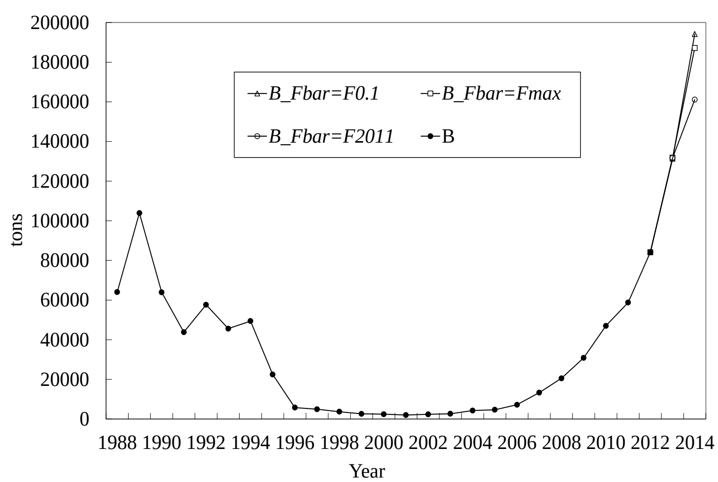


Fig. 6.14. Cod in Div. 3M: Projected Total Biomass under the three Scenarios.

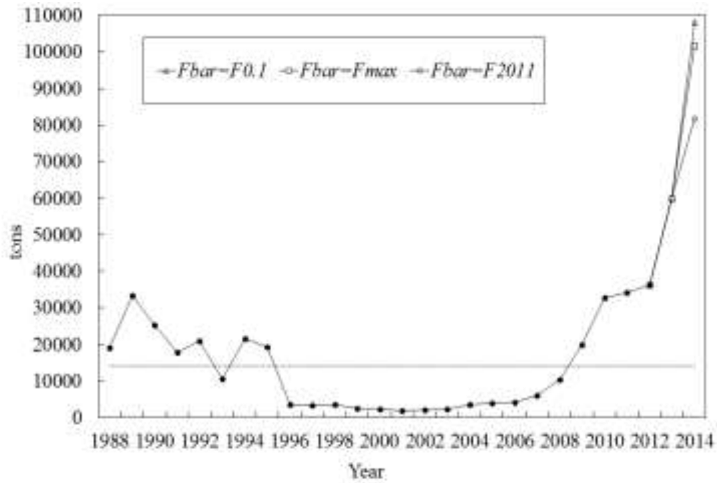


Fig. 6.15. Cod in Div. 3M: Projected SSB under the three Scenarios

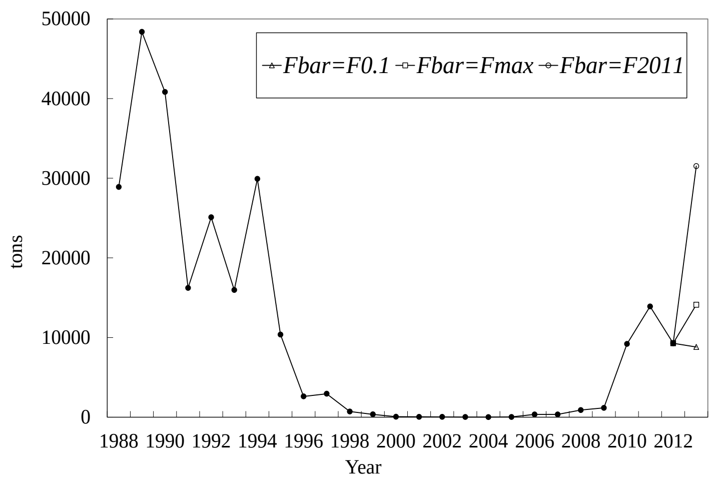


Fig. 6.16. Cod in Div. 3M: Projected removals under the three Scenarios

j) Research recommendations

For Cod in Div. 3M STACFIS **recommended** that *an age reader comparison exercise be conducted*.

STATUS: No progress and this recommendation is reiterated.

For Cod in Div. 3M STACFIS **recommended** that *the most recent catch at age figures be revised*.

The next full assessment for this stock will be in 2013.

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

Interim Monitoring Report (SCR Doc. 12/26, 27, 38; SCS Doc. 11/22, 12/8, 9)

a) Introduction

There are three species of redfish that are commercially fished on Flemish Cap; deep-sea redfish (*Sebastes mentella*), golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*). The term beaked redfish is used for *S. mentella* and *S. fasciatus* combined. Because of difficulties with identification and separation, all three species are reported together as 'redfish' in the commercial fishery. All stocks have both pelagic and demersal concentrations and long recruitment process to the bottom. Redfish species are long lived with slow growth.

i) Description of the fishery

The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-1999, when a minimum catch around 1 100 t was recorded mostly as bycatch 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 300 m, basically pursued by Portuguese bottom trawl and Russia pelagic trawl. Furthermore, the increase of cod catches and reopening of the Flemish Cap cod fishery in 2010 also contributed to the increase of redfish catch over the most recent years up to 9 700 t in 2011.

This new golden redfish fishery 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. If the 2008-2010 average beaked redfish proportion in the overall redfish catch is maintained in 2011, the predicted catch of beaked redfish in 2011 would be 4 600 t.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	5	5	5	5	5	5	8.5	10.0	10.0	6.5
TAC	5	5	5	5	5	5	8.5	10.0	10.0	6.5
STATLANT 21	2.0	3.1	6.4	6.3	5.6	7.9	8.7	8.5	9.7	
STACFIS Redfish total catch	1.9	2.9	6.6	7.2	6.7	8.5	11.3	8.5	9.7	
STACFIS Beaked redfish catch	1.9[1]	2.9[1]	4.1[1]	6.0	5.1	4.3	3.7	5.4	4.6[2]	

[1] Estimated beaked redfish catch plus estimated redfish bycatch in shrimp fishery
[2] Provisional

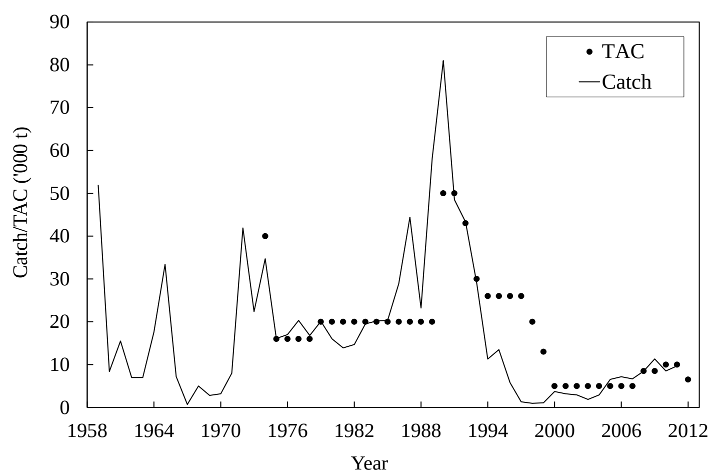


Fig. 7.1. Redfish in Div. 3M: total redfish catches and TACs.

b) Data Overview

Research surveys

Total biomass index given by the Flemish Cap EU survey declined on the first years of the interval until 1990, fluctuating at low level since then until 2003. A sequence of increasingly strong year classes (2000-2002) lead rapidly the stock biomass index to a maximum in 2006. The stock biomass index declined as fast as it went up and was in 2010 in the vicinity of the average level (1988-2011). Last year EU survey results indicate that in 2011 this recent decline has been halted and the stock biomass index was kept at the 2010 level. (Fig. 7.2).

Despite a sequence of abundant year classes and a low to very low exploitation regime over the last fifteen years, survey trends 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.

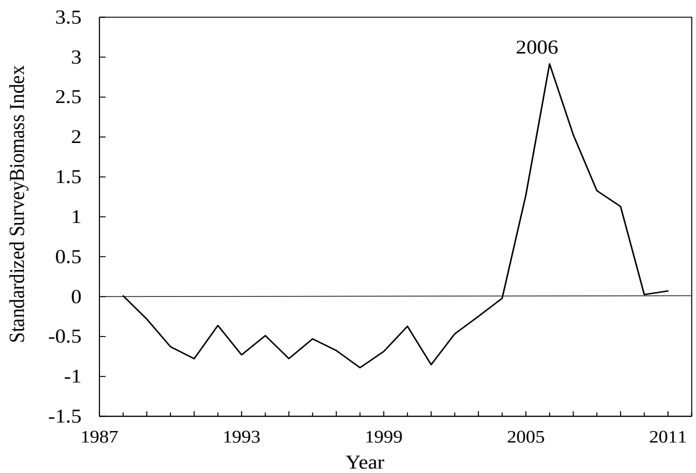


Fig. 7.2. Beaked redfish in Div. 3M: survey standardized total biomass index (1988-2011).

c) Conclusions

The perception of the stock status has not changed.

The next full assessment of the stock is planned for 2013.

d) Research recommendations

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

STATUS: Since the Div. 3M shrimp fishery is under a moratorium this recommendation is now out of context.

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*.

This recommendation has been addressed by several ecosystem and feeding studies presented in the Scientific Council 2012 June meeting. The common conclusion of these studies is that redfish consumption by cod in the Flemish Cap bank has increased over the second half of the 2000s up to present.

STATUS: This recommendation has been addressed on this meeting.

For redfish in Div. 3M STACFIS reiterated its **recommendation** that *the important line of ecosystem research based on the feeding sampling routine of the EU survey catch be done on an annual basis*.

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

Interim Monitoring Report (SCR Doc. 12/26; SCS Doc. 12/05, 06, 08)

a) Introduction

A total catch of 64 t was reported for 2011 (Fig. 8.1).

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
STACFIS	0.1	0.1	0.05	0.05	0.1	0.1	0.1	0.1	0.1	

ndf No directed fishing

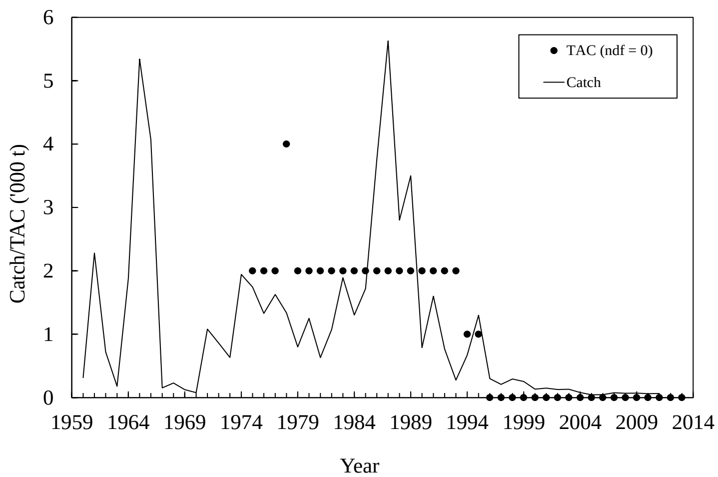


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs (ndf is plotted as 0 TAC).

b) Data Overview

The EU bottom trawl survey on Flemish Cap was conducted during 2011. The survey estimates remained at low levels as previous years (Fig. 8.2 and 8.3).

Recruitment from 1991 to 2005 was very weak. 2007-2009 surveys show the 2006-2008 year-classes to be stronger than cohorts seen since the early 1990s.

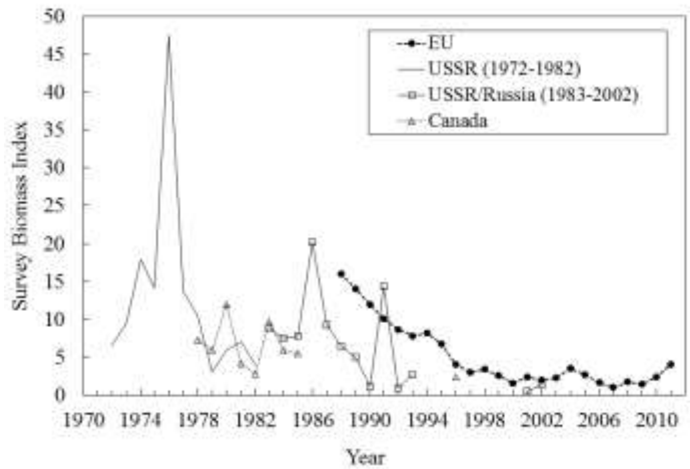


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys.

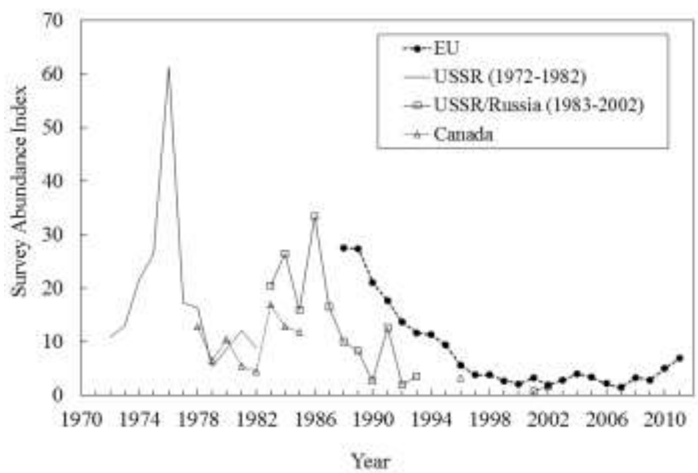


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys.

c) Conclusion

This stock continues to be in a very poor condition. Recruitment improved recently and these year classes are recruiting to SSB. Although there are signs of improved recruitment, there is no major change to the perception of the stock status.

The next full assessment is expected to be in 2014.

d) Research Recommendations

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 F_{bar} range, therefore STACFIS **recommended** that *others 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}.

STATUS (for all): Work is been done but no progress to report. All recommendations will be addressed during the next full assessment

C. STOCKS ON THE GRAND BANK: SA 3 AND DIV. 3LNO

Environmental Overview

(SCR Doc. 12/07, 12/09, SCS Doc. 12/14)

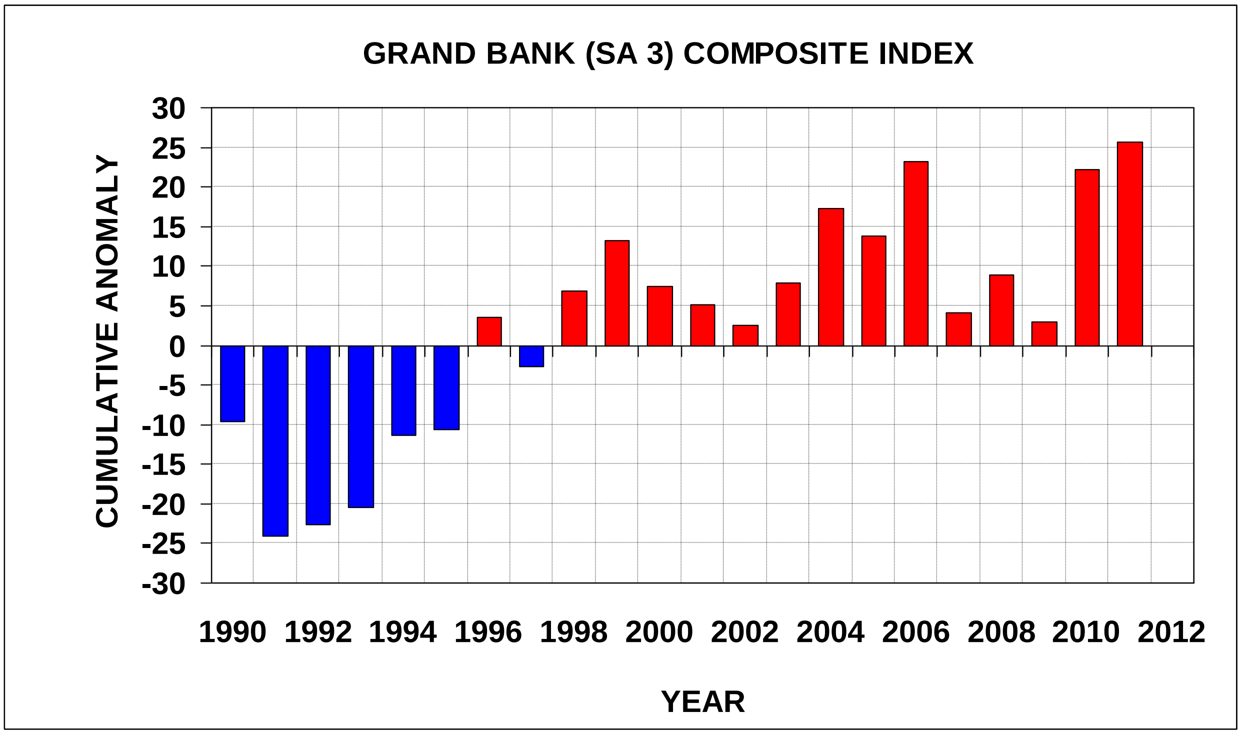


Fig. IV-3. Composite ocean climate index for NAFO Subarea 3 (SA3 Div. 3LNO) derived by summing the standardized anomalies.

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 2010/2011.

The composite climate index in Subarea 3 (Div. 3LNO) peaked in 2011 and has remained above normal since the late 1990s following an intense cooling period during the first-half of the 1990's (Fig. IV-3). The annual surface temperature at Station 27 (Div. 3L) having been near-normal or above normal since 2003, reached a 61-year high of 2.2 standard deviation (SD) above their long-term mean in 2006, decreased to near normal in 2007 and increased to above normal from 2008 to 2011. Bottom temperatures at Station 27 were the highest on record in 2011 at +3.3 SD. Bottom temperatures at Station 27 were above normal from 1996-2008, decreased to slightly below normal in 2009 but increased to the 3rd highest in 2010 at +1.7 SD and to the highest on record in 2011 at +3.3 SD. Vertically averaged temperatures also set record highs increasing to the 2nd highest on record in 2010 (+1.9 SD) and to the highest on record in 2011 at +2.9 SD. Annual vertically averaged salinities at Station 27 decreased from +1.0 SD in 2008 to about >1.0 SD below normal in 2010 and 2011, the freshest conditions since 1995. In 2011, the annual mean stratification decreased to the lowest since 1980 at 2.0 SD below normal, although the overall trend has been increasing over the past few decades. During 2011 the annual averaged mixed-layer depth was 1.6 SD deeper than normal. The winter and spring values were deeper than normal by 1 and 1.4 SD, respectively. In 3LNO, spring bottom temperatures were generally higher than normal and the warmest on record in 2011. Bottom temperatures during the autumn in Div. 3LNO generally ranged from <0.5°C on the northern Grand Bank and in the Avalon Channel to 3.5° - 4°C along the shelf edge in 2011. Over the southern areas, bottom temperatures ranged from 2° to 6°C with the warmest bottom waters found on the Southeast Shoal and along the edge of the Grand Bank in Div. 3O. Except for a few isolated areas autumn temperatures were above normal over the entire Div. 3LNO area with anomalies at 0.5° - 2°C above the long term mean.

9. Cod (*Gadus morhua*) in NAFO Div. 3NO

Interim Monitoring Report (SCR 12/12; SCS Doc. 12/05, 06, 08, 09)

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 826 t in 2011.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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	1.6	0.9	0.6	0.3	0.7	0.7	0.6	0.8	0.8	
STACFIS	4.3-5.5[1]	0.9	0.7	0.6	0.8	0.9	1.1	0.9	0.8	

[1] STACFIS could not precisely estimate the catch. Figures are the range of estimates.
ndf No directed fishery and bycatches of cod in fisheries targeting other species should be kept at the lowest possible level.

