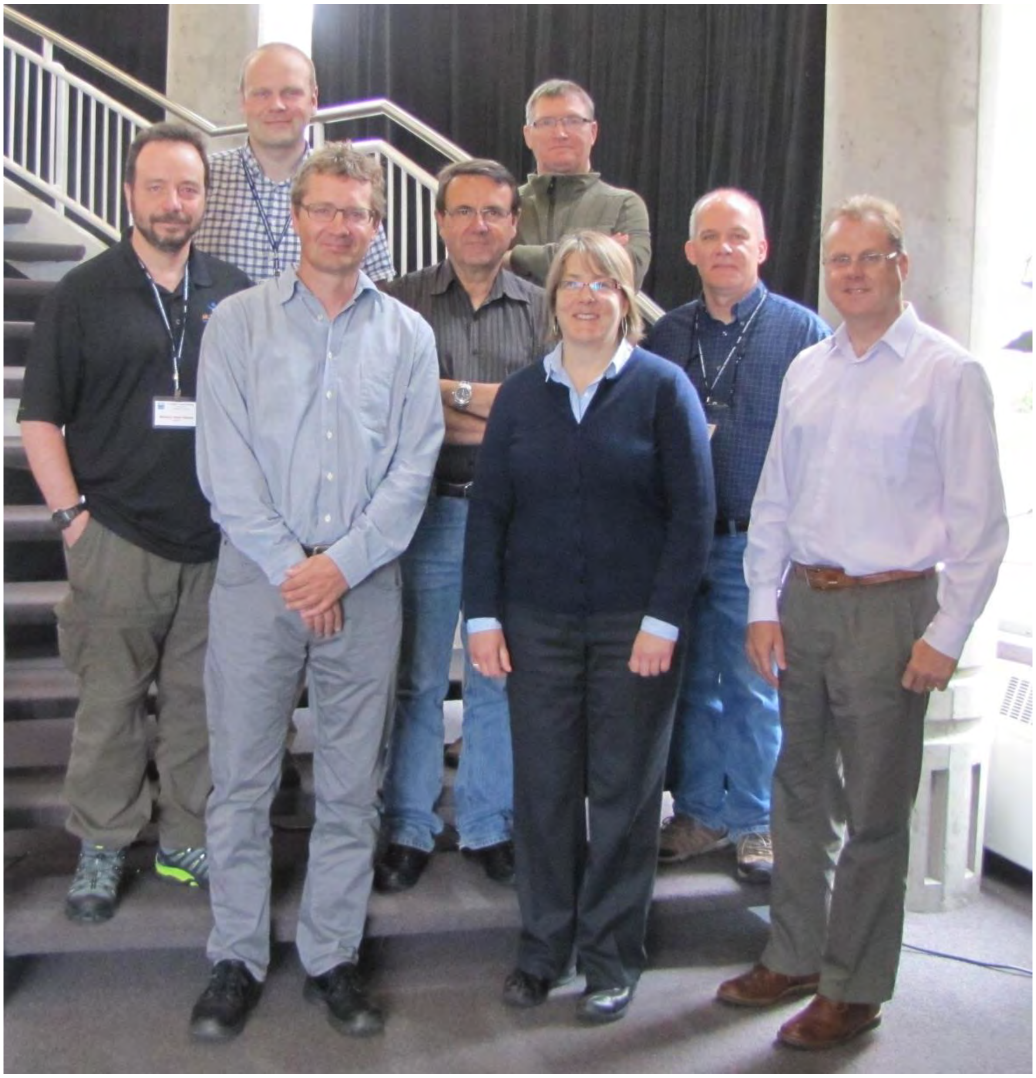
PART B: SCIENTIFIC COUNCIL 7-20 JUNE MEETING - 2013

Contents



SC Chairs and the SC Coordinator

Back: Neil Campbell (SC Coordinator), Don Stansbury (Canada, STACREC)

Middle: Mariano Koen-Alonso (Canada, WGEAFM), Jean-Claude Mahé (EU-France, STACFIS), Gary Maillet (Canada, STACFEN)

Front: Carsten Hvingel (Norway, SC Chair) Margaret Treble (Canada, STACPUB), Andrew Kenny (EU-UK, WGEAFM)

Scientific Council Participants during the June 2012 Meeting

Report of Scientific Council Meeting

7-20 JUNE 2013

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at Alderney Landing, Dartmouth, NS, Canada, during 7-20 June 2013, 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), France (St Pierre et Miquelon), Japan, the Russian Federation 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 7 June 2013. 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 1230 hours on 7 June 2013. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda. The Council considered **adopted** the STACFEN, STACPUB, STACFIS and STACREC reports on 20 June 2013.

The concluding session was called to order at 0900 hours on 20 June 2013.

The Council considered and **adopted** the report the Scientific Council Report of this meeting of 7-20 June 2013. 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 1430 hours on 20 June 2013.

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

The Agenda, List of Research (SCR) and Summary (SCS) Documents, and List of Representatives, Advisers and Experts, are given in Appendix V-VII.

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

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 2012

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.*

STATUS: No progress.

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.*

STATUS: No progress

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 **recommends** 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 **recommends** *that the Secretariat compile information regarding the timelines from article submission to publication and present the data to Scientific Council in June 2014*.

STACPUB **recommends** that *the Secretariat print the Scientific Council Reports upon request using spiral binding.*

STACPUB **recommends** that *the Summary Sheets be made more easily accessible on the website.*

STACPUB **recommends** that *the Coral and Sponge Guides be updated to include the additional VME species that are listed in the CEM.*

STACPUB **recommends** that *the new design for the cover be implemented for regular issues of the Journal and the current Journal cover design be used for special symposia editions with a unique picture chosen to reflect the theme of the meeting.*

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.

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

The Secretariat presented: "Estimating fishing effort in the NAFO Regulatory Area using vessel monitoring system data". STACREC found this work to be a useful contribution to the understanding of variation in catches and **recommends** that *the Secretariat continue to develop this work by incorporating target species and making the data available via a web extraction tool.*

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)) will be undertaken during the Scientific Council meeting on 12-19 September 2013.

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.

Cod in Division 3M

Advice June 2013 for 2014

Recommendation for 2014

In the short term the stock can sustain values of F up to F_{max}, 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. Projections are heavily influenced by the 2010 year class, which is estimated to be extremely large, but with high uncertainty. Given the uncertainty in the projections, Scientific Council makes these recommendations for 2014 only, and does not advise using the 2015 results as a basis for management decisions. The stock should be reassessed in 2014.

Management objectives

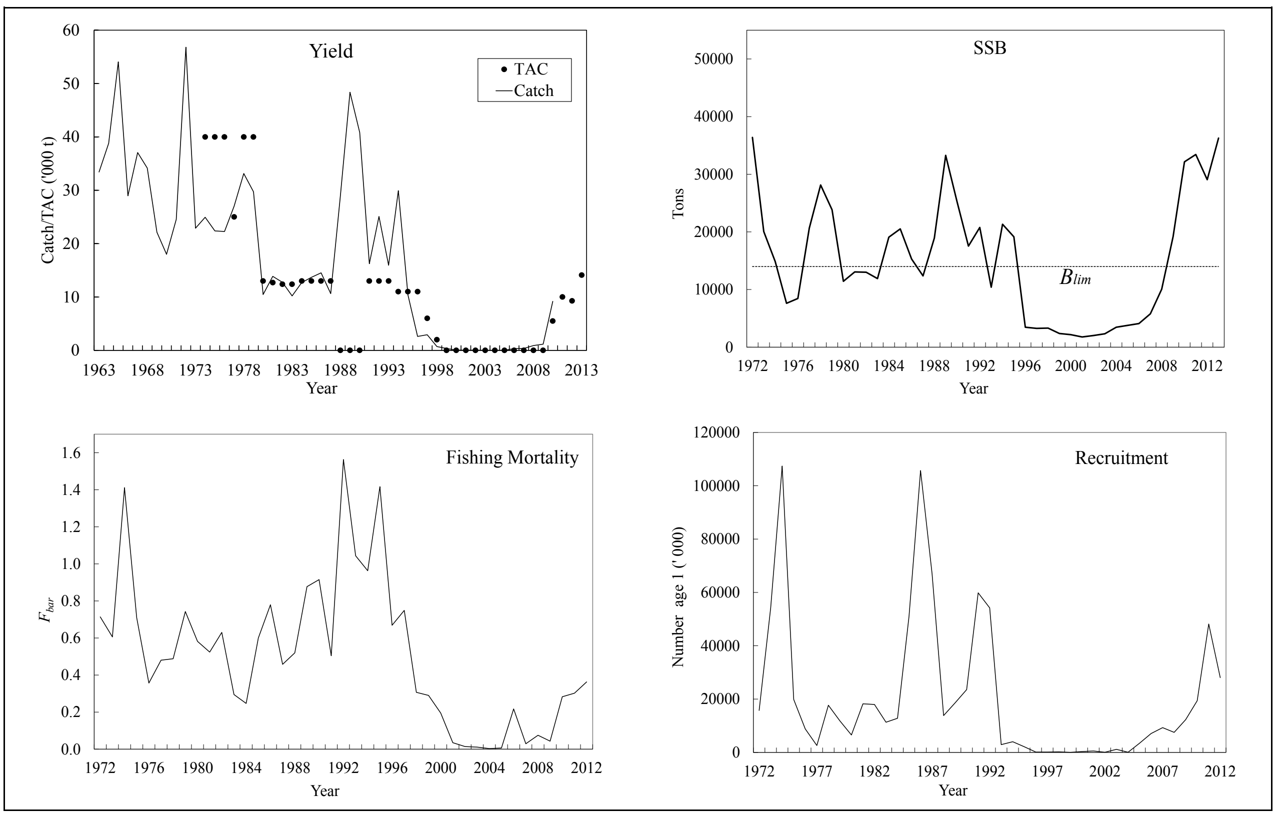
No explicit management plan or management objectives defined by Fisheries Commission. General convention objectives (GC Doc. 08/3) are applied.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Unknown	B_{msy} unknown, stock increasing
Eliminate overfishing	Not accomplished	Current F not sustainable in the long term
Apply Precautionary Approach	Intermediate	Only B_{lim} is defined
Minimise harmful impacts on living marine resources and ecosystems	Intermediate	VME closures in effect, no specific measures.
Preserve marine biodiversity	Unknown	Cannot be evaluated

- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The cod stock in Flemish Cap is considered to be a separate population.



Stock status

Current SSB 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 2012 is high, at the level of more than twice F_{max}.

Reference points

B_{lim}: 14 000 t of spawning biomass (STACFIS 2008).

Projections

	Total biomass (B)			Spawning Stock Biomass (SSB)			Yield (t)		
	5%	50%	95%	5%	50%	95%	5%	50%	95%
Fishing mortality (F)=$F_{0.1}$ (median=0.085)									
2013	56681	84139	123214	23218	36274	53972		14113	
2014	73341	116604	180008	36290	61946	98400	5253	9142	14787
2015	108560	171317	265541	60070	100614	165438	14727	23626	37698
Fishing mortality (F)=F_{max} (median=0.140)									
2013	56319	84086	122757	23168	36277	54027		14113	
2014	73277	116617	178999	36528	62032	98464	8536	14521	23305
2015	104107	164311	256187	56909	94836	157739	21218	33518	52688
Fishing mortality (F)=F_{2012} (median=0.363)									
2013	56621	84208	123004	23183	36460	54255		14113	
2014	73787	116640	179196	36862	61824	98655	21512	32470	52390
2015	85144	142867	227577	40818	75177	131648	31367	49436	77229
Catch=TAC_{2013}									
	Total Biomass			SSB			F		
	5%	50%	95%	5%	50%	95%	5%	50%	95%
2013	56613	84078	122899	23190	36230	54366	0.1201	0.1913	0.3043
2014	73466	116513	178478	36807	62157	97733	0.0830	0.1337	0.2285
2015	98745	165579	262320	51811	95533	164692	0.0450	0.0787	0.1480

	Yield (t)			$P(B<B_{lim})$			$P(F>F_{0.1})$			$P(F>F_{max})$			
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2013	2015	$P(B_{15}<B_{12})$
$F_{0.1}$	14113	9142	15640	<5%	<5%	<5%							<5%
F_{max}	14113	14521	23494	<5%	<5%	<5%							<5%
F_{2012}	14113	32470	41778	<5%	<5%	<5%	>95%	>95%	>95%	85.58%	>95%	>95%	<5%
Catch=TAC_{2013}	14113	14113	14113	<5%	<5%	<5%	>95%	92.90%	43.80%	85.60%	46.40%	7.30%	<5%

Assessment

A quantitative model introduced in 2008 was used (STACFIS 2008). Model settings were in general kept unchanged and the results are consistent with the previous assessments. Due to problems of estimating exact catches for 2011 and 2012, catches for those years were entered as a probability distribution reflecting "best expert estimate" and the uncertainty associated. The use of imprecise catch estimates for the recent two years introduces additional element of uncertainty in the assessment. Without improved estimates of catch this assessment method will be discontinued in 2014.

The next full assessment is planned for 2014.

Human impact

Mainly fishery related mortality. Other sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biological and environmental interactions

Redfish and shrimp are important prey items for cod. Recent studies indicate important trophic interactions between these species in the Flemish Cap. Changes in maturity of cohorts in the late 1990s - early 2000s may be a response to increased feeding opportunities, water temperature and density dependent changes in growth rate.

Fishery

Cod is caught in a directed trawl fishery and as bycatch in other trawl fisheries, mainly the redfish fishery. The fishery is regulated by quota.

Recent catch estimates and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	ndf	ndf	5.5	10	9.3	14.1
STATLANT 21	0.0	0.0	0.1	0.1	0.4	1.2	5.3	9.8	9.0	
STACFIS	0.0	0.0	0.3	0.3	0.9	1.2	9.2	13.6[1]	13.7[1]	

ndf = no directed fishery

Effects of the fishery on the ecosystem

No specific information available. General impacts of fishing gear on the ecosystem should be considered.

Special comments

In 2012 the lack of length distributions and age-length keys from some contracting parties has further increased uncertainty in the current assessment.

Sources of information

SCR Doc. 13/13, 13/41, 13/50; SCS Doc. 13/05, 13/07, 13/09, 13/15, 13/16, GC Doc. 08/3

Redfish in Division 3M

Advice June 2013 for 2014 and 2015

Recommendation for 2014 and 2015

Because of weaker incoming recruitment and uncertainty regarding current levels of natural mortality, Scientific Council recommends not increasing the current TAC (6 500 t).

Management objectives

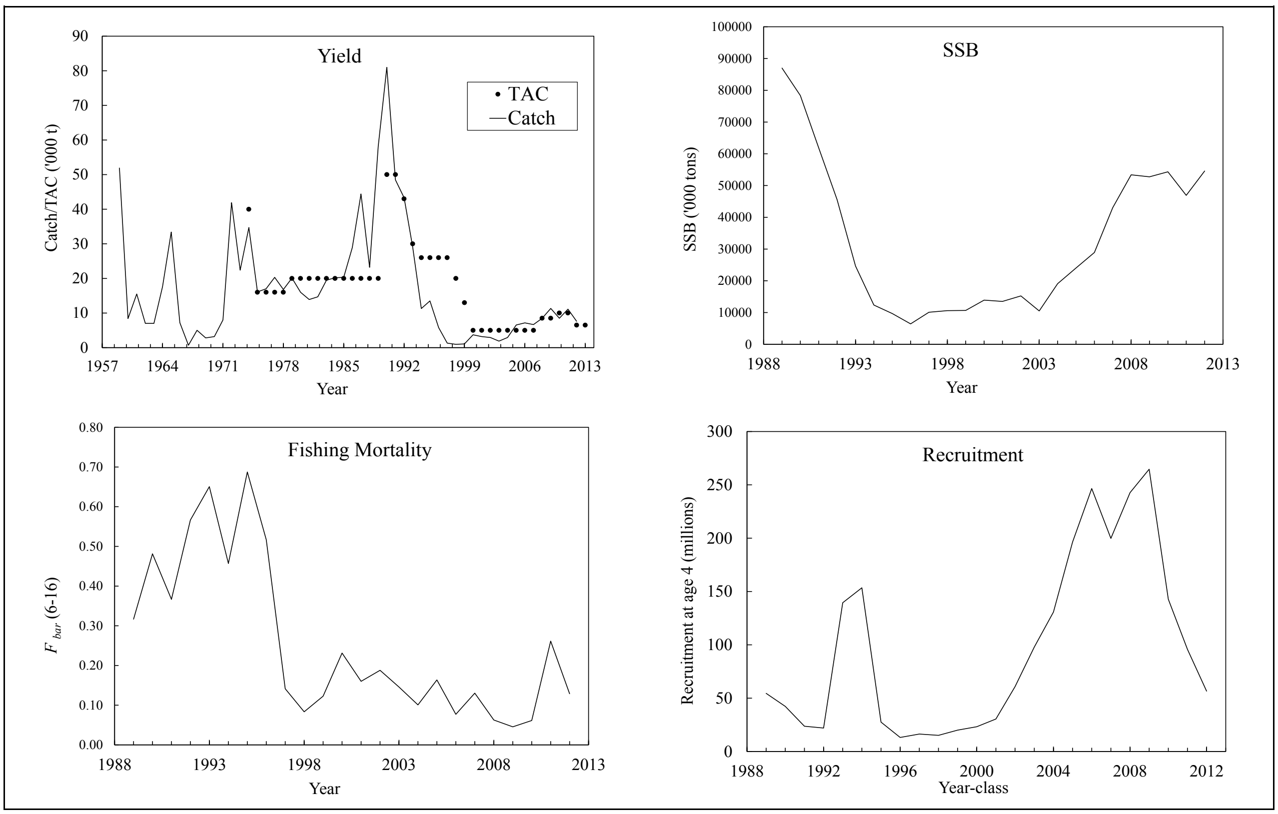
No explicit management plan or management objectives defined by Fisheries Commission. General Convention objectives (GC Doc. 08/3) are applied.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Unknown	B_{msy} unknown, Stock stable at a high level
Eliminate overfishing	Intermediate	F_{msy} unknown, catch at low levels
Apply Precautionary Approach	Unknown	Reference points not defined
Minimise harmful impacts on living marine resources and ecosystems	Intermediate	VME closures in effect, no specific measures, low bycatch reported
Preserve marine biodiversity	Unknown	Cannot be evaluated

- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

Catches of redfish in Div. 3M includes 3 species of the genus Sebastes; *S. mentella*, *S. marinus* and *S. fasciatus*. For management purposes they are considered as one stock (STACFIS 2013). Advice is based on data only for two species (*S. mentella* & *S. fasciatus*), labeled as Beaked redfish.



Stock status

The stock has increased since 2005 and has remained at a relatively high level in recent years. Fishing mortality has remained stable since the late 1990s. Recent recruitment is declining.

Reference points

No updated information on biological reference points was available.

Projections

Given the uncertainty about the actual level of current natural mortality (M) (see STACFISH 2013) and its impact on short term model projections, Scientific Council decided not to use model predictions as basis for the recommendation.

Assessment

The present assessment evaluates the status of the Div. 3M beaked redfish stock, composed of two very similar species (*S. mentella* and *S. fasciatus*). Input data comes from EU Flemish Cap bottom trawl survey and the fishery (STACFIS 2013). A quantitative model introduced in 2003 was used (STACFIS 2013). Model settings were in general kept unchanged and the results are consistent with the previous assessments. A sensitivity analysis pointed to changes in natural mortality in recent years which were included in the assessment. The next full assessment is planned for 2015.

Human impact

Mainly fishery related mortality. Other sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and Environmental interactions

The three species of redfish found in Div. 3M are difficult to distinguish, and are landed as "redfish". Redfish is an important component in the diet of cod, especially in those years when successful recruitment events were observed in redfish stocks. The perceived changes in natural mortality are consistent with the dynamics of the cod stock.

Fishery

Redfish is caught primarily in bottom trawl fisheries, but some landings are reported from fisheries with mid-water trawl. Cod is the main bycatch species in shallower waters, and Greenland halibut in deeper waters. In turn, redfish are also caught as bycatch in fisheries directed for cod and Greenland halibut. The fishery in NAFO Div. 3M is regulated by minimum mesh size and quota.

Until 2005 catches comprised of mainly *S. mentella*, while from 2005 onwards catches of *S. marinus* increased.

Recent catch estimates of all redfish and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	5	5	5	5	5	8.5	10.0	10.0	6.5	6.5
STATLANT 21	3.1	6.4	6.3	5.6	7.9	8.7	8.5	9.7	6.7	
STACFIS total catch	2.9	6.6	7.2	6.7	8.5	11.3	8.5	11.1	7.6	

Effects of the fishery on the ecosystem.

No specific information is available. General impacts of fishing gears on the ecosystem should be considered.

Special comments

None.

Sources of information

SCR Doc. 12/068, 13/013, 034; SCS Doc. 12/26, 13/05, 07,09; GC Doc 08/3.

Yellowtail flounder in Divisions 3LNO

Advice June 2013 for 2014 and 2015

Recommendation for 2014 and 2015

Fishing mortality up to 85% F_{msy} corresponding to a catch of 26 000 t in 2014 and 23 500 t in 2015 has low risk (<5%) of exceeding F_{lim}, and is projected to maintain the stock well above B_{msy}.

Management objectives

No explicit management plan or management objectives are defined by Fisheries Commission. General convention objectives (GC Doc. 08/3) are applied. Advice is provided in the context of the Precautionary Approach Framework (FC Doc. 04/18).

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	OK (green)	Stock increasing, $B>B_{msy}$
Eliminate overfishing	OK (green)	$F<F_{msy}$
Apply Precautionary Approach	OK (green)	Stock in safe zone of PA framework
Minimise harmful impacts on living marine resources and ecosystems	Intermediate (yellow)	VME closures in effect, Bycatch restrictions for moratorium stocks
Preserve marine biodiversity	Unknown (white)	Cannot be evaluated

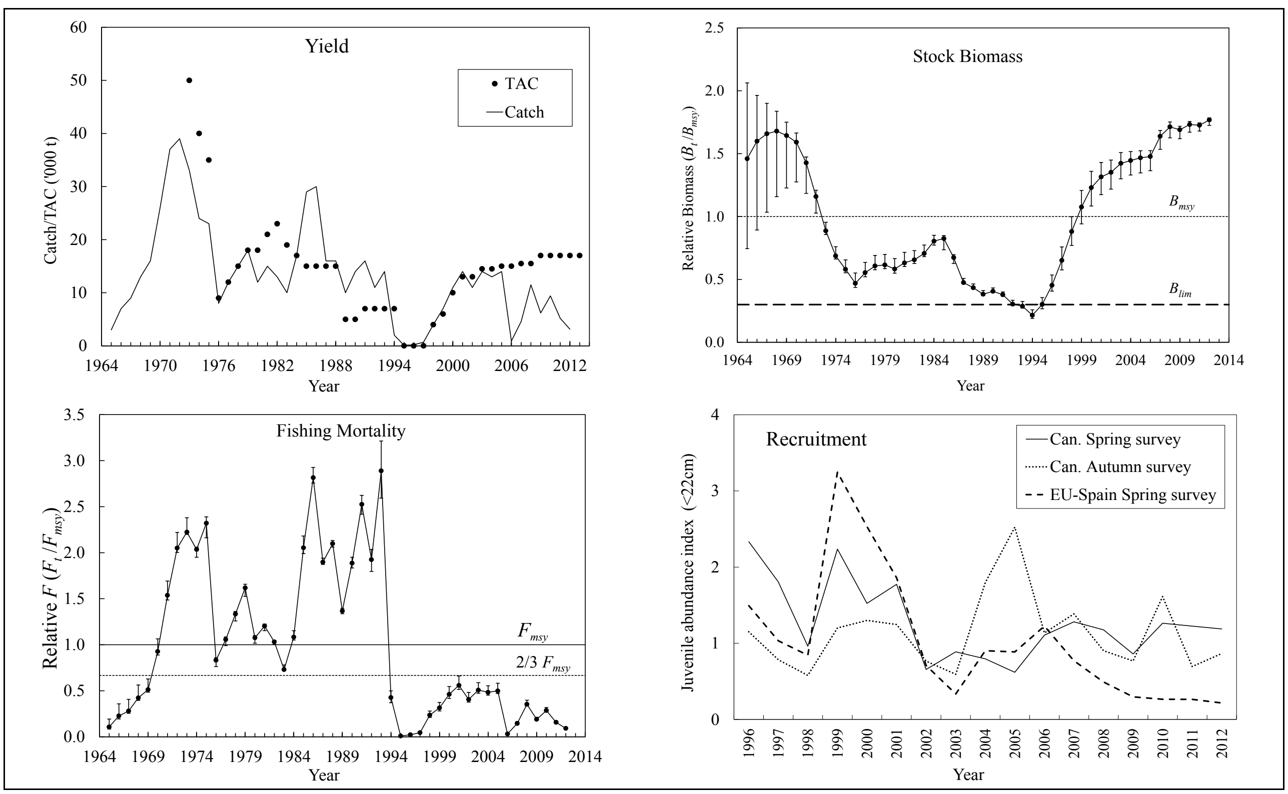
Legend: green = OK; yellow = Intermediate; red = Not accomplished; white = Unknown

Management unit

The stock occurs in Divisions 3LNO, mainly concentrated on the southern Grand Bank and is recruited from the Southeast Shoal area nursery ground.

Stock status

The stock size has steadily increased since 1994 and is now well above B_{msy}. There is very low risk of the stock being below B_{msy} or F being above F_{msy}. Recent recruitment appears about average.



Reference points

B_{lim} is 30% B_{msy} and F_{lim} is F_{msy} (STACFIS 2004 p. 133).

Projections

				Catch$_{2013}$ = 17 000 t						
	Yield (000 t)			Risk (F_y>F_{msy})			Risk (B_y<B_{lim})			
	2013	2014	2015	2013	2014	2015	2013	2014	2015	$B_{2016}<B_{2013}$
2/3 F_{msy}	17.00	20.66	19.40	<5%	<5%	<5%	<5%	<5%	<5%	>95%
75% F_{msy}	17.00	23.03	21.31	<5%	<5%	<5%	<5%	<5%	<5%	>95%
85% F_{msy}	17.00	25.82	23.48	<5%	<5%	<5%	<5%	<5%	<5%	>95%
F_{msy}	17.00	29.88	26.45	<5%	48%	<5%	<5%	<5%	<5%	>95%

				Catch$_{2013}$ = 6 656 t						
	Yield (000 t)			Risk (F_y>F_{msy})			Risk (B_y<B_{lim})			
	2013	2014	2015	2013	2014	2015	2013	2014	2015	$B_{2016}<B_{2013}$
2/3 F_{msy}	6.66	21.75	20.07	<5%	<5%	<5%	<5%	<5%	<5%	>95%
75% F_{msy}	6.66	24.25	22.05	<5%	<5%	<5%	<5%	<5%	<5%	>95%
85% F_{msy}	6.66	27.18	24.30	<5%	<5%	<5%	<5%	<5%	<5%	>95%
F_{msy}	6.66	31.46	27.38	<5%	49%	49%	<5%	<5%	<5%	>95%

Assessment

A surplus production model was used (STACFIS 2011 p 168); model settings were unchanged; the results were consistent with the previous assessment. Input data come from research surveys and the fishery (STACFIS 2013). Next full assessment is planned for 2015.

Human impact

Mainly fishery related mortality has been documented. Other sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and Environmental interactions

As stock size increased from the low level in the mid-90s, the stock expanded northward and continues to occupy this wider distribution. This expansion coincided with warmer temperatures; temperatures continue to warm, and will likely not limit the stock distribution in the near future.

Despite the increase in stock size observed since the mid-90s, length at which 50% of fish are mature has been lower for both males and females in the recent period. There also seems to have been a slight downward trend in weight at length since 1996. The cause of these changes is unknown.

Fishery

Yellowtail flounder is caught in a directed trawl fishery and as by-catch in other trawl fisheries. The fishery is regulated by quota and minimum size restrictions. American plaice and cod, are taken as by-catch in the yellowtail flounder fishery. There is a 15% bycatch restriction on American plaice and a 4% bycatch limit on cod in Div. 3NO.

Recent catch estimates and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC[1]	14.5	15.0	15.0	15.5	15.5	17	17	17	17	17
STATLANT 21	13.1	13.9	0.6	4.4	11.3	5.5	9.1	5.2	3.1	
STACFIS	13.4	13.9	0.9	4.6	11.4	6.2	9.4	5.2	3.1	

[1] SC recommended any TAC up to 85% F_{msy} in 2009 to 2013.

Effects of the fishery on the ecosystem

Fishing intensity on yellowtail flounder has impacts on Div. 3NO cod and Div. 3LNO American plaice through bycatch. General impacts of fishing gears on the ecosystem should also be considered.

Special comments

Catch of yellowtail flounder has been low in recent years. If catches increase fishing mortality on Div. 3NO cod and Div. 3LNO American plaice will also increase.

Sources of information

SCR Doc. 11/34, 13/11, 13/37, 13/38; SCS Doc. 13/5, 13/7, 13/9, 13/10, 13/13; GC Doc 08/3; FC 04/18

White hake in Divisions 3NO

Advice June 2013 for 2014-15

Recommendation for 2014-2015

Based on the low recruitment, catches of white hake in Div. 3NO should not exceed their current levels of 100-300 t.

Management objectives

No explicit management plan or management objectives defined by Fisheries Commission. General convention objectives (GC Doc. 08/3) are applied. Advice is based on survey indices and catch trends in relation to estimates of recruitment.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Unknown	B_{msy} unknown, Stock at low level
Eliminate overfishing	Intermediate	F_{msy} unknown, fishing mortality is low
Apply Precautionary Approach	Not accomplished	Reference points not defined
Minimise harmful impacts on living marine resources and ecosystems	Intermediate	No specific measures, general VME closures in effect
Preserve marine biodiversity	Unknown	Cannot be evaluated

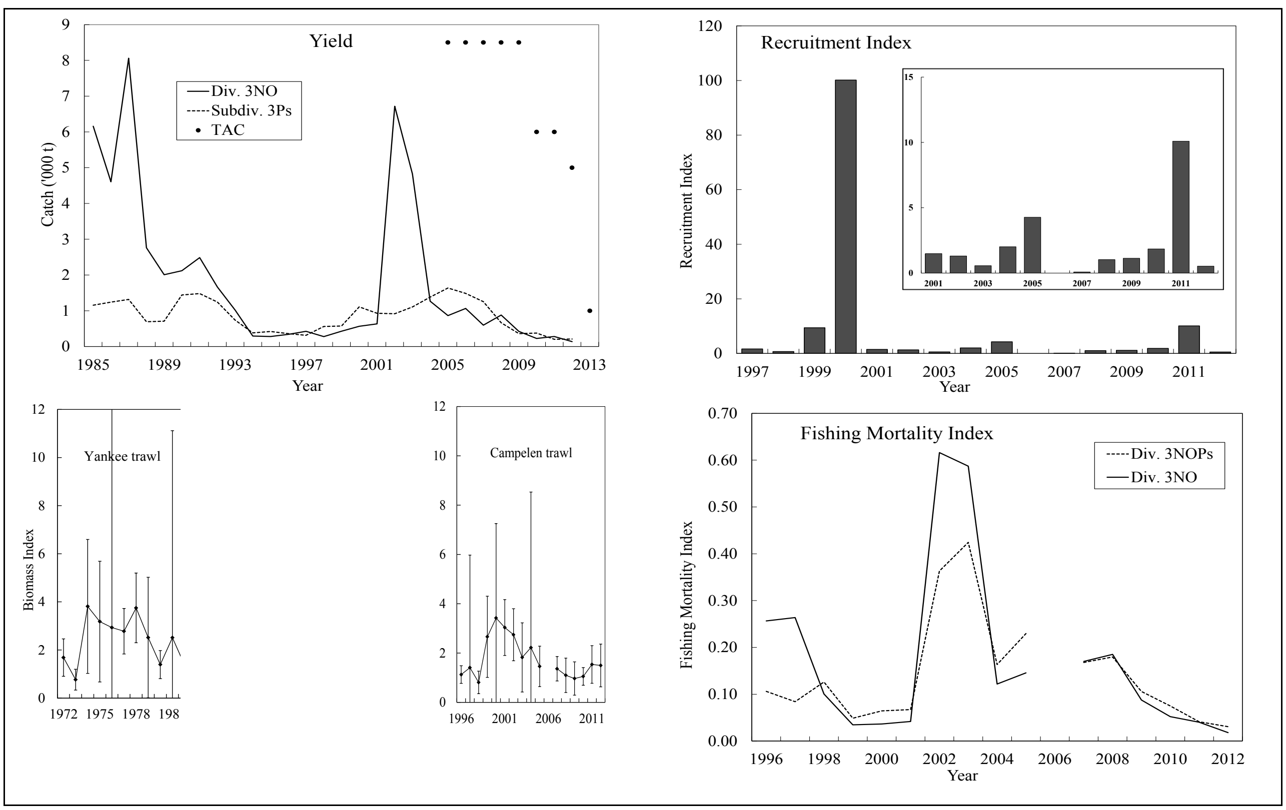
- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The management unit is confined to NAFO Div. 3NO, which is a portion of the stock that is distributed in NAFO Div. 3NO and Subdivision 3Ps.

Stock status

The stock biomass remains at relatively low levels. No large recruitments have been observed since 2000. Fishing mortality is low.



Reference points

Not defined.

Projections

Quantitative assessment of risk at various catch options is not possible for this stock at this time.

Assessment

This assessment is based upon a qualitative evaluation of stock biomass trends and recruitment indices. The assessment is considered data limited and as such associated with a relatively high uncertainty. Input data are research survey indices and fishery data (STACFIS 2013). The next full assessment of this stock is planned for 2015.

Human impact

Mainly fishery related mortality has been documented. Mortality from other human sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and Environmental interactions

On the Grand Bank, white hake are near the northern limit of their range, concentrating along the southwest slope at temperatures above 5°C. The major spawning area is located on the shelf-edge on the Grand Bank. Weaker ocean currents on the continental slope during spawning period are hypothesized to reduce potential losses of eggs and larvae due to entrainment in the Labrador Current and increase recruitment potential. White hake feed mostly on crustaceans and fish. Larger individuals are reported to be cannibalistic and to feed upon eggs and juveniles. In nearshore areas, white hake are also thought to predate on smaller juvenile cod. Predators of white hake include cod, other fish species, Atlantic puffins, Arctic terns, other seabirds and seals.

Fishery

White hake is caught in directed gillnet, trawl and long-line fisheries. In directed white hake fisheries, cod, black dogfish, monkfish and other species are landed as bycatch. In turn, white hake are also caught as bycatch in gillnet, trawl and long-line fisheries directing for other species. The fishery in NAFO Div. 3NO is regulated by quota.

Recent catch estimates and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	-	8.5	8.5	8.5	8.5	8.5	6	6	5	1[1]
STATLANT 21	1.9	1.0	1.2	0.7	0.9	0.5	0.3	0.2	0.1	
STACFIS	1.3	0.9	1.1	0.6	0.9	0.4	0.2	0.2	0.1	

[1] May change in season. See NAFO FC Doc. 13/01 quota table.

Effects of the fishery on the ecosystem

No specific information is available. General impacts of fishing gears on the ecosystem should be considered.

Special comments

Adjustments of the TAC within the fishing season should be based upon scientific advice. Any potential increase in fishable biomass within the short term is expected to be detected in the existing annual assessment/monitoring process and will be reported to Fisheries Commission accordingly.

Sources of Information

SCR Doc. 13/12, 30; 07/21; 05/60; SCS Doc. 13/05, 07, 09, 16.

Capelin in Divisions 3NO

Advice June 2013 for 2014-2015

Recommendation for 2014-2015

No directed fishery.

Management objectives

No explicit management plan or management objectives defined by Fisheries Commission. General convention objectives (GC Doc. 08-03) are applied. Advice is based on qualitative evaluation of biomass indices in relation to historic levels.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Not accomplished	B_{msy} unknown, stock at low level
Eliminate overfishing	OK	No directed fishery
Apply Precautionary Approach	Unknown	Reference points not defined
Minimise harmful impacts on living marine resources and ecosystems	OK	VME closures in effect, no directed fishing
Preserve marine biodiversity	OK	No directed fishery

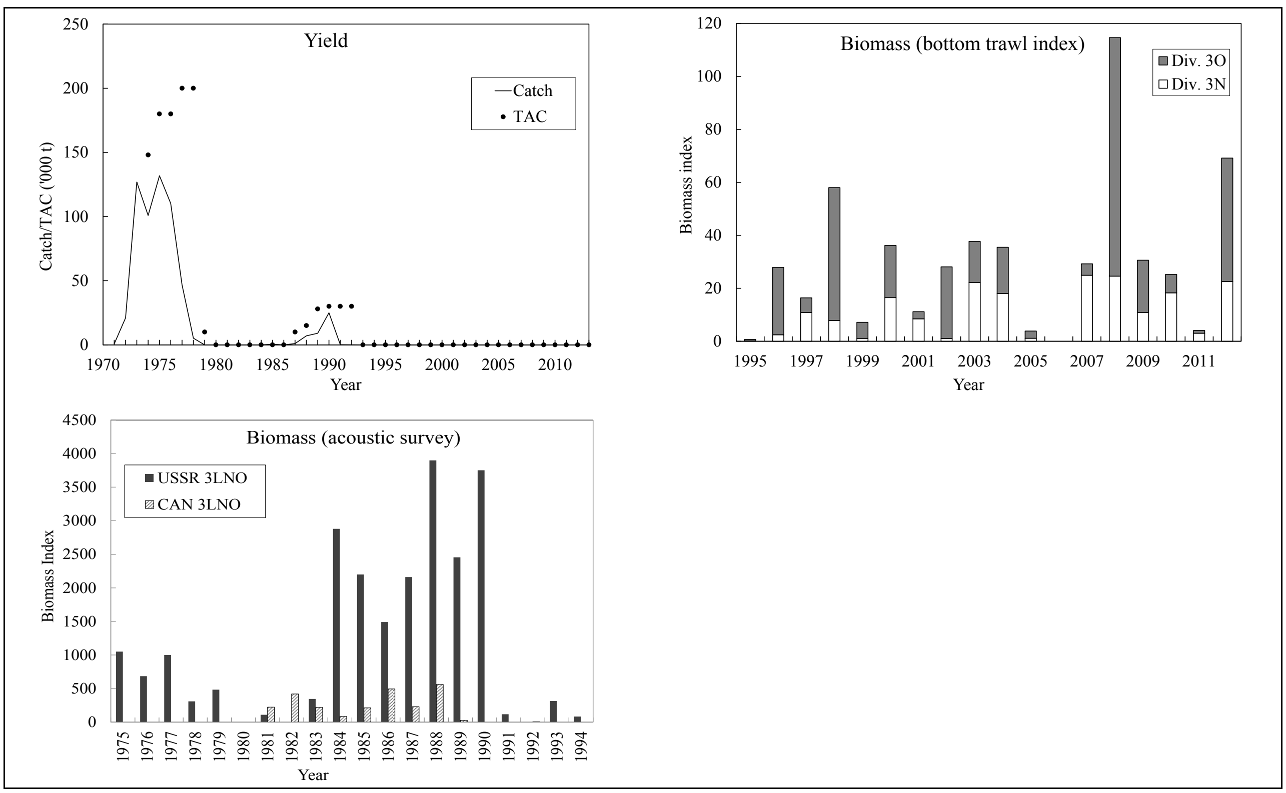
- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The capelin stock is distributed in Div. 3NO, mainly on the Grand Bank.

Stock status

Acoustic surveys series terminated in 1994 indicated a stock at a low level. Biomass indices from bottom trawl surveys have not indicated a change in stock status since then.



Reference points

Not defined.

Projections

Quantitative assessment of risk at various catch options is not possible for this stock at this time.

Assessment

Assessment was based on evaluation of trends in acoustic survey data (1975 – 1994) and bottom trawl surveys (1995 – 2012). Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

Next full assessment is planned for 2015.

Human impact

Low fishery related mortality due to moratorium and low bycatch in other fisheries. Other sources (e.g. pollution, shipping, oil-industry) are considered minor.

Biological and Environmental Interactions

Changes in growth, maturity and recruitment are linked to temperature on the Grand Banks. Recent increases in temperature (STACFEN 2013) may provide more favorable conditions for capelin. Cod in Div. 3NO has increased slightly in recent years, and may cause increased natural mortality through predation.

Fishery

Capelin is caught in a directed trawl fishery. There is low bycatch in other trawl fisheries. The fishery is regulated by quota and has been under moratorium since 1995, and there have been no reported catches since 1993.

Effects of the fishery on the ecosystem

No fishery.

Special comments

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only. Investigations to evaluate the status of capelin stock should utilize trawl acoustic surveys to allow comparison with historical time series.

Source of Information

SCR Doc. 13/46

Cod in Division 3NO

Advice June 2013 for 2014-16

Recommendation for 2014 - 2016

No directed fishery to allow for stock rebuilding. By-catches of cod in other fisheries should be kept at the lowest possible level. Projections based on either $F_{status\ quo}$ or F=0 suggest a >95% probability that the stock will remain below B_{lim} by 2016.

Management objectives

General convention objective are applied in conjunction with an Interim Conservation Plan and Rebuilding Strategy adopted in 2011 (NAFO/FC Doc. 11/22). The long-term objective of this plan is to achieve and to maintain the spawning stock biomass in the "safe zone", (PA framework, FC Doc. 04/18), and at or near B_{msy}.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Not accomplished	Stock is below B_{lim}
Eliminate overfishing	OK	F is very low, $F < F_{lim}$ (0.3)
Apply Precautionary Approach	OK	B_{lim} and F_{lim} established. No directed fishery.
Minimise harmful impacts on living marine resources and ecosystems	OK	No directed fishery
Preserve marine biodiversity	OK	No directed fishery

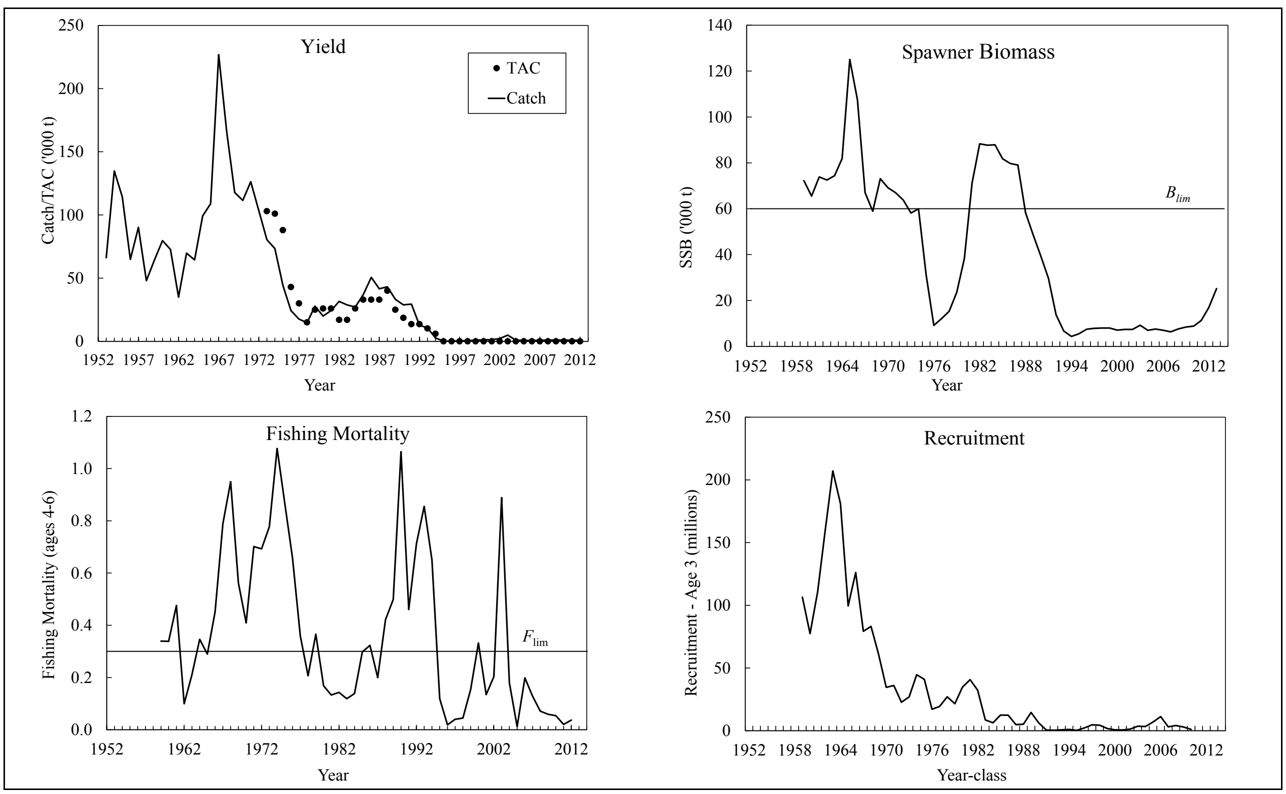
- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The stock occurs in Div. 3NO, with fish occupying shallow parts of the bank, particularly the southeast shoal area (Div. 3N) in summer and on the slopes of the bank in winter.

Stock status

The spawning biomass has doubled since 2010 but remains well below B_{lim}. This increase in biomass has been driven by the relatively strong 2005 and 2006 year classes and by fishing mortality well below F_{lim}. More recent year classes do not appear strong.



Reference points

B_{lim} is 60 000 t and F_{lim} is 0.3 (SC 2011).

Projections

SSB is projected to increase but remain below B_{lim} in both scenarios.

Fishing Mortality	Yield			P(SSB< B_{lim})			P(SSB_{2016} < SSB_{2013})
	2014	2015	2016	2014	2015	2016	
$F = 0$	-	-	-	>95%	>95%	>95%	<5%
Fstatus quo = 0.04	1224	1110	1177	>95%	>95%	>95%	<5%

Assessment

A sequential population analysis model was used; settings were unchanged from- and the results were consistent with the previous assessment. Input data comes from research surveys and by-catch fisheries (STACFIS 2013). Next assessment is planned for 2016.

Human impact

Mainly bycatch related fishery mortality has been documented. Other sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and Environmental interactions

Productivity of this stock was above average during the warm 1960s. During the cold 1990s, productivity was very low and surplus production was near zero.

Fishery

A moratorium was implemented in 1994. Catches since that time have been low levels of by-catch in other fisheries.

Recent catch estimates and TACs are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	Ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.9	0.6	0.3	0.7	0.7	0.6	0.8	0.8	0.7	
STACFIS	0.9	0.7	0.6	0.8	0.9	1.1	0.9	0.8	0.7	

ndf No directed fishery

Effects of the fishery on the ecosystem

There is no directed fishery.

Special comments

As part of the Conservation and Rebuilding Strategy "The Fisheries Commission shall request the Scientific Council to review in detail the limit reference point when the Spawning Stock Biomass has reached 30 000 t" (FC Doc. 13/01). As the stock is currently nearing this level, Scientific Council notes that multiple years of SSB greater than 30 000 t will be needed prior to re-evaluation of reference points as productivity at these levels of biomass is not well known.

Sources of information

SCR Doc. 13/10, 13/43, 13/44; SCS 13/5, 13/7, 13/9, 13/10

Redfish in Division 3O

Advice June 2013 for 2014-16

Recommendation for 2014-2016

There is insufficient information on which to base predictions of annual yield potential. Stock dynamics and recruitment patterns are also poorly understood. Catches have averaged about 13 000 t since the 1960s and over the long term, catches at this level appear to have been sustainable. Scientific Council is unable to advice on a more specific TAC level.

Management objectives

No explicit management plan or management objectives defined by Fisheries Commission. General convention objectives (NAFO/GC Doc 08/3) are applied. Advice is based on survey indices and catch trends (the observation of a period of stable catches since the 1960s).

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Unknown	B_{msy} unknown, stock increasing since the 2000s
Eliminate overfishing	OK	Fishing mortality low
Apply Precautionary Approach	Unknown	Reference points not defined
Minimise harmful impacts on living marine resources and ecosystems	OK	VME closures in effect, low bycatch rates reported
Preserve marine biodiversity	Unknown	Cannot be evaluated

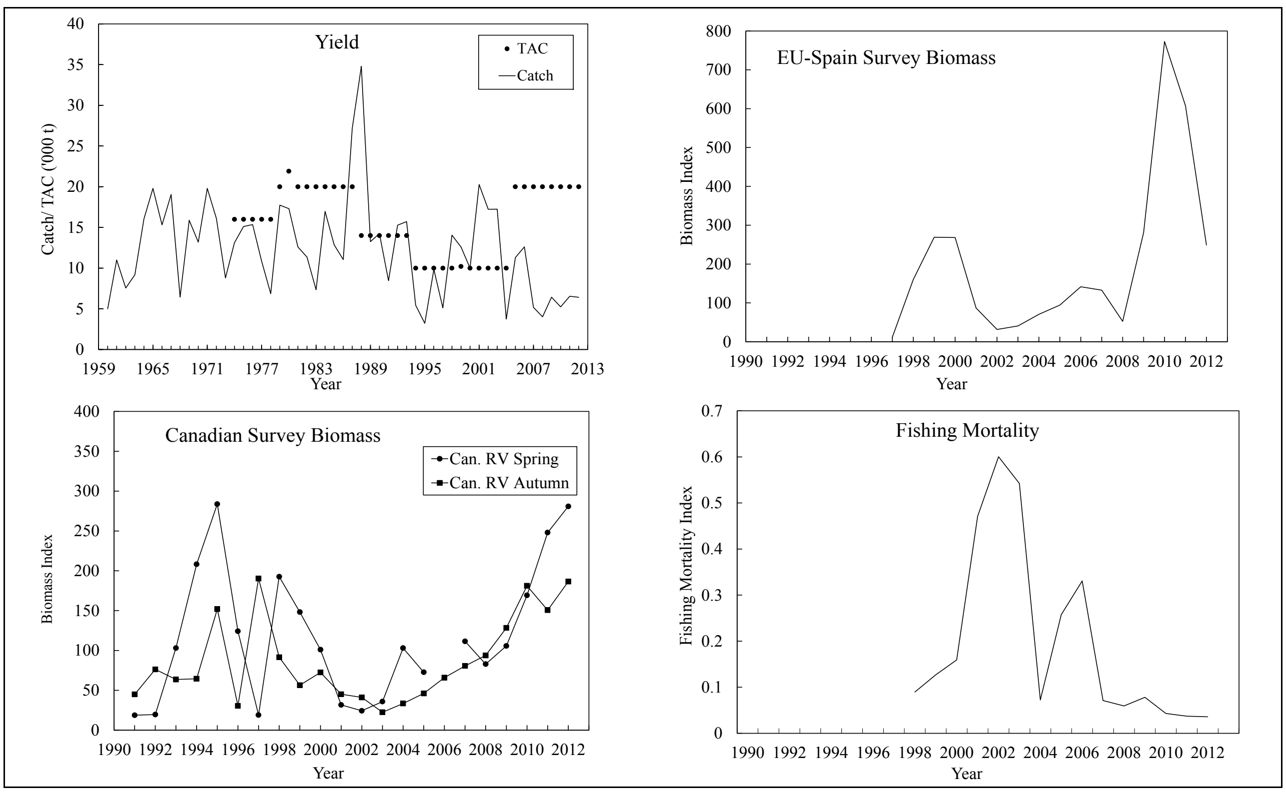
- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The management unit is confined to NAFO Div. 3O.

Stock status

The stock appears to have increased since the early 2000s. Current fishing mortality appears low and recent recruitment is unknown.



Reference points

Not defined.

Projections

Quantitative assessment of risk at various catch options is not possible for this stock at this time.

Assessment

Based upon a qualitative evaluation of trends in stock biomass, fishing mortality proxy and recruitment. The assessment is considered data limited and as such associated with a relatively high uncertainty. Input data are research survey indices and fishery data (STACFIS 2013). The next full assessment is planned for 2016.

Human impact

Mainly fishery related mortality has been documented. Mortality from other human sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and environmental interactions

The zooplankton index for the area peaked in 2010 and has remained above normal in recent years indicating favourable feeding conditions for redfish in their early life stages. Variation in stock size seems to some degree to be associated with atmospheric and temperature drivers. Water temperatures across Div 3LNO have been generally stable and above the long-term mean since the mid-1990's and prolonged cooling has not occurred in nearly two decades.

Fishery

Redfish is caught primarily in bottom trawl fisheries, but some landings are reported from mid-water trawl fisheries. The fishery is regulated by minimal mesh size and quota. Cod, American Plaice, witch flounder and other species are landed as bycatch. In turn, redfish are also caught as bycatch in other fisheries.

Recent catch estimates and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC[1]	10	20	20	20	20	20	20	20	20	20
STATLANT 21	6.4	11.9	11.0	7.5	5.1	6.3	6.5	6.5	6.4	
STACFIS	3.8	11.3	12.6	5.2	4.0	6.4	5.2	6.5	6.4	

[1] 2004 only applied within Canadian fishery jurisdiction.

Effects of the fishery on the ecosystem

No specific information is available. General impacts of fishing gears on the ecosystem should be considered. A large area of Div. 3O has been closed to protect corals.

Special comments

Length frequencies suggest that the Div. 3O redfish fishery takes predominantly immature fish.

Sources of Information

SCR Doc. 13/09, 18, 36, SCS Doc. 13/05, 07, 09.

Witch flounder in Divisions 2J3KL

Advice June 2013 for 2014-16

Recommendation for 2014 - 2016

No directed fishery to allow for stock rebuilding. By-catches of witch flounder in other fisheries should be kept at the lowest possible level.

Management objectives

No explicit management plan or management objectives are defined by Fisheries Commission. General convention objectives (GC Doc. 08/3) are applied. Advice is based on survey indices, catch trends and estimates of recruitment.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Red	Stock below B_{lim}
Eliminate overfishing	Green	No directed fishery
Apply Precautionary Approach	Green	B_{lim} established, No directed fishery
Minimise harmful impacts on living marine resources and ecosystems	Green	No directed fishery
Preserve marine biological biodiversity	Green	No directed fishery

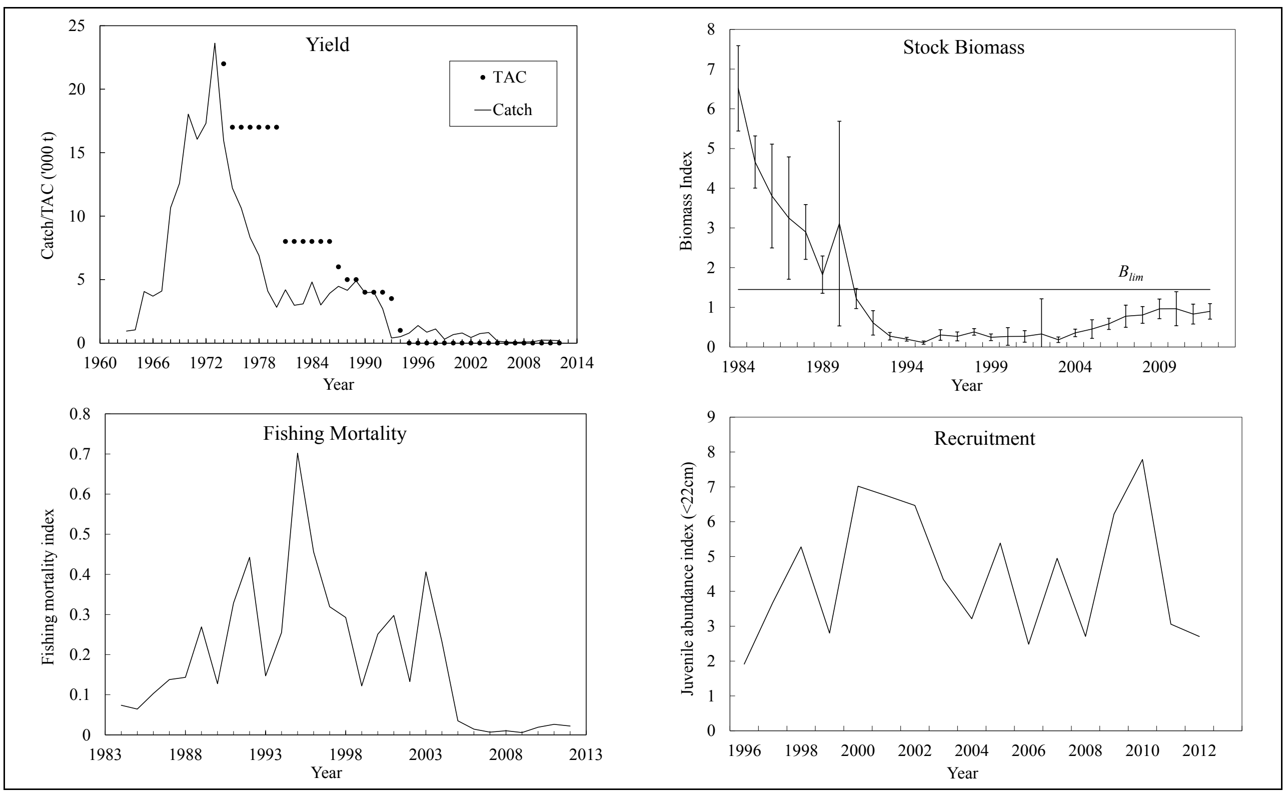
Green: OK
Yellow: Intermediate
Red: Not accomplished
White: Unknown

Management unit

The stock is widely distributed throughout the shelf area of Div. 2J3KL in deeper channels around the fishing banks, primarily in Div. 3K.

Stock status

The stock remains below B_{lim}. Recruitment in 2011 and 2012 was below average and fishing mortality is currently low.



Reference points

B_{lim} is 15% of the highest observed survey biomass, adjusted to the entire stock distribution (B_{1984}*1.48) (STACFIS 2010 p 193).

Projections

Quantitative assessment of risk at various catch options is not possible at this time.

Assessment

Qualitative evaluation of trends in survey biomass indices relative to exploitation and recruitment information were used to assess the status of the stock. Next assessment is planned for 2016.

Human impact

Mainly bycatch related fishery mortality has been documented. Other sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and Environmental interactions

In the late 1970s and early 1980s witch flounder were widely distributed throughout the Div. 2J3KL shelf area in deeper channels around the fishing banks, and were more abundant in Div. 3K. By the mid-1980s they were rapidly disappearing and by the early 1990s had virtually disappeared from the area entirely except for some very small catches along the slope and more to the southern area. Since 1998, witch flounder have been found mostly along the deep continental slope area, in depths of 200-750m.

Fishery

A moratorium was implemented in 1995 following drastic declines in catch from the mid-70s, and catches since then have been low levels of bycatch in other fisheries (e.g. Greenland halibut and redfish fisheries).

Recent catch estimates and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	
STACFIS	0.8	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	

ndf no directed fishing.

Effects of the fishery on the ecosystem

There is no directed fishery.

Special comments

None.

Sources of information

SCR Doc. 13/39; SCS Doc. 13/7, 13/9, 13/13

Northern shortfin squid in SA 3+4

Advice June 2013 for 2014 - 2016

TAC recommendation for 2014 – 2016

During 2012, the northern stock component remained in a state of low productivity. Therefore, Scientific Council recommends a TAC of no more than 34 000 t/yr.

Management objectives

No explicit management plan or management objectives defined by Fisheries Commission. General Convention objectives (GC Doc. 08/3) are applied.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at B_{msy}	Unknown	B_{msy} inappropriate given life history
Eliminate overfishing	Unknown	Not quantifiable
Apply Precautionary Approach	Intermediate	Reference points based on productivity level
Minimise harmful impacts on living marine resources and ecosystems	OK	VME closures in effect, no bycatch in SA 3 jig fishery, no SA 4 directed trawl fishery since 1999
Preserve marine biological biodiversity	Unknown	Cannot be evaluated

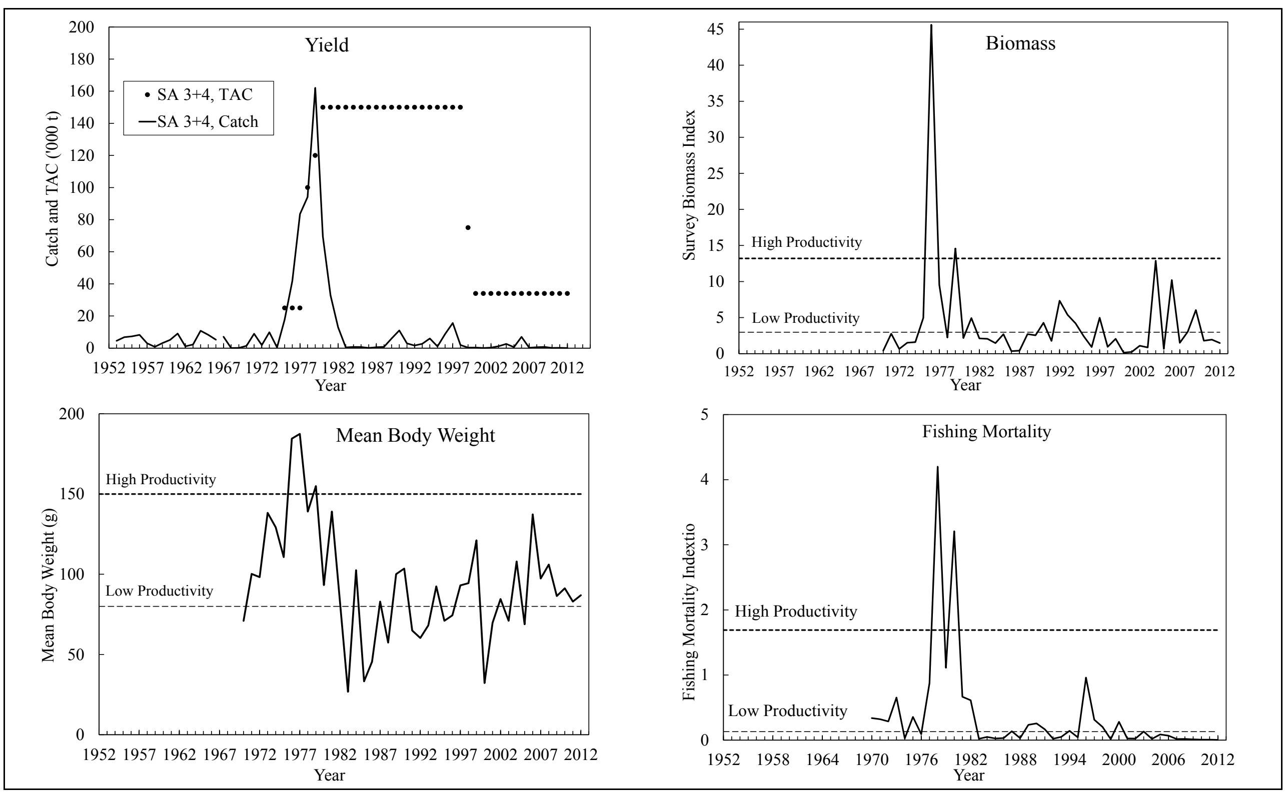
- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The species is assumed to constitute a single stock throughout its range in the Northwest Atlantic Ocean, from Newfoundland to Florida, including Subareas 2-6, but is managed as northern (Subareas 3+4) and southern stock components (Subareas 5+6).

Stock status

During 2012, the northern stock component remained in a state of low productivity and fishing mortality indices were at the lowest levels in the time series.



Reference points

Conventional reference points are inappropriate for squid stocks because of their unique life history. Two references, "high-" or "low productivity" states are defined by trends in stock biomass and mean body weight (STACFIS 2013). Low productivity periods have an estimated potential annual yield of 19 000 t to 34 000 t. The potential yields of a high productivity state have not been determined.

Projections

Projections were not possible because recruitment is highly variable and cannot currently be predicted.

Assessment

The assessment consisted of a comparison of average survey biomass indices and mean body weights, during high (1976 – 1981) and low (1982 – 2011) productivity periods, with the values of these indices during the most recent year. Fishing mortality indices were used to assess exploitation. Uncertainty in the assessment is high because recruitment, occurrence of the species in the survey area, and growth rates are highly variable and greatly influenced by oceanographic conditions. Assessment data were from research surveys and the catches (STACFIS Report 2013). The next assessment is planned for 2016.

Human impacts

Fishery related mortality in SA 3+4 is currently low. Other sources (e.g. pollution, shipping, oil-industry) are undocumented.

Biology and Environmental Interactions

This species is annual semelparous (spawns once during the year then dies). A sufficient numbers of spawners must survive the fishery (spawner escapement) each year in order to ensure a high probability of successful recruitment during the subsequent year and sustain the stock. Ocean climate effects have a strong influence on the distribution, growth rates, and recruitment. This species is both an important prey and predator in the ecosystem. It is consumed by a wide range of cetacean, pinniped, avian, invertebrate, and finfish predators and the natural mortality is very high. Small Northern shortfin squid prey primarily upon crustaceans and larger squid prey primarily upon finfish, and during the autumn, on smaller shortfin squid.

Fisheries

Prior to the mid-1980s, international bottom trawl and midwater trawl fleets participated in directed fisheries in Subareas 3, 4 and 5+6. Since 1999, there has been no directed fishery in Subarea 4, but some squid is taken as bycatch in the Canadian small-mesh bottom trawl fishery for silver hake. Directed fisheries currently consist of a Canadian inshore jig fishery in Subarea 3 and a small mesh bottom trawl fishery in Subareas 5+6. There is no bycatch in the jig fishery. The fishery is regulated by a quota.

Recent catch and TACs are:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	34	34	34	34	34	34	34	34	34	34
STATLANT 21	2.6	0.6	7.0	0.2	0.5	0.7	0.1	0.1	<0.1	
STACFIS	2.6	0.6	7.0	0.2	0.5	0.7	0.1	0.1	<0.1	

Effects of the fishery on the ecosystem

The effects of the directed fisheries on the ecosystem are unknown, but are limited to specific seasons as a result of the species' migration patterns on and off the continental shelves.

Special comments

The assessment of this annual northern stock component may not reflect stock conditions during the years for which management advice is given because the most recent year of data used in the assessment is always for two years prior. Fishery removals in relation to the biomass levels of each stock component affect one another. The southern stock component is managed by the Mid-Atlantic Fishery Management Council.

Sources of information

SCR Doc. 98/59, 75; 99/66; 06/45; 13/31

b) Monitoring of Stocks for which Multi-year Advice was Provided in 2011 or 2012

The assessments (interim monitoring) found nothing to indicate a significant change in the status of all five stocks. Accordingly, Scientific Council reiterates this previous advice as follows:

Recommendation for American plaice 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. Bycatch in fisheries targeting other species should be kept at the lowest possible level.

Recommendation for Redfish in Div. 3LN: (2012) 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):

	B/Bmsy			
Year	Status quo F	1/6 Fmsy	1/3 Fmsy	2/3 Fmsy
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 recommends 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

Recommendation for Thorny skate in Div. 3LNOPs: (2012) 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.

Recommendation for American plaice in Div. 3LNO: (2012) 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 recommends 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.

c) Special Requests for Management Advice

i - ii) Harvest Control Rules for Greenland halibut (Item 3a) and Exceptional circumstances in the Greenland halibut management strategy (Item 3b)

The Fisheries Commission adopted in 2010 an MSE approach for Greenland halibut stock in Subarea 2 + Divisions 3KLMNO (FC WP 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 Fisheries Commission according to Annex 1 of FC Working Paper 10/7.

Scientific Council responded:

The TAC for 2014 derived from the HCR is 15 441 t.

As per the HCR adopted by the Fisheries Commission, survey slopes were computed using the most recent five years of survey data (2008-2012) and are illustrated below (Fig. 1). The data series included in the HCR computation are the Canadian Autumn Div. 2J3K index, the Canadian Spring Div. 3LNO index and the EU Flemish Cap index covering depths from 0-1400m. Averaging the individual survey slopes yields *slope*= -0.0022. Therefore, the computed TAC is: 15510*[1+2*(-0.0022)] = 15 441 t. This change from the 2013 TAC is within the ± 5% constraint on TAC change that is part of the HCR.

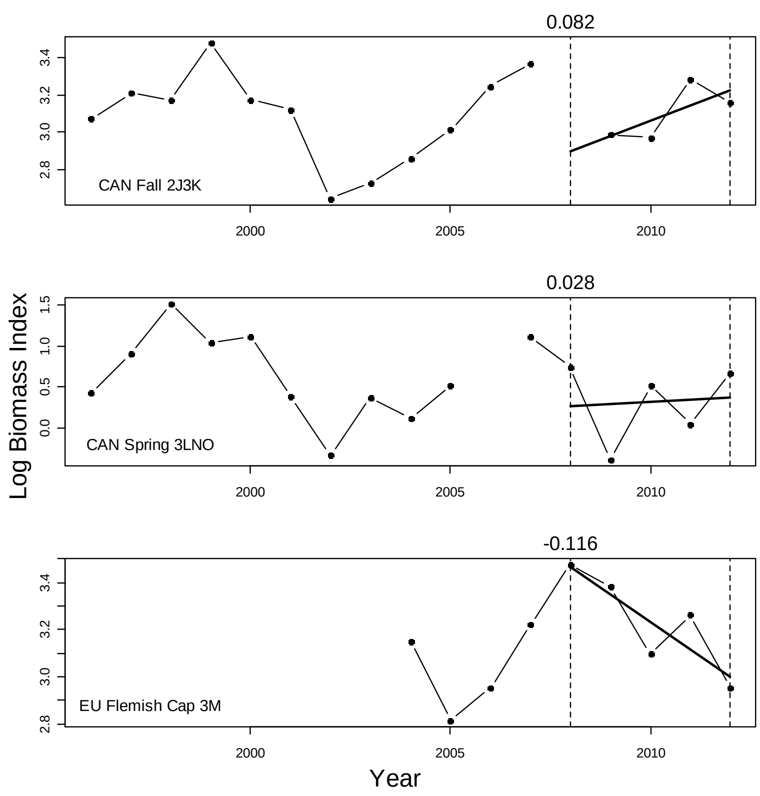


Fig. 1. Input for Greenland Halibut in Subarea 2 + Divisions 3KLMNO Harvest Control Rule. Slopes are estimated from linear regression of log-scale biomass indices (mean weight per tow) over 2008-2012. Survey data come from Canadian fall surveys in Divs. 2J3K,Canadian spring surveys in Divs. 3LNO and EU Flemish Cap survey (to 1400m depth) in Div 3M.

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

Scientific Council responded:

According to the indicator based on surveys, exceptional circumstances are presently occurring, however, having a survey observation above the simulated distributions does not constitute a conservation concern. Due to the unavailability of STACFIS catch estimates in 2011 and 2012, Scientific Council is unable to determine whether recent catches constitute an exceptional circumstance.

The "primary indicators" used to determine if exceptional circumstances are occurring are catch and surveys. The observed values are compared to the simulated distributions from both SCAA-based operating models and XSA-based operating models. If the observed values are outside of the 90% confidence interval (i.e. outside 5^{th}-95^{th} percentiles) from the simulations presented to WGMSE during September 2010, then Scientific Council shall advise Fisheries Commission that exceptional circumstances are occurring.

STACFIS catch estimates for 2011 and 2012 are not available. Therefore, Scientific Council cannot compare observed catches to the simulated distributions, and is unable to determine if exceptional circumstances are occurring in respect to this indicator. Scientific Council 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 2012 catches range from 15794 to 18100 t in the XSA based OMs and in SCAA based OMs, from 16323 to 16323 t. The STATLANT 21 catches for 2012 were 15198 t, against a TAC of 15510 t.

For the three surveys that comprise the input data to the HCR, the 2012 observed values were compared with composite distributions of simulated surveys for both SCAA-based and XSA-based operating models. Out of the six comparisons possible (three surveys; two sets of operating models), there was one case (Canadian Autunm Div. 2J3K) for which the observed survey index exceeded the 95^{th} percentile.

Fisheries Commission adopted the HCR for an initial four year period, noting it would "review the progress of this management strategy in four years with advice from the Scientific Council". The review of the MSE will necessitate the availability of appropriate technical expertise within SC to carry out the work.

Accordingly, the specifics of the management strategy review should be made explicit. This could be further discussed at the WG-CPRS. A review should assess if the MSE approach adopted in 2010 is allowing the stock to reach the defined management objectives. This review could range from continued monitoring of the primary and secondary indicators (biological parameters, recruitment, fishing mortality, exploitable biomass), or consideration of additional HCRs based upon the current set of operating models, through to conducting a full MSE process with new operating models, HCRs and performance statistics. At present, unavailability of catch estimates would not allow all operating models used in the previous MSE to be reconstituted. Any changes in management objectives or performance statistics need to be provided by Fisheries Commission well ahead of this review.

iii) Consequences resulting from a decrease in mesh size in the mid-water trawl fishery for redfish in Div. 3LN to 90mm or lower (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.

Scientific Council deferred their response to this request until its September meeting.

iv) Provide B_{msy} and F_{msy} for cod in Div. 3M (Item 6)

The Fisheries Commission requests the Scientific Council to provide B_{msy} and F_{msy} for cod in Div. 3M.

Scientific Council concluded that is not possible at this time to provide candidates values of B_{msy} and F_{msy} for this stock.

Scientific Council estimated the Yield per Recruit (YPR), Spawner per Recruit (SPR) and Maximum Sustainable Yield (MSY) reference points with uncertainty to provide candidates for B_{msy} and F_{msy} for cod Div. 3M. The results of the B_{msy} and F_{msy} estimated based on different stock-recruitment relationship (Ricker, Beverton-Holt and Segmented Regression) were not plausible due to the high uncertainty in the stock recruit relationship for this stock. 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 and the level of recruitment that should be used to estimate the MSY is needed.

v) Encounter thresholds for VME indicator species (Item 7)

Recognizing the work accomplished by the Scientific Council in 2012 on sea pens and sponges, Fisheries Commission requests the Scientific Council to complete request 17 of 2011 by making recommendations for encounter thresholds and move on rules for small gorgonian corals, large gorgonian corals, sea squirts, erect bryozoans, crinoids and cerianthid anemone which are 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. In the case of sea pens and sponges make recommendations for encounter thresholds and move on rules for the exploratory fishing area of seamounts.

Scientific Council responded:

General comment regarding encounter protocols and closed areas

Scientific Council reiterates its June 2012 statement that management through the closing of areas with significant concentrations of VME indicator species is the most effective measure for protecting VMEs in the NRA and that the need to implement encounter protocols gradually becomes redundant as the locations of the benthic VMEs becomes increasingly well-defined. This avoids issues associated with the implementation of complex move-on rules.

Scientific Council notes that a number of closed areas are currently in effect protecting VMEs, and additional new areas and extensions are proposed to the next Fisheries Commission meeting by the FC WGFMS-VME to cover zones of significant catches of large gorgonian corals and sea pens.

Response summary

A GIS model-based encounter threshold of 0.2 kg/trawl was calculated for small gorgonian corals inside the fishing footprint and proposed outside, on the continental slopes of the NRA. Issues with catchability and data quality prevented similar analyses being performed on large gorgonian corals and the other VME indicator taxa inside the fishing footprint. This candidate threshold for the small gorgonian corals is a good example of a threshold value likely to be impractical. Maps of their distribution in the NRA have been provided for informational purposes and Scientific Council is not making explicit recommendations regarding closures via these maps.

For areas outside of the fishing footprint along the continental slopes, the same thresholds calculated inside the footprint should be considered for those taxa where thresholds have been provided. Specifically: 300 kg/trawl for Sponges, 7 kg/trawl for Sea Pens and 0.2 kg /trawl for Small Gorgonian Corals. For the Large Gorgonian corals an encounter threshold of 2 kg/ trawl could be used based on RV cumulative catch data from inside the fishing footprint. For all other VME indicator species, outside of the fishing footprint, the presence of the VME indicator should be considered as the threshold, given the high risk of significant adverse impact.

For seamounts, presence of any of the VME indicator species should be considered to trigger move-on rules.

In 2012, candidate move-on rules for sponges and sea pens were provided based on information on their spatial distribution. Those move-on rules were not applicable to the seamounts. Scientific Council was unable to provide further recommendations on the move-on rule for other VME indicator species.

General Comments on Commercial Encounter Protocols

Scientific Council notes that the encounter thresholds recommended thus far were developed to identify significant concentrations of VME indicator species (i.e. VMEs). They were not developed as conservation thresholds and

Scientific Council considers that closures, not encounter thresholds and complex move on rules, are the most effective measure to protect VME in the fishing footprint.

In June 2012, Scientific Council stated that "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 new 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 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".

Scientific Council notes that a number of closed areas are currently in effect protecting VMEs, and additional new areas and extensions are proposed to the next Fisheries Commission by the FC WGFMS-VME to cover zones of significant catches of large gorgonian corals and sea pens. Although single observations suffice to identify the presence of VME species in a given location, defining realistic areas of VME for closure purposes is better achieved by integrating all available habitat and species distribution data.

Scientific Council notes a review of all available information will be undertaken in 2014.

Inside the Fishing Footprint in the NRA and Outside of Closed Areas

Small Gorgonian Corals

A GIS model-based commercial encounter threshold for Small Gorgonian Corals was calculated using methodology applied to EU research vessel biomass survey data (2006-2012). Application of the GIS model to Small Gorgonian corals yields a result of 0.2 kg (200 g) per commercial tow (based on the median tow length of 13.8 nm as determined from VMS data) as the candidate encounter threshold for identification of significant concentrations of Small Gorgonian Coral. The small value of this threshold would likely render it impractical for real life application.

Scientific Council was not able to develop move-on rules for the small gorgonian corals. Move-on rules for the small gorgonian corals would be very complex to apply. Area-specific values based on the distribution map (Fig. 2) could be provided but the task of integrating the effects across the different VME indicator species and fisheries would render move-on rules impractical in real life applications.

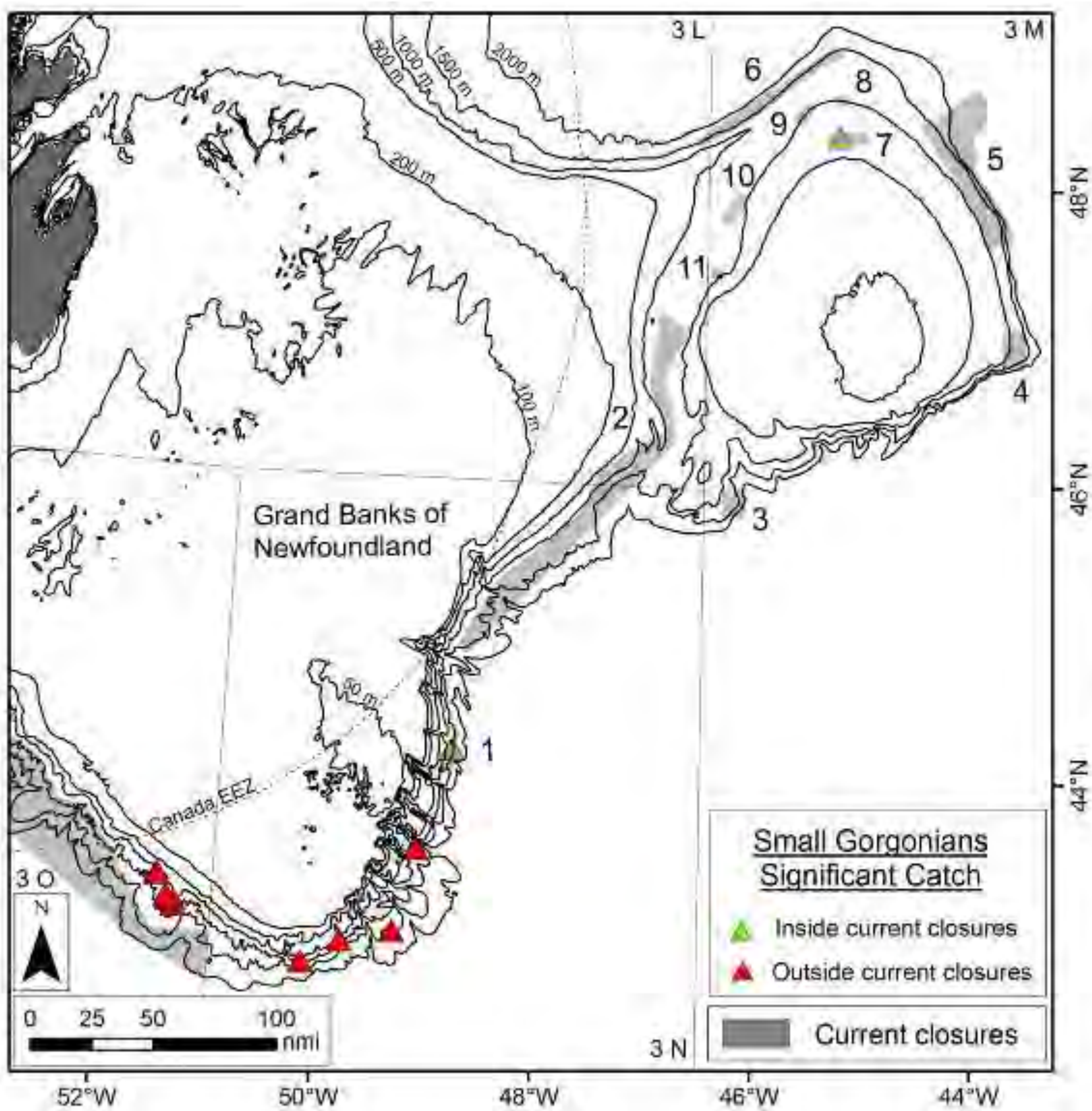


Fig. 2. Location of significant catches (≥ 0.2 kg/trawl) of small gorgonian corals from research vessel surveys in the NRA (Div. 3LMNO) from 2006-2012 in relation to the current closed areas.

Large Gorgonian Corals, Sea Squirts, Erect Bryozoans, Crinoids and Cerianthid Anemones

Scientific Council was not able to produce model-based commercial encounter thresholds or move on rules for Large Gorgonian Corals, Sea Squirts, Erect Bryozoans, Crinoids and Cerianthid Anemones inside the fishing footprint in the NRA and outside of closed areas at this time due to data quality issues. Catchability is believed to be very low for these taxa and trawls are not the appropriate gear to sample them.

The Scientific Council has illustrated the known locations for these VME indicator taxa, according to their relative abundance in the trawl surveys (Fig. 3, Fig. 4). For comparative purposes the location of the Sea Squirts, Erect Bryozoans, Crinoids and Cerianthid Anemones are shown in relation to the fishing locations from (2010-2012) from the response to FC request 16 (Fig. 5). Crinoids and Cerianthid Anemones were caught in the NEREIDA rock dredges which sampled some areas (Beothuk Knoll) not sampled in the EU surveys (Fig. 6).

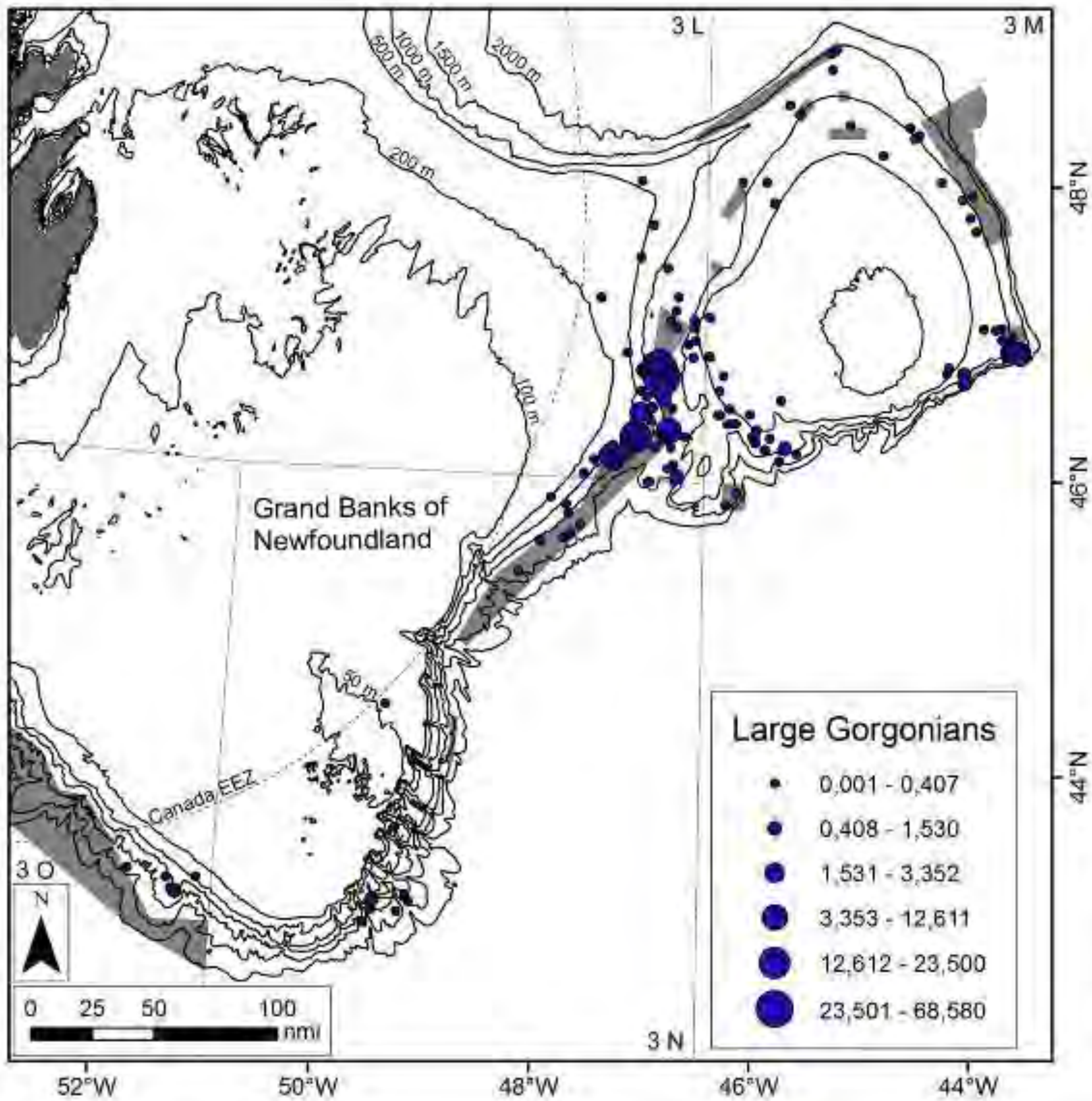


Fig. 3. Relative abundance (kg/RV trawl) of large gorgonians from EU research trawl surveys from 2006-2012 in the NRA in relation to closed areas.

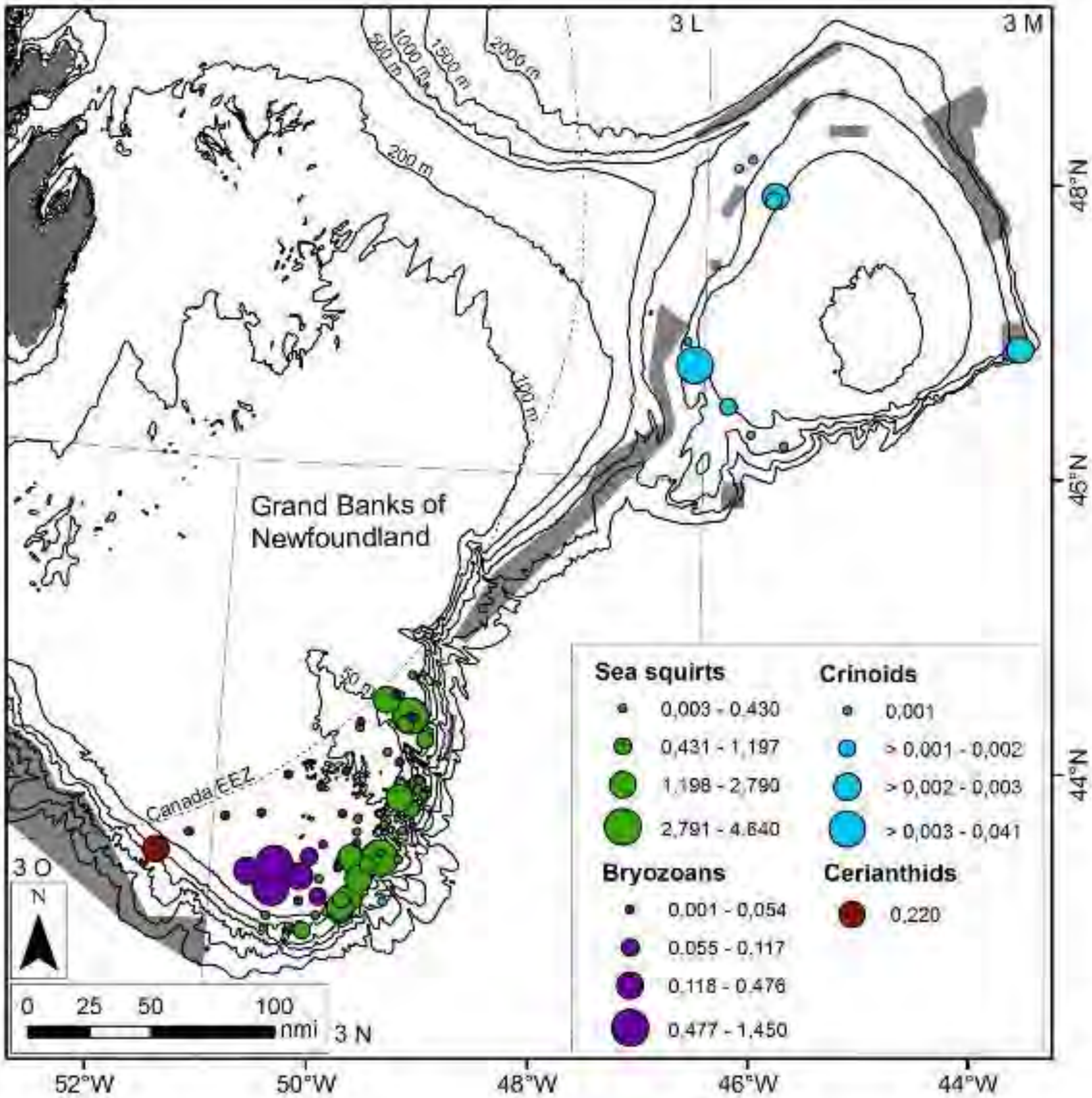


Fig. 4. Relative abundance (kg/RV trawl) of sea squirts, crinoids, bryozoans and cerianthid anemones collected from EU research trawl surveys from 2006-2012 in the NRA in relation to closed areas.

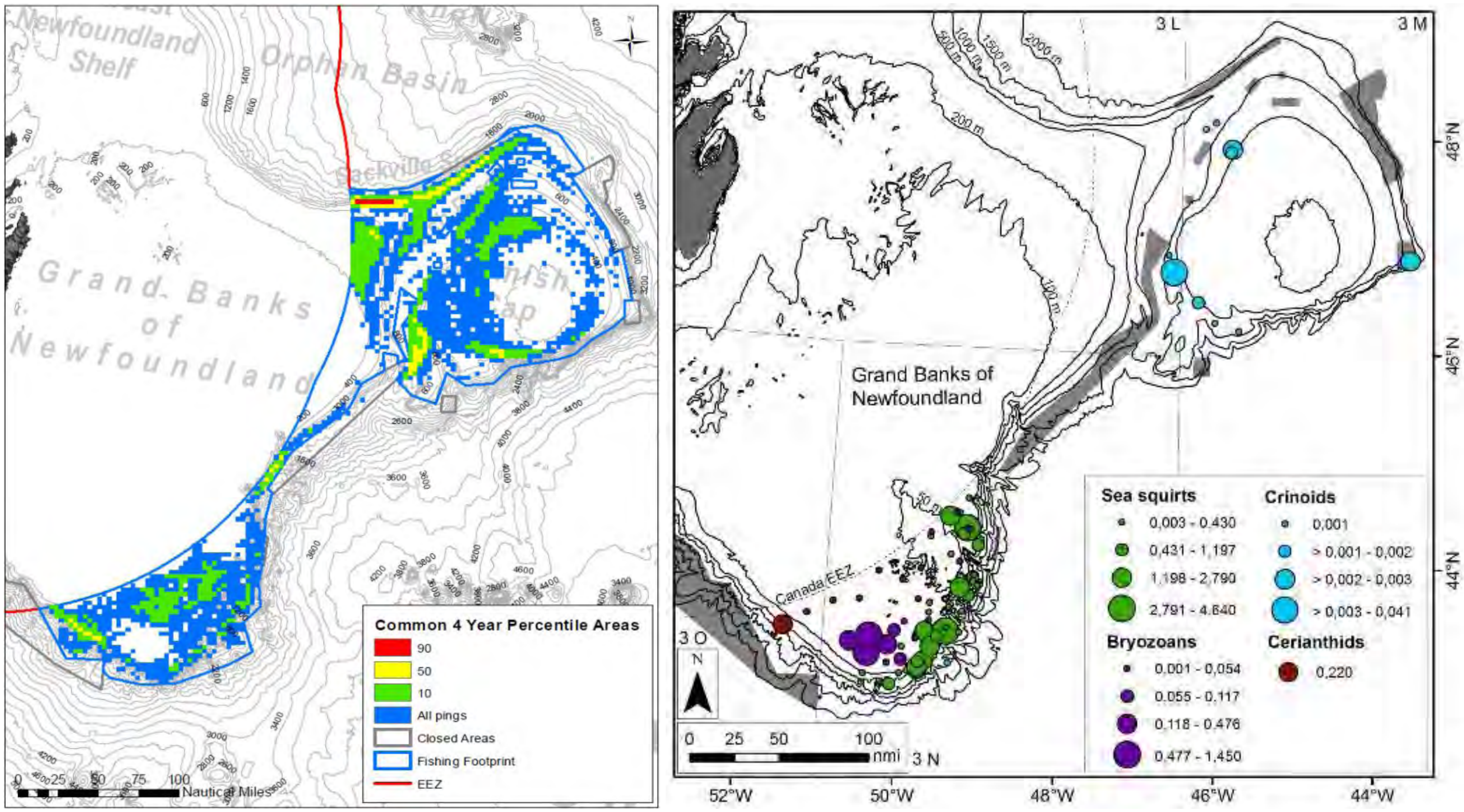


Fig. 5. **Left.** Map showing the area occupied by the 90th, 50th and 10th percentiles of bottom fishing activity, and all cells with fishing less than the 10th percentile (e.g. all cells with VMS pings, 2008 - 2011). Note the area occupied in blue has exactly the same amount of fishing effort as the area occupied in red indicating that the intensity of fishing activity is much higher in the red area compared to the blue area. **Right.** Relative abundance (kg/RV trawl) of sea squirts, crinoids, bryozoans and cerianthid anemones collected from EU research trawl surveys from 2006-2012 in the NRA in relation to closed areas. Catchability issues render it difficult to relate these values to *in situ* biomass of each group, between groups and even to evaluate the relative abundance from different depths and bottom types within a group (Fig. 3 above).

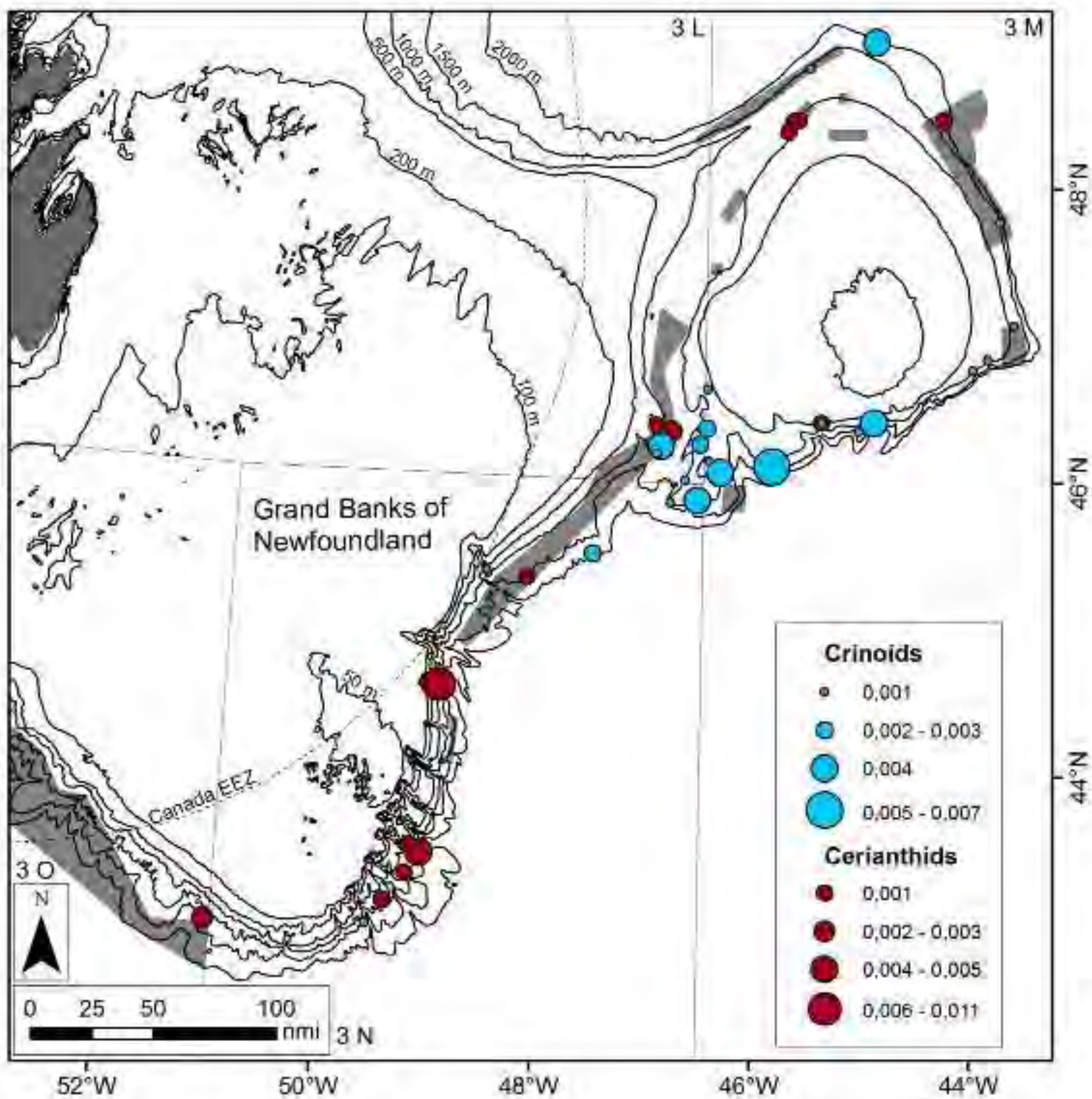


Fig. 6. Relative abundance (kg/rock dredge set) of crinoids and cerianthid anemones collected from NEREIDA Project (Rock dredge sampler) during 2009 and 2010 in the NRA.

Outside the Fishing Footprint in the NRA

There are not enough data available on the distribution of VME and VME indicator taxa outside the fishing footprint in the NRA to develop scientifically based encounter thresholds and move on rules, with most data coming from the NEREIDA underwater video/images.

Sponges, Sea Pens, Small and Large Gorgonian Corals

In the absence of data outside of the fishing footprint on the continental slopes of Grand Bank and Flemish Cap, the same threshold defined for inside the fishing footprint should be considered for the slope areas outside of the fishing footprint in the NRA. This is a reasonable assumption as similar sponge and other VME species straddle the fishing footprint along the slope, although new information obtained through exploratory fishing and full analysis of the NEREIDA data could alter this recommendation. Specifically: 300 kg/trawl for Sponges, 7 kg/trawl for Sea Pens and 0.2 kg /trawl for Small Gorgonian Corals.

Previously, a threshold of 2 kg of Large Gorgonian Coral/RV trawl was calculated from the cumulative RV catch distribution to identify significant concentrations of large gorgonian corals. The Scientific Council recommends considering a 2 kg/trawl as the commercial encounter threshold for large gorgonian corals outside of the fishing footprint on the continental slopes of the NRA given their fragility, extreme longevity and vulnerability to fishing gear impacts. This value cannot be scaled to reflect commercial trawl lengths as the relationship between bycatch weight and trawl length is not linear.

Sea Squirts, Erect Bryozoans, Crinoids and Cerianthid Anemones

Until protection measures are in place the presence of any of these taxa in the catch may be used to trigger the move on rule and associated encounter reporting outside of the fishing footprint along the continental slopes of the NRA.

Exploratory Fishing area of Seamounts

Presence of any of the VME indicator taxa (including *Lophelia* or other reef-building stony corals which to date have not been identified in the fishing footprint or on the continental slopes of the NRA) may be used to trigger move-on rules and reporting.

Summary of Existing and Candidate Encounter Thresholds:

	Inside Fishing Footprint	**Outside Fishing Footprint in NRA (Continental Slopes)**	**Exploratory Fishing on Seamounts**
Large Gorgonian Corals		2 kg/trawl	presence
Small Gorgonian Corals	0.2 kg/trawl	0.2 kg/trawl	presence
Sea squirts		presence	presence
Erect Bryozoans		presence	presence
Crinoids		presence	presence
Sponges	300 kg/trawl*	300 kg/trawl	presence
Sea Pens	7 kg/trawl*	7kg/trawl	presence
Lophelia and other Reef Building Stony Corals**		presence	presence

* Currently in 2013 Conservation and Enforcement Measures ** Not known to occur inside the fishing footprint

vi) Productivity of Cod in Div. 3NO and define MSY reference points (Item 8)

In the medium term, the Fisheries Commission requests the Scientific Council to continue research on the productivity of 3NO Cod and define MSY reference points.

Scientific Council responded:

Scientific Council concluded that there have been major changes in productivity for Div. 3NO cod. During the 1990s sustainable yield was near zero. As an interim F target Scientific Council recommends either $F_{0.1}$ (0.19) or $F_{35\%SPR}$ (0.2) based on long term data. Scientific Council further recommends a level of 180 000 - 185 000 t of SSB as an interim B_{target}.

There have been major changes in productivity for Div. 3NO cod. This has had a major impact on the level of fishing mortality that the population can sustain without decline. The population was in a low productivity period for an extended period of time during the 1990s. During this period sustainable yield was near zero. Current levels of productivity are much higher, although not as high as in the 1960s. Fishing mortality reference points based on average conditions and/or that do not take variation in recruitment into account can result in levels of fishing that produce severe population decline. There is a need to develop fishing mortality reference points that can be updated using only recent data, but that incorporate all components of productivity.

Despite the problem of changing productivity, Scientific Council revised the Div. 3NO reference points approved by the Fisheries Commission and considers as interim reference points proxies based on the yield per recruit (YPR) and spawner per recruit (SPR) using long term data to estimate the reference points. It is recommended that until more information is available: a value of $F_{0.1}$ (0.19) or $F_{35\%}$ (0.20) be considered as a possible F_{target}. These levels of F have a very low probability of being higher than $F_{lim} = F_{max}$ (less than 5%). A possible candidate for B_{target} could be the equilibrium SSB of the proposed F_{target} ($F_{0.1}$ or $F_{35\%}$), which gives a value around 180 000 – 185 000 t. Taking a similar definition for B_{isr} as the ICES MSY $B_{trigger}$, a B_{isr} candidate for Div. 3NO cod could be a value around 120 000 t if a very low probability is taken (less than 5%) or 135 000 t if a low probability is taken (less than 10%). A population which has reached equilibrium when fishing at the proposed F targets has a low probability (5 or 10%) of falling below these levels.

vii) Witch flounder in Div. 3NO reference points or proxies including B_{lim} (Item 9)

With regards to witch flounder in Div. 3NO, the Fisheries Commission requests the Scientific Council to provide reference points or proxies, including B_{lim}.

Scientific Council responded:

Scientific Council analysed available data for Div. 3NO witch but was not able to recommend reference points at this time. Biomass indices in the mid 1980s were higher, but it was considered unlikely that they represent the highest level experienced by this stock. Thus in this case it was not appropriate to apply the 85% decline criterion for establishing a limit reference point. The lowest points in the biomass index occurred from 1993 to 1998, and measuring increase of the stock against this level is a useful metric, until a limit reference point can be calculated. Establishing reference points for this stock remains a priority in Scientific Council, and further analysis should continue, to be presented in the full assessment of this stock scheduled in 2014.

Scientific Council examined reference point (RP) calculations for Div. 3NO witch, including a review of previous work on RPs for this stock. Scientific Council's earlier conclusions were that it was not possible to adopt limit reference points (LRPs) based on those previous analyses. All available indices 4 survey series (Canadian spring and autumn, EU survey in NRA, and USSR/Russian series), Canadian CPUE, biological data, and catch from 1960-2012 were considered as possible sources of data. There has been no age-based data for this stock since 1993.

Scientific Council noted the variability and the different trends in the indices. In 2012, Scientific Council responded that the Canadian autumn survey probably has the best chance of being an index of total stock size. However, this index only covers the period 1990-2012, and not the earlier periods where other indices and catch were clearly higher. The Canadian spring survey index has data from 1973 to 2012, and was therefore considered the most useful index to examine for developing a possible LRP. To account for survey coverage in strata between 366 and 731 m in depth, which began in 1991, biomass index data prior to then was multiplied by 1.2, based on the average proportion of biomass in the deeper strata from 1991 to 1995.

This biomass index was highest in 1985 and 1988, at a level about 2.5 times the 2011–12 average, and lowest during 1993-98, at about one-third of the 2011–12 average. The newly developed SSB index shows similar patterns. SC concluded that the biomass in the 1980s, while higher, likely did not represent the highest stock size (B_0), given the high catches which occurred over several years in the 1960s and early 1970s. Thus in this case it was not appropriate to apply the 85% decline criterion for establishing a limit reference point.

Another candidate for a proxy for an LRP is the lowest biomass from which there has previously been a rapid and sustained recovery ($B_{recover}$). Scientific Council considered it unlikely that this criterion has been met for this stock, but that comparing current stock size to the low level of the 1990s would be a useful metric to monitor until an LRP can be calculated.

Scientific Council noted that establishing reference points for this stock remains a priority, and that further analysis should continue, to be presented in the full assessment of the stock scheduled for Scientific Council in 2014. Now that an SSB index has been developed, one aspect of the work should focus on possible SSB-recruit relationships, while further exploration of population modeling should be conducted.

viii) Reassessment of fishing activity with respect to SAI (Item 10)

The Fisheries Commission requests the Scientific Council to use Annex 1.E.V of the NCEM to guide development of their work plan related to reassessment of fishing activity with respect to Significant Adverse Impact (SAI) on VME and would note that this assessment is a single component of the broader EAF Roadmap being developed separately by Scientific Council.

Scientific Council responded:

This is a preliminary work plan to be reviewed in 2014 with regard to content and timeline.

The modified NCEM narrows the scope of assessments of bottom fishing activities, focusing them on the assessment of Significant Adverse Impacts (SAI) on Vulnerable Marine Ecosystems (VME). In this context, Scientific Council has developed a two-step work plan where a first step is centered in the review of the closures for corals, sponges and seamounts (which is due in 2014), and a second step, which builds upon the results of the first, focused on the analysis of SAI on VMEs by 2016.

Following the modifications of the NAFO Conservation and Enforcement Measures (NCEM) in 2012, Scientific Council was requested to develop a work plan to achieve the assessment of all NAFO fisheries by 2016 and every 5 years thereafter, identifying the necessary steps to be taken, as well as the information and resources to do so.

In this context, Scientific Council recognized that the review of the corals, sponges, and seamount closures schedule for 2014 is a necessary step towards the reassessments of bottom fishing activities due in 2016. Therefore, the work plan to achieve the assessments of bottom fishing was developed in two steps, an initial step describing the work towards the review of the closures in 2014, and a second step that uses the output of that review to develop the assessments of bottom fishing.

Step 1. Review of VME fishery closures 2014

A considerable body of evidence has already been reported on VME status in the NRA since 2008 and each year an up-date of the NEREIDA program analysis on VME related work has been conducted and reported. The data associated with these analyses, including RV trawl survey data, are readily available. In addition with already available data and ongoing analyses, new evidence is required through the additional processing of some of the key sample data sets, namely (organization performing action in parentheses):

1. (NEREIDA) New video analysis from the Flemish Cap closures (DFO, Canada).

2. (NEREIDA) Analysis of rock dredge samples against recently produced list of VME indicator species (IEO, Spain).

3. New Canadian and European research trawl survey data for years 2011/12/13 (IEO, Spain; DFO, Canada).

4. (NEREIDA) Box core sample species biomass layer (Cefas, UK)

5. (NEREIDA) Habitat suitability models results of VME indicator species distribution and abundance/biomass (DFO, Canada).

6. (NEREIDA) Examination of VME distributions within the wider biogeographic region of the NW Atlantic (DFO, Canada; IEO, Spain).

7. Analysis of fishing activity VMS data integrated with historic fishing effort maps to generate a map of fishing activity between 1987 and 2012 (NAFO).

Step 2. Assessment of SAI on VMEs by bottom fisheries

The tasks identified in Table 1 is a preliminary work plan to be reviewed in 2014 with regard to content and timeline. The assessment should (as far as possible) address the FAO criteria[1] for assessing Significant Adverse Impacts, namely;

i. the intensity or severity of the impact at the specific site being affected;

ii. the spatial extent of the impact relative to the availability of the habitat type affected;

iii. the sensitivity/vulnerability of the ecosystem to the impact;

iv. the ability of an ecosystem to recover from harm, and the rate of such recovery;

v. the extent to which ecosystem functions may be altered by the impact; and

vi. the timing and duration of the impact relative to the period in which a species needs the habitat during one or more of its life history stages.[2]

Table 1. Tasks and responsible bodies for assessment of significant adverse impacts on VMEs

NCEM Assessment Task	FAO Criteria	Approach	Lead
Type(s) of fishing conducted or contemplated, including vessels and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing (harvesting plan)	i	Information and data is required to describe the fleet activities spatially and temporally. This will require integrating VMS data with information on the fishery e.g. fleet register and catch. The work undertaken to address FC Request 16 (2012) by Scientific Council contributes to this task.	STACFIS
Existing baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes can be compared	i, ii, iii	The outcome of the "review of fisheries closures" should provide much of the seabed habitat data necessary to address this task, but additional input will be required from STACFEN in relation to assessing the physical oceanography	SC WGESA/STACFEN
Identification, description and mapping of VMEs known or likely to occur in the fishing area	iii	The outcome of the "review of fisheries closures" should provide much of the necessary information. In addition further work to develop habitat suitability models for VME in the NRA will be useful	SC WGESA
Identification, description and evaluation of the occurrence, scale and duration of likely	i, ii	The work undertaken to address FC Request 16 (2012) by Scientific Council contributes to this task.	SC WGESA

[1] Food and Agriculture Organization of the United Nations, International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (Rome: FAO, 2009).
[2] *Ibid*, Para. 18.

NCEM Assessment Task	FAO Criteria	Approach	Lead
impacts, including cumulative impacts of activities covered by the assessment on VMEs			
Consideration of VME elements known to occur in the fishing area	iii	The outcome of the "review of fisheries closures" should provide much of the necessary information	SC WGESA
Data and methods used to identify, describe and assess the impacts of the activity, the identification of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment;	N/A	To be done in due course	SC WGESA
Risk assessment of likely impacts by the fishing operations to determine which impacts on VMEs are likely to be significant adverse impacts	ii, iii, iv, v	The work undertaken to address FC Request 16 (2012) by Scientific Council contributes to this task.	SC WGESA
The proposed mitigation and management measures to be used to prevent significant adverse impacts on VMEs, and the measures to be used to monitor effects of the fishing operations	N/A	To be done in due course	Joint FC/SC Working Group on the Ecosystem Approach

ix) Witch flounder in Div. 3NO exploitable biomass and spawning stock biomass (Item 11)

With regards to witch flounder in Div. 3NO, the Fisheries Commission requests the Scientific Council to provide estimates for exploitable biomass and for spawning stock biomass, or appropriate proxies, as well as smoothing, as appropriate.

Scientific Council responded:

An index of spawning stock biomass (SSB) for witch flounder in Div. 3NO was accepted by Scientific Council. The index shows an increase from the lowest values in the mid-1990s, but remains well below the peak values in 1985 to 1990. Indices of exploitable biomass, although not developed here, would likely be very similar to the total biomass indices.

An SSB index was developed from Canadian spring survey (Campelen or Campelen equivalent) data from 1984 – 2012 by combining length frequency data for females with corresponding maturity at length estimates, and applying annual length-weight relationships to give estimates of female SSB (Fig. 7). The data were also examined in attempts to develop reference points for the stock (see Section VII 1. c) vii, for further description of the survey data). Smoothers can be applied to the data as necessary, depending on the purpose. Although no index of exploitable biomass was calculated, Scientific Council noted that it would likely be very similar to the index of total biomass from the surveys, given the relatively low proportion of young fish in the datasets.

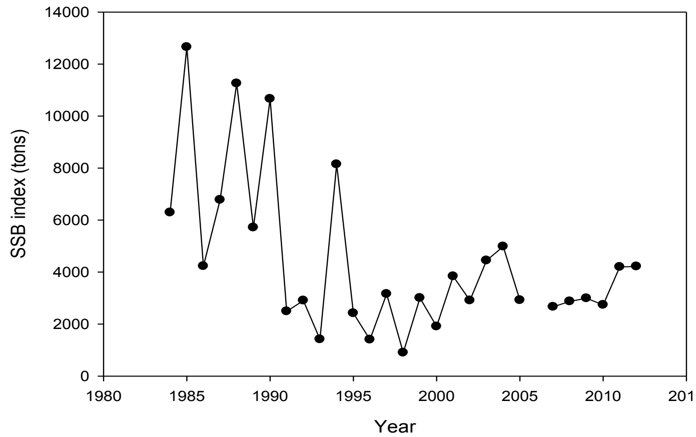


Fig. 7. SSB index for 3NO witch flounder, derived from Canadian spring survey data.

x - xi) Consideration for reopening stocks under moratorium (Item 12a) and sustainable harvest rates for healthy stocks (Item 12b)

With regards to stocks without reference points and that cannot be developed, the Fisheries Commission requests the Scientific Council to provide advice on:

a) considerations for reopening stocks under moratorium.

b) what would constitute a sustainable harvest rate for healthy stocks.

Scientific Council responded:

A full answer implies the existence of reference points for the stocks in question. Scientific Council recommends high priority is given to the development of limit reference points within Scientific Council. Scientific Council also recommends that the current NAFO Precautionary Approach framework be revised and that this should be conducted in close cooperation between Scientific Council and the proposed joint FC-SC Working Group on Risk-Based Management Strategies.

Reference points are needed to delineate sustainable levels of exploitation. Reopening of fisheries would occur when the stock has increased to a level where there is low risk of impeded recruitment. This level is typically marked by the reference point B_{lim}, and at a minimum, this reference point should be defined before a fishery is reopened. A sustainable harvest rate of a "healthy stock" – e.g. when the stock is in the Safe Zone of the PA Framework – would be no greater than F_{msy}. To fully answer the questions therefore implies the existence of reference points.

In theory reference points can be defined for all stocks either derived quantitatively or as proxies. However, this has to be done on a stock by stock basis as each stock is a special case. For a few stocks particular circumstances – for example indices that do not adequately cover the stock distribution – might in the interim prohibit this.

Scientific Council is in the process of developing reference points for all stocks. This is time consuming, and has to be done in addition to all other commitments of SC and FC and is therefore not yet finalized.

Scientific Council recognizes the need to speed up the definition and assignment of PA (and/or other) reference points to all NAFO stocks. Scientific Council further notes that the current PA framework has been in place for some time and would benefit from review and recommends that this be given high priority in the work of the new FC/SC WG on risk-based management strategies. This work would be the first step in the process of developing management plans for all stocks as intended by Fisheries Commission.

xii) Progress on the "Roadmap for EAF" (Item 13)

Fisheries Commission requested Scientific Council to report on the progress of the "Roadmap for developing an Ecosystem Approach to Fisheries for NAFO" regarding:

a) The general progress of the Roadmap;

b) Further developments on the stock interactions studies between cod, redfish and shrimp in the Flemish Cap by applying multi species models and by quantifying potential yield and biomass tradeoffs with different fishing mortalities in the multispecies context. The predation of cod over cod juveniles should be taken into account

c) Developments on stock interaction studies for the Grand Banks (NAFO Divisions 3KL and 3NO). The spatial overlap between these stocks should be considered.

Scientific Council responded:

a) The "Roadmap" lays out the organizing framework to develop an EAF. It is a framework that includes both Scientific Council and Fisheries Commission. Scientific Council has made progress on many aspects of the Roadmap, although there are still gaps that need to be addressed (see Table 2). Required inputs from Fisheries Commission include 'goal setting' (e.g. defining explicit ecosystem objectives, developing governance mechanisms to discuss/set multispecies objectives), and 'monitoring' (e.g. developing mechanisms to ensure the availability of catch information for both commercial and non-commercial species); 'risk assessment' would also require important input from Fisheries Commission.

Limited human resources and funding support impose limits to the pace at which many of the studies required to support the roadmap can be carried out

b) Studies estimating cod consumption of shrimp, redfish and cod (i.e. cannibalism) and redfish consumption of shrimp in the Flemish Cap reinforced the notion that strong trophic interactions between these species exist. Additional work on multispecies modeling incorporated these results and showed that model outcomes were similar in trend to work reported by Scientific Council in 2012. Further work is required to provide the required quantitative advice.

c) A variety of studies (e.g. analysis of ecosystem trends, diet studies, ecological modeling) are ongoing.

a) The "Roadmap for developing an Ecosystem Approach to Fisheries for NAFO" (hereafter referred to as "Roadmap") was initially conceived in 2010 as a conceptual foundation from where Scientific Council could discuss and propose a way forward for an ecosystem approach to fisheries for NAFO. The Roadmap is not a fixed plan; as its name indicates, it is a guiding set of ideas whose details evolve as it is developed and implemented. Limited human resources and funding support impose limits to the pace at which many of the studies required to support the roadmap can be carried out.

The Roadmap was originally developed around the concept of Integrated Ecosystem Assessments (IEA), and its core premises are: a) the approach has to be objective-driven, b) it should consider long-term ecosystem sustainability, c) it has to be a place-based framework, and d) trade-offs have to be explicitly addressed.

In terms of setting sustainable exploitation levels, the overall framework can be summarized as a 3-tiered hierarchy. The first tier defines fishery production potential at the ecosystem level, taking into account environmental conditions and ecosystem state. This allows a first order consideration for the potential influence of large scale climate/ecological forcing on fishery production, as well as explicitly considering the basic limitation imposed by primary production on ecosystem productivity. The second tier utilizes multispecies assessments to allocate fisheries production among a set of commercial species, taking into account species interactions as well as considerations on the resilience and stability of the exploited assemblage. This tier explicitly considers the trade-offs among fisheries, and allows identifying exploitation rates which are consistent with multispecies sustainability. The third tier involves single-species stock assessment, where the exploitation rates derived from tiers 1 and 2 can be further examined to ensure single-species sustainability. This hierarchical sequence allows considering the sustainability of the exploitation at the ecosystem, multispecies assemblage, and single stock level.

The current representation of the Roadmap (Fig. 8) provides an operational perspective of how the EAF could be implemented in a possible work-flow process. This schematic incorporates the hierarchical approach to define exploitation rates, and integrates the impacts on benthic communities (e.g. VMEs) associated with the different fisheries that take place within the ecosystem.

Although significant progress has been made since the original proposal of the Roadmap, there is still a fair amount of work that remains to be done (Table 2). Fully addressing Fisheries Commission Request 13a requires input not just from Scientific Council, but also from Fisheries Commission. Summarizing the progress on the Roadmap should not be limited to the work done by Scientific Council and its WGs, it should also include the work that Fisheries Commission and its WGs have done. Some of the most important components of the Roadmap (Fig. 8) that requires input from Fisheries Commission includes 'goal setting' (e.g. defining explicit ecosystem objectives, developing governance mechanisms to discuss/set multispecies objectives), and 'monitoring' (e.g. developing mechanisms to ensure the availability of catch information for both commercial and non-commercial species); although 'risk assessment' would also require important input from Fisheries Commission. Table 2 provides a summary of the progress to date following the structure described in Fig. 8.

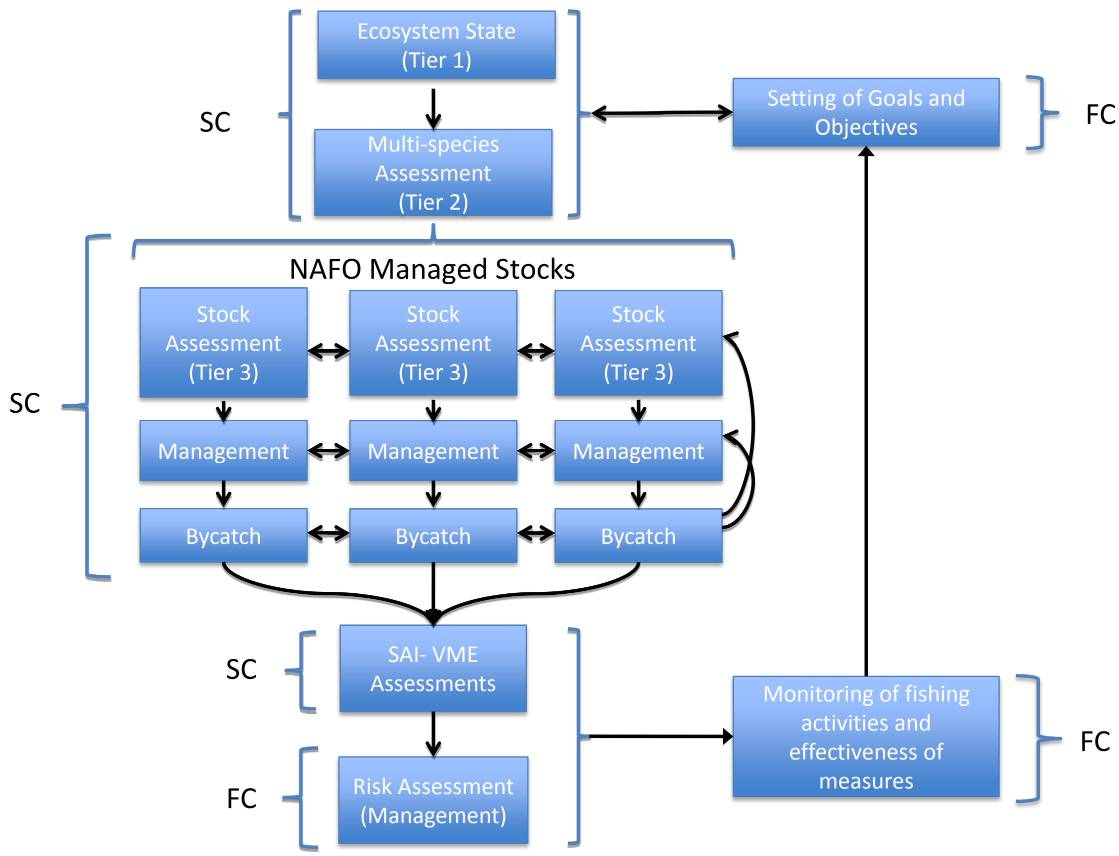


Fig. 8. Current working template of the Roadmap.

b) Studies on food consumption by cod, and redfish in the Flemish Cap were carried out. In these studies, emphasis was put on estimating cod consumption of shrimp, redfish and cod (i.e. cannibalism), and on the estimation of redfish consumption of shrimp. These consumption analyses reinforced the notion of strong trophic interactions between these three species in the Flemish Cap. Beyond their stand-alone usefulness, and their role in defining possible scenarios for natural mortality in stock-assessment, these consumption estimates were also incorporated into the ongoing multispecies modeling exercise for the Flemish Cap.

The multispecies modeling work was advanced by exploring the impact of different catchability considerations on both qualitative and quantitative model behavior. Current results indicate that the qualitative behavior of the model is robust to catchability assumptions, but quantitative estimates are not. Therefore, further work is required before the quantitative answers required can be provided.

c) Studies on species interactions and ecosystem trends in the Grand Banks are ongoing. Between 2007 and 2012, the Ecosystem Research Initiative of Fisheries and Oceans Canada supported a research program on the Newfoundland-Labrador marine ecosystem (the ERI-NEREUS program). ERI-NEREUS, together with other dedicated research efforts like NEREIDA, was instrumental in the development of the Roadmap. These studies explored, for example, trends in fish functional groups, the role of fishing pressure and environmental drivers on common trends in core groundfishes, diets of core groundfish (cod, Greenland halibut, American plaice, yellowtail flounder, and redfish) and pelagic (capelin, sandlance, and Arctic cod) fishes, as well as exploring bottom-up (climate, food availability) and top-down (predation, impact of fishing) effects on key species. Many of these results have been presented at SC and SC WGEAFM meetings, and even though the ERI-NEREUS program has already ended, there are ongoing efforts aimed at continuing some of this work in support of both, the Roadmap and DFO efforts towards developing ecosystem approaches. This ongoing work also includes estimations of food consumption for fish stocks in the Grand Banks, as well as the development of minimum-realistic multispecies models. Results from these research activities are being tabled at SC as they become available, but the complexity of the Grand Bank ecosystem, together with limited human resources and funding support, necessarily impose limits to the pace at which many of these studies can be carried out.

Table 2. Summary of progress on the development and implementation of the Roadmap to date. Information is schematically summarized following the steps (boxes) as described in Figure 1. For each component (box), a brief description of the task associated with it, the progress to date, the work that still needs to be done, and some issues deemed critical are provided. In many cases, other NAFO bodies are expected to have relevant information that could add to the progress summarized here by Scientific Council.

Roadmap Component	Progress to date	Work to be done	Critical issues
Goal Setting			
• Defining ecosystem level objectives for NAFO fisheries.	Initial discussions on the implications of species interactions in setting TAC for species in the Flemish Cap.	Development of governance mechanisms to discuss and set multispecies objectives	Lack of explicit objectives
	Acknowledgement of the role of trophic interactions in the context of management of fisheries directed to these spp.		
	[more to be added by FC, and SC-FC WGs]	[more to be added by FC, and SC-FC WGs]	[more to be added by FC, and SC-FC WGs]
Ecosystem State			
• Defining spatial management units	Ecoregion analyses for Newfoundland and Labrador, Flemish Cap, Atlantic US, and partially on Scotian shelf.	Integrate ecoregion analysis across NAFO convention area	Consideration of the broader set of climate change impacts

Roadmap Component	Progress to date	Work to be done	Critical issues
• Exploring temporal variability of units	Some candidate ecosystem-level management units identified.	Correspondence between stock boundaries and candidate ecosystem management units	Better integration of environmental and oceanographic information (e.g. STACFEN work)
• Defining productivity state and its variability	Preliminary Fisheries Production Potential models for Newfoundland and Labrador, Flemish Cap, and Scotian Shelf; studies on this topic are also available for the Atlantic US.	Consideration of different scales and how to integrate them	Incorporation of northern NAFO divisions (0 and 1)
	Preliminary Aggregate Biomass Production models for Newfoundland and Labrador, Flemish Cap; studies on this topic are also available for Scotian Shelf and Atlantic US.	Identification of ranges of variability in the past compared to present.	Incorporation of oceanic waters (i.e. open ocean ecosystems)
	Initial studies linking elements of productivity and environmental drivers in Newfoundland and Labrador, and Flemish Cap; studies on this topic are also available for Scotian Shelf and Atlantic US.	Improved Fisheries Production Potential and Aggregate Biomass models	More comprehensive consideration of top predators (seabirds, sharks, seals, and cetaceans)
		Integrate environmental drivers into models of ecosystem productivity.	Developing more specific/functional connections and collaborations with ICES Working Group on the Northwest Atlantic Regional Sea (WGNARS)
Multispecies assessment			
• Description of species interactions and trends	Studies of food habits in Flemish Cap and Newfoundland and Labrador; studies on this topic are also available for Scotian Shelf and Atlantic US	Improving multispecies modelling for Flemish Cap	Considerations of environmental drivers and species interactions on reproductive potential (e.g. integration of the NAFO SC WGRP work)

Roadmap Component	Progress to date	Work to be done	Critical issues
• Quantification of diets and predation	Preliminary modelling of key species in the Flemish Cap.	Developing preliminary multispecies models for Newfoundland and Labrador	Enhanced participation and incorporation of information from Scotian Shelf and US
• Understanding the role of environmental drivers in ecosystem structure and dynamics	Testing specific hypothesis of bottom-up and top-down regulation in Newfoundland and Labrador	Improved characterization of diets and its variability in space and time	Developing more specific/functional connections and collaborations with ICES Working Group on the Northwest Atlantic Regional Sea (WGNARS)
• Understanding the response of food webs to anthropogenic impacts	Studies of common trends among multiple stocks in Flemish Cap, and Newfoundland and Labrador; studies on this topic are also available for Scotian Shelf and Atlantic US.	Improved/additional estimation of consumption/predation for key stocks	
• Definition of multispecies reference points	Estimation of consumption/predation for some stocks	Improved understanding of the linkage between lower trophic level characteristics and dynamics and fish production.	
• Provision of advice on candidate TAC based on multispecies considerations		Study the role of environmental drivers in the regulation and structure of food webs.	
Stock Assessment			
• Stock identification	Current single-species assessments	Development and/or improvement of assessment models.	Reliable estimates of fishery catches and stock indicators for their use in stock and ecosystem assessments
• Assessment of the status of the stock	Some shrimp assessments include predation	Inclusion of predation in more assessments.	Improve integration between stock-assessments and ecosystem analyses.
• Consideration of processes/environmental drivers affecting recruitment, growth, maturation and spatial distribution.	Redfish assessment has considered the impact of predation in setting natural mortality.		

Roadmap Component	Progress to date	Work to be done	Critical issues
• Consideration of sources of mortality at the stock level			
Management			
• Provision of advice on stock-specific TAC with multispecies considerations	Provision of current TAC advice on NAFO stocks	Development of rebuilding plans for more stocks.	Definition of explicit management objectives for each stock
• Definition of stock-level reference points	Precautionary approach framework and reference points for some stocks	Further development of reference points.	Consideration of stock specific management objectives in the context of ecosystem objectives
• Development and implementation of harvest control rules, stock-specific management strategy evaluation frameworks and rebuilding plans	Management strategy evaluation approach for Greenland halibut	Revision of the precautionary approach framework	
	Rebuilding plans for some stocks are under development	Complete rebuilding plans (including harvest control rules)	
		Develop mechanisms to links and evaluate TAC from multispecies candidates.	
	[more to be added by FC, and SC-FC wgs]	[more to be added by FC, and SC-FC wgs]	[more to be added by FC, and SC-FC wgs]
By-catch			
• Evaluation of by-catch of commercial and non-commercial species (including VME-defining spp).	Compilation of available information of bycatch by fishery for commercial spp.	Incorporation of non-commercial spp (including VME-defining spp)	Lack of full catch information for both commercial and non-commercial spp, including VME-defining spp, on a tow-by-tow basis
• Reporting of bycatch for use in all assessments (stocks, ecosystems, and SAI-vmes)	Suite of management measures associated with by-catch (e.g. Limits of spp under moratoria in directed fisheries)	Improve reliability of catch information	

Roadmap Component	Progress to date	Work to be done	Critical issues
• Development and implementation of measures to control by-catch levels.	Adoption of the catch reporting tow-by-tow	Link tow position with catch information (e.g. Full use of vms data for scientific analysis)	
		Develop comprehensive approach to report bycatch across fisheries and make available to NAFO bodies for their inclusion in analyses.	
	[more to be added by FC, and SC-FC wgs]	[more to be added by FC, and SC-FC wgs]	[more to be added by FC, and SC-FC wgs]
Assessment of Significant Adverse Impacts (SAI) on VMEs			
• What the nature of the VME is.	Identification and mapping of VME elements and indicator species.	Assess VME resilience.	Lack of full catch information for both commercial and non-commercial species, including VME-defining species, on a tow-by-tow basis
• What the nature of the pressure is.	Identification and review of impacts on seabed.	Integration of macro and megafauna data layers.	Understanding the functional relationships between VMEs and fisheries yields.
• What the impact is, as a combination of the nature of the VME and pressure.	Assessment of distribution and intensity of fishing activity (including initial evaluation of cumulative pressure from fishing), taking into account the type of fishery, gear employed, etc.	Determine the status of vmes as essential fish habitats.	Determining what proportion of vmes is optimal in a given fishery (i.e. How much VME we need to protect).
• Analysis of fishing impacts on benthic ecosystems	Modelling VME indicator species by-catch	Assessment of current closures for the protection of high concentrations of vme-indicator species by 2014.	How vme closures relate to other human activities, and how these interactions may affect fisheries and fisheries resources.
	Modelling VME presence.	Fisheries assessments regarding their impacts on VMEs (i.e. First assessments by 2016).	

Roadmap Component	Progress to date	Work to be done	Critical issues
	Evaluating criteria for VME indicator species.	Use the tools developed for VMEs to assess fishing impacts on benthic ecosystems at large.	
Risk Assessment			
• Assess the likelihood of significance adverse impacts on VMEs, in the context of current activities and objectives.	Development of selected VME-indicator spp maps, showing the risk of bottom fishing impacts.	Continue the development and implementation of management measures to minimize or prevent SAI on VME s	Develop, design, and implement a strategy to assess risk at the ecosystem level.
• Assess the likelihood of fisheries having significant adverse impacts on ecosystem structure and function.	Implementation of closed areas for the protection of high concentration of selected VME -indicator spp.	Develop guideline to ensure consistent application of risk assessment criteria in the context of current activities and objectives.	Ensure full interaction between all NAFO bodies to define risks in a manner that is acceptable and properly understood by all.
• Development and implementation of management actions in response to the outcomes of risk assessments.	Implementation of closed areas for the protection of physical VME elements		
	Implementation of encounter protocols for selected VME-indicator spp		
	[more to be added by FC, and SC-FC wgs]	[more to be added by FC, and SC-FC wgs]	[more to be added by FC, and SC-FC wgs]
Monitoring			
• Collection, analysis, and interpretation of data pertaining to ecosystem status and human activities relevant to the NAFO convention objectives.	RV surveys (stock status, ecosystem interactions, etc)	Improve/enhance collection of scientific information on non-commercial spp in RV surveys	Lack of full catch information for both commercial and non-commercial spp, including VME-defining spp, on a tow-by-tow basis
• Use of available data to track the effectiveness of management measures	VMS (fishing footprint, intensity of fishing, compliance of management regulations)	Improve reliability of catch information from commercial fleets	Basic scientific information lacking in some areas (e.g. Seamounts, northern areas)

Roadmap Component	Progress to date	Work to be done	Critical issues
	NAFO and scientific observer programs	Link tow position with catch information (e.g. Full use of VMS data for scientific analysis)	Basic scientific data are very limited for some ecosystem components (e.g. Epipelagic and bathypelagic zones).
		Develop and integrated way to summarize and track fleet composition and activities.	
	[more to be added by FC, and SC-FC WGs]	[more to be added by FC, and SC-FC WGs]	[more to be added by FC, and SC-FC WGs]

xiii) Stock interactions with Div. 3LNO shrimp (Item 14)

This item has been deferred to the September SC/NIPAG meeting.

xiv) Sargasso Sea management measures (Item 15)

The Fisheries Commission requests the Scientific Council to: *comment and advise on whether the Sargasso Sea provides forage area or habitat for living marine resources that could be impacted by different types of fishing; and on whether there is a need for any management measure including a closure to protect this ecosystem.*

Scientific Council deferred their response to this request until its September meeting.

xv - xvi) Analysis of fishing effort (Item 16a) and Assessment of risk of SAI on VME indicator aggregations and VME elements (Item 16b)

Fisheries Commission requested Scientific Council to begin the development of the assessment of risk of significant adverse impacts on VME indicator aggregations and VME elements in the NAFO RA.

a) Analyze fishing effort (VMS data) in the NRA to define areas of different levels of fishing intensity (e.g. a map of 90%, 80%, 70%... effort) and assess these in conjunction with habitat data in order to map out areas where fishing activities would therefore have no or little significant adverse impact on VMEs and where encounter protocols and move on rules would therefore have little utility.

b) In view of the area management currently implemented and to facilitate evaluation of the need for further protective measures in response to UNGA 61/105, assess the risk of significant adverse impacts on VME indicator aggregations and VME elements in the NAFO RA. This assessment should consider spatial and temporal distribution of fishing activity, and the best available knowledge on the spatial distribution of VME indicators and VME indicator elements.

Scientific Council responded:

This is a presentation of preliminary results for a necessary component of reassessment of bottom fishing activities, underlying analysis is to be further refined: The analysis of VMS data indicates that most of the fishing effort for the 2008-2011 period has been concentrated in a relatively small area within the fishing footprint. Most of the overall biomass of the VME species considered (sponges and seapens) outside of the closed areas is found in the large region associated with low fishing intensity, but additional work is required to fully characterize the likelihood of encounters, and the consequent risk of SAIs.

Significant progress has been made to address this FC Request, but further work is required to perform a full assessment of the risk of Significant Adverse Impacts (SAI) on VME species.

The approach taken to address this request so far involved 3 steps, namely;

1. Use NAFO Vessel Monitoring System data (VMS) to generate fishing intensity maps for each year (2008 2011). These intensity maps allow identification of areas that encompass different levels of fishing effort (i.e. mapping the areas associated with different percentiles in the cumulative effort distribution).

2. Generate biomass surface maps utilizing the specified VME taxa caught by the RV surveys (2005 2010)

3. Start the assessment of interactions between VME indicator species and fishing activity by comparing composite fishing intensity maps (i.e. only considering cells that were fished all years) with the biomass layers of sponge and sea pen to evaluate the degree of overlap (i.e. potential for interaction).

The results of the VMS analysis for 2008 - 2011 reveal a consistent spatial pattern of fishing activity with clear spatial gradients in fishing intensity. The most intensively fished region contained one tenth of all effort in an area of only 242km^2, whereas effort concentration declines as the rest of the footprint is considered. The relationship between area occupied by fishing activity and fishing intensity is shown in Fig. 9 and the spatial extent of selected fishing activity percentiles is shown in Fig. 10.

To test the assertion that highly fished areas have a reduced likelihood of VME indicator species encounters, the interaction between the VMS effort layers and biomass layers for sponge and seapens was undertaken.

For each fishing activity percentile the sum of the VME species biomass present (determined from the survey trawl biomass layers was calculated and expressed as a percentage of the total biomass for that species (excluding closed areas). The relationship between the percentage biomass for each VME indicator species (sponge and seapen) and the fishing activity percentile area is shown in Fig. 10. The results show that there is a higher proportion of sponge and seapen biomass found in areas of low fishing intensity e.g $<10^{th}$ percentile, compared to areas fished with higher intensity e.g. $>10^{th}$ percentile.

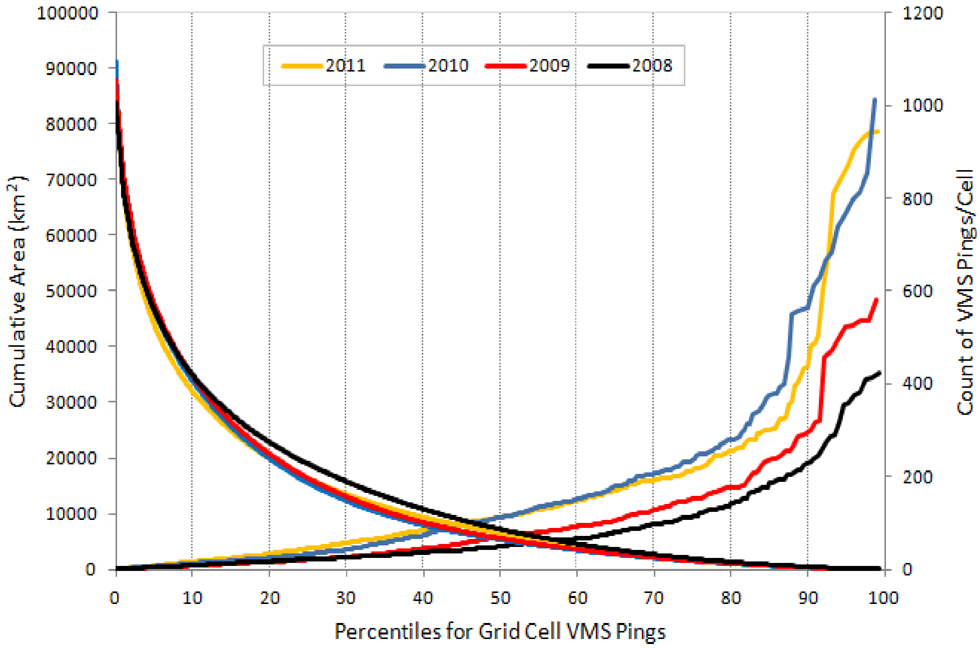


Fig. 9. The relationship between the percentiles for grid cell VMS pings, cumulative area occupied and fishing intensity (Count of VMS pings/cell) for years 2008, 9, 10 & 11. The data highlight how the intensively fished cells occupy a very small area compared to the least intensively fished cells which occupy a very large area.