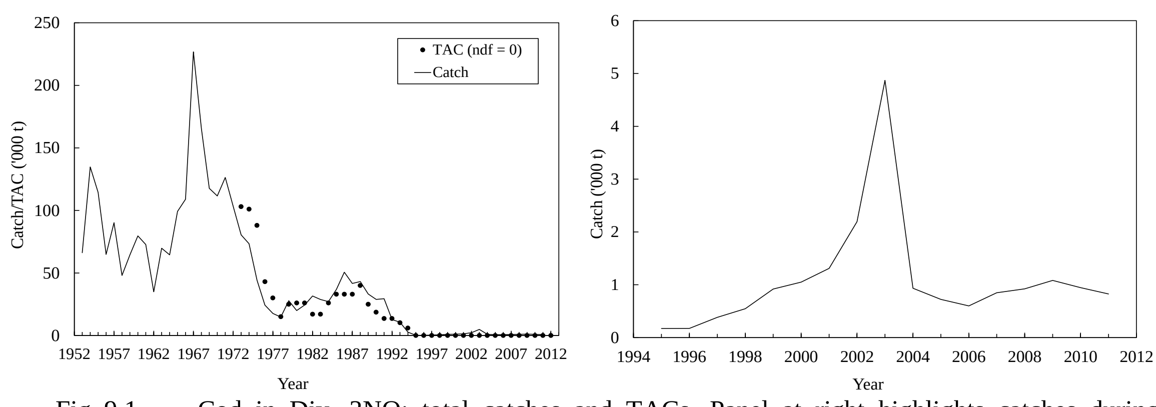


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) Data Overview

Canadian bottom trawl surveys. Canadian spring and autumn surveys were conducted in Div. 3NO during 2011. 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 remained at similar levels in 2011 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).

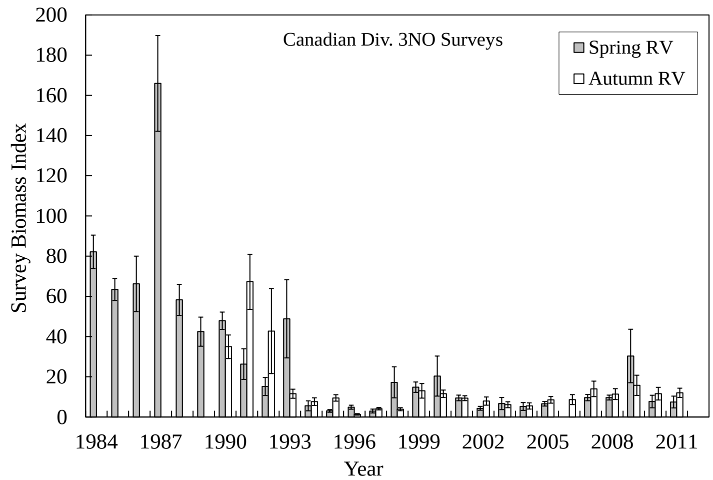


Fig. 9.2. Cod in Div. 3NO: survey biomass index (± 1 sd) from Canadian spring and autumn research surveys.

EU-Spain bottom trawl survey. Stratified-random surveys were conducted by EU-Spain in the NRA area of Div. 3NO in May-June in 2011. The mean weight per tow was relatively low and stable from 1997-2005 with the exception of 1998 and 2001 (Fig. 9.3). Since 2008 there has been a considerable increase in the index, with the highest estimate in the series in 2011. The increase was due to improved recruitment from the 2005-2007 year classes.

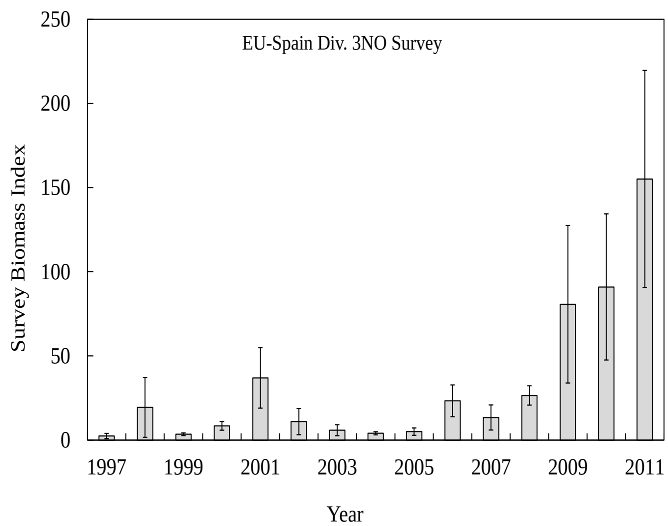


Fig. 9.3. Cod in Div. 3NO: survey biomass index (± 1 sd) from EU-Spain Div. 3NO surveys.

c) Conclusion

The most recent analytical assessment (2010) concluded that SSB was well below B_{lim} (60 000 t) in 2009. Canadian survey indices for 2010 and 2011 suggest a subsequent decline in the overall stock, whereas the EU-Spain survey indices have increased for the portion of the stock outside the Canadian EEZ. Overall, the 2011 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

(SCR Doc. 12/14, 32; SCS Doc. 12/5, 6, 8, 9)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3LN; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics.

Between 1959 and 1964 reported catches declined from 45 000 t to 10 000 t, oscillating over the next 21 years (1965-1985) around an average level of 21 000 t. Catches increased afterwards to a 79,000 t high in 1987 and fall steadily to a 450 t minimum reached in 1996. Catches were kept at a low level since then (450-3 000 t), until 2009.The NAFO Fisheries Commission implemented a moratorium on directed fishing for this stock between 1998 and 2009. The fishery reopen in 2010 with a TAC of 3 500 t. The Fisheries Commission endorsed the Scientific Council recommendation from the 2010 analytical assessment and set the TAC for 2011 and 2012 at 6 000 t. Catches increased in 2010 and 2011 to 4 100 t and 5 395 t (Fig. 10.1). Catches from EU-Portugal, Russian and Canadian fleets justified most of the increase on the redfish catch observed on divisions 3L and 3N in 2010 and 2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	6.0	6.0
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	6.0	6.0
STATLANT 21	1.0	0.7	0.4	0.2	0.2	0.4	0.3	3.1	5.4	
STACFIS	1.3	0.6	0.7	0.5	1.7	0.6	1.1	4.1	5.4	

ndf No directed fishery.

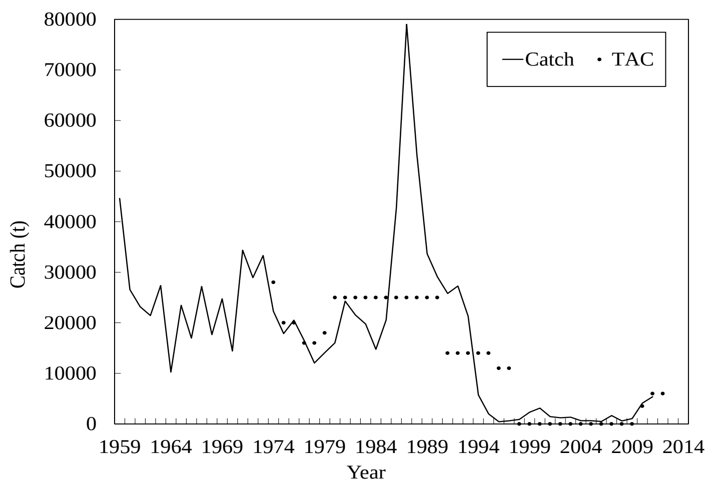


Fig. 10.1. Redfish in Div. 3LN: catches and TACs (No directed fishing is plotted as zero TAC)

b) Input Data

i) Commercial fishery data

Most of the commercial length sampling data available for the Div. 3LN beaked redfish stocks came, since 1990, from the Portuguese fisheries. Length sampling data from EU-Spain and from Russia were used to estimate the length composition of the bycatch for those fleets in several years. Above average mean lengths, an apparent stable length structure of the catch with no clear trends towards smaller or larger length groups and proportions in numbers of small redfish usually below 1%, are observed on most of the years of the 1990-2005 interval. However, well below average mean lengths occurred on most years from 2006 onwards coupled with high proportions of small redfish in the catch. Under a very low exploitation regime, such sudden drop on the mean lengths of the redfish bycatch in Div. 3LN on the most recent years would probably reflect the recruitment of above average year classes to the exploitable stock, from 4-5 years back in time.

ii) Research survey data

From 1978 onwards several stratified-random bottom trawl surveys have been conducted by Canada in various years and seasons in Div. 3L and in Div. 3N. Since 1991 two Canadian series of annual stratified-random surveys covered both Div. 3L and Div. 3N on a regular annual basis: a spring survey (May-Jun.) and an autumn survey (Sep.-Oct. 3N/Nov.-Dec. 3L for most years). No survey was carried out in spring 2006 on Div. 3N.

The design of the Canadian surveys was based on a stratification scheme down to 732 m for Div. 3LN. From 1996 onwards the stratification scheme has been updated to include depths down to 1 464 m (800 fathoms) but only the autumn surveys have swept strata below 732 m depth, most on Div. 3L. Until the autumn of 1995 the Canadians surveys were conducted with an Engels 145 high lift otter trawl with a small mesh liner (29 mm) in the codend and tows planned for 30 minute duration. Starting with the autumn 1995 survey in Div. 3LN, a Campelen 1800 survey gear was adopted with a 12 mm liner in the codend and 15 minute tows The Engel data were converted into Campelen equivalent units in the 1998 assessment.

Since 1983 Russian bottom trawl surveys in NAFO Div. 3LMNO turn to stratified-random, following the Canadian stratification for Subarea 3. On 1984 standard tows were set to half hour at 3.5 knots, with a standard gear. From 1984 until 1990, vessels conducting this survey were of the same tonnage class with the exception of 1985, when a vessel of smaller tonnage class was employed. This smaller category was later employed on the 1991 and 1993 surveys. On 1992 and 1994 Russian survey was carried out only in Div. 3L. On 1995 the Russian bottom trawl series in NAFO Sub area 3 was discontinued.

In 1995 EU-Spain started a new stratified-random bottom trawl spring (May-June) survey on NAFO Regulatory Area of Div. 3NO. Despite changes on the depth contour of the survey, all strata in the NRA to 732m were covered every year following the standard stratification. From 1998 onwards the Spanish survey was extended to 1464 m and in 2004 expanded to the Regulatory Area of Div. 3L. From 1995 until 2000 the survey was carried out by the Spanish stern trawler *C/V Playa de Menduiña* using a *Pedreira* bottom trawl net. In 2001 the *R/V Vizconde de Eza* , trawling with a *Campelen* net, replaced the commercial stern trawler. In order to maintain the data series obtained since 1995, comparative fishing trials were conducted in spring 2001 to develop conversion factors between the two fishing vessel and gear combinations. Former Div. 3NO redfish survey indices from C/V *Playa de Menduíña* have been transformed to R/V *Vizconde de Eza* units, and so the Div. 3N Spanish spring survey series (1995-2011) has been included in the assessment framework since 2010.

The survey biomass series used in the assessment framework and the female SSB survey series were standardized to zero mean and unit standard deviation and so presented on Figure 10.2. From the first half of the 1980s to the first half of the 1990s Canadian survey data in Div. 3L and Russian bottom trawl surveys in Div. 3LN suggests that stock size suffered a substantial reduction. Redfish survey bottom biomass in Div. 3LN remained in general below average level until it started a discrete and discontinuous increase from 2002 onwards. 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 2011, 100% of the biomass indices were above the average of their own series on 1978-1985, only 13% on 1986-2005, and 68% on 2006-2011.

Both 1991-2011 spring and autumn standardized female SSB series for Div. 3LN combined showed very similar patterns to correspondent survey biomass series.

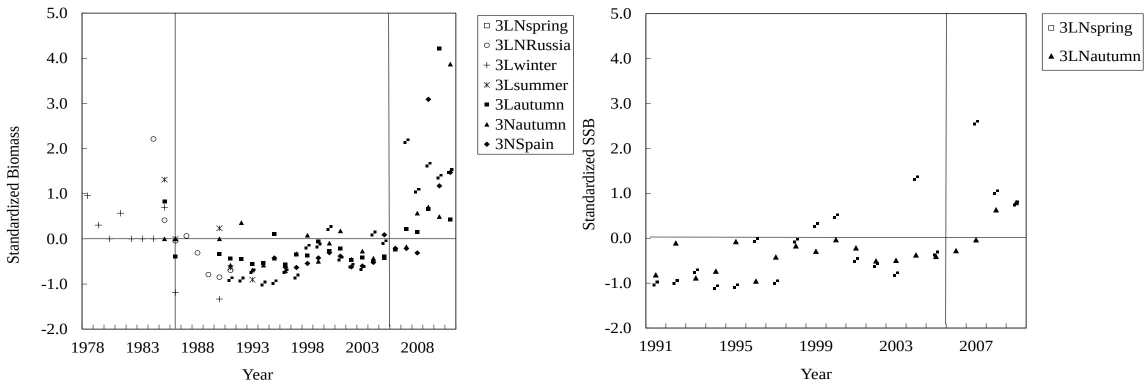


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2011, left panel) and female spawning biomass (1991-2011, right panel). Each series standardized to zero mean and unit standard deviation.

During the first half of the 1990's on both survey series the mean lengths were below or slightly above average. Mean lengths on most of the years between 1996 and 2004 were well above the mean, reflecting a shift on the stock length structure to larger individuals probably justified by a higher survival of the year classes through this interval. However since 2005 mean lengths generally fall to below average, just as observed on the bycatch and commercial catch of recent years (Fig. 10.3). This below average pattern on surveys and catch at length seems to confirm the occurrence of pulses on recruitment.

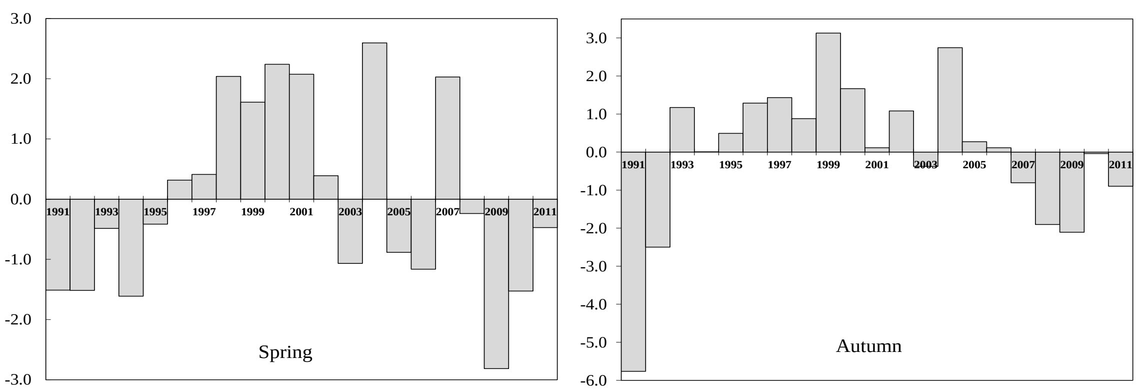


Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2011.

iii) Recruitment

There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN in the range of 12-14 cm for 1991 and 15-18cm for 1992. From commercial catch and Canadian survey length data there are signs of recent recruitment of above average year classes to the exploitable stock.

c) Assessment Results

An ASPIC model framework (Prager, 1994), was used to assess the status of the stock. This framework uses a non-equilibrium Schaeffer surplus production model to describe stock dynamics. All 1959-2010 catches used in this assessment are the catches adopted by STACFIS for this stock. A catch of 5 768 t, taken from the NAFO STATLANT 21A on May 22nd, was used in this assessment as the redfish catch in Div. 3LN for 2011.

The input data were:

I1 (Statlant CPUE)	Statlant cpue for Div. 3LN, $_{1959-1994}$ & catch for Div. 3LN $_{1959-2011}$
I2 (3LN spring survey)	Canadian spring survey biomass for Div. 3LN, $_{1991-2005,\ 2007-2011}$
I3 (3N autumn survey)	Canadian autumn survey biomass for Div. 3N, $_{1991,\ 1993-2011}$
I4 (3LN Power russian survey)	Russian spring survey biomass for Div. 3LN , $_{1984-1991\ (Power\ and\ Vaskov,1992)}$
I5 (3L winter survey)	Canadian winter survey biomass for Div. 3L, $_{1985-1986\ and\ 1990}$
I6 (3L summer survey)	Canadian summer survey biomass for Div. 3L$_{,\ 1978-1979,\ 1981,1984-1985,\ 1990-1991and\ 1993}$
I7 (3L autumn survey)	Canadian autumn survey biomass for Div. 3L, $_{1985-1986,\ 1990-1994,\ 1996-2011}$
I8 (3N spring spanish survey)	Spanish survey biomass for Div. 3N, $_{1995-2011}$

The 2009 Spanish spring biomass index for Div. 3N has an enormously high magnitude, corresponding to more than a ten times fold increase from the previous year. This jump can only be compared to the isolated highs observed in autumn 1992 for Div. 3N and 1995 for Div. 3L, that have been considered outliers of the respective survey biomass series and excluded from the ASPIC framework. But on recent years smaller bumps have also been observed in the other actual series, disturbing the gradual survey biomass increase observed in all of them:

- On 2007 the Div. 3LN spring survey records a 3.3 fold increase from 2005 (no 2006 survey on Div. 3N).
- On 2010 the Div. 3L autumn survey records a 3.7 fold increase from 2009, and
- On 2011 the Div. 3N autumn survey records a 3.6 fold increase from 2010

These substantial increases result from one or two large redfish hauls within a few strata that represent a large proportion of the swept area biomass and the likelihood of their occurrence is expected to increase as stock gets bigger.

Four input options, corresponding to four possible arrangements related with the Spanish survey and with the above mentioned jumps on the spring and both autumn series, were used to test the goodness of fit of the model to the available survey data. An overview of the exploratory analysis under a traffic light rating frame lead to the conclusion that so far the model will perform better without the Spanish survey on Div. 3N and the recent outliers of the Div. 3LN spring survey (2007), of the Div. 3L autumn survey (2010) and of the Div. 3N autumn survey (2011). Also the comparison of key parameters and trajectories with the previous 2010 $\text{ASPIC}_{\text{fit}}$ assessment confirms that the chosen input option represents the consistent update of the survey data framework adopted on the ASPIC 2008.

Apart the exclusion of the Spanish series and of the 2007 spring Div. 3LN point, two out of the six newly available survey points from the last assessment until now have to be excluded from the 2012 ASPIC framework. STACFIS expressed its concern that if the biomass indices continue to have these large outliers, this model may not be appropriate to capture future stock dynamics.

Different starting values for key parameters, different random number seeds and different magnitudes of last year surveys were used to test the robustness of the $\text{ASPIC}_{\text{fit}}$ 2012 formulation. The catch and seed related options arrived to the same or very similar solutions, showing that the ASPIC results given by the chosen formulation are insensitive to changes on first value/default inputs chosen to initialize the assessment. Small variability is induced on the trajectories of relative biomass and fishing mortality by variability on last year surveys, in line with the logistic model chosen for biomass growth.

A 2011-2009 $\text{ASPIC}_{\text{fit}}$ retrospective analysis was carried out. From one year to the next ASPIC assessments over estimate biomass (and F_{msy}) and under estimate fishing mortality (and MSY and B_{msy}) at relatively small rates (4%-9%). These retrospective patterns are the model response to the general increase of the still standing survey series, recorded over the most recent years.

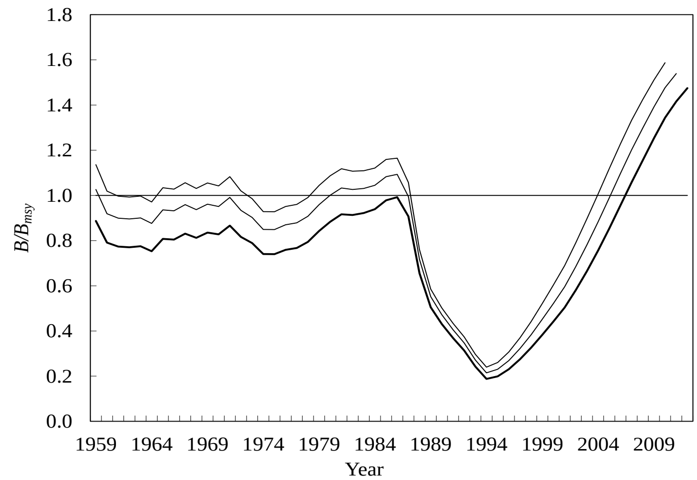


Fig. 10.4a. Redfish in Div. 3LN: Retrospective *B/B*$_{msy}$ from ASPIC$_{\text{last year 2011-2009}}$

The ASPIC 2012 input formulation runs on both deterministic (FIT) and bootstrap (BOT) mode with 1000 trials. The previous ASPIC$_{bot}$ 2010 assessment (with the 2010 survey input framework) was also extended to 2010-2011 by a short term projection with the catches from the last couple of years.