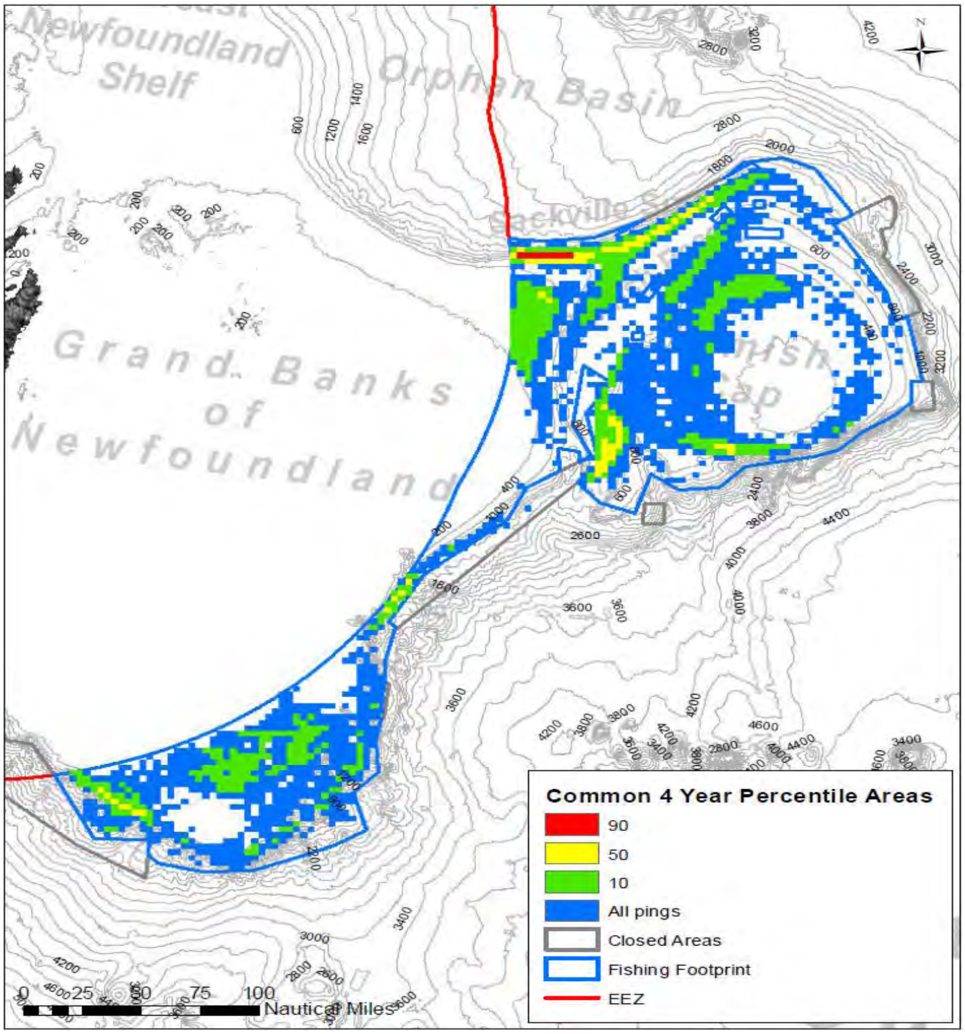


Fig. 10. Map showing the area occupied by the 90th, 50th and 10th percentiles of bottom fishing activity, and all cells with fishing less than the 10th percentile (e.g. all cells with VMS pings). Note the area occupied in blue has exactly the same amount of fishing effort as the area occupied in red indicating that the intensity of fishing activity is much higher in the red area compared to the blue area

2. Coastal States

a) 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.*

Scientific Council responded:

The assessments (interim monitoring) found nothing to indicate a significant change in the status of the stock. Accordingly, Scientific Council therefore did not change the advice. The next full assessment of this stock will take place in 2014.

The Scientific Council reviewed the status of this stock at the June 2013 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 overall 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) Golden redfish, Demersal Deep-sea redfish, Atlantic wolfish, Spotted wolfish and American plaice in Subarea 1 (Item 2)

Advice for golden redfish (Sebastes marinus), demersal deep-sea redfish (Sebastes mentella), American plaice (Hippoglossoides platessoides), Atlantic wolfish (Anarhichas lupus), spotted wolfish (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:

The assessments (interim monitoring) found nothing to indicate a significant change in the status of these stocks. Accordingly, Scientific Council therefore did not change the advice. The next full assessment of this stock will take place in 2014.

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

Advice for Greenland halibut in Division 1A (inshore) was in 2012 given for 2013 – 2014. Denmark (on behalf of Greenland) requests the Scientific Council to continue to monitor the status of Greenland halibut in Subarea 1A inshore annually, and should significant change in stock status be observed, the Scientific Council is requested to provide updated advice as appropriate.

The Scientific Council responded:

The assessments (interim monitoring) found nothing to indicate a significant change in the status of the stock. Accordingly, Scientific Council therefore did not change the advice. The next full assessment of this stock will take place in 2014

iv) Pandalus borealis in SA 0+1 (Item 6)

Scientific Council deferred addressing this request to the September SC/NIPAG meeting.

b) 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 advice on Total Allowable Catch levels for 2014, separately, for Greenland halibut in 1) the offshore area of Divisions 0A+1B and 2) 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 increasing trends in biomass and CPUE indices together with high CPUE and promising incoming year classes for Greenland halibut in Div. 0A and Div. 1AB Scientific Council advises that the TAC for the Greenland halibut in Div. 0A and Div. 1A offshore + Div. 1B could be increased to 16 000 t.

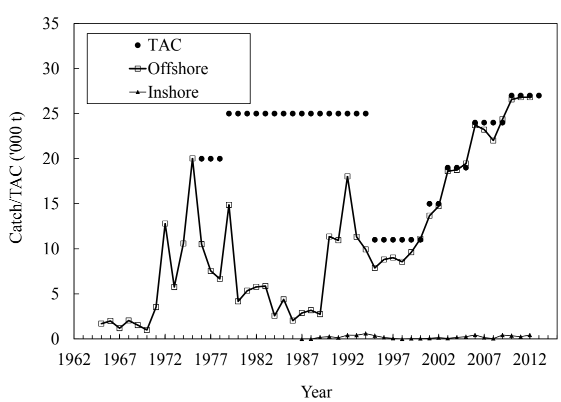
Div. 0B+1C-F: TAC was increased in 2010. The biomass and CPUE indices have been relatively stable. Scientific Council advises that there is a low risk to the Greenland halibut in Div. 0B and Div. 1C-F if the TAC for 2014 remains unchanged and should not exceed 14 000 t.

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 tons in 1992 and remained at about 10 000 tons until 2000. Since then catches increased gradually to 26 900 tons 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 and 2012.

	Catch ('000 t)		
Year	STACFIS	STATLANT	TAC ('000 t)
2010	27	27	27[1]
2011	27	27	27[1]
2012	27	27	27[1]
2013			27[1]

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



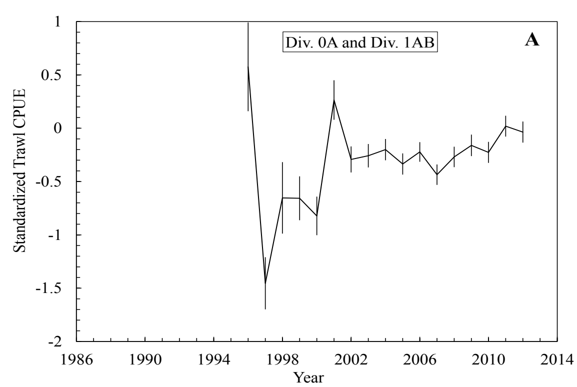
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2012 were available from Div. 0A and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2012.

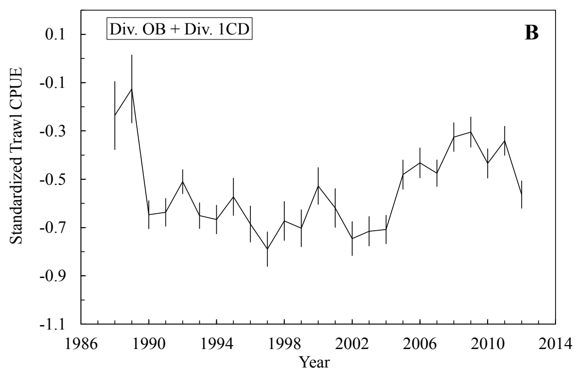
Assessment: No analytical assessment or risk analysis could be performed, therefore only qualitative statements on risk can be provided.

Commercial CPUE indices. Combined standardized trawl catch rates in Div. 0A and Div. 1AB decreased slightly in 2012 but has shown an increasing trend since 2007. Standardized CPUE for gillnets increased gradually from 2006-2011, with a slight decrease in 2012.

The combined Div. 0B and 1CD standardized catch rates were relatively stable from 1990-2004, then increased from 2004-2009. CPUE has decreased since 2009 but in 2012 it is still above the level observed during 1990 to 2004. The standardized CPUE for gillnets in Div. 0B has been increasing since 2007 and in 2012 was at the highest level in the time series.

Unstandardized gillnet CPUE is significantly higher in Div. 0A compared to Div. 0B and the unstandardized trawl CPUE in 2012 were also higher in Div. 0A and 1AB compared to Div. 0B-1CD.

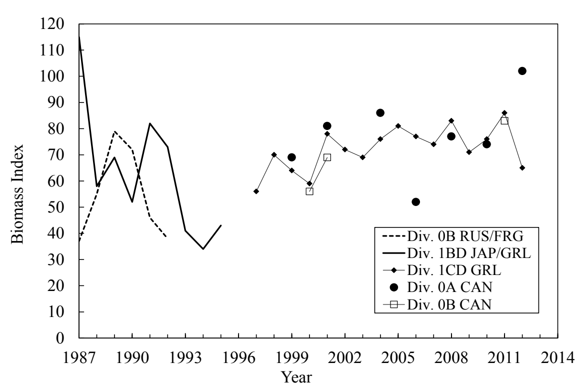




Biomass: The index of trawlable biomass for Div. 0A-South has been variable with a generally increasing trend from 1999 to 2012. The 2012 estimate is the highest of the time series. However, this result is influenced by one very large set when removed reduces the estimate by 15%. Div. 0A-North was surveyed again in 2012 with much better coverage than either of the previous surveys conducted in 2004 and 2010 resulting in a significant increase in biomass and abundance estimates for this area.

The survey biomass index in Div. 1CD has increased gradually over the fourteen year time series, was the highest observed in 2011, but decreased in 2012 to the lowest level seen since 2000.

Recruitment: Recruitment (age one) in the entire area covered by the Greenland shrimp survey has been rather stable from 2003-2010. Then recruitment increased to the highest level in the time series in 2011 but decrease to the lowest level seen since 1997 (1996 year-class) in 2012.



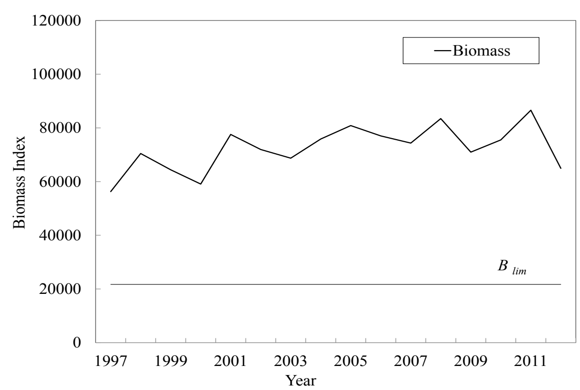
Fishing Mortality: Level not known.

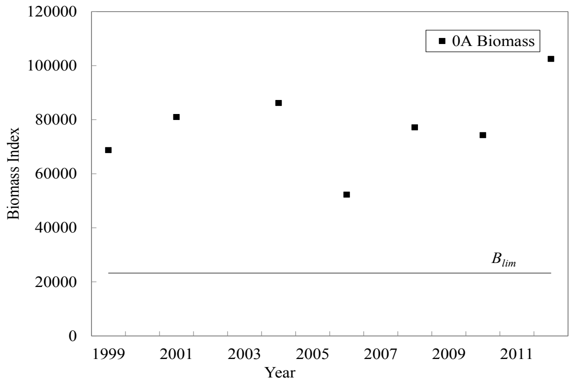
State of the Stock: Div. 0A+1AB: The biomass index in Div. 0A-South has been gradually increasing while abundance has remained relatively stable since 1999, the beginning of the time series. The biomass was in 2012 well above B_{lim}. Additional biomass has been estimated in Div. 0A-North with the improved coverage of the 2012 survey. Length composition in the surveys has varied without trend over the time series. Trawl catches have been relatively stable with some variation without trend in the gillnet catch frequencies. Standardized CPUE indices in Div. 0A and 1AB have been increasing in recent years.

Div. 0B+1C-F: The biomass index in Div. 1CD has shown an increasing trend since 1997, but decreased in 2012. The biomass was in 2012 well above B_{lim}. Length compositions in the catches and deep sea surveys have been stable in recent years. Standardized CPUE has decreased since 2009 but in 2012 it is still above the level observed during 1990 to 2004. The Standardized CPUE for gillnets in Div. 0B has been increasing since 2007 and in 2012 was at the highest level in the time series.

Reference Points: Age-based or production models were not available for estimation of precautionary reference points. A preliminary proxy for B_{lim} was set as 30% of the mean biomass index estimated for surveys conducted between 1997-2012 in Div. 1CD and 1999-2012 in Div. 0A-South.

B_{msy} is not known for this stock. If it is assumed that the stock is at or close to B_{msy} the B_{lim} should according to Report of the NAFO Study Group on Limit Reference Points (SCS Doc. 04/12) be set at 30% of mean survey biomass. If the stock increases B_{lim} should be increased accordingly.





Special Comments: A quantitative assessment of risk at various catch options is not possible for this stock. Therefore it is not possible to quantitatively evaluate whether the advised increase in TAC is sustainable. If indices of stock size begin to decline in the short term (3 to 4 years), the TAC should be reduced.

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

The next Scientific Council assessment of this stock will be in 2014.

Sources of Information: SCR Doc. 13/06, 23, 33, 35; SCS Doc. 13/08, 9, 14.

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i) Pandalus borealis in Subareas 0 and 1

Scientific Council deferred addressing this request to the September SC/NIPAG meeting.

3. Scientific Advice from Council on its own Accord

a) Roughhead Grenadier in SA 2+3

Roughhead grenadier in Subareas 2+3

Advice June 2013 for 2014-2016

Recommendation for 2014-2016
Scientific Council assesses this stock under its own initiative.

Management objectives

No explicit management plan or management objectives defined by Fisheries Commission. General convention objectives (GC Doc. 08/3) are applied.

Convention objectives	*Status*	*Comment/consideration*
Restore to or maintain at Bmsy	Unknown	Cannot be evaluated
Eliminate overfishing	OK	Fishing mortality rate is low
Apply Precautionary Approach	Unknown	Reference points not defined
Minimise harmful impacts on living marine resources and ecosystems	OK	VME closures in effect
Preserve marine biodiversity	Unknown	Cannot be evaluated

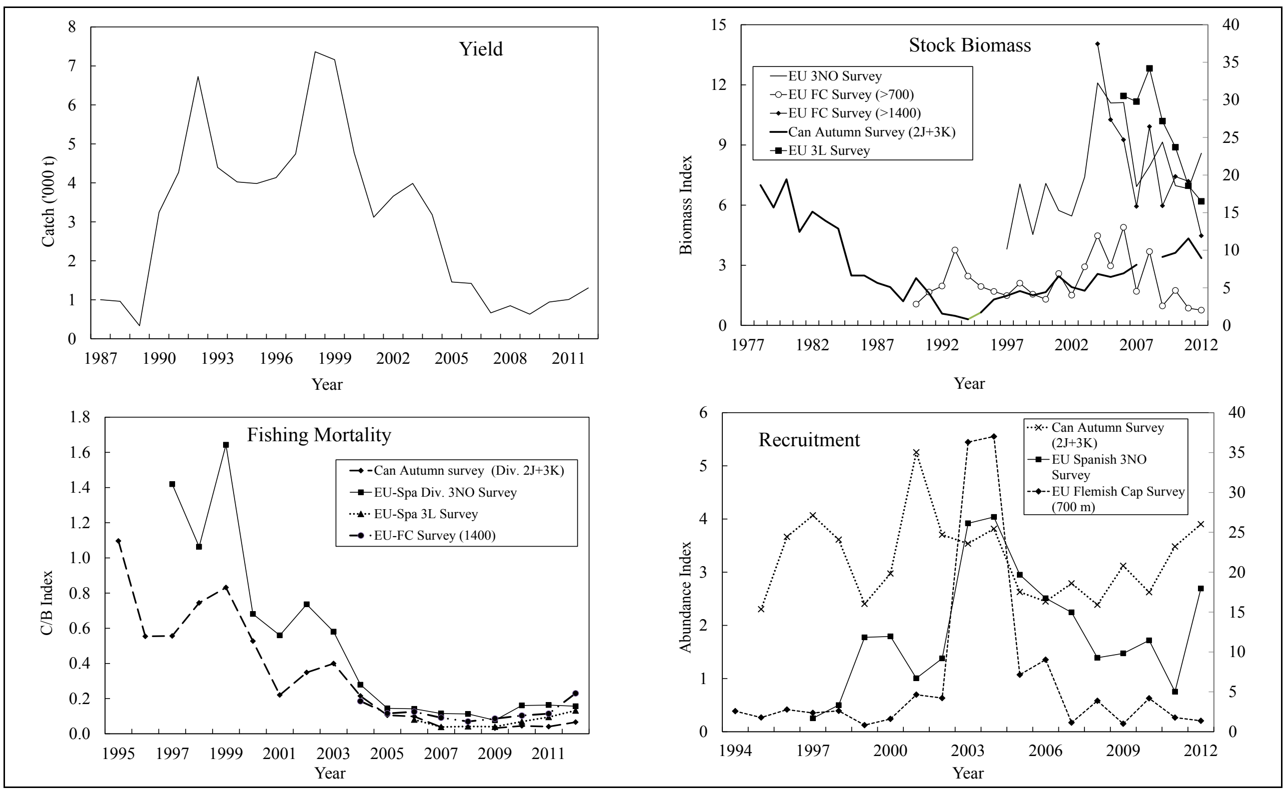
- OK
- Intermediate
- Not accomplished
- Unknown

Management unit

The stock structure of this species in the North Atlantic remains unclear. 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.

Stock status

Survey indices indicate a stable or declining stock in recent years. Fishing mortality indices have remained at low levels since 2005. Good recruitment is indicated in 2012 but indices of recruitments have high uncertainty.



Reference points

Not defined.

Projections

Quantitative assessment of risk at various catch options is not possible for this stock at this time.

Assessment

Biomass indices from the surveys with depth coverage till 1400 meters are considered as the best survey information and are used to monitor trends in resource status (STACFIS 2013). The next full assessment of this stock will be in 2016.

Human impact

Mainly fishery related mortality. Other mortality sources (e.g. pollution, shipping, oil-industry) are undocumented.

Environmental impact

Bottom temperatures in Div. 2J, 3K and 3KL have remained well above normal for the past several years and a warm oceanographic regime may permit increased growth and productivity.

Fishery

Roughhead grenadier is taken as by-catch in the Greenland halibut fishery, mainly in NRA Div. 3LMN.

Recent catch estimates are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012
STATLANT 21	1.7	1.3	0.6	0.5	0.41	0.71	0.8	1.0	1.3
STACFIS	3.2	1.5	1.4	0.7	0.8	0.6	0.9	1.0	1.3

Effects of the fishery on the ecosystem

No specific information is available. General impacts of fishing gear on the ecosystem should be considered.

Special comments

None.

Sources of Information

SCR Doc. 13/12, 13, 17, 27 and 29; SCS Doc. 13/05, 07 and 09.

VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

1. Scientific Council, (in conjunction with NIPAG), 12 – 19 Sep 2013

Scientific Council noted that the Scientific Council shrimp advice meeting will be held at the NAFO Secretariat, 12-19 September in advance of the 2013 Annual Meeting. The Council noted the NAFO stocks will be addressed first so that the advice will be available to NAFO Contracting Parties on Monday, 16 September, 1 week in advance of the Annual Meeting.

2. Scientific Council, 23 – 27 Sep 2013

Scientific Council noted the Scientific Council meeting will be held in the Westin Hotel, Halifax, NS, Canada, 23-27 September 2013.

3. Scientific Council, June 2014

Scientific Council agreed that its June meeting will be held on 30 May – 12 June, 2014, in Halifax or Dartmouth. The Secretariat will present some options for venues at the September meeting.

4. Scientific Council, (in conjunction with NIPAG), Sep 2014

It was noted that an invitation to host this meeting had been extended by Greenland Institute of Natural Resources. Details will be discussed during the September 2013 meeting.

5. Scientific Council, September 2014

Scientific Council noted that the Annual meeting will be held in September in Halifax, Nova Scotia, Canada, unless an invitation to host the meeting is extended by a Contracting Party.

6. NAFO/ICES Joint Groups

a) NIPAG, 12-19 Sep 2013

Scientific Council noted the NIPAG meeting will be held at the NAFO Secretariat, 12 – 19 September 2013.

b) NIPAG, 2014

It was noted that an invitation to host this meeting had been extended by Greenland Institute of Natural Resources. Details will be finalized during the September 2013 meeting.

c) WGDEC, 2014

The ICES/NAFO Joint Working Group on Deep-water Ecology (WGDEC), chaired by Odd-Aksel Bergstad, Norway, is scheduled to meet at ICES Headquarters, 24–28 March 2014 to address the various items on its agenda.

d) WGHARP, 2013

The NAFO/ICES Working Group on Harp and Hooded Seals (WGHARP), chaired by Mike Hammill, Canada, will meet for 5 days, August 26-30 at PINRO in Murmansk, Russia. The working group will provide quota advice to ICES member states of their harvests of harp and hooded seals in the northeast Atlantic, review current research in the northwest Atlantic and advise on other issues as requested.

7. Scientific Council Working Groups

a) WGESA (formerly SC WGEAFM)

The Working Group on Ecosystem Science and Assessment will meet at the NAFO Secretariat, Dartmouth, Nova Scotia, Canada, 19–28 November, 2013.

b) WGRP

It is anticipated that the WG on Reproductive Potential will meet in conjunction with the ICES/NAFO symposium 'Gadoid Fisheries: the Ecology and Management of Rebuilding' to be held 15-18 October 2013 in St. Andrews, New Brunswick, Canada. The WG will review its progress to date and discuss whether further terms of reference are necessary or if the group has provided as much input to Scientific Council as it can at this time. The need for further ToR will also be discussed by Scientific Council at the September 2013 meeting.

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Topics for Future Special Sessions

a) World Conference on Stock Assessment Methods, Boston, USA, July 2013

Scientific Council was informed of progress on the World Conference on Stock Assessment Methods, which NAFO has agreed to co-sponsor. This conference will be held at the Boston Seaport during 15–19 July, 2013. Scientific Council has provided financial support to two members (B. Healey, Canada, and D. Gonzalez, EU-Spain), as well as the keynote speaker, Sidney Holt, who has been involved in fisheries matters in the northwest Atlantic since January 1949, when he participated as a member of the UK delegation to the conference which led to the establishment of the International Convention for the Northwest Atlantic Fisheries.

b) Joint ICES – NAFO Gadoid Symposium

The ICES/NAFO symposium 'Gadoid Fisheries: the Ecology and Management of Rebuilding' will be held 15-18 October, 2013 in St. Andrews, New Brunswick, Canada. The abstract deadline has been extended to June 30, 2013. The symposium has been organized as 6 sessions: Effects of life history on productivity and stock rebuilding; The ghost of fishing past: effects of fishing on recovery potential; Climate change and stock rebuilding; Case histories of successful or failed rebuilding; Community ecology and stock rebuilding: effects of predators, prey and competitors; Stock assessment and fisheries management.

Response has been good and to date 94 abstracts have been submitted, spread across all sessions. A rough time plan has been made and it is expected that there will be 50 oral presentations selected from the submitted abstracts.

Council discussed the best way to provide support to this meeting and determined that it would be of benefit to ensure that some members of Council are able to attend. Therefore, it was decided that the approved funding would be used to support the attendance of Joanne Morgan, Canada and Kathy Sosebee, USA.

c) ICES IMR Symposium: Effects of fishing on benthic fauna, habitat and ecosystem function, Tromso, Norway 2014.

Scientific Council received information on a conference being organized by ICES and the Institute of Marine Research, Norway, entitled "Effects of fishing on benthic fauna, habitat and ecosystem function". This symposium will review the physical and biological effects of fishing activities to sea bottom ecosystems, look at various technical conservation measures designed to mitigate these effects and ultimately try to quantify the overall ecosystem impact. The aim is to develop tools for use in informed ecosystem-based fisheries management. Scientific Council decided to support this important symposium, and this item will be added to the budget to be presented to STACFAD in September 2013.

X. MEETING REPORTS

1. Report of the 5th WGEAFM meeting in Dartmouth, Canada

The Scientific Council Working Group on Ecosystem Approaches to Fisheries Management (WGEAFM), met at the NAFO Headquarters, Dartmouth, Canada, on November 21-30, 2012. The detailed outcomes of this meeting are reported in SCS Doc. 12/26.

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).

Following a request by the Scientific Council chair, WGEAFM organized its work for this meeting so to provide input towards addressing 5 ecosystem-related Fisheries Commission requests (FC Requests # 7, 10, 13, 14 and 16). These Fisheries Commission requests were integrated into the long-term ToRs.

The final form of the ToRs addressed at the 5th 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. Given that VME-related NAFO closures (i.e. areas of high concentrations of corals, sponges, and seamounts) will be reviewed by FC in 2014 using the outcomes from the NEREIDA project, develop a work plan to make available all necessary information and analyses by the 6th WGEAFM meeting (2013), so it can be summarized for SC consideration at the 2014 June meeting.

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

ToR 2.1. [Roadmap] Update on ecoregion analyses, including temporal variability and the impact of taxonomical information on ecoregion delineation and boundaries.

ToR 2.2. [Roadmap] Preparatory work towards 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]. Report progress on the development of Fisheries Production Potential Models for NAFO ecosystems.

ToR 3.2. [FC Request # 13 – item b)]. Report progress on the studies between cod, redfish and shrimp in the Flemish Cap through multispecies models and by quantifying potential yield and biomass tradeoffs with different fishing mortalities in the multispecies context; the predation of cod over cod juveniles should be taken into account.

ToR 3.3. [FC Request # 13– item c) and FC Request #14]. Report progress on species/stock interaction studies for the Grand Banks (NAFO Div. 2J3KLNO), considering spatial overlap whenever possible, and with special consideration of the impact of these interactions on 3LNO shrimp, and their potential implication for management advice.

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 Request # 7]. This is a follow-up work on encounter thresholds and move-on rules. For small gorgonian corals, large gorgonian corals, sea squirts, erect bryozoans, crinoids and cerianthid anemone, 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. In the case of sea pens and sponges consider encounter thresholds and move on rules for the exploratory fishing area of seamounts.

ToR 4.2. [FC Request # 16]. Begin the development of the assessment of risk of significant adverse impacts on VME indicator aggregations and VME elements in the NAFO RA by

a) Analyze fishing effort (VMS data) in the NRA to define areas of different levels of fishing intensity (e.g a map of 90%, 80%, 70%... effort) and assess these in conjunction with habitat data in order to map out areas where fishing activities would therefore have no or little significant adverse impact on VMEs and where encounter protocols and move on rules would therefore have little utility.

b) In view of the area management currently implemented and to facilitate evaluation of the need for further protective measures in response to UNGA 61/105, assess the risk of significant adverse impacts on VME indicator aggregations and VME elements in the NAFO RA. This assessment should consider spatial and temporal distribution of fishing activity, and the best available knowledge on the spatial distribution of VME indicators and VME indicator elements.

ToR 4.3. [FC Request # 13- item a)]. Summarize the general progress of the Roadmap to EAF.

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

ToR 5.1. [FC Request # 10]. This is a follow-up on the work plan for the reassessment of NAFO fisheries in 2016. Considering the modifications of the NCEM approved in the 2012 Annual Meeting, which focuses the fisheries assessments on SAI on VMEs, provide guidance to develop a work plan to achieve the reassessment of all NAFO fisheries by 2016 and every 5 years thereafter, identifying the necessary steps to be taken, as well as the information and resources 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.

ToRs 6.1. Discussion on the potential role and participation of WGEAFM in the project “Scientific review of best practices in bottom trawling” led by Michel Kaiser (Bangor University), Simon Jennings (University of East Anglia and CEFAS), Ray Hilborn (University of Washington), Jeremy Collie (University of Rhode Island) Bob McConnaughey (NOAA), Steve Murawski (University of South Florida), Ana Parma (CENPAT, Argentina), Roland Pitcher (CSIRO, Australia), and Adriaan Rijnsdorp (Wageningen University, Netherlands).

In addressing ToR 1, WGEAFM discussed recent results from the ongoing analysis of NEREIDA samples, but the bulk of the work under this ToR was centered in the development of a work plan to review current closures for the protection on VME indicators (i.e. species and elements), which is due for review in Fisheries Commission in 2014. This work is a necessary step towards the assessment of bottom fishing activities scheduled for 2016; FC Request #10 (addressed under ToR 5) asked SC to provide a revised work plan for those assessments of bottom fishing activities.

In addressing ToR 2, WGEAFM explored the temporal variability of the ecoregions in the Newfoundland-Labrador (NL) shelf, as well as the influence of taxonomical layers in the delineation of ecoregions in this system. Results from this work indicated that the general regions proposed as candidate ecosystem-level management areas (i.e. the NL shelf, NAFO Div. 2HJ3K, and the Grand Bank, NAFO Div. 3LNO) appeared robust over time, but the delineation of the ecoregions within could change; furthermore, periods of time associated with important ecosystem changes seem to exhibit more fragmentation in the ecoregion structure. Including taxonomic information, although helped refining some ecoregion elements, had limited impact in the delineation of the overall ecoregion structure. Under this ToR, WGEAFM also advanced the analyses of the candidate management units proposed by NEFSC-NOAA in relationship with the distribution of fishing fleets in the US Northeast Atlantic. These analyses indicated a good confluence between ecological structures and spatial fishing patterns, indicating the potential utility of the areas defined as ecosystem-based management units. WGEAFM also continued the preparatory work towards the integrated ecoregion analysis at the scale of the Northwest Atlantic planned for a workshop preliminary scheduled for October 2013.

In addressing ToR 3, WGEAFM continued working on the development of Fisheries Production Potential (FPP) models, the study of species interactions and modelling in the Flemish Cap, as well as ecosystem studies and species interactions in the Grand Banks; these studies on species interactions also allowed addressing some of the elements contained in FC Request #13. The FPP modeling work rendered initial estimates for the fisheries production potential for several areas in the NAFO convention area, including the NL shelves, Flemish Cap and the Scotian Shelf. These results were considered promising, but very preliminary; further work on this topic was planned to take place after the 2012 WGEAFM meeting, at a working meeting in Woods Hole, MA, scheduled for February 2013. The studies on species interactions in the Flemish Cap involved the estimation of food consumption by cod and redfish in this system, with emphasis on the consumptions on shrimp by both predator, redfish by cod, and cannibalism in cod. Some of these consumptions estimates were used to continue advancing the development of the Flemish Cap cod-redfish-shrimp model. Overall, results from the consumption studies, and modeling, reinforced the notion that there are strong trophic interactions among cod, redfish, and shrimp in the Flemish Cap, although further work is required to produce reliable quantitative advice from the multispecies model. A synthesis of current understanding of the structure and functioning of the Flemish Cap was also produced. Regarding species interactions in the Grand Banks, WGEAFM discussed ongoing research and summarized the work done under the DFO Ecosystem Research Initiative in NL, the ERI-NEREUS program, during 2007-2012. Some of these results included descriptions of trends in the fish community, development and evaluation of ecosystem indicators of trophic structure, diet studies for core fish species in the NL marine community, studies on the environmental regulation of capelin, and analyses of the role of fishing, food availability (capelin), and seal predation on the trajectory of 2J3KL Atlantic cod. Ongoing ecosystem research in the NL ecosystem includes diet studies, analysis of trends in the fish community, and ecological modeling.

In addressing ToR 4, WGEAFM worked on developing thresholds and encounter protocols for small gorgonian corals, large gorgonian corals, sea squirts, erect bryozoans, crinoids and cerianthid anemone, in order to provide guidance for the SC response to FC Request #7. The GIS-based method to estimate threshold values could only be applied for small gorgonians inside the fishing footprint; it was considered that, due to data issues, its application to other taxa would produce unreliable results. Catchabilities for all these taxa are believed to be very small, and that imposes limitations in the development of practical move-on rules. Under this ToR, WGEAFM also analyzed VMS, sponges, and sea pens data to produced maps of fishing intensity, and to start analyzing the relationships between VME density distributions and fishing intensity. This work was aimed to provide input to SC regarding FC Request # 16. The analysis of fishing intensities, based on 2008-2011 VMS data, showed a clear gradient in fishing effort, with significant amounts of effort concentrated in very small areas; these areas were fairly consistent over the time period analyzed. Conversely, a large area within the fishing footprint was subjected to comparatively much lower fishing intensities. A large fraction of the total sponge and sea pen biomass predicted within the fishing footprint is located in the area of low fishing intensity, but additional analyses are required before a proper assessment of the relationship between these VME taxa and fishing, including the potential for SAIs, can be produced. The other main topic covered in this ToR was a summary of progress in the development of the Roadmap; this summary was aimed at generating the information needed by SC to address FC Request #13.

In addressing ToR 5, and in the context of FC Request #10, WGEAFM considered the 2012 modifications in the NCEM regarding assessments of bottom fishing activities, and revised accordingly its work plan to developed assessments of bottom fishing activities by 2016. This work plan also relies in the analyses that will be done as part of the review of VME closures by 2014. WGEAFM proposed an updated work plan, but it will revise it in 2013, based on the progress made on the many analyses involved.

In addressing ToR 6, WGEAFM discussed an initiative proposed by Ray Hilborn (USA), Simon Jennings (UK) and Mike Kaiser (UK) to conduct a global *"review of best practices in bottom fishing"*. This initiative is seeking support from stakeholders, e.g. RFMOs, through data sharing, understanding of current management practices and to engage in discussions to improve practices. WGEAFM concluded that in principle this would be a good initiative for NAFO to support, so long as it does not place unreasonable demands on either the NAFO Secretariat or Scientific Council time or resources. It was suggested that WGEAFM co-chair Andrew Kenny could act as point of contact between WGEAFM and the initiative following approval of formal links between NAFO SC and this initiative.

As other business, WGEAFM noted that a FC proposal was adopted in the September 2012 Annual Meeting for the creation of a new joint Scientific Council - Fisheries Commission working group that would focus on the development and implementation of ecosystem approaches to fisheries management. Since the terms of reference for this new joint working group were expected to be developed intersessionally, WGEAFM discussed the matter and made available its comments to the SC chair, for consideration during that process.

Following the ongoing cross-attendance practice, the co-chair of the ICES Working Group on the Northwest Atlantic Regional Sea (WGNARS), Catherine Johnson, attended the 5th WGEAFM meeting, presenting a summary of the work done by ICES WGNARS in its 2012 meeting.

WGEAFM also discussed next step and future activities. It was proposed that the 6th WGEAFM meeting to take place in November 19-28, 2013, at the NAFO Secretariat in Dartmouth, Canada. WGEAFM proposed to continue addressing its long-term ToRs, focusing the work during the 6th meeting as follows:

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

Review for VME closures.

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

Update on ecoregions and results from integrated ecoregion analysis.

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

Update on FPP modeling.

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

Revised work plan for SAI-VMEs in 2016.

In addition to the report of the 5th WGEAFM meeting, the SC WGEAFM co-chairs informed SC that, after the meeting of the working group in November 2012, other WGEAFM-related activities took place, namely:

a) ICES WGNARS. This ICES working group met at the Bedford Institute of Oceanography, Dartmouth, from January 28 to February 1, 2013. In accordance to the ongoing cross-attendance practice, WGEAFM co-chair Mariano Koen-Alonso attended this meeting and presented a summary of the NAFO SC WGEAFM work to date. This meeting shifted from the previous 3-day to a longer 5-day format. As part of this shift, WGNARS will focus its work towards more specific Integrated Ecosystem Assessment (IEA) analysis and products. During the meeting, three working sessions took place; these sessions were focused on i) refining IEA goals and vetting core indicators with relevant stakeholders, ii)evaluation of ecosystem indicators performance with respect to ecosystem drivers and responses relative to threshold levels, and iii) evaluation of risks of multi-sector ocean uses impacts in the region. These working sessions were planned around the theme of climate change, in consideration of the record high sea surface temperatures observed throughout the Northwest Atlantic in 2012. The results of this meeting are reported in the ICES WGNARS Report 2013 (ICES CM2013/SSGRSP:03).

b) Fisheries Production Potential modeling. A working meeting to continue developing the FPP models took place at the Northeast Fisheries Science Centre (NEFSC), NOAA, Woods Hole, MA, on 10-15 February 2013. This meeting was attended, among others, by several WGEAFM members (Pierre Pepin, Michael Fogarty and Mariano Koen-Alonso), and the results obtained are being processed and will be tabled at the next WGEAFM meeting in November 2013.

Scientific Council considerations

Scientific Council took notice of the progress made by WGEAFM and recognized the usefulness and large amount of work carried out by the group, and approved the plans for the next meeting in November 19 – 28, 2013 at the NAFO Headquarters. Scientific Council noted that the working group should take care to provide the report no later than 1st April. To avoid confusion with the joint FC – SC Working Group on the EAFM, Scientific Council has decided to rename this group, *"Working Group on Ecosystem Science and Assessment (WGESA)"*.

2. Report from WGDEC, Mar 2013

WGDEC was requested to update all records of deep-water vulnerable marine ecosystems (VMEs) in the North Atlantic. New data from a range of sources including multibeam echosounder surveys, fisheries surveys, habitat modelling and seabed imagery surveys was provided. For several areas across the North Atlantic, WGDEC makes recommendations for areas to be closed to bottom fisheries for the purposes of conservation of VMEs.

Within the NEAFC regulatory area the following areas were considered;

- **N-W Rockall.** New data further support the boundary revision proposed by WGDEC in 2012. WGDEC therefore reiterates its recommendation from 2012, i.e. to modify the existing boundary to better protect VMEs.

- **S-W Rockall**. New data suggest the presence of VMEs outside the current closures in this area. Two closures to bottom fisheries are recommended.

- **The Hatton-Rockall Basin**. New data suggest significant aggregations of deep-sea sponges in this area. A closure to bottom fishing is recommended. Notice is also drawn to a potential cold-seep VME, but due to uncertainty in location and extent of the ecosystem, no closure to bottom fisheries is recommended at present.

- **The Hatton Bank.** Although no new information on VMEs were available, new information on bottom fishing vessel activity was provided allowing for better definition of the area in the SW of the bank that was proposed for closure in 2012. Two closures to bottom fisheries for protection of VMEs in this area are recommended.

- **The Josephine Seamount**. This is a NEAFC existing fishing area and an OSPAR MPA site. Although no new VME indicator data were available to the group, WGDEC considers that VMEs are very likely to be present in this area. A closure to bottom fishing for their protection is recommended.

Within the EEZs of various countries the following areas were considered;

- **Rosemary Bank** (EC EEZ). New information on trawl bycatch of deep-sea sponges was available. A closure to bottom fisheries for protection of VMEs in this area is recommended.

- **Faroese Waters** (Faroe Islands EEZ). New information from longline and trawl bycatch of coral and gorgonians were available. Significant amounts of coral indicate the presence of VMEs in two areas. Two closures to bottom fisheries for protection of VMEs in this area are recommended.

- **North Shetland-Tampen ground** (EC EEZ). New information on a significant trawl bycatch of deep-sea sponges was available. The record is close to other historical records of deep-sea sponges suggesting a wider area of this VME. A closure to bottom fisheries for protection of VMEs in this area is recommended.

- **Hebridean Terrace Seamount** (EC EEZ). New information from ROV surveys indicates the presence of coral gardens on the steep slopes of this seamount. A closure to bottom fisheries around the steep flanks for protection of VMEs is recommended.

- **Whittard Canyon, Irish Margin/Bay of Biscay** (EC EEZ). New information from ROV surveys suggested the presence of VMEs in this area. A closure to bottom fisheries for protection of VMEs in this area is recommended.

Within the Northwest Atlantic (NAFO regulated) the following areas were considered;

- **The Grand Banks and Flemish Cap**. New Russian records of bycatch levels of VME indicators were presented but they were very low (not exceeding 1 kg of VME indicator species). No recommendations are made for closures to bottom fisheries.

WGDEC was asked if buffer zones around areas closed to bottom fishing are appropriate and to explain the criteria used to apply buffer zones. In the past WGDEC has drawn closure boundaries inclusive of a buffer zone and thus considers that current and proposed closure boundaries are appropriately delineated. The 'rule-of-thumb' for applying a buffer zone is to horizontally extend the closure around the records of VME indicator species by two to three times the depth of the water. The outer extents of these points are then joined to form the boundary. In some situations boundaries are drawn according to geomorphological features or 'VME elements', rather than actual records of VME indicators, in which case a precise buffer zone cannot be defined. Buffer zones adopted in new recommendations will be illustrated.

WGDEC was asked to assess the list of VME indicator species with a view to whether it is exhaustive and can be harmonized with the NAFO list of VME indicator species. WGDEC did not think an exhaustive list of species associated with VMEs in the NEAFC RA was necessary. Instead a list of VME types that encompass those species was thought to be more useful. Such a list was developed and it is described how those species on the NAFO list be integrated and harmonized.

WGDEC mapped VME elements (i.e. geomorphological features) in the NEAFC RA at depths <2000 m. The Mid-Atlantic Ridge is highlighted as one contiguous VME element. VME elements within the Rockall-Hatton area are mapped and those without current protection measures are highlighted. An analysis of all isolated seamounts with summits <2000 m in the NEAFC area was undertaken and a map is presented. Attention is drawn to six areas. In addition all known hydrothermal vents in the NEAFC RA were mapped. It was clear that most are too deep to be at risk from bottom fishing impacts. The few that are at depths <2000 m are highlighted as they are potentially at risk.

WGDEC was asked to assess whether the regulations for longline fishing as adopted by SEAFO and CCAMLR would be appropriate to vessels operating in the NEAFC RA. WGDEC concluded that the CCAMLR regulations are appropriate to the large industrialized longline vessels operating in the NEAFC area. If adopted by NEAFC these regulations would result in improved VME conservation objectives. The success, however, of the CCAMLR regulations appears to be contingent upon observer coverage which at present in NEAFC only applies to exploratory fisheries.

WGDEC was requested to incorporate data on known hydrothermal vents and cold-seeps in the North Atlantic into the ICES VME database. This was done and the sites are described together with a list of the associated fauna. The chapter concludes with an appraisal of potential threats from anthropogenic pressures.

WGDEC generated cumulative bycatch curves for sponges, sea-pens, and *Lophelia pertusa* (stony coral) using a subset of survey data from the ICES VME database. These analyses are discussed in relation to similar work undertaken by NAFO Scientific Council. While informative for WGDEC in defining VME encounters during scientific surveys, it was not possible to extrapolate this to generate confident estimates of VME thresholds for commercial vessels.

WGDEC reviewed the ecosystem section of the area overviews that WGDEEP uses in its reports. A suggestion for standardization of content and restructuring is made and it is emphasized that specific attention should be given to the occurrence of VMEs in each area.

3. WGFMS-VME

The Chair of the Working Group updated Scientific Council of progress by the WG FMS-VME group. Recommendations have been made to Fisheries Commission on the basis of advice provided by Scientific Council.

4. Meetings Attended by the Secretariat

a) ASFA

The 41st Annual Meeting of the Aquatic Sciences and Fisheries Abstracts (ASFA) took place from 25–29 June 2012 in Rinville, Oranmore, Co. Galway, Ireland. The Marine Institute hosted the meeting, with Anne Wilkinson and Fintan Bracken as the hosts, and with Dr. Richard Grainger, Chief of the FAO service responsible for ASFA. The meeting was chaired by Linda Noble (UK) and Helen Wibley (FAO) acted as rapporteur. NAFO was represented by Alexis Pacey, Publications Manager at the NAFO Secretariat. The meeting covered a number of topics: software and technical information, the ASFA partnership status, ASFA's new publishing partner, the ASFA trust fund, training activities, new products and the new ASFA database. The next meeting will be held 23 – 27 September 2013 in Lima, Peru.

b) CWP

The meeting of the UN-FAO Coordinating Work Party on Fisheries Statistics (CWP) was attended by Neil Campbell and Barbara Marshall, at the FAO Headquarters, Rome, 4 – 8 February 2013. The current draft of the CWP handbook was presented to the group, new material on data confidentiality guidelines was written by participants, and the chapter on the ecosystem approach to fisheries management was approved. A finished draft is hoped to be circulated in late 2013. The FAO presented a global database framework for sharing vessel registry and port state inspection information. Extensive work has been done on incorporating aquaculture bodies and new

RFMO/As into the CWP process. NAFO, ICES, ICCAT and CCAMLR discussed issues with their catch statistics and would like to see this addressed more thoroughly at a future session. George Campanis, formerly of the NAFO Secretariat, will be Chair for the 2015 meeting.

c) FIRMS

The meeting of the UN-FAO Fisheries Resource Monitoring Systems (FIRMS) was attended by Barbara Marshall and Neil Campbell, at the FAO Headquarters, Rome, 4 – 8 February 2013, with Barbara Marshall acting as Chair. The name of the initiative has been switched from Fisheries Resource Monitoring Systems to Fisheries Information & Monitoring System. Coverage continues to increase, with the addition of a number of tuna RFMOs, however coverage in the Pacific and Indian Ocean remains lacking.

FIRMS considered the best way to use this data, and received a presentation from Seafood Watch, on the potential for FIRMS information feeding into their high-level fishery assessment information. All information on NAFO stocks is up-to-date, covering Grand Bank, Flemish Cap, Pelagic Redfish, and Shrimp fisheries. There will be a meeting of the FIRMS Technical Working Group by WebEx in 2014 and the Steering Committee in conjunction with the CWP in early 2015.

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. General Plan of Work for September 2013 Annual Meeting

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

2. New Procedures for reviewing FC requests for advice

Scientific Council were informed of the proposal adopted by Fisheries Commission at the 2012 Annual Meeting to streamline the process of delivering requests for advice, improve transparency and promote better communication between FC and SC (FC. Doc. 12-26). The text is presented below:

NAFO Contracting Parties resolve to establish a clear and transparent process for developing the Fisheries Commissions document entitled “Fisheries Commission Request for Scientific Advice on Management In 20XX And Beyond Of Certain Stocks In Subareas 2, 3 And 4 And Other Matters” as follows:

1) A Steering Committee composed of the Scientific Council Coordinator and members of Contracting Parties should be established to coordinate all requests for advice and serve as the contact point between the Scientific Council and the Fisheries Commission regarding any need of clarification on the FC requests for scientific advice during the June Scientific Council meeting or whenever necessary during the year. This Steering Committee should be in place during an interim period until the process is well established within NAFO. After the interim period, consideration should be given to having the Scientific Council Coordinator assume the tasks of the Steering Committee.

2) Prior to the Annual Meeting, the Steering Committee should:

   i. Update the above FC Request for Scientific Advice document to:

   - reflect the stock assessment schedule and requests that remain unanswered from the previous year;
   - include requests received from Contracting Parties in Advance of the Annual Meeting;
   - include requests originating from the various FC Working Groups

   ii. Distribute to Contracting Parties all requests as a draft FC document three days prior to the Annual Meeting.

3) During the Annual Meeting, the Steering Committee should:

   i. Update the FC Request document with additional requests and distribute to all Contracting Parties.

ii. and ensures that intent of requests is clear and aligned with what SC can produce. The FC Request for Scientific Advice should be updated in order to reflect any necessary changes to improve clarification.

iii. Prior to the conclusion of the Annual Meeting Z, the FC document is discussed in FC Plenary with the SC Chair present. Should the workload exceed SC capacity, prioritization may need to take place.

A first set of questions should be submitted by Heads of Delegation or their designate to NAFO Secretariat minimum of one week prior to the start of the Annual Meeting.

Additional requests may result from the unfolding of the meeting. These requests should be provided to the SC Coordinator no later than Wednesday COB and before the request for scientific advice is discussed in the Scientific Council.

3. Other Matters

a) ICES invitation to participate in Greenland Halibut benchmark meetings

Scientific Council discussed their response to an invitation from ICES to participate in the forthcoming benchmark process for Greenland halibut stocks. It was decided that NAFO would be unable to participate at a corporate level in this initiative. NAFO has gone through a lengthy process of developing a management plan for its Greenland halibut stock, and this plan is due to be reviewed in 2014. As it is not clear at present what workload this review will involve and in what ways involvement in the benchmark process can feed into this, it was decided that Scientific Council could not make further commitments on behalf of its scientists at present. It was noted that individual members of Scientific Council are involved in the benchmark process, and there may be requests to include some stocks by NAFO coastal states. Scientific Council will monitor progress with interest.

b) Documentation relating to STACFIS catch estimation methods and procedures

Scientific Council reviewed several presentations on this issue, which will be made available to the [peer review panel] on catch estimation, along with additional relevant details. The following text summarizes the presentations and SC review.

Introduction (SCR Doc. 13/051)

Estimates of catch from surveillance authorities were first introduced to SC in the mid-1980's, and were subjected to various reviews, within NAFO and externally. By the early 1990's, another source of catch estimation, from scientific observers on some fleets, arose within Scientific Council. For a number of years the different estimates of catch agreed with each other but not with STATLANT. Scientific Council has recognized the difficulties resulting from the use of unofficial estimates of catch in its stock assessments, particularly when there are discrepancies between these and the official data. However, it chose to use these estimates, which in many cases were believed to be more reliable than officially reported (STATLANT) data, accepting that the underlying raw data were not always available to Scientific Council, for reasons of confidentiality. Such acceptance of unofficial or undocumented catch data is common in various other scientific assessment bodies, such as ICES and ICCAT.

The issue of reliable catch data has occupied much time in Scientific Council over the years, as it is an important input into stock 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 has previously stated that it is not its responsibility to provide the best catch figures, and has noted that it would prefer to receive accurate official catch data to conduct its work, rather than have to use unofficial estimates. However, for at least some stocks, Scientific Council still requires the use of unofficial estimates of catch for its stock assessments.

Catch estimation methods

Canada (SCR 13/023)

Observer data from the Canadian fishery directing for yellowtail flounder from 1998 onward was examined. Catch per unit effort (CPUE) for yellowtail flounder, American plaice and cod was estimated using a generalized linear model with gamma error and a log link. Data were combined over the main effects of year, month, division, and tonnage class, all entering the model as factors. The estimated CPUE was then applied to the reported effort to give an estimate of catch in each year. For yellowtail flounder, in most years reported catch was 95% or more of the estimated catch. For the two bycatch species, reported catch was generally a lower proportion of the estimated catch. For American plaice, reported catch was 70-80% of the estimated catch in most years and for cod it was often less than 80% of the estimated catch but the difference in tons was small. Catch estimates for yellowtail flounder using modelled and unmodelled CPUE from the same data were similar.

EU/Spain (SCR 13/053)

The method used to estimate the Spanish catch by species since 2004 is based on the information collected by the NAFO Observers and the Spanish Scientific Observers. This method does not have a temporal stratum to estimate the catches and it is well known that CPUE for many species are seasonally dependent. The main reason to have no temporal stratum it is that the estimation is carried out by fishery since the species CPUEs between fisheries are very different and there are more variables than just seasonality.

The annual distribution of effort (fishing hours) is split by fishery and Division from the NAFO Observer information. The NAFO Observer Information has almost 100% coverage of the total effort made by the Spanish fleet in the NRA, and so this process gives the annual effort in hours fished by each of the Spanish fisheries in the NRA.

The annual CPUE of different species by fishery and NAFO Division are calculated with the scientific observer data. These CPUEs are multiplied for each fishery and division by the total effort obtained from NAFO observers to get the estimates of the total catch by species division and fishery.

Uncertainty of the catch estimated by this method for certain species was analyzed with a bootstrap, using the scientific observers individual observations (catch by haul) to calculate the confidence intervals of the estimates. The medians of the bootstrap are very close to the estimation made by the method based on the observers information in all Divisions, and the 5 and the 95 percentiles have a deviation around 10% of the mean in all Divisions.

EU/Portugal (SCR 13/052)

The scientific sampling program, implemented by Portugal for the NAFO Area, consists of having scientific observers onboard its fleet. The main objective of this program is to collect length and biological samples associated with the catch and effort data of the hauls they came from. The catch recorded by these observers has the main goal of raising the samples to the total vessel catch, and not to estimate the total fleet catches. Nevertheless the Portuguese catch estimation method is based on these scientific observers. The exercise to estimate catches became routine when it was needed to improve the input data for the assessment of several stocks. The methodology can be summarized in general as an application, by species and division, of the scientific observed CPUE to the total official effort. The percentage of effort observed was also provided for 2000-2012.

EU/France (fisheries statistics validation tool)

EU/France has developed a validation tool (SACROIS) for fisheries statistics, aiming at cross-checking data from different sources, as required in EU control Regulations. The application is crossing information, at the most disaggregated level, from the fishing fleet register, logbooks, fishing forms, sales notes, VMS and the scientific census of fishing activity calendars, in order to build a dataset compiling the most accurate and complete information for each individual fishing trips. The application verifies and controls the different sources of data, with the aim of displaying validated and qualified landings per species and effort data series. The application provides also several quality indicators and evaluates the completeness of the data flows. In the context of NAFO, France fisheries are all based in St-Pierre and Miquelon where the statistical system does not currently permit the use of the

SACROIS application. Nevertheless, all St-Pierre and Miquelon vessels are submitted to the logbook regulation for the monitoring of their spatial catches and effort.

Next steps and recommendations

Scientific Council discussed various options but was unable to find a clear way forward at this point. The ideal solution from the point of view of SC would be for flag states to provide accurate catch estimates and independent means of corroboration. Scientific Council can assist in developing methods of catch verification.

c) Terms of reference for joint SC/FC Groups

Scientific Council discussed the draft terms of reference for the joint FC – SC working groups on Risk Based Management and on the Ecosystem Approach to Fisheries Management. In general the objectives and proposed specific duties for the group were welcomed. Most discussion centered on the form which discussion would take at these meetings. Scientific Council believes that its role at these meeting is to clarify technical aspects of the scientific advice and this function is best served by an open form of dialogue between members of Scientific Council and Fisheries Commission. During other phases of the meeting it may be desirable to revert to a delegation-based style. A "Scientific Council Delegation" could be formed at this point. Scientific Council felt that this would be best determined by the co-chairs of the meeting, and proposed deleting the phrase, "and with the consent of Contracting Parties" from the end of the second paragraph of both terms of reference.

d) Review of Performance Assessment Panel recommendations to Scientific Council and progress to date

Scientific Council reviewed its progress to date against the various recommendations of the Performance Assessment (Annex 1). It was noted that Scientific Council has now addressed all recommendations directed to itself, either through taking action (e.g. new advice formats, tables of catch options) or by establishing new bodies to address these issues (e.g. proposed new joint SC-FC working groups).

e) Implementation of Performance Assessment Panel recommendations

The further implementation of Performance Assessment recommendations to Scientific Council was discussed. It was noted that some recommendations have been implemented (e.g. use of VMS data, cooperation with external organizations), some remain in progress and require coordination between NAFO bodies (e.g. establishment of joint SC – FC working groups). The implementation of others, such as development of scientific capacity, requires the commitment of resources.

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. The Secretariat will remind Designated Experts of this request by mid-July.

3. Meeting Highlights for the NAFO Website

The Secretariat, in conjunction with the Chairs of each Committee will prepare highlights of the meeting. This information will be uploaded to the NAFO website after the meeting.

4. Scientific Merit Awards

At the September 2012 meeting, Scientific Council adopted a proposal to grant Antonio Vazquez (EU – Spain) a Scientific Council Merit Award. Antonio has been involved in NAFO and ICNAF work since 1974, during which time he has been a highly valued colleague, acting as Vice-Chair and Chair of Scientific Council (2004-2007), authoring many research documents and leading many research projects for the benefit of NAFO Scientific Council. Scientific Council wished Antonio a very happy retirement.

Scientific Council were also informed that Bill Brodie (Canada) and Jean-Claude Mahé (EU – France) were retiring during the coming year. Both were nominated for merit awards, and these nominations were warmly endorsed by Scientific Council. The awards will be presented during the September meeting.

5. Budget Items

The budget for the current year 2013 was presented to Scientific Council.

The 2014 budget was discussed by Scientific Council and will be presented to STACFAD in September 2013 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) Review of exploratory fisheries report

Scientific Council has received an exploratory report. The information provided will be useful for the future work of Scientific Council in studying bycatch, species diversity and distribution.

b) Oil and gas exploration in the NAFO Area

Scientific Council reviewed information received by the Secretariat, via WWF, regarding a Strategic Environmental Assessment being undertaken by the Canada – Newfoundland and Labrador Offshore Petroleum Board Environmental Affairs Department (C-NLOPB). This exercise is being undertaken in respect of oil and gas exploration in the Flemish Pass and Flemish Cap areas. Scientific Council noted the responsibility for external relations lies with the General Council, and it was agreed that the Chair of Scientific Council would write to the Chair of General Council, informing her of the situation and passing on the relevant materials, in advance of their agenda deadline for the Annual Meeting.

c) Election of SC Officers

A nomination committee was convened consisting of Joanne Morgan, Ricardo Alpoim and Carsten Hvingel. The committee proposed as SC Chair – Don Stansbury (Canada), STACREC Chair & SC Vice-chair– Kathy Sosebee (USA), STACFIS Chair – Brian Healey (Canada), STACPUB – Margaret Treble (Canada). These nominations were endorsed by Scientific Council. The position of STACFEN Chair was left open until September.

d) Management plans for Div. 3LNO American plaice

NAFO adopted an Interim 3LNO American Plaice Conservation Plan and Rebuilding Strategy (CPRS) in 2011 (FC Doc. 11/21). The CPRS includes decision rules for adjusting fishing mortality depending on the stock status relative to PA reference points. These rules are too vague and/or incomplete in their current formulation to be tested by simulation. Scientific Council has conducted a number of studies looking at the performance of alternative harvest control rules that are simpler, mathematically explicit and amenable to simulation testing. In 2012 SC advised that the CPRS decision rules were complicated, and that the performance statistics (which embody the management objectives) were vague and recommended simpler harvest control rules be considered for adoption. Preliminary work on management strategy evaluation (MSE) for Div. 3LNO American plaice was reviewed by SC. This study tested the performance of simple, explicit, survey based harvest control rules against an age-aggregated Bayesian surplus production operating model. This operating model explicitly takes into account both observation and process errors and is capable of quantifying risks with respect to PA reference points, a requirement under the NAFO PA framework. The work shows promise and should be continued. Discussions on management objectives and performance statistics are needed and this could take place under the auspices of the new Joint Fisheries

Commission-Scientific Council Working Group on Risk-Based Management Strategies. Further scientific work on the MSE for American plaice should be conducted and reviewed by Scientific Council.

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 20 June 2013, the Council considered the draft report of this meeting, and adopted the report with the understanding that the Chair and the Secretariat will incorporate later the text insertions related to plenary sessions of 7-20 June 2013 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 facilities. There being no other business the meeting was adjourned at 1430 hours on 20 June 2013.

ANNEX 1. SCIENTIFIC COUNCIL PROGRESS ON PERFORMANCE ASSESSMENT RECOMMENDATIONS

PRP	Recommendation	SC/FC/ GC (Priority)	GC Proposal (GC Doc. 12/03)	Prospective SC Action (GC Doc 12/08)	SC Progress to date
4 Chapter 6, 6.3 #1, p. 132	Encourages NAFO to continue developing cooperative relationships with other RFMO/As and International Organizations, as appropriate, to achieve its objectives and facilitate its work.	GC/FC/SC (ST)	The WG recommends to GC to continue developing and strengthening cooperation with other RFMOs and international organizations in line with Article XVII of the NAFO amended convention.	*Scientific Council has long standing and ongoing connections and commitments with other international scientific organizations (e.g. ICES, PICES, NAMMCO) and plans to continue with these.* *Scientific Council made specific comments in support of ongoing cooperation in relation to seals and whales (ICES WGHARP) in the NAFO regulatory area, in light of their omission from the new convention in their June 2012 report (SCS 12-18).*	*Given the ongoing nature of this recommendation, and Scientific Council's continuing close collaboration with other international organizations, SC considers the objectives of this recommendation to have been met.*
7 Chapter 4, 4.4.3 #5, p. 92	Careful consideration should be given to developing and consolidating NAFO fishery resources data-access and utilization rules. These should take into consideration intellectual property rights related to scientific analyses as well as industrial confidentiality provisions to be attached to certain categories of data (e.g. detailed fishing location).	FC/SC/SEC (ST)	The WG recommends that: FC, possibly upon input from the SC/STACREC, develops and consolidates rules to facilitate access and utilization of data hosted by the Secretariat including in particular, VMS data, for scientific purposes; FC encourages the SC to use VMS data for preparation of advice FC strengthens rules on secure and confidential treatment of data taking into consideration intellectual property rights and commercial sensitivity of information taking into account experiences in other RFMOs.	*Scientific Council has used VMS data in the preparation of its responses to Fisheries Commission requests, and is keen to make further use of such data.*	*Scientific Council is using processed VMS data obtained from the Secretariat in the preparation of its advice and considers the objectives of this recommendation to have been met.*

8 Chapter 4, 4.4.1 #6 p. 87	The PRP noted the potential utility of VMS information in verifying stock assessment input data. It suggested that this potential should be further investigated and, in particular, possible rules should be considered to govern the use of VMS data. Such rules would be in the interests of reaching a common understanding on how and why VMS data should be used as well as on avoiding overly-restrictive usage conditions.	FC/SC (MT)	*See above*	*See above*	
9 Chapter 4, 4.4.3 #2, p. 91	From the information available, the PRP noted that it was largely unable to determine to what extent Contracting Parties directly share fishing and research vessel data. However, the manner in which such data are used by the Scientific Council for assessment purposes strongly suggests close and significant sharing/exchanging of such data by the NAFO body corporate.	SC/ CPs (ST)	*See above*	*See above*	

10 Chapter 4, 4.4.2 3 & 4 p. 90	Encourages NAFO to continue to address the data requirements attached to implementation of UNGA Resolution 61/105, with some urgency. All efforts should be expended to encourage the timely submission of marine living resources information to expedite the comprehensive collection of essential data to improve knowledge of the benthos, and benthic environment, in the NAFO Convention Area as a whole.	FC/SC /CPs (MT)	Taking into account the progress made in 2011 the WG recommends that: FC, upon recommendation of the SC and the FC WGFMS VME, reviews data requirements for the implementation of UNGA Resolution 61/105 on a regular basis and at the latest in 2014 as foreseen by NAFO CEM (Article 21), once the information from the NEREIDA project is available (MT); In addition the WG urges CPs to comply with reporting requirements as laid down in Chapter II of NAFO CEM (ST).	*Scientific Council, through its Working Group on the Ecosystem Approach to Fisheries Management, has tabled a number of proposals for data needs to support the reassessment of VMEs in 2014 and fishery plans in 2016 (e.g. fishery independent survey data, VMS, haul-by-haul catches, observer reports, etc.). These views were endorsed by SC in June 2012. The key element is that data is available at the finest level possible (e.g. haul by haul), so that Scientific Council can determine the best way to analyse it.*	*Scientific Council understands that data should now be being collected at a haul by haul basis, and will be in a better position to comment on this recommendation during 2014 once it has had a chance to review this data.*
11 Chapter 4, 4.2.2 #1, p. 74	Suggests that NAFO consider enhancing its application of risk-based assessment approaches (e.g. the Greenland Halibut Management Strategy Evaluation and Kobe Matrix) when evaluating management strategies.	FC/SC (MT)	The WG recommends that the FC mandates the FC WGFMS-CPRS to consider the broader use of the PA framework, extension of management strategy evaluation and/or other risk-based management approaches (e.g. Kobe matrix) including conservation plans and rebuilding strategies, as appropriate.	*Rather than directing this work to the WGFMS-CPRS, Scientific Council supports the establishment of a joint FC/SC working group on the precautionary approach framework to address all issues regarding the implementation and extension of the current framework and implementation of management strategy evaluations. Further discussions will be held with Fisheries Commission on this matter.*	*Scientific Council is working with Fisheries Commission to draft terms of reference for a new joint working group on the application of risk based management, which will supersede the WGFMS-CPRS.* *Progress on this issue is dependent on the appropriate expertise and capacity being available within Scientific Council.*

12 Chapter 4, 4.6.6 #3, p. 110	Encourages NAFO to broaden consideration of MSE-type approaches to managing other fisheries for which it is responsible.	FC/SC	*See above*	*See above*	
13 Chapter 4, 4.2.3 #5, p.110 Chapter 4, 4.2.4 #1, p.76	Encourages NAFO to consolidate its policy to address ecosystem management considerations, including by compiling the information necessary for evaluating trends in the status of dependent, related and associated species specifically. A consolidated list of bycatch species , for instance, should be included in the NCEM to assist monitoring of bycatch during directed fishing.	FC/SC (MT)	The WG recommends that: SC prepares recommendations on how to implement the next steps of the Roadmap for Developing an Ecosystem Approach to Fisheries for NAFO based on its ToR and in line with the recommendations of the Performance Review Report and that it examines the application of the Ecosystem Approach to Fisheries in other RFMOs to that end; SC consider the usefulness and practicability of identifying the different types of ecosystems present in the NAFO area; SC continues to take into account environmental factors impacting on NAFO fisheries;	*Work on how to implement the Roadmap to EAF is already ongoing and potential avenues had been presented for discussion with FC and WGFMS-VME through the SC proposal for developing fisheries assessments. As part of this process SC supports the creation of a SC/FC working group to address EAF issues.* *SC and its WGEAFM are already working on the delineation of ecoregions and identification of candidate ecosystem-level management areas. As part of the work in STACFEN and WGEAFM, studies looking at the impact on environmental drivers on fish stocks are also underway. This information is expected to be integrated with multispecies models and single species stock assessments as part of the implementation of the Roadmap to EAF.* *SC has already requested access to VMS and tow-by-tow information to further its VME studies and develop SAI assessments; this information request also includes by-catch and non-commercial species data. These data are expected to feed into the analyses and models required for the development of the Roadmap to EAF.* *See also response to recommendation 10.*	*Scientific Council is working with Fisheries Commission to draft terms of reference for a new joint working group on the application of risk based management, which will supersede the WGFMS-VME.* *Scientific Council has prepared recommendations on the next step for implementation of the roadmap, review of coral and sponge closures by 2014, and development of fisheries assessments by 2016. This is an item which would benefit from close cooperation between SC and FC in the joint working group.*

			FC and SC jointly develop the definition of bycatch, compile a consolidated list of the main relevant bycatch species (commercial, non-commercial, targeted, non-targeted, VMEs, …) and consider the issue of bycatches in the framework of conservation plans and rebuilding strategies, management plans and other management measures; (ST) The SC, as appropriate, adjusts the data collection requirements to include the information necessary for evaluating trends in the status of dependent, related and associated species to address ecosystem management considerations. *See also recommendations 14, 15 and 16*		
14 Chapter 4, 4.3 #6, p. 81	Recommends that NAFO consider augmenting its efforts to implement a more EAF friendly management approach as well as to embrace the PAF more widely. If bycatch continues to be a problem, then NAFO ecosystem-based management and its EAF may fall short of best practice.	FC/SC (MT)	*See 13*	*See above*	

15 Chapter 4, 4.3 #7, p. 81	Strongly encourages the development, and consolidation, of the Scientific Council's EAF Roadmap. It also encourages NAFO as a whole to give strategic consideration as to how the Roadmap may assume a more holistic focus so that it addresses ecosystem components more widely, not just those for harvested, or associated, species alone. In these terms, NAFO should focus on the sustainable use of the entire ecosystem for which it is responsible rather than just fishery-target species.	FC/SC (MT)	*See 13*	*See above*	
16 Chapter 4, 4.6.2 #5, p.97	Endorses NAFO's continuing execution of its customary (target species-directed) management requirements and assessments for the stocks that it manages. It should also strive to address new challenges associated with further development of the EAF (Section 4.3) and increased formalization of the PAF (Section 4.6.2) etc. The use of standardized, well-understood and scientifically robust	FC/SC (MT)	See above	*See above*	
17 Chapter 4, 4.6.3 #3 p. 107	Encourages NAFO to review the Exploratory Fisheries Protocol with a view to developing a strategic framework for conservation and management measures for all potential new and exploratory fisheries. In this respect, NAFO may wish to take account of the	FC/SC (MT)	The WG recommends that the FC mandates the WGFMS-VME to review the Exploratory Fisheries Protocol with a view to developing a strategic framework for conservation and management measures	*Scientific Council notes the current meeting of the WGFMS-VME made a recommendation to FC to expand its terms of reference to have a wider view of the ecosystem approach. Scientific Council supports this measure, along with the proposal to expand the terms of reference of WGFMS-CPRS to cover wider aspects of the precautionary approach, and the proposal*	*Scientific Council reviewed its first exploratory fishing report at its June meeting. Scientific Council remains unclear as to the relevance of this recommendation, given the lack of specific proposal to SC. It is not apparent what form such a proposed "strategic framework" would take.*

	way in which CCAMLR has approached the issue in terms of developing a unified regulatory framework.		for all potential new and exploratory fisheries.	*to make both of these joint FC-SC bodies.* *Scientific Council is unclear as to the relevance of this recommendation, given the lack of specific proposal to SC. It is not apparent what form such a proposed "strategic framework" would take.*	
18 Chapter 4, 4.6.4 #2, 3 & 4 p. 108	Recognizes that a NAFO strategic imperative should be to articulate a specific plan aimed at developing ways to conserve biodiversity. NAFO, in general, and the Scientific Council in particular, are also encouraged to formally determine the potential effects that areas closed to fishing are likely to exert in terms of affecting fishing, protecting habitats and conserving biodiversity in the NAFO Convention Area.	FC/SC /SEC/ CP (LT)	Taking into account the recommendations on the Ecosystem Approach and the mandate of the 2007 NAFO amended Convention, the WG recommends that the FC mandates the WGFMS-VME to analyse, based on an overview provided by the Secretariat, the way other RFMOs address the need to conserve biodiversity as a basis for discussions in the FC on a possible strategy for biodiversity.	*Scientific Council recognizes that the development of ways to conserve biodiversity is fundamental to the roadmap to the ecosystem approach, and SC will continue its work to support the implementation of this roadmap. Issues of biodiversity, such as the definition of ecoregions, are currently being investigated by the WGEAFM.* *Given the fact that the recommendation from the panel extends to the NAFO Convention Area, Scientific Council believes that Contracting Parties, especially coastal states, should be added to the list of responsible bodies.*	*Work to define ecoregions is still ongoing within Scientific Council. This will be fundamental to the roadmap to the ecosystem approach, the implementation of which is NAFO's main tool to conserve biodiversity.*
19 Chapter 4, 4.6.4 #2, p. 108	NAFO's efforts to address potential threats to biodiversity in the Convention Area are largely linked to the management of relevant fisheries and their likely impacts. In this respect, NAFO has not articulated any specific plans aimed at developing ways to conserve biodiversity. The PRP sees the development of such plans as a strategic imperative for NAFO.	FC/SC (MT)	*See above*	*See above*	

20 Chapter 4, 4.6.4 #3, p. 108	The PRP notes that NAFO has not yet attempted to formally determine the potential effects that areas closed to fishing are likely to exert in terms of affecting fishing, protecting habitats and conserving biodiversity in the Convention Area. NAFO in general, and the Scientific Council in particular, are encouraged to consider such matters.	SC (LT)	*See above*	*See above*	
24 Chapter 4, 4.4.1 #4, p. 87	Recommends that the Fisheries Commission and the Scientific Council promptly resolve any discrepancies between STATLANT 21A catch estimates and those of STACFIS, if possible, or at least provide some guidance on how they arise, including underlying assumptions made and/or consequences anticipated.	GC/FC/SC/CPs (ST)	The WG recommends that GC submits the issue of catch discrepancy between STATLANT 21A catch estimates and those of STACFIS to an external peer review process.	*Scientific Council has cooperated with the group conducting the peer review into catch estimation methods of STACFIS, and will be pleased to support the group in the second part of their work, examining the discrepancy between the STACFIS and STATLANT figures.*	*Scientific Council continues to cooperate with the panel, although found it was not in a position to provide all the information requested of it.* *Documentation produced by the June SC meeting will be passed to the panel to assist in their interim progress report. Given the problems in obtaining a full set of STATLANT figures in advance of the June SC meeting, Scientific Council urges all contracting parties to observe the 1st May deadline for provision of STATLANT 21A to the Secretariat.*
25 Chapter 4, 4.5 #1, p. 96	Consideration should be given on how dialogue between the Scientific Council and the Fisheries Commission could be strengthened, while still maintaining the intended 'philosophical' separation between them. The content of any such dialogue should be considered in terms of providing both groups with the best information available so that	FC/SC (ST)	The WG recommends that: FC considers more regular inter-sessional meetings between managers and scientists for issues requiring discussion (e.g via WebEx or teleconference),	*Scientific Council notes that the recommendations arising from the GC Working Group in response to this point are directed to the Fisheries Commission. Scientific Council further notes the Performance Assessment Panel's proposal that SC develop more "user friendly" documentation of concepts and methods, and feels the creation of such documentation, for example a glossary of*	*No comment.*

	decisions, or actions, are based on interpretable, unambiguous and informed understanding. The detailed recommendations below outline two possible areas to be considered in the interests of improving the use of the Scientific Council's advice by the Fisheries Commission. These include: Tabular presentation of key management decisions to be taken rather than decisions being obscured in other documentation. This would serve as a 'targeted framework' and could extend the use of standardized management procedures by providing more risk-based, or risk-determined scientific advice. Developing consolidated descriptions of the scientific approaches models and underlying assumptions used by the Scientific Council. This could be in the form of a users' manual outlining, with attached lay explanations, the various assessment being undertaken.		A joint meeting of the FC and SC be held at the upcoming Annual Meeting or as soon as possible thereafter, to discuss the appropriate means to address, amongst other issues, broader implementation of the PAF, updating the framework for provision of advice, updating the template for the presentation of advice and recommendations, and the improvement of the process to develop questions to the SC. FC develop a framework for the presentation of key management decisions.	*key terms, would be beneficial.* *Recognising the need for transparency, further steps, such as the public archiving of assessment data, could be considered.*	
26 Chapter 4, 4.5 #7, p. 98	Suggests that NAFO as a whole may wish to reflect on the use, and allocation, of its scientific capacity from time-to time, although the burden of scientific input appears to be shared by all NAFO Contracting Parties in proportion to their respective fishery activities.	FC/SC /CPs (MT)	The WG recommends the FC and SC analyse the availability of and the need for scientific capacity and identifies possibilities to extend scientific expertise by specific schemes (e.g. scholarship, meeting participation fund, etc).	*Scientific Council supports this proposal, but recognizes that such changes required to expand the capacity of SC to address requests from FC will require financial support from Contracting Parties, through support of their own scientists' participation in NAFO activities, and through increased budgets of Scientific Council.*	*Scientific Council reiterates its position that such changes required to expand the capacity of SC to address requests from FC will require financial support from Contracting Parties, through support of their own scientists' participation in NAFO activities, and through increased budgets of Scientific Council.*

34 Chapter 7, 7.5 #2, p. 148	Highlights the point that, reports should be as succinct as possible and confined to matters of substance only to improve documentation of meeting outcomes. Technical details can be provided in appendices and as far as possible reports should represent a distillation of collective views, unless otherwise decided for controversial/high priority subjects. Executive summaries of key conclusions and decisions should be provided if possible.	All bodies (ST)	The WG recommends that all NAFO bodies strive for clear and succinct reporting as recommended by the review panel and that the Secretariat provides proper guidance to rapporteurs and Chairs to that end.	*Scientific Council advice is given in summary sheets at the start of SC report, with technical details given in appendices and research documents. In 2012, SC began the process of revising the summary sheets to make the advice more prominent.*	*Scientific Council has taken steps to reduce the length of its reports and to make its advice more succinct and advice sheets more clear. Work is ongoing to this end.*
35 Chapter 4, 4.9 #3, p. 115	If the situation should evolve, the PRP suggests that the above Resolution conditions may need to be reviewed in respect of NAFO addressing all the explicit provisions of UNFSA Article 11 that need to be taken into account when allocating fishing opportunities to new Members.	FC/SC (LT)	The WG recommends that NAFO reconsider previous work undertaken by the Working Group on the Allocation of Fishing Rights to Contracting Parties of NAFO and review the Resolution to Guide the Expectations of Future New Members with Regard to Fishing Opportunities in the NAFO Regulatory Area (NAFO GC Doc. 99/8), should new members join the organization or new fisheries come under NAFO management.	*Quota allocation is not an issue for Scientific Council.*	*N/A*

Chapter 4, 4.6.2	Urges the Scientific Council to review the current absence of any formally defined decision rule(s) framework for the application of the PAF. The Panel notes that this gap may exacerbate perceived differences between the Scientific Council and Fisheries Commission. The Scientific Council should also develop a strategy to be used in applying the PAF to new and exploratory fisheries specifically.	SC		*Scientific Council feels this recommendation should also be addressed to Fisheries Commission.* *See response to "11 Chapter 4, 4.2.2 #1, p. 74" above.*	*A formal rule-based framework for implementation of the PA framework could be discussed by the joint SC-FC Working Group on Risk Based Management*
Chapter 4, 4.5	Tabular presentation of key management decisions to be taken rather than decisions being obscured in other documentation. The would serve as a 'targeted framework' and could extend the use of standardized management procedures by providing more risk- based, or risk- determined scientific advice.	SC		*Scientific Council is taking steps to try to expand the risk based approach to advice but the ability to do so will be limited in some cases where data currently do not allow the use of quantitative assessment models.*	*Scientific Council feels that this recommendation is somewhat unclear due to its reference to management decisions.* *Tables of management options have been requested by FC and work is underway to present advice in this format*
Chapter 4, 4.6.2	Developing consolidated descriptions of the scientific approaches, models and underlying assumptions used by the Scientific Council. This could be in the form of a users' manual outlining, with attached lay explanations, the various assessment being undertaken.	SC		*See response to "25, Chapter 4, 4.5 #1, p. 96" above.* *As an outcome of the SISAM initiative which NAFO has been a partner in, Scientific Council is co-sponsoring the World Conference on Stock Assessment methods in July 2013 and will consider the results of this initiative.*	*Scientific Council will provide advice in a revised format in 2013. It is hoped that this will be more accessible to lay readers.*

Chapter 4, 4.5	Suggests that the extent to which various reference points were being taken into account when stock recovery plans are being considered should be made much more explicit and should be documented alongside the PAF.	SC		*Scientific Council feels that this recommendation is best directed to the FC WGFMS – CPRS. Scientific Council could take into account specific rebuilding plans and reference points when formulating advice on those where such plans are in place.*	*This matter will be addressed by the joint SC-FC Working Group on Risk-Based Management*
Chapter 5, 6.1	Urges the Scientific Council to give careful consideration to improving its explanation of both the scientific processes it follows and the conclusions and results/advice it provides.	SC		*Scientific Council has changed the way it provides advice to make the recommendation more prominent. Work is ongoing to investigate alternative ways of presenting its advice.*	*As discussed above, Scientific Council has taken steps to make its advice more accessible.*

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 10 and 20 June 2013, 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, and Spain), Russian Federation, USA and Japan.

Highlights of Climate and Environmental Conditions in the NAFO Convention Area for 2012

- The North Atlantic Oscillation index (NAO), a key indicator of climate conditions over the North Atlantic was strongly positive resulting in an increase in arctic air outflow and cooling of air temperatures during the winter.
- Annually however, air temperature remained above normal by >1ºC over the entire NAFO area.
- Air temperatures experienced over Newfoundland increased in 2012, reaching a record high in St. John's at 1.9ºC (2.3 standard deviations (SD)) above normal.
- Air temperatures on the Scotian Shelf and adjacent offshore areas remained above normal by approximately 2 SD, the highest values in over a hundred years in some areas.
- Sea ice was below normal in the Northern Labrador Sea and Shelf regions in January and February but above normal in March.
- The annual sea ice extent on the NL Shelf remained below normal for the 17^{th} consecutive year, but increased slightly over the record low in 2011.
- There were 499 icebergs detected south of 48ºN on the Northern Grand Bank, up from only 3 in 2011 but still lower than the 1981-2010 mean of 767.
- Ice coverage and volume on the Scotian Shelf were the fourth lowest in the 51 year long record, but statistically the same as the three lowest years of 1969, 2010, 2011.
- Sea surface temperatures were below normal by up to 1°C in the Labrador Sea during the winter of 2012, but above normal throughout the remainder of the year.
- In 2012, wintertime convection in the Labrador Sea reached 1400m, significantly deeper than the 200m seen in 2011, though still less than the 1600m of 2008.
- The deep layer (1000-1500m) in the Labrador Basin is continuing to warm and become more saline since 2002 with large resets in 2008 and 2012 due to convective mixing.
- The increasing trend of the total inorganic carbon and decreasing levels of pH continue in the Labrador Basin in 2012.
- Surface chlorophyll concentrations were below normal on the Labrador and Greenland Shelves, but normal in the central Labrador Basin in 2012.
- The abundance of the large calanoid copepod *Calanus finmarchicus* was near normal on Labrador Shelf and above normal on the Greenland Shelf.
- Annual water-column averaged temperature at Station 27 off southeastern Newfoundland decreased to 1 SD (0.4°C) above normal from the record high of 3 SD (1°C) in 2011.

- Station 27 annual bottom temperatures (176 m) decreased significantly in 2012 to 1.2 SD above normal from the record high of 3.4 SD (1.3°C) in 2011.

- The area of the cold intermediate layer (CIL) water mass (<0°C) on the eastern Newfoundland and southern Labrador Shelf during 2012 was near 0.5 SD below normal compared to the record low of 2 SD below normal in 2011.

- Spring bottom temperatures in Div. 3Ps and 3LNO remained above normal at 1.8 (0.8ºC) and 1.9 (1.2ºC) SD, respectively.

- Autumn bottom temperatures in Div. 2J, 3K and 3LNO decreased from 2 (0.9ºC), 2.7 (1.4ºC) and 1.8 (0.7ºC) SD above normal in 2011 to 1.1 (0.5ºC), 1.2 (0.7ºC) and 0.2 (0.1ºC) SD above normal in 2012, respectively.

- A composite climate index derived from 27 meteorological, ice and ocean temperature and salinity time series for the NL region show a declining trend since the peak in 2010, however the index still indicates warmer than normal conditions throughout the region.

- A composite climate index derived from 18 selected temperature time series for the Scotian Shelf region was the highest in 43 year series; twice as large as the previous highest value of 2006.

- Bottom temperatures were above normal in 2012 with anomalies for NAFO Div. 4Vn, 4Vs, 4W, 4X of +0.5°C (+1.2 SD), +1.2°C (+1.8 SD), +1.7°C (+2.3 SD), and +2.1°C (+3.0 SD) respectively.

- The volume of the CIL on the Scotian Shelf, defined as waters with temperatures <4ºC, was 2.3 SD below the long-term mean, the lowest in the 43 years of surveys.

- Stratification on the Scotian Shelf in 2012 strengthened significantly compared to 2011, and was the fourth strongest since 1950.

- Upper water-column nitrate inventories were generally below normal within the upper 50m in 2012 from southern Labrador (Div. 2J), across the Newfoundland Shelf (Div. 3K) and Grand Bank (Div. 3LNO), down to the northeast Gulf of St. Lawrence (Div. 4RS), with near-normal to above average levels in the southern Gulf of St. Lawrence and variable conditions across the Scotian Shelf (Subarea 4).

- Deep inventories of nitrate that represent the main limiting nutrient for the next production cycle, were consistently negative across Subareas 2-3, while generally above normal across in Subarea 4 in 2012.

- Phytoplankton biomass inferred from chlorophyll *a* inventories were consistently below normal in 2012 over much of the northern Subareas (Div. 2J to 3LNO) with variable levels throughout the Gulf of St. Lawrence and Scotian Shelf (Subarea 4).

- The satellite derived timing indices of the spring bloom have shown some tendency to advance (e.g. become earlier) and the bloom duration to decline in recent years across the northwest Atlantic.

- Although many of the copepod abundance indices reached their highest levels in 2010-2011 in the northern Subareas, the anomaly time series indicated relatively weak secondary production throughout the northwest Atlantic in 2012.

1. Opening

The Chair opened the meeting by welcoming participants to this June 2013 Meeting of STACFEN.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 13/03, 13/04, 13/08, 13/09, 13/18, 13/19, 13/28, and SCS Doc. 13/07, 13/08, 13/10, 13/13.

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 2012

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.

STACFEN **recommended** *Secretariat 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 2013 along with a number of interdisciplinary presentations on environmental regulation of resource populations.

5. Invited Speaker

The Chair introduced this year's invited speaker Dr. Paul Snelgrove. Dr. Snelgrove is the Director of the Canadian Healthy Oceans Network and Chairs its Scientific Steering Committee, and is an Associate Professor at Memorial University of Newfoundland. He has held a Canada Research Chair in Boreal and Cold Oceans Systems since 2002 at the Ocean Sciences Centre and has a joint appointment in the Biology Department. From 1996-2003 he held an NSERC Industrial Research Chair in Fisheries Conservation. Prior to that, he was a Killam postdoctoral fellow at Dalhousie University and also at Rutgers University after completing a PhD at the Massachusetts Institute of Technology/Woods Hole Oceanographic Institution. Dr. Snelgrove was also active with the Census of Marine Life where he oversaw the synthesis phase of the 10-year international program that was completed in 2010.

The following is an abstract of Dr. Snelgrove's presentation entitled *"**Sustaining Marine Biodiversity in Canada and Globally**"*.

Human pressures on the global ocean continue to increase, creating new challenges for sustainable ocean use and a recognized need to maintain ocean functions and biodiversity. Ultimately, efforts to sustain marine biodiversity must consider at least some closed area strategies, which entails a wide range of scientific considerations. The Census of Marine Life provided a framework for collaborative research in marine biodiversity that helped launch the Canadian Healthy Oceans Network (CHONe), a national research program that is uniting researchers to provide new insights into marine biodiversity and provide scientific guidelines for policy in ocean conservation and sustainable use. Our researchers have worked in shallow and deep-water habitats in the Atlantic, Pacific and Arctic Oceans, from cutting edge, high definition imagery of deep-water corals, sponges, and fishes to genetic samples and physical specimens of microbes, plankton, and sedimentary infauna. CHONe represents a potential model for national academic and government partnership to advance biodiversity research structured around interlinking themes that provide scientific input to advise policy needs. In this presentation I present examples of research projects from CHONe's three themes of Marine Biodiversity, which links functional and species diversity to habitat complexity, Ecosystem Function, which links biodiversity to ecosystem processes, and Population Connectivity, which links population structure to spatial planning. For example, under Marine Biodiversity CHONe established biodiversity research focus areas to link seafloor and benthic characteristics (e.g. rugosity, bathymetry, organic flux) to predict benthic biodiversity. Within Ecosystem Function, CHONe scientists studied links between biodiversity and key functions related to ocean health (e.g. bioturbation, biogeochemical fluxes) to try to understand how they respond to natural and anthropogenic disturbances. Population Connectivity has developed tools to address how dispersal of marine organism early life stages influences patterns of diversity, resilience, and source/sink dynamics of species and biological communities. I also discuss how we are working to integrate outcomes from these themes to identify

approaches to bridge science and policy, and communicate these results to the complex user groups who ultimately influence policy application.

The invited lecture presented by Dr. Snelgrove was well received by Scientific Council and stimulated discussion on the benefits and different strategies to sustain and protect biodiversity in the oceans and efforts to integrate scientific results into development of policy.

6. Integrated Science Data Management (ISDM) Report for 2012

(SCR Doc. 13/25)

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 2012 was presented in SCR Doc. 13/25. 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 2013 required the submission to ISDM of a completed oceanographic inventory form for data collected in 2012, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2012. 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 2012 are included. This report will also provide an update on other ISDM activities during 2012. Data that have been formatted and archived at ISDM are available to all members on request. Requests can be made by telephone (613) 990-6065, by e-mail to isdm-gdsi@dfo-mpo.gc.ca, by completing an on-line order form on the ISDM web site at http://www.isdm.gc.ca/isdm-gdsi/request-commande/form-eng.asp or by writing to Services, Integrated Science Data Management (ISDM), Fisheries and Oceans Canada, 12th Floor, 200 Kent St., Ottawa, Ont. Canada K1A 0E6.

Highlights of the Integrated Science Data Management (ISDM formerly MEDS) Report for 2012:

The following is the inventory of oceanographic data obtained by ISDM during 2012 (numbers in brackets refers to counts in 2011):

- Real-time temperature and/or salinity data collected and processed in 2012; total 342058 (279186) stations
- Delayed-mode temperature and/or salinity profiles collected and processed in 2012; total 2834 (1170) stations
- Delayed-mode temperature and/or salinity profiles collected prior to 2012 and processed in 2012; total 7373 (6413) stations
- Near-surface underway temperature and/or salinity data collected in 2012; total 3133 (1270) stations
- Drifting Buoys in the NAFO Area in 2012; Total 457156 (364648) messages from 208 (162) buoys
- BIO Current meters recovered in 2012 and processed; total 20 instruments on 15 moorings
- BIO Current meters recovered in 2012 but not yet processed; total 25 instruments on 29 moorings
- Wave Buoys in the NAFO Area in 2012; 15 Environment Canada meteorological buoys, 3 Wave Instruments from the Oil and Gas industry
- Tide and water level data in the NAFO Area in 2012; total of 26 tide gauges
- During 2012, Argo Canada acquired and deployed 11 Argo profilers in the NAFO region

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 2012 was presented in **SCR Doc. 13/03, 13/04** and **SCS Doc. 13/08, 13/14**. The regional hydrography in summer and autumn 2012 was presented and discussed based on data from standard sections along the west coast of Greenland and data retrieved during trawl surveys. Following three years of negative state of North Atlantic Oscillation (NAO) with the

2009-10 value being a record low in the entire time series, the NAO index for the Dec-Jan-Feb (DJF) period of 2011-12 was strongly positive, close to the level in early 1990s, a period which experienced the highest NAO index values in the last 2 decades. A strong positive NAO phase normally results in colder conditions over the northwest Atlantic including West Greenland region which coincided with air temperature slightly below normal. This was followed by an exceptional atmospheric warming during summer resulting in higher than normal annual air temperatures and rapid retreat of sea ice. The annual sea surface temperature anomalies for 2012 indicate positive anomalies of 1.0°C along West Greenland. Time series of mid-June temperatures on top of Fylla Bank were near the long-term mean. The normalized near-surface (<100m) temperature and salinity indices were slightly below normal over the West Greenland shelf. Water temperatures and salinity in the upper 700m along the Cape Desolation section in autumn remained higher than normal. The upper 50 to 300m of the Fyllas Bank section was characterized by negative potential temperature anomalies, in contrast to positive temperature anomalies between 300 and 700m. The salinity of the upper 500m was below its long-term mean.

Subareas 1 and 2. A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2012 was presented in **SCR Doc. 13/19**. NCEP reanalysis of surface air temperature indicated below normal conditions with an anomaly of 0 to -2°C in the Labrador Sea during the winter period; for the summer period the anomaly was positive with a range of approximately 1-3°C; the fall period was characterized by a strong positive anomaly of 4-6°C in the Baffin Bay/Davis Strait area north of the Labrador Sea. Sea surface temperature (SST) anomalies in the Labrador Sea followed the pattern observed in the air temperature being negative (0 to -1°C) in the winter and positive (1 to 3°C) in the summer. The Labrador Shelf ice anomaly was below normal in Jan-Feb 2012 (reference period: 1979-2000). In the March 2012, sea ice conditions on the northern Labrador Sea/Davis Strait area were well above normal. Winter time convection in 2012 reached to 1400 m, which is significantly deeper than the 800 m seen in 2011, though still less than the 1600 m of 2008. The 1000-1500m layer has been warming since 2002 with resets in 2008 and 2012. The increasing trend of the total inorganic carbon and decreasing trend of pH continue. For the year of 2012 as a whole, chlorophyll *a* estimated from 2-week ocean colour composite images was below normal on the Labrador and Greenland Shelves, but normal in the central Labrador Basin. The abundance of *Calanus finmarchicus* was near (above) normal on Labrador (Greenland) Shelf.

Subareas 2 and 3. A description of environmental information collected in the Newfoundland and Labrador (NL) Region during 2012 was presented in **SCR Doc. 13/18** and **SCS Doc. 13/13**. Air temperatures remained above the long-term mean at Labrador by 1.4 SD (1.8°C at Cartwright) and Newfoundland by 2.3 SD (1.9°C at St. John's, a record high). The annual sea ice extent on the NL Shelf remained below normal (0.7 SD) for the 17th consecutive year, but increased by 1 SD over the record low in 2011. As a result of these and other factors, local water temperatures on the NL Shelf remained above normal in most areas but decreased significantly over 2011 values. Sea surface temperatures attained record highs (>2 SD) in some areas of the Grand Banks. At a standard monitoring site off eastern Newfoundland (Station 27), the depth-averaged annual water temperature decreased to 1 SD (0.4°C) above normal from the record high of 3 SD (1°C) in 2011. Annual surface temperatures at Station 27 increased to 1.5 SD (1°C, 2nd highest on record) above normal while bottom temperatures (176 m) decreased to 1.1 SD (0.4°C), down from the record high of 3.4 SD (1.3°C) in 2011. The annual depth-averaged salinities at Station 27 were near the long-term average. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland and southern Labrador Shelf during 2012 was near 0.5 SD below normal compared to the record low value of 2 SD below normal in 2011, implying a continuation of less cold shelf water than normal. Spring bottom temperatures in NAFO Div. 3Ps and 3LNO during 2012 were above normal by an average of about 1°C, a moderate decrease over 2011 conditions. During the fall, bottom temperatures in Div. 2J, 3K and 3LNO decreased from 2, 2.7 and 1.8 SD above normal in 2011 to 1.1, 1.2 and 0.2 SD above normal in 2012 respectively, a significant decrease. The volume of CIL (<0°C) water on the NL Shelf during the fall was close to normal. A composite climate index derived from 27 meteorological, ice and ocean temperature and salinity time series declined from 2nd and 4th highest in 2010 and 2011 to the 8th highest in the 63 year time series in 2012.

An investigation of the biological and chemical oceanographic conditions in subareas 2 to 5 in 2012 was presented in **SCR Doc. 13/09** and **SCS Doc. 13/13.** Biological and chemical variables collected in 2012 from coastal high frequency monitoring stations, semi-annual oceanographic transects, and ships of opportunity ranging from the Labrador-Newfoundland (LAB-NL) and Grand Bank (GB) Shelf (Subareas 2 and 3), extending west into the Gulf of St. Lawrence (GSL; Subarea 4) and further south along the Scotian Shelf (SS) and the Bay of Fundy (BoF; Subarea 4) and into the Gulf of Maine (GoM; Subarea 5) were presented and referenced to previous information from earlier periods when available. Information concerning the interannual variations in inventories of nitrate, chlorophyll *a* and indices of the spring bloom inferred from satellite ocean colour imagery, as well as the abundance of major taxa of zooplankton collected as part of the 2012 Atlantic Zone Monitoring Program (AZMP) was reviewed. In general, nitrate inventories in both the upper and lower water-column continue to remain below normal along the northern transects across the LAB-NL Shelf and GB while above average levels are typical of the northwest GSL and the SS transects and fixed stations in 2012. The annual trends in chlorophyll *a* inventories were below normal in 2011-2012 across the northern Subareas (Div. 2J to 3LM) in comparison to near-normal and above average levels in 2012 along the GSL and SS. The magnitude of the spring bloom was below normal for most of the northern and southern Subareas with the exception of the GSL which displayed positive anomalies in 2012. The timing indices (initiation, peak timing, and duration) of the spring production cycle generally tended to earlier and shorter cycles over the entire zone in 2012 with exceptions observed in the GSL and in specific areas on the SS. Although many of the copepod abundance indices reached their highest levels in 2010-2011 in the northern Subareas, the anomaly time series indicated relatively weak secondary production throughout the northwest Atlantic in 2012. The non-copepod taxa increased substantially in 2012 along the GB and northeast GSL fixed stations and transects.

Subarea 4. A description of environmental information collected on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas during 2012 was presented in **SCR Doc. 13/08**. A review of the 2012 physical oceanographic conditions on the SS and in the eastern GoM and adjacent offshore areas indicates that above normal conditions prevailed. The climate index, a composite of 18 selected, normalized time series, averaged +2.8 standard deviations (SD) with 16 of the 18 variables more than 1.0 SD above normal making 2012 as the warmest year in the last 43 years. The anomalies did not show a strong spatial variation. Bottom temperatures were above normal with anomalies for NAFO Div. 4Vn, 4Vs, 4W, 4X of +0.5°C (+1.2 SD), +1.2°C (+1.8 SD), +1.7°C (+2.3 SD), and +2.1°C (+3.0 SD) respectively. Compared to 2011, bottom temperatures increased in Div. 4Vs, 4W and 4X by 0.4, 1.5 and 1.7°C. The exception was Div. 4Vn where temperature decreased by 0.2°C.

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 2013 Meeting along with relevant abstracts:

"**Impact of interannual changes of large scale circulation and hydrography on the spatial distribution of beaked redfish (*Sebastes mentella*) in the Irminger Sea**". Authors: Ismael Núñez-Riboni, Kristján Kristinsson, Matthias Bernreuther, Hendrik M. van Aken, Christoph Stransky, Boris Cisewski and Alexey Rolskiy.

This study presents evidence of the influence of hydrography and large scale ocean circulation on the geographical distribution of beaked redfish (Sebastes mentella) in the Irminger Sea at the interannual time scale, from 1992 to 2011. The results reveal the average relation of adult pelagic redfish to their physical habitat in shallow and intermediate waters: The most preferred latitude, longitude, depth, temperature and salinity for redfish are approximately 58ºN, 41ºW, 557 m, 4.5ºC and 34.87, respectively. The redfish habitat corresponds in a TS diagram to a mixing triangle between East Greenland Current Water (EGCW), Labrador Sea Water (LSW) and Irminger Current Water (ICW). The geographical centre of mass of the redfish distribution (as revealed by acoustic fish density) indicates displacements from year to year. Changes of hydrographic conditions were investigated in detail as possible reason for these displacements. Empirical Orthogonal Analysis reveals that maximum variations of water mass volume on an interannual time-scale in the study region correspond to ICW and LSW changes, while EGCW remains comparatively stable. Indices of redfish mass centre, LSW volume, ICW temperature and Subpolar Gyre (SPG) intensity suggest that the geographical redfish displacements are closely related to interannual changes of ICW modulated by the SPG intensity with a lag of one or two years. In comparison, LSW seems to have no impact on the redfish distribution at the studied depth range (roughly 100-800m). The time lag between ICW and redfish displacements indicates an indirect influence of temperature on redfish. Hence, changes of chlorophyll-a (from satellite imagery), as proxy for primary production, were used in a first approach to study the role of food availability. The analysis is based on acoustic and trawl data from nine expeditions coordinated by the International Council for the Exploration of the Sea (ICES), around 71,000 hydrographic stations from the Integrated Climate

Data Center, World Ocean Database 2009 and Coriolis (among others), 60 years of circulation data from the Max-Planck Institute Ocean Model and 14 years of satellite chlorophyll-a from SeaWiFS, MODIS-Aqua and MERIS.

Subareas 4-6. Several ongoing oceanographic, plankton and benthic studies conducted by the Northeast Fisheries Science Center (NEFSC) in NAFO Subareas 4 through 6 was presented in **SCS Doc. 13-10.** A total of 1,893 CTD (conductivity, temperature, depth) profiles were collected and processed during 12 cruises conducted by the Northeast Fisheries Science Center (NEFSC) cruises in 2012. Of the total CTD profiles 1,835 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. Hourly temperature records obtained by participants of the Environmental Monitors on Lobster Trap Project (see emolt.org) at approximately 70 fixed locations/depths around the Gulf of Maine and Southern New England Shelf indicate that 2012 was the warmest year since the project began in 2001. Early 2013 records provide evidence of continued warm conditions. Eighty-five satellite-tracked surface drifters were deployed off the coast of New England in 2012, and dozens more are planned for 2013 (see_http://www.nefsc.noaa.gov/drifter). The collective archive helps resolve the transport pathways of estuarine and shelf waters. During 2012, zooplankton community distribution and abundance were monitored using 734 bongo net tow samples taken on six surveys. Each survey covered all or part of the continental shelf region from Cape Hatteras northeastward through the Gulf of Maine. A number of benthic studies were conducted in 2012 around Subareas 4-6. Water temperatures were the highest observed in 2012 during the benthic missions which began in 2005 throughout the water column shelf-wide and in the upper water column over the slope at all latitudes.

An investigation of the relationship between meteorological and hydrographic variables and distribution of redfish was presented in **SCR Doc. 13/28**. This work explores a link between hydro- meteorological conditions and migratory behaviors of beaked redfish (*Sebastes mentella*). Data was collected by onboard observers on fishing vessels between 2002 and 2011. Barometric and sea-surface temperature data was collected using vessel instrumentation, while temperature at fishing depth was collected in some years using telemetry equipment on the trawl net. The authors found a negative correlation between sea surface temperature in the Norwegian and Irminger Seas, but not in the Labrador Sea. No significant relationships between atmospheric pressure and CPUE of redfish were observed. The authors noted that the optimum temperature for redfish reported in this study was consistent with previous work, and speculated that redfish become entrained in bodies of warmer water flowing towards the Norwegian Sea. It was noted that redfish accumulated at areas of strong temperature gradients, and also that they could be on either the warm or cold sides of these gradients. In conclusion, the authors found weak evidence for interactions between redfish CPUE and climatic conditions, which they attributed to interannual variability and not to long-term climate change.

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 2012 are available from Subarea 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 **recommends** 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; temporary USA contact P, Fratantoni). Contact information for newly appointed National Representatives to be forwarded to the NAFO Secretariat.

12. Other Matters

No other matters were raised in 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. Paul Snelgrove (Memorial University of Newfoundland), and contributions to the interdisciplinary session by Ismael Núñez-Riboni, Kathy Sosebee, and Neil Campbell.

The meeting was adjourned at 15:00 on 10 June 2013.

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 8 and x June 2013, 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), France (in respect of Saint Pierre et Miquelon, Russian Federation, Japan 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 items 6d Sampling Yearbooks, 6e Review of NAFO Journal cover and website changes, 6f changes to the ASFA search function, and 6g notice of anew multi-disciplinary marine journal.

4. Review of Recommendations in 2012

STACPUB **recommended** that *historical documents and publications from ICNAF and NAFO be scanned, digitized, including metadata, and be available on the web.*

STATUS: This is in progress. (See also Item 6a)

STACPUB **recommended** that *the Sampling Yearbooks be scanned and digitized and made available on the web, including the metadata.*

STATUS: This is in progress. In addition, detailed length frequencies information stored at the NAFO Secretariat can be made available electronically in due time.

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

STATUS: This was published in October 2012 as Studies No. 44.

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.*

STATUS: This has been done and was published in December 2012.

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.*

STATUS: The Secretariat provided three samples of different map projections for the Journal cover. This is further discussed under item 6d.

STACPUB **recommended** that *further enquiries into the search function on the ASFA database be researched because the author search does not consistently display an author's name under the "corporate author" entry. Sometimes it shows up as anonymous.*

STATUS: ProQuest, ASFA's publishing partner, updated their platform in 2012, including their advanced search capabilities which should solve this problem. (See also item 6e)

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.*

STATUS: Results from some sample format changes were presented to Scientific Council at this meeting. (See also item 6b)

5. Review of Publications

a) Annual Summary

i) Journal of Northwest Atlantic Fishery Science (JNAFS)

Volume 44, Regular issue, was printed in December 2012 and there were 165 copies made.

Volume 45, Regular issue, has a total of five papers that have been submitted for publication, two have been published (online) and the rest are in review process. The paper edition will be printed in December 2013.

The STACPUB Chair was aware that at least on one occasion in 2012 there had been an unusual length of time between submission of an article and publication. The General Editor advised the Committee that there had been a technical problem with the Journal email that caused submissions of articles to go unanswered for a month or more, but this has been resolved.

STACPUB **recommends** that *the Secretariat compile information regarding the timelines from article submission to publication and present the data to Scientific Council in June 2014*.

ii) NAFO Scientific Council Studies

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

Studies No. 45 (2013) is in progress: *NAFO Research Vessel Stock-by-Stock Surveys Summary 2000–2010.* This is currently under review with Designated Experts and will be published following the June meeting.

iii) NAFO Scientific Council Reports

A total of 65 printed copies of the NAFO Scientific Council Reports 2012 (340 pages) were produced in April 2013. The electronic version was published in January 2013.

iv) Progress report of meeting documentation CD

STACPUB was informed that: Approximately 20 copies of the Meeting Documentation CD 2012 were produced. The CD contains:

- GC/FC Proceedings 11–12
- GC/FC Report Sep 12
- SC Reports 2012
- NAFO Convention
- NCEM 2013
- Rules of Procedure
- Annual Report 2012
- Performance Review Report

vi) ASFA

The 41st Annual Meeting of the Aquatic Sciences and Fisheries Abstracts (ASFA) took place from 25–29 June 2012, in Rinville, Oranmore, Co. Galway, Ireland. The Irish Marine Institute hosted the ASFA meeting with Anne Wilkinson and Fintan Bracken as the hosts, and with Dr. Richard Grainger, Chief of the FAO service responsible for ASFA. The meeting was chaired by Linda Noble (UK) of the Marine Biological Association and Helen Wibley of the ASFA Secretariat performed the duties of Rapporteur. The meeting was attended by Alexis Pacey, Publications Manager at the NAFO Secretariat.

The meeting covered many topics ranging from: software and technical information; the ASFA partnership status; ASFA's publishing partner ProQuest; the ASFA trust fund; training activities and demos; new products, in particular the new ASFA database; and discussion around the future direction of ASFA. The next meeting will be held 23–27 September 2013, in Peru, South America.

Most ASFA entries are up-to-date as of April 30, 2013.

6. Other Matters

a) Review of historical ICNAF documentation.

All NAFO documents and publications have been posted to the website. The scanning of ICNAF meeting documents and publications has been completed and the meta-data added and uploaded. An ICNAF tab has been created on the updated website which includes an ICNAF history, documents and publications. The final phase of the digitization project will be to break down the large ICNAF publications (e.g. Research Bulletin and Selected Papers) into more accessible sections, such as a Table of Contents style, similar to what exists for JNAFS and the Studies.

The development of the search function was delayed due to human resources issues at the Secretariat. A new database manager, Mark Harley, was hired by the Secretariat in April 2013 so work on the search function will begin again during the next year.

b) Increasing size of the NAFO Scientific Council Reports

Discussion around reformatting the SC Reports (Redbook) took place. An example was shown of a two column format that would reduce the number of pages by 25%. Another possibility would be to compile the SC Reports and the Standing Committees separately giving the option to print as two volumes if necessary.

After discussing the possibilities STACPUB agreed that the Scientific Council Reports should remain in a single column format as it is presently. It was noted that a review of the format of the Summary Sheets is being conducted in Scientific Council that may result in a move to a single column format for that section of the report. A comment was made that if the number of Redbooks printed were reduced then it would be possible to use a spiral binding that would accommodate more pages.

STACPUB **recommends** that *the Secretariat print the Scientific Council Reports upon request using spiral binding.*

STACPUB **recommends** that *the Summary Sheets be made more easily accessible on the website.*

c) VME Indicator Species Guide

In order to facilitate data collection at sea, NAFO has published guides to the corals and sponges of the NAFO Regulatory Area (NAFO Scientific Council Studies 42 & 43).

In 2012, NAFO adopted a comprehensive list of Vulnerable Marine Ecosystem (VME) indicator species, which now forms part of the NAFO Conservation and Enforcement Measures (CEM) (Chapter II, Article 15, para. 7, Annex I.E.VI). The encounter provisions of Article 22 require vessels to quantify catches of these species, and if levels exceed threshold values, to follow proper reporting and move-on provisions.

It is apparent that there is some degree of disconnect between the contents of the current sponge and coral guides and the list of VME species in the CEM. STACPUB discussed how to proceed with updating these guides to produce a comprehensive work.

In order to accomplish this, an institution/lab would need to be involved with designated experts providing content for the guides. It may be possible to have the Ecosystem Working Group coordinate this work in collaboration with the Secretariat. The cost and workload for updating the guides would need to be considered by STACFAD.

STACPUB **recommends** that *the Coral and Sponge Guides be updated to include the additional VME species that are listed in the CEM.*

d) Review of the Journal cover and presentation of the new on-line Journal interface and structure

STACPUB considered three different map styles as a possible replacement for the Journal cover. Neither of the options met with strong support. Discussion followed, with one suggestion to look at using photos on the cover as is done in some other journals. Alexis Pacey (Publications Manager) from the Secretariat prepared some examples that were distributed during the meeting and preferences were indicated with comments provided from the group. It was suggested that there could be two covers, one for regular issues and one for symposia. The regular issue would feature relevant images in full colour. The symposium version would be the same as the current Journal, except the image would reflect the symposium theme.

STACPUB **recommends** that *the new design for the cover be implemented for regular issues of the Journal and the current Journal cover design be used for special symposia editions with a unique picture chosen to reflect the theme of the meeting*.

An updated on-line Journal interface and structure was presented at the meeting. The updated interface would enable articles to be linked to other websites or within articles for authors wanting to use links for their published work. The content previously published would remain the same. If STACPUB members have any comments on the interface or structure these could be provided to the Secretariat.

e) ASFA search presentation

A presentation showing the new database and all its search features was presented. When NAFO SCR documents are added to the database both corporate author (NAFO) and main author are entered. The new search engine used by the ProQuest database has the option to search by corporate author or main author so this should ensure all documents associated with a particular main author search are retrieved.

A pdf guide for ASFA users is available. If Scientific Council members continue to have problems with the ASFA database, they should contact the Secretariat describing the specific problem.

f) New Journal

A new international, multidisciplinary journal is starting up: "*Marine and Freshwater Living Resources*". The content deals with cutting edge research on marine and aquatic living resources, covering issues regarding health, climate change, fish habitat, sociology, recreational and artisanal fishing, and sustainable exploitation of aquatic living resources. The editor is Josep Lloret. The Journal is peer-reviewed, publishes in electronic-only format and an ongoing basis (no issues). The language of the journal is English. Submissions are welcome.

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 11:45 hours on 20 June 2013.

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), France (in respect of St. Pierre et Miquelon), Japan, Russian Federation and United States of America. The Scientific Council Coordinator and other members of the Secretariat were in attendance.

1. Opening

The Chair opened the meeting at 1400 hours on 8 June 2013, welcomed all the participants and thanked the Secretariat for providing support for the meeting. The Committee also met on 15 and 18 June 2013 to review unfinished agenda items. The report was reviewed on 19 June.

2. Appointment of Rapporteur

Barbara Marshall (NAFO Secretariat) was appointed as rapporteur.

3. Review of Recommendations in 2012

There were no recommendations made in 2012.

4. Fishery Statistics

a) Progress report on Secretariat activities in 2012/2013

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).

TABLE 1. Dates of receipt of STATLANT 21A and 21B reports for 2010-2012 up to 4 June 2013.

Country/Component	STATLANT 21A (deadline, 1 May)			STALANT 21B (deadline 31 August)		
	2010	2011	2012	2010	2011	2012
CAN-CA	31 Mar 11	24 Apr 12	21 May 13	8 Aug 11	21 May 12	
CAN-M						
CAN-SF	28 Apr 11	14 May 12	21 Apr 13	10 June 11		
CAN-G	29 Apr 11	29 Apr 12	9 May 13	27 July 11		
CAN-N	29 Apr 11	30 Mar 12	30 Apr 13	31 Aug 11	6 Sep 12	
CAN-Q		19 Jun 12				
CUB		4 May 12	7 May 13			
E/BUL			21 May 13(NF)			21 May 13(NF)
E/EST	27 Apr11	17 May 12	2 May 13 (revised 6 Jun 13)	31 Aug 11	2 Sep 12	
E/DNK		18 May 12	17 May 13		21 Aug 12	
E/FRA-M		21 May 12	4 Jun 13			
E/DEU	28 Apr 11	26 Apr 12	28 May 13	23 Aug 11	7 Jul 12	
E/LVA	14 Apr 11	17 May 12	22 Apr 13	16 Aug 11	24 Aug 12	
E/LTU		2 May 12	27 May 13		31 Aug 12	
E/POL		26 Apr 12 (no fishing)			26 Apr 12 (no fishing)	
E/PRT	27 Apr 11	8 May 12 (revised 29 May 12)	23 Apr 13	31 Aug 11	14 Nov 12	
E/ESP	8 June 11	30 May 12	28 May 13 (revised 29 May 13)	11 May 11	3 Sep 12	
E/GBR	1 Jun 11	26 Apr 12	8 May 13	16 Aug 11		
FRO	6 May 11	30 Apr 12	2 Jun 13	6 May 11	27 Aug 12	
GRL	27 Apr 11	19 Apr 12	30 Apr 13	29 Apr 11	6 Sep 12	
ISL	4 May 11	31 May 12	23 May 13 (NF)	1 Sep 11	20 Aug 12	
JPN		25 Apr 12 (no fishing)	26 Apr 13 (NF)		25 Apr 12 (no fishing)	26 Apr 13 (NF)
KOR						
NOR	28 Apr 11	27 Apr 12	30 Apr 13	19 Aug 11	2 Sep 12	
RUS	27 Apr 11	29 Apr 12	21 May 13	26 Jul 11	6 Sep 12	
USA	16 May 11	21 May 12	21 May 13			
FRA-SP	29 Ap 11	14 May 12	21 May 13	4 Aug 11	24 Aug 12	
UKR	20 Jan 11 (no fishing)					

5. Research Activities

a) Biological Sampling

i) Report on activities in 2012/2013

STACREC reviewed the list of Biological Sampling Data for 2012 (SCS Doc. 13/11) 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 2013 Meeting.

ii) Report by National Representatives on commercial sampling conducted

Canada-Newfoundland (SCS Doc. 13/13, 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), capelin (SA 2 + Div. 3KL), and marine mammals (SA 2-4).

Denmark/Greenland: Length frequencies were available from the Greenland trawl fishery in Div. 1A and 1D. CPUE data were available from the Greenland trawl fishery in Div. 1AB and 1CD. (SCS Doc. 13/08). 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 (SCR Doc. 13/48).

EU-Estonia (SCS Doc. 13/16): Specifically trained NAFO observers collected length, age and sex data. In 2012 EU-Estonia sampled catches (including discards) of Greenland halibut, Northern shrimp, redfish, Atlantic halibut, Capelin, Cod and Haddock in Divisions 3LNO. All lengths are TL and length group (LG) 10 means lengths from 10.0 to 10.9 cm. Mesh size of trawls for mixed fishery of demersal and pelagic fish, in codend was 139-145 mm, for skates 286 mm.

Length distributions for *Sebastes sp.* bycatch in Div. 3L shrimp fishery in 2010 and 2012 were prepared There was no redfish sampling in 2011. Length distribution of capelin in Div. 3L shrimp fishery in 2012 is given.Length distributions for cod and Greenland halibut were also available.

EU-Germany (SCS Doc. 13/14): In 2012 length frequency distributions for cod in Div. 1F were presented.

EU-Portugal (SCS Doc 13/05): Data on catch rates were obtained from trawl catches for redfish (Div. 3LMNO), Greenland halibut (Div. 3LM), roughhead grenadier (Div. 3LM) and cod (Div. 3M). Data on length composition of the catch were obtained for Cod (Div. 3LMNO), redfish *S. mentella* (Div. 3LMNO), American plaice (Div. 3MN), Yellowtail flounder (Div. 3N), Greenland halibut (Div. 3LMN), roughhead grenadier (Div. 3LN), witch flounder (Div. 3O), white hake (Div. 3O) and thorny skate (Div. 3M).

EU-Spain (SCS Doc. 13/07): A total of 14 Spanish trawlers operated in Div. 3LMNO NAFO Regulatory Area during 2012, amounting to 1,652 days (25,410 hours) of fishing effort. In 2012, Spanish effort in this Area was similar to the 2011 effort and 11% higher to the 2010. Total catches for all species combined in Div. 3LMNO were 14,770 tons in 2012. Nine IEO scientific observers were onboard Spanish vessels in 2012, comprising a total of 350 observed fishing days, around 21% coverage of the total Spanish effort. In 2012, 540 length samples were taken, with 65 864 individuals of different species examined to obtain the length distributions. Besides recording catches, discards and effort, these observers carried out biological sampling of the main species taken in the catch. For Greenland halibut, roughhead grenadier, American plaice and cod this includes recording weight at length, sex-ratio, maturity stages, performing stomach contents analyses and collecting material for reproductive studies. Otoliths of these four species were also taken for age determination.

One Spanish trawler operated in NAFO Regulatory Area, Div. 6G using a midwater trawl gear, during 2012, amounting to 22 days (165 hours) of fishing effort. The most important species in catches was the Beryx splendens. Other species present in catches were *Ruvettus pretiosus*, *Aphanopus carbo* and *Epigonus telescopes*. One IEO scientific observers were onboard Spanish vessel and conducted catches length distribution for *Beryx splenden*, *Epigonus telescopes* and *Hopplosethus mediterraneus*.

Russian Federation (SCS Doc. 13/09): Biological data on Greenland halibut from Div. 1D were collected by observers aboard Russian fishing vessels. Biological data were collected by NAFO observers on fishing vessels for these species:

Greenland halibut (Reinhardtius hippoglossoides), Acadian redfish (Sebastes fasciatus), Deep-sea redfish (Sebastes mentella), Golden redfish (Sebastes marinus), Roughhead grenadier (Macrourus berglax), Roundnose grenadier (Coryphaenoides rupestris), American plaice (Hippoglossoides platessoides), Witch flounder (Glyptocephalus cynoglossus), Cod (Gadus morhua), Threebeard rockling (Gaidropsarus ensis), White hake (Urophycis tenuis), Thorny skate (Amblyraja radiata), Black dogfish (Centroscyllium fabricii), Northern wolffish (Anarhichas denticulatus), Atlantic wolffish (Anarhichas lupus), Spotted wolffish (Anarhichas minor), Blue hake (Antimora rostrata), Marlin-spine grenadier (Nezumia bairdii), Atlantic halibut (Hippoglossus hippoglossus).

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 2012 (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 2012 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2HJ3KLNO. The spring survey in Div. 3LNOP was conducted from April to late June, and the portion in Div. 3LNO consisted of 479 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 627 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 2012, 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 in 2012 and earlier were discussed in detail in STACFEN.

Denmark/Greenland: The West Greenland standard oceanographic stations were surveyed in 2012 as in previous years (SCR Doc. 13/003).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2012. In July-August 220 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.13/26).

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 1997-2012 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 2012 50 valid hauls were made. (SCS Doc. 13/08).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2012 the longline survey was conducted in Uummannaq (28 sets) and Upernavik (7 set).

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2012 a total of 41 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: The Spanish bottom trawl survey in NAFO Regulatory Area Div. 3NO was conducted from 3rd to 21st of June 2012 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 122 hydrographic stations were taken within a depth range of 45-1450 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 and Atlantic cod.

In 2003 it was decided to extend the Spanish 3NO survey toward Div. 3L (Flemish Pass). In 2012, the bottom trawl survey in Flemish Pass (Div. 3L) was carry out on board R/V *Vizconde de Eza* using the usual survey gear (Campelen 1800) from July 30th to August 18th. 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 105 and 7 of them were nulls. Survey results, including abundance indices and length distributions of the main commercial species, are presented as Scientific Council Research documents. Survey results for Div. 3LNO of the northern shrimp (*Pandalus borealis*) were presented in SCR 12/61. 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 (*Gadus morhua, Hippoglossoides platessoides, Reinhardtius hippoglossoides, Notacanthus chemnitzii, Hydrolagus affinis* and *Harriotta Raleighana*) were performed and 1534 stomach contents were analysed in depths of 112 to 1329 m. Ninety-four hydrographic profile samplings were made in a depth range of 105-1369 m.

EU-Spanish and Portugal Survey: The EU bottom trawl survey in Flemish Cap (Div. 3M) was carried out on board R/V *Vizconde de Eza* using the usual survey gear (Lofoten) from June 24th to July 26th 2012. 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 179 and five of them were nulls. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, roughhead grenadier and Greenland halibut are presented as Scientific Council Research documents. Flemish Cap survey results for northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 12/53. 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. 13/10): 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 autumn multispecies bottom trawl survey which cover NAFO Subareas 4-6, the scallop dredge survey which covers NAFO Subareas 5 and 6, and the northern shrimp trawl survey which covers NAFO Div. 5Y. In addition, the report contained information on catches of cod, yellowtail flounder, American plaice, witch flounder, thorny skate, and Atlantic halibut from NAFO Div. 3N. Additionally, surveys were conducted in NAFO Subareas 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 2012; descriptions of research on marine mammals and sharks; inventory of number of ages collected and 60 000 fish aged in 2012, including ages of cod, white hake, yellowtail flounder and witch flounder; 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 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.

iii) EU Flemish Cap survey manual

SCR Doc. 13/021 – Vázquez, A., J. M. Casas and R. Alpoim – Protocols of the EU bottom trawl survey of Flemish Cap.

Methods and procedures used in the EU bottom trawl survey of Flemish Cap (NAFO Division 3M) are described in detail. The objectives of publicising these protocols are to achieve a better understanding of its results, and to contribute to the routines being unaltered. It was agreed that this information might be appropriate for a Studies volume.

Other Contracting Parties are encouraged to also publish their survey protocols.

It was noted that a small working group had worked a few years ago to update Studies No. 2 - Manual on Groundfish Surveys in the Northwest Atlantic but no progress had been made.

SCR Doc. 13/005 – Vázquez, A., J. M. Casas, W. B. Brodie, F. J. Murillo, M. Mandado, A. Gago, R. Alpoim, R. Bañón, and A. Armesto – List of Species as recorded by Canadian and EU Bottom Trawl Surveys in Flemish Cap.

A list of species recorded in each haul of both Canadian (1977-1985) and EU (1988-2002 and 2003-2012) bottom trawl surveys. Even though sampling intensity and taxonomic interest changed with time, the three periods can be considered almost homogeneous. Main change occurred when the EU survey increased the depth range, from 730 to 1460 meters depth, and all invertebrates were recorded. Glaring omissions of common species were highlighted in the early time series of the surveys.

c) Tagging Activities (SCS Doc. 13/12)

STACREC noted that tagging activities had been reported in SCS Doc. 13/12. Participants were asked to check the document and send in any additional information before finalization in September.

d) Other Research Activities

i) NEREIDA Project

Generation of encounter thresholds: The IEO and DFO worked in collaboration for applying a geospatial model to generate encounter thresholds for small gorgonian corals. A biomass layer for the small gorgonian corals was created using the EU-Spain in Div. 3LNO and EU-Spain-Portugal in Div 3M trawl survey data for the period 2006-2010. The 2011 VMS fishing trawl lines were also used to give some information on the impact of using 0,2 kg threshold on the fishing activities.

Box core samples: A further 12 Box Core samples in the Flemish Cap area have been analysed by Cefas in collaboration with IEO bringing the total samples analysed to 40 from a total of 360 samples collected. The results show again the importance of the current closed areas in protecting the highest densities and biomass of VME indicative taxa in the Flemish Pass and Sackville Spur areas.

Scientific trawl and rock dredge samples: Work on sponges was carried out (50 spp have been identified so far). Other groups (corals, hydroids, echinorderms and molluscs) are already complete. Still to do are arthropods, annelids, bryozoa, brachiopoda, sipuncula, nemertina and others. The identification work is hopefully going to be completed by the end of 2013.

The processing of the NEREIDA samples and data is entirely dependent on a continuation of the programme in 2013 with support from the European Commission as provisionally agreed during the NAFO 34th Annual meeting (2012). Given the short time-line the timely approval of EC support is therefore essential.

6. Review of SCR and SCS Documents

The following papers were presented to STACREC:

SCR Doc. 13/001 - N. Campbell and R. Federizon - Estimating fishing effort in the NAFO Regulatory Area using vessel monitoring system data

STACREC reviewed work done by the Secretariat to summarize effort using VMS data, as a follow-up to the SC Catch Estimation Working Group (SCR Doc. 13-01). The anonymized data circulated to Scientific Council aggregated effort by flag state, division and depth strata, allowing members of SC to derive effort metrics specific to the distribution of their fishery of interest.

STACREC found this work to be a useful contribution to the understanding of variation in catches and **recommends** that *the Secretariat continue to develop this work by incorporating target species and making the data available via a web extraction tool.*

SCR Doc. 13/007 - O.A. Jørgensen, Ole Secher Tendal and Nanette Hammeken Arboe - Preliminary mapping of the distribution of corals observed off West Greenland as inferred from bottom trawl surveys 2010-2012

During 2010-2012 corals were sampled in 9 bottom trawl surveys conducted by the Greenland Institute of Natural Resources along the west coast of Greenland at depths down to 1500 m. In total, 779 trawl hauls were completed of which 202 contained one or several species of corals. The catches were small, only five records > 1 kg. Corals from several taxonomic groups were identified: Alcyonacea (soft corals), Gorgonacea (branching corals), Pennatulacea (sea pens) ,Scleractinia (stony corals), and Antipatharia (black corals). There were few corals (mainly soft corals) at depths < 500 m. Only in a small area between 63°N and 64°N and at 1000-1500 m depth was there a relatively high density and diversity of corals.

SCR Doc. 13/10 - 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 1997-2012

Greenland halibut (*Reinhardtius hippoglossoides*), American plaice (*Hippoglossoides platessoides*) and Atlantic cod (*Gadus morhua*) indices from the bottom trawl survey that Spain carries out in Spring since 1995 in Div. 3NO of the NAFO Regulatory Area are presented. Mean catch per town, biomass, length for the three species are presented since 1997, year in which the survey extended the depth strata. For Greenland halibut and Atlantic cod the age distributions are presented, too. Greenland halibut biomass and abundance estimates present a decreasing trend since 1999 and an increasing until 2009. In 2011-2012 the biomass drops under the 2008 value. In 2011 and 2012 the presence of all the ages is poor. For American plaice we can see an increasing trend along the whole period. No good recruitments were seen since 2004. For Atlantic cod it can be seen an increasing since 2005. There have been no good recruitments since 2009.

SCR Doc. 13/11 - 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

Mean catches, biomass and length distribution from the Spanish survey in 3NO for yellowtail flounder (*Limanda ferruginea*) are presented for the period 1995-2012, for redfish (Sebastes spp) for the period 1997-2012 and for witch flounder (*Glyptocephalus cynoglossus) for* the period 2002-2012. Yellowtail flounder does not show a clear trend since 1998. Redfish indices oscillate greatly over time. Good year classes have not been registered recently. Witch flounder is very scarce and also lacks a clear trend in the data series, being the values always poor. Recruitment was quite good at the beginning of the series but very poor in recent years.

SCR Doc. 13/12 - 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 Div. 3NO

Data for roughhead grenadier (*Macrourus berglax*), thorny skate (*Amblyraja radiata*) and white hake (*Urophycis tenuis*) from the Spanish Spring survey are presented, for roughhead grenadier and thorny skate for the period 1997-2012 and for white hake for the period 2001-2012. The length distribution is presented as numbers per haul stratified mean catches. The indices of roughhead grenadier show no clear trend. Thorny skate indices increased to a historical maximum in 2000 and after which it has followed an oscillating trend until 2011 with an increase in 2012. White hake biomass shows a decline since the great maximum in 2001, with a small peak in 2005. Values in 2011 and 2012 were slightly higher than in previous year but nevertheless represented one fifth of the 2001 maximum.

SCR Doc. 13/13 - José Miguel Casas and Diana González Troncoso - Results from Bottom Trawl Survey on Flemish Cap of June-July 2008-2012

A stratified random bottom trawl survey on Flemish Cap has carried out since 1988 up to 1460 meters since 2004. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, Greenland halibut, roughhead grenadier and shrimp are presented. The general indexes for this year are estimated taken into account the traditional swept area (strata 1-19, up to depths of 730 m.) and the total area surveyed (strata 1-34, up to depths of 1460 m.). The composition of the species in 2012 is similar to that found in the beginning of the series: cod at high levels, shrimp residual, redfish fluctuating around 200-300 kt. and Greenland halibut and grenadiers at low levels. Everything seems to point to a return to the situation found at the beginning of the EU survey series, and prior to the changes induced by the collapse of cod in the late 90´s. Only American plaice with low values of biomass does not show clear signs of recovery.

SCR Doc. 13/14 - Adriana Nogueira, Xabier Paz and Diana González-Troncoso - Ecological trend on demersal community in the Southern Grand Banks (NAFO Div. 3NO) from the Spanish Surveys: 2002- 2011

Some ecological indices were calculated from the data obtained in the research surveys conducted by Spain in NAFO Div. 3NO between the years 2002 and 2011. These indices were calculated for individual populations (intrinsic population rate of growth and mean length) and for all the community (ABC curves, indices about faunal diversity, proportion of non-commercial species, mean length in community and size spectra). We use the data of twenty five species caught in the survey along the years, included Northern shrimp (*Pandalus borealis*). The data of Northern shrimp, capelin (*Mallotus villosus*) and Northern sand lance (*Ammodytes dubius*) have a great influence in the value of the indices, as their abundance is very high in relation to their contribution to the biomass. The indices present a general stable pattern with a slight improvement in recent years. After two decades of moratorium, yellowtail flounder (*Limanda ferruginea*) seems to be recovered and other important commercial species as Atlantic cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*) begin to recover in the South of the Grand Banks.

SCR 13/15 - Heino Fock and Christoph Stransky - Stock Abundance Indices and Length Compositions of Demersal Redfish and Other Finfish in NAFO Sub-area 1 and near bottom water temperature derived from the German bottom trawl survey 1982-2012

Survey abundance, biomass estimates and length compositions for golden and deep sea redfish >= 17 cm (*Sebastes marinus* and *S. mentella*), juvenile redfish <17 cm, American plaice (*Hippoglossoides platessoides*), Atlantic and spotted wolfish (*Anarhichas lupus* and *A. minor*) and thorny skate (*Raja radiata*) in Division 1C to 1F were presented. In 2011, time series for the indices were calculated based on exact swept areas. For golden redfish, American plaice and both species of wolffishes, stocks sizes have declined significantly until the early 1990s and remained at a low level since until 2000. Since then, abundances increased only slightly and for 2012, indices are well below the average values from the 1980s. For thorny skate, abundances increased in the early 1990s and for deep-sea redfish in the late 1990s. All upward trends observed until 2004-2007 are stagnant since then. All stocks considered are presently composed of small and mainly juvenile specimens except for spotted wolffish. Near bottom water temperature continued to be high since 1996.

SCR 13/16 - Esther Román, Concepción González-Iglesias and Diana González-Troncoso - Results for the Spanish Survey in the NAFO Regulatory Area of Division 3L for the period 2003-2012

The series for the Spanish survey in Div. 3L of mean catches, biomass and length distribution for Greenland halibut, American plaice and witch flounder are presented for the period 2003-2012. Greenland halibut biomass and abundance estimates show an increasing trend since 2003, cut in year 2009. In 2011-2012 the biomass drops under the 2006 value. American plaice biomass and abundance estimates present an increasing trend since 2010. Regarding witch flounder, the biomass and abundance decreased in 2012, but there is no a clear trend in the period 2003-2012.

SCR 13/17 - Esther Román, Ángeles Armesto and Diana González-Troncoso - Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2012

The series for the Spanish survey in Div. 3L of mean catches, biomass and length distribution for Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish are presented for the period 2003-2012. Atlantic cod shows an increasing trend since 2008. Roughhead grenadier has decreasing since 2008. Redfish presents an increase in its indices since 2007. Thorny skate indices decreased between 2008 and 2011, increasing in 2012. Black dogfish presents no trend during the series.

SCR Doc. 13/24 - W. Brodie, P.A. Shelton, E. Couture, and K. Dwyer - A Discussion of the NAFO Precautionary Approach Framework

SCR Doc. 13/24 presented the development of the NAFO precautionary approach (PA) framework, the current status of implementation and its many challenges. In 2004, the Fisheries Commission adopted a precautionary approach framework for the management of NAFO stocks. The framework, which operates on a single stock at a time, identifies five zones into which a stock can be classified, depending on the status of the stock with respect to fishing mortality and biomass. The framework specifies various limit and buffer reference points which define zones, as well as corresponding recommended strategies and management actions associated with each zone. A recent initiative within NAFO has been the development of conservation plans and rebuilding strategies for some depleted stocks, which have drawn on the current PA framework in establishing harvest control rules. Implementation of the PA in the context of these recently developed rebuilding strategies for depleted groundfish stocks such as Atlantic cod and American plaice on the Grand Bank was also discussed. This process has resulted in some questions around the adequacy of the existing framework and some of its reference points, and suggests that some further examination of the PA is warranted. STACREC noted that the proposed SC-FC WG on risk-based management strategies may have duties related to PA development and implementation.

SCR 13/26 - Rasmus Nygaard and Ole A. Jørgensen - Biomass and Abundance of Demersal Fish Stocks off West and East Greenland estimated from the Greenland Institute of Natural resources Shrimp Fish Survey, 1988-2012.

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2012. The gear was changed in this survey in 2005. No correction for this gear change has been made and the 2005 - 2012 time series is hence not directly comparable with 1988-2004 time series. In July-August 220 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.13/26).

SCR Doc. 13/32 – Mandado, M. and A. Vázquez – An index of retrospective pattern in VPA analysis.

Several aggregation indices are proposed to measure the occurrence of retrospective pattern in VPA. Their behaviour is checked by simulation. The sensibility of those indices to changes in natural mortality and in survey catchability would point to these two circumstances as responsible for pattern, among other possible causes.

SCR Doc. 13/47 –Vázquez, A., A. Pérez-Rodríguez, and M. Mandado – On Variability of Survey Results.

An analysis of the variability of the catches of RV *Cornide de Saavedra* and RV *Vizconde de Eza* in Flemish Cap survey is used as a basis for analysing results of a comparative trawling experiment done between both vessels in 2003 and 2004. Results are interpreted globally, and they indicate a generalized higher catchability of RV *Vizconde de Eza*.

7. Other Matters

a) CWP Handbook

Unfortunately the CWP Handbook is not yet available for review.

b) Summary on Progress of Previous recommendations

In 2010 the following recommendation was made:

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

STATUS: Nothing to report and this recommendation is reiterated.

This was further discussed and it was decided not to pursue it any further.

c) Stock Assessment Spreadsheets

Designated Experts were reminded to include their spreadsheets under the DATA tab on the SharePoint.

d) Historical catch data for publication in an SCS Document

It was noted that there is some historical catch information available at the Secretariat that it is not easily available to the public. It was agreed that this information might be interesting and useful. The Secretariat agreed to compile the information for presentation in an SCS document for next year.

8. Adjournment

The Chair thanked the participants for their valuable contributions to the Committee. Special thanks were extended to the rapporteur and the Scientific Council Coordinator and all other staff of the NAFO Secretariat for their invaluable assistance in preparation and distribution of documents. There being no other business the Chair adjourned the meeting at 1200 hours on 20 June 2013.

Annex 1. Historical Catch Data by Species and Division

Table 1a. STACFIS catch ('000 t) estimates by NAFO Division and species from 2000 to 2012 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			N/A	0.10	N/A	N/A
	2012			N/A	0.12	N/A	N/A
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
	2012					0	0
Cod[1]	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	0.58	0.29
	2012				13.70	0.53	0.21

[1] Cod in 3M: Values for 2011 and 2012 are estimated from the assessment conducted in year + 1

Species	Year	2J	3K	3L	3M	3N	3O
Redfish[2]	2000			0.66	3.66	0.82	10.00
	2001			0.65	3.22	0.25	20.30
	2002			0.65	2.93	0.33	17.20
	2003			0.58	1.88	0.75	17.20
	2004			0.40	2.92	0.24	3.80
	2005			0.58	6.55	0.08	10.70
	2006			0.05	7.16	0.44	12.60
	2007			0.12	6.66	1.55	5.18
	2008			0.22	8.47	0.38	4.00
	2009			0.06	11.32	0.99	6.40
	2010			0.26	8.50	3.69	5.20
	2011			1.97	11.12	5.40	6.50
	2012				7.63	4.26	6.40
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
	2012			0.12		3.84	0.27
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
	2012					0.01	0.13

[2] Redfish in 3M: Values are estimated total redfish catch

Species	Year	2J	3K	3L	3M	3N	3O
Witch	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
	2012	0.07	0.02	0.11		0.20	0.11
Yellowtail	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
	2012			0.20		2.46	0.47

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

Species	Year	0A	0B	1AB Offshore	1CD	2G	2H	2J	3K	3L	3M	3N	3O	Other
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									
	2012	6.37	6.97	6.50	7.47									
Roughead Grenadier	2000								139	1382	2109	888	38	211
	2001								97	1465	753	754	48	
	2002								147	1905	869	700	36	
	2003					1	4	16	91	1342	886	1201	443	
	2004					4	8	19	58	1310	844	897	42	
	2005						1	15	93	642	457	235	13	
	2006							21	54	696	488	111	6	44
	2007							10	22	294	191	146	1	
	2008					0	0	1	3	347	355	132	9	
	2009								6	379	136	102	6	
	2010							7	24	649	153	94	14	
	2011							1	61	426	294	224	1	
	2012							3	13	652	511	119	5	

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 7 to 20 June 2013, 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), France (in respect of St-Pierre et Miquelon), Japan, Russian Federation, and the United States of America. Various members of the Committee, notably the designated stock experts, were significant in the preparation of the report considered by the Committee.

The Chair, 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 2012

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 2012. 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 (SCS Doc. 13/02). 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. Again 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 and 2012 catches has made it impossible for STACFIS to provide the best assessments for some stocks and had lead to increased uncertainties for others for which analytical assessment could be carried. STACFIS notes that if it does not have the information and time available to estimate catches during the June meeting, it will be unable to perform assessments and conduct the necessary work to provide answers to FC requests including advices on TAC levels.

III. STOCK ASSESSMENTS

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

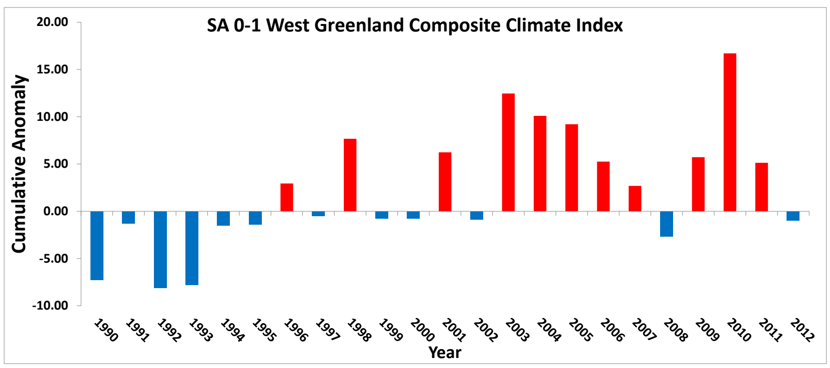
(SCR Doc. 13/03, 13/04, 13/19, SCS Doc. 13-08, 13-14)

Recent Conditions in Ocean Climate and Lower Trophic Levels

● The composite climate index in Subarea 0-1 shifted slightly negative in 2012 after several years of mainly high positive anomalies reaching a maximum in 2010.

● The composite spring bloom index revealed near normal conditions in recent years after a large decline in productivity in 2010.

● The abundance of calanoid copepods was above normal in SA 0-1 in 2012.