Correlation among the majority of possible combinations of surveys is high but the model has a relative poor fit to most input series due to the usual wide inter annual variability of redfish abundance indices. Patterns on residuals between observed and model generated values are observed, as in previous assessments.

Nevertheless these diagnostic features have little impact on the robustness of the ASPIC$_{bot}$ 2012 results, as pointed out by (Fig. 10.4b, 10.4.c and 10.4d; Table 10.1):

- Small bias between the bias corrected and the point estimates (< 10%) for all key parameters,
- *B/B*$_{msy}$ and *F/F*$_{msy}$ point estimate trajectories sticking to their bias corrected ones,
- While keeping their un-skew track far from their 80% CL's boundaries (Fig. 9c and 9d),
- Both 2012 and 2010 ASPIC$_{bot}$ assessments gave very similar results.

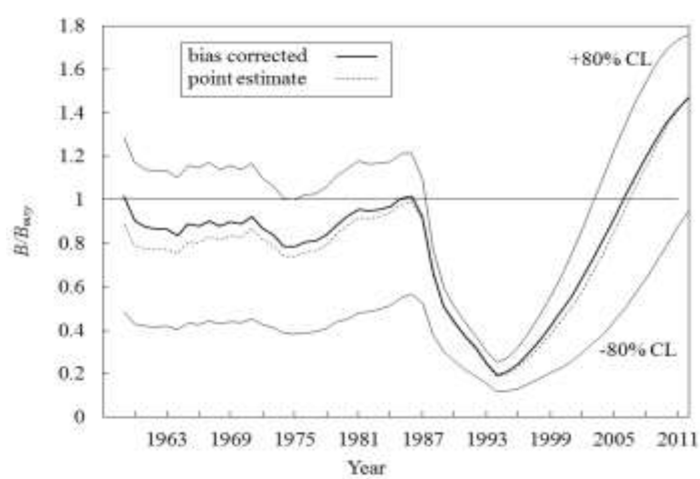


Fig. 10.4b. Redfish in Div. 3LN: *B/B*$_{msy}$ 1959-2012 trajectories (point estimate and bias corrected with approximate 80% CL's).

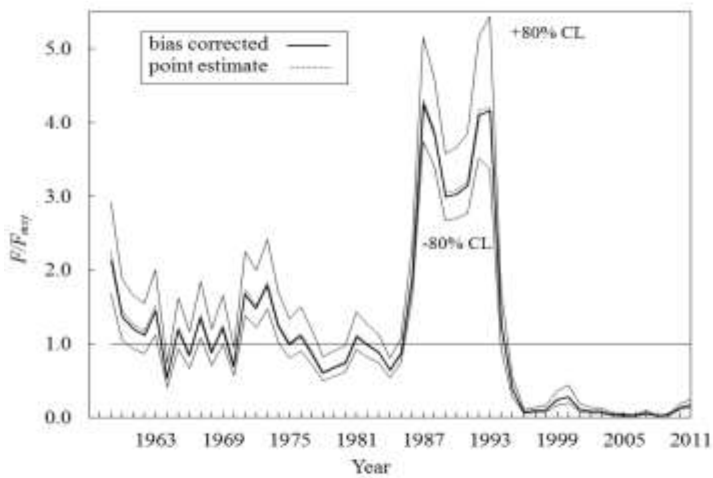


Fig. 10.4c. Redfish in Div. 3LN: F/F_{msy} 1959-2010 trajectories (point estimate and bias corrected with approximate 80% CLs).

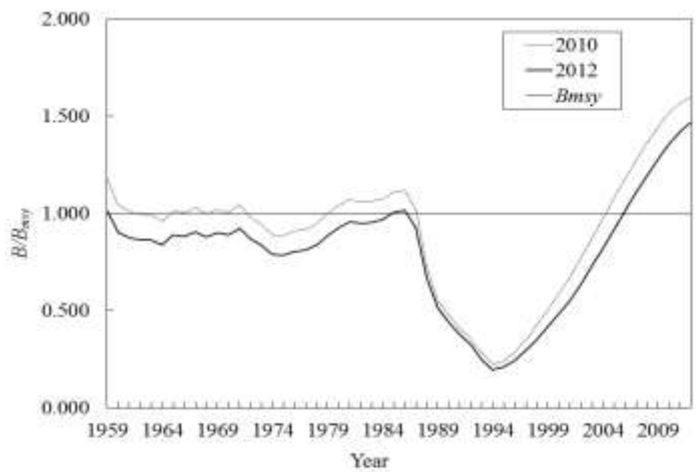


Fig. 10.4d. Redfish in Div. 3LN: B/B_{msy} 1959-2012 trajectories from 2012 and 2010 (extended) $ASPIC_{bot}$ assessments.

Table 10.1. Summary of the ASPIC 2012 results from bootstrapped analysis.

Param. name	ASPIC assessment	Point estimate	Bias corrected	Estimated bias in pt estimate	Estimated relative bias	Bias-corrected approximate confidence limits 80% lower	80% upper	50% lower	50% upper	Inter-quartile range	Relative IQ range
B1/K	2012	0.443	**0.507**	0.064	14.37%	0.241	0.643	0.315	0.519	0.204	0.460
K	2012	450300	**466510**	16210	3.60%	351100	747600	398800	608400	209700	0.466
MSY	2012	23700	**24799**	1099	4.64%	21360	31580	22430	26430	4002	0.169
Ye Last year+1	2012	18360	**17642**	-718	-3.91%	10640	32820	14670	26200	11530	0.628
Bmsy	2012	225100	**233203**	8103	3.60%	175600	373800	199400	304200	104800	0.466
Fmsy	2012	0.105	**0.111**	0.006	5.50%	0.082	0.131	0.090	0.116	0.027	0.253
B Last year+1/Bmsy	2012	1.475	**1.470**	-0.005	-0.35%	0.950	1.761	1.164	1.637	0.473	0.321
F Last year/Fmsy	2012	0.168	**0.170**	0.00196	1.16%	0.139	0.241	0.153	0.204	0.050	0.299

The model results suggest a maximum sustainable yield (MSY) of 25 000 t that can be produced with a fishing mortality of 0.11 when stock biomass is at B_{msy} level. Relative biomass was slightly below B_{msy} for most of the former years up to 1987, supporting a fishing mortality at or moderately above F_{msy}. Between 1986 and 1992 catches were higher than MSY (26 000 t-79 000 t), pushing fishing mortality well above F_{msy} from 1986 until 1993. Those eight years of heavy over-fishing determine the fall of biomass from B_{msy} in 1986 to 19% B_{msy} in 1994, when a minimum stock size is recorded. Since 1996 fishing mortality was kept at low to very low levels. Over the moratorium years biomass was allowed to increase and is now above B_{msy}.

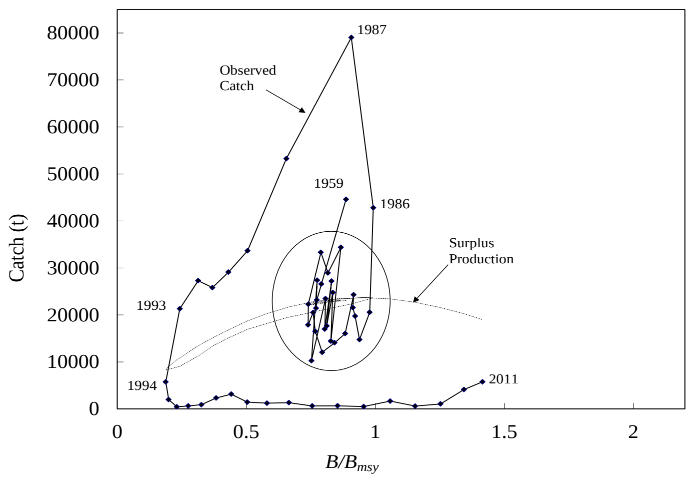


Fig. 10.4e. Redfish in Div. 3LN: Catch versus Surplus Production from ASPIC$_{fit}$ 2012

Catch versus surplus production trajectories are presented on Fig. 10.4e. From 1960 till 1985 catches form a scattered cloud of points around surplus production curve. On 1986-1987 catches rise well above the surplus production and though declining continuously since then were still above equilibrium yield in 1993. Estimated catch has been well below surplus production levels since 1994.

Biomass: Relative biomass was close to B_{msy} for most years up to 1987. Biomass decreased from 1987 to a minimum in 1994. During the moratorium years biomass increased and is now above B_{msy} .

Fishing mortality: Fishing mortality has been low since 1995.

Recruitment: From commercial catch and Canadian survey length data there are signs of recent recruitment of above average year classes to the exploitable stock.

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

d) Reference Points

The ASPIC bias corrected results were put under the precautionary framework (Fig. 10.5). The trajectory presented shows a stock slightly below B_{msy} under exploitation above F_{msy} through 25 years in a row (1960-1985). The stock rapidly declined afterwards to below B_{lim} in 1993 after fishing mortality rises to well above F_{msy} (1987-1993). Biomass gradually approaches and finally surpasses B_{msy} with fishing mortality being kept at a very low level since 1995.

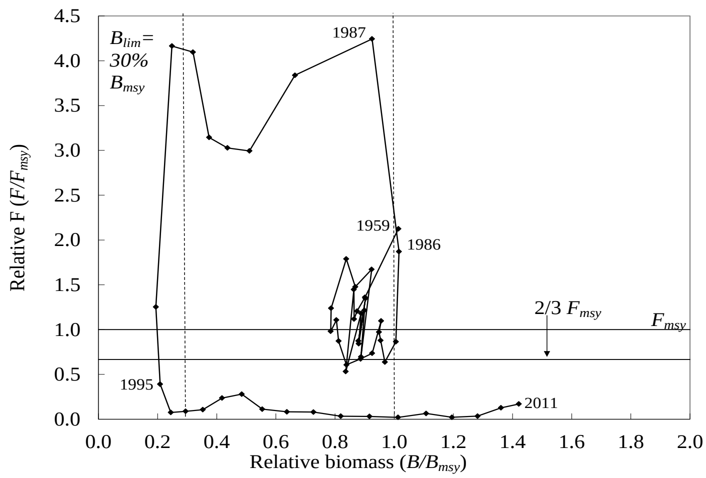


Fig. 10.5. Redfish in Div. 3LN: stock trajectory under a precautionary framework for $ASPIC_{bot}$ 2012.

e) Projections

Four ASPIC short term stochastic projections were carried out assuming a *status quo* catch for 2012, forwarded with increasing options of constant fishing mortality on 2013 and 2014, from $F_{statusquo}$ to 2/3 F_{msy} , stopping at 1/6 F_{msy} and 2/3 F_{msy} in between (Table 10.2a and 10.2b; Fig. 10.6). For all projection options considered the lower 80% confidence limit of the projected relative biomass trajectory being is at or above B_{msy} in 2013-2015.

Table 10.2. Short term projections for redfish in Div. 3LN. The 10^{th}, 50^{th}, and 90^{th} percentiles of projected B/ B_{msy} , F/ F_{msy} and catch (t) are shown, for projected F values of $F_{statusquo}$, 1/6 F_{msy}, 1/3 F_{msy} and 2/3 F_{msy}. *Status quo* catch for 2012.

Fsatutsquo	percentiles			**1/6 Fmsy**	percentiles		
Year	10	50	90	Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy				BIOMASS RELATIVE TO Bmsy			
2012	0.950	**1.470**	1.761	2012	0.950	**1.470**	1.761
2013	1.023	**1.514**	1.782	2013	1.023	**1.514**	1.782
2014	1.078	**1.554**	1.797	2014	1.079	**1.554**	1.797
2015	1.151	**1.588**	1.811	2015	1.151	**1.589**	1.811
FISHING MORTALITY RELATIVE TO Fmsy				FISHING MORTALITY RELATIVE TO Fmsy			
2012	0.137	**0.164**	0.228	2012	0.137	**0.164**	0.228
2013	0.139	**0.170**	0.241	2013	0.138	**0.169**	0.238
2014	0.139	**0.170**	0.241	2014	0.138	**0.169**	0.238
YIELDS FOR 2013 AND 2014				YIELDS FOR 2013 AND 2014			
2012	5768	**5768**	5768	2012	5768	**5768**	5768
2013	5915	**6172**	6643	2013	5858	**6113**	6579
2014	5967	**6346**	7058	2014	5910	**6287**	6991
1/3 Fmsy	percentiles			**2/3 Fmsy**	percentiles		
Year	10	**50**	90	Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy				BIOMASS RELATIVE TO Bmsy			
2012	0.950	**1.470**	1.761	2012	0.950	**1.470**	1.761
2013	1.023	**1.514**	1.782	2013	1.023	**1.514**	1.782
2014	1.059	**1.528**	1.768	2014	1.030	**1.478**	1.711
2015	1.120	**1.541**	1.760	2015	1.037	**1.450**	1.657
FISHING MORTALITY RELATIVE TO Fmsy				FISHING MORTALITY RELATIVE TO Fmsy			
2012	0.137	**0.164**	0.228	2012	0.137	**0.164**	0.228
2013	0.275	**0.337**	0.477	2013	0.550	**0.675**	0.953
2014	0.275	**0.337**	0.477	2014	0.550	**0.675**	0.953
YIELDS FOR 2013 AND 2014				YIELDS FOR 2013 AND 2014			
2012	5768	**5768**	5768	2012	5768	**5768**	5768
2013	11620	**12126**	13050	2013	22850	**23830**	25640
2014	11560	**12277**	13650	2014	22100	**23397**	26060

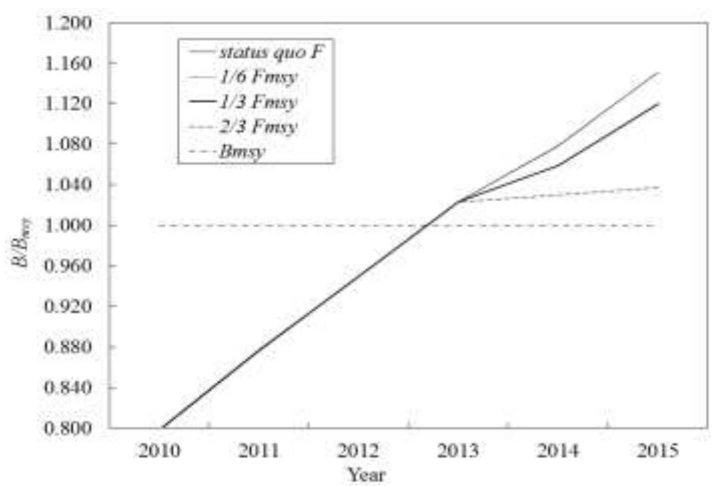


Fig. 10.6. Redfish in Div. 3LN: 2010-2015 bias corrected B/B_{msy} trajectories under several 2013-2014 F/F_{msy} options.

Most recent catches continue to be at a low level on the historical context of this fishery and the response of the stock to a direct fishery of the magnitude of years between the mid-1960s and the mid-1980s is unknown. Therefore, these projection results which indicate substantial increases in projected yield should be treated with caution.

e) Research Recommendations

For redfish in Div. 3LN STACFIS **recommended** that, *in order to prevent increasing unfitness of the ASPIC model to most recent survey data, alternate age based models be explored with the existing data. To undertake such type of assessment Div. 3LN redfish age length keys for the 1990s and 2000s should be provided*.

For redfish in Div. 3LM STACFIS also **recommended**, *in order to allow the fitness of the ASPIC model to the full length of the main survey series, the review of appropriate methods to recalculate survey indices*.

The next full assessment of this stock will be in 2014.

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO

(SCS Doc. 12/4, 5, 8, 9, 14; SCR Doc. 12/6, 12, 17, 33, 34)

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. This year, STACFIS only had STATLANT 21A available as estimates of catches in 2011. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessment for this stock.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	3.7	2.7	2.4	0.9	1.5	1.9	1.8	2.0	1.2	
STACFIS	6.9-10.6	6.2	4.1	2.8	3.6	2.5	3.0	2.9	na	

[1] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishery
na not available

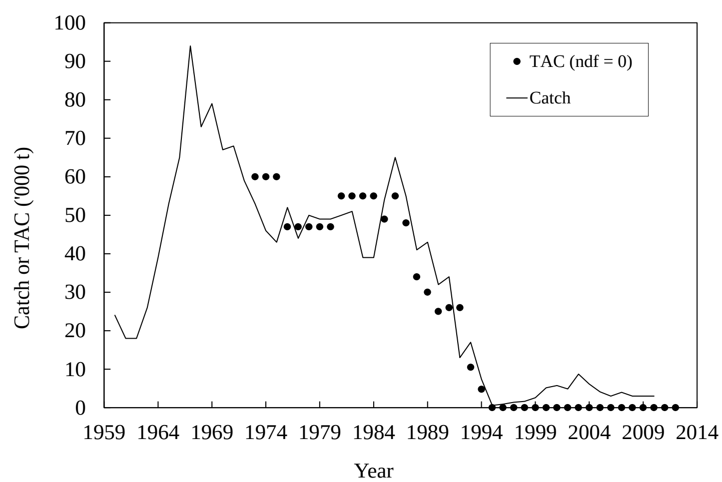


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC. There is no catch in plot for 2011.

b) Input Data

Biomass and abundance data were available from: annual Canadian spring (1985-2011) and autumn (1990-2011) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2011). Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2011.

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 2011 bycatch in the Canadian fishery and length sampling of bycatch in the Canadian, EU-Spain, EU-Portugal and Russian (only two length frequency samples) fisheries. STACFIS could not estimate total catch for 2011, therefore the 2011 catch-at-age was not calculated.

In 2011 American plaice were taken as bycatch in the Canadian yellowtail fishery, EU-Spain and EU-Portugal skate, redfish and Greenland halibut fisheries. Length frequency data were available from the Canadian bycatch of American plaice in Div. 3LNO, mainly from the yellowtail fishery. Samples were taken from all 3 Divisions, and lengths ranged from 24-70 cm, with a peak around 38 cm. The bycatch for EU-Spain ranged in length from 17-70 cm, with a peak at 34-38 cm. The bycatch in the EU-Portugal fishery consisted of American plaice ranging from 14-56 cm, with a peak at 26-34 cm. The small amount of sampling data available for Russia indicated a peak at 33 cm and another at 43 cm.

ii) Research survey data

Canadian stratified-random bottom trawl surveys. Biomass and abundance 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 biomass estimate increased in 2010 and again in 2011. The abundance index follows a similar trend. 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.

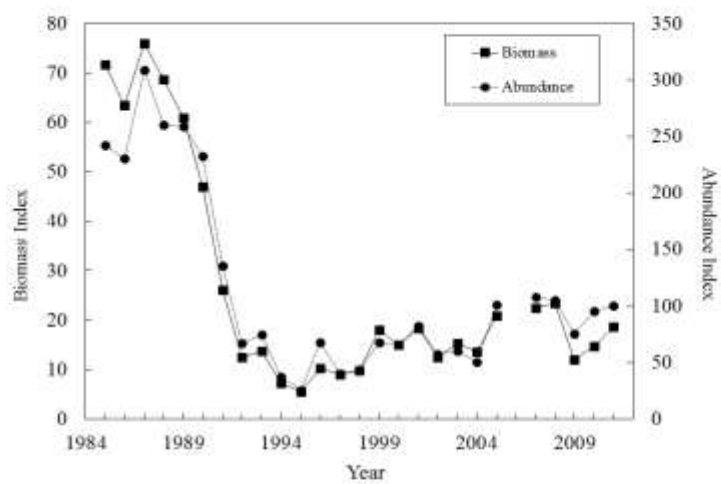


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys (Data prior to 1996 are Campelen equivalents and since then are Campelen).

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 proportion of fish aged 0-5 years is somewhat lower in 2011 but still above the average of the time series.