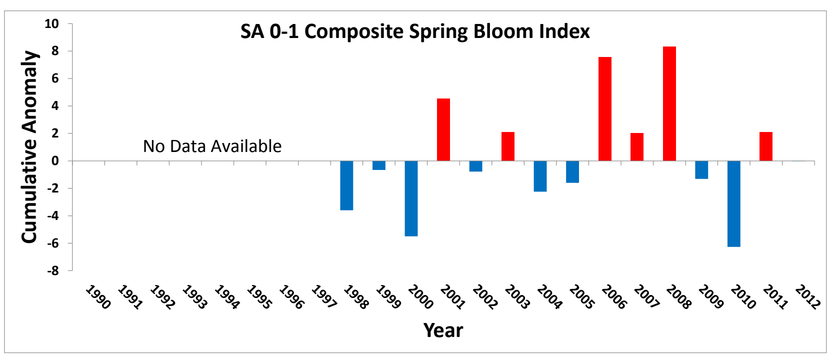


Fig. IV-1. Composite climate index for NAFO Subarea 1 (West Greenland) derived by summing the standardized anomalies of meteorological and ocean conditions during 1990-2012 (top panel), composite spring bloom (magnitude) index during 1998-2012 (bottom panel). Note the 2012 value for the composite spring bloom is zero. Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

Environmental Overview

Hydrographic conditions in this region depend on a balance of atmospheric forcing, advection and ice melt. Winter heat loss to the atmosphere in the central Labrador Sea is offset by warm water carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried south by the east Baffin Island Current. The water mass circulation off Greenland comprises three main currents: Irminger Current (IC), West Greenland and East Greenland Currents (WGC and EGC). The EGC transports ice and cold low-salinity Surface Polar Water (SPW) to the south along the eastern coast of Greenland. The East Greenland Coastal Current (EGCC), predominantly a bifurcated branch of the

EGC on the inner shelf, transports cold fresh Polar Water southwards near the shelf break. The IC is a branch of the North Atlantic current and transports warm and salty Atlantic Waters northwards along the Reykjanes Ridge. The current bifurcates south of the Denmark Strait and a small branch continues northward through the strait to form the Icelandic Irminger Current. The bulk of the IC recirculates to the south making a cyclonic loop in the Irminger Sea. The IC transports then southwards salty and warm Irminger Sea Water (ISW) along the eastern continental slope of Greenland, parallel to the EGC. The core properties of the water masses of the WGC are formed in the western Irminger Basin where the EGC meets the IC. After the currents converge, they turn around the southern tip of Greenland, forming a single jet (the WGC) and propagate northward along the western coast of Greenland. During this propagation considerable mixing takes place and ISW gradually deepens. The WGC consists thus of two components: a cold and fresh inshore component, which is a mixture of the SPW and melt water, and saltier and warmer ISW offshore component. The WGC transports water into the Labrador Sea and, hence, is important for Labrador Sea Water formation, which is an essential element of the Atlantic Meridional Overturning Circulation (AMOC).

Ocean Climate and Ecosystem Indicators

The composite climate index in Subarea 0-1 was negative in 2012 after several years of positive anomalies reaching a maximum in 2010 (Figure X). Cold, fresh conditions persisted in the early to mid-1990's followed by a general warming trend in the past decade with the exception of a brief cooling event in 2008. The composite spring bloom index revealed near normal conditions in recent years after a large decline in the production cycle in 2010 that coincided with the peak in the climate index. Despite a strong positive phase of the North Atlantic Oscillation (NAO) in winter 2011-2012 that normally results in cool air and water temperatures, the annual sea surface temperature anomalies for 2012 indicate positive anomalies of 1.0°C along West Greenland. This was the result of exceptional atmospheric warming during summer 2012 resulting in higher than normal annual air temperatures and rapid retreat of sea ice. Time series of mid-June temperatures on top of Fylla Bank were near the long-term mean. The normalized near-surface (<100m) temperature and salinity indices were slightly below normal over the West Greenland shelf. Water temperatures and salinity in the upper 700m along the Cape Desolation section in autumn remained higher than normal. The upper 50 to 300m of the Fyllas Bank section was characterized by negative potential temperature anomalies, in contrast to positive temperature anomalies between 300 and 700m. The salinity of the upper 500m was below its long-term mean.

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

(SCR Doc. 13/06, 23, 33, 35; SCS Doc. 13/08, 9, 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).

A TAC was first established for SA 0+1, including Div. 1A inshore, in 1976 and set at 20 000 t. It increased to 25 000 in 1979 and remained at this level until 1994. In 1994 Scientific Council decided to make separate assessments and advice for the inshore area in Div. 1A and for SA 0 + Div. 1A offshore + Div.1B-1F. As a result the TAC for SA 0 + Div. 1A offshore + Div.1B-1F decreased to 11 000 t and remained at this level until 2001 with almost all the catch coming from Div. 0B and Div. 1CD. Between 2001 and 2010 the TAC increased to 27 000 t following a series of new surveys in previously unassessed areas of Div. 0A and 1AB and improving stock status in Div. 0B and 1CD. Since 2001 the TAC has been divided between Div. 0A+1AB and Div. 0B+1C-F with current levels of 13 000 t for Div. 0A+1AB and 14 000 t for Div. 0B+1CD (Fig. 1.1).

Catches have been reported to NAFO STATLANT 21 since 1965. Catches in 0 + Div. 1A offshore + Div.1B-1F were at very low levels from 1965-1972, then fluctuated between approximately 4 500 t and 20 000 t from 1973-1980. Catches during the period from 1981 to 1989 varied around 3 000 t, increased to 18 500 t in 1992 then declined to 11 800 t in 1994. Catches were relatively stable at approximately 8 500 t from 1995 to 2000. Since then catches have increased to current levels of 27 300 t following increases in the TACs, with the TAC achieved in most years (Fig. 1.1).

The fishery in Subarea 0. Before 1984, USSR and GDR conducted trawl fisheries in 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 and catches reached 12 800 t in 1992 followed by a decline to 3 200 t in 1995. In 1995 a Canadian gillnet fishery began. During 1995-2000 catches increased to 5 400 t. Since 1998 the fishery in Div. 0B has been executed almost exclusively by Canadian vessels. Catches have increased since then and have been approximately 6 900 t since 2010. In 2012 the catch was 7 000 t comprised of about 1/3 gillnet and, 2/3 trawl (mainly twin trawl).

In Div. 0A fishing occurred in only a few years between 1993 and 2000 with catches of less than 700 t. Catches increased from 3 000 t in 2001 to 6 600 t in 2009, following increases in the TAC and have remained at approximately 6 400 since then. Longline gear was used for only a few years in the early 2000s and took about 1/3 of the catches in 2003. Gillnets entered the fishery in 2004 and in 2012, the catch was 6 400 t, evenly distributed between gill net and trawl gears (mainly twin trawl).

The fishery in Div. 1A offshore + Div. 1B-1F. The fishery in SA 1 took place in Div. 1D and to a minor extent Div. 1C prior to 2001. Catches were 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 2012. Catches fluctuated between 1 800 and 5 900 t during the period 1987-2000. Catches in Div.1CD varied around 5 700 t from 2000-2009 then increased in 2010 to 13 700 t and has remained at that level since then. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 t in 2004 and there has not been any gillnet fishery in the area since then. An offshore longline fishery in Div. 1CD took place during 1994-2002. Since then longline fishery has only taken place irregularly and with small catches. Offshore catch in Div. 1CD in 2012 was 7 500 t taken entirely by trawl gear.

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 600 t in 2001 to 4 000 t in 2005, then increased in 2006 and has varied around 6 400 t since then. Catch in 2012 was 6 500 t. All catches in recent years were taken by trawlers from Greenland, Russian Federation and Faroe Islands.

Inshore catches in Div. 1B-1F amounted to 440 t in 2012, which were mainly taken by gillnets. The offshore catches were taken by single and twin trawl.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	19	19	24	24	24	24	27	27	27	27
SA 0	10	10	12	11	11	12	13	13	13	
SA1 exl. Div. 1A inshore	10	10	12	12	12	12	14	14	14	
Total STATLANT 21 [1]	19[3]	20[3]	24[3]	23[3]	22	25	27	27	27	
Total STACFIS	19	20	24	23	23	25	27	27	27	

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

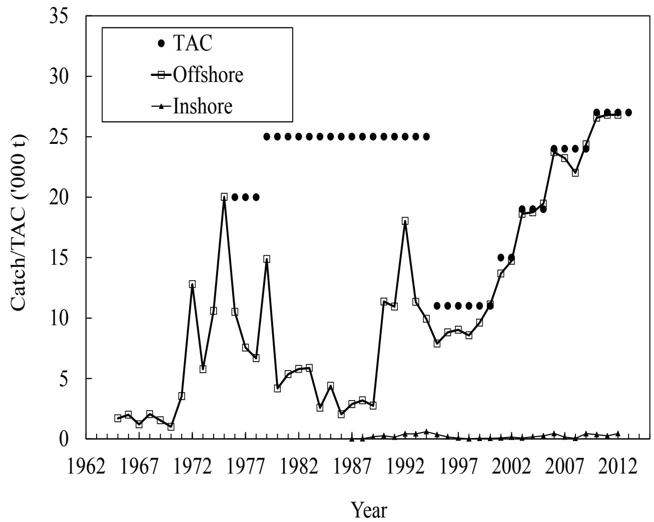


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

b) Input Data

i) Commercial fishery data

Length frequencies were available from Canadian fisheries for the Div. 0A gillnet and Div. 0B gillnet and trawl. The bulk of the catches in the gillnet fishery in Div. 0A were between 50 and 80 cm with a mode around 65 cm, similar to that seen in previous years. The 2012 0B gillnet fishery had a length range similar to that seen in Div. 0A, but shifted slightly to smaller sizes (mode of 63 cm) compared to 2011 (mode of 65 cm). The length distributions in the single and twin trawl fishery in Div. 0B had modes at 52 cm and 50 cm, respectively. The modes in both Div. 0A and 0B trawl catches have varied between 49 and 52 cm in recent years.

Length frequencies were available from trawl fisheries by Greenland in Div. 1A and 1D, Russian Federation in Div. 1D, and Norway in Div. 1D. Samples from a Norwegian long-line fishery in Div. 1D in 2011 were also available. In 2012 catch from Greenland in Div. 1A had a mode of 48 cm. In recent years the trawl catches have been dominated by fish of 44-52 cm. In Div. 1D the catches by Russian Federation, Norway and Greenland showed modes around 48-54 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 in 2011 the 2008-2009 level. The CPUE increased further in 2012. 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. CPUE decreased slightly in 2012 but is still at a high level.

The standardized trawl CPUE series for Div. 0A+1AB combined decreased slightly in 2012 but has shown an increasing trend since 2007 (Fig 1.2). Catch rates before 2001 are from only one or two vessels fishing a small exploratory allocation and may not be directly comparable to subsequent years.

The standardized catch rates from Div. 0B decreased gradually from 1995 to 2002, but has been increasing again until 2009. CPUE has been decreasing since then and was in 2012 among the lowest in the time series. The unstandardized catch rates are, however, now at the same level as in Div. 1CD.

Standardized catch rates in Div. 1CD decreased gradually from 1989-1997 but increased since then until 2008. CPUE decreased slightly in 2009 and 2010 but increased between 2011 and 2012 to the highest level seen since 1990.

The standardized trawl CPUE series for Div. 0B+1CD combined was relatively stable from 1990-2004, then increased from 2004-2009. CPUE has decreased since 2009 but in 2012 it is still above the level observed during 1990 to 2004 (Fig. 1.2). Catch rates in 1988 and 1989 are from one 4000 GT vessel fishing alone in the area and may not be directly comparable to subsequent years.

Standardized CPUE for gillnets in Div. 0A increased gradually from 2006-2011 with a slight decrease in 2012 (Fig. 1.3).

Standardized CPUE for gill nets in Div. 0B has been increasing since 2007 and was at the highest level in the time series in 2012 (Fig. 1.3).

Unstandardized gillnet CPUE is significantly higher in Div. 0A compared to Div. 0B and the unstandardized trawl CPUE in 2012 were also higher in Div. 0A and 1AB compared to Div, 0B-1CD,

It is not known how the technical development of fishing gear or vessel changes in the fleets has influenced the catch rates. There are indications that the coding of trawl gear type in the log books is not always reliable, which also can influence the estimation of the catch rates, therefore, the catch rates should be interpreted with caution.

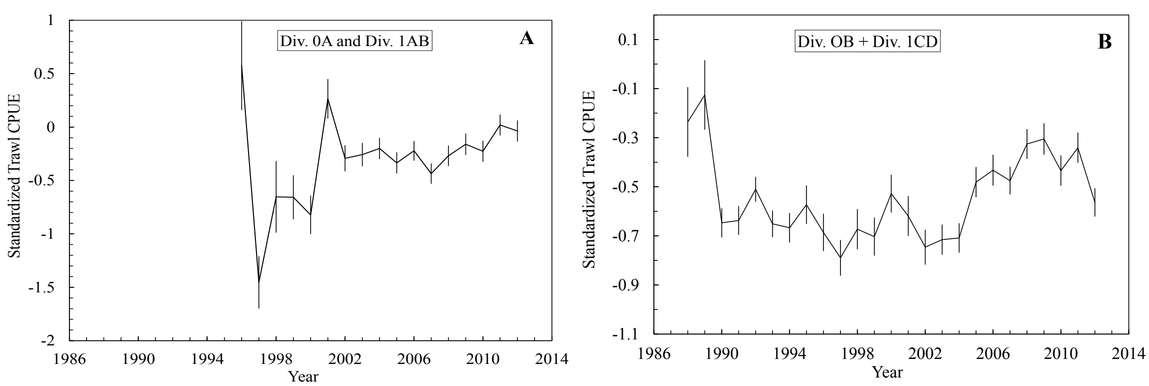


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawler CPUE from Div. 0A and Div. 1AB with ± S.E . B: Combined standardized trawler CPUE from Div. 0B and Div. 1CD with ± S.E.

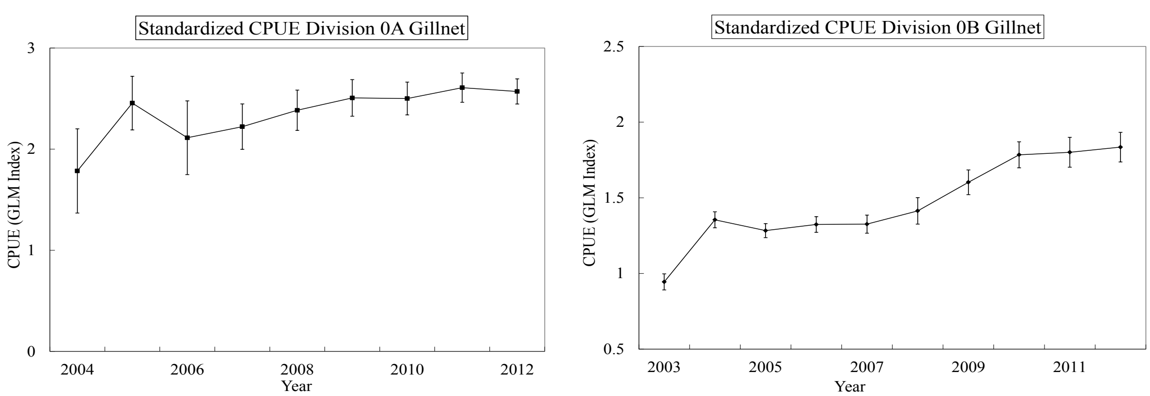


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): Standardized gillnet CPUE from Div. 0A (left). Standardized gillnet CPUE from Div. 0B (right).

ii) Research survey data

Japan-Greenland and Greenland deep sea surveys in Div. 1CD. From 1987-95 bottom trawl surveys were conducted in Div. 1BCD jointly by Japan and Greenland (the survey area was re-stratified and the biomass estimates were recalculated in 1997). The Japan-Greenland survey in 1987 only covered depths down to 1000 m and the biomass at depths 1000-1500 m is estimated by a GLM. In 1997 Greenland initiated a new survey series covering Div. 1CD. The index of trawlable biomass in Div. 1CD has been variable with a gradually increasing trend since 1997. 2011 was the highest in the time series but then in 2012 biomass decreased to the lowest level seen since 2000 (Fig. 1.4). Abundance increased between 1997 and 2001 was relatively stable during 2002-2011 but decreased to the lowest level in the time series in 2012.

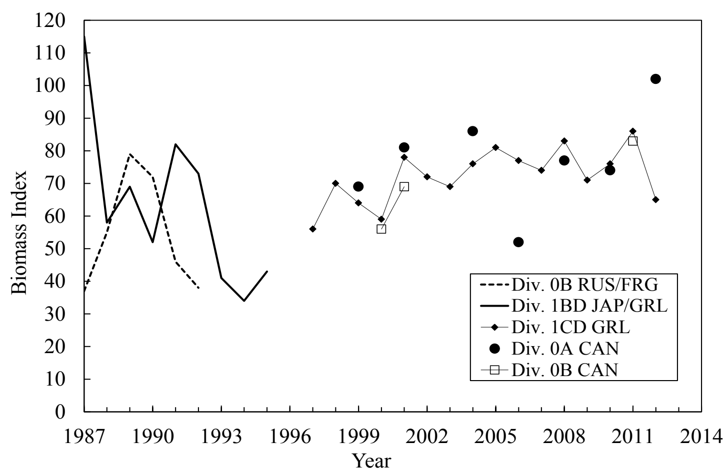


Fig. 1.4. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass indices from bottom trawl surveys. There was incomplete coverage of the 2006 survey in Div. 0A. Further, results for surveys from Div. 1A (2001, 2004 and 2010) and Div. 0A-North (2004, 2010, 2012) are not included.

Canada deep sea survey in Div. 0A. The index of trawlable biomass for Div. 0A-South has been variable with a generally increasing trend from 1999 to 2012. The 2012 estimate is the highest of the time series. However, it is influenced by one very large set in a depth stratum that comprises 30% of the area covered. With this set removed the biomass estimate drops 15%. In 2006 the survey suffered from poor coverage with two of the four strata at depths 1001-1500 m missed that had accounted for approximately 14% of biomass in previous surveys (Fig. 1.4). Abundance increased slightly in 2012 but has been relatively stable since 1999. The overall length distribution showed a small mode at 21 cm, similar to that observed in 2006, with a larger mode at 42 cm, slightly higher than seen in previous surveys. The abundance of fish 40-60 cm has been increasing since 2006.

Div. 0A-North was surveyed again in 2012 with much better coverage than either of the previous surveys conducted in 2004 and 2010 resulting in almost a doubling of the biomass and abundance estimates for this area. Length frequencies had a small mode at 21 cm, similar to that observed for 0A-South, with a larger mode at 45 cm, similar to the 2004 distribution.

Canada deep sea survey in Div. 0B. Division 0B was last surveyed in 2011, the third time this area had been surveyed using RV *Pâmiut*. Prior to this there had been a survey conducted in 1986 using the RV *Gadus Atlantica*. Biomass had increased compared to previous surveys in 2000 and 2001. 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 and fish survey in Div. 1A-1F. Since 1988 annual surveys with a shrimp trawl have been conducted off West Greenland during July-September. The survey covers the area between 59°N and 72°30'N (Div. 1A-1F), from the 3-mile limit to the 600-m depth contour line. The survey area was re-stratified in 2004 based on better information about depths. All biomass and abundance indices have been recalculated. The recalculation did not change the trends. The trawl was changed in 2005 but the data have not been adjusted and the two time series are not directly comparable.

Estimated trawlable biomass and abundance of Greenland halibut in the offshore areas has fluctuated during 2005-2012 with an overall declining trend. Biomass in 2011 was the highest in the 2005-2012 time series followed by a decline in 2012 to the lowest in the time series.

The year class index of one-year-old fish in the total survey area, including Disko Bay, was variable for year classes 1989 to 1996 then increased to a peak in 2000 followed by a sharp decline in 2001 and a period of relative stability followed by an increase from 2008 to the highest in the time series in 2010. This was followed by a decrease in the 2011 year class to the lowest estimate since 1996 and was at the level of the early 1990s (Fig. 1.5). This decrease was seen in all Divisions.

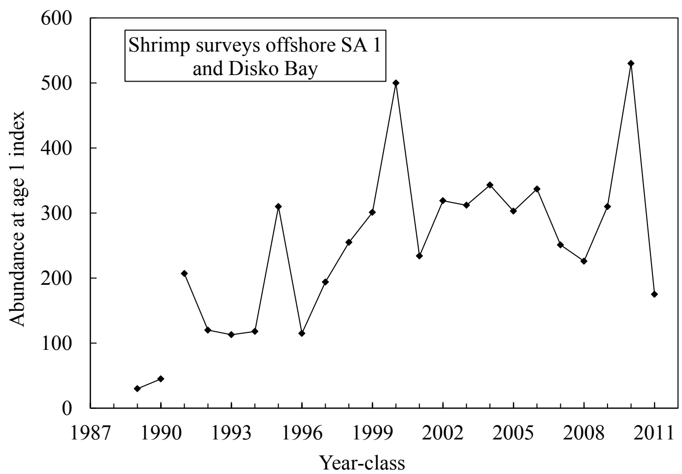


Fig. 1.5. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1). The new 2005–2012 time series estimates are adjusted to the old 1989-2004 time series.

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 in 2012, but results were not tabled as the outcome of the analysis did not improve significantly over previous attempts. 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: Catches have increased in response to increases in the TAC from approximately 10 000 t in the late 1990s to 26 900 t in 2010, and remained at that level in 2012.

Data: Biomass indices from deep sea surveys in 2012 were available from Div. 0A and Div. 1CD. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2012. Length distributions were available from both surveys and the fishery in SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD.

Assessment: No analytical assessment could be performed.

Commercial CPUE indices. Combined standardized trawl catch rates in Div. 0A and Div. 1AB decreased slightly in 2012 but has shown an increasing trend since 2007. Standardized CPUE for gillnets increased gradually from 2006-2011, with a slight decrease in 2012.

The combined Div. 0B and 1CD standardized catch rates were relatively stable from 1990-2004, then increased from 2004-2009. CPUE has decreased since 2009 but in 2012 it is still above the level observed during 1990 to 2004. The standardized CPUE for gillnets in Div. 0B has been increasing since 2007 and in 2012 was at the highest level in the time series.

Unstandardized gillnet CPUE is significantly higher in Div. 0A compared to Div. 0B and the unstandardized trawl CPUE in 2012 were also higher in Div. 0A and 1AB compared to Div. 0B-1CD.

Biomass: The index of trawlable biomass for Div. 0A-South has been variable with a generally increasing trend from 1999 to 2012. The 2012 estimate is the highest of the time series. However, this result is influenced by one very large set when removed reduces the estimate by 15%. Div. 0A-North was surveyed again in 2012 with much better coverage than either of the previous surveys conducted in 2004 and 2010 resulting in a significant increase in biomass and abundance estimates for this area.

The survey biomass index in Div. 1CD has increased gradually over the fourteen year time series, was the highest observed in 2011, but decreased in 2012 to the lowest level seen since 2000.

Recruitment: Recruitment (age one) in the entire area covered by the Greenland shrimp survey has been rather stable from 2003-2010. Then recruitment increased to the highest level in the time series in 2011 but decrease to the lowest level seen since 1997 (1996 year-class) in 2012.

Fishing Mortality: Level not known.

State of the Stock: Div. 0A+1AB: The biomass index in Div. 0A-South has been gradually increasing while abundance has remained relatively stable since 1999, the beginning of the time series. The biomass was in 2012 well above B_{lim}. Additional biomass has been estimated in Div. 0A-North with the improved coverage of the 2012 survey. Length composition in the surveys has varied without trend over the time series. Trawl catches have been relatively stable with some variation without trend in the gillnet catch frequencies. Standardized CPUE indices in Div. 0A and 1AB have been increasing in recent years.

Div. 0B+1C-F: The biomass index in Div. 1CD has shown an increasing trend since 1997, but decreased in 2012. The biomass was in 2012 well above B_{lim}. Length compositions in the catches and deep sea surveys have been stable in recent years. Standardized CPUE has decreased since 2009 but in 2012 it is still above the level observed during 1990 to 2004. The Standardized CPUE for gillnets in Div. 0B has been increasing since 2007 and in 2012 was at the highest level in the time series.

e) Precautionary Reference Points

Age-based or production models were not available for estimation of precautionary reference points. A preliminary proxy for B_{lim} was set as 30% of the mean biomass index estimated for surveys conducted between 1997-2012 in Div. 1CD and 1999-2012 in Div. 0A-South Fig 1.6 and 1.7.

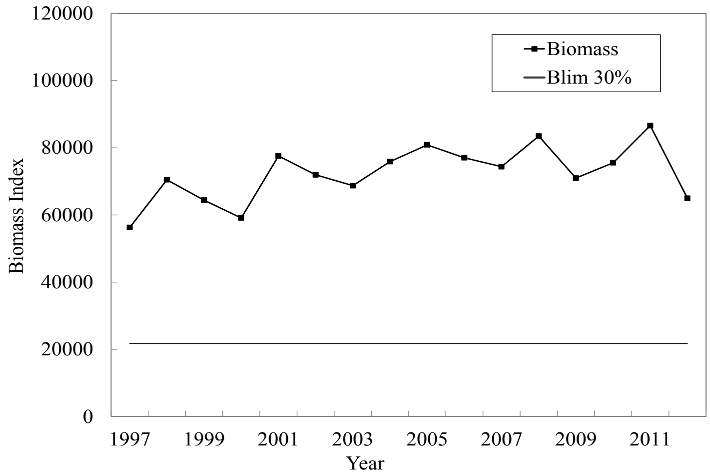


Fig. 1.6. Greenland halibut in Subareas 0+1: Biomass trends in Div. 1CD and preliminary B_{lim}.

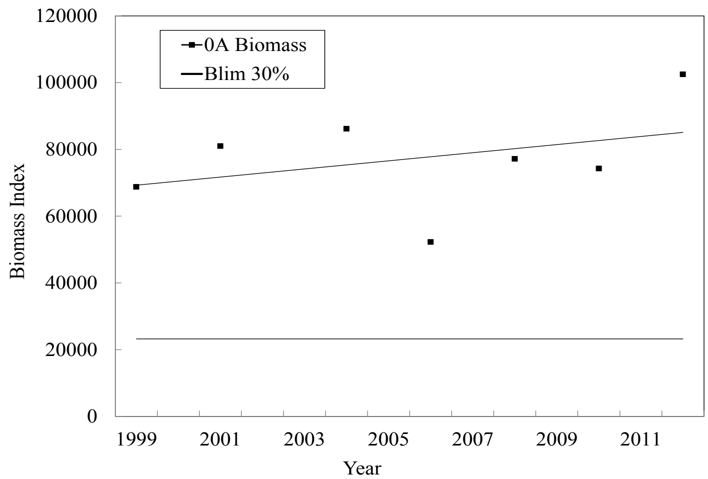


Fig. 1.7. Greenland halibut in Subareas 0+1: Biomass trends in Div. 0A and preliminary B_{lim}.

f) Research Recommendation

The next assessment will be in 2014.

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

Interim monitoring report

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. 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. There is little migration between the subareas and a separate TAC is set for each area. From 2012 the TAC has been split in two categories, an ITQ for vessels larger than 30' ft and a shared quota for small vessels and open boats. The split had several effects. In the Disko Bay in 2012, small open boats ran out of quota in the autumn of 2012, and larger vessels had only taken about 95% of their TAC at the end of the year. Furthermore, large ITQ vessels are allowed and able to catch in an area north of their native area and land in their home area. This had the effect that some Disko Bay vessels took part of their quota in Uummannaq and Upernavik leading to an increased fishery in these areas and some unused TAC in the Disko Bay (Table 2.1).

i) Fisheries and catches

Total catches 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 catches have decreased, but remained around 20 000 t/yr for the 3 areas combined.

Disko Bay: Catches increased from about 2 000 t in the mid 1980s and peaked in 2004 with more than 12 000 t. From 2006 catches decreased and in 2009 only 6 300 t was landed. In 2012 8500 tons were landed in the Disko Bay, but only between 7900 and 7750 tons were actually caught in the Disko Bay. (Table 2.1 and Fig 2.1, left)

Uummannaq: catches increased from a level of 3 000 t in the mid 1980s and peaked in 1999 at a level of more than 8 000 t. Catches then decreased and from 2002 were at a level of 5 000 to 6 000 t. In 2012 the TAC was increased to 6300 tons prior to the season. Small vessels and open boats ran out of shared quota in the autumn of 2012 but ITQ vessels still had some quota left at the end of the year. In total 6130 tons were caught in the Uummannaq area (Table 2.1 and Fig 2.1, center).

***Upernavik*:** Catches increased from the mid 1980's and peaked in 1998 at a level of 7 000 t. This was followed by a period of decreasing catches. In 2012, 6800 tons were caught in the Upernavik area, but part of these catches were landed in the Disko Bay (Table 2.1 and Fig 2.1, right).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Disko Bay – TAC					12.5	8.8	8.8	8.0	8.0	8.3
Disko Bay - Catch	12.9	12.5	12.1	10.0	7.7	6.3	8.5	8.0	7.8	
Uummannaq - TAC					5.0	5.0	5.0	5.0	6.0	6.3
Uummannaq - Catch	5.2	4.9	6.0	5.3	5.4	5.5	6.2	6.4	6.1	
Upernavik - TAC					5.0	5.0	6.0	6.0	6.0	6.8
Upernavik - Catch	4.6	4.8	5.1	4.9	5.5	6.5	5.9	6.5	6.8	
Division 1A Unknown		0.8							0.1	
STACFIS Total	22.7	22.9	23.2	20.6	18.9	18.3	20.6	20.9	21.3	

na no advice
ni no increase in effort

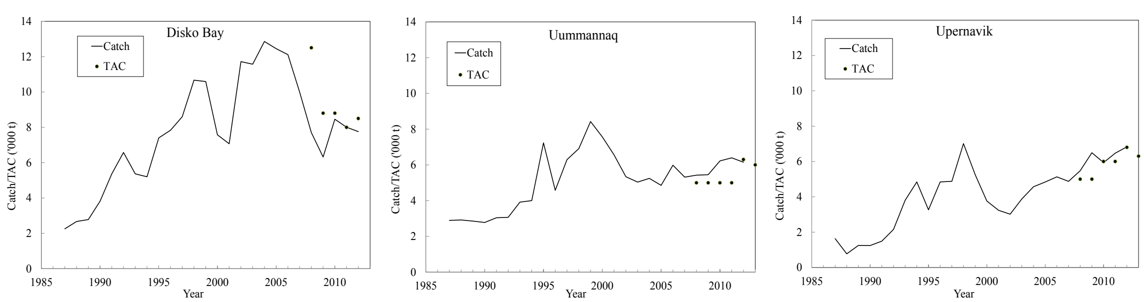


Fig 2.1. Greenland halibut in Div. 1A inshore: catches and TAC in Disko Bay, Uummannaq and Upernavik.

b) Data overview

i) Commercial fishery data

In the Disko Bay mean length in landings, have decreased since 2001 and the 2012 summer fishery mean was the lowest observed (Fig 2.2 left). In Uummannaq, the mean length increased in both the 2012 summer and winter longline fishery and the 2013 winter fishery (Fig 2.2 center). In Upernavik, mean length in the landings have been stable since 1999, except for a decrease in the 2010 and 2011 summer fishery (Fig 2.2 right). However, in 2012 the mean length increased in both the summer and winter longline fishery.

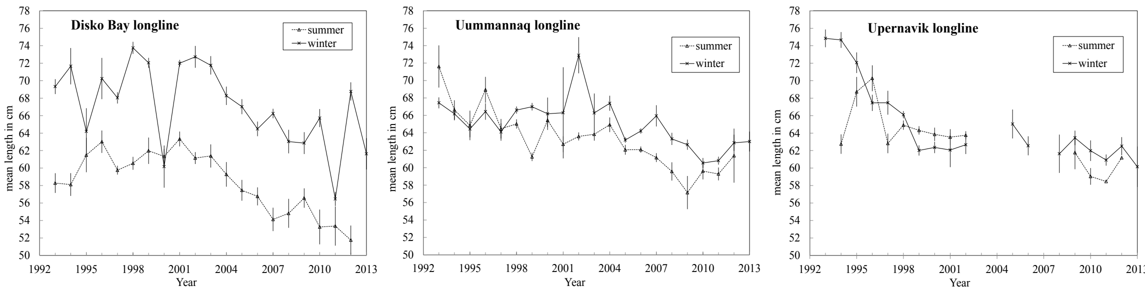


Fig. 2.2. Greenland halibut in Div. 1A inshore: Longline mean length in landings from Disko Bay, Uummannaq and Upernavik.

CPUE index. A standardized CPUE series based on logbooks provided by vessels larger than 30 ft was initiated in 2011 (Fig 2.3). However, the analysis only explained about 25 % of the variability in the data and only 5-30% of the catches were reported in logbooks. In 2012, the CPUE series indicated slight increase in the Disko bay, a decrease in Uummannaq and an increase in Upernavik.

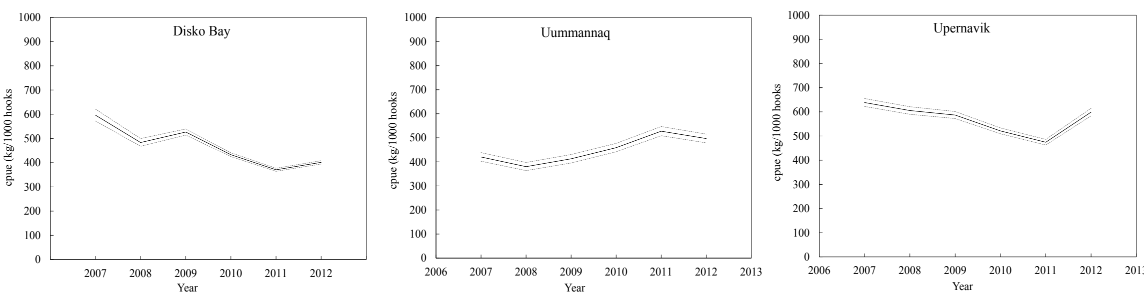


Fig 2.3. Greenland halibut in Div. 1A inshore: LOGBOOK CPUE =overall mean + year + month + vessel +-1SE.

ii) Research survey data

The Disko Bay part of the Greenland Shrimp and Fish survey: Annual abundance and biomass indices and length frequencies were derived from the stratified random bottom trawl survey. The trawl survey mainly catches individuals less than 50 cm. The gear was changed in 2005. From 2012, no correction for this gear change has been made and the indices from 2005 to 2012 have been recalculated according to the new gear, making the two time series non-comparable. After record high abundance estimate in 2011 driven by a large number of age1 individuals, indices decreased to slightly below average for the 2005 to 2012 period (Fig 2.4 left). Likewise the biomass index decreased from a record high in 2011 to below average in 2012 (Fig 2.4 right).

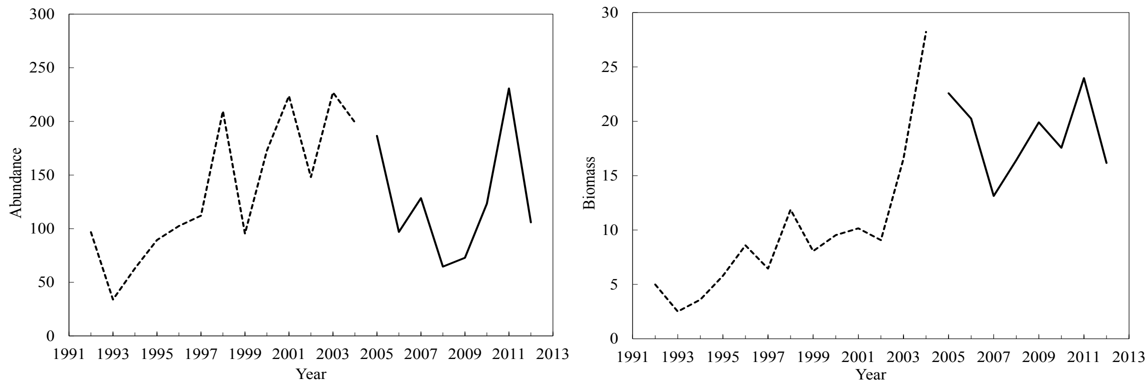


Fig 2.4. Greenland halibut in Div. 1A inshore: Disko Bay abundance and biomass indices for Greenland halibut from the Disko Bay part of the Greenland Shrimp and Fish trawl survey.

The Disko Bay Gillnet survey: The Disko Bay gillnet survey targets pre fishery recruits 35-50 cm using 4 varying meshsize sections. The survey started in 2001 and was continued in 2012. Both the CPUE and NPUE decreased from a record high in 2011 to below average in 2012 (Fig 2.5). However, in the 2012 survey the 60mm mesh section of the gillnet did not function properly.

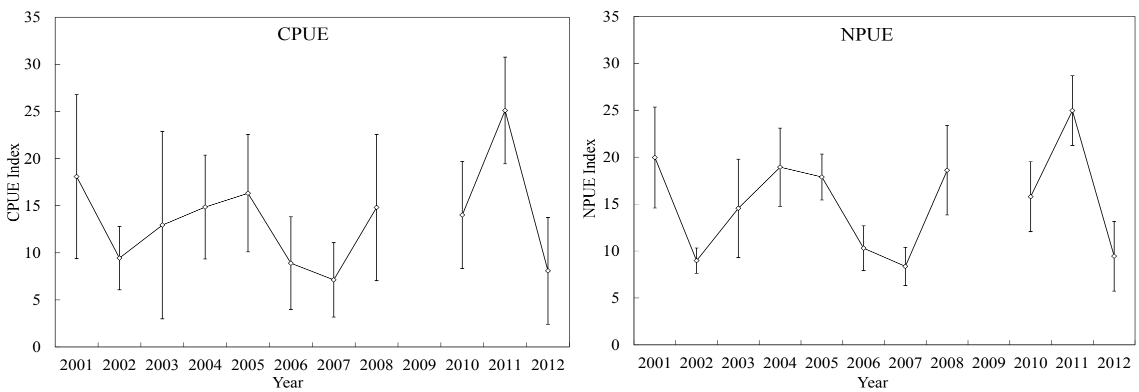


Fig 2.5. Greenland halibut in Div. 1A inshore: Disko Bay gillnet survey CPUE and NPUE + 95% CI indicated.

c) Conclusion

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

d) Research recommendations

These stocks will next be assessed in 2014.

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

(SCR Doc. 13/006)

a) Introduction

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is taken as by-catch in the Greenland halibut fishery. A total catch of 6 tons was estimated for 2012. 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 roughead grenadier.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agreed TAC	4.2	4.2	4.2							
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	
STATLANT 21	0.02	0.01	0.02	0.01	0.00	0.00	0.03	0.00	0.01	
STACFIS	0.02	0.01	0.02	0.03	0.00	0.00	0.03	0.00	0.01	

ndf : No directed fishing. No TAC set for 2007 – 2013.

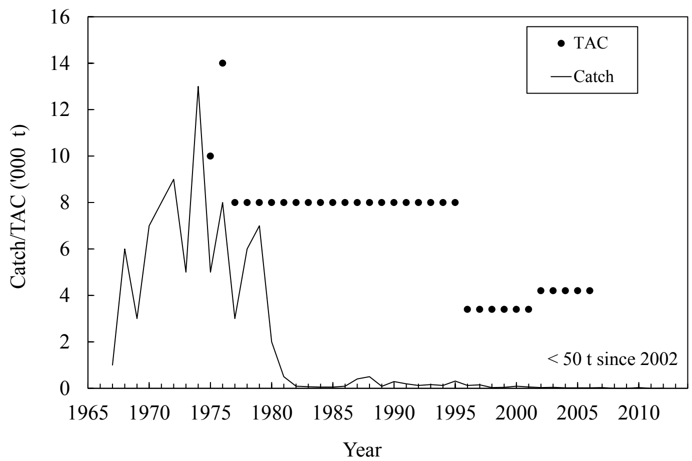


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2013.

b) Data Overview

i) 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 1997-2012 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 2012 the biomass index in Div. 1CD has been increasing gradually since 2010. 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 9 cm pre anal fin length.

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

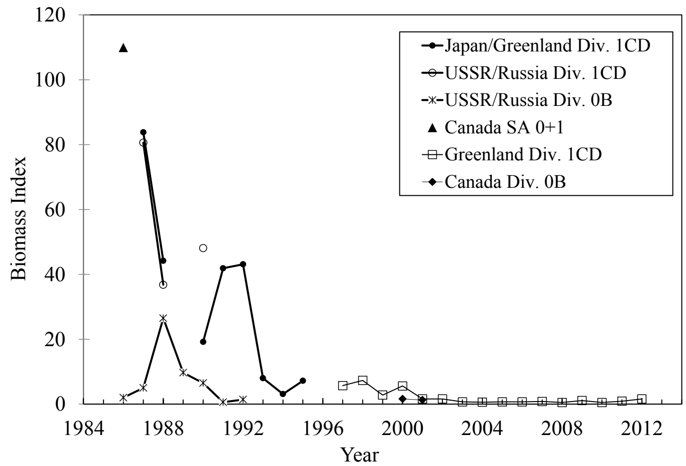


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/ Greenland, Canadian and Greenland surveys in Div. 0B and Div. 1CD.

c) Conclusion

Despite the fact that the biomass has increased gradually since 2010 the biomass in 2012 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 (SCR Doc. 07/88 13/06 15 26. SCS Doc. 13/08)

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 2012, 158 t were reported to Greenland including 26 t reported as by-catch 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 by-catch in the shrimp fisheries. Since 2012 sorting grids have also been used inshore. 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 by-catch in the inshore fishery, targeting Greenland halibut and cod.

Recent catches ('000 t) are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	1	1	1	1	1	1	1	1	1	1
STATLANT 21	0.3	0.2	0.4	0.3	0	0.02	0	0.2	0.12	
STACFIS	0.3	0.2	0.4	0.3	0.4	0.4	0.3	0.2	0.16	

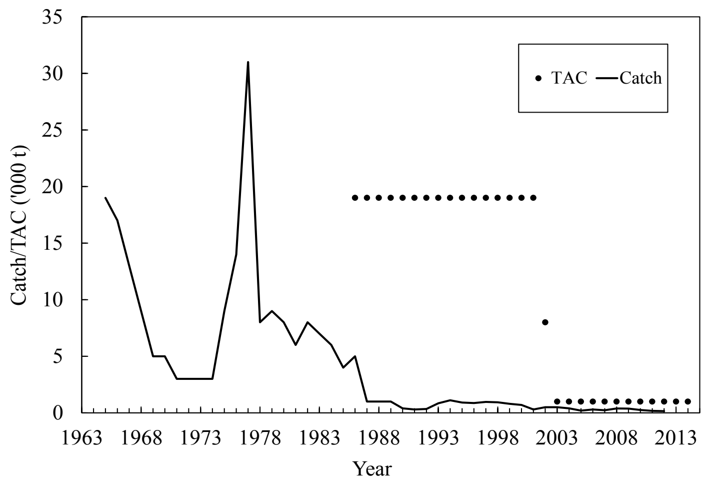


Fig. 4.1. Demersal redfish in Subarea 1: catches and TAC.

b) Data overview

i) Research survey data

The Gear was changed in the Greenland Shrimp and fish survey in 2005, but indices for redfish prior to 2005 have been converted to the new gear.

The index calculations for the EU-Germany survey was updated in 2012 for the whole survey period. The update was to include strata with less than 5 hauls per strata and updating trawl parameters.

Golden redfish (*Sebastes marinus*)

The indices of the EU-Germany survey (Division 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 (Fig 4.2). The biomass indices for golden redfish in the Greenland shrimp and fish survey (Division 1A-F) increased in 2011 and 2012. For this survey no separation of species were made prior to 2006.

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 (1CD) survey biomass index decreased from 1987 to 1995 (Fig 4.3). The Greenland deep-sea survey (Division 1CD) indices were at a low level from 1997 to 2007, but the indices increased and have remained higher since then (Fig 4.3).

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 and Fish survey (Division 1A-F) decreased during the 1990s and has remained at a low level since then. In 2012 the combined redfish abundance from the Greenland Shrimp and Fish survey is the lowest on record (Fig 4.4).

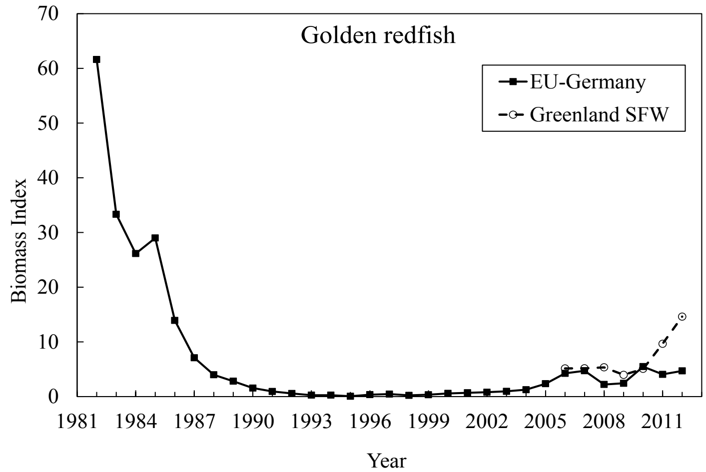


Fig. 4.2. Golden redfish (≥17 cm) survey biomass indices derived from the EU-Germany survey and the Greenland shrimp and fish survey (Division 1A-F) since 2006.

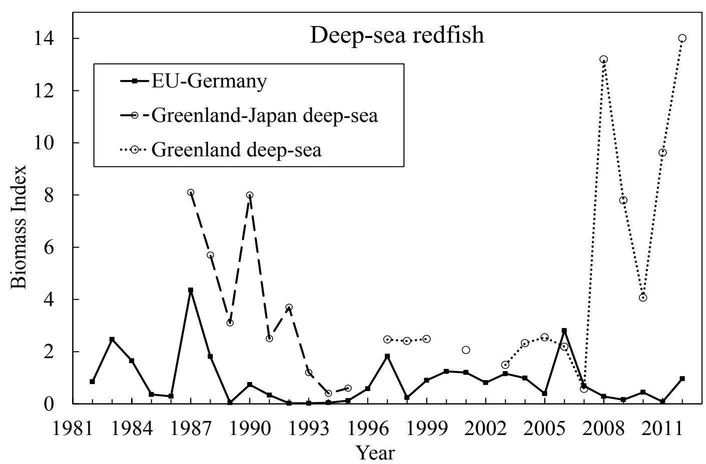


Fig. 4.3. Demersal deep-sea redfish (≥17 cm) survey biomass indices derived from the EU-Germany survey (1C-F) and from the joint Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (1CD, 1997-2011).

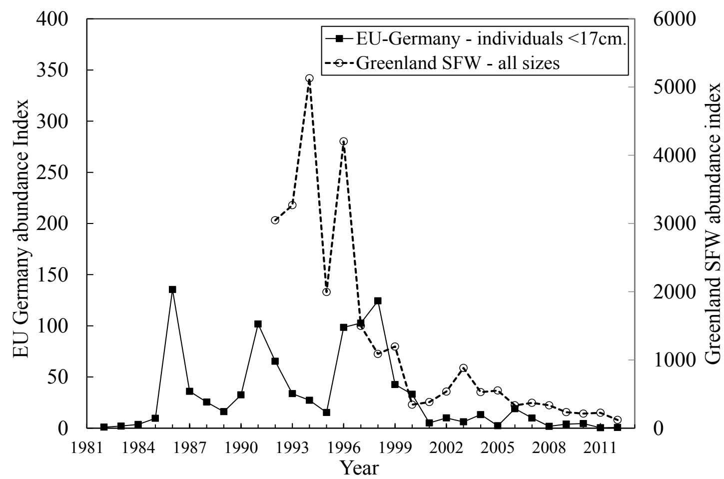


Fig. 4.4. Demersal redfish in Subarea 1: Juvenile deep-sea redfish and golden redfish combined survey abundance indices for EU-Germany survey (1C-F, individuals <17cm) and the Greenland Shrimp and Fish survey (Division 1A-F, All sizes and both species combined).

c) Conclusion

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

d) Research Recommendations

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

STATUS: No progress 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 13/15 26; SCS Doc. 13/08)

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 by-catch 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. 5.1.). Catches then decreased to <100 t/yr during the 1980s and remained low until 2002. The majority of the catches since 2002 are mainly taken inshore by small vessels and open boats. Offshore logbook reported catches of wolffish amounts to less 30 t/yr since 2008 and none as a shrimp fishery by-catch.

Recent nominal catches (t) for wolfish are:

	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	1008
STACFIS	393	313	515	764	880	1195	1175	1315	779	1008

ndf – No directed fishery
na – No advice

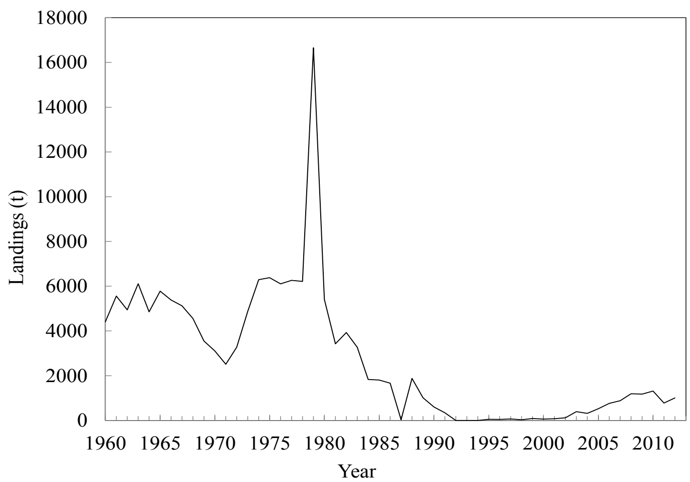


Fig 5a.1. Wolffish in SA1: Catches of Atlantic wolffish and spotted wolffish in SA1 combined from 1960 to 2012.

b) Data Overview

i) Research survey data

The Gear was changed in the Greenland Shrimp and fish survey in 2005, but indices for wolffish have been converted to the new gear.

Atlantic wolffish: Biomass indices decreased in the 1980s in the EU-Germany survey (Div. 1B-1F) and remained at low levels during the 1990s. From 2002 to 2005 biomass indices in both the EU-Germany survey and the Greenland shrimp fish survey (Div. 1A-1F) increased, but both indices returned to below average after 2006 (Fig. 5a.2.left). In general the surveys show similar trends. 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 and remained at low levels throughout the 1990s. After 2002 biomass indices in both surveys increased and have remained at higher levels since then. (Fig 5a.2.right). No distinct new incoming year classes were observed prior to the increasing biomasses and both surveys may not fully cover the distribution of this stock. In general the surveys show similar trends, but with different orders of magnitude. The stock consists of all sizes including very large individuals with no signs of distinct year-classes.

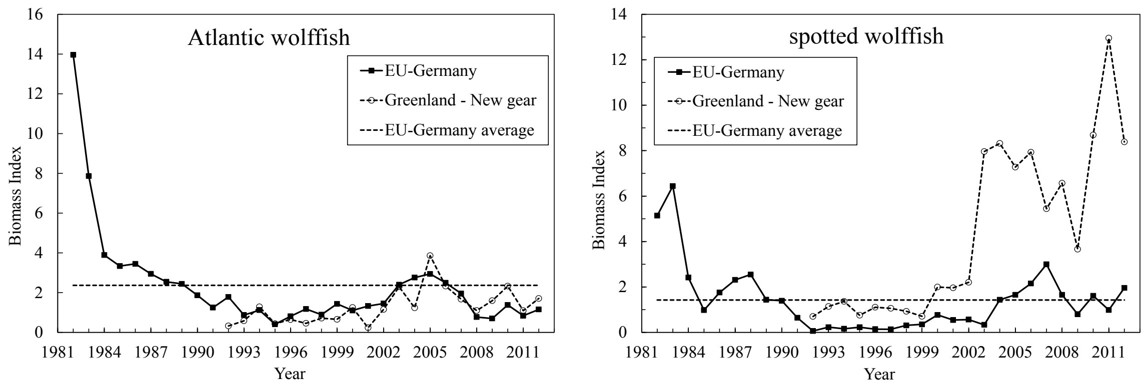


Fig. 5a.2. Wolffish survey biomass indices in SA1.

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. This recommendation is reiterated.

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 by-catch.*

STATUS: No progress This recommendation is reiterated.

These stocks will next be assessed in 2014

05b. American plaice (*Hippoglossoides platessoides*) in Subarea 1

Interim monitoring report (SCR Doc. 07/88 13/15 26; SCS Doc. 13/08)

a) Introduction

American plaice in subarea 1 have mainly been taken as a by-catch 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 by-catches of American plaice in SA1, but American plaice may be part of the by-catch in other fisheries reported as “fish not specified”.

Recent catches (t) are:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
STATLANT 21	0	0	0	0	0	0	0	0	0	0
STACFIS	0	0	0	0	0	0	0	0	0	0

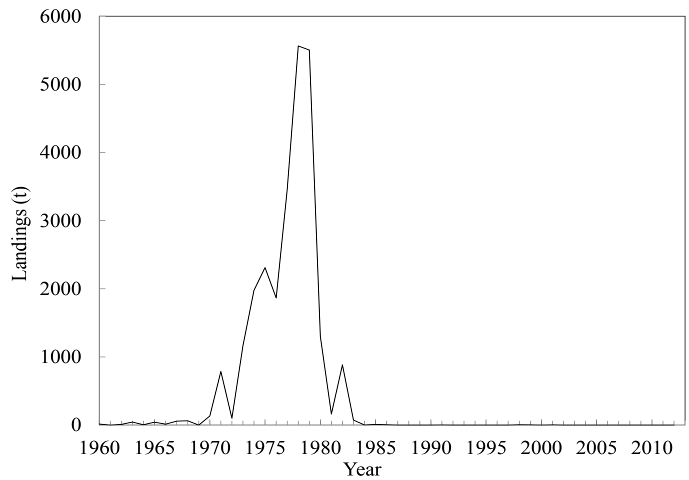


Fig 5b.1. Catches of American plaice in SA1 from 1960 to 2012.

b) Data

i) Research survey data

Biomass indices decreased in the 1980s in the EU-Germany survey (Div. 1C-F) and remained at low levels throughout the 1990s. From 2002 to 2004 biomass indices in the EU-Germany survey increased, but indices have remained below average since then.

The Greenland Shrimp fish survey (Div. 1A-F) which extends further north, were also at low levels throughout the nineties but increased from 2002 to 2004. The gear was changed in this survey in 2005 making the two time series less comparable. In general the two surveys show similar trends for the stock with differing orders of magnitude. (Fig. 5b.2). The stock is mainly composed of individuals less than 35 cm.

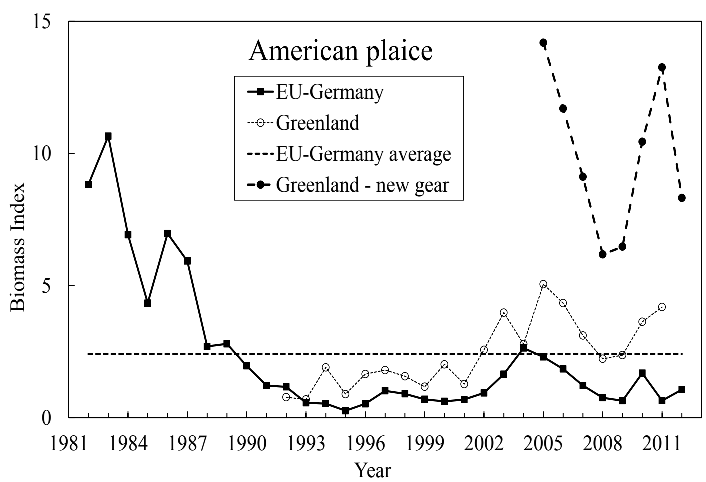


Fig. 5b.2. American plaice survey biomass indices in SA1.

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. 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 by-catch.*

STATUS: No progress. This recommendation is reiterated.

These stocks will next be assessed in 2014.

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

(SCR Doc. 13/09, 13/18, SCS Doc. 13-13)

Recent Conditions in Ocean Climate and Lower Trophic Levels

● Ocean climate composite index on SA3 – Flemish Cap continues to remain well above normal in 2012 and recent years.

● The composite spring bloom index has remained stable over the past decade and recent years.

● Secondary productivity inferred from the composite zooplankton index peaked in 2010 and has remained above normal in recent years.

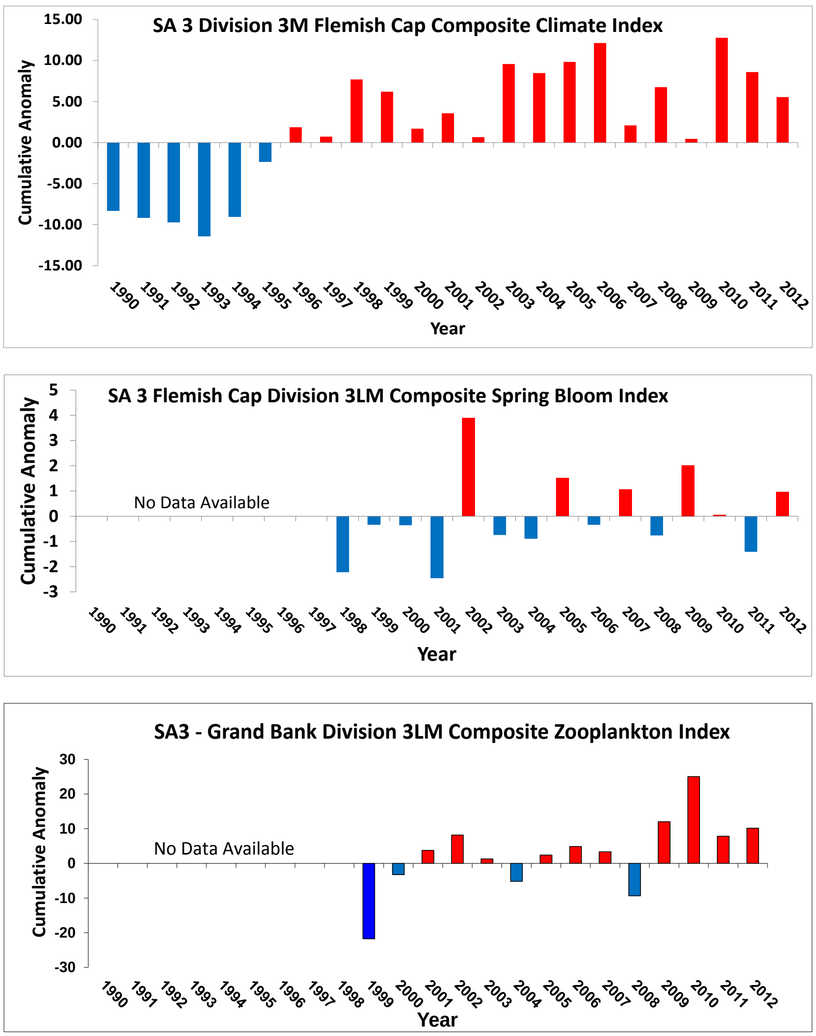


Fig. IV.2. Composite ocean climate index for NAFO Subarea 3 (Div. 3M) derived by summing the standardized anomalies during 1990-2012 (top panel), composite spring bloom (magnitude) index (Div. 3LM) during 1998-2012 (middle panel), composite zooplankton index (Div. 3LM) during 1999-2012 (bottom panel). Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

Environmental Overview

The water masses characteristic of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water, generally warmer and saltier than the sub-polar Newfoundland Shelf waters with a temperature range of 3-4°C and salinities in the range of 34-34.75. The general circulation in the vicinity of the Flemish Cap consists of the offshore branch of the Labrador Current which flows through the Flemish Pass on the Grand Bank side and a jet that flows eastward north of the Cap and then southward east of the Cap. To the south, the Gulf Stream flows to the northeast to form the North Atlantic Current and influences waters around the southern areas of the Cap. In the absence of strong wind forcing the circulation over the central Flemish Cap is dominated by a topographically induced anti-cyclonic (clockwise) gyre. Variation in the abiotic environment, is thought to influence the distribution and biological production of Newfoundland and Labrador Shelf and Slope waters, given the overlap between arctic, boreal, and temperate species. The elevated temperatures on the Cap as a result of relatively ice-free conditions, may allow longer growing seasons and permit higher rates of productivity of fish and invertebrates on a physiological basis compared to cooler conditions prevailing on the Grand Banks and along the western Slope waters. 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 which may influence year-class strength of various fish and invertebrate species.

Ocean Climate and Ecosystem Indicators

The composite climate index in Subarea 3 (Div. 3M) has remained above normal in recent years (2010-2012) although the index has declined consecutively in the past three years (Figure IV.2). Below normal climate conditions characterized the early to mid-1990's period with above average levels throughout the last decade. The composite spring bloom index has been relatively stable over the past decade and no long-term trends apparent in productivity during the period of rapid warming (Figure IV.2). The composite zooplankton index (mainly composed of copepod and meroplankton taxa) peaked in 2010 and has remained at relatively high levels throughout the recent years (Figure IV.2). Surface temperatures on the Flemish Cap were above normal in 2012. Along the 47ºN section, the summer Cold-Intermediate Layer (CIL) area was near normal in 2012 implying cooler conditions after record-low values in 2010-2011. Bottom temperature anomalies across the Flemish Cap ranged from 1-2 standard deviations above normal in 2012, and have remained high since 2008.

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

(SCR Doc. 13/13, 13/41, 13/50; SCS Doc. 13/05, 13/07, 13/09, 13/15).

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. A TAC of 10 000 t for 2011 and 9 280 t for 2012 were established. In 2011 and 2012, 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 2011 and 2012 has made impossible for STACFIS to provide the best assessments for some stocks. However, the model used for the assessment of this stock estimated catches of 13 640 t for 2011 and 13 670 t for 2012[3]. TAC for 2013 is 14 113 t.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	ndf	ndf	5.5	10	9.3	14.1
STATLANT 21	0.0	0.0	0.1	0.1	0.4	1.2	5.3	9.8	9.0	
STACFIS	0.0	0.0	0.3	0.3	0.9	1.2	9.2	13.6[1]	13.7[1]	

ndf No directed fishery
[1] See estimation of parameters

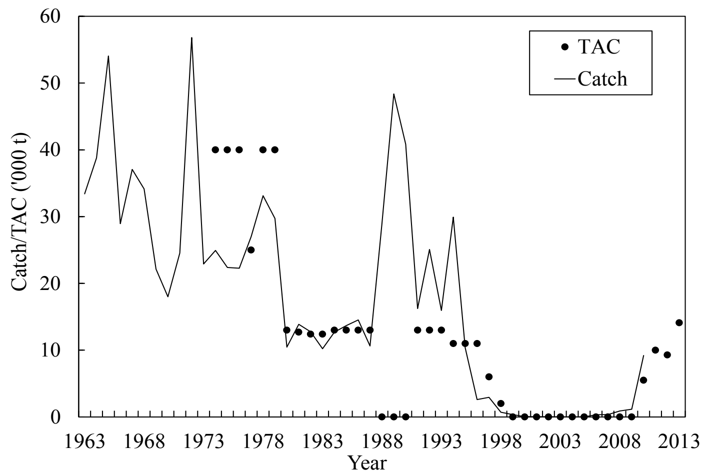


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch line includes estimates of misreported catches since 1988. No direct fishery is plotted as 0 TAC

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 2011. In 2010-2012, with the fishery opens, there was a good sampling level. In 2012 there were length distributions for EU-Estonia, EU-Lithuania, Norway, EU-Portugal, Russia and EU-Spain. The mode for Portugal was 54 cm. The Estonian length distribution is very scatter with a no clear mode. Norway and Spain have the mode around 63-64 cm, Lithuania in 85 cm and Russia in the range of 60-78 cm. In 2012 there were no a consistent ALK for commercial catches, so the one of 2011 was used. In 2009-2010 age 4 was the most abundant in the catch, whereas it was ages 7 and 8+ in 2011 and 5 in 2012.

In 2011, the length distribution from UK was quite different from the length distributions of the rest of the countries. Length distribution from UK was not available for the 2012 fishery at the time of the assessment.

[3] See Estimation of Parameters

ii) Research survey data

Canadian survey. Canada conducted research vessel surveys on Flemish Cap from 1978-1985. Surveys were done with the R/V *Gadus Atlantica*, fishing with a lined Engels 145 otter trawl. The surveys were conducted in January-February of each year from 1978 to 1985 covered depths between 130 and 728 m.

From a high value in 1978, a general decrease in abundance can be seen until 1985, reaching the lowest level in 1982 (Fig. 6.2).

Abundance at age indices were available from the Canadian survey. For this survey, indices of recruitment at age 1 were low in all the years except in 1982 and 1983 (Fig. 6.3).

EU survey. 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 113.2 in 2012 (Fig. 6.2). The growth of the strong year classes since 2005 has contributed to the increase in biomass.

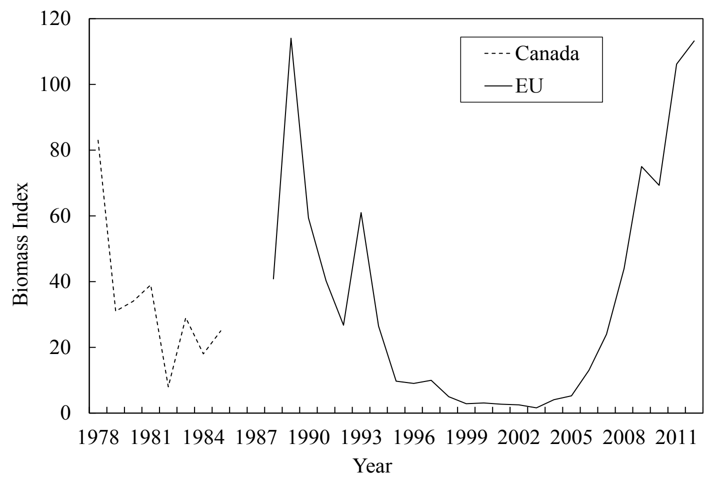


Fig. 6.2. Cod in Div. 3M: survey biomass estimates from Canadian survey (1978-1985) and EU-Flemish Cap survey (1998-2012)

Abundance at age indices were available from the EU 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; note that the level of both surveys is different in the two y-axis).

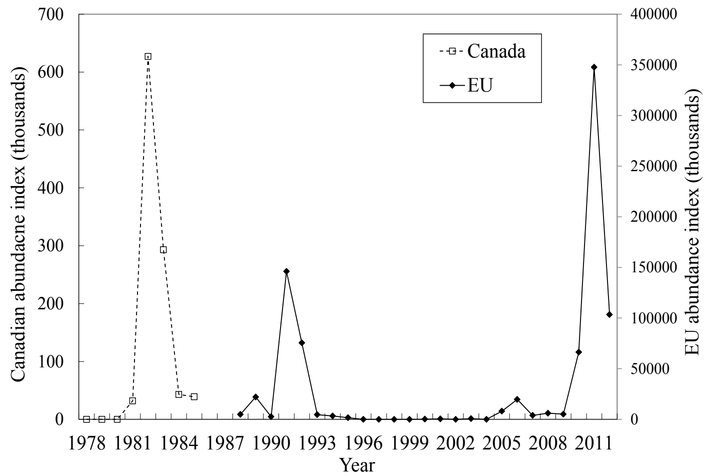


Fig. 6.3. Cod in Div. 3M: Number at age 1 in the EU survey, 1988-2012

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

iii) Biological data

Mean weight at age in the stock, derived from the Canadian and the EU Flemish Cap surveys data, shows a strong increasing trend since the beginning of the series, although in the last years the mean weight shows a general decrease, mainly since 2009.

There are maturity information from the Canadian survey for years 1978-1985 and for the EU survey for 1990-1998, 2001-2006 and 2008-2012. 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. For 2012 the A_{50} decreased slightly but it is still higher than the 2010 value.

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 1988-2012, except for 2002-2005, for which only total catch is available. As STACFIS was unable to estimate the catch in 2011 and 2012 appropriately, a lognormal prior over these catches 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. In 2012, as the TAC is almost the same as the 2011 one and from the VMS data there is no evidence that the effort has changed, the same prior was used.

Tuning: numbers at age from the Canadian survey (1978-1985) and from EU Flemish Cap survey (1988-2012).

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 2011-2012	$LN(median, sd)$	Median=9.46, sd=0.1313
Survivors(2012,a), a=1-7 Survivors(y,7), y=1988-2011	$LN\left(median = medrec \times e^{-medM - \sum_{age=1}^{a} medFsurv(age)}, cv = cvsurv\right)$	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	$LN(median = medF(a),\ cv = cvF)$	medF=c(0.0001, 0.005, 0.01, 0.01, 0.01, 0.005, 0.005) cvsurv=0.7
Total Catch 2002-2005	$LN(median = CW_{mod}(y),\ cv = cvCW)$	CW_{mod} is arised from the Baranov equation cvCW=0.05
Survey Indices: Canada and EU (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 survey abundance index q is the survey catchability at age N is the commercial abundance index α = 0.5, β = 0.58 for EU survey (survey made in July), and α = 0.08, β = 0.17 for Canadian survey (made in January-February) Z is the total mortality
M	$M \sim LN(\text{median}, cv)$	Median=0.218, cv=0.3

Total catches in 2011 and 2012 were estimated within the modelling framework. Substantial difficulties were encountered in attempting to estimate the total removals in both years while simultaneously estimating survivors, survey catchabilities and fishing mortality. STACFIS notes that it may not be possible to continue the analytical assessment of this stock in future years without data on total removals.

d) Assessment Results

The 2011 and 2012 catch posterior medians, estimated by the model, are 13 640 t and 13 670 t, respectively.

Note that estimates of SSB are available for 2013, whereas total biomass estimates are available to 2012 only. This difference arises because there are no age 1 recruitment estimates for 2013, 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).

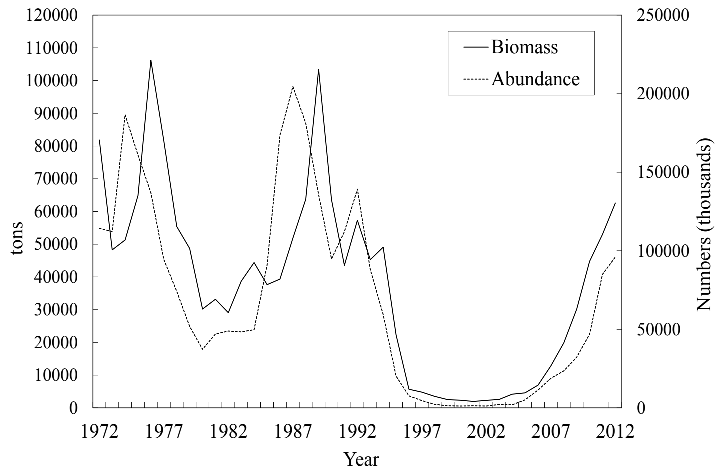


Fig. 6.4. Cod in Div. 3M: Biomass and Abundance estimates for years 1988 to 2012

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.