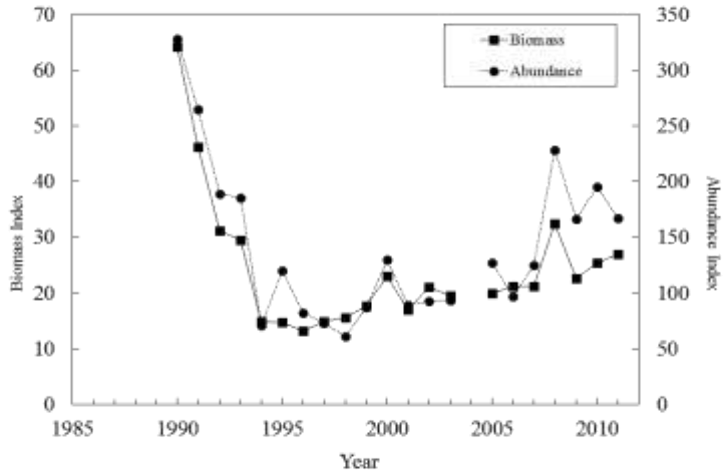


Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys (Data prior to 1995 are Campelen equivalents and since then are Campelen).

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. In more recent years the stock appears more heavily concentrated in Div. 3N in the NAFO Regulatory Area. Results from Canadian spring and autumn surveys both suggest that more than 50% of the stock biomass was located in Div. 3N in 2011.

EU-Spain Div. 3NO Survey. From 1998-2011, 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.

Although variable, generally the biomass and abundance indices declined from 2006-2009 and have been increasing since then.

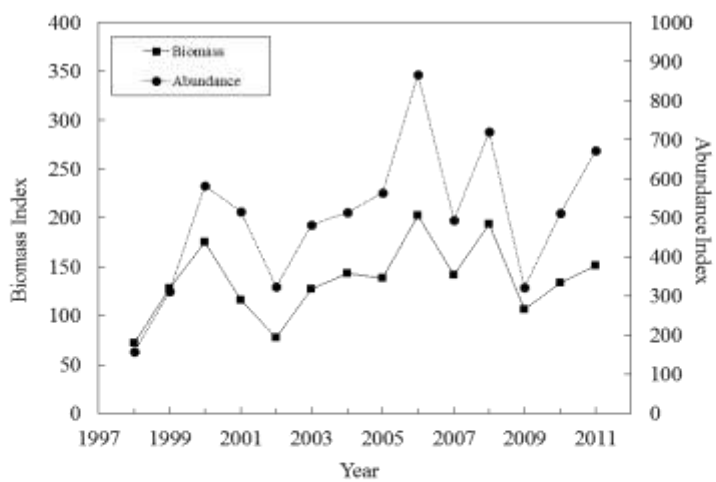


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from the EU-Spain Div. 3NO survey (Data prior to 2001 are Campelen equivalents and since then are Campelen).

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 1960s to mid-1970s, with perhaps a slight increase over that time period. Male A_{50} then began a fairly steady decline to the 1991 cohort which had an A_{50} of just over 3 years. Male A_{50} has increased somewhat but is still below the 1960s and 1970s with an A_{50} of about 4 years compared to 6 years at the beginning of the time series. For females, estimates of A_{50} have shown a large, almost continuous decline, since the beginning of the time series. For females the A_{50} for recent cohorts is less than 8 years compared to 11 years for cohorts at the beginning of the time series.

L_{50} declined for both sexes but increased in recent cohorts. The recent 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 33-34 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 2011. 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) Assessment Results

Since STACFIS was not able to estimate total catch, the analytical assessment using the ADAPTive framework could not be updated in 2012. During the previous assessment in 2011, STACFIS concluded that:

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 at the start of 2011 was 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.

The 2012 assessment does not indicate a change in the status of the stock, based on last year's analytical model and the 2011 survey results.

d) Precautionary Reference Points

Based on the 2011 assessment the biomass for this stock is estimated to be below B_{lim} (50 000 t) and fishing mortality in 2010 was below F_{lim} (0.3).

e) Short Term Considerations

Simulations were carried out in 2011 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).

SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11). SSB was projected to have a 50% probability of reaching B_{lim} by the start of 2014 (i.e. end of 2013) when F=0 (Table 13.1). The current projections predicted 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 2014.

f) Research Recommendations

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.*

STATUS: ADAPT model formulations were explored in order to compare the effect of estimating *F*ratio to the current formulation with an *F* ratio constraint of 1. Despite determining that estimating *F*ratio over the survey time period in blocks gave a slightly lower overall mean square residual (MSR) and lower MSR on ages, it was sensitive to the period of time that the stock collapsed and the period of low catches afterward. Output from the model using this formulation indicated that it builds a population in the 1980s which is not consistent with the perception of the stock based on surveys. The retrospective pattern when *F*ratio was estimated was large. Based on these results, and since it was concluded that the current model formulation has a good fit with small error on the population number estimates and a small retrospective pattern, it was recommended that there be no change to the current assessment (NAFO SCR Doc. 12/17).

STACFIS **recommended** that *investigations be undertaken to compare ages obtained by current and former Canadian age readers.*

STATUS: Work is ongoing.

12. Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO

Interim Monitoring Report (SCS 12/05, 12/08, 12/09, 12/14)

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, were very low. The low catches since 2006 were related to reduced Canadian effort in the fishery due to various market and economic reasons.

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

	2003[1]	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	14.5	14.5	15.0	15.0	15.5	15.5	< 85% F_{msy}[2]	< 85% F_{msy}[2]	< 85% F_{msy}[2]	< 85% F_{msy}[2]
TAC	14.5	14.5	15.0	15.0	15.5	15.5	17	17	17	17
STATLANT 21	13.3	13.1	13.9	0.6	4.4	11.3	5.9	9.3	5.2	
STACFIS	13.5-14.1	13.4	13.9	0.9	4.6	11.4	6.2	9.4	5.2	

[1] In 2003, STACFIS could not precisely estimate the catch.
[2] SC recommended any TAC up to 85% F_{msy} in 2009 to 2012.

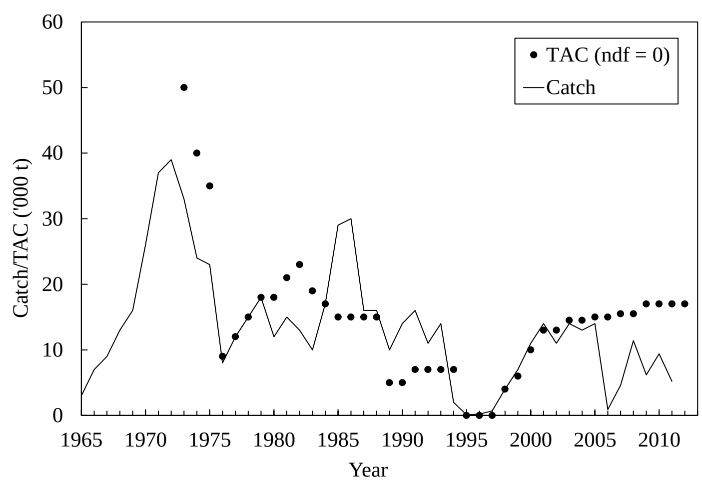


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

b) Data Overview

i) Research survey data

Canadian stratified-random spring surveys. Problems with the Canadian survey vessel resulted in incomplete coverage, particularly in Div. 3N, in the 2006 spring survey, and survey results in that year may not be comparable with those in other years. The index of trawlable biomass in 2008 was the highest in the series, declined in 2009, but increased in 2010 and 2011. Since 1999, the index of trawlable biomass has been variable, but remains well above the level of the late 1980s and early 1990s.

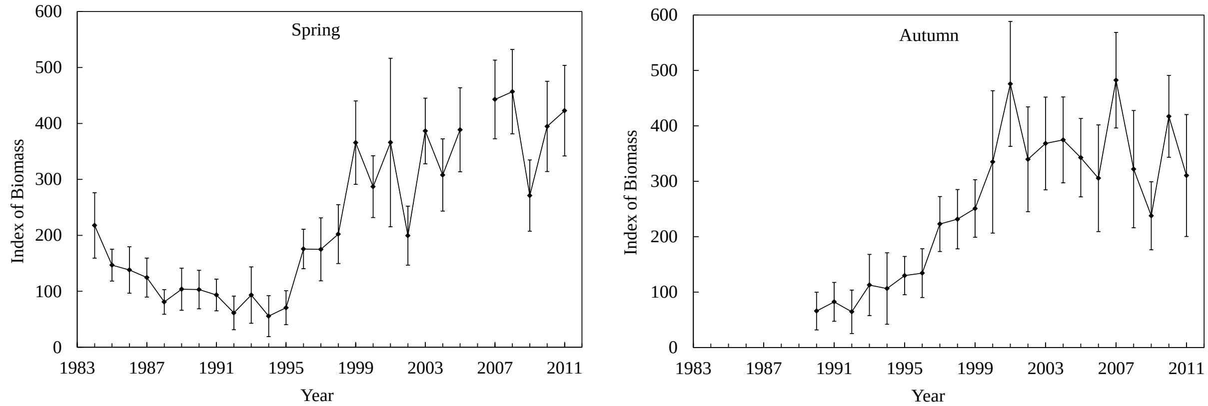


Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx. 95% confidence intervals, from Canadian spring and autumn surveys.

Canadian stratified-random autumn surveys. The index of trawlable biomass for Div. 3LNO increased steadily from the early-1990s (Fig. 12.2). Following a decline in 2002 from a peak value in 2001, biomass in 2002-2006 remained relatively stable, and then increased to the series high in 2007. The biomass index has since been variable, but was still well above values in the early part of the time series.

EU-Spain stratified-random spring surveys in the NAFO Regulatory Area of Div. 3NO. Beginning in 1995, 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, was relatively stable from 2000-2008 and has increased slightly thereafter (Fig. 12.3).

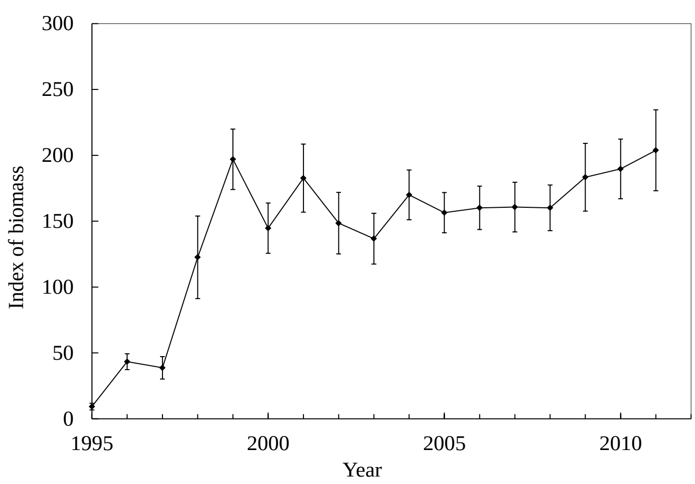


Fig.12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the EU-Spain spring surveys in the Regulatory Area of Div. 3NO. Data are in Campelen equivalents ±1SD.

Stock distribution. In all surveys, yellowtail flounder were most abundant in Div. 3N, in strata on the Southeast Shoal and those immediately to the west (360, 361, 375 & 376), which straddle the Canadian 200 mile limit. Yellowtail flounder appeared to be more abundant in the Regulatory Area of Div. 3N in the 1999-2011 surveys than from 1984-1995, and the stock has continued to occupy the northern portion of its range in Div. 3L, similar to the mid-1980s when overall stock size was also relatively large. The vast majority of the stock was still found in waters shallower than 93 m in both seasons.

Recruitment: Total numbers of juveniles (<22 cm) from spring and autumn surveys by Canada and spring surveys by 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. The spring survey by EU-Spain has shown lower than average numbers of small fish in the last five surveys. Although no clear trend in recruitment is evident, the number of small fish in the Canadian surveys has been about average in the last six years. Based on a comparison of small fish (<22 cm) in research surveys, recent recruitment appears to be about average.

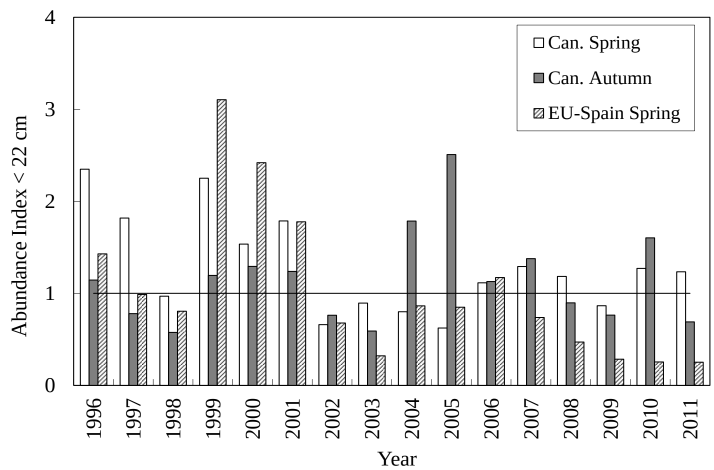


Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile abundance indices from spring and autumn surveys by Canada (Can.) and spring surveys by EU-Spain. Each series is scaled to its mean (horizontal line).

c) Conclusion

Overall, there is nothing to indicate a change in the status of the stock.

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

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

Interim Monitoring Report (SCR Doc 12/14; SCS Doc. 5, 8, 9, 14)

a) Introduction

Reported catches in the period 1972-84 ranged from a low of about 2 400 t in 1980 and 1981 to a high of about 9 200 t in 1972 (Fig. 13.1). With increased bycatch in other fisheries, catches rose rapidly to about 9 000 t in 1985 and 1986, mainly due to increased effort in Div. 3N. From 1987 to 1993 catches ranged between about 3 700 and 7 500 t and then declined to less than 1 200 t in 1994 t when it was agreed there would be no directed fishing on the stock. Since then, catches have averaged about 500 t; in 2011 the catch was reported as 351 t, taken mainly in the NRA.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.9	0.6	0.3	0.2	0.2	0.2	0.3	0.4	0.4	
STACFIS	0.9-2.2[1]	0.6	0.3	0.5	0.2	0.3	0.4	0.4	0.4	

[1] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishery.

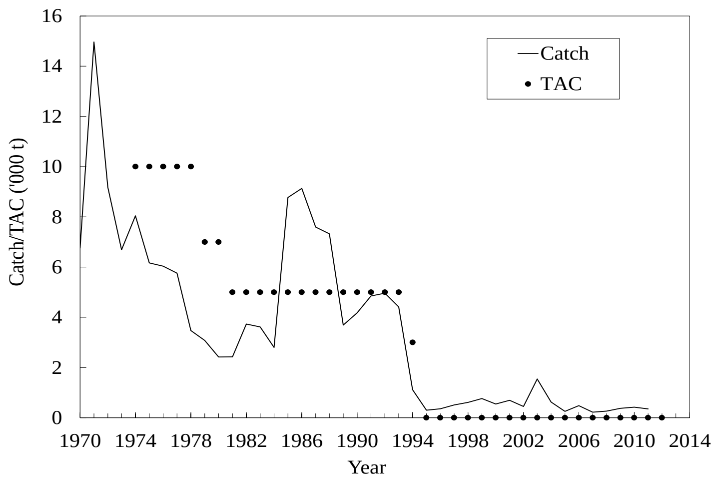


Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as 0 TAC.

b) Data Overview

i) Research survey data

Canadian spring RV survey biomass index. The combined Div. 3NO survey biomass index generally declined until the mid-1990s, then increased slightly, remaining relatively stable since 2004 (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.

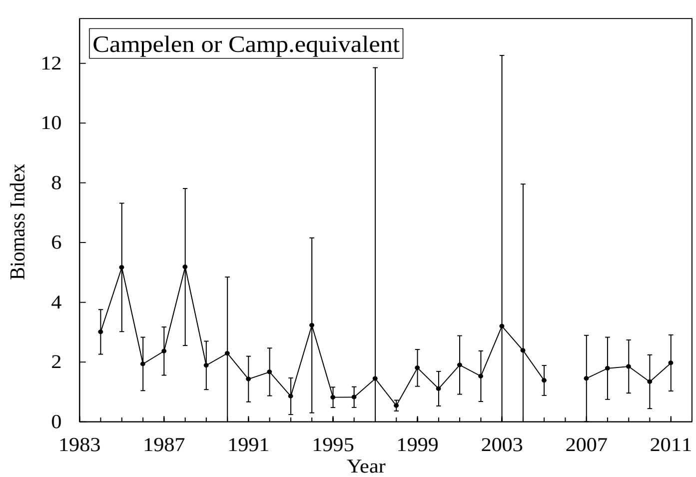


Fig. 13.2. Witch flounder in Div. 3NO: survey biomass index from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units.

Canadian autumn RV survey biomass index. 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 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. The 2010 value of 5.5 is the second highest in the series, but the index value in 2011 declined to about the level of 2004-2006.

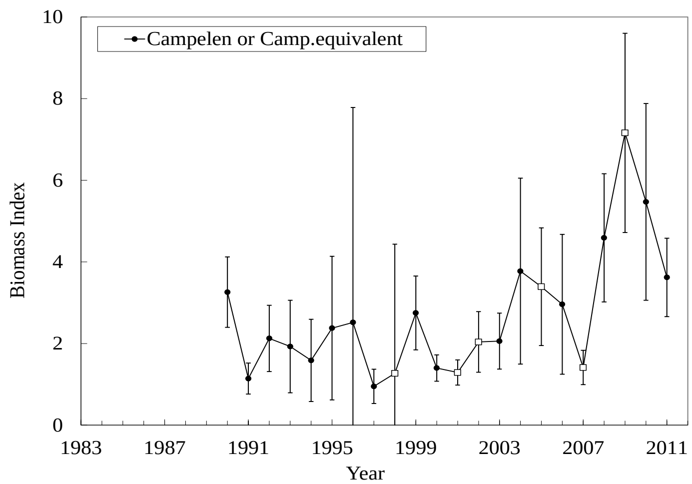


Fig. 13.3. Witch flounder in Div. 3NO: survey biomass index from Canadian autumn surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols indicate years in which more than 50% of the deep water (> 730 m) strata were covered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

Spanish Div. 3NO RV survey biomass index . Surveys have been conducted annually from 1995 to 2011 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1462 m (since 1998). In 2001, the research vessel (R/V *Playa de Menduiña*) and survey gear (Pedreira) were replaced by the R/V *Vizconde de Eza* using a Campelen trawl (SCR Doc. 05/25). Data for witch flounder in Div. 3NO prior to 2001 have not been converted and therefore data from the two time series cannot be compared. In the Pedreira gear time series, the biomass increased from 1995-2000 but declined in 2001; in the Campelen gear time series, the biomass index has been variable, including a high point in 2010, but has been generally decreasing since 2004 (Fig. 13.4).

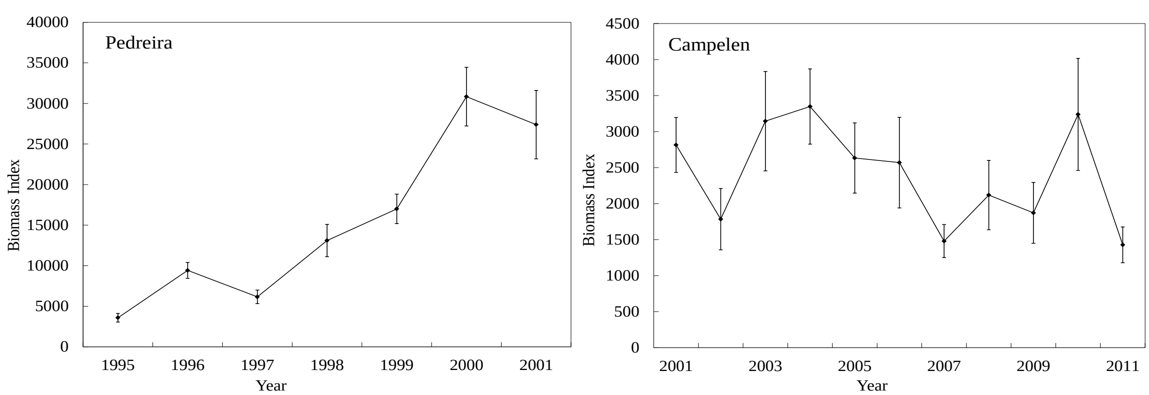


Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from Spanish Div. 3NO surveys (± 1 standard deviation). Data from 1995-2001 are in Pedreira units; data from 2001-2011 are in Campelen units. Both values are present for 2001.

c) Conclusion

Overall, there is nothing to indicate a change in the status of the stock since the 2011 assessment.

The next full assessment of this stock is planned for 2014.

d) Research Recommendation

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.

STATUS: Some analysis has been started, but there is no progress to report at this time. This recommendation is reiterated.

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

Interim Monitoring Report

a) Introduction

The fishery for capelin started in 1971 and catches were high 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 2011 (Fig. 14.1). No catches have been reported for this stock since 1993.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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

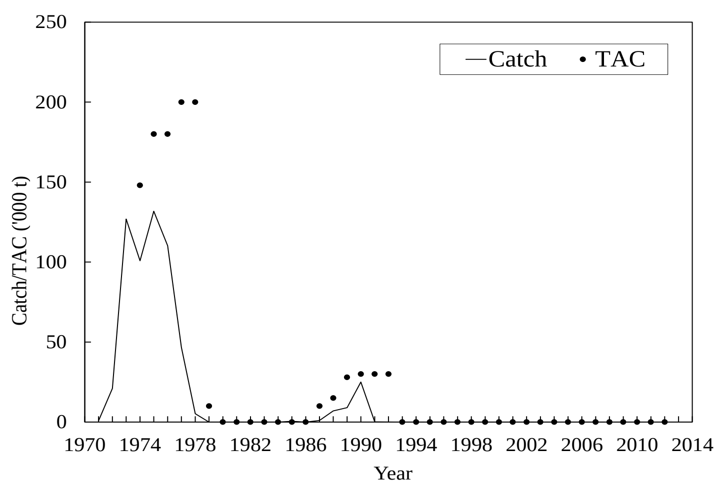


Fig. 14.1. Capelin in Div. 3NO: catches and TACs

b) Data Overview

Trawl acoustic surveys of capelin on the Grand Bank previously conducted by Russia and Canada on a regular basis have not been repeated since 1995. In recent years, STACFIS has repeatedly recommended investigation of the capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this recommendation has not been acted upon. The only indicator of stock dynamics currently available is capelin biomass indices obtained during Canadian stratified-random spring trawl surveys. In 1996-2011, when Campelen trawl was used as a sampling gear, survey biomass of capelin in Div. 3NO varied on a scale of 4 to 119 (Fig.14.2). In 2008 the biomass index sharply increased to its maximum. In next three years the biomass decreased. In 2011 the survey biomass is the lowest in the time series. To be consistent with the methodology used in previous years, the 2010 biomass estimate has been revised from last year's assessment.

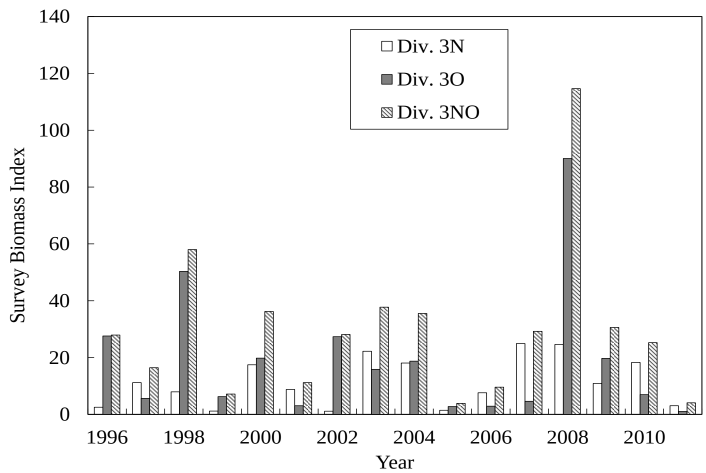


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates in 1996-2011.

c) Estimation of Stock Condition

Since interpolation by density of bottom trawl catches to the area of strata for pelagic fish species such 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 1990-2011. 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 for combining Engel and Campelen trawl data. Trawl sets which did not contain capelin were not included in the account. The confidence intervals around the average catch index were obtained by bootstrapping of standardized catch values. According to data from 1996-2011, the mean catch varied between 0.009 and 1.56 t/km^2. In 2011, this parameter was the lowest in the period and equaled 0.009 (Fig. 14.3). Years when the stock supported a fishery had this index valuing 2 or more.

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

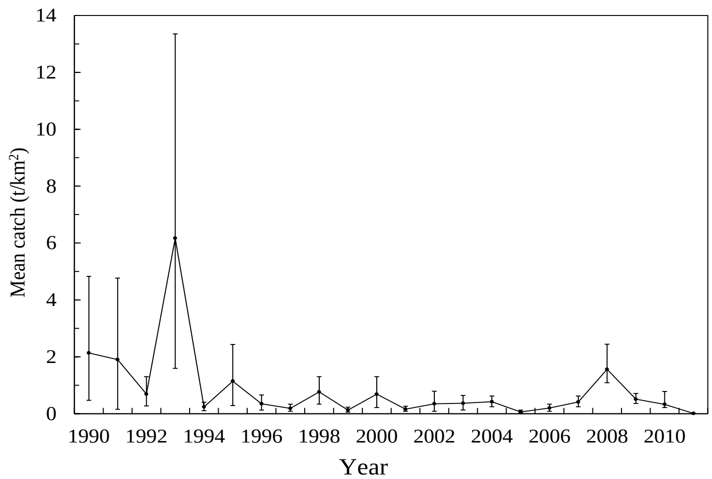


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km2) in 1990-2011.

d) Assessment Results

Based on available data, there is nothing to indicate a change in the status of this stock.

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.*

The next full assessment of the stock is planned for 2013.

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

Interim Monitoring Report (SCS Doc. 12/05, 06, 08, 09, 14)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3O; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatu*s). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics 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, declined to 4 000 t by 2008 and have since ranged between 5 200 t to 6 500 t with the 2011 reported catch at 6 500 t.

Nominal catches and TACs ('000 t) for redfish in the recent period are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC			NR	NR	NR	NR	NR	NR	NR	NR
TAC[1]	10	10	20	20	20	20	20	20	20	20
STATLANT 21	21.6	6.5	11.9	11.0	7.5	5.1	6.3	6.5	6.5	
STACFIS	17.2	3.8	11.3	12.6	5.2	4.0	6.4	5.2	6.5	

[1] 2003-2004 only applied within Canadian EEZ.

NR: Scientific Council unable to advise on an appropriate TAC

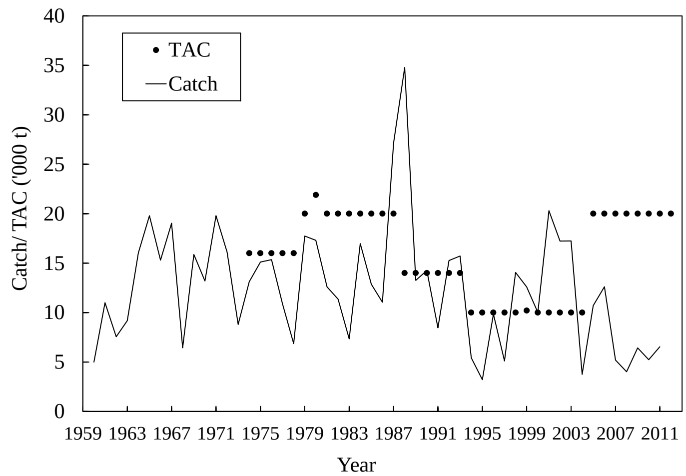


Fig. 15.1. Redfish in Div. 3O: catches and TACs. The TAC for 1974-2004 applied only within the Canadian EEZ

b) Data Overview

Surveys

Canadian spring and autumn surveys were conducted in Div. 3O during 2011. 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 biomass index has been increasing in both indices since the mid-2000s (Fig. 15.2). For each survey series the average over 2009-2011 represents an increase in the range of 400% to 600% 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.

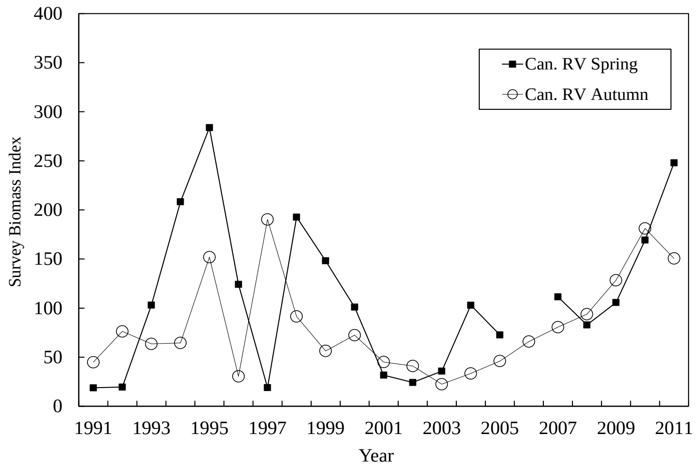


Fig. 15.2. Redfish in Div. 3O: Mean survey biomass index from Canadian surveys in Div. 3O (Campelen equivalent estimates prior to autumn 1995).

c) Conclusion

Catches were stable from 2009 to 2011 while survey indices have increased. Overall, this indicates improvement in the status of the stock that will be evaluated in detail at the next assessment.

The next full assessment of this stock is planned to be in 2013.

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

(SCR Doc. 12/10, 15, 21, 28; SCS Doc. 12/ 05, 08, 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 France in their respective EEZs, and Div. 3LNO is managed by NAFO.

Catch History

Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skate species taken in the Canadian and EU-Spain catches. Thus, the skate fishery on the Grand Banks can be considered a fishery for thorny skate. In Subdivision 3Ps, Canada has established a TAC of 1 050 t. In 2005, NAFO Fisheries Commission established a TAC of 13 500 t for thorny skate in Div. 3LNO. For 2010 and 2011, the TAC for Div. 3LNO was reduced to 12 000 t. The TAC was further reduced to 8 500 t for 2012.

Catches for NAFO Div. 3LNO increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this new fishery were EU-Spain, EU-Portugal, Russia, and Canada. Catches by all countries in Div. 3LNOPs over 1985-1991 averaged 18 066 t; with a peak of 29 048 t in 1991 (STATLANT 21A). From 1992-1995, catches of thorny skate declined to an average of 7 554 t, however there are substantial uncertainties concerning reported skate catches prior to 1996. Average STACFIS catch in Div. 3LNO for 2005-2010 was 4 947 t. STACFIS catch in 2011 was 5 389 t for Div. 3LNO. STATLANT catch in Subdivision 3Ps was 517 t.

Recent nominal catches and TACs (‘000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Div. 3LNO:										
TAC			13.5	13.5	13.5	13.5	13.5	12	12	8.5
STATLANT 21	14.3	11.8	3.5	5.5	6.2	7.1	5.7	5.4	5.4	
STACFIS	11.6	9.3	4.2	5.8	3.6	7.4	5.6	3.1	5.4	
Subdiv. 3Ps:										
TAC			1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
STATLANT 21	1.8	1.3	1.0	1.0	1.8	1.4	0.6	0.3	0.5	
Div. 3LNOPs:										
STATLANT 21	16.1	13.1	4.5	6.5	8.0	8.5	6.4	5.7	5.9	
STACFIS	13.4	10.6	5.2	6.8	5.4	8.8	6.2	3.4	5.9	

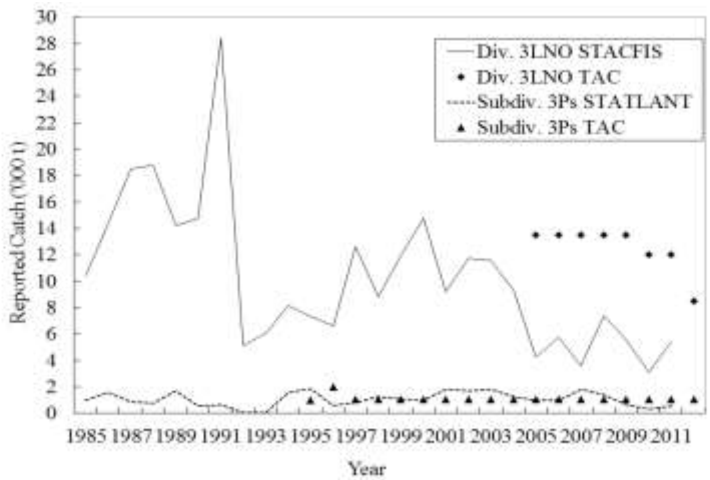


Fig. 16.1. Thorny skate in Div. 3LNOPs: catches and TAC.

b) Data Overview

i) Commercial fisheries

Thorny skates from either commercial or research survey catches are currently not aged.

Commercial length frequencies of skates were available for EU-Spain (1985-1991, 1997-2011), EU-Portugal (2002-2004, 2006-2011), Canada (1994-2008, 2010), and Russia (1998-2008, 2011).

In 2008-2011, commercial length distributions from EU-Portugal, EU-Spain, and Russia in skate-directed trawl fisheries (280 mm mesh) of Div. 3LNO in the NRA indicated that the range of sizes caught 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 TL was significantly smaller than those of EU-Spain and Russia (27-95 cm; with a mode of 66 cm). In 2011, EU-Portugal directed for skates with a smaller codend mesh size (200 mm). Thorny skate ranged from 32-82 cm, with a mode of 60 cm.

In other trawl fisheries (130-135 mm mesh) of Div. 3LNO (NRA) in 2008-2009, length distributions of skate bycatch also did not vary between EU-Spain and Russia. In 2008, the size range of skate bycatch reported by EU-Portugal was similar to that of Russian trawlers (28-104 cm with a mode of 58 cm); although Russia also reported a small catch of 12-18 cm young-of-the-year skates. EU-Portugal caught an abbreviated range of smaller skates in 2009, a 24–84 cm range with a mode of 46 cm (2009). In 2011, EU-Portugal the length distribution ranged from 30-84 with a mean length of 61.9cm. Russia only sampled 38 skates in 2011; while Canada did not measure skate lengths for Div. 3LNO in 2011 to compare with those of previous years.

No standardized commercial catch per unit effort (CPUE) exists for thorny skate.

ii) Research surveys

Canadian spring surveys. Stratified-random research surveys have been conducted by Canada in Div. 3L, 3N, 3O, and Subdiv. 3Ps in spring; using a Yankee-41.5 otter trawl in 1972-1982, an Engel-145 otter trawl in 1983-1995, and a Campelen-1800 shrimp trawl in 1996-2009. Maximum depth surveyed was 366 m before 1991, and ~750 m since then. Subdivision 3Ps was not surveyed in 2006; nor was the deeper portion (>103 m) of Div. 3NO in that year, due to mechanical difficulties on Canadian research vessels.

Indices for Div. 3LNOPs in 1972-1982 (Yankee series) fluctuated without trend (Fig. 16.2a).

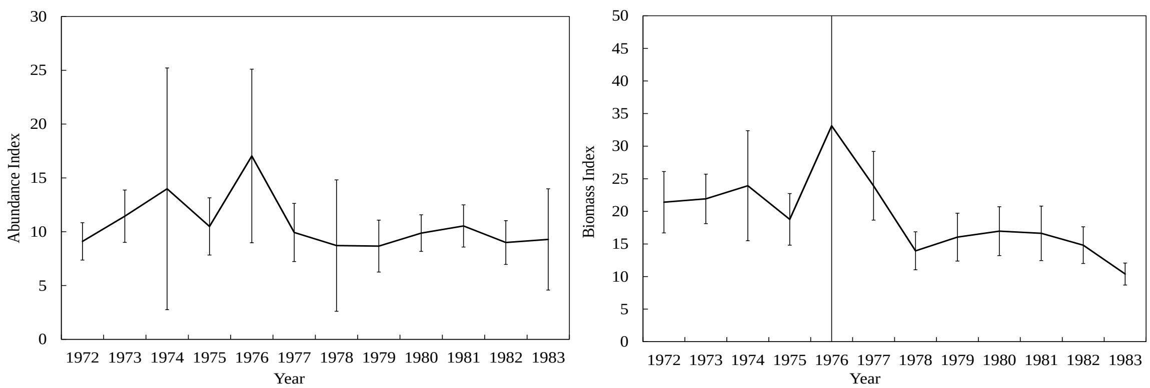


Fig. 16.2a. Thorny skate in Div. 3LNOPs: 1972-1982 abundance and biomass indices from Canadian spring surveys.

Standardized mean number and weight per tow are presented in Figure 16.2 for Div. 3LNOPs. Catch rates of thorny skate in Div. 3LNOPs declined from the mid-1980s until the early 1990s. Since 1997, biomass indices have been slowly increasing while abundance indices remain relatively stable at low levels (Fig. 16.2b).

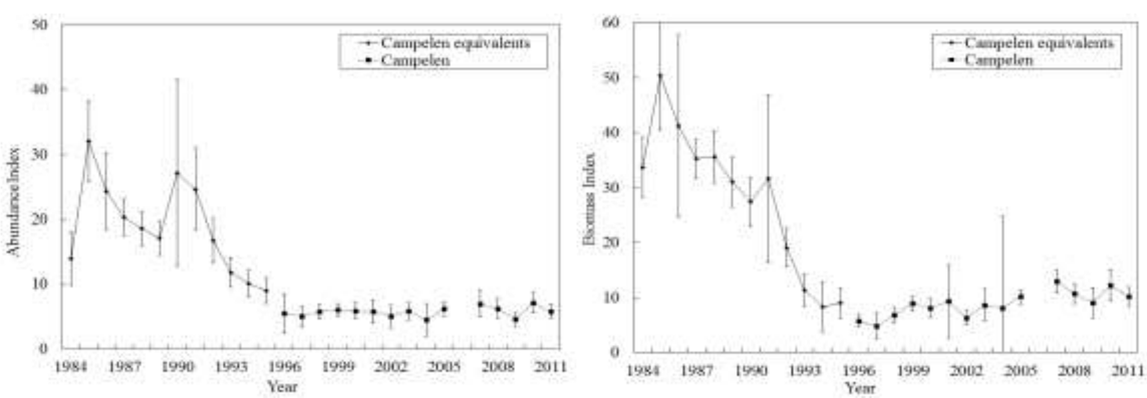


Fig. 16.2b. Thorny skate in Div. 3LNOPs: 1984-2011 abundance (left) and biomass (right) indices from Canadian spring RV surveys. Survey in 2006 was incomplete

Canadian autumn surveys. Stratified-random autumn surveys have been conducted by Canada in Div. 3L, 3N, and 3O; using an Engel-145 otter trawl in 1990-1994, and a Campelen-1800 shrimp trawl in 1995-2011 to depths of ~1 450 m.

Autumn survey catch rates, similar to spring estimates, declined over the early 1990s. Catch rates have been stable since 1995 (Fig. 16.3). 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.

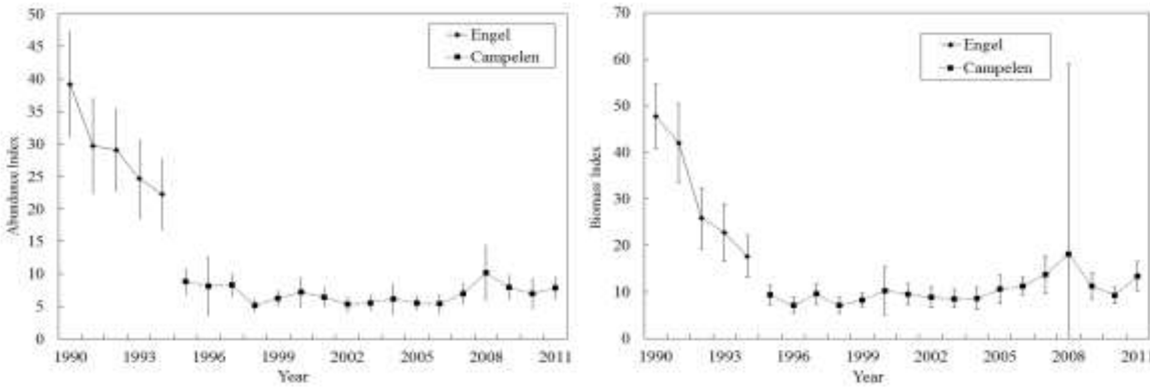


Fig. 16.3. Thorny skate in Div. 3LNO, 1990-2011, abundance (right) and biomass (left) indices from Canadian autumn surveys. Note that Engel trawl data in 1990-1994 and Campelen trawl data in 1995-2011 are not directly comparable.