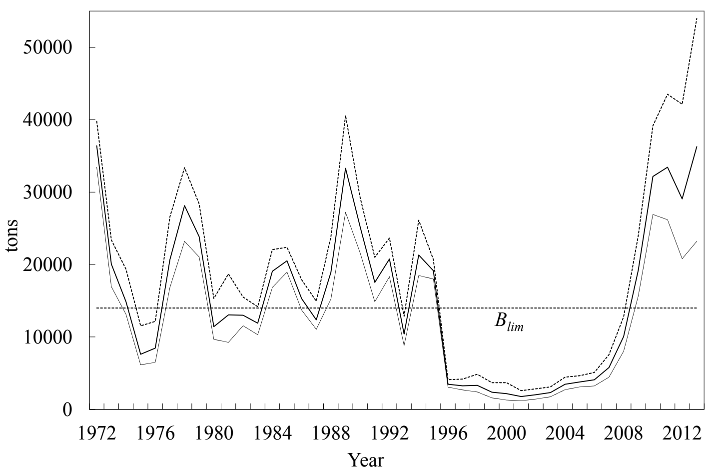


Fig. 6.5. Cod in Div. 3M: Median and 90% probability intervals SSB estimates for years 1988 to 2013. The horizontal dashed line is the B_{lim} level of 14 000 t.

Recruitment: After a series of recruitment failures between 1996 and 2004, recruitment at age 1 values in 2005-2012 are higher, especially the 2010-2012 values (Fig. 6.6). There is a high uncertainty associated with those last values.

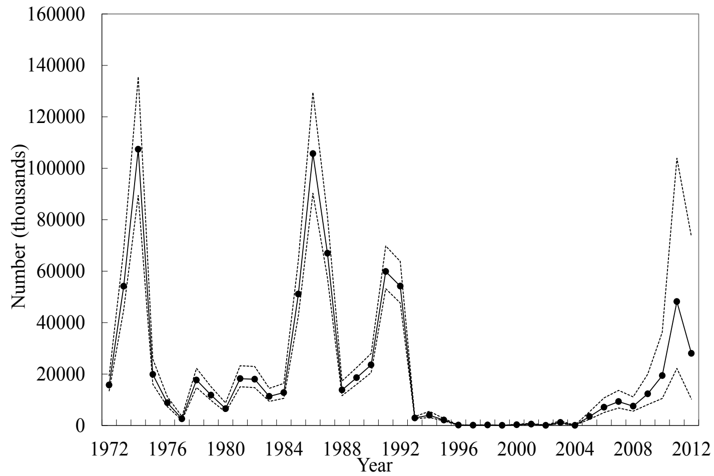


Fig. 6.6. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2012

Fishing mortality: *F* increased in 2010-2012 with the opening of the fishery (Fig. 6.7). F_{bar} in 2012 (0.363) was more than twice F_{max} (0.140).

Consistent with the changing age distribution in the catches of 2010-2012, the exploitation patterns in the three years are different between them. 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. In 2012 the largest value, with difference, is at age 5. This sudden change contributes to significant revisions in estimated yield-per-recruit reference points (Section g).

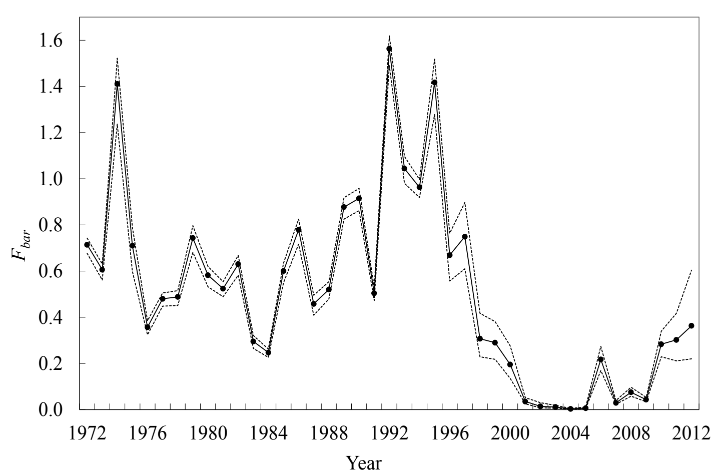


Fig. 6.7. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2012

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 an underestimation in the last two years after several years of underestimation (Fig. 6.8). SSB has shown a large revision with no systematic patterns (Fig. 6.9). Fishing mortality presents an overestimation in the last two years (Fig. 6.10).

The results of the retrospective analysis are quite different from what we saw in last year assesment. Further studies can be necessary.

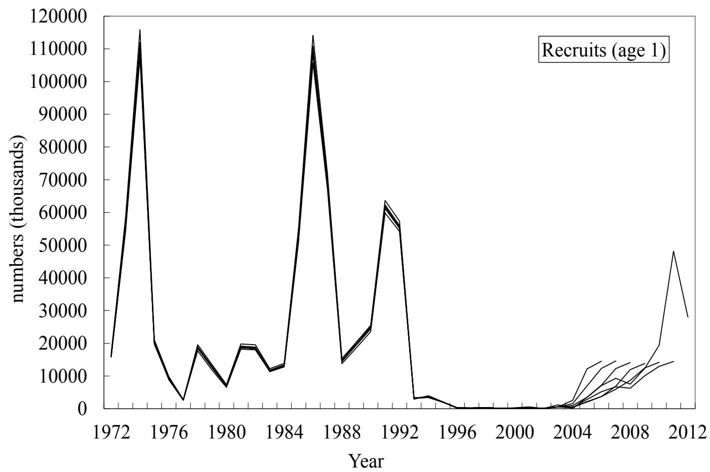


Fig. 6.8. Cod in Div. 3M: Retrospective results for recruitment

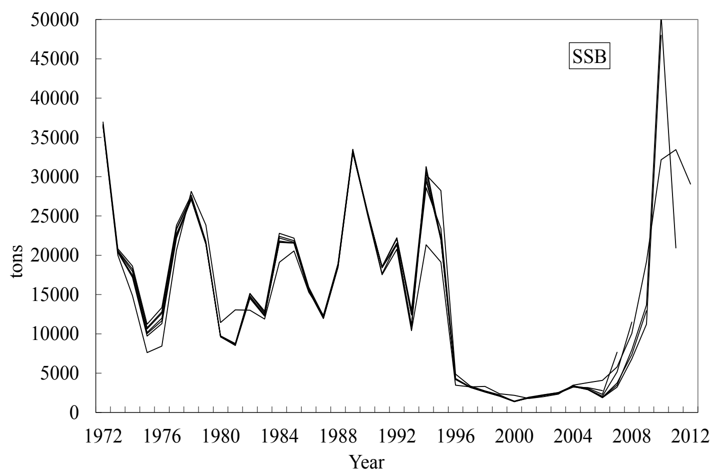


Fig. 6.9. Cod in Div. 3M: Retrospective results for SSB

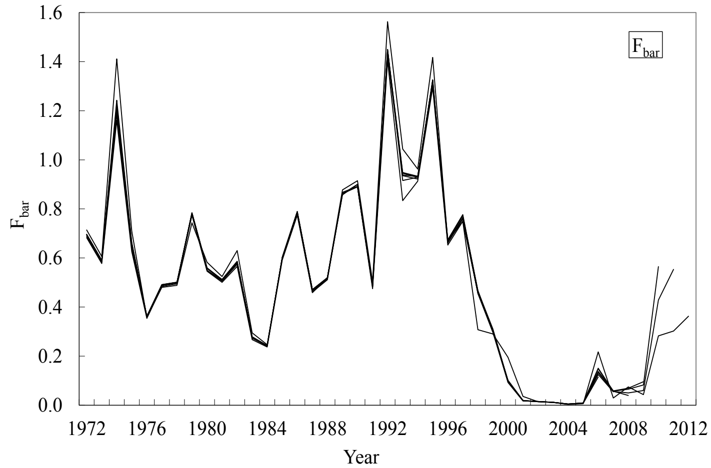


Fig. 6.10. Cod in Div. 3M: Retrospective results for $F_{bar.}$

f) State of the stock

Current SSB is estimated to be well above B_{lim}. Recent recruitments are relatively high, but these estimates are imprecise. Fishing mortality in 2012 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-F_{bar} plot.

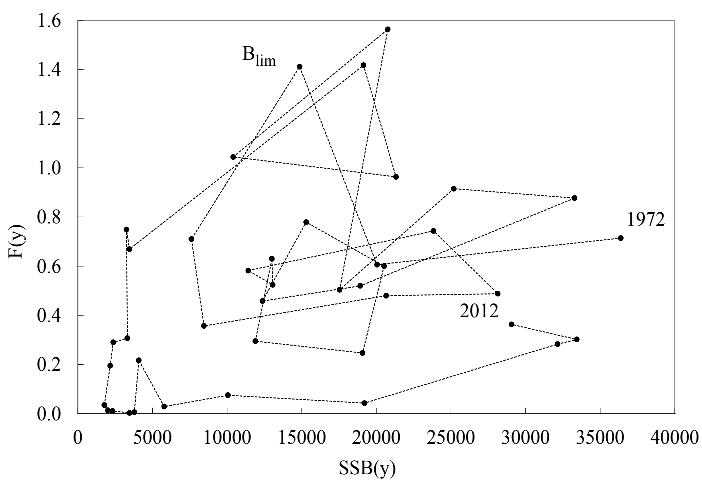


Fig. 6.11. Cod in Div. 3M: Stock-F_{bar}(3-5) (posterior medians) plot. B_{lim} is plotted in the graph.

Figure 6.12 shows the Bayesian yield per recruit with respect to F_{bar}, in which we can see the estimated values for $F_{0.1}$, F_{max} and F_{2012}. $F_{0.1}$ and F_{max} are similar as the estimated last year.

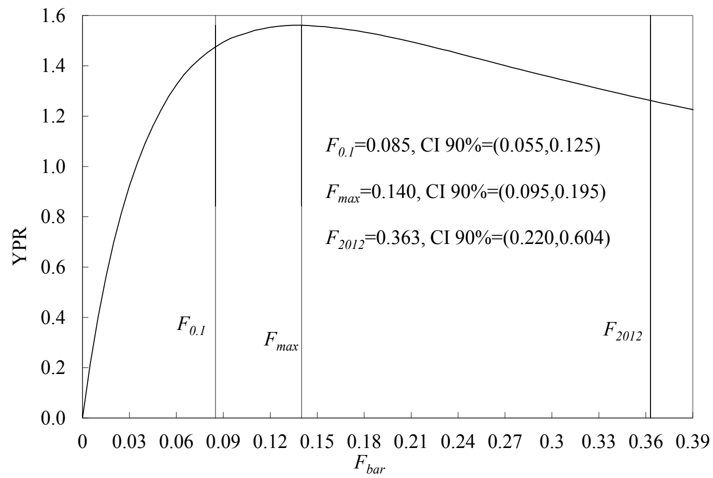


Fig. 6.12. Cod in Div. 3M: Bayesian Yield per recruit

h) Stock projections

Stochastic projections of the stock dynamics over a 3 year period (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 2013-2015: Recruits per spawner were drawn randomly from the last eight years of the assessment (2005-2012), as these are the years in which recruitment has started to recover.

Maturity ogive: 2012 maturity ogive.

Natural mortality: 2012 natural mortality from the assessment results.

Weight-at-age in stock and weight-at-age in catch: 2012 weight-at-age in catch.

PR at age for 2013-2015: Mean of 2011 and 2012 PRs.

F_{bar}*(ages 3-5)*: Four scenarios were considered. All scenarios assumed that the Yield for 2013 is the established TAC (14 113 t):

(Scenario 1) $F_{bar} = F_{0.1}$ (median value = 0.085).

(Scenario 2) $F_{bar} = F_{max}$ (median value = 0.140).

(Scenario 3) $F_{bar} = F_{2012}$. (median value = 0.363).

(Scenario 4) Additionally, a projection based in a constant catch equal to the TAC of 2013 (14 113 t) was performed.

Figures 6.13 to 6.15 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 1972-2012 estimates (Fig. 6.13 and 6.14). The removals associated with these F_{bar} levels are lower than those in the period before 1995 except in the case of $F_{bar} = F_{2012}$, for which the catches reach the level seen until 1979 and before the collapse of the stock (Fig. 6.15).

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:

	B			SSB			Yield		
	5%	50%	95%	5%	50%	95%	5%	50%	95%
$F_{bar}=F_{0.1}$ (median=0.085)									
2013	56681	84139	123214	23218	36274	53972		14113	
2014	73341	116604	180008	36290	61946	98400	5253	9142	14787
2015	108560	171317	265541	60070	100614	165438	14727	23626	37698
$F_{bar}=F_{max}$ (median=0.140)									
2013	56319	84086	122757	23168	36277	54027		14113	
2014	73277	116617	178999	36528	62032	98464	8536	14521	23305
2015	104107	164311	256187	56909	94836	157739	21218	33518	52688
$F_{bar}=F_{2012}$ (median=0.363)									
2013	56621	84208	123004	23183	36460	54255		14113	
2014	73787	116640	179196	36862	61824	98655	21512	32470	52390
2015	85144	142867	227577	40818	75177	131648	31367	49436	77229
Catch=TAC_{2013}									
	Total Biomass			SSB			F		
	5%	50%	95%	5%	50%	95%	5%	50%	95%
2013	56613	84078	122899	23190	36230	54366	0.1201	0.1913	0.3043
2014	73466	116513	178478	36807	62157	97733	0.0830	0.1337	0.2285
2015	98745	165579	262320	51811	95533	164692	0.0450	0.0787	0.1480

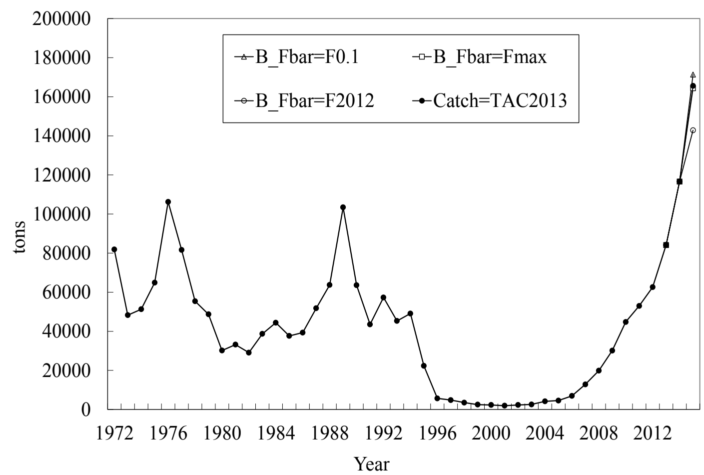


Fig. 6.13. Cod in Div. 3M: Projected Total Biomass under all the Scenarios.

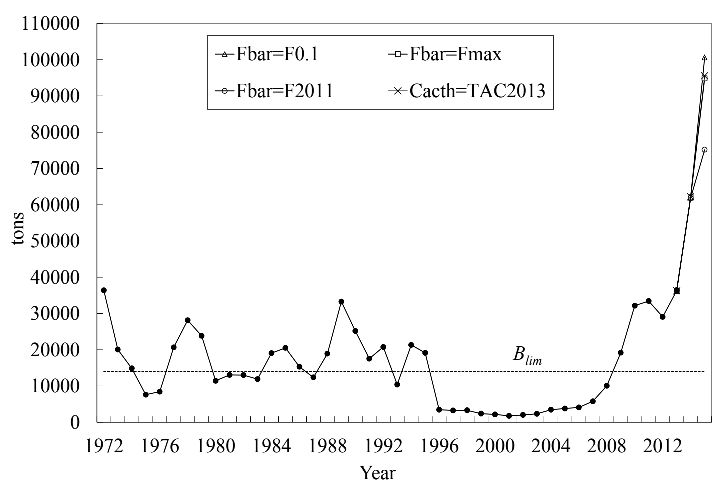


Fig. 6.14. Cod in Div. 3M: Projected SSB under all the Scenarios.

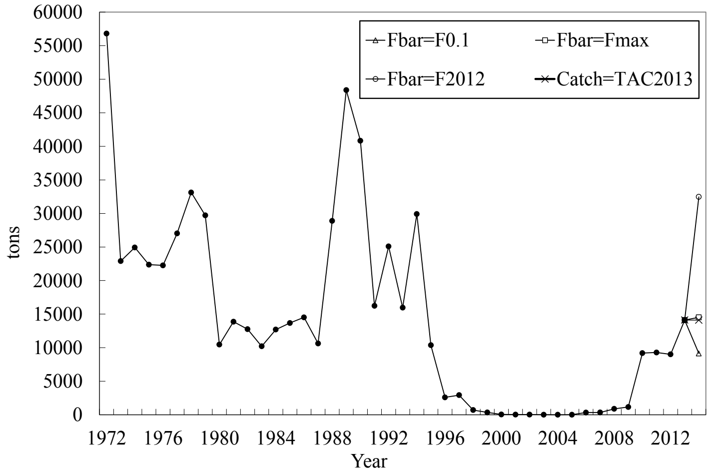


Fig. 6.15. Cod in Div. 3M: Projected removals under all the Scenarios.

The risk of each scenarios is presented in the following table, with the limit reference points for each case:

	Yield			P(B<Blim)			P(F>F0.1)			P(F>Fmax)			P(B15<B12)
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015	
$F_{0.1}$	14113	9142	15640	<5%	<5%	<5%							<5%
F_{max}	14113	14521	23494	<5%	<5%	<5%							<5%
F_{2012}	14113	32470	41778	<5%	<5%	<5%	>95%	>95%	>95%	85.58%	>95%	>95%	<5%
Catch=TAC_{2013}	14113	14113	14113	<5%	<5%	<5%	>95%	92.90%	43.80%	85.60%	46.40%	7.30%	<5%

i) Research recommendations

STACFIS **recommended** that *an age reader comparison exercise be conducted*.

STATUS: No progress. This recommendation is reiterated.

STACFIS **recommends** that *the most recent catch at age figures be revised*.

STACFIS **recommends** to *investigate the retrospective pattern*.

The next full assessment for this stock will be in 2014.

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

(SCR Doc. 12/068, 13/013, 034; SCS Doc. 12/26, 13/05, 07,09).

a) Introduction

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

i) Description of the fishery

The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-1999, when a minimum catch around 1 100 t was recorded mostly as by-catch of the Greenland halibut fishery. An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. A new golden redfish fishery occurred on the Flemish Cap bank from September 2005 onwards on shallower depths above 300m, basically pursued by Portuguese bottom trawl and Russia pelagic trawl. Furthermore, the 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 7 600 t in 2012.

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. The estimated catch of beaked redfish in 2012 was 5 900 t.

No STACFIS catch estimates were available for 2011-2012. Over the previous five years (2006-2010) an average annual bias of 15% plus was recorded between overall STACFIS catch estimate and overall STATLANT nominal catch. In order to mitigate the lack of scientific catch information a 15% surplus was added to the STATLANT catch of each fleet for the last couple of years. This inflated STALANT catches are included in the present assessment as the STACFIS catch estimates.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	5	5	5	5	5	8.5	10.0	10.0	6.5	6.5
STATLANT 21	3.1	6.4	6.3	5.6	7.9	8.7	8.5	9.7	6.7	
STACFIS total catch [1,2]	2.9	6.6	7.2	6.7	8.5	11.3	8.5	11.1	7.6	
STACFIS catch [2]	2.9	4.1	6.0	5.1	4.3	3.7	5.4	9.0	5.9	

[1] Estimated redfish catch of all three redfish species
[2] On 2011-2012 STACFIS catch estimates based on the average 2006-2011 bias

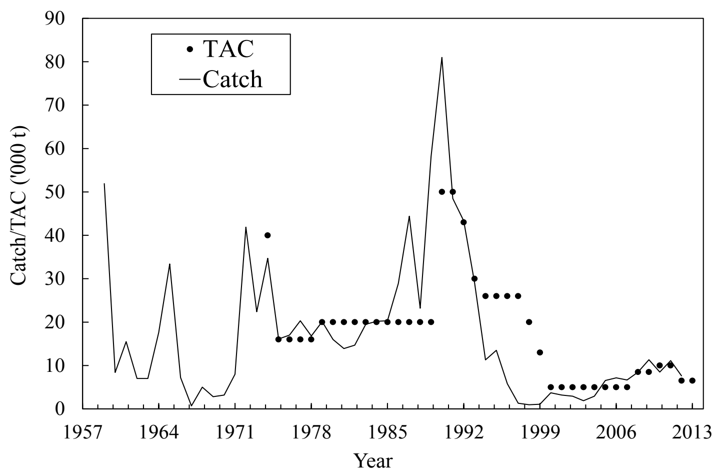


Fig. 7.1. Redfish in Div. 3M: catches and TACs.

b) Input Data

The Div. 3M redfish assessment is focused on beaked redfish, regarded as a management unit composed of two populations from two very similar species: the Flemish Cap *S. mentella* and *S. fasciatus*. The reason for this approach is the historical dominance of this group in the 3M redfish commercial catch. During the entire series of EU Flemish Cap surveys beaked redfish also represents the majority of redfish survey biomass (78%).

i) Commercial fishery and by-catch data

Sampling data. Most of the commercial sampling data available for the Div. 3M redfish stocks since 1989 are from the Portuguese fisheries. Length sampling data from Russia, Japan and Spain were also available for several years and used to estimate the length composition of the commercial catches for those fleets in those years. The annual length composition of the Portuguese trawl catch was applied to the rest of the commercial catches. The available

1998-2012 3M beaked redfish commercial length weight relationships from the Portuguese commercial catch were used to compute the mean weights of all commercial catches and corresponding catch numbers at length.

Redfish by-catch in numbers at length for the Div. 3M shrimp fishery is available for 1993-2004, based on data collected on Canadian and Norwegian vessels. The commercial and by-catch length frequencies were summed to establish the total removals at length. These were converted to removals at age using the *S. mentella* age-length keys with both sexes combined from the 1990-2012 EU surveys. Annual length weight relationships derived from Portuguese commercial catch were used for determination of mean weights-at-age.

The 1999-2007 cohorts dominated sequentially the overall catch through 2000-2012, some of them in several years, first in the shrimp by-catch and later on in the commercial fishery.

ii) Research survey data

EU Flemish Cap bottom trawl survey

Survey bottom biomass was calculated based on the abundance at length from EU bottom trawl survey for the period 1988-2012 and on the Div. 3M beaked redfish length weight relationships from EU survey data for the same period.

Age compositions for Div. 3M beaked redfish EU survey stock and mature female stock from 1989 to 2012 were obtained using the *S. mentella* age length keys mentioned above. Mean weights-at-age were determined using the EU survey annual length weight relationships.

Gonads of the Flemish Cap beaked redfish species were collected by the EU survey since 1994, though not every year. Maturity ogives at length were from 1994 (*S. fasciatus* and *S. mentella*) and 1999 (*S. mentella*). New 2011 and 2012 maturity ogives were available for this assessment but the analysis of samples from the rest of the years backwards has just begun. Preliminary results revealed relevant changes on maturity for the three redfish species with length at maturity falling on all of them. The use on the last couple of years of these new maturity ogives at length, instead of the former ones, would lead to a sudden increase on the size of the female spawning component of unrealistic high magnitude.

Since most of the biomass and abundance of the beaked redfish female spawning stock has been historically composed of age 7 and older females, until the shift to younger maturity is clarified back in time for the two redfish species involved in the assessment, the female spawning stock shall be represented by the age 7 plus female segment of the beaked redfish stock.

Survey results. After declining on the first years of the assessment survey exploitable biomass and abundance were kept at low level between 1991 and 2001. A sequence of abundant year classes (2001-2002) lead the stock to a maximum in 2006. Year class strength declined afterwards, and the last cohort entering the exploitable stock (2008 year class, in 2012) is near the low level of recruitment at age 4 observed over the 1990's. Until 2010 exploitable stock follow a similar trend to recruitment. However, decline was halted in 2011 and in 2012 the stock indices showed signs of recovery, taking off again from its average level. The 7+ female survey indices (accepted as a proxy to female spawning stock) extended their increase further on until 2009, but fell in 2010 and 2011. Those indices also went up on 2012 to a level close to their 2009 high (Fig. 7.2).

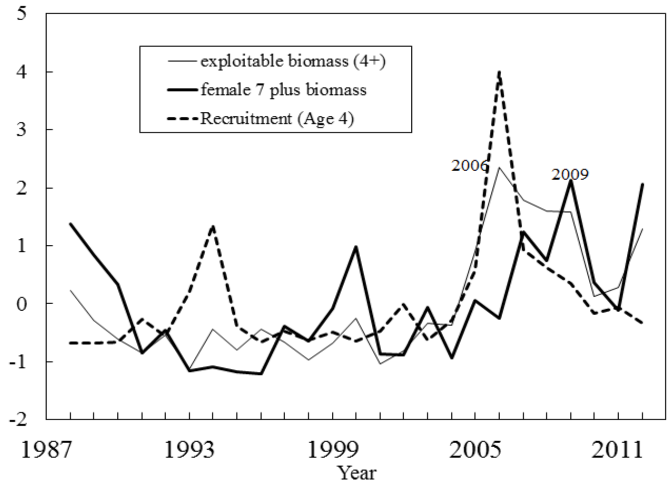


Fig. 7.2. Beaked redfish in Div. 3M: standardized biomass, female spawning biomass and recruitment at age 4 abundance from EU surveys (1988-2012). Each series standardized to the mean and unit standard deviation.

Despite a sequence of abundant year classes and a low to very low exploitation regime over the last seventeen years, survey results suggest that the beaked redfish stock has not been able to hold its growth suffering instead a severe decline on the second half of the 2000's. This unexpected downward trend on stock size can only be attributed to mortality other than fishing mortality. From survey results the decline appeared to have been halted on the last couple of years as regards exploitable and female spawning stock.

Since 2004 a rapid increase was observed on survey biomass both of golden (*Sebastes marinus*) and Acadian (*Sebastes fasciatus*) redfish stocks. Due to their shallower depth distributions these two redfish species overlap with cod to an extent greater than deep sea redfish (*Sebastes mentella*). Since 2006, the cod stock started to recover, while those two redfish stocks declined sharply. Redfish is an important component in the diet of cod, especially on those years when successful recruitment events were observed in redfish stocks.

c) Estimation of Parameters

The Extended Survivors Analysis (XSA) (Shepherd, 1999)[4] run with natural mortality kept constant at 0.1 until the 2009 assessment. The month of peak spawning (larval extrusion) for Div. 3M *S. mentella*, was taken to be February, and was used for the estimate of the proportion of fishing mortality and natural mortality before spawning. EU survey abundance at age was used for calibration. The XSA model specifications are given below:

Catch data from 1989 to 2010, ages 4 to 19+				
Fleets	First year	Last year	First age	Last age
EU summer survey (Div. 3M)	1989	2012	4	18
Natural Mortality (*M*) is assumed 0.1 for all years, ages.				
Tapered time weighting not applied				
Catchability independent of stock size for all ages				
Catchability independent of age for all ages				
Terminal year survivor estimates not shrunk towards a mean F				
Oldest age survivor estimates not shrunk towards the mean F of previuos ages				
Minimum standard error for population estimates from each cohort age = 0.5				

4 SHEPHERD, J. G. 1999. Extended survivors analysis: an improved method for the analysis of catch-at-age data and abundance indices. *ICES J. Mar. Sci.*, **56**(5): 584-591.

The magnitude of the increase of redfish natural mortality (M) has been analysed on the sensitivity analysis of the present assessment. From the 2011 sensitive analysis, carried out for a set of natural mortality options, a natural mortality of 0.4 was adopted for ages 4-6 through 2006-2010, extended to ages 7 on 2009-2010. This was the lowest possible level of natural mortality giving assessment results in line with the 2006-2010 survey declines, and at the same time key diagnostics very close to the best ones.

In the present assessment eleven options regarding 2006-2012 natural mortality will be considered. These options are listed below. Most of them are follow ups of the 2011 rational, except for two options. The goodness of fit of the model for each of the *M* options is given by the sum of squared *log* q_{age} (logorithms of catchability at age) residuals for 2006-2012, the most recent period of the assessment interval when it is assumed that M increased.

Run 1	M = 0.1+M_{cod} for ages 4 - 6 on 2006 - 2008 and all age groups on 2009 - 2012.
Run 2	M = 0.40 on ages 4 - 6 on 2006 - 2008, and on all ages groups on 2009 - 2012 (extended XSA_{2011} assessment framework)
Run 3	M is kept constant at 0.10 on all ages and all years (standard XSA assessment framework)
Run 4	M 2006-2010 = XSA_{2011} assessment framework. M = 0.20 on all age groups on 2011-2012.
Run 5	M 2006-2010 = XSA_{2011} assessment framework. M = 0.15 on all age groups on 2011-2012.
Run 6a	M 2006-2010 = XSA_{2011} assessment framework. M = 0.125 on all age groups on 2011-2012.
Run 6b	M 2006-2010 = XSA_{2011} assessment framework. M = 0.12 on all age groups on 2011-2012.
Run 6c	M 2006-2010 = XSA_{2011} assessment framework. M = 0.115 on all age groups on 2011-2012.
Run 6d	M 2006-2010 = XSA_{2011} assessment framework. M = 0.11 on all age groups on 2011-2012.
Run 6e	M 2006-2010 = XSA_{2011} assessment framework. M = 0.105 on all age groups on 2011-2012.
Run 6f	M 2006-2010 = XSA_{2011} assessment framework. M = 0.10 on all age groups on 2011-2012.

Run 1: $M_{2006\text{-}2012}=M_{cod,2006\text{-}2012}+0.1$

Natural mortality constant through ages but year dependent over the 2006-2012 interval, just as if the increase by cod predation 2006 onwards would impact on an annual basis just the natural mortality of the species within the beaked redfish combo. Preliminary numbers of redfish cod consumption ('000s) between 2006 and 2012 were made available for this assessment. These numbers are rough estimates that still need to be disaggregated by species. Nevertheless they are a first attempt to evaluate on an annual basis the magnitude of redfish consumption by cod. Therefore they were integrated on the quantitative approach to estimate natural mortality surplus over most recent years. For practical purposes it was assumed on this analysis that most of those natural deaths came from either one of the two beaked redfish species.

The estimates of cod consumption were used to calculate an extra natural mortality M_{cod} that would be added each year, between 2006 and 2012, to the standard *M* of 0.1. The expanded natural mortalities are applied at each age and year of the 2006-2012 interval with the same criteria adopted on the 2011 assessment (on 2006-2008 only the younger ages 4 to 6 were considered to be vulnerable to the increase on cod consumption). Tuning had not converged after 70 iterations and the sum of squared *log* q_{age} residuals record a maximum well above the runs with other *M* options (Fig. 7.3).

Run 3: $M_{1989\text{-}2012}= 0.1$

Natural mortality constant through ages and over the entire interval, just as if the increase of cod predation 2006 onwards would only impact golden redfish (*Sebastes marinus*), the species outside the beaked redfish combo. Tuning converged before 70 iterations, but the sum of squared *log* q_{age} residuals is the second highest of the sensitivity runs (Fig. 7.3).

Run 2 and Run 4 to 6f: from $M_{2011\text{-}2012}= 0.4$ down to $M_{2011\text{-}2012}= 0.1$

Between 2010 and 2012 survey biomass and abundance of exploitable and spawning stock increased again along with a general increase of commercial catch from an average level of 4 500 t (2009-2010) to 7 500 t (2011-2012). Taken together, diminishing natural mortality estimates in 2011-2012could be justified in this set of runs.

So one set of options to take into account on the sensitivity analysis is a $M_{2011\text{-}2012}$ somewhere between 0.4 (=previous $M_{2009\text{-}2010}$) and 0.1 (= constant $M_{=>2005}$). This sequence of runs pointed to 0.1 as the best option for natural mortality on the last couple of years, with a minimum sum of squared *log* q_{age} residuals plateau for *M* between 0.125 and 0.1 (Fig. 7.3).

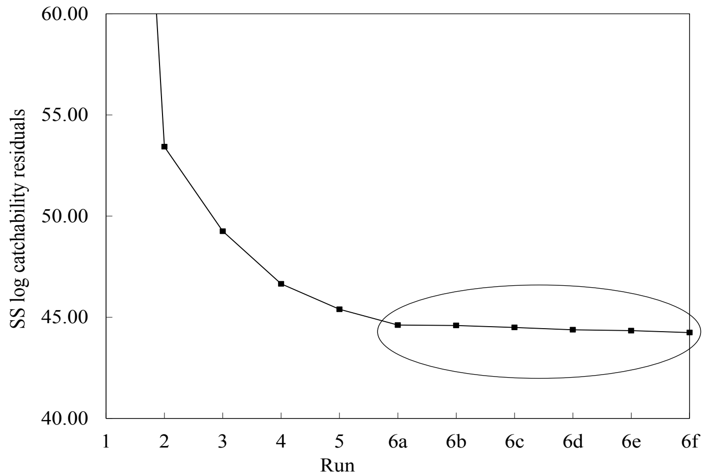


Fig. 7.3. Beaked redfish in Div. 3M: goodness of fit of XSA_{2013} for several *M* options between 2006 and 2012.

The 4 plus exploitable and 7 plus female biomass XSA trends from the five natural mortality options between Run 1 and Run 6a compared with the trends given by the survey and the standard *M* run. The trends for the runs between Run 4 and Run 6a were very similar and in line with the survey story. The trends of the other three options, Run 1, Run 2, and Run 3, ignore what was going on through one of the two intervals to be considered on the last seven years of survey: first decline on 2006-2010, then stability and/or increase on 2011-2012 (Fig. 7.4 and 7.5).

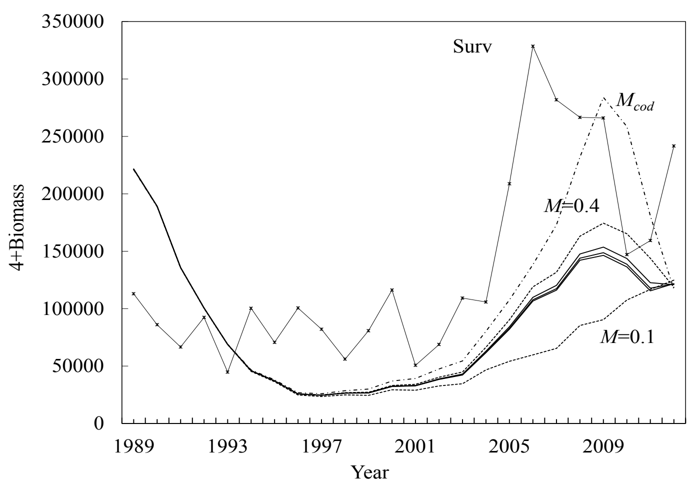


Fig. 7.4. Beaked redfish in Div. 3M: XSA 4+ biomass with six different M sets *versus* EU survey 4+biomass, 1989-2012.

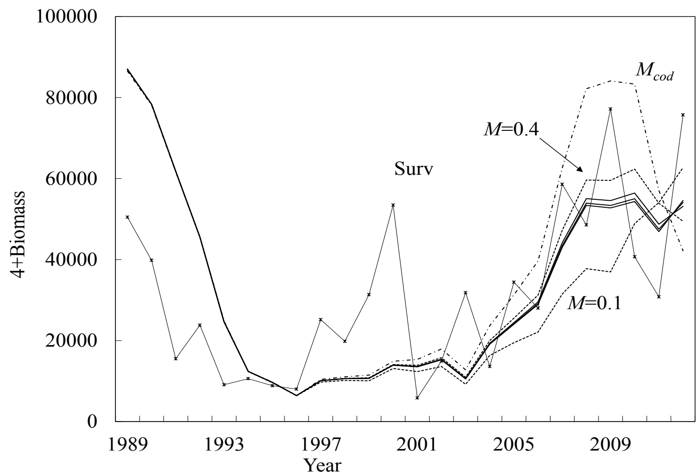


Fig. 7.5. Beaked redfish in Div. 3M: XSA with six different *M* sets versus EU survey 7+ female biomass, 1989-2012.

For $M_{2011\text{-}2012}$ between 0.125 and 0.1 the lowest natural mortality gave the best tuning. Nevertheless this return to *M*=0.1 would imply that from 2011 onwards the impact of cod predation on either beaked redfish species would be again accommodated in the standard level assumed by the assessment before the start of the cod boom. This is a hypothesis far from being demonstrated by the ongoing predator-prey research regarding cod-redfish relationship on the Flemish Cap. Choosing the "best" XSA_{2013} fit with $M_{2011\text{-}2012}$=0.1 would leave no room to a remaining extra level of cod predation. That could only be justified by a clear improvement on the model performance leading to much more robust results, which is not the case: $M_{2011\text{-}2012}$ going down from 0.125 to 0.1 turns on a minimal improvement on the diagnostics of the assessment.

Taking into account the results of the sensitivity analysis of the XSA_{2013} assessment, natural mortality at 0.4 was applied on ages 4-6 through 2006-2010, and extended to ages 7 plus on 2009 and 2010. Natural mortality has been kept constant through all ages on 2011 and 2012, but with an overall decline to 0.125 (Run 6a).

d) Assessment Results

XSA diagnostics show high standard errors associated with the average catchability at age and year patterns in catchability residuals. From 2002 onwards residuals are smaller, namely on 2011 and 2012, while the marked negative/positive pattern of the former years fades away.

A 2013-2009 retrospective XSA was carried out for the patterns and magnitude of bias on the main results of recent assessments back in time (Fig. 7.6). It covers a period of rapid and profound contrast on the dynamics of the stock, driven by year to year increases (and declines) on natural mortality and consecutive declines on recruitment at age 4. Nevertheless, and as regards exploitable biomass, this retro XSA show no systematic retrospective pattern, being this assessment very much in line with their immediate predecessors (2012-2011). Reverse retrospective patterns are observed on the 7 plus female biomass (under estimate) and average (6-16) fishing mortality (over estimate) but with small bias on the sequential estimates of both parameters even on recent years.

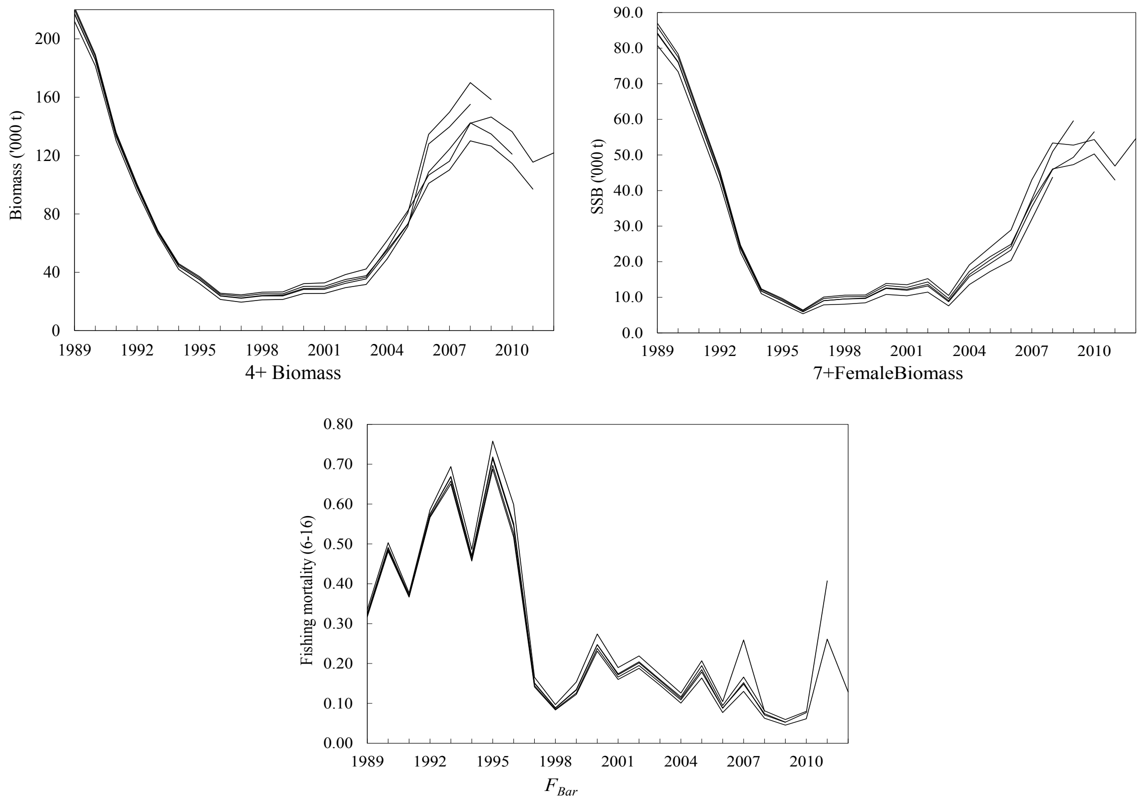


Fig. 7.6. Beaked redfish in Div. 3M: XSA retrospective analysis, 2013-2009: exploitable 4+ biomass, 7+ female biomass and average fishing mortality (ages 6-16).

Taking into account both the consistency of the results with the survey trends and the improvement of the diagnostics with the adopted level of M, the 2013 XSA assessment was accepted with the 2011-2012 decrease in natural mortality previously defined.

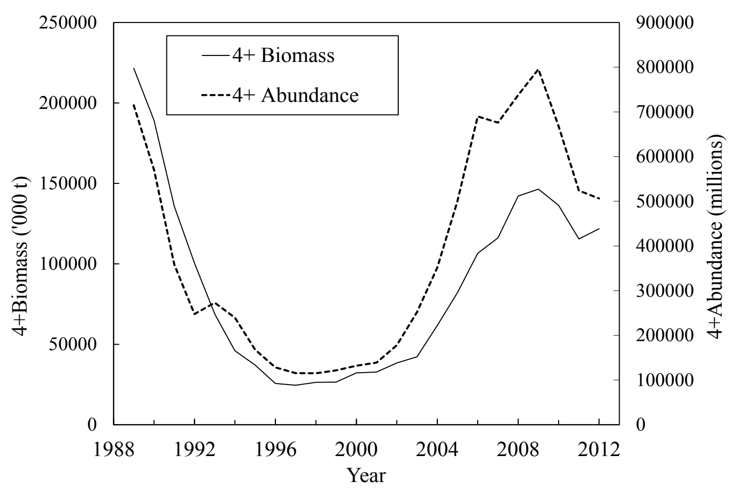


Fig. 7.7. Beaked redfish in Div. 3M: age 4+ biomass and Age 4+ abundance from XSA.

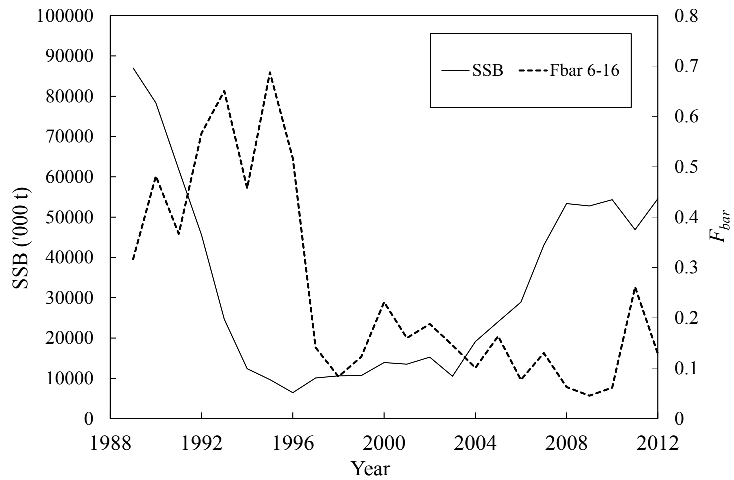


Fig. 7.8. Beaked redfish in Div. 3M: female spawning biomass and fishing mortality trends from XSA.

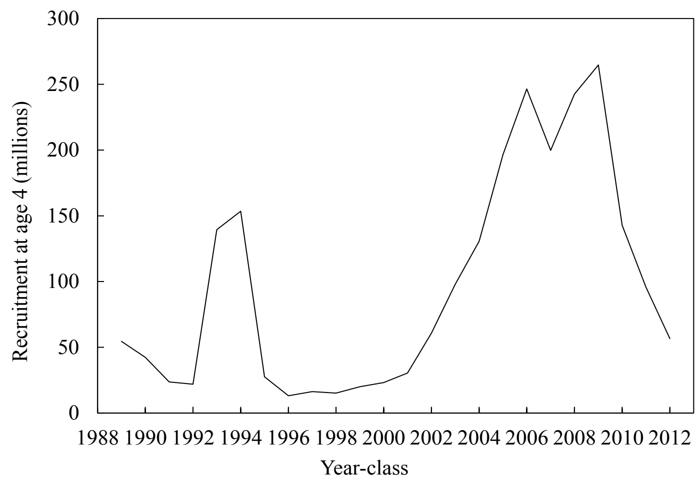


Fig. 7.9. Beaked redfish in Div. 3M: recruitment at age 4.

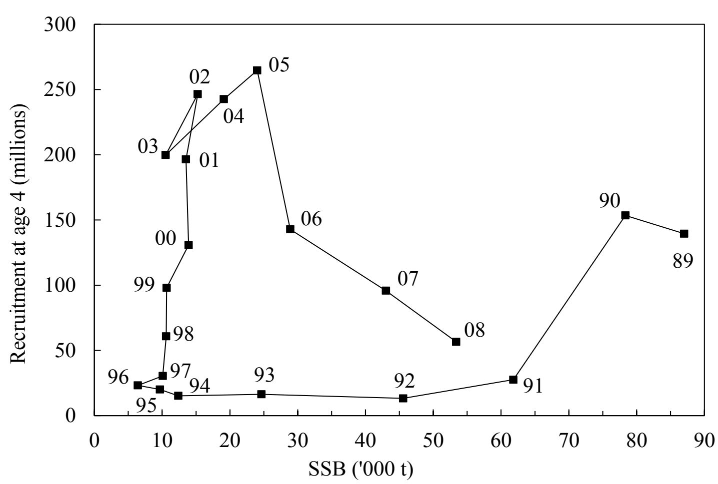


Fig. 7.10. Beaked redfish in Div. 3M: Stock/Recruitment plot (labels indicate age class).

Biomass and abundance (Fig. 7.7): Experienced a steep decline from the 1989 until 1996. The exploitable stock was kept at a low level until the early 2000s, basically dependent on the survival and growth of the existing cohorts. Above average year classes coupled with high survival rates allowed a rapid growth of biomass and abundance since 2003 and sustained the stock at a high level on 2008-2009. In 2010 and 2011 biomass and abundance of exploitable stock went down for causes other than fishing. These declines were halted at well above average levels on the terminal year and, at least for biomass, there was some improvement on 2012.

Spawning stock biomass (Fig. 7.8): The 7+ female biomass (a proxy to female spawning stock biomass) follows the trends of the exploitable stock until 2007. Between 2008 and 2010 has been relatively stable at a high level.

Fishing Mortality (Fig. 7.9): High commercial catches (at a maximum level between 1989 and 1993) led to high fishing mortalities through the first half of the 1990s. Fishing mortality fell between 1996 and 1997 and since then has been kept at a low level until 2009. *F* increased in 2011 but returned to low level in 2012.

Recruitment (Fig. 7.10 and 7.11): The recruitment at age 4 increased from 2002 until 2006 and was kept at a high level until 2009, with 2005 year class as the most abundant year class of the assessment interval. Recruitment to exploitable stock declined since then and is approaching the level of the weak year classes from the 1990s. This reflect higher natural mortalities at pre-recruited ages, rather than the return to a low productivity regime.

Status of the stock : The stock has increased since 2005 and has remained at a relatively high level in recent years. Fishing mortality has remained stable since the late 1990s. Recent recruitment is declining.

e) Short term projections

In order to quantify the outcome of uncertainty regarding natural mortality at present and on next coming years, short term (2015) stochastic projections were obtained for 7 plus female stock biomass and yield under $F_{status\ quo}$ = 0.15 for two natural mortality scenarios (2013-2015):

- *M*=0.125 (2011-2012 *M* selected option in 2013 XSA), or
- *M*=0.40 (2009-2010 *M* selected option in 2011 XSA)

$F_{status\ quo}$ is defined as the 2010-2012 average F_{6-16} at age given by the present XSA, with associated errors.

No stock recruitment relationship was assumed and so recruitment varied randomly around the 1989-2010 geometric mean. The 2011 and 2012 recruitments were excluded from the average due to the greater uncertainty of their estimate by the present XSA.

Uncertainty is associated to the usual vectors needed to forward projections, with the exception of natural mortality, which was fixed for all ages and years. Proportion of 7 plus female proportion at age (proxy to maturity ogive), as well as stock and catch weights at age, are the 2010-2012 averages with associated errors.

	Population in 2013		Exploitation pattern		Stock weights		Catch weights		Maturity	
Age		CV		CV		CV		CV		CV
4	61515	0.786	0.0283	0.008	0.125	0.011	0.131	0.008	0.000	0.000
5	48794	0.340	0.0360	0.008	0.155	0.004	0.159	0.010	0.000	0.000
6	69904	0.418	0.0388	0.010	0.188	0.006	0.188	0.012	0.000	0.000
7	67860	0.308	0.0423	0.032	0.220	0.005	0.224	0.018	0.523	0.053
8	84092	0.246	0.0239	0.008	0.269	0.021	0.288	0.012	0.677	0.109
9	51436	0.263	0.0212	0.010	0.299	0.010	0.325	0.014	0.740	0.057
10	27073	0.321	0.0416	0.031	0.330	0.019	0.396	0.038	0.770	0.038
11	22542	0.206	0.0674	0.040	0.359	0.008	0.411	0.019	0.791	0.061
12	20035	0.207	0.1061	0.072	0.401	0.013	0.472	0.027	0.805	0.064
13	12295	0.215	0.1324	0.056	0.414	0.067	0.461	0.066	0.794	0.074
14	8812	0.169	0.1620	0.079	0.441	0.015	0.483	0.025	0.819	0.084
15	5330	0.206	0.3761	0.359	0.503	0.108	0.516	0.043	0.859	0.097
16	1461	0.230	0.6431	0.600	0.483	0.045	0.578	0.028	0.812	0.070
17	489	0.200	0.3603	0.298	0.549	0.066	0.572	0.066	0.951	0.079
18	249	0.172	0.3629	0.419	0.482	0.039	0.492	0.034	0.875	0.130
19	11742	0.172	0.3629	0.419	0.526	0.046	0.661	0.067	0.877	0.090

$F_{status\ quo}$ was applied to the 2012 survivors at age 5+ coupled with the geometric mean recruitment at age 4 in order to get the starting population at the beginning of 2012 (the same level of recruitment is fixed for 2014). Being the internal and external standard errors from XSA diagnostics two measures of the uncertainty around the survivor estimate for each age, their average was adopted as the coefficients of variation associated with the starting population at age.

Results of the SSB and yield short term projections under $F_{status\ quo}$ for the two *M* scenarios are tabulated below for 5%, 50% and 95% probability levels:

Female spawning biomass					Female spawning biomass				
M=0.125	2013	2014	2015	2016	M=0.40	2013	2014	2015	2016
p5	62032	64837	64417	63817	p5	62032	49901	38087	28818
p50	71326	75683	76180	76592	p50	71326	58142	44763	34313
p95	83475	90023	91480	94384	p95	83475	68925	53538	42151

Yield				Yield			
M=0.125	2013	2014	2015	M=0.40	2013	2014	2015
p5	8318	8412	8710	p5	6288	5035	4117
p50	9346	9518	10047	p50	7147	5812	4874
p95	10525	10885	11597	p95	8104	6748	5736

Given the uncertainty in the actual level of *M* and its impact on short term projections with the same fishing mortality given by the difference of female spawning stock biomass at the end of the projection interval in relation with its size at the beginning (stability versus a 50% reduction), STACFIS decided not to use such approach as basis to recommendation regarding 2014-2015 allowable catch for this stock.

f) Reference Points

No updated information on biological reference points was available.

g) Research Recommendations

STACFIS **recommends** that, *in order to quantify 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 by species and to the size structure of the redfish most affected by cod predation, the existing feeding data from the past EU surveys be analyzed on a refined scale*.

STACFIS also **recommends** that *this important line of ecosystem research based on the feeding sampling routine of the EU survey catch be done on an annual basis*.

The next full assessment for this stock is planned to be in 2015.

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

Interim Monitoring Report (SCR Doc. 13/13; SCS Doc. 13/05, 07, 09)

a) Introduction

A total catch of 115 t was reported for 2012 (Fig. 8.1).

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	

ndf No directed fishing

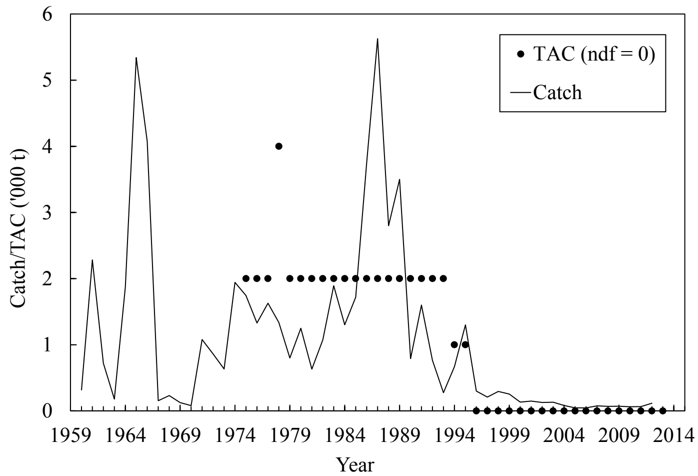


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs (ndf is plotted as 0 TAC).

b) Data Overview

The EU bottom trawl survey on Flemish Cap was conducted during 2012. 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.

c) Conclusion

This stock continues to be in a very poor condition. Recruitment improved recently and these year classes will be recruiting to SSB over the next few years. Although 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.

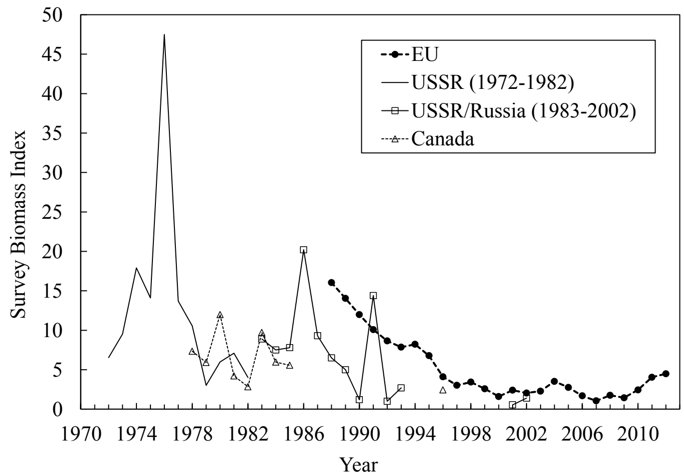


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys.

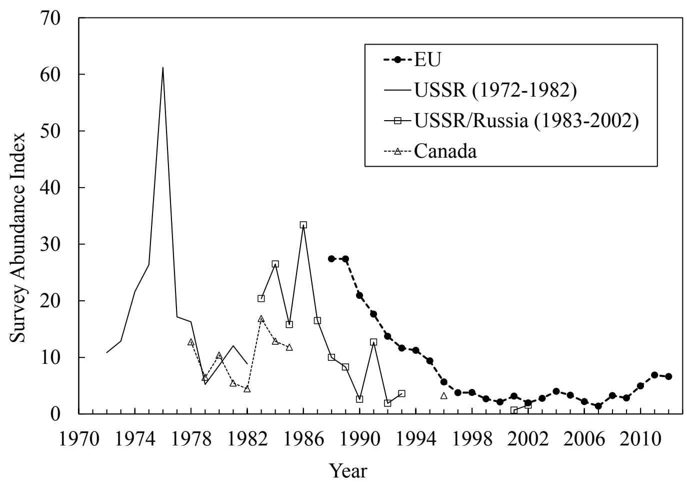


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys.

d) Research Recommendations

STACFIS **recommended** that *the utility of the XSA must be re-evaluated and the use of alternative methods (for eg. 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: 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

(SCR Doc. 13/09, 13/18, SCS Doc. 13-13)

Recent Conditions in Ocean Climate and Lower Trophic Levels

● Ocean climate composite index on SA3 - Grand Bank continues to remain well above normal in 2012 and recent years.

● The composite spring bloom index peaked in 2008 and has remained relatively high through 2011 until declining below normal in 2012.

● Secondary productivity inferred from the composite zooplankton index peaked in 2011 and has remained well above normal for the past several years.

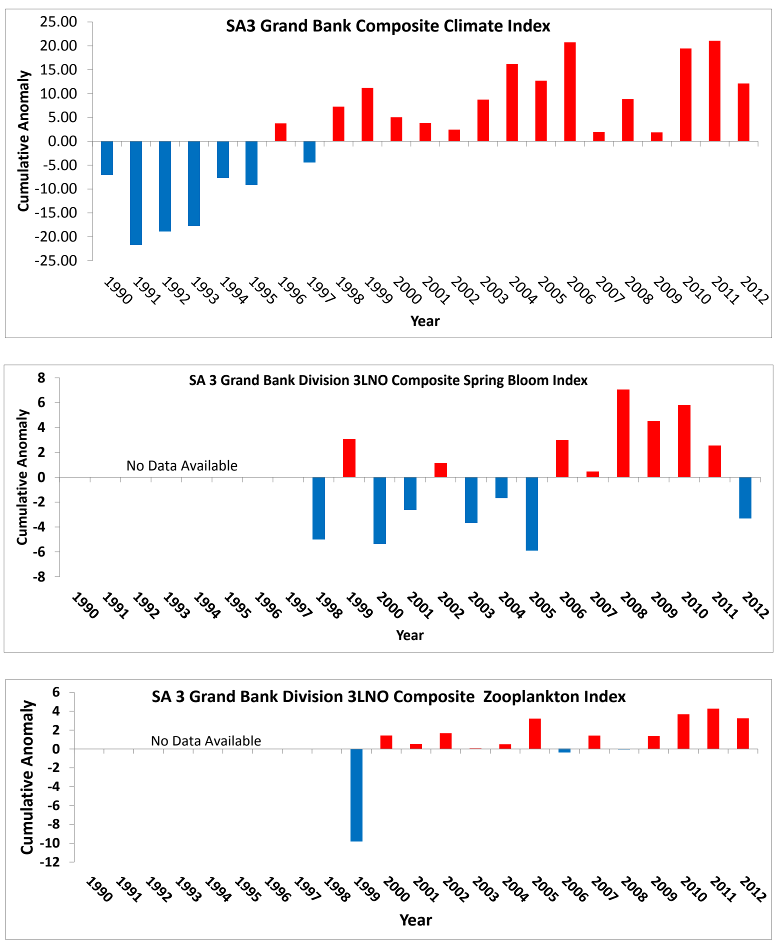


Fig. IV.3. Composite ocean climate index for NAFO Subarea 3 (SA3 Divs. 3LNO) derived by summing the standardized anomalies (top panel) during 1990-2012, composite spring bloom (overall magnitude) index (Divs. 3LNO) during 1998-2012 (middle panel), and composite zooplankton index (bottom panel) during 1999-2012. Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

Environmental Overview

The water mass characteristic of the Grand Bank 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 1-4ºC 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 Bank in Div. 3O bottom temperatures may reach 4-8ºC due to the influence of warm slope water from the south. The general circulation in this region consists of the relatively strong offshore Labrador Current at the shelf break and a considerably weaker branch near the coast in the Avalon Channel. Currents over the banks are very weak and the variability often exceeds the mean flow.

Ocean Climate and Ecosystem Indicators

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 1990s (Fig. IV.3). The composite index declined in 2012 from the record high value observed in 2011 along with cooling events in 2007 and 2009 (Fig. IV.3). Primary productivity based on the composite spring bloom index peaked in 2008 and has remained relatively high through 2011 until 2012 showing a negative composite anomaly (Figure IV.3). Secondary productivity inferred from the composite zooplankton index peaked in 2011 and has remained well above normal for the past several years (Fig. IV.3). The annual surface temperatures at Station 27 in Div. 3L continue to remain above normal reaching +1.6 SD (~1°C) in 2012. Bottom temperatures at Station 27 decreased to 1.2 SD from record high values observed in 2011. Vertically averaged temperatures which also set record highs in 2011 at 2.7 SD decreased to +1.3 SD in 2012. Salinities at Station 27 were near the long temp mean in 2012 except at the surface where it was 0.8 SD above normal. The vertical thickness of the layer of cold <0°C water (commonly referred as the cold-intermediate-layer or CIL on the shelf) at Station 27 reached a remarkably low value of 4.8 SD below normal in 2011 but increased to 1.7 SD below normal in 2012. Spring bottom temperatures in NAFO Div. 3LNO during 2012 were above normal by an average of about 1°C, a moderate decrease over 2011 conditions. During the autumn, bottom temperatures in Div. 3LNO decreased from 1.8 SD above normal in 2011 to 0.2 SD above normal in 2012, indicating significant cooling over the Grand Bank.

9. Cod (*Gadus morhua*) in NAFO Div. 3NO

(SCR 13/10, 43, 44; SCS Doc. 13/05, 07, 09, 10)

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 and has been between 600 t and 1100 t since that time. The catch in 2012 was 734 t.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.9	0.6	0.3	0.7	0.7	0.6	0.8	0.8	0.7	
STACFIS	0.9	0.7	0.6	0.8	0.9	1.1	0.9	0.8	0.7	

ndf No directed fishery and by-catches of cod in fisheries targeting other species should be kept at the lowest possible level.

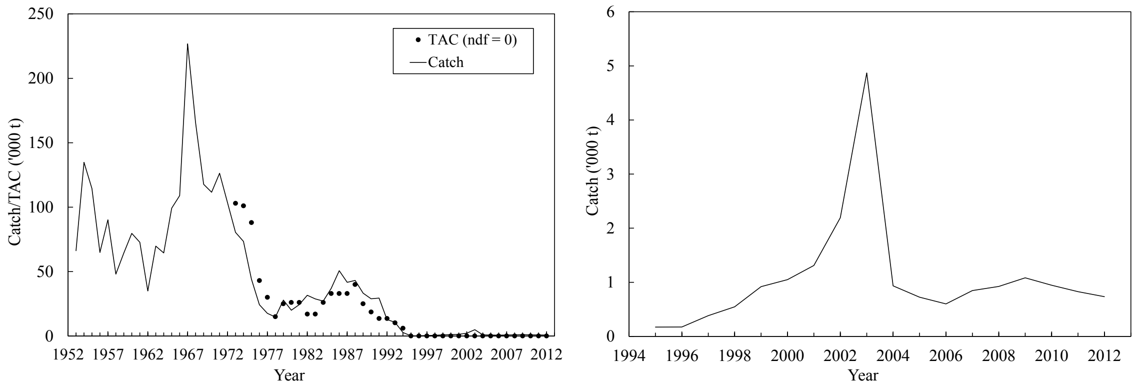


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) Data Overview

This assessment utilizes commercial catch at age data for 2010-2012 along with data from Canadian spring (1984-2012), autumn (1990-2012), and juvenile (1989-1994) surveys. As per previous assessments, trends in the EU-Spain survey were presented but not used as input to the assessment model.

i) Commercial fishery data

Catch-at-age. Calculation of catch at age used Canadian length and age sampling for 2010-2012 and length sampling from Russia (2010-2012), EU-Portugal (2010-2012) and EU-Spain (2010-2012). The catch-at-age for these fleets was constructed by applying Canadian survey age length keys to the available length sampling. The catch from 2010-2012 was dominated by ages 3-6.

ii) Research survey data

Canadian bottom trawl surveys. 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 before increasing again in 2012. Trends in abundance and biomass indices are very similar and patterns are similar for the spring and autumn surveys (Fig. 9.2).

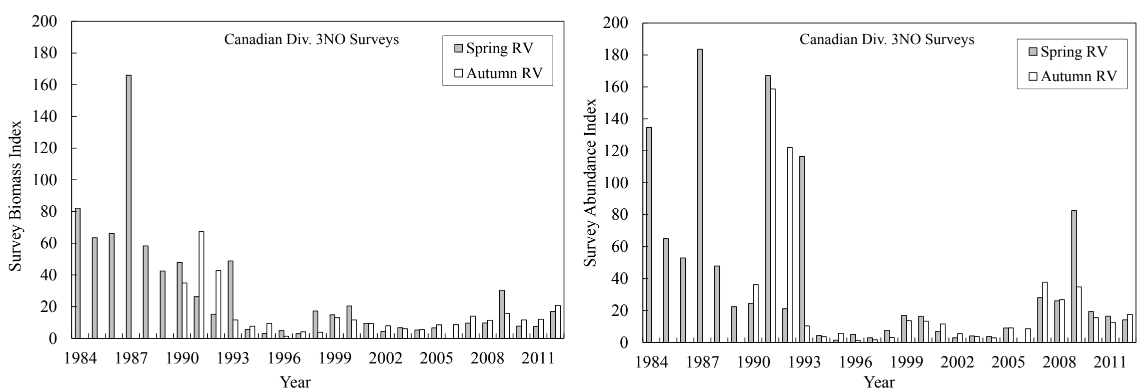


Fig. 9.2. Cod in Div. 3NO: survey biomass and abundance indices from Canadian spring and autumn surveys.

Canadian juvenile surveys. The index increased from 1989 to 1991, and declined steadily from 1992 to 1994 (Fig. 9.3).

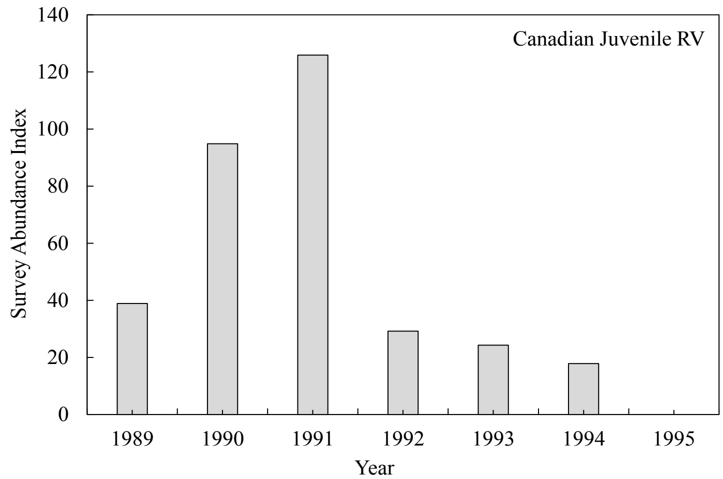


Fig. 9.3. Cod in Div. 3NO: survey abundance index from Canadian Juvenile surveys.

EU-Spain Div. 3NO surveys. The biomass index was relatively low and stable from 1997-2005 with the exception of 1998 and 2001 (Fig. 9.4). Since 2008 there has been a considerable increase in the index, with the highest estimate in the series in 2011 and a subsequent decline in 2012. The increase was due to improved recruitment from the 2005-2007 year classes. Abundance and biomass indices show similar trends.

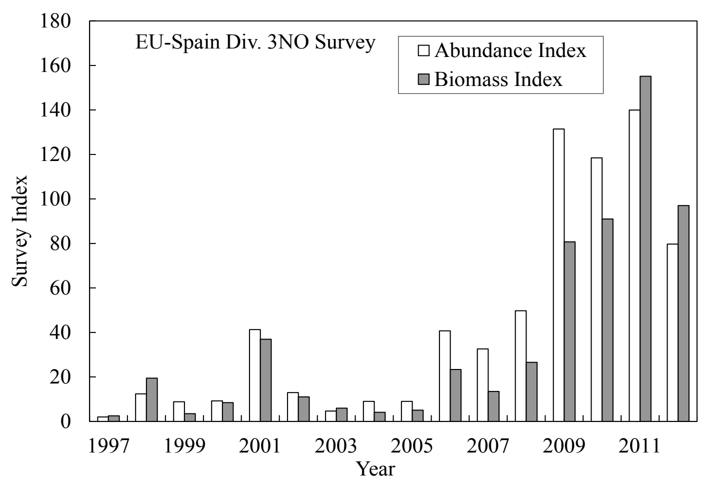


Fig. 9.4. Cod in Div. 3NO: survey abundance and biomass indices from EU-Spain Div. 3NO surveys.

iii) Biological Studies

Maturity-at-age. Annual proportion mature is modeled by cohort. The estimated age at 50% maturity (A50) ranged between 5.6 and 7.4 years for cohorts produced from the 1950s to 1980s. Age at 50% maturity declined between 1980 and the late 1990s from approximately 6.8 to 4.5 years. Since that time there has been a variable but increasing trend in the A50, with the most recent estimable cohorts (2005-2007) ranging from 5.6 to 6.4 years, similar to values in the early to mid 1980s.

c) Estimation of Parameters

Sequential population analysis (SPA). An ADAPT was applied to catch-at-age calibrated with the Canadian spring, autumn and juvenile survey data (ages 2-10) to estimate population numbers at ages 3-12 in 2013. The SPA formulation also estimated numbers at age 12 from 1994-2012 and survey catchabilities at ages 2-10 for each survey. In the estimation, an *F*-constraint was applied to age 12 from 1959-93 by assuming that fishing mortality was equal to the average fishing mortality over ages 6-9. Natural mortality was assumed fixed at 0.2 for all years and ages. The mean square error of the model fit was 0.617

d) Assessment Results

The SPA results calibrated with the three Canadian survey indices indicate that the spawning stock was at an extremely low level in 1994 and remained stable at a low level to 2010. SSB has subsequently increased and the 2013 estimate of 25 160 (Fig. 9.5) is the highest level observed since 1991.

The 2005-2006 year classes were estimated to have the highest levels of recruitment in the past two decades, with levels comparable to those from the mid - late 1980s but well below historic values (Fig. 9.5). Estimated recruitment has not been as strong for subsequent year classes.