EU-Spain Div. 3NO survey. 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 3NO index is generally fluctuating within a narrow biomass range. A comparison of common strata found little difference between the time series between 1997-2005 and 1997-2010. Differences in the survey indices appear to result from poor catch rates in the EU-Spain survey in deeper strata not sampled in Canadian surveys.

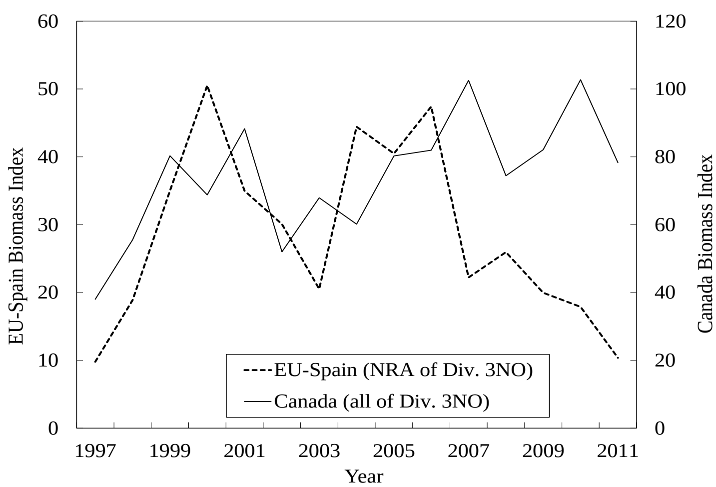


Fig. 16.4. Thorny skate in Div. 3NO: estimates of biomass from EU-Spain spring surveys and Canadian RV spring surveys from 1997-2011.

EU-Spain 3L survey. EU-Spain survey indices in the NRA of Div. 3L are available for 2003-2011 (excluding 2005). The stratified random spring bottom trawl survey is conducted by the R/V *"Vizconde de Eza"* using a Campelen bottom trawl. The survey only occurs in the NAFO Regulatory Area (Flemish Pass), and does not cover the entire divisions. The EU-Spain Div. 3L index has been in decline since 2007 which is similar to the Canadian autumn Div. 3L survey index, while the Canadian spring Div. 3L index fluctuates within a narrow biomass range throughout the time period (Fig. 16.5).

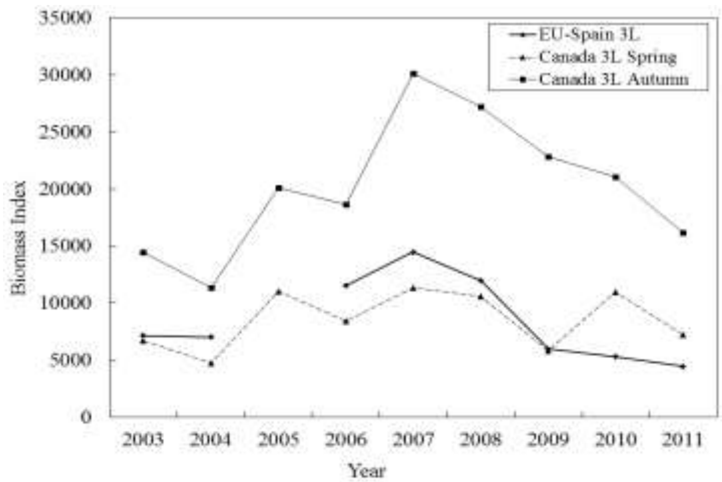


Fig. 16.5. Thorny skate in Div. 3L: Biomass indices from the EU-Spain Div. 3L survey and the Canadian autumn and spring RV surveys for NAFO Div. 3L from 2003-2011.

iii) Biological studies

Based on Canadian Campelen spring surveys in Div. 3LNOPs, various life stages of thorny skate underwent different changes in abundance over time. In 1996-2011, the abundance of thorny skate recruits (5-20 cm TL) appeared to be relatively stable, estimates of male and female immature skates fluctuated along decreasing trends, and estimates of mature skates fluctuated along an increasing trend.

Recruitment index (skate < 21cm) has been fluctuating without any clear trend from 1996-2009. The index in 2010 and 2011 is however 50% above average. Thorny skates have low fecundity and long reproductive cycles. These characteristics result in low intrinsic rates of increase, and suggest low resilience to fishing mortality.

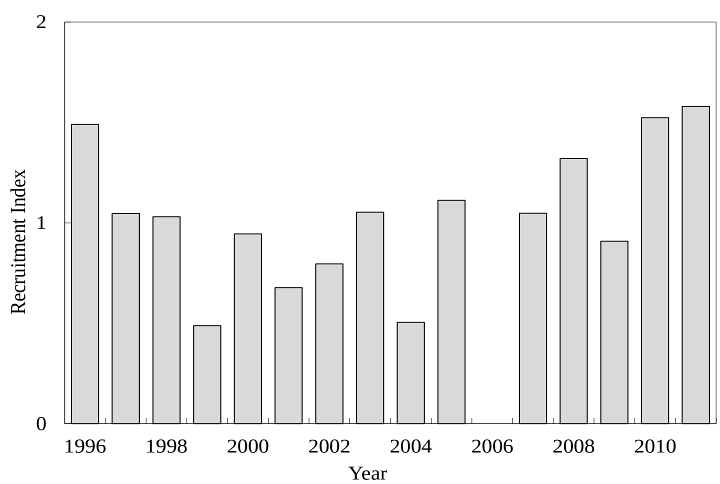


Fig. 16.6. Thorny skate in Div. 3LNOPs: Standardized recruitment index from Canadian spring surveys in Div. 3LNOPs, 1996-2011. Survey in 2006 was incomplete.

c) Assessment Results

Assessment Results: No analytical assessment was performed.

Biomass: The Canadian spring survey biomass indices fluctuated without trend prior to the mid-1980s then declined rapidly until the early-1990s. The Canadian spring Campelen series, 1996 to 2011, has been showing an increasing trend in biomass since 1997. While the Canadian autumn survey shows stability. Both EU-Spain surveys, which cover only the NRA have been in decline since 2007.

Fishing Mortality: A fishing mortality index (Catch/survey biomass for Div. 3LNO) has been low since 2005.

Recruitment: Recruitment index (Skate < 21cm) has been fluctuating without any clear trend from 1996-2009. The index in 2010 and 2011 is however 50% above average.

Reference Points: None defined. .

State of the Stock: This stock has remained at low levels since the mid 1990's. Recruitment index in 2010 and 2011 is 50% above average.

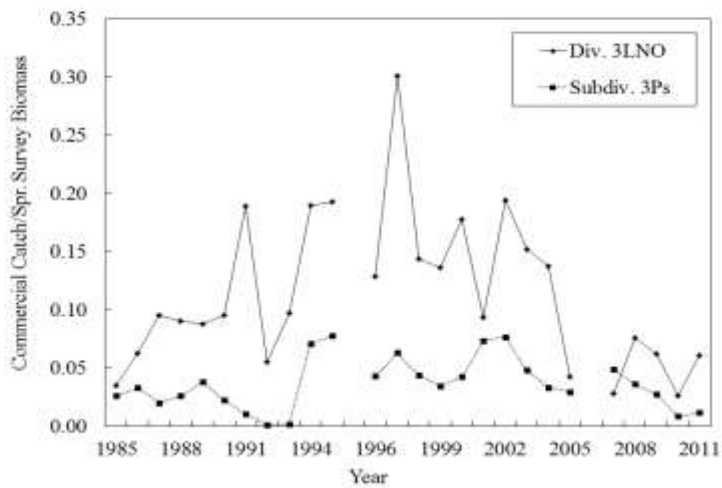


Fig. 16.7. Thorny skate in Div. 3LNOPs: Fishing Mortality Index (catch/spring survey biomass) for Div. 3LNO and Subdiv. 3Ps in 1985-2011. Commercial catch estimates are STACFIS-agreed numbers; biomass indices are from Canadian Campelen spring research surveys. Survey in 2006 was incomplete.

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.*

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.*

STATUS: Analysis was conducted, differences in the survey indices appear to result from poor catch rates in the EU-Spain survey in deeper strata not sampled in Canadian surveys. .

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

Interim Monitoring Report (SCR Doc. 12/15; SCS Doc. 12/05, 08, 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 Russia in 2003, in the NRA of Div. 3NO; resulting in the 2003-2004 peak. There were no directed fisheries by EU-Spain in 2004 or by EU-Spain, EU-Portugal, or Russia in 2005-2011. 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 in the NRA of Div. 3NO was first implemented by Fisheries Commission in 2005 at 8 500 t, and then reduced to 6 000 t for 2010 and 2011. The TAC in Div. 3NO for 2012 is 5 000 t.

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-agreed catches decreased to an average of 677 t in 2005-2010, and was 152 t for 2011 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 619 t in 1994-2002 (Fig. 17.1). Subsequently, catches increased to an average of 1 174 t in 2004-2007, then decreased to a 468-t average in 2008-2010; with 202 t for 2011.

Recent nominal catches and TACs (000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Div. 3NO:										
TAC	-	-	8.5	8.5	8.5	8.5	8.5	6	6	5
STATLANT 21	6.2	1.9	1.0	1.2	0.7	0.9	0.5	0.3	0.2	
STACFIS	4.8	1.3	0.9	1.1	0.6	0.9	0.4	0.2	0.2	
Subdiv. 3Ps:										
STATLANT 21	1.1	1.4	1.6	1.5	1.3	0.7	0.4	0.4	0.2	

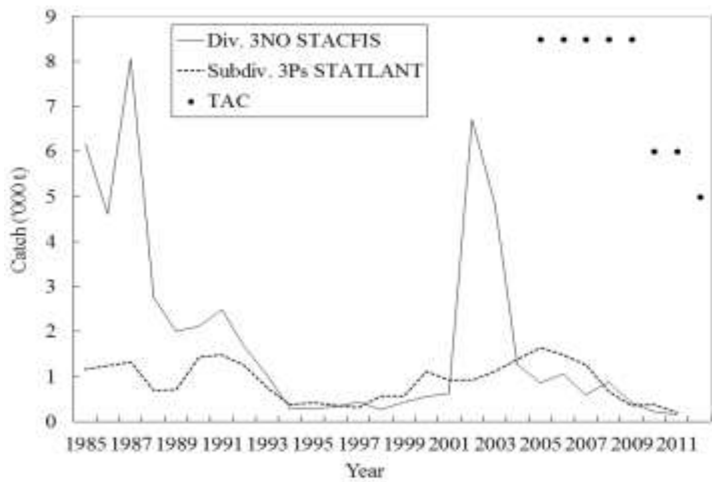


Fig. 17.1. White hake in Div. 3NO and Subdiv. 3Ps: Total catch of white hake in NAFO Division 3NO (STACFIS) and Subdivision 3Ps (STATLANT-21A). The Total Allowable Catch (TAC) in the NRA of Div. 3NO is indicated on the graph.

b) Data Overview

i) 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 2011. 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 1995-2011. 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 2003-2011, 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.

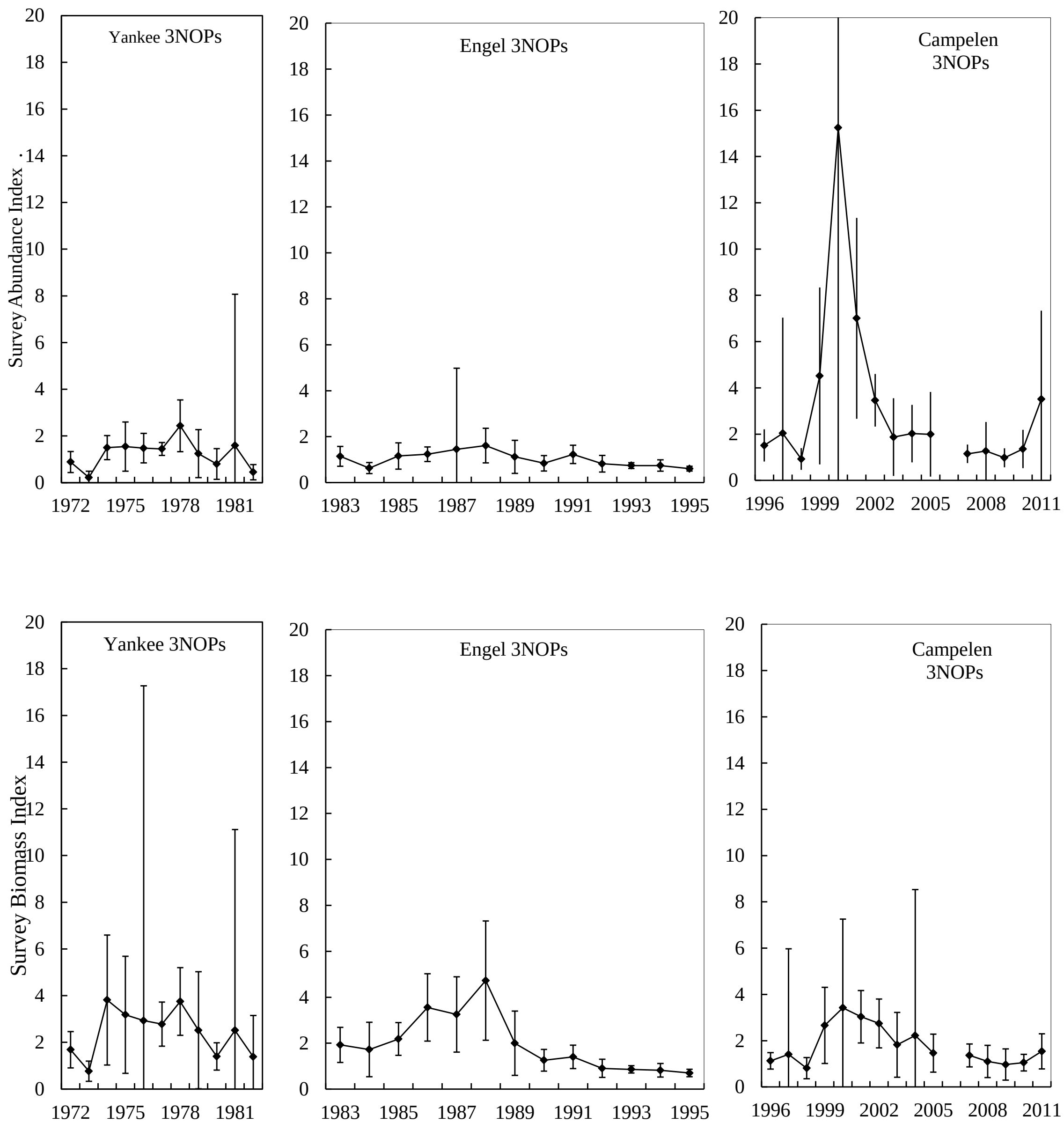


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: abundance and biomass indices from Canadian spring research surveys, 1972-2011. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. The Yankee, Engel, and Campelen time series are not standardized, and are thus presented on separate panels. Error bars are 95% confidence limits.

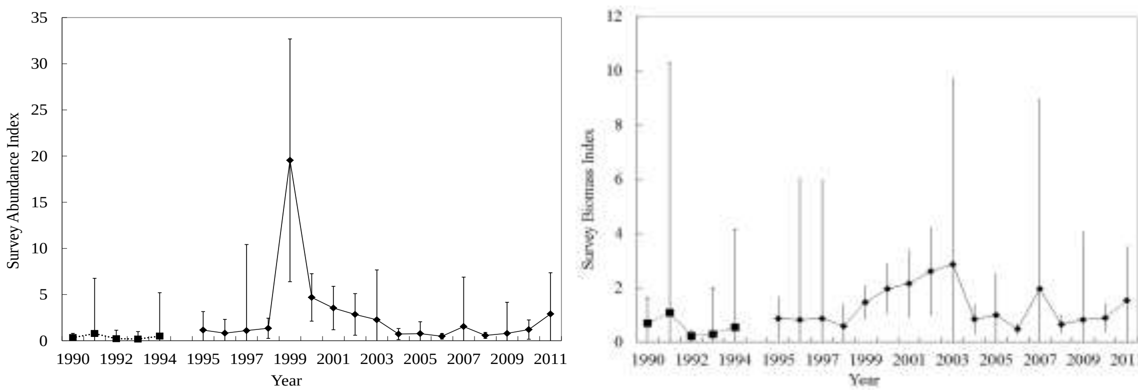


Fig. 17.2b White hake in Div. 3NO: abundance (left panel) and biomass indices (right panel) from Canadian autumn surveys, 1990-2011. The Engel (■, 1990-1994) and Campelen (♦, 1995-2011) time series are not standardized. Error bars are 95% confidence limits.

EU-Spain stratified-random bottom trawl surveys in the NRA. EU-Spain biomass indices in the NAFO Regulatory Area of Div. 3NO were available for white hake in 2001-2011 (Fig. 17.3). EU-Spain 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 EU-Spain index increased slightly relative to 2008. In 2011 the EU-Spain index increased. The overall trend is similar to that of the Canadian spring survey index (Fig. 17.3).

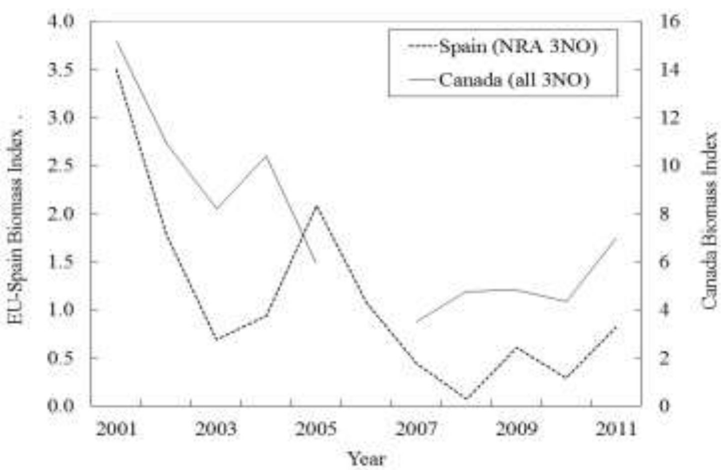


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from EU-Spain Campelen spring surveys in 2001-2011 compared to Canadian spring survey indices in all of Div. 3NO. Estimates from 2006 Canadian survey are not shown, since survey coverage in that year was incomplete.

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 similar large year classes were observed during intervening years. The index of recruitment for 2011 is comparable to that seen in 1999.

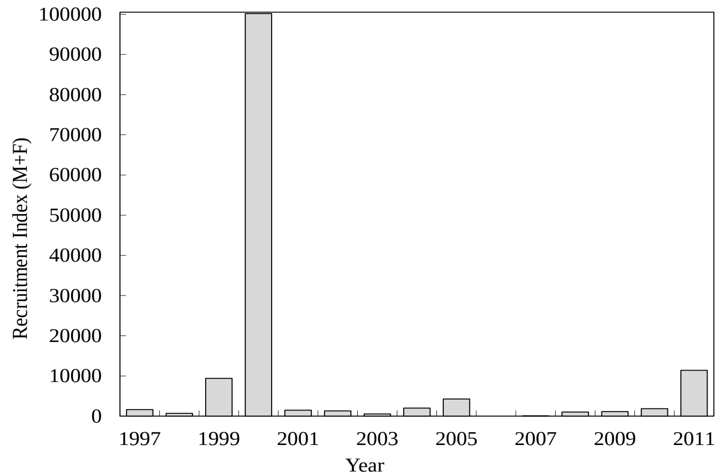


Fig. 17.4. White hake in Div. 3NO and Subdiv. 3Ps: recruitment index from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2011. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

c) Conclusion

Based on current information there is no significant change in status of this stock.

The next full assessment of this stock is planned for 2013.

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 hake comprise a single breeding population*.

STATUS: Genetic studies are completed and results will be presented during the next full assessment therefore this recommendation is reiterated.

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2011+); thereby allowing age-based analyses of this population*.

STATUS: Otoliths are being collected but have yet to be aged. This recommendation is reiterated

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *survey conversion factors between the Engel and Campelen gear be investigated for this stock*.

STATUS: No progress to date. This recommendation is reiterated.

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*.

STATUS: No progress to date. This recommendation is reiterated.

D. WIDELY DISTRIBUTED STOCKS: SA 2, SA 3 AND SA 4

Environmental Overview

(SCR Doc. 11/16, 11/13, and 11/14)

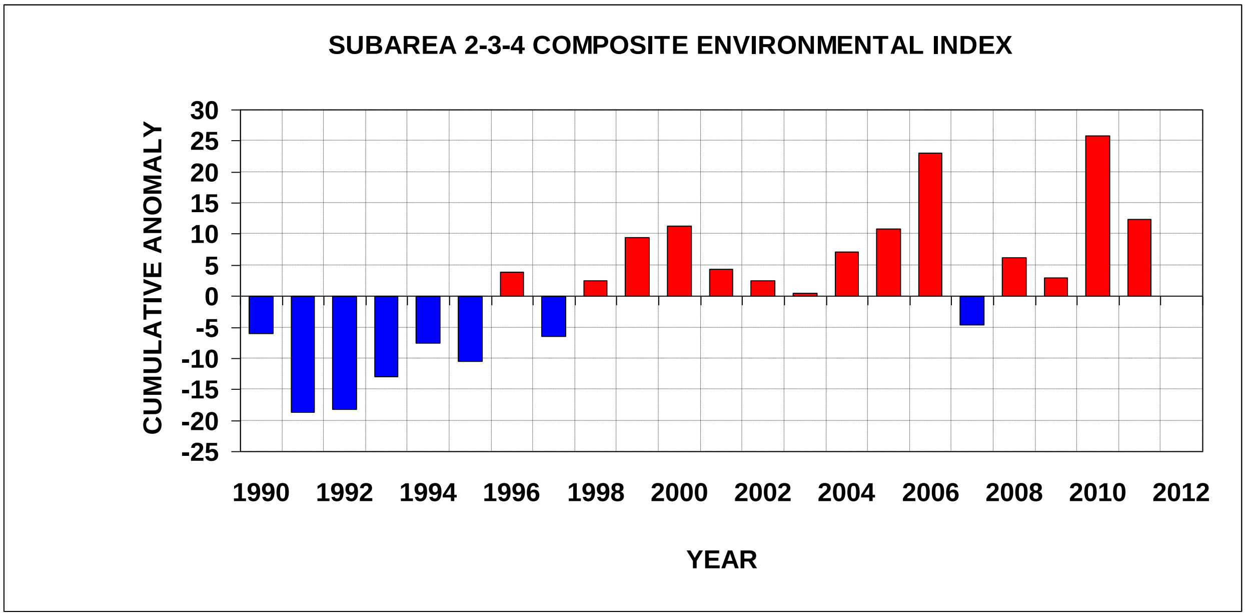


Fig. IV-4. Composite ocean climate index for NAFO Subarea 2-3-4 (widely distributed stocks) derived by summing the standardized anomalies.

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 3º-4ºC and salinities in the range of 34-34.75. On average bottom temperatures remain <0ºC over most of the northern Grand Banks but increase to 1-4ºC in southern regions and along the slopes of the banks below 200 m. North of the Grand Bank, in Div. 3K, bottom temperatures are generally warmer (1-3ºC) except for the shallow inshore regions where they are mainly <0ºC. In the deeper waters of the Flemish Pass and across the Flemish Cap bottom temperatures generally range from 3-4ºC. Throughout most of the year the cold, relatively fresh water overlying the shelf is separated from the warmer higher-density water of the continental slope region by a strong temperature and density front. This winter-formed water mass is generally referred to as the Cold Intermediate Layer (CIL) and is considered a robust index of ocean climate conditions. In general, shelf water masses undergo seasonal modification in 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.

The composite climate index across the widely distributed stocks in Subareas 2 to 4 has remained above normal in recent years (2008-2011) showing a peak in 2010 (Fig. IV-4). The below normal levels observed during the early to mid-1990s were moderated somewhat by the less intense cooling observed in Subarea 1 (West Greenland). Water temperatures on the Newfoundland and Labrador Shelf remained above normal, setting new record highs in some areas in 2011. Salinities on the NL Shelf were fresher-than-normal in many areas from 2009-2011. At a standard monitoring site off eastern Newfoundland (Station 27), the depth-averaged annual water temperature increased to a record high in 2011 at 3 SD above the long-term mean. Annual surface temperatures at Station 27 were above normal by 0.6 SD (0.4°C) while bottom temperatures (176 m) were at a record high at 3.4 SD (1.3°C) above normal. The annual depth-averaged salinities at Station 27 were below normal for the 3rd consecutive year. The annual stratification index at Station 27 decreased to 2 SD below normal, the lowest since 1980. The area of the CIL water mass with temperatures <0°C on the eastern Newfoundland Shelf (Bonavista Section) during the summer of 2011 was at a record low value at 2 SD below normal, implying warm conditions, while off southern Labrador it was the 4th lowest at 1.5 SD below normal. On the Grand Bank (Flemish Cap Section) the CIL area was the second lowest on record. The volume of CIL (<0°C) water on the NL shelf during the autumn was below normal (4th lowest since 1980) for the 17th consecutive year. Average temperatures along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. Spring bottom temperature in 3LNO during 2011 was above 0°C and up to 1°-2°C higher than normal. During the autumn, bottom temperatures in 2J and 3K were also at a record high value, at 2 and 2.7 SD above normal, respectively, and in 3LNO they were 1.8 SD above normal. Generally, bottom temperatures were about 1°-2°C above normal in most regions, with very limited areas of the bottom covered by <0°C water.

Above normal ocean temperature also prevailed further south on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas. The climate index, a composite of 18 selected, normalized time series, averaged +0.9 SD with 17 of the 18 variables more than 0.5 SD above normal; compared to the other 42 years, 2011 ranks as the 6th warmest. Bottom temperatures were above normal in NAFO Subarea 4 with anomalies ranging from 0.3 to 0.8 °C above normal. Stratification on the Scotian Shelf weakened significantly in 2011 compared to 2010. The change was mainly due to a decrease in sea surface temperature, although surface salinity was the lowest in a decade. Since 1950, there has been a slow increase in stratification on the Scotian Shelf, resulting in a change in the 0-50 m density difference of 0.36 kg m^{-3} over 50 years. The density difference due to the decrease in surface salinity accounted for 48% of the change in stratification.

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

Interim Monitoring Report (SCR Doc. 12/15; SCS Doc. 12/05, 06, 08, 09 and 14)

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 2007-2012 period catches were at similar low level. A total catch of 931 t was estimated for 2011 (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	0.5	0.7	0.8	0.9
STACFIS	3.7	4.2-3.8[1]	3.2	1.5	1.4	0.7	0.8	0.6	0.9	0.9

[1] In 2003, STACFIS could not precisely estimate the catch.

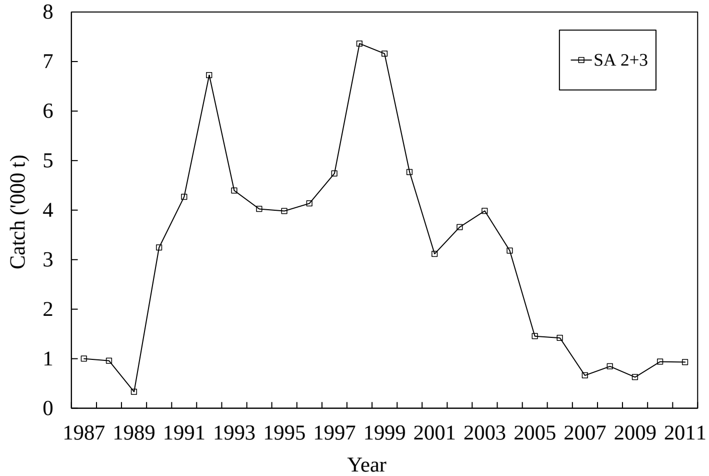


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

b) Data Overview

Surveys

There is no survey index covering the total distribution, in depth and area, of this stock. The Canadian autumn survey series (Div. 2J+3K) and the EU-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).

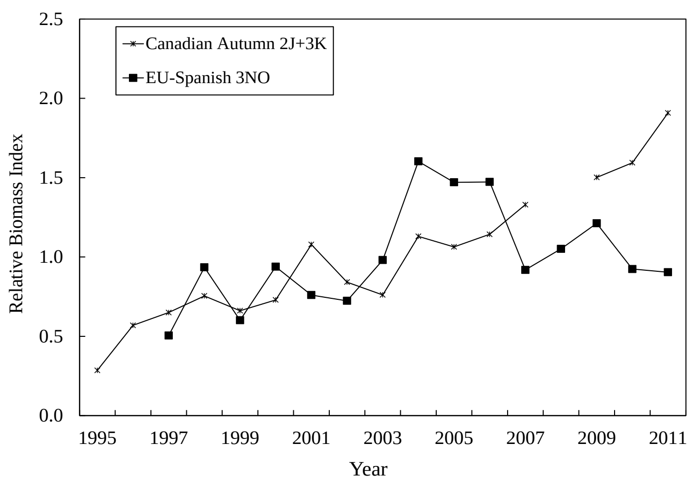


Fig. 18.2. Roughhead grenadier in Subareas 2+3: Relative (to the mean of the period) biomass indices from the Canadian autumn (Div. 2J+3K) survey and EU- Spanish 3NO survey.

The catch/biomass (C/B) ratios have a clear decline trend in the period 1995-2005 and since then are stable at low levels (Fig. 18.3). This is due to the fact that all surveys indices are relatively high and catches remain low.

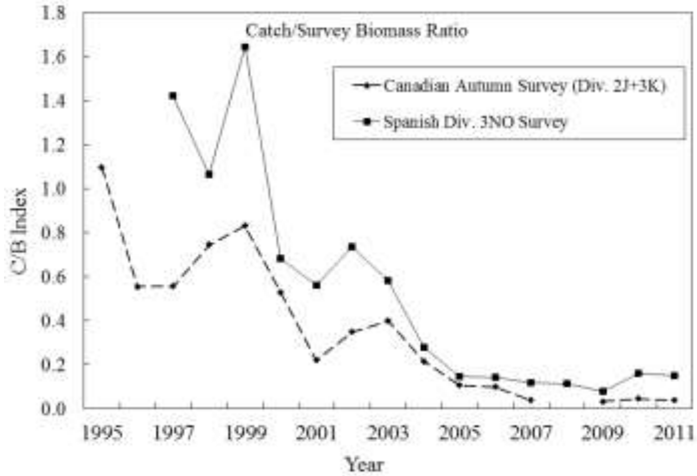


Fig. 18.3. Roughhead grenadier in Subareas 2+3: The catch/biomass (C/B) ratios from the Canadian autumn (Div. 2J+3K) survey and EU-Spanish 3NO survey.

c) Conclusion

Based on overall indices for the current year, there is no significant change in the status of the stock.

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.

In 2011 STACFIS recommended *to study the possibility of including in future assessments all surveys series for roughhead grenadier before 1995.*

STATUS: New information was not available in this matter.

Both recommendations will be addressed next year during the full assessment.

19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL

Interim Monitoring Report (SCS Docs. 12/05, 12/08, 12/09, 12/14)

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. From 2005-2010, catches averaged less than 200 t and in 2011, 219 t were taken.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.5	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.2	
STACFIS	0.7	0.8	0.2	0.1	0.1	0.1	0.1	0.2	0.2	

ndf no directed fishing.

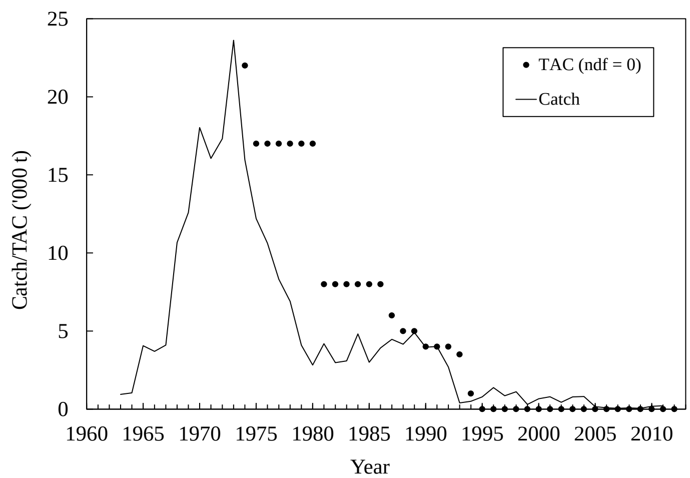


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) Data Overview

i) Surveys

Canadian surveys were conducted in Divs. 2J3KL during autumn 2011 (Fig 19.2). The survey biomass estimates showed an increasing trend from 2003 to 2009, and have since remained stable, although estimates are imprecise. Survey coverage in Div. 3L was incomplete in 2004 and 2005, and in 2008 there were substantial survey coverage deficiencies in 2J, 3K and 3L (SCR 09/012). Results in these years may, therefore, not be comparable to other years.

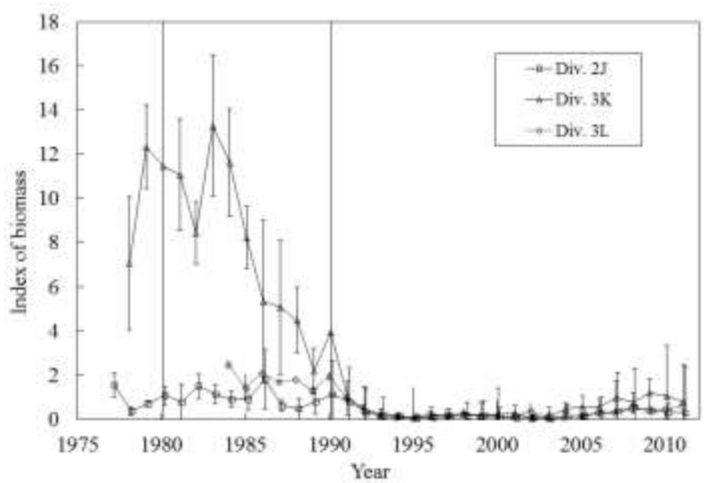


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: Index of biomass (with 95% confidence limits) from Canadian autumn surveys. Values are Campelen units or, prior to 1995, Campelen equivalent units.

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.*

Bowering and Vazquez (SCR Doc. 02/075) explored the distribution and abundance of witch flounder on the Flemish cap and in the Flemish pass based on research vessel survey data in order to address a similar research recommendation in the past. They concluded that the witch flounder resource in Div. 3L did not appear to be strongly linked to that in Div. 3M and that, based on the distribution and abundance of witch in the deep water of the Flemish pass, bycatch from this area would have to be extremely small. For this current recommendation, then, catch taken in Div. 3M and survey data from Canadian autumn surveys and EU summer surveys from 2003-2011 were examined (SCR Doc. 12/040). Catch of witch flounder in Div. 3M has remained relatively small and in recent years has been below 340 t. In recent years, trends in the EU summer survey of Div. 3M are similar to the trends in reported catch from Div. 3M. Distributions of witch flounder in the more recent surveys of Div. 3M are much like those reported in SCR Doc. 02/75, with very few of the sets in the Flemish Pass containing witch flounder. There is potential for Div. 2J3KL witch flounder to be caught in the area of the Grand Bank that extends into Div. 3M on the western side of the Flemish Pass (the Sackville Spur). As well, there is a portion of the Flemish Cap that extends into Div. 3L, and witch from Div. 3M could potentially be caught in Div. 3L. Survey catches in both of these areas have been negligible in recent years, however, and commercial catches from these areas would likely be very low. There is nothing in the recent catch or survey data to refute the previous conclusions concerning the relationship of witch flounder in this area, and STACFIS still considers that the witch flounder population in Div. 3M is not strongly linked to the Div. 2J3KL witch flounder stock.

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).*

Biomass estimates of witch flounder in Div. 2J3KL were produced from the Canadian autumn RV (1984-2011) survey data using only information from strata which have contained witch flounder in at least one year. Although there was a slight increase in mean number and weight per tow using these index strata, the confidence limits around the estimates were not improved, and in some years remained quite large.

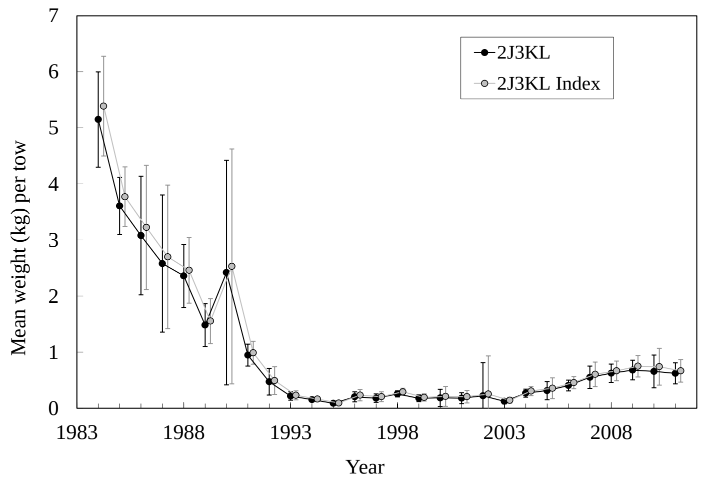


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: Mean weight (kg) per tow (with 95% confidence limits) from Canadian autumn surveys for all strata (Div. 2J3KL) and index strata (Div. 2J3KL Index). Values are Campelen units or, prior to 1995, Campelen equivalent units.

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

(SCR Doc. 12/06, 12, 19, 21, 24, 26, 30; SCS Doc. 12/05, 06, 08, 09, 12; 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 NAFO 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 considerable reductions 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. For 2011, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the previous year’s assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	36	16	nr*	nr*	nr*	nr*	<10.5[*,2]	<8.8[*,2]	<14.5[*,2]	16.3†
TAC	42	20	19	18.5	16	16	16	16	17.2 †	16.3 †
STATLANT 21	30.6	16.0	17.8	17.7	15.3	15.0	14.7	15.7	15.7	
STACFIS	32-38[1]	25.5	23.3	23.5	22.7	21.2	23.2	26.2	na	

nr – no recommendation
na – not available
* – 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.

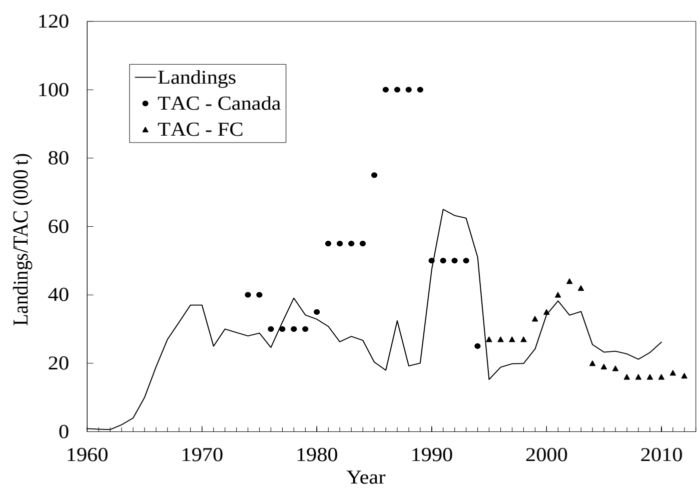


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

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 (1978-2011), EU in Div. 3M (1988-2011) and EU-Spain in Div. 3NO (1995-2011). Commercial catch-at-age data were available from 1975-2010 but were not computed for 2011 because STACFIS could not estimate total catch.