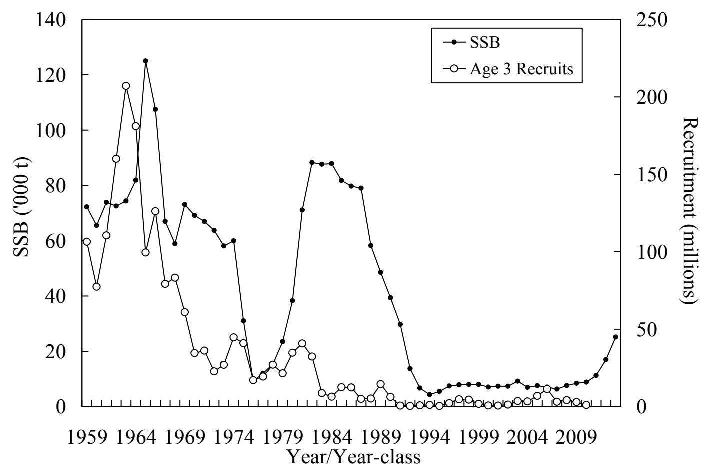


Fig. 9.5. Cod in Div. 3NO: time trend of spawner stock biomass (SSB) and corresponding recruitment from the SPA.

Fishing mortality was low in the early years of the moratorium but then increased and peaked in 2003 (Fig. 9.6). Fishing mortality over the past five years has been less than 0.1 and amongst the lowest values in the time series.

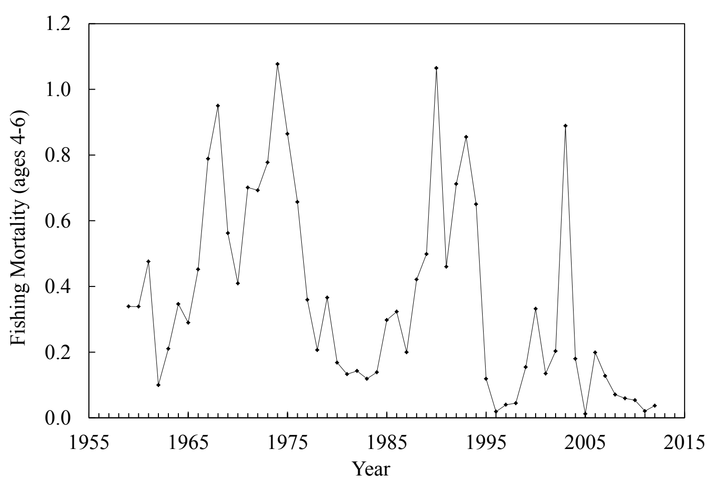


Fig. 9.6. Cod in Div. 3NO: time trend of average fishing mortalities from the SPA.

e) Retrospective Analysis

A retrospective analysis was conducted to investigate whether there were systematic trends in the estimates of population size. A 5-year period was chosen to evaluate, whereby a complete year of data was removed in succession from the model but the formulation remained the same. The retrospective analysis indicated recruitment and SSB tended to be overestimated in previous years, whereas the retrospective pattern was very small for mean F (ages 4-6) (Fig. 9.7).

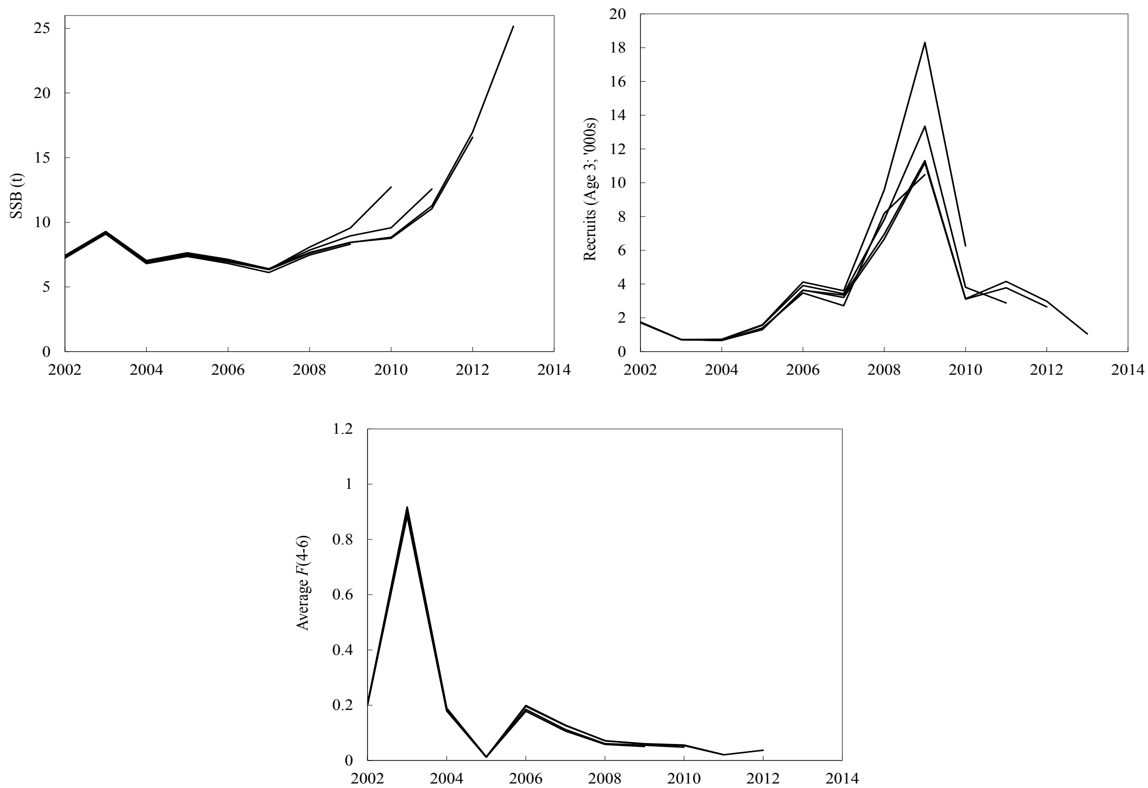


Fig. 9.7. Cod in Div. 3NO: Five-year retrospective analysis of SSB, age 3 recruitment and average *F* on ages 4-6.

f) State of the Stock

The 2013 spawning biomass has doubled since 2010 but remains well below B_{lim}. This increase in biomass has been driven by the relatively strong 2005 and 2006 year classes and by fishing mortality values that are amongst the lowest in the time series (F<0.1). More recent year classes do not appear strong.

g) Reference Points

The current estimate of B_{lim} is 60 000 t (Fig. 9.8). SSB in 2013 is estimated to be 25 160 t which is 42% of B_{lim}. STACFIS notes that SSB is approaching the point at which B_{lim} will be re-evaluated. Mean fishing mortality for ages 4-6 in 2012 was estimated to be 0.04, well below the F_{lim} of 0.3

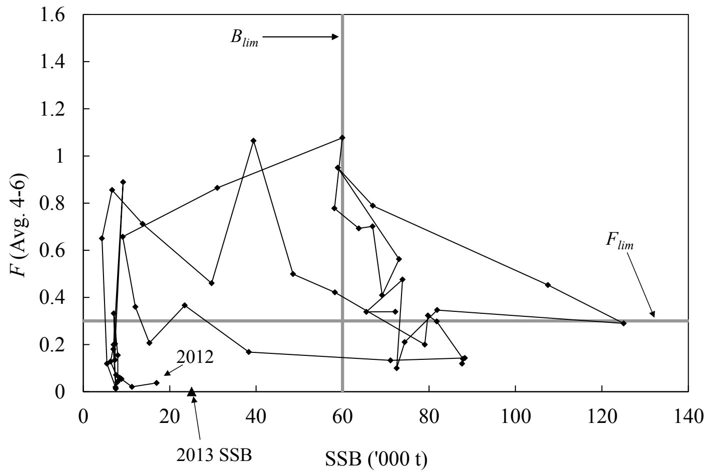


Fig. 9.8. Cod in Div. 3NO: stock trajectory 1959-2012.

h) Short-Term Considerations – Stochastic Projections

Simulations were carried out to examine the trajectory of the stock under two scenarios of fishing mortality: F=0, F=0.04 (the average F on ages 4-6 from 2010-2012). For these simulations the results of the SPA and the covariance of these population estimates were used. The following inputs were the basis of these projections:

Age	Estimate of 2013 population numbers ('000)	Relative error on population estimate	Weight-at-age mid-year (avg. 2010-2012)	Weight-at-age beginning of year (avg. 2010-2012)	Maturity-at-age (avg. 2010-2012)	PR rescaled relative to ages 4-6 (avg. 2010-2012)
3	1045.7	0.573	0.46	0.45	0.01	1.94
4	2244.9	0.426	0.68	0.53	0.06	1.36
5	2468.3	0.358	1.05	0.84	0.20	0.85
6	1512.0	0.306	1.73	1.31	0.54	0.79
7	4490.9	0.277	2.70	2.20	0.87	0.95
8	2289.4	0.255	4.04	3.62	0.98	1.27
9	754.9	0.264	5.73	4.69	1.00	0.59
10	558.4	0.263	5.21	5.53	1.00	1.24
11	140.3	0.265	8.12	6.07	1.00	0.46
12	54.9	0.278	9.85	8.62	1.00	0.06

Simulations were limited to a 3-year period. Recruitment (at age 3) was only re-sampled from the moratorium period (1994-2012) as this represents a reasonable expectation of what has occurred at recent low stock size levels.

At *F*=0 spawning stock biomass is estimated to increase and there is a >95% probability that SSB will remain under B_{lim} by 2016 (Fig. 9.9, Table 1, Table 2). At *F*=0.04 the population is estimated to grow slightly slower, with a >95% probability of being below B_{lim} by 2016. If the fishing mortality in 2013-2015 remains at the average estimated in 2010-2012 then yield is projected to be stable but low over the 3-year time period.

Table 1. Stochastic Projection Results

F=0	Beginning of Year SSB			
Percentile	2013	2014	2015	2016
0.95	43676	54413	60894	58401
0.75	36050	45526	50133	49199
0.5	31861	39993	44287	43742
0.25	28454	35985	39898	39224
0.05	23676	29881	33396	34007

F=0.04	Beginning of Year SSB			
Percentile	2013	2014	2015	2016
0.95	42775	52057	55459	51639
0.75	35464	43220	46285	43736
0.5	31342	38214	40712	38903
0.25	28003	34139	36655	34741
0.05	23534	28574	30635	29175

F=0.04	Yield			
Percentile	2013	2014	2015	2016
0.95	1535	1688	1483	1600
0.75	1281	1395	1268	1336
0.5	1127	1214	1114	1175
0.25	998	1080	980	1031
0.05	834	893	823	862

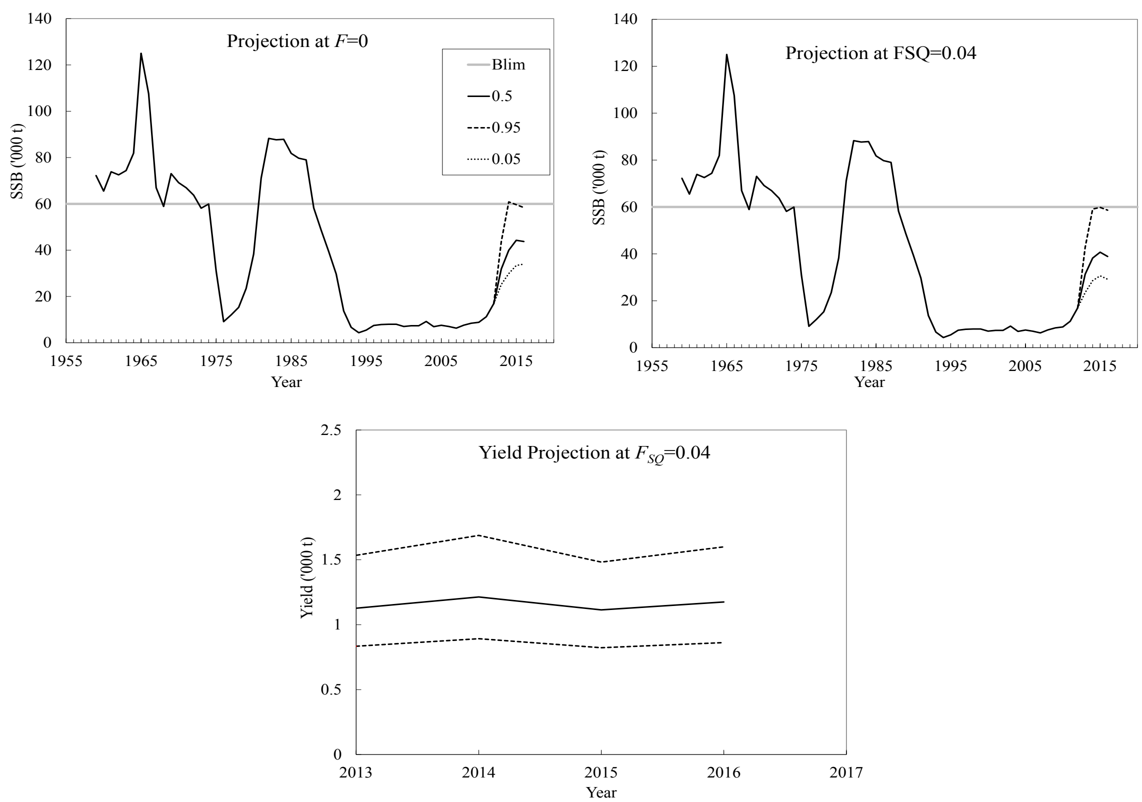


Fig. 9.9 Cod in Div. 3NO: Stochastic projections at *F*=0 and *F*=0.04 (the average *F* on ages 4-6 from 2010-2012).

Table 2. Risk assessment of the probability of being below B_{lim} under various fishing scenarios. Yield is the median projected value.

	Yield			P(SSB<B_{lim})			
Fishing Mortality	2014	2015	2016	2014	2015	2016	P(SSB_{2017}<SSB_{2013})
$F = 0$	-	-	-	>95%	>95%	>95%	<5%
F_{SQ}= 0.04	1214	1114	1175	>95%	>95%	>95%	<5%

i) Other Studies

Differences in the trends of the Canadian spring and EU-Spain surveys in recent years were explored. These surveys occur at approximately the same time of year but show differing trends. The Canadian survey showed a moderate increase in indices in 2009 but then declined again in subsequent years. The EU-Spain indices, on the other hand showed a substantial increase from 2008-2011 and although values declined in 2012 they remain well above the earlier part of the time series. Trends based only on strata located in the NRA were examined but did not resolve the differences, suggesting the differences between surveys are not entirely related to the small overall portion of the stock covered by the EU-Spain survey.

The next assessment of this stock will be in 2016.

j) Research Recommendation

STACFIS **recommends** *continuing to monitor the consistency in trends between the Canadian and EU-Spain surveys.*

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

Interim Monitoring Report (SCR Doc. 13/011; SCS Doc. 13/05,07, 09)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3LN, the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics and the surveys.

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. During that time catches were taken as by-catch primarily in Greenland halibut fisheries. With the reopening of the fishery in 2010 catches increased in 2011 and 2012 to 5 395 t and 4 261 t.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	ndf	ndf	3.5	6.0	6.0	6.5
STATLANT 21	0.7	0.4	0.2	0.2	0.4	0.3	3.1	5.4	4.3	
STACFIS	0.6	0.7	0.5	1.7	0.6	1.1	4.1	5.4	4.3	

ndf No directed fishery.

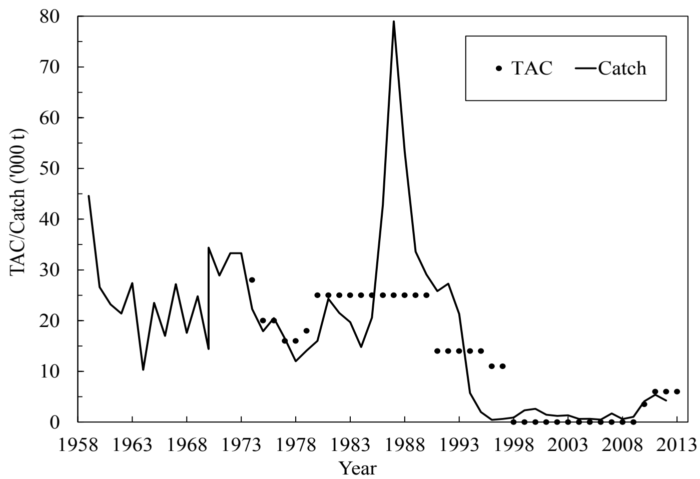


Fig. 10.1. Redfish in Div. 3LN: catches and TACs.

b) Data Overview

i) Research surveys

Most of the available surveys in Div. 3L and Div. 3N have been incorporated in the assessment framework for this stock and have been standardized in order to be presented on Fig. 10.2.

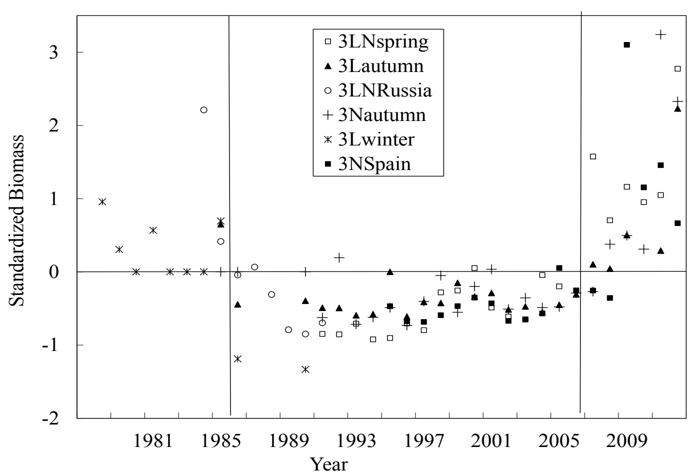


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2012). Each series is standardized to the mean and unit standard deviation.

From the first half of the 1980s to the first half of the 1990s Canadian survey data in Div. 3L and Russian bottom trawl surveys in Div. 3LN suggests that stock size suffered a substantial reduction, as response to catches raising from an average of 21 000 t (1965-1985) to 41 500 t (1986-1992). Redfish survey bottom biomass in Div. 3LN remained well below average level until 1998 and start a discrete (but discontinuous) increase afterwards. A pronounced increase of the remaining biomass indices has been observed over the most recent years since 2006. Considering all available bottom trawl survey series occurring in Div. 3L and Div. 3N from 1978 until 2012, 100% of the biomass indices were at or above the average of their own series on 1978-1985, only 9% on 1986-2005, and 76% on 2006-2012.

c) Estimation of Stock Parameters

i) Relative exploitation

Ratios of catch to Canadian spring survey biomass were calculated for Div. 3L and Div. 3N combined and are considered a proxy of fishing mortality (Fig. 10.3). Spring survey series was chosen since is usually carried out on Div. 3L and Div. 3N during May till the beginning of June, and so can give an index of the average biomass at the middle of each year.

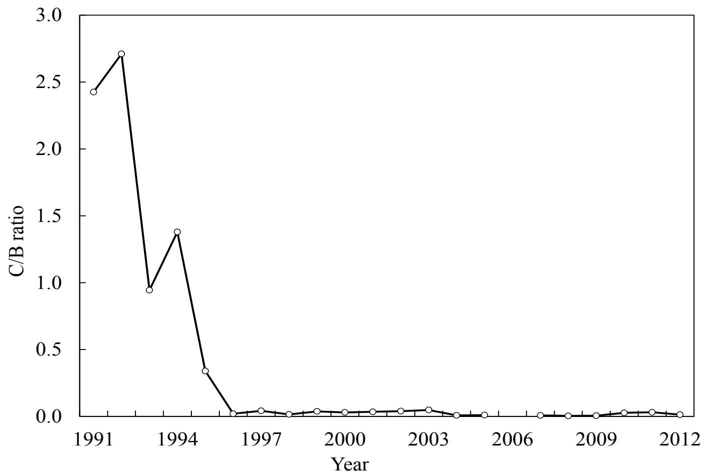


Fig. 10.3. Redfish in Div. 3LN: C/B ratio using STACFIS catch and Canadian spring survey biomass (1991-2012).

Catch/Biomass ratio declined from 1991 to 1996, with a drop between 1992 and 1993. From 1996 onwards this proxy of fishing mortality is kept at a level close to zero.

d) Conclusions

There is nothing to indicate a change in the status of the stock. The increase of the catch with the reopening of the fishery in 2010, have not altered the perception of the stock given by the available surveys.

The next full assessment of this stock is planned for 2014.

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO

Interim Monitoring Report (SCR 13/10, 16; SCS 13/05, 07, 09, 10)

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. After the moratorium, catches reached a peak in 2003, but have been lower since then (Fig. 11.1). STACFIS only had STATLANT 21A available as estimates of catches in 2011 and 2012. The inconsistency between the information available to produce catch figures used in the previous years' assessments and that available for the 2011 and 2012 catches has made it impossible for STACFIS to provide the best assessment for this stock in 2012. STATLANT 21A catch in 2012 was 1267 t (Fig. 11.1).

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	2.7	2.4	0.9	1.5	1.9	1.8	2.0	1.2	1.3	
STACFIS	6.2	4.1	2.8	3.6	2.5	3.0	2.9	na	na	

ndf No directed fishery
na not available

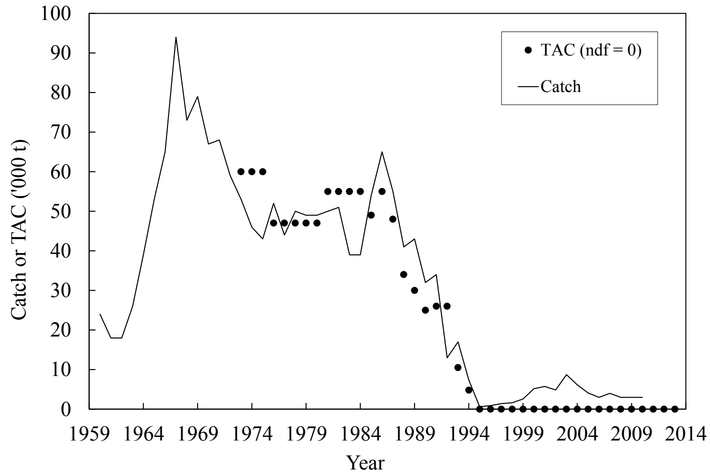


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC. There is no catch in plot for 2011 and 2012.

b) Research Survey Data

Canadian stratified-random bottom trawl surveys. Biomass and abundance estimates from spring surveys for Div. 3LNO 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 has been increasing for the past three years. The abundance index follows a similar trend.

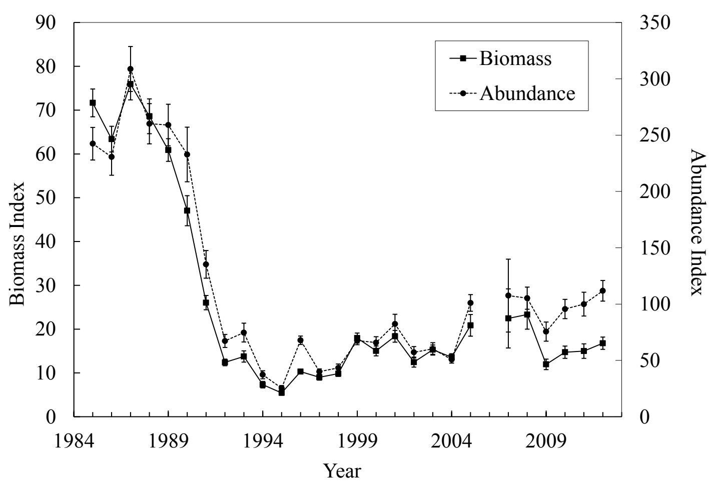


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys (Data prior to 1996 are Campelen equivalents and since then are Campelen).

Biomass and abundance indices from the autumn survey declined from 1990 to the mid 1990s. Both indices have shown an increasing trend since 1995 but remain well below the level of the early-1990s (Fig. 11.3).

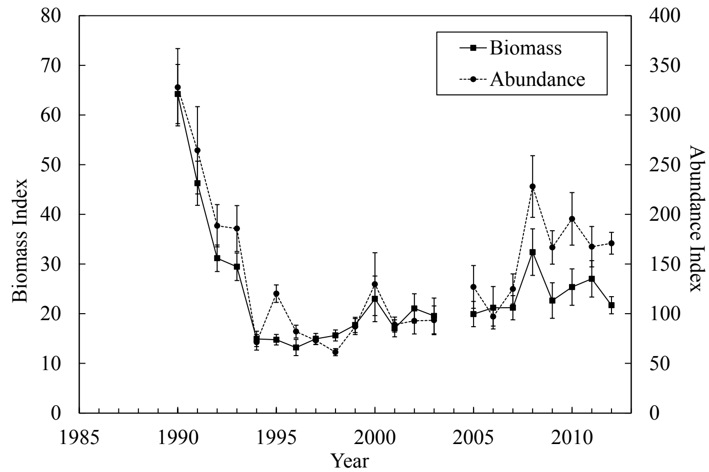


Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from Canadian autumn surveys (Data prior to 1995 are Campelen equivalents and since then are Campelen).

EU-Spain Div. 3NO Survey. From 1998-2012, surveys have been conducted annually by EU-Spain in the Regulatory Area in Div. 3NO. Although variable, generally the biomass and abundance indices declined from 2006-2009 and have been higher since then.

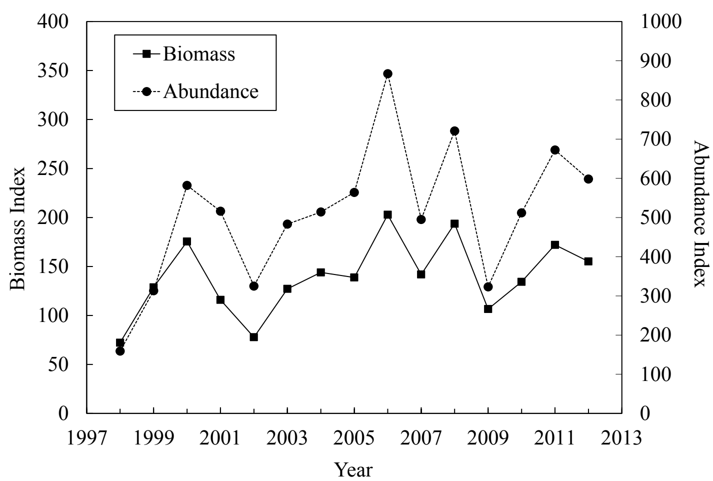


Fig. 11.4 American plaice in Div. 3LNO: biomass and abundance indices from the survey by EU-Spain (Data prior to 2001 are Campelen equivalents and since then are Campelen).

c) Conclusion

Based on available data, 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 Recommendations

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

(SCR Doc. 13/11, 37, 38; SCS Doc. 13/5, 7, 9, 10, 13)

a) Introduction

There was a moratorium on directed fishing from 1994 to 1997, and small catches were taken as by-catch in other fisheries. The fishery was re-opened in 1998 and catches increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches from 2001 to 2005 ranged from 11 000 t to 14 000 t. Since then, catches have been below the TAC and in some years, have been very low. The low catch in 2006 was due to corporate restructuring and a labour dispute in the Canadian fishing industry. Industry related factors have continued to affect catches which remained well below the TAC in 2011 and 2012.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC[1]	14.5	15.0	15.0	15.5	15.5	17	17	17	17	17
STATLANT 21	13.1	13.9	0.6	4.4	11.3	5.5	9.1	5.2	3.1	
STACFIS	13.4	13.9	0.9	4.6	11.4	6.2	9.4	5.2	3.1	

[1] SC recommended any TAC up to 85% F_{msy} in 2009 to 2013.

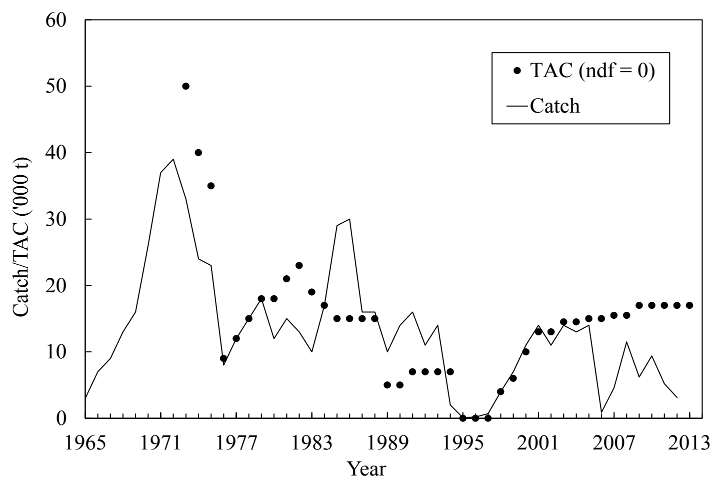


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

b) Input Data

Abundance and biomass indices were available from: annual Canadian spring (1971-82; 1984-2012) and autumn (1990-2012) bottom trawl surveys; annual USSR/Russian spring surveys (1972-91); and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2012). Length frequencies of the catch from Canada (Div. 3LNO), Portugal (Div. 3N) and Spain (Div. 3NO) were also available for 2011 and 2012.

i) Commercial fishery data

Length Frequencies (SCR Docs. 13/11; SCS Doc. 12/8, 9; 13/7, 9). Length frequencies were available from the 2011 and 2012 yellowtail flounder fisheries by Canada, EU-Spain and EU-Portugal. Catch from the Canadian fishery in 2011 and 2012 were similar in length distribution as previous years, and yellowtail flounder ranged in size from 18-56cm with a mode at 37cm. Samples of yellowtail flounder taken in the 2011 and 2012 Spanish and Portuguese fisheries for Greenland halibut and as by-catch in skate fisheries were small, however, frequencies showed generally smaller fish, with modes in the frequencies less than 37cm .

ii) Research survey data

Canadian stratified-random spring surveys (SCR Doc. 13/38). The index of trawlable biomass declined in 2009, but increased to the highest in the series in 2012. Since 1999, the index of trawlable biomass has been variable, with a slight increasing trend, and remains well above the level of the late 1980s and early 1990s.

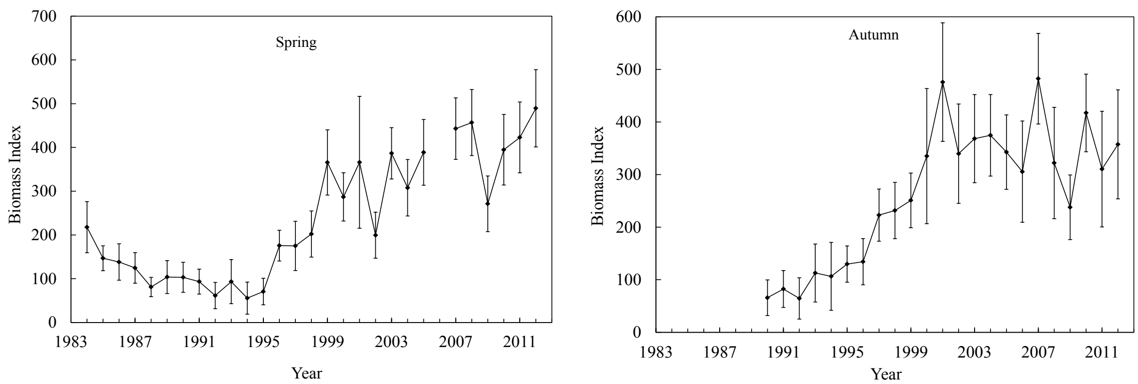


Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx 95% confidence intervals, from Canadian spring and autumn surveys. Values are Campelen units or, prior to autumn 1995, Campelen equivalent units.

Canadian stratified-random autumn surveys (SCR Doc. 13/38). The index of trawlable biomass for Div. 3LNO increased steadily from the early-1990s (Fig. 12.2) to the series high in 2007. The biomass index then decreased to 2009 to about the level of the late 1990s, increased in 2010 and remained high in 2011 and 2012.

EU-Spain stratified-random spring surveys in the Regulatory Area of Div. 3NO. (SCR Doc. 13/11). The biomass index of yellowtail flounder increased sharply up to 1999, in general agreement with the Canadian series in Div. 3LNO, and has been relatively stable from 2000-2012 (Fig. 12.3).

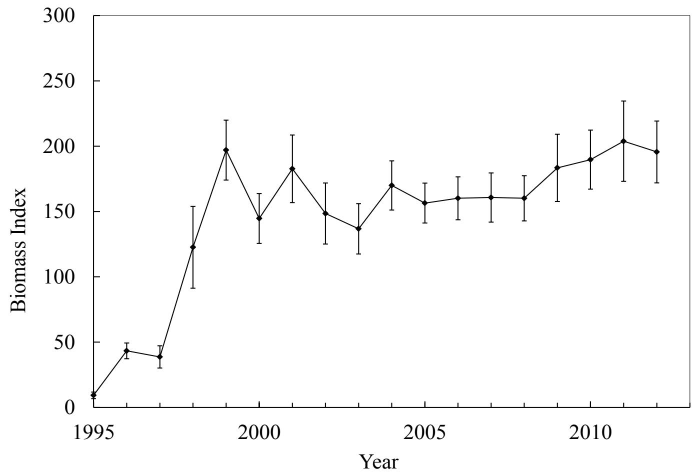


Fig. 12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the EU-Spain spring surveys in the Regulatory Area of Div. 3NO ±1SD. Values are Campelen units or, prior to 2001, Campelen equivalent units.

Stock distribution (SCR Doc. 13/38). In all surveys, yellowtail flounder were most abundant in strata on the Southeast Shoal and those immediately to the west (360, 361, 375 & 376), which straddle the Canadian 200 mile limit. Yellowtail flounder appear to be more abundant in the Regulatory Area of Div. 3N in the 1999-2012 surveys than from 1984-1995, and the stock has continued to occupy the northern portion of its range in Div. 3L, similar to the mid-1980s when overall stock size was also relatively large. The vast majority of the stock was still found in waters shallower than 93m in both seasons.

c) Estimation of Parameters

(SCR Doc. 13/37)

The assessment of Div. 3LNO yellowtail flounder in 2013 used a non-equilibrium surplus production model (ASPIC; version 5.34). The input data for 2013 was: Catch data (1965-2012, with catch set to the TAC, 17 000 t, in 2013), Russian spring surveys (1984-91), Canadian spring (Yankee) surveys (1971-82), Canadian spring (1984-2012 omitting 2006) surveys, Canadian autumn (1990-2012) surveys and the EU-Spain spring (1995-2012) surveys.

d) Assessment Results

(SCR Doc. 13/37)

Recruitment: Total numbers of juveniles (<22 cm) from spring and autumn surveys by Canada and spring surveys by EU-Spain are given in Fig. 12.4 scaled to each series mean. High catches of juveniles seen in the autumn of 2004 and 2005 were not evident in either the Canadian or EU-Spain spring series. Although no clear trend in recruitment is evident, the number of small fish was above the 1996-2012 average in the Canadian surveys of 2010, and the 2011 and 2012 Canadian spring surveys. The spring survey by EU-Spain has shown lower than average numbers of small fish in the last six surveys. Based on a comparison of small fish (<22 cm) in research surveys, recent recruitment appears to be about average.

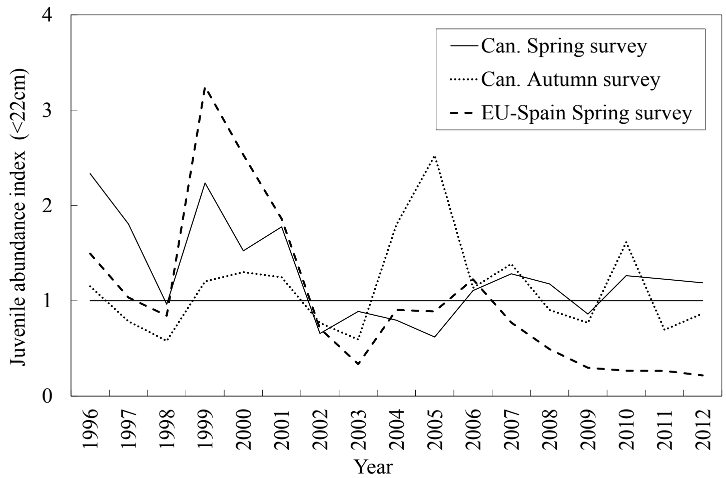


Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile length index estimated from 1996 to 2012 annual spring and autumn surveys by Canada (Can.) and annual spring surveys by EU-Spain. Horizontal line represents series means.

Stock Production Model: (SCR Doc. 13/37). The surplus production model results are very similar to the 2011 assessment results, and indicate that stock size increased rapidly after the moratorium in the mid-1990s and has now begun to level off. Bias-corrected estimates from the model suggests that a maximum sustainable yield (*MSY*) of 18 970 t can be produced by total stock biomass of 74 760 t (B_{msy}) at a fishing mortality rate (F_{msy}) of 0.25.

Biomass: Biomass estimates in all surveys have been relatively high since 2000. The analysis showed that relative population size (B/B_{msy}) was below 1.0 from 1973 to 1998. Relative biomass from the production model has been increasing since 1994, is estimated to be above the level of B_{msy} after 1999, and is 1.8 times B_{msy} in 2013 (Fig. 12.5).

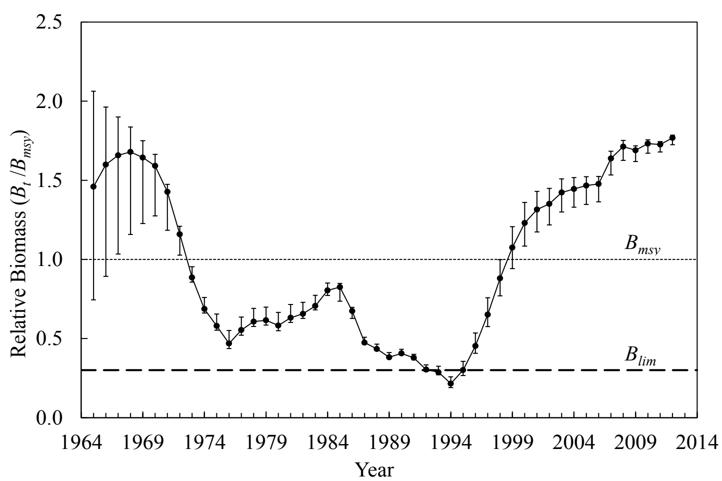


Fig. 12.5. Yellowtail flounder in Div. 3LNO: bias corrected relative biomass trends with approximate 80% confidence intervals.

Fishing Mortality: Relative fishing mortality rate (F/F_{msy}) was above 1.0, in particular from the mid-1980s to early-1990s when the catches exceeded or doubled the recommended TACs (Fig. 12.6). *F* has been below F_{msy} since 1994. From 2007-2012 *F* averaged about 20% of F_{msy}.

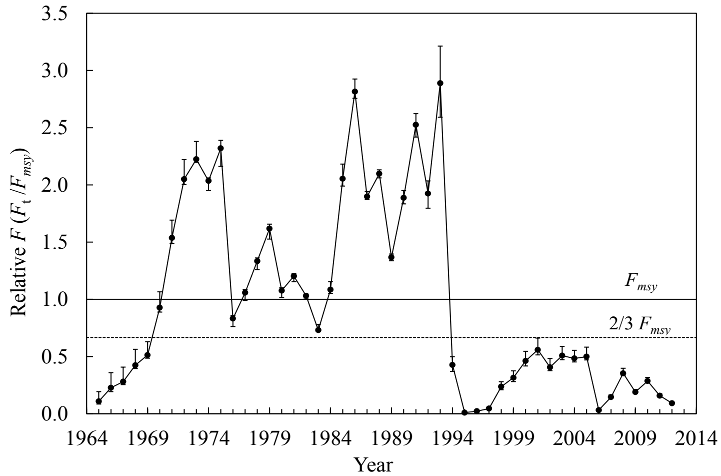


Fig. 12.6. Yellowtail flounder in Div. 3LNO: bias corrected relative fishing mortality trends with approximate 80% confidence intervals.

e) State of the Stock

The stock size has steadily increased since 1994 and is now above B_{msy}. There is very low risk (<5%) of the stock being below B_{msy} or F being above F_{msy}. Recent recruitment appears about average.

In most years since the moratorium (1994-97) was put in place, the catch remained below the estimated surplus production levels and have been low enough to allow the stock to grow (Fig. 12.7).

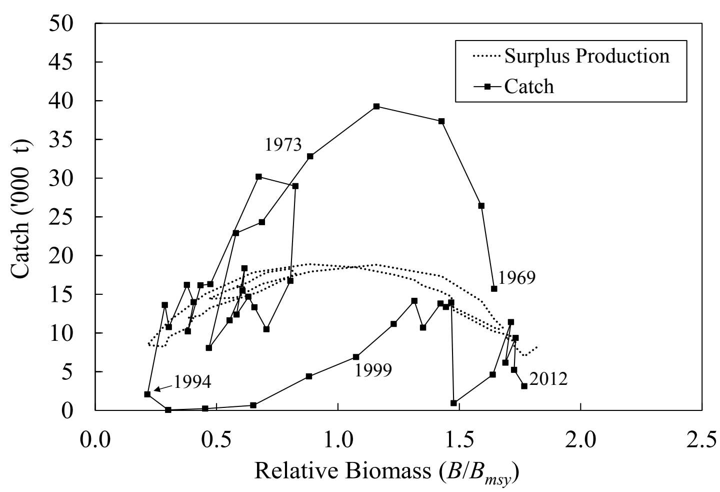


Fig. 12.7. Yellowtail flounder in Div. 3LNO: catch trajectory.

f) Medium Term Considerations

Medium-term projections were carried out by extending the ASPIC bootstrap projections (500 iterations) forward to the year 2018 assuming two levels of catch in 2013 (TAC level (17 000t) and the average of the 2007-2012 catch (6 656 t)) followed by constant fishing mortality from 2014-2018 at several levels of F (F_{2012}, 2/3 F_{msy}, 75% F_{msy}, and 85% F_{msy}, and F_{msy}). The projections are conditional on the estimated values of r, the intrinsic rate of population growth and K, the carrying capacity.

F_{msy} was estimated to be 0.25. Although yields are projected to decline in the medium term at both levels of catch in 2013 for 2/3 F_{msy}, 75% F_{msy}, and 85% F_{msy} (Table 12.1; Fig. 12.8), at the end of the projection period, the risk of biomass being below B_{msy} is less than 5% in all cases.

The probability that $F > F_{msy}$ in 2013-2016 was less than .05 at 2/3, 75% and 85% F_{msy} for both catch scenarios in 2013 (Table 12.2), and for projections at F_{msy}, the probability that $F > F_{msy}$ is approximately 0.5. For biomass projections, in all scenarios for 2013-2016, the probability of biomass being below B_{msy} was less than 0.05. Biomass in 2016 is projected to be less than B_{2013} at all levels of *F* projected for both catch scenarios with probability >0.95.

Table 12.1. Medium-term projections for yellowtail flounder. The 5th, 50th and 95th percentiles of catch and relative biomass B/B_{msy}, are shown, for projected *F* values of F_{2012}, 2/3 F_{msy}, 75% F_{msy} and 85% F_{msy}. The results are derived from ASPIC bootstrap runs (500 iterations) with catch constraints in 2013 of 17 000 t (TAC) or 6 656 t (mean catch 2007-2012).

		Projections with catch in 2013= 17 000 t (TAC)									
		Projected Catch (000 tons)					Projected Relative Biomass (B/B_{msy})				
		2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
F_{2012}	5	3.03	3.13	3.19	3.23	3.26	1.68	1.75	1.80	1.83	1.86
	50	3.03	3.14	3.21	3.25	3.28	1.70	1.78	1.83	1.86	1.88
	95	3.05	3.15	3.22	3.27	3.30	1.73	1.80	1.84	1.87	1.89
2/3 F_{msy}	5	20.56	19.29	18.49	17.94	17.55	1.68	1.56	1.48	1.43	1.39
	50	20.66	19.40	18.60	18.07	17.72	1.70	1.58	1.50	1.45	1.42
	95	20.99	19.93	19.23	18.74	18.40	1.73	1.62	1.56	1.51	1.48
75% F_{msy}	5	22.91	21.17	20.08	19.33	18.80	1.68	1.53	1.43	1.37	1.33
	50	23.03	21.31	20.22	19.50	19.02	1.70	1.55	1.46	1.40	1.36
	95	23.45	22.00	21.04	20.38	19.91	1.73	1.60	1.52	1.47	1.43
85% F_{msy}	5	25.66	23.28	21.80	20.79	20.05	1.68	1.50	1.38	1.31	1.25
	50	25.82	23.48	21.99	21.01	20.35	1.70	1.52	1.40	1.33	1.28
	95	26.34	24.36	23.06	22.16	21.53	1.73	1.58	1.48	1.41	1.37
F_{msy}	5	29.67	26.18	24.02	22.56	21.48	1.68	1.45	1.31	1.21	1.15
	50	29.88	26.45	24.30	22.86	21.89	1.70	1.47	1.33	1.24	1.18
	95	30.58	27.68	25.79	24.48	23.55	1.73	1.54	1.42	1.33	1.28

		Projections with catch in 2013 = 6 656 t (mean catch 2007-2012)									
		Projected Catch (000 tons)					Projected Relative Biomass (B/B_{msy})				
		2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
F_{2012}	5	3.19	3.24	3.27	3.28	3.29	1.78	1.82	1.85	1.87	1.88
	50	3.20	3.25	3.28	3.30	3.31	1.82	1.85	1.87	1.89	1.90
	95	3.21	3.27	3.31	3.33	3.35	1.84	1.87	1.89	1.90	1.91
2/3 F_{msy}	5	21.62	19.90	18.87	18.20	17.73	1.78	1.62	1.52	1.45	1.40
	50	21.75	20.07	19.02	18.33	17.89	1.82	1.65	1.54	1.48	1.44
	95	22.03	20.66	19.75	19.12	18.69	1.84	1.69	1.60	1.54	1.50
75% F_{msy}	5	24.10	21.84	20.51	19.63	19.01	1.78	1.59	1.48	1.40	1.34
	50	24.25	22.05	20.69	19.80	19.21	1.82	1.62	1.50	1.42	1.38
	95	24.61	22.80	21.60	20.78	20.24	1.84	1.66	1.56	1.49	1.45
85% F_{msy}	5	27.00	24.04	22.28	21.13	20.28	1.78	1.56	1.42	1.33	1.27
	50	27.18	24.30	22.51	21.34	20.57	1.82	1.58	1.45	1.36	1.30
	95	27.65	25.25	23.68	22.60	21.89	1.84	1.64	1.51	1.44	1.38
F_{msy}	5	31.22	27.05	24.59	22.96	21.76	1.78	1.51	1.35	1.24	1.16
	50	31.46	27.38	24.89	23.25	22.16	1.82	1.53	1.37	1.27	1.20
	95	32.10	28.69	26.48	24.95	23.94	1.84	1.59	1.45	1.36	1.29

Table 12.2. Yield (000 t), $P(B_y<B_{msy})$ and $P(F_y>F_{msy})$ for projected F values of 2/3 F_{msy}, 75% F_{msy}, 85% F_{msy} and F_{msy}. The results are derived from an ASPIC bootstrap run (500 iterations) with catch constraints in 2013 of 17 000 t (TAC) or 6 656 t (mean catch 2007-2012).

				$Catch_{2013}$ = 17 000 t						
	Yield (000 t)			**$P(F_y>F_{msy})$**			**$P(B_y<B_{lim})$**			
	2013	**2014**	**2015**	**2013**	**2014**	**2015**	**2013**	**2014**	**2015**	**$P(B_{2016}<B_{2013})$**
2/3 F_{msy}	**17.00**	**20.66**	**19.40**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**
75% F_{msy}	**17.00**	**23.03**	**21.31**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**
85% F_{msy}	**17.00**	**25.82**	**23.48**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**
F_{msy}	**17.00**	**29.88**	**26.45**	**<5%**	**48%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**

				Catch 2 < .0513 = 6 656 t						
	Yield (000 t)			**$P(F_y>F_{msy})$**			**$P(B_y<B_{lim})$**			
	2013	**2014**	**2015**	**2013**	**2014**	**2015**	**2013**	**2014**	**2015**	**$P(B_{2016}<B_{2013})$**
2/3 F_{msy}	**6.66**	**21.75**	**20.07**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**
75% F_{msy}	**6.66**	**24.25**	**22.05**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**
85% F_{msy}	**6.66**	**27.18**	**24.30**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**<5%**	**>95%**
F_{msy}	**6.66**	**31.46**	**27.38**	**<5%**	**49%**	**49%**	**<5%**	**<5%**	**<5%**	**>95%**

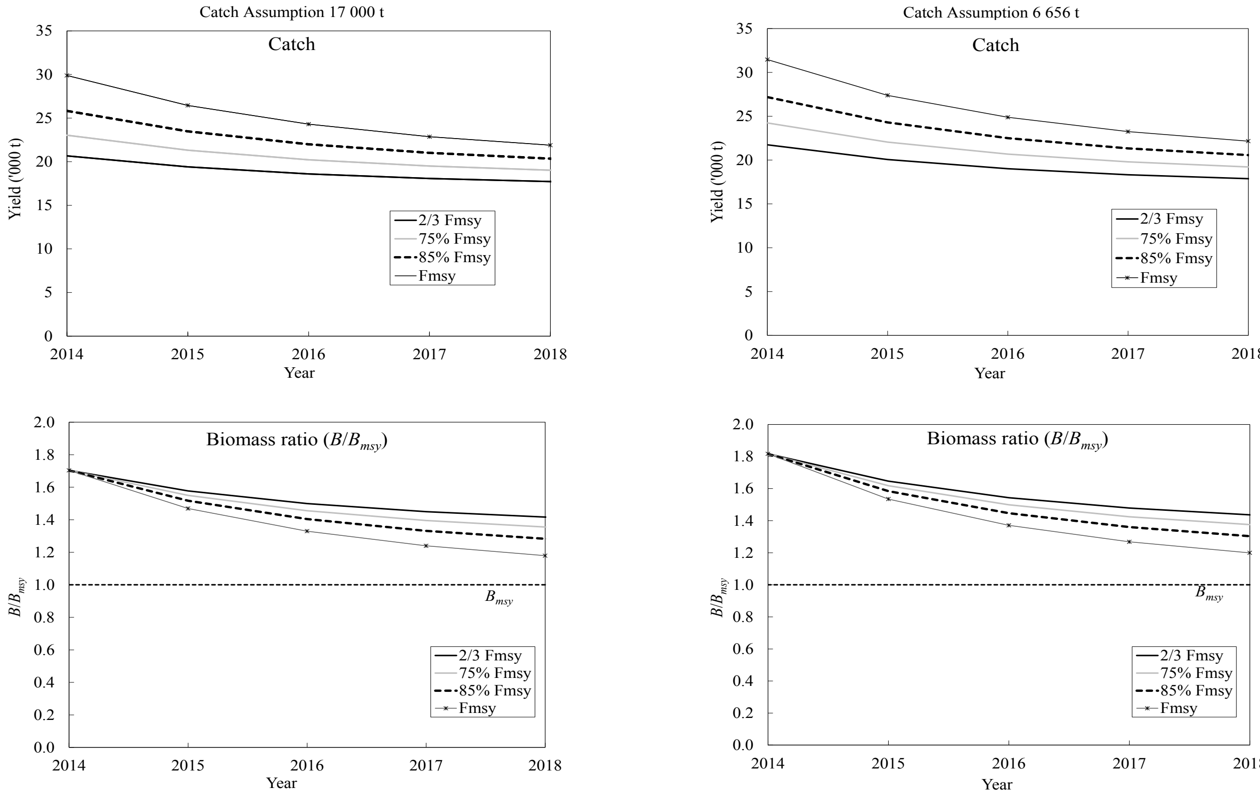


Fig. 12.8. Yellowtail flounder in Div. 3LNO: medium term projections for two catch scenarios and at four levels of F (2/3 F_{msy}, 75% and 85% F_{msy} and F_{msy}). Top panels shows projected catch and lower panels are projected relative biomass ratios (B/B_{msy}). Results are median values derived from ASPIC bootstrap runs (500 iterations) with catches of 17 000 t (left) and average catch of 2007-2012 (6 656 t) (right) assumed in 2013.

g) Reference Points

The surplus production model outputs indicate that the stock is presently above B_{msy} and F is below F_{msy} (Fig. 12.9). Scientific Council considers that 30% B_{msy} is a suitable limit reference point (B_{lim}) for stocks where a production model is used. At present, the risk of the stock being below B_{lim} = 30% B_{msy} is very low (<5%).

Currently the biomass is estimated to be above B_{lim} and F, below F_{lim} (=F_{msy}) so the stock is in the safe zone as defined in the NAFO Precautionary Approach Framework.

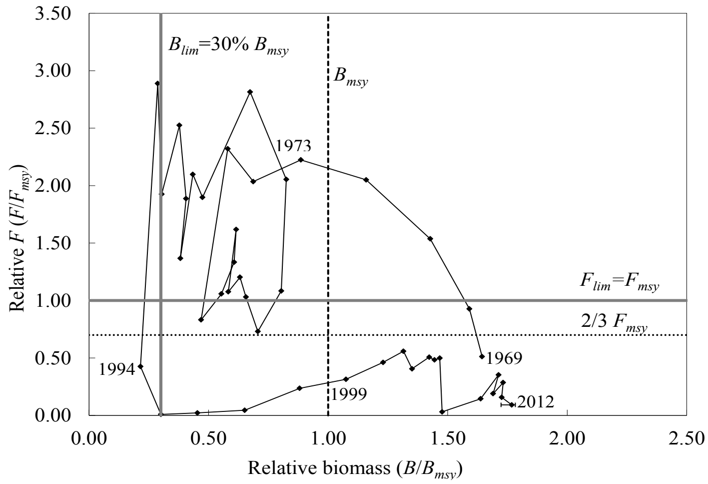


Fig. 12.9. Yellowtail flounder in Div. 3LNO: stock trajectory estimated in the surplus production analysis, under a precautionary approach framework.

The next full assessment of this stock will be in 2015.

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

Interim Monitoring Report (SCR Doc. 13/11; SCS Doc. 13/5, 7, 9, 13)

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 by-catch 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 when it was agreed there would be no directed fishing on the stock. Since then, catches have averaged about 500 t; in 2012 the catch was reported as 314 t, similar to 2011, taken mainly in the NRA.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.6	0.3	0.2	0.2	0.2	0.3	0.4	0.4	0.3	
STACFIS	0.6	0.3	0.5	0.2	0.3	0.4	0.4	0.4	0.3	

ndf No directed fishery.

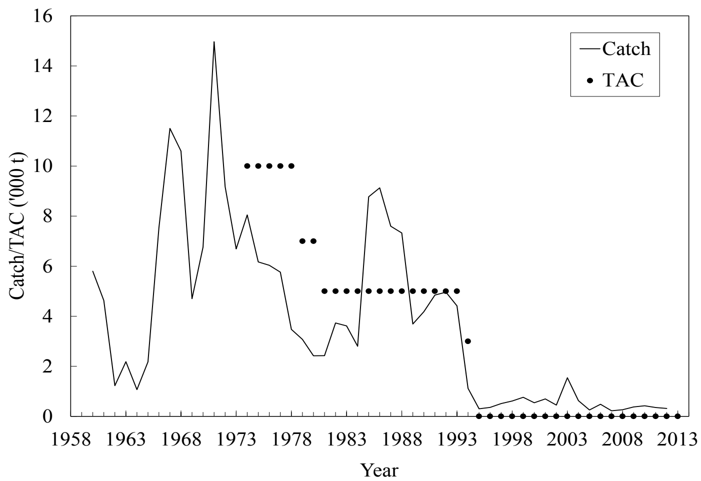


Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as 0 TAC.

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).

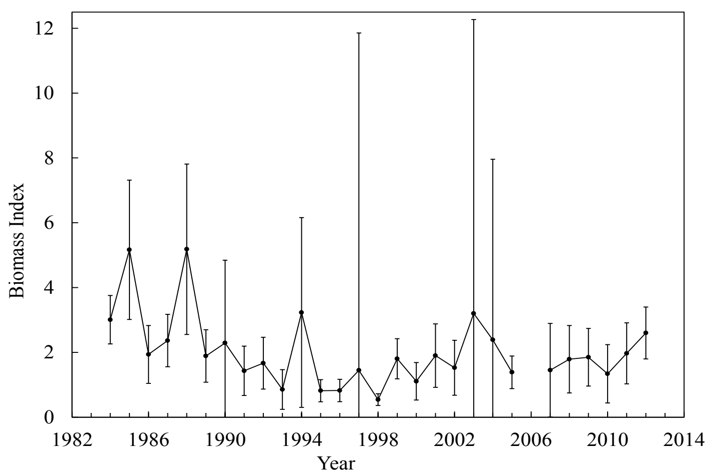


Fig. 13.2. Witch flounder in Div. 3NO: survey biomass index from Canadian spring surveys 1984-2012 (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units. The 2006 survey estimate is biased due to substantial coverage deficiencies and is therefore not included.

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 increased in recent years, reaching the highest value in the time series in 2009. The 2010 and 2012 index values are almost identical to each other, and are the second and third highest in the series, but the value in 2011 was about the same as in 2004-2006.

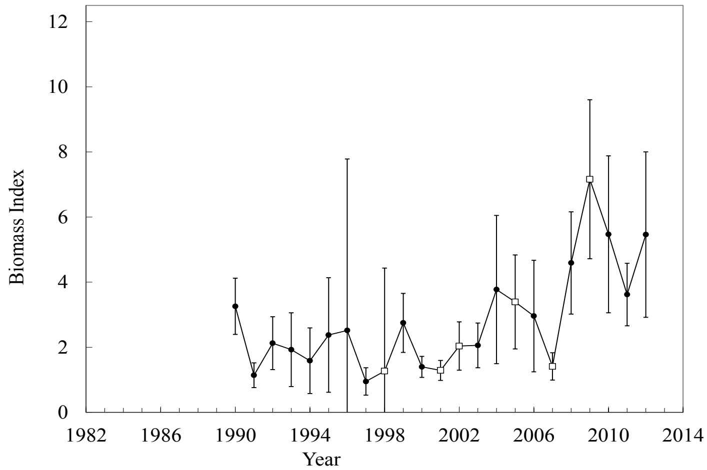


Fig. 13.3. Witch flounder in Div. 3NO: survey biomass index from Canadian autumn surveys 1990-2012 (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols indicate years in which more than 50% of the deep water (> 730 m) strata were covered by the survey.

Spanish Div. 3NO RV survey biomass index. Surveys have been conducted annually from 1995 to 2012 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1462 m (since 1998). In 2001, the research vessel (R/V *Playa de Menduiña*) and survey gear (Pedreira) were replaced by the R/V *Vizconde de Eza* using a Campelen trawl (NAFO SCR 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 had been generally decreasing 2004 to 2009, but has since been variable, including a high point in 2010 (Fig. 13.4).

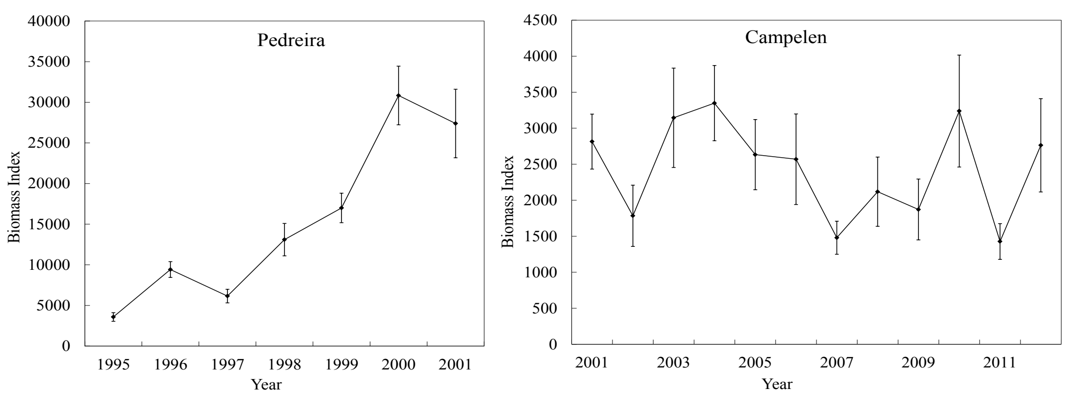


Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from Spanish Div. 3NO surveys (± 1 standard deviation). Data from 1995-2001 are in Pedreira units; data from 2001-2012 are in Campelen units. Both values are present for 2001.

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

In 2012, 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 substantial progress to report at this time. It is anticipated that this work will be completed in 2014 and presented in the next Scientific Council assessment.

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

(SCR Doc. 13/46)

a) Introduction

The fishery for capelin started in 1971 and catch was highest in the mid-1970s with a maximum catch of 132 000 t in 1975. The directed fishery was closed in 1992 and the closure has continued through 2012 (Fig. 14.1). No catches have been reported for this stock since 1993.

Nominal catches and TAC’s ('000 t) are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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

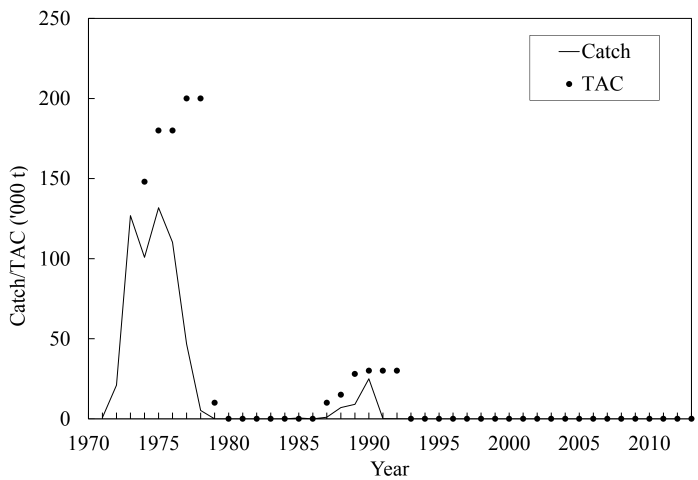


Fig. 14.1. Capelin in Div. 3NO: catches and TACs.

b) Data Overview

i) Research survey data

Trawl acoustic surveys of capelin on the Grand Bank previously conducted by Russia and Canada on a regular basis have not been repeated since 1995. In recent years, STACFIS has repeatedly recommended investigation of the capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this recommendation has not been acted upon. The only indicator of stock dynamics presently available may be capelin biomass indices obtained during Canadian stratified-random spring trawl surveys. In 1996-2012, when a Campelen trawl was used as a sampling gear, survey biomass index of capelin in Div. 3NO varied from 3.9 to 114 thousand (Fig.14.2), and the average value for this period is 32 thousand. In 2005, survey biomass index of capelin in Div. 3NO was 3.9 thousand, the lowest level since 1996; estimates in 2006 are not compatible because of poor cover in that year. In 2007 survey biomass index increased and was 29.2 thousand. In 2008 the biomass index sharply increased to 114 thousand. In 2009-2011, trawl biomass index sharply decreased to the level of 4.1 thousand. In 2012, trawl biomass index significantly increased and was 69.1 thousand.

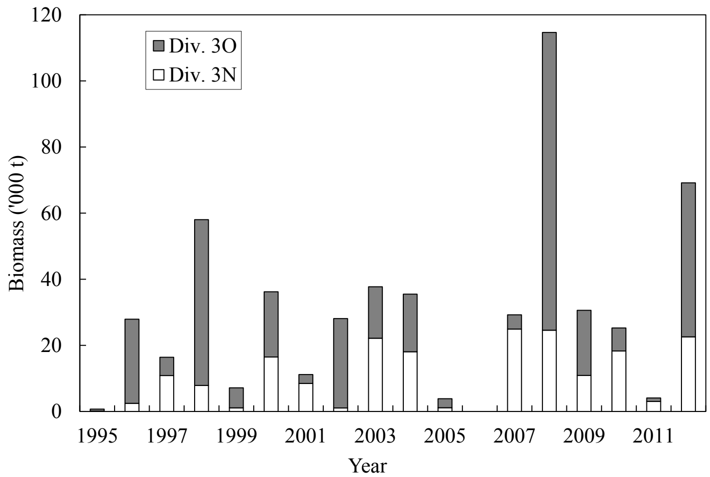


Fig. 14.2. Capelin in Div. 3NO: survey biomass index from Canadian spring surveys in 1996-2012.

c) Estimation of Stock Parameters

Since interpolation by density of survey bottom trawl catches to the area of strata for such pelagic fish species as capelin can lead to significant deviation of the total biomass, the average value of all non-zero catches was used as an index for evaluation of the stock biomass in 1990-2012. The proportion of zero and non-zero catches remained relatively stable, however, if this proportion changes, the index may not be comparable between years.

Survey catches were standardized to 1 km^2 from Engel and Campelen trawl data. Sets, which did not contain capelin, were not included in account. The confidence intervals around the average catch index were obtained by bootstrapping of standardized catch values. According to data from 1996-2010, the mean catch varied between 0.06 and 1.56. In 2011 and 2012, this parameter was 0.04 and 0.47, respectively (Fig. 14.3).

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

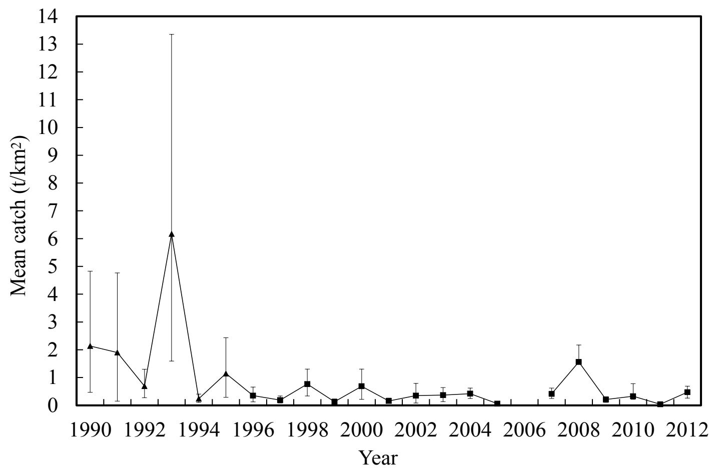


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km^2) from Canadian spring surveys in 1996-2012. Estimates prior to 1996 are from Engel and from 1996-2012 are from Campelen.

c) Assessment Results

Acoustic surveys series terminated in 1994 indicated a stock at a low level. Biomass indices from bottom trawl surveys since then have not indicated a change in stock status since then

d) Precautionary Reference Points

STACFIS is not in a position to determine biological reference points for capelin in Div. 3NO.

e) Research recommendations

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

This stock is expected next to be fully assessed in 2015.

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

(SCR Doc. 13/36; SCS Doc. 13/5, 7, 9)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3O; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics. Most studies the Council has reviewed in the past have suggested a closer connection between Div. 3LN and Div. 3O, for both species of redfish. However, differences observed in population dynamics between Div. 3LN and Div. 3O suggested that it would be prudent to keep Div. 3O as a separate management unit. STACFIS was also informed that a recent study of redfish population structure combining genetic and morphometric data has been submitted for review to a primary journal. This study could be helpful to unraveling redfish population structure of Grand Banks stocks.

i) Fishery and Catches

The redfish fishery within the Canadian portion of Div. 3O has been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, while catch in the NRA portion of Div. 3O during that same time was regulated only by mesh size. A TAC was adopted by NAFO in September 2004. The TAC has been 20 000 t from 2005-2012 and applies to the entire area of Div. 3O. Nominal catches have ranged between 3 000 t and 35 000 t since 1960 (Fig. 15.1). Catches averaged 13 000 t up to 1986 and then increased to 27 000 t in 1987 and 35 000 t in 1988. Catches declined to 13 000 t in 1989, increased gradually to about 16 000 t in 1993 and declined further to about 3 000 t in 1995, partly due to reductions in foreign allocations within the Canadian fishery zone since 1993. Catches increased to 20 000 t by 2001, subsequently declined to 4000 t in 2008 and have been in the range of 6000 to 6500 t since 2009.

The large redfish catches in 1987 and 1988 were due mainly to increased activity in the NRA by non-Contracting parties (NCPs). There has been no activity in the NRA by NCPs since 1994. From 1983-1996 estimates of under-reported catch ranged from 200 t to 23 500 t. There have also been estimates of over-reported catch in the recent period since 2000, with a maximum value of 4 300 t in 2003.

The redfish fishery in Div. 3O occurs primarily in the last three quarters of the year. Canadian, Portuguese, Russian and Spanish fleets have accounted for most of the catch and bottom trawling is the primary gear accounting for greater than 90% of the catch. The catch by midwater trawls is predominantly by Russia but there has been low reporting of catch by this gear since 2004.

Nominal catches and TACs ('000 t) for redfish in the recent period are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC[1]	10	20	20	20	20	20	20	20	20	20
STATLANT 21	6.4	11.9	11.0	7.5	5.1	6.3	6.5	6.5	6.4	
STACFIS	3.8	11.3	12.6	5.2	4.0	6.4	5.2	6.5	6.4	

[1] 2004 only applied within Canadian fishery jurisdiction.

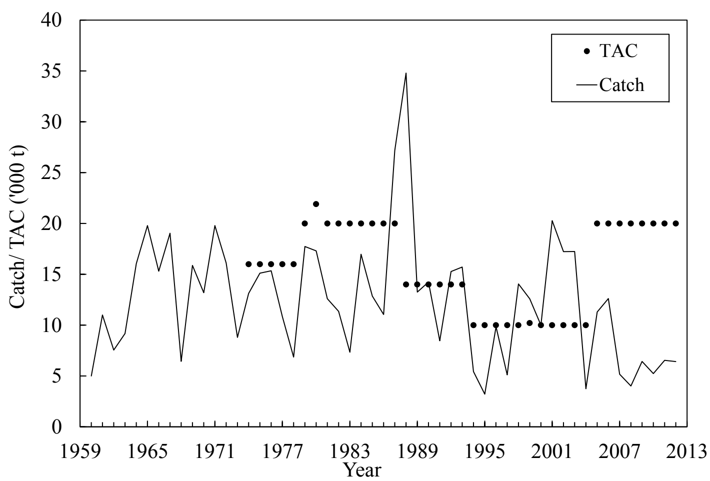


Fig. 15.1. Redfish in Div. 3O: catches and TACs (from 1974 to 2004 applied to Canadian fisheries jurisdiction; from 2005 for entire Div. 3O area).

b) Input Data

Abundance, biomass and size distribution data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring and autumn surveys for 1991-2012 and EU/Spain surveys in the NRA portion from 1997-2012. Length frequencies were available from sampling of the commercial catches from Portugal, Russia and Spain in 2012.

i) Commercial fishery data

A standardized catch rate series was produced for Canadian fleets fishing within the Canadian Exclusive Economic Zone and for NRA fleets. However, there are large uncertainties associated with the catch used in the calculation of CPUE. Also, it is questionable whether catch rate indices are indicative of stock trends. Redfish tend to form patchy aggregations that are at times very dense and in Div. 3O there is a limited amount of fishable area in deeper waters along the steep slope of the southwest Grand Bank where larger fish tend to be located.