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 and 2011 values are approximately 50% lower than the 2007 – 2009 estimates. At present, most of the Canadian landings come from Divs. 2J3K.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN over 1988-2011 (SCS 12/08) declined sharply in 1991 from initial levels. Consistent increases were estimated over the mid-1990s until 2000. The standardized CPUE remained at exceptionally high levels over 2007-2011, though with much inter-annual variation. Most of the Portuguese catch in recent years is taken in Divs. 3LM.

Spatial analysis of catch and effort trends of the Spanish fleet (SCR 09/22, SCS 12/09) indicated the area being fished by this fleet contracted as effort has been substantially reduced since 2003 under the FC rebuilding plan. Fishing is now concentrated within Div. 3LM. The standardized CPUE for the Spanish fleet has also increased considerably after 2005.

Unstandardized catch rates from the Russian fleet over 1998-2009 (SCS Doc. 10/05) indicate similar patterns as in the other fleets. In 2010, 89% of the catch by Russia 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 2004-2007 period, but less consistency thereafter. (Fig 20.2).

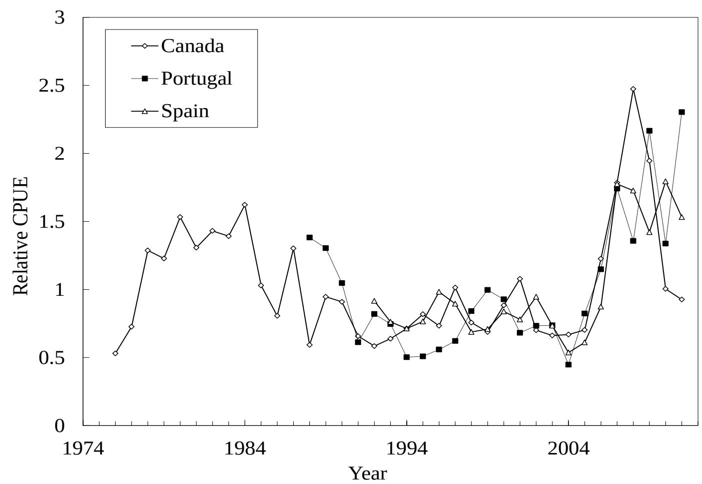


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2011 average.)

STACFIS previously recognized that trends in commercial catch per unit effort for Greenland halibut in Subarea 2 and Div. 3KLMNO should not be used as indices of the trends in the stock (*NAFO Sci. Coun. Rep.*, 2004, 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

Length samples of the 2011 fishery were provided by EU-Estonia, EU-Spain, EU-Portugal, Russia and Canada. Aging information was available for Russian, Spanish and Canadian fisheries.

STACFIS could not estimate total catch for 2011, therefore the 2011 catch-at-age was not calculated.

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 12/19). 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) for this resource (SCR Doc. 12/30). 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. 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 improvements in the last two surveys are resulting from indications of recruitment in Divs. 2J3K.

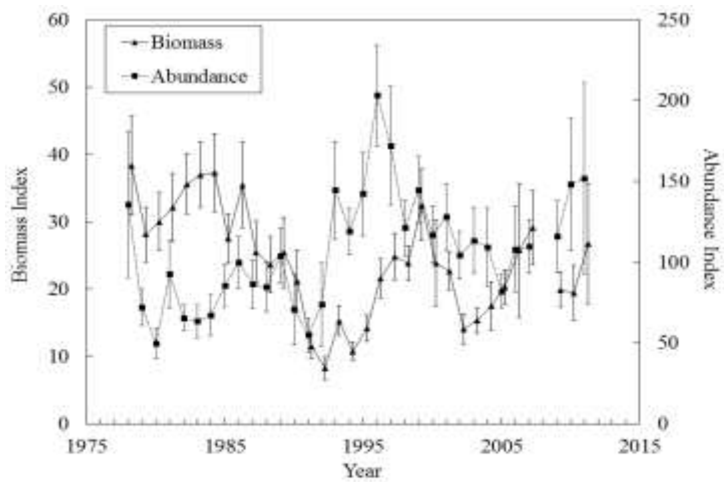


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

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.

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 2011 are below the time-series average. The abundance of recruits has increased in this survey in the most recent three surveys.

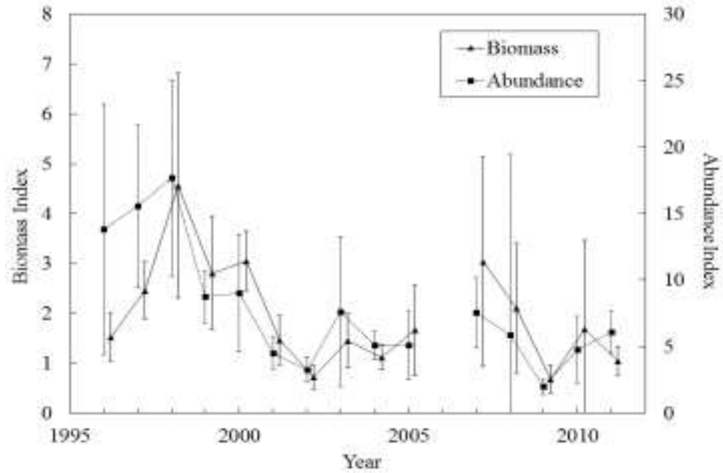


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M (Flemish Cap)

Surveys conducted by the EU in Div. 3M during summer (SCR 12/26) indicate that the Greenland halibut biomass index 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 continually over 1998-2002. The 2002 – 2008 results were relatively stable, with the exception of an anomalously low value in 2003. In 2009 to 2011, 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 2011 estimate is above the time-series average. Over 2009-2011, recruitment indices from this survey are very low.

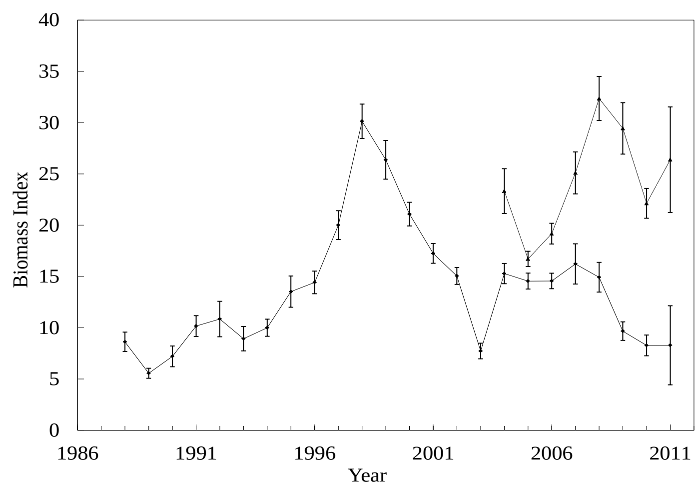


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (± 1 S.E.) from EU summer surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

EU-Spain stratified-random surveys in NAFO Regulatory Area of Div. 3NO

The biomass index for this survey of the NRA (SCR Doc. 12/12) generally declined over 1999 to 2006 (Fig. 20.6) but increased four-fold over 2006-2009. Survey results for 2011 have declined 50% from the 2010 level, but remain above the time-series average.

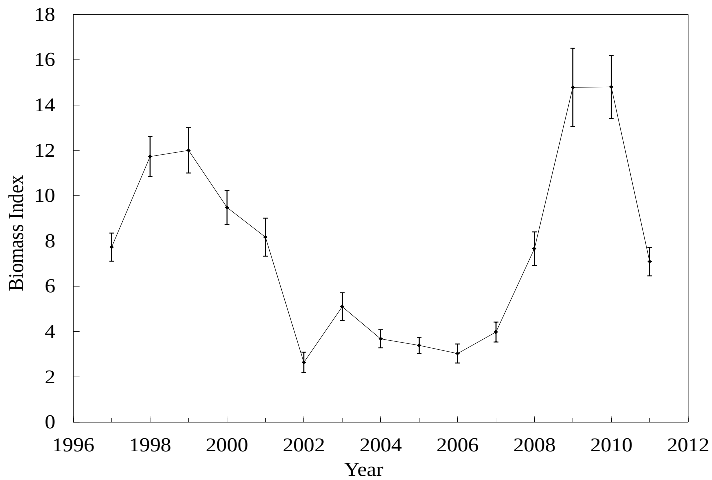


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in the NRA of Div. 3NO.

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 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 2008-2011. These discrepancies complicate interpretations of overall resource status.

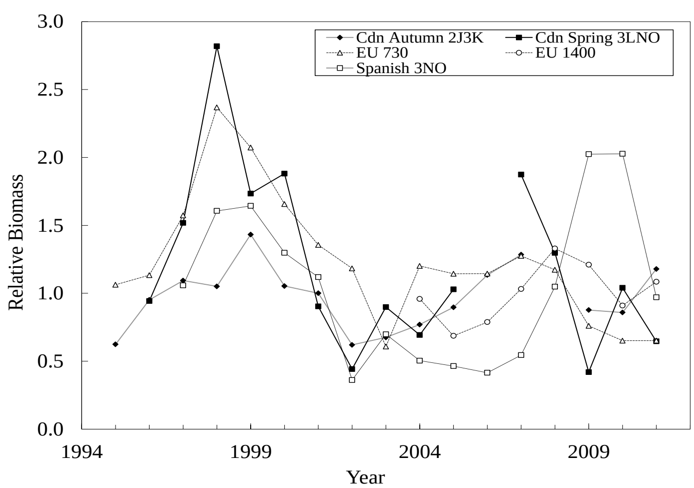


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices from Canadian autumn surveys in Div. 2J3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and EU-Spain surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2011 average.

c) Estimation of Parameters

The eXtended Survivors Analysis (XSA) methodology which has been used to estimate the status of the stock using survey data augmented by catch information could not be updated during the current assessment as STACFIS could not estimate the total catch.

State of the Stock: During the previous assessment of this stock, STACFIS noted that: 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.

Information from surveys used to compute the HCR over the past four years has been variable but generally shows a declining trend. Although the Canadian autumn survey has been somewhat stable over this period, the Canadian spring and EU Flemish Cap surveys have declined. The recruitment signal is also not consistent among these surveys – both Canadian surveys have shown some increases whereas the recruitment signal from the EU survey is quite pessimistic.

d) Other Studies

Distribution of spawning and sex ratio in Greenland halibut (SCR Doc. 12/24)

Spawning area and time and sex ratio by depth were examined from data collected from the commercial fisheries of Canada and Spain and by research vessel surveys conducted by Canada and the EU. The data from commercial fisheries indicate that the proportion female increases with depth. This is particularly evident for depths greater than 600 m. However, the interpretation of the change in sex ratio with depth is complicated by issues of gear selectivity. Spawning fish were found in all areas and in all months. There tended to be a higher proportion of females in spawning condition in the northern areas. Canadian data indicate that spawning is in the summer and autumn while data from Spain seem to indicate more year round spawning. The ability to determine peak spawning time and area is hampered by the lack of sampling throughout the year in all areas.

e) 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

During the previous assessment of this resource, F_{max} was computed to be 0.41 and $F_{0.1}$ was 0.22.

References

NAFO 1993. STACFIS REPORT.

NAFO 2004. STACFIS REPORT.

f) Research Recommendations

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

STATUS: No progress. This recommendation is reiterated.

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

STATUS: Research ongoing, and this issue is also discussed further in the STACREC Report. This recommendation is reiterated.

There is no synoptic survey which covers the full range of this stock. In addition, very few age 10+ fish are captured in either commercial fisheries or in trawl surveys. STACFIS **recommended** *expansion of surveys to cover the entire* *stock distribution and/or exploratory surveys be conducted with gears other than those currently deployed to complement the 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 Sub-Area 2 and Divisions 3KLMNO be conducted*.

STATUS: A tagging experiment was conducted by Canada during early 2012, and additional experiments are planned for 2013. This recommendation is reiterated.

This stock will be next assessed during June 2013.

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

Interim Monitoring Report (SCR Doc. 98/59; 98/75; 02/56; 10/31)

a) Introduction

The species has a lifespan of less than one year. The Subareas 3+4 and Subareas 5+6 stock components are assessed and managed separately by NAFO and the U.S. Mid-Atlantic Fishery Management Council, respectively. Indices of relative biomass and mean body size, computed using data from the Div. 4VWX surveys conducted during July by the Canada Division of Fisheries and Oceans, and relative fishing mortality indices are used to assess whether the stock was at a low or high productivity level during the previous year. The Subareas 3+4 stock component has been in a low productivity period since 1982.

Since 1999, there has been no directed fishery for *Illex* in Subarea 4 and most of the catches from Subareas 3+4 have been from Subarea 3. Since 2003, catches from Subareas 3+4 have been low during most years and ranged between 120 t in 2010 to about 7, 000 t in 2006 (Fig. 21.1). Similar to 2010, the catch in Subareas 3+4 was 123 t in 2011 and was mostly taken from Subarea 3 (73%).

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC SA 3+4	34	34	34	34	34	34	34	34	34	34
STATLANT 21 SA 3+4	1.1[1]	2.6	0.6	7.0[1]	0.2[1]	0.5	0.7	0.1	0.1[1]	
STATLANT 21 SA 5+6[2]										
STACFIS SA 3+4	1.1	2.6	0.6	7.0	0.2	0.5	0.7	0.1	0.1	
STACFIS SA 5+6	6.4	26.1	12.0	14.0	9.0	15.9	18.4	15.8	18.8	
STACFIS Total SA 3-6	7.5	28.7	12.6	21.0	9.2	16.4	19.1	15.9	18.9	

[1] Includes amounts (ranging from 18-37 t) reported as Unspecified Squid from Subarea 4.

[2] Catches from Subareas 5+6 are included because there is no basis for considering separate stocks in Subareas 3+4 and Subareas 5+6

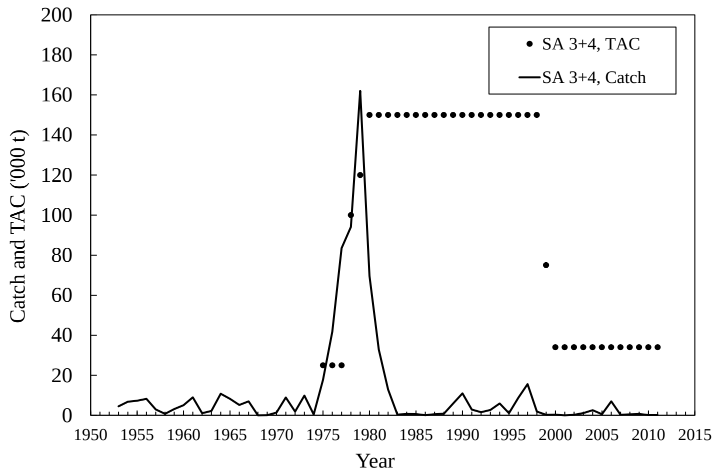


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

b) Data Overview

The relative biomass indices, derived using the Div. 4VWX July Canadian surveys, have fluctuated widely since 2003. The third and fourth highest indices in the time series occurred during 2004 and 2006, but both years were followed by very low indices. Similar to the 2010 index, the 2011 index was below the 1982-2010 average for the low productivity period (Fig. 21.2).

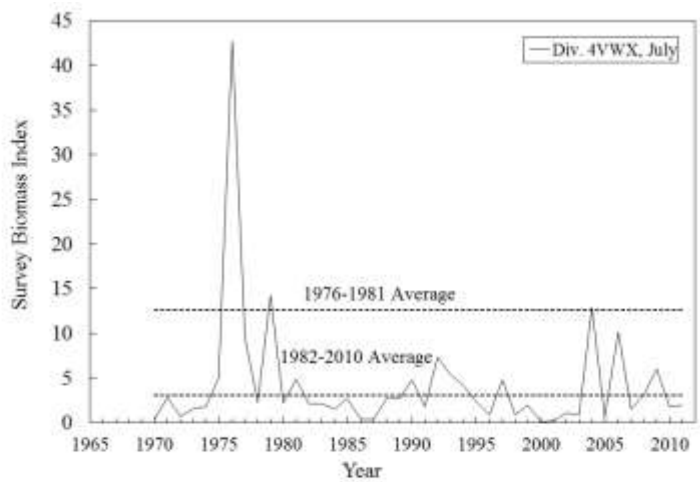


Fig. 21.2. Northern shortfin squid in Subareas 3+4: survey biomass indices from the July survey in Div. 4VWX.

Mean body weights of squid caught during the Div. 4VWX surveys have gradually declined since 2006, and in 2011, mean body weight (83 g) was slightly above the 1982-2010 average for the low productivity period (81g, Fig. 21.3).

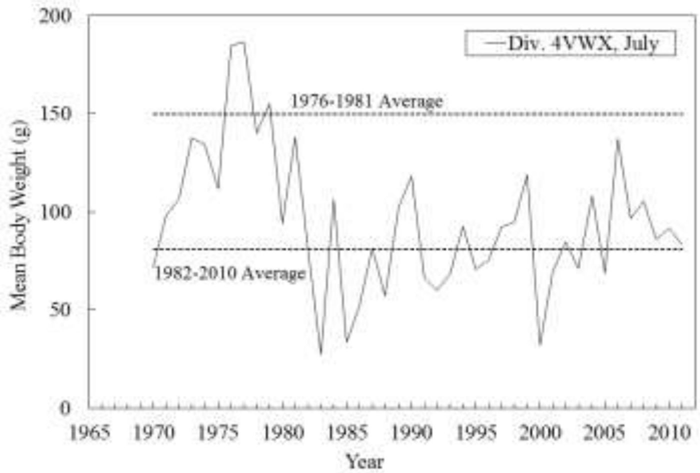


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX.

Catch/biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index) have been well below the 1982-2010 average (0.14) during most years since 2001and the ratio was 0.01 in 2011 (Fig. 21.4).

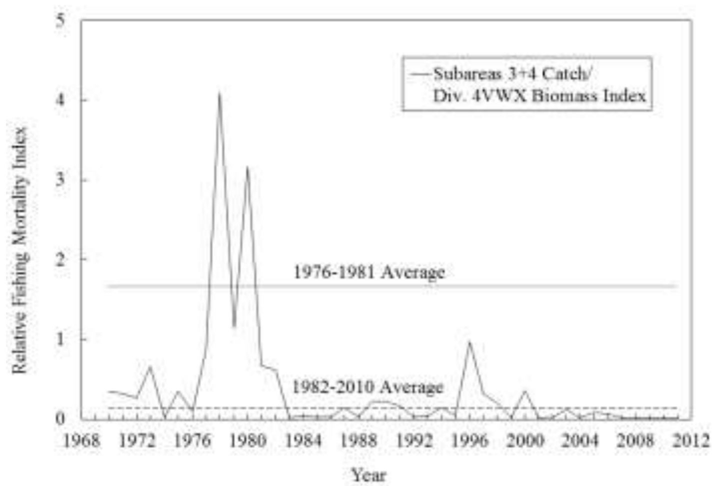


Fig. 21.4. Northern shortfin squid in Subareas 3+4: catch/biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index).

c) Conclusion

In 2011, the biomass index from the Div. 4VWX survey was below and mean body weight was slightly above the 1982-2010 mean for the low productivity period, but continued to remain below the average for the high productivity period. Catch/biomass ratios have also been very low during most years since 2001. In 2011, the stock remained in a state of low productivity.

The next full assessment of the 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. This recommendation is reiterated.

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

STACFIS reviewed the assessments of stocks managed by NAFO in June 2012. Based on the available information and the most recent assessments, STACFIS found no reason to modify the classification made at the June meeting in 2011. STACFIS reiterates that 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	Greenland halibut in Uummannaq[2] Greenland halibut in Upernavik[2] Greenland halibut in Disko Bay[2]
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[1,3]			SA1 Redfish SA0+1 Roundnose grenadier
Unknown	SA2+3 Roughhead grenadier 3NO Capelin 3O Redfish	0&1A Offsh. & 1B–1F Greenland halibut		SA2+3 Roundnose grenadier

[1] Shrimp will be re-assessed in October 2012
[2] Assessed as Greenland halibut in Div. 1A inshore
[3] Fishing mortality may not be the main driver of biomass for Div. 3M Shrimp

2. Other Business

There was no other business.

VI. 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.