Sampling of the redfish fisheries was conducted by Russia, Spain, and Portugal from the 2012 trawl fishery. There was no Canadian catch in 2012. Fleets generally fished between 125 and 585 m. Length frequencies were similar among participating countries with an overall size range of 8-40 cm and a modal length of 21-22 cm.

ii) Research survey data

Abundance and biomass data, as well as mean numbers and weights (kg) per tow, were available from Canadian spring and autumn stratified-random surveys during 1991-2012. In 2006, only autumn indices were available due to inadequate survey coverage in the spring survey. The surveys cover to depths of 732 m (400 fathoms) in spring and to 1 464 m (800 fathoms) in autumn. Until the autumn of 1995 these surveys were conducted with an Engels 145 high lift otter trawl. Thereafter a Campelen 1800 survey trawl was used. The Engel data were converted into Campelen equivalent units.

Data were available from EU-Spain spring surveys conducted in the NAFO Regulatory Area (NRA) of Div. 3O from 1997 to 2012. These surveys use the same stratification scheme as the Canadian surveys and the area of redfish habitat covered in Div. 3O is less than 8% compared to the Canadian surveys for strata <732m. The surveys covered depths to 1500m (800 fathoms) with the exception of 1995-1996 when complete coverage was not achieved. Until 2001, these surveys were conducted with a using a Pedreira type bottom trawl and thereafter with a Campelen trawl similar to that used in Canadian surveys. The data prior to 2001 were converted into Campelen equivalent units.

Biomass Indices. Results of bottom trawl surveys for redfish in Div. 3O indicated a considerable amount of variability during the 1990's. This occurred between seasons and years. It is difficult to interpret year to year changes in the estimates in this period. The Canadian spring survey index (Fig. 15.2) increased steadily from the early 2000s to 2012.. The Canadian autumn surveys generally support the pattern of the spring survey index with a gradual and steady increase from 2003 to 2010 and stable values thereafter near the highest in the series

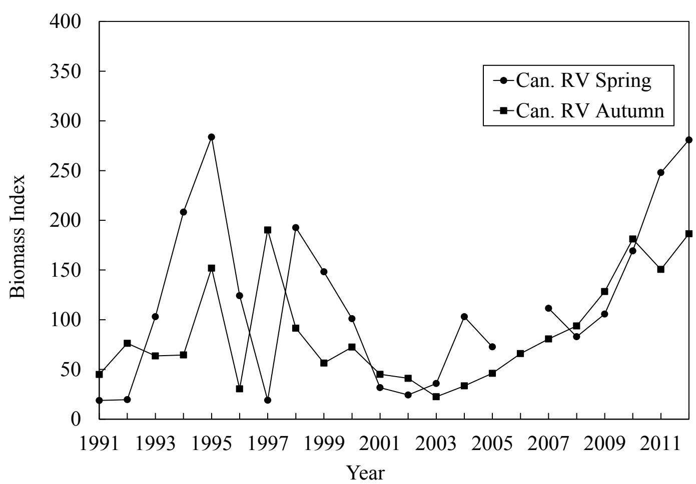


Fig. 15.2. Redfish in Div. 3O: survey biomass indices from Canadian surveys in Campelen equivalent units for surveys prior to autumn 1995.

The biomass indices for Div 3O from the EU/Spain (Fig. 5.3) increased sharply from 2008 to 2010 then declined to 2012. Although the recent surveys show large fluctuation, they are amongst the largest values in the surveys series. These surveys generally agree with the Canadian spring surveys except for opposite trend in the past 2 years.

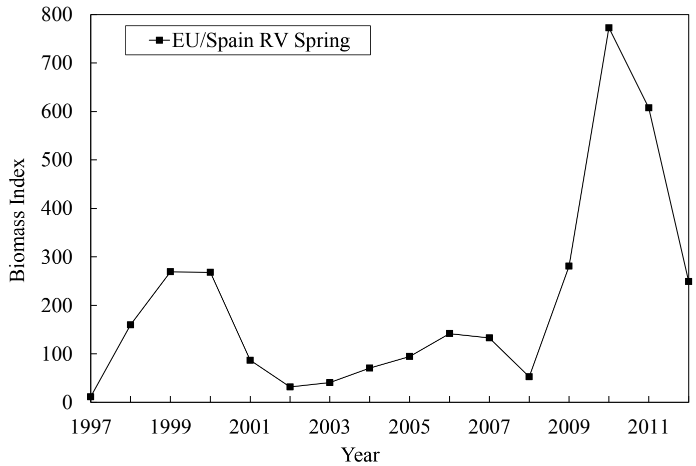


Fig. 15.3. Redfish in Div. 3O: survey biomass indices from EU/Spain spring surveys in Campelen equivalent units for surveys prior to 2002.

Recruitment. There was a new relatively large pulse at 17cm in the 2007 surveys corresponding to a year class born in the early 2000s that remains dominant in 2012 at 21 cm. (Fig. 15.4)., This represents the best sign of recruitment in the population since the 1988 year-class. In general, the annual persistence of modes in the range of 20cm – 25cm over the entire times series without consistent tracking at earlier sizes complicates the interpretation of population dynamics of redfish in Div. 3O.

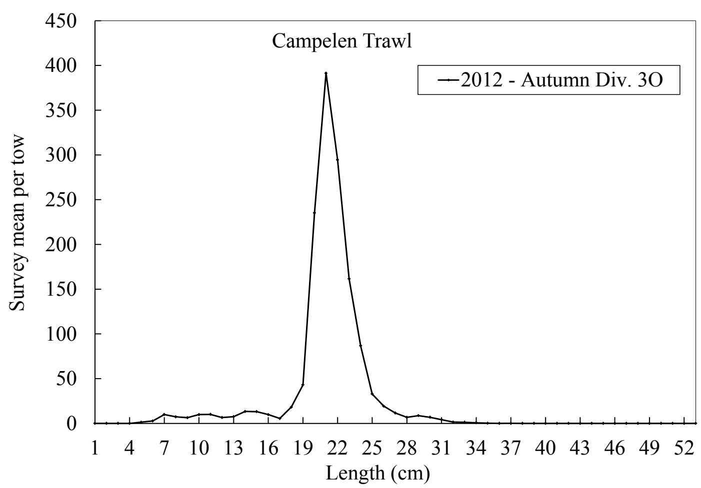


Fig. 15.4. Redfish in Div. 3O: Size distribution (stratified mean per tow) from Canadian autumn surveys for 2012.

c) Estimation of Stock Parameters

i) Non-Equilibrium Surplus Production Model (ASPIC)

The catch (1960-2012) and the Canadian Autumn survey biomass (1991-2012) were utilized in a non-equilibrium surplus production model (ASPIC). Other indices considered in the exploratory analysis as covariates were surveys by Canada (1991-2012 spring), Russia (1983-1991 and 1993 spring/summer), and EU/Spain (1996-2012 spring); standardized fishery CPUE for fleets in the NRA (1987-2011) and standardized fishery CPUE for Canadian fleets (1960-2010. Various formulations and diagnostics were evaluated but the results were not accepted by STACFIS as being indicative of stock dynamics.

STACFIS considers there is scope for evaluating other production models and encouraged the continuation of monitoring the consistency between the indices available for this stock.

ii) Fishing mortality

A fishing mortality proxy was derived from catch to biomass ratios. As most of the catch of the 1990s was taken in the last three quarters of the year, the catch in year "*n*" was divided by the average of the Canadian Spring (year = *n*) and Autumn (year = *n*-1) survey biomass estimates to better represent the relative biomass at the time of the year before the catch was taken. Prior to 1998 the catch was composed of fish greater than 25 cm which are not well represented in the survey catch. From 1998 to 2012, the fishery size composition more resembled the survey size composition. Accordingly, catch/biomass ratios were only calculated for the surveys from 1998-2012. The results (Fig. 15.5) suggest that relative fishing mortality increased steadily from 1998 to 2002 remained high in 2003 but declined substantially in 2004. In 2005, relative fishing mortality increased once more and was around the series average. The 2006 estimate of fishing mortality was calculated using only the autumn survey biomass. The values for 2007-2012 were among the lowest in the time series.

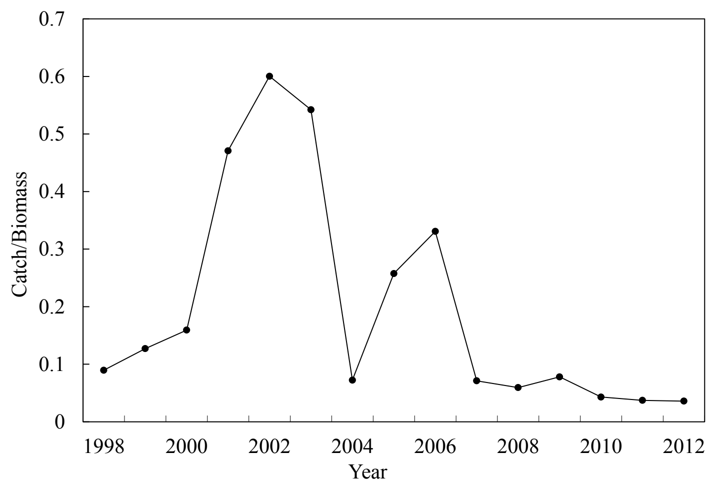


Fig. 15.5. Redfish in Div. 3O: catch/survey biomass ratios for Div. 3O. The 2006 value was calculated using only the autumn biomass estimate.

iii) Size at maturity

No new maturity at length data were available. However, based on previous analyses of size at maturity for this stock (L_{50} is about 28 cm for females and 21 cm for males) and with current catches dominated by lengths between 18cm-24 cm, it is clear that the fishery is based predominantly on immature fish.

d) Assessment Results

Biomass: All survey indices show an overall increasing trend since the early 2000's.

Fishing Mortality: Catch/survey biomass index peaked in 2002 at 0.6 and has decreased since that time. Relative fishing mortality for 2007-2012 is approximately 0.06 and among the lowest values in the time series.

Recruitment: An early 2000 year class appeared as a relatively large pulse at 17cm in the 2007 surveys and remains dominant at 21 cm in 2012. Recent recruitment could not be estimated

State of the Stock: The stock appears to have increased since the early 2000s. Current fishing mortality is low and recent recruitment is unknown.

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

e) Recommendations

STACFIS noted that although previous attempts at applying surplus production models to this stock were unsuccessful, additional data may improve model fits. STACFIS **recommended** that *additional work be undertaken to explore the application of surplus production model to this stock.*

STATUS: A surplus production model was attempted again in this assessment. Various formulations and diagnostics were evaluated but the results were not accepted by STACFIS

STACFIS **recommends** that for Redfish in Div. 3O, *a recruitment index be developed for this stock.*

The next full assessment will be in 2016.

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

Interim Monitoring Report (SCR Doc. 13/12, 17; SCS Doc. 13/05, 07, 09)

a) Introduction

Thorny skate on the Grand Banks was first assessed by Canada for the stock unit 3LNOPs. Subsequent Canadian assessments also provided advice for Div. 3LNOPs. However, Subdiv. 3Ps is presently managed as a separate unit by Canada and France in their respective EEZs, and Div. 3LNO is managed by the NAFO.

Catch History: Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skate species taken in the Canadian and EU-Spain catches. Thus, the skate fishery on the Grand Banks can be considered a fishery for thorny skate. In 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, and to 7 000 t for 2013-2014.

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 and 4 243 t in 2012 for Div. 3LNO. STATLANT catch in 2011 was 517 t and 361 t in 2012 for Subdiv. 3Ps.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Div. 3LNO:										
TAC		13.5	13.5	13.5	13.5	13.5	12	12	8.5	7
STATLANT 21	11.8	3.5	5.5	6.2	7.1	5.7	5.4	5.4	4.2	
STACFIS	9.3	4.2	5.8	3.6	7.4	5.6	3.1	5.4	4.2	
Subdiv. 3Ps:										
TAC		1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
STATLANT 21	1.3	1.0	1.0	1.8	1.4	0.6	0.3	0.5	0.4	
Div. 3LNOPs:										
STATLANT 21	13.1	4.5	6.5	8.0	8.5	6.3	5.7	5.9	4.6	
STACFIS	10.6	5.2	6.8	5.4	8.8	6.2	3.4	5.9	4.6	

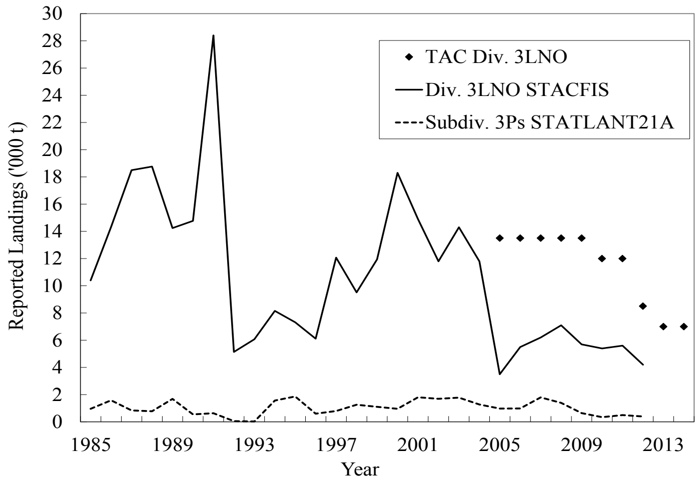


Fig. 16.1. Thorny skate in Div. 3LNO and Subdiv. 3Ps: landings and TAC.

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, 1997-2009, 2012), EU-Portugal (2002-2004, 2006-2011), Russia (1998-2008, 2011, 2012), and Canada (1994-2008, 2010, 2012).

In skate-directed trawl fisheries (280 mm mesh), EU-Spain reported 23-93 cm skates in Div. 3N (mode at 42 cm). In other trawl fisheries, Russian trawlers in Div. 3LN reported 24-78 cm skates (mode at 57 cm) in 2012.

Directing for monkfish with 305 mm mesh gillnets in Div. 3O, Canada caught an abbreviated range of larger thorny skates in 2012: 62-96 cm with a mode of 76 cm.

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. 3LNO 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 1996-2012. Subdiv. 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).

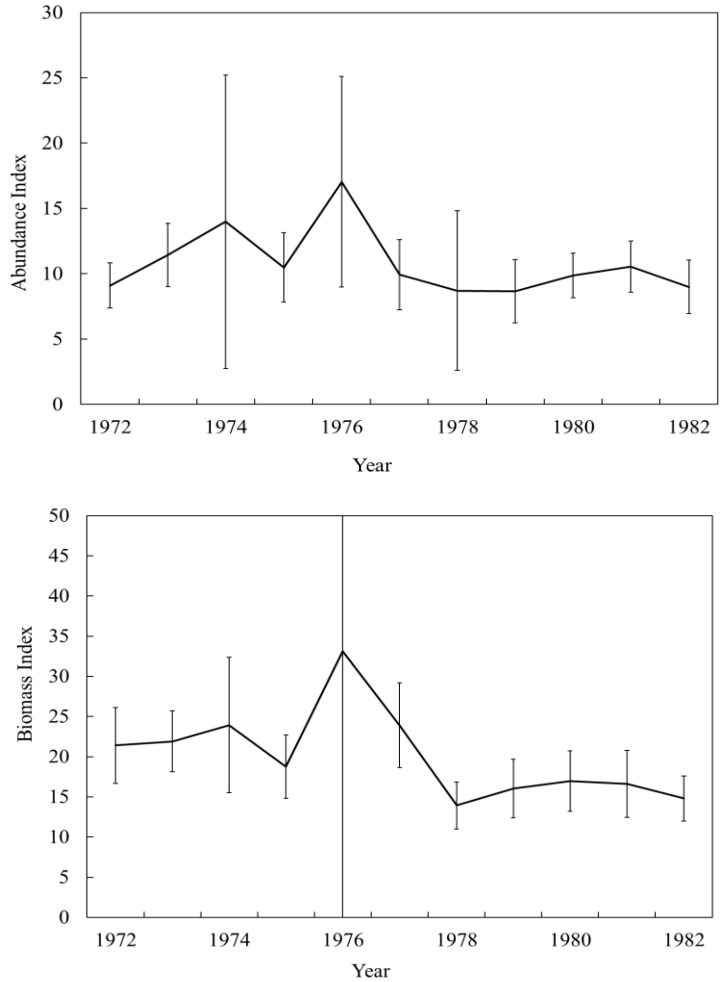
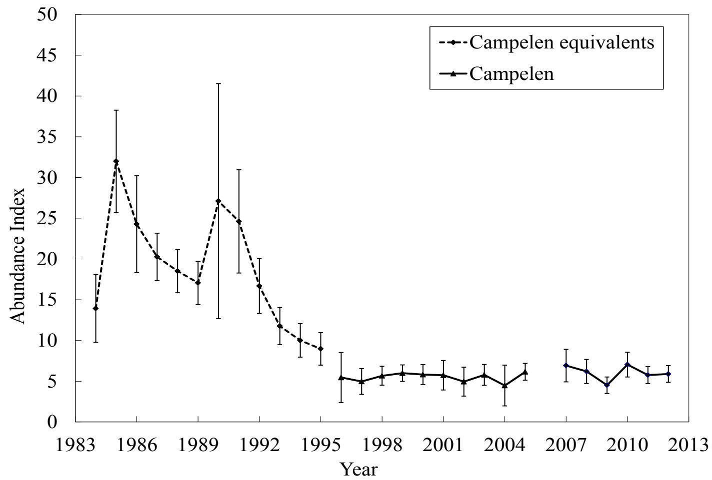


Fig. 16.2a. Thorny skate in Div. 3LNOPs: 1972-1983 abundance and biomass indices from Canadian spring surveys

Standardized mean number and mean weights per tow are presented in Fig. 16.2b for Div. 3LNOPs. Catch rates of thorny skate in Div. 3LNOPs declined from the mid1980s until the early 1990s. Since 1997, biomass indices have been increasing very slowly from low levels, while abundance indices remain relatively stable at very low levels.



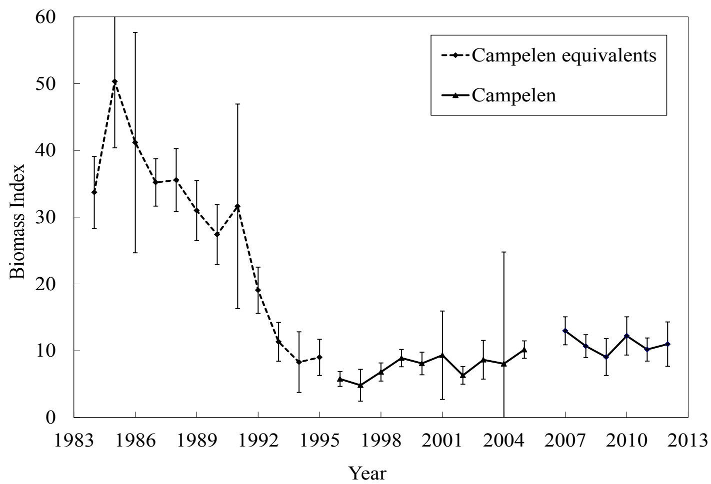


Fig. 16.2b. Thorny skate in Div. 3LNOPs, 1984-2012: abundance (top) and biomass (bottom) indices from Canadian spring surveys. The survey in 2006 was incomplete, due to mechanical difficulties on Canadian research vessels.

Canadian autumn surveys. Stratified-random autumn surveys have been conducted by Canada in Div. 3LNO in the autumn; using an Engel 145 otter trawl in 1990-1994, and a Campelen 1800 shrimp trawl in 1995-2012 to depths of ~1 450 m.

Autumn survey indices, similar to spring estimates, declined during the early 1990s. Catch rates have been stable at very low levels since 1995 (Fig. 16.3). Autumn indices of abundance and biomass are, on average, higher than spring estimates. This is expected, because thorny skates are found deeper than the maximum depths surveyed in spring (~750 m), and are more deeply distributed during winter/spring.

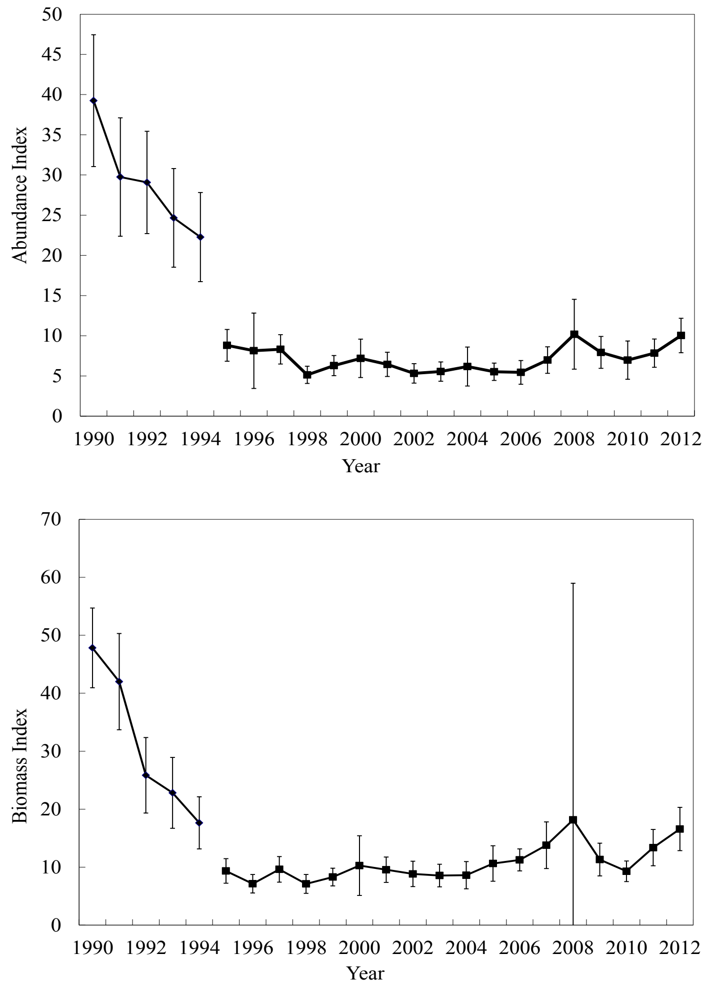


Fig. 16.3. Thorny skate in Div. 3LNO, 1990-2012, abundance (top) and biomass (bottom) indices from Canadian autumn surveys. Note that Engel trawl data in 1990-1994 and Campelen trawl data in 1995-2011 are not directly comparable

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). In 2007, the two indices diverged: the EU-Spain index declined, while the Canadian Div. 3NO biomass index fluctuated within a narrow range. A comparison of common sampled strata between both time series found little difference between 1997-2005 and 1997-2010. Differences in biomass indices appear to result from poor catch rates in the EU-Spain survey of deeper strata that were not sampled by Canadian surveys. In 2012, both biomass indices increased from 2011 levels.

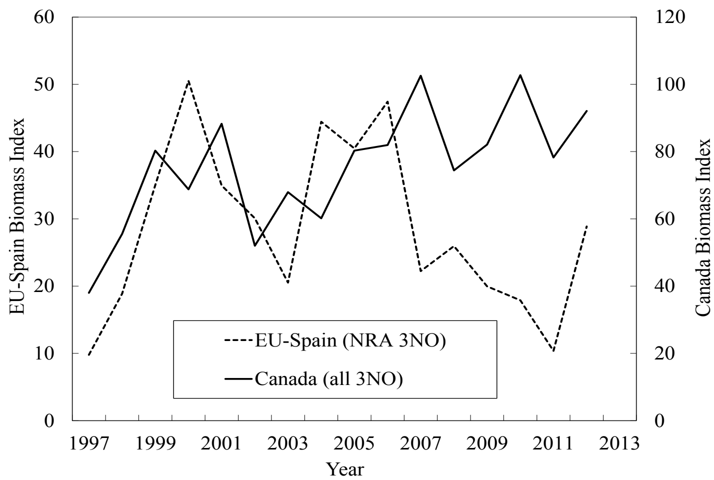


Fig. 16.4. Thorny skate in Div. 3NO: estimates of biomass from the Spanish spring survey and Canadian spring survey in 1997-2012.

EU-Spain Div. 3L survey. EU-Spain survey indices in the NRA of Div. 3L are available for 2003-2012 (excluding 2005). The stratified random spring 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); thus not sampling the entire Division. Both the EU-Spain and Canadian autumn Div. 3L biomass indices generally declined from 2007-2011, while the Canadian spring index was more variable during this period (Fig. 16.5). Current biomass estimates increased relative to 2011.

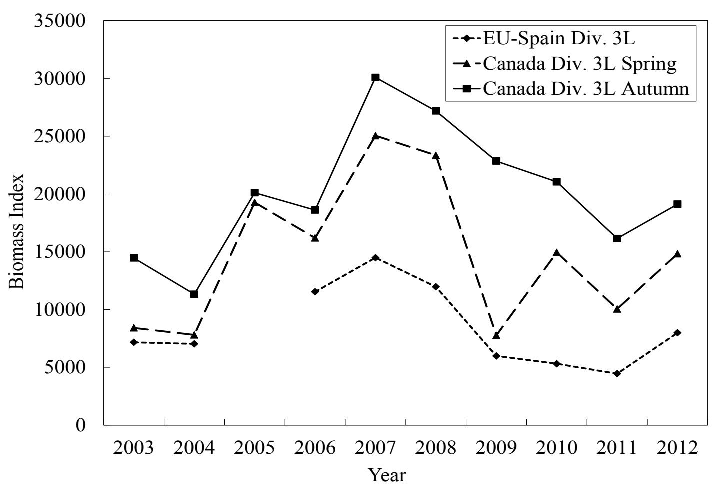


Fig. 16.5. Thorny skate in Div. 3L: Biomass indices from EU-Spain Div. 3L survey and the Canadian spring and autumn research surveys for Div. 3L from 2003-2012.

c) Conclusion

With an update of abundance and biomass indices to 2012, there is nothing to indicate a significant change in the status of this stock.

The next assessment of this stock is planned for 2014.

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

(SCR Doc. 13/12, 30; SCS Doc. 13/05, 07 ,09)

a) Introduction

The advice requested by Fisheries Commission is for NAFO Div. 3NO. Previous studies indicated that white hake constitute a single unit in 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 NAFO Regulatory Area (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 2005-2012. In 2003-2004, 14% of the total landings 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 this species by other countries. A TAC for white hake was first implemented by Fisheries Commission in 2005 at 8 500 t, and then reduced to 6 000 t for 2010 and 2011. The TAC in Div. 3NO for 2012 was 5 000 t, and 1 000 t for 2013.

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 catches 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. Catches declined to 202 t and 139 t in 2011 and 2012 respectively in Div. 3NO.

Commercial catches of white hake in 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. Catches declined to 202 t and 212 t in 2011 and 2012 respectively in Subdiv. 3Ps.

Recent nominal catches and TACs ('000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Div. 3NO:										
TAC	-	8.5	8.5	8.5	8.5	8.5	6	6	5	1[1]
STATLANT 21	1.9	1.0	1.2	0.7	0.9	0.5	0.3	0.2	0.1	
STACFIS	1.3	0.9	1.1	0.6	0.9	0.4	0.2	0.2	0.1	
Subdiv. 3Ps:										
STATLANT 21	1.4	1.6	1.5	1.3	0.7	0.4	0.4	0.2	0.2	

[1] May change in season. See NAFO FC Doc. 13/01 quota table.

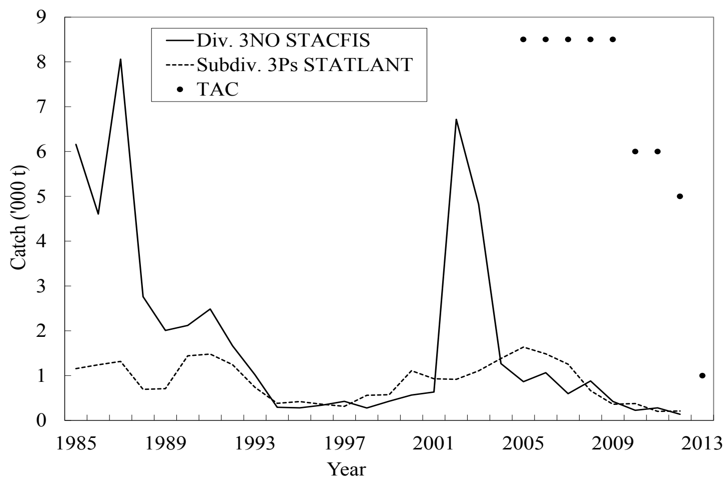


Fig. 17.1. White hake in Div.3NO and Subdivision 3Ps: Total catch of white hake in NAFO Division 3NO (STACFIS) and Subdivision 3Ps (STATLANT-21A). The Total Allowable Catch (TAC) in the NRA of Div. 3NO is indicated on the graph.

b) Input Data

i) Commercial fishery data

Length composition. Length frequencies were available for Canada (1994-2012), EU-Spain (2002, 2004, 2012), EU-Portugal (2003-2004, 2006-2012, and Russia (2000-2007). In the Canadian fishery in 2004-2012, peak lengths caught by longlines in Div. 3O and Subdiv. 3Ps were generally 58-78 cm, although in Subdiv. 3Ps in 2012 the fishery caught a contracted range of mainly 50-63 cm white hake. For that period, gillnets in Div. 3O and Subdiv. 3Ps caught mainly 64-78 cm. Sizes reported from commercial trawls fishing in the NRA of Div. 3NO by EU-Spain in 2012 were 27-52 cm. EU-Portugal reported a wider range of sizes (24-83 cm) in 2011, and 25-68 cm fish in 2012.

ii) Research survey data

Canadian stratified-random bottom trawl surveys. Data from spring research surveys in NAFO Div. 3N, 3O, and Subdiv. 3Ps were available from 1972 to 2012. 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 Div. 3NO were available from 1990 to 2012. 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 1995-2012. There are no survey catch rate conversion factors between trawls for white hake; thus each gear type is presented as a separate time series.

Abundance and biomass indices of white hake from the Canadian spring research surveys in Div. 3NOPs are presented in Fig. 17.2a. In 2003-2010, the population remained at a level similar to that previously observed in the Campelen time series for 1996-1998. The dominant feature of the white hake abundance time series was the peak observed over 2000-2001. In recent years, the spring abundance of white hake increased in 2011 but declined in 2012. Biomass in 2011 and 2012 remained stable at levels similar to those observed since 2005.

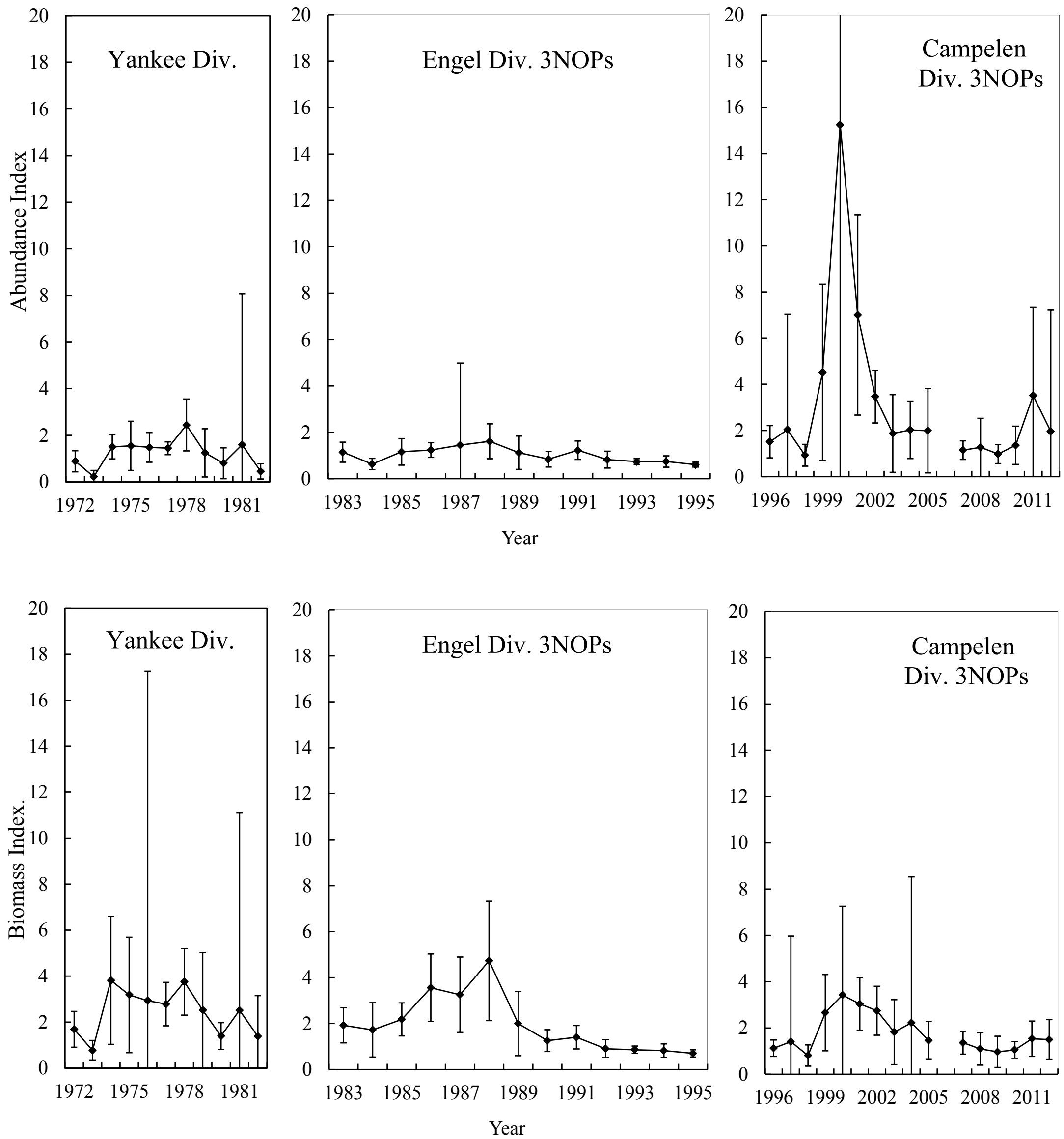
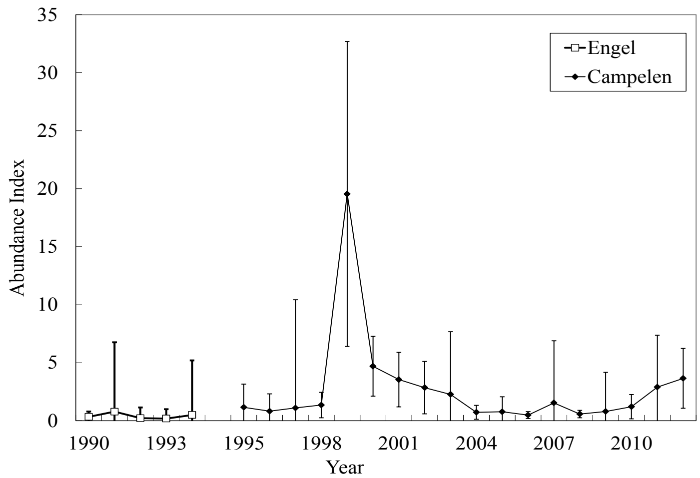


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: abundance and biomass indices from Canadian spring research surveys, 1972-2012. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. Yankee, Engel, and Campelen time series are not standardized, and thus are presented on separate panels. Error bars are 95% confidence limits.

Canadian autumn surveys of Div. 3NO (Fig. 17.2b) have the peak in abundance reflected by the very large 1999 year-class. Autumn indices then declined to levels similar to those observed during 1996-1998 until 2010. In recent years, both biomass and abundance appear to have increase slightly.



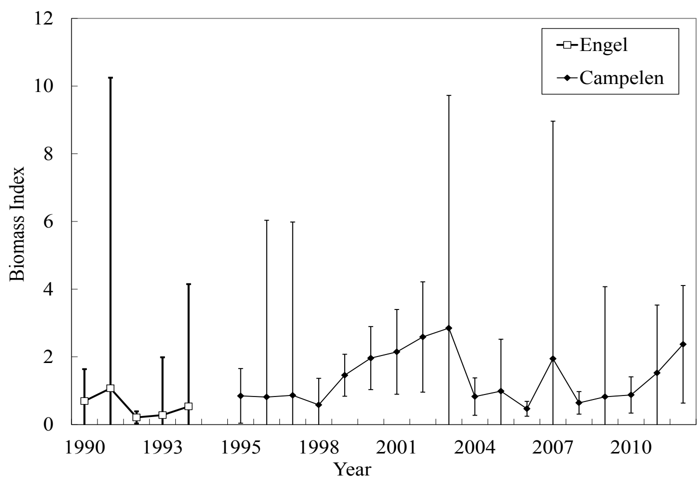


Fig. 17.2b White Hake in Div. 3NO: abundance (top panel) and biomass indices (bottom panel) from Canadian autumn surveys, 1990-2012. Engel (□, 1990-1994) and Campelen (♦, 1995-2012) time series are not standardized. Error bars are 95% confidence limits.

EU-Spanish stratified-random bottom trawl surveys in the NRA. EU-Spain biomass indices in the NAFO Regulatory Area (NRA) of Div. 3NO were available for white hake from 2001 to 2012 (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 2009-2010, the EU-Spain index increased slightly relative to 2008, with another small increase over 2011-2012. The overall trend is similar to that of the Canadian spring survey index (Fig. 17.3).

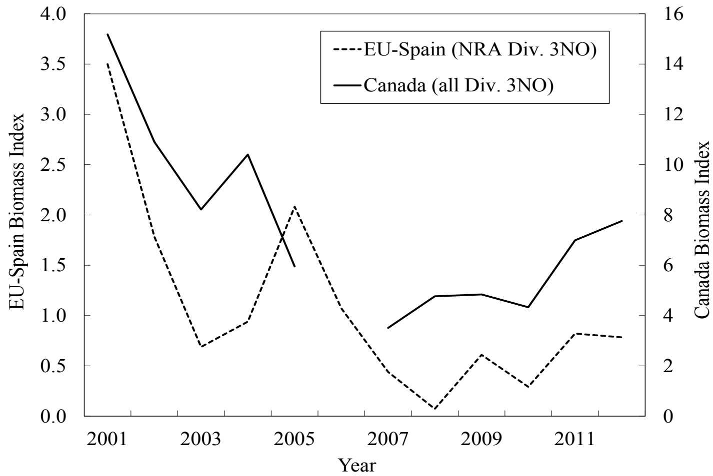


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from EU-Spain Campelen spring surveys in 2001-2012 compared to Canadian spring survey indices in all of Div. 3NO. Estimates from 2006 Canadian survey are not shown, since survey coverage in that year was incomplete.

iii) Biological studies

Distribution. White hake in Div. 3NO and Subdiv. 3Ps are confined largely to an area associated with the warmest bottom temperatures (4-8°C) along the southwest edge of the Grand Banks, edge of the Laurentian Channel, and southwest coast of Newfoundland.

White hake distribute at different locations during various parts of their life cycle. Fish <27 cm in length (1st year fish) occur almost exclusively on the Grand Bank in shallow water. Juveniles (2+ years) are widely spread, and a high proportion of White Hake in the Laurentian Channel portion of Subdiv. 3Ps are juveniles. Mature adults concentrate on the southern slope of the Bank in Div. 3NO, and along the Laurentian Channel in Subdiv. 3Ps.

Maturity. Maturity at size was estimated for each sex separately, using Canadian Campelen spring survey data from 1996-2012. Length at 50% maturity (L_{50}) is different between sexes; with fifty percent of males maturing at 39 cm, and fifty percent of females maturing at 54 cm. However, L_{50} was very similar for each sex between Div. 3NO and Subdiv. 3Ps (Fig. 17.4).

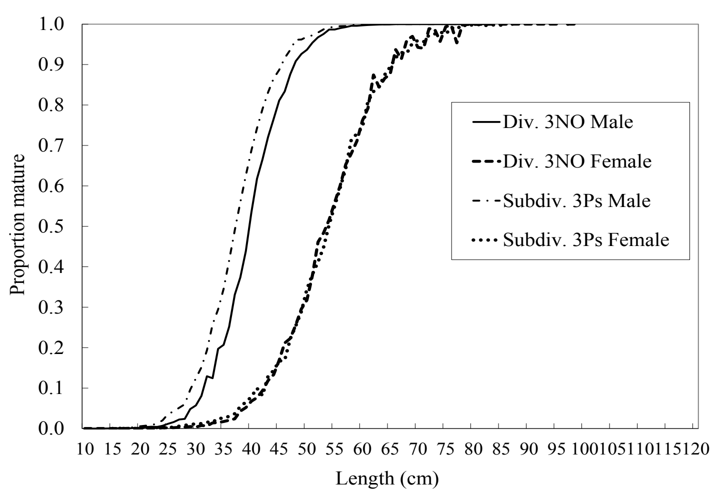


Fig. 17.4. White hake in Div. 3NO and Subdiv. 3Ps: ogives calculated for each sex from Canadian spring surveys, and averaged over 1996-2012 (excluding 2006).

Life stages. Canadian spring survey trends in abundance for 1996-2012 were staged based on length as one year olds, 2+ juveniles, and mature adults (Fig. 17.5). Recruitment of one year old male and female white hake was highest in 2000, and has since declined. There are currently no indications of increased abundance of either mature or one year old white hake. For both males and females, the abundance of immature white hake increased slightly in 2012.

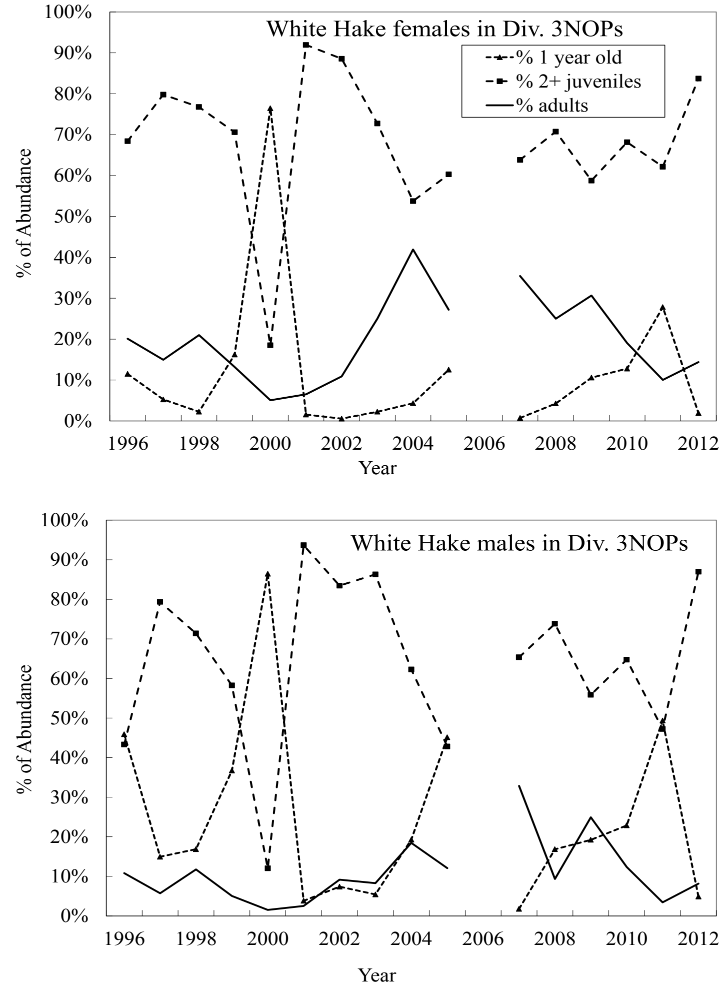


Fig. 17.5. White hake in Div. 3NO and Subdiv. 3Ps: proportion of stages in terms of abundance by sex from Canadian Campelen spring survey data in 1996-2012. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

iv) Recruitment

In Canadian spring research surveys, the number of white hake less than 27 cm in length is assumed to be an index of recruitment at age 1. The recruitment index in 1999 and 2000 was large, but no large value has been observed during 2001-2010. The index of recruitment for 2011 is comparable to that seen in 1999. The index declined in 2012.

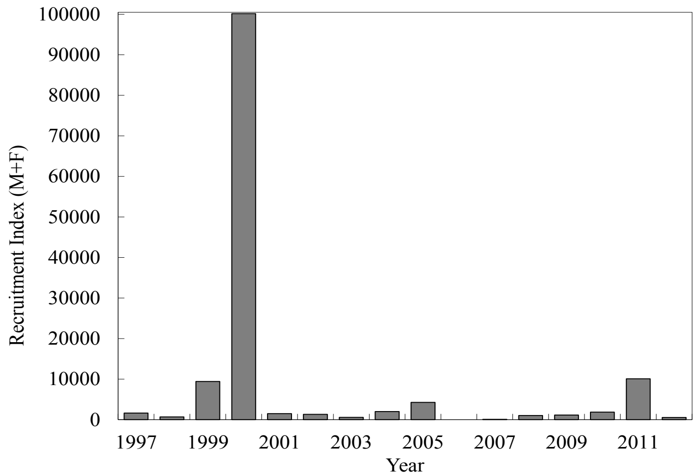


Fig. 17.6. White hake in Div. 3NO and Subdiv. 3Ps: recruitment index from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2012. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. Inset plot depicts 2001-2012 on a smaller scale.

c) Assessment Results

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

Recruitment. The 1999 year-class was very large, but no large year class has been observed since then. Recruitment was higher in 2011 but not comparable to the high recruitment observed in 2000.

Relative *F* (commercial catch/Canadian spring survey biomass). Using STACFIS agreed commercial catch and Canadian spring survey biomass index, estimates of relative *F* were calculated for white hake in Div. 3NO and Div. 3NOPs. Relative fishing mortality (Rel. *F*) has fluctuated, but increased considerably in 2002-2003 (Fig. 17.7). Current estimates of Relative *F* are low.

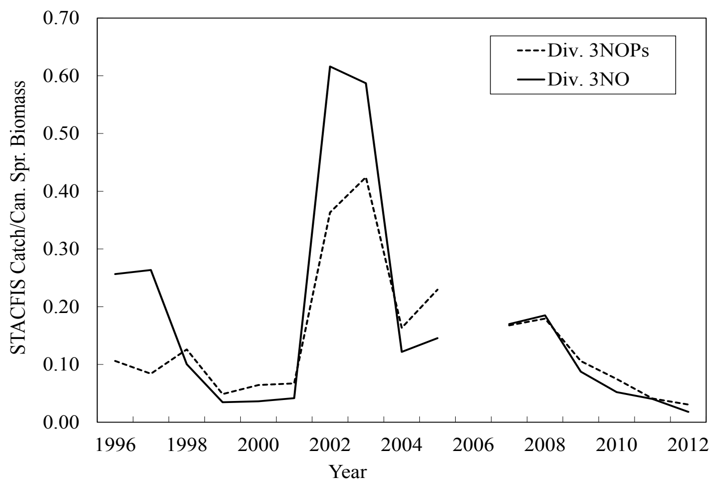


Fig. 17.7. White hake in Div. 3NO and Subdiv. 3Ps: estimates of relative *F* from STACFIS agreed commercial catches/Canadian Campelen spring survey biomass (1996-2012). Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

State of the stock. The stock biomass remains at relatively low levels. No large recruitments have been observed since 2000. Fishing mortality is low.

d) Reference Points

Reference points have not been determined.

e) Other Studies

Genetic Research. Recently published genetic research in relation to stock structure (Roy *et al*. 2012, *Can. J. Fish. Aquat. Sci.* Vol. 69:415-429) was presented at this assessment meeting. This research investigated stock structure in white hake and identified three genetically distinct populations. One distinct population was predominantly located off southern Newfoundland in NAFO Div. 3O and 3Ps. These results confirm that the proper management unit for white hake is Div. 3NOPs.

f) Research Recommendations

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

STATUS: Results were presented to Scientific Council.(See Other Studies)

STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2009+); thereby allowing age-based analyses of this population.*

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

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

STATUS: Commercial catches are sampled for age and sex when possible.

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

No progress on this recommendation. This recommendation is reiterated.

The next full assessment of this stock is planned for 2015.

D. WIDELY DISTRIBUTED STOCKS: SA 2, SA 3 AND SA 4

(SCR Doc. 11/16, 11/13, and 11/14)

Recent Conditions in Ocean Climate and Lower Trophic Levels

● Ocean climate composite index across Labrador to the Scotian Shelf (SA2-4) remain well above normal in 2012 and recent years.

● The composite spring bloom index has remained at or above normal since 2006.

● The composite zooplankton index was slightly negative in 2012 after 6 years of positive values reaching a peak in 2010.

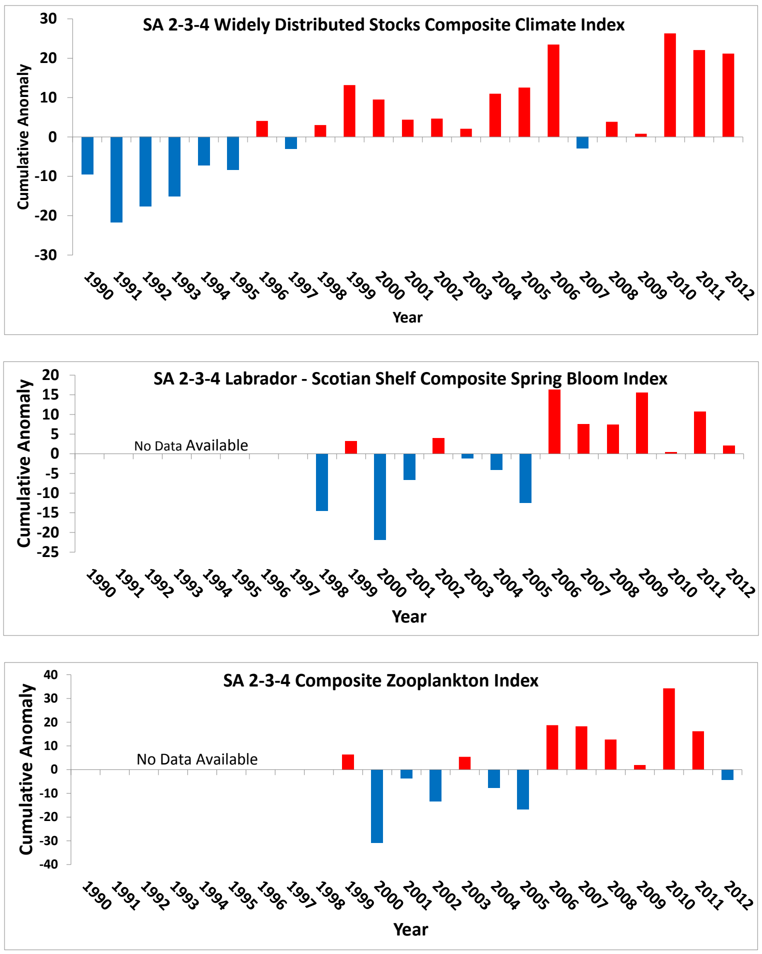


Fig. IV.4. Composite ocean climate index for NAFO Subarea 2-3-4 (widely distributed stocks) derived by summing the standardized anomalies (top panel) during 1990-2012, composite spring bloom (magnitude) index during 1998-2012, and composite zooplankton index (bottom panel) during 1999-2012. Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

Environmental Overview

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1-2ºC and salinities of 32-33.5. Labrador Slope Water flows southward along the shelf edge and into the Flemish Pass region, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 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 in the Scotian Shelf, Bay of Fundy and Gulf of Maine regions are determined by many processes: heat transfer between the ocean and atmosphere, inflow from the Gulf of St. Lawrence supplemented by flow from the Newfoundland Shelf, exchange with offshore slope waters, local mixing, freshwater runoff, direct precipitation and melting of sea-ice. The Nova Scotia Current is the dominant inflow, originating in the Gulf of St. Lawrence and entering the region through Cabot Strait. The Current, whose path is strongly affected by topography, has a general southwestward drift over the Scotian Shelf and continues into the Gulf of Maine where it contributes to the counter-clockwise mean circulation. The properties of shelf waters are modified by mixing with offshore waters from the continental slope. These offshore waters are generally of two types, Warm Slope Water, with temperatures in the range of 8-13ºC and salinities from 34.7-35.6, and Labrador Slope Water, with temperatures from 3.5ºC to 8ºC and salinities from 34.3 to 35. Shelf water properties have large seasonal cycles, east-west and inshore-offshore gradients, and vary with depth.

Ocean Climate and Ecosystem Indicators

The composite climate index across the widely distributed stocks in Subareas 2 to 4 has remained well above normal in 2012 and recent years showing a peak in 2010 although cooling was apparent from 2007-2009 (Figure IV.4). The composite spring bloom index has remained above normal since 2006 although has declined in recent years (Figure IV.4). The composite zooplankton index has remained above average since 2006, reaching a maximum in 2010 but shift to negative values in 2012 (Figure IV.4). Labrador Sea sea-surface temperatures (SST) during 2012 ranged from 0 to -1°C below normal in winter, 0 to -1°C below normal in spring, while for the summer and autumn, the SST in Labrador Sea was 1 to 3°C above normal. The hydrographic survey of the AR7W line conducted in June 2012 indicated convection to 1400m across the Labrador Basin. The strong winter cooling triggering deeper than average convection in 2012 coincided with the high NAO index. The increasing decadal trend of the total inorganic carbon and decreasing trend of pH continue into 2012. For the year of 2012 as a whole, chlorophyll *a* estimated from remote sensing imagery was below normal on the Labrador and Greenland Shelves, but normal in the central Labrador Basin. The abundance of *Calanus finmarchicus* was near (above) normal on Labrador (Greenland) Shelf. The annual sea ice extent on the NL Shelf in 2012 remained below normal for the 17th consecutive year, but increased by 1 SD over the record low in 2011. As a result of these and other factors, local water temperatures on the NL Shelf remained above normal in most areas but decreased significantly over 2011 values. Sea surface temperatures attained record highs (>2 SD) in some areas of the Grand Banks. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland and southern Labrador Shelf during 2012 was near 0.5 SD below normal compared to the record low value of 2 SD below normal in 2011, implying a continuation of less cold shelf water than normal. Spring bottom temperatures in NAFO Div. 3Ps and 3LNO during 2012 were above normal by an average of about 1°C. During the autumn, bottom temperatures in Div. 2J, 3K and 3LNO decreased from 2, 2.7 and 1.8 SD above normal in 2011 to 1.1, 1.2 and 0.2 SD above normal in 2012 respectively, a significant decrease. The volume of CIL (<0°C) water on the NL shelf during the autumn was close to normal. A number of different physical oceanographic indices on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas indicate above normal conditions in 2012. The composite climate index for the Scotian Shelf and Gulf of Maine revealed record-high values making 2012 as the warmest year in the last 43 years. Bottom temperatures were consistently above normal with positive anomalies ranging from 1 to 3 SD in 2012.

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

(SCR Doc. 13/12, 13, 17, 27 and 29; SCS Doc. 13/05, 07 and 09)

a) Introduction

The stock structure of this species in the North Atlantic remains unclear because there is little information on the number of different populations that may exist and their relationship. Roughhead grenadier is distributed throughout NAFO Subareas 0 to 3 in depths between 300 and 2 000 m. However, for assessment purposes, NAFO Scientific Council considers the population of Subareas 2 and 3 as a single stock.

i) Description of the fisheries and catches

Roughhead grenadier is becoming an important commercial fish in the waters managed by the Northwest Atlantic Fishery Organization (NAFO), especially in the NAFO Regulatory Area (NRA). Roughhead grenadier is taken as by catch in the Greenland halibut fishery, mainly in NRA Div. 3LMN. Most roughhead grenadier catches are taken by trawl and the only management regulation applicable to roughhead grenadier in the NRA is a general groundfish regulation requiring the use of a minimum 130 mm mesh size.

A substantial part of the grenadier catches in Subarea 3 previously reported as roundnose grenadier has been roughhead grenadier. To correct the catch statistics STACFIS revised and approved roughhead grenadier catch statistics since 1987. Catches of roughhead grenadier increased sharply from 1989 (333 t) to 1992 (6725 t); since then until 1997 total catches have been about 4000 t. In 1998 and 1999 catches increased and were near the level of 7 000 t. Since then, catches decreased to 600 t in 2009. Catches for the Subarea 2+3 roughhead grenadier in 2011 were 1 016 t and 1 303 t in 2012 (Fig. 18.1) . Most of the catches were taken in Div. 3LMN by Spain, Portugal and Russia fleets. In the catch series available, less than 2% of the yearly catch has been taken in Subarea 2.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
STATLANT 21	1.8	1.7	1.3	0.6	0.5	0.41	0.71	0.8	1.0	1.3
STACFIS	4.2-3.82	3.2	1.5	1.4	0.7	0.8	0.6	0.9	1.0	1.3

1 In 2003, STACFIS could not precisely estimate the catch.

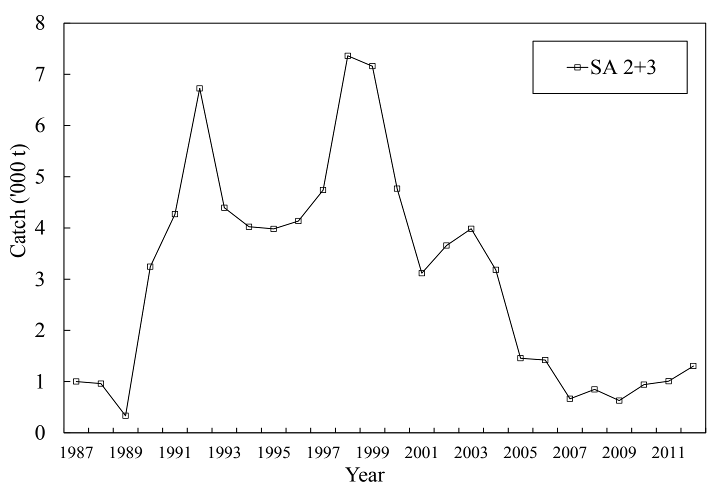


Fig. 18.1. Roughhead grenadier in Subareas 2+3: STACFIS catches.

b) Input Data

i) Commercial fishery data

Length frequencies from the Spanish, Russian and Portuguese trawl catches in Div. 3LMNO are available since 1992, 1992 and 1996 respectively. Due to the growth differences between sexes, length and age data have been analyzed by sex. The Spanish and Portuguese lengths frequencies were presented as pre anal fin length (AFL), while the Russian ones as total lengths. The roughhead length compositions from the Russian catches have been converted to AFL. Catch-at-age data from the total catches in Div. 3LMNO were obtained since 1992 applying an annual Spanish commercial ALK. In the commercial fishery catches, females attain larger lengths and ages than males. Since 2006 it can be observed a decreased in the mode of the catch at age, in the last three years the mode was around 6 cm AFL.

ii) Research survey data

Biomass indices for the roughhead grenadier Subareas 2 and 3 stock are available from various research surveys, with different depth and area coverage. None of them cover the total area and depth distribution of this stock.

Canadian autumn surveys. The estimates from 1995 onwards are not directly comparable with the previous time series because of the change in the survey gear. Taking into account the incomplete coverage of some strata in Div. 2GH and 3LMNO only the index of Div. 2J and 3K from both series (Engel and Campelen) are comparable. The Engel series (1978-1994) present a clear decreasing trend since 1978 until 1994. The Campelen series shows an opposite trend, the index increase from 1995 to 2011 with a slight decline in 2012. (Fig. 18.2).

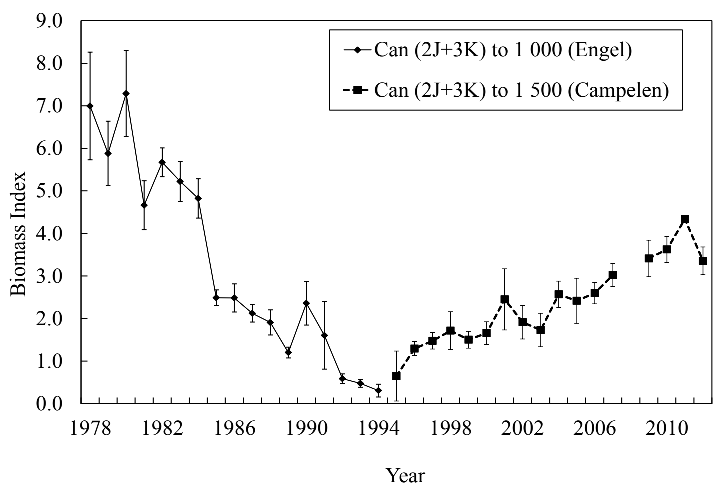


Fig. 18.2. Roughhead grenadier in Subareas 2+3: biomass indices (+/- SE) from the Canadian autumn (Div. 2J3K) survey.

Canadian spring surveys. Figure 18.3 shows the biomass estimate from this survey from 1996 until 2012. Operational difficulties in 2006 resulted in incomplete coverage of the survey in Div. 3NO and the estimate for this year is not directly comparable. From 1996 to 2004, the biomass level does not present a clear trend. In 2005 and 2007, the biomass index had a big increase. After 2007 it is more or less stable at similar level than the period 1996-2004. Biomass estimates from the spring survey series are considerably lower than the ones obtained in the autumn series, as the spring surveys cover only the southern divisions and the shallower depths, where according to the Canadian deepwater survey information this species is less abundant.

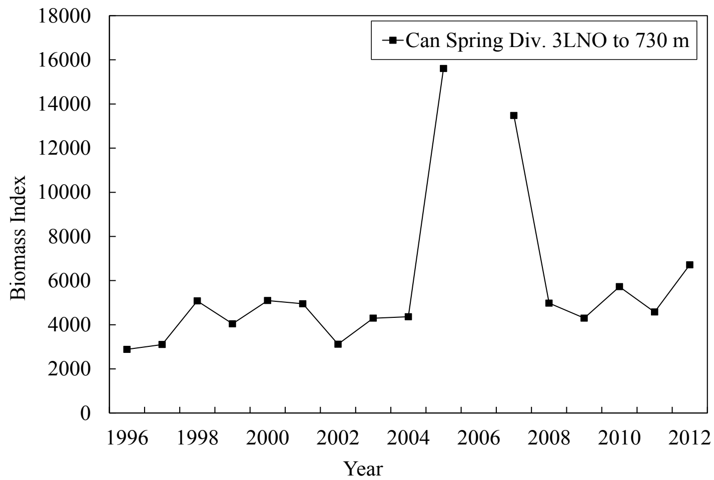


Fig. 18.3 Roughhead grenadier in Subareas 2+3: biomass indices from the Canadian spring surveys.

Canadian deepwater survey: Canada conducted deepwater bottom trawl surveys (750 - 1500 m.) in 1991, 1994 and in 1995 in Div. 3KLMN. Most part of the biomass was taken in Div. 3L and 3M at depth more than 700 m, which confirms that the stock in those Divisions is distributed beyond the depths covered by the spring surveys in those Divisions.

EU (Spain and Portugal) Flemish Cap survey. Indices of biomass are presented for the full depth range over 2004 to 2012 and 0-730 m from 1991-2012 (Fig. 18.4). The roughhead grenadier age composition from this survey series was presented. The 730 m. biomass index presents a peak in 1993. From then until 2002, the biomass index was more or less stable. From 2002 onwards, the biomass index shows an increasing trend, reaching a historical maximum in 2006. Since 2007 the indices have been variable with a general decreased trend, reaching their historical minimum in 2012. The 1400 index show a clear decreased trend since the beginning of the series with its minimum in 2012.

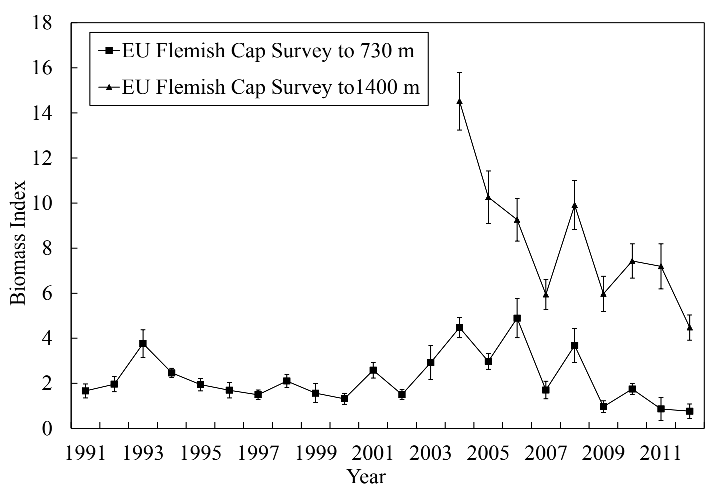


Fig. 18.4. Roughhead grenadier in Subareas 2+3: biomass indices ($^{+}/_{-}$ SE) from the EU Flemish Cap (Div. 3M) survey.

EU (Spain) Div. 3NO survey. From 1997 to 2002 the biomass index of this survey did not show a clear trend. However, since then it has increased and in the period 2004-2006 reached the maximum level. In 2007 decreased to the 2003 level and since then until 2012 was more or less stable. (Fig. 18.5).

EU-Spanish Div. 3L Survey (Flemish Pass). The roughhead grenadier biomass index from 2006 to 2008 was stable and since them presents a clear decreasing trend, reaching the time series minimum in 2012 (Fig. 18.5).

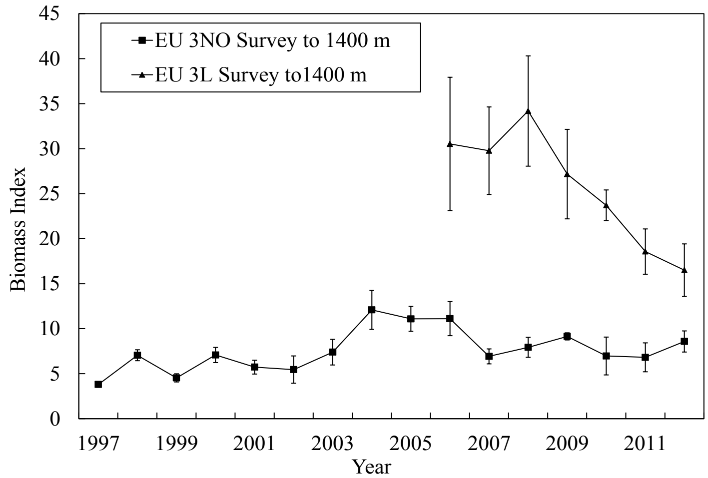


Fig. 18.5. Roughhead grenadier in Subareas 2+3: biomass indices (+/- SE) from the EU-Spanish Div. 3NO and 3L surveys.

Summary of research surveys data trends. There are not available surveys indices covering the total distribution, in depth and area, of this stock. According to other information this species is predominant at depths ranging from 800 to 1 500 m, therefore the best survey indicators of stock biomass should be the series extending 1 500 m depth as they cover the depth distribution of roughhead grenadier fairly well. Figure 18.6 presents the biomass indices for the following series: Canadian autumn Div. 2J+3K Engel (1978-1994) and Campelen (1995-2012), EU Div. 3NO (1997-2012), EU Div. 3L (2006-2012), EU Flemish Cap to 700 m (1990-2012) and EU Flemish Cap to 1400 m (2004-2012). An increase is shown since 1995 until 2004-2008 for all available indices and since then all the indices show a decreasing trend, except the Canadian autumn Div. 2J+3K index.

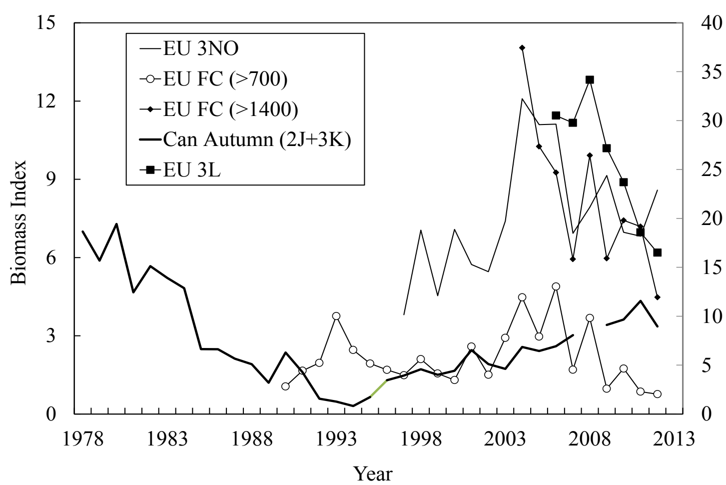


Fig. 18.6. Roughhead grenadier in Subareas 2+3: Biomass indices for the Canadian autumn Div. 2J+3K Engel (1978-1994) and Campelen (1995-2012), EU Div. 3NO (1997-2012), EU Div. 3L (2006-2012), EU Flemish Cap to 700 m (1990-2012) and EU Flemish Cap to 1400 m (2004-2012).

iii) Recruitment

Figure 18.7 presents the abundance index series for age 3 and for the individuals less than 9 cm for different surveys indices. In the age 3 Figure, a strong 2001 year class can be clearly seen in 2004 in the EU Flemish Cap and EU Div. 3NO series and less clearly in the Canadian Autumn survey. The strong 2001 year class have been weaker than expected since 2005 in many years for all survey indices. This is an indication of the problems to track the cohort signal in older ages. Since 2004 the level of the recruitment was more or less constant in all series at low level. In 2012 an increase in the recruitment level can be observed in the Canadian autumn (Div. 2J+3K) and the EU Div. 3NO survey. The length recruitment picture is similar to the age picture; there is a recruitment peak in ages in 2004 that in lengths can be observed in 2003 and 2004 due to that the individuals less than 9 cm are a mix of ages 1, 2 and 3. This peak is observed in the Canadian autumn Div. 2J+3K index two years before. In lengths, it can be observed a good recruitment in 2012 in the Canadian Autumn Div. 2J+3K and the EU Div. 3NO series that is less evident in the age recruitment indices. Despite the difficult to follow cohorts strength all recruitment indices analysed (Surveys indices ages 3, Survey indices less than 9 cm) show a clear recruitment peak around 2004 and good recruitment signal in 2012.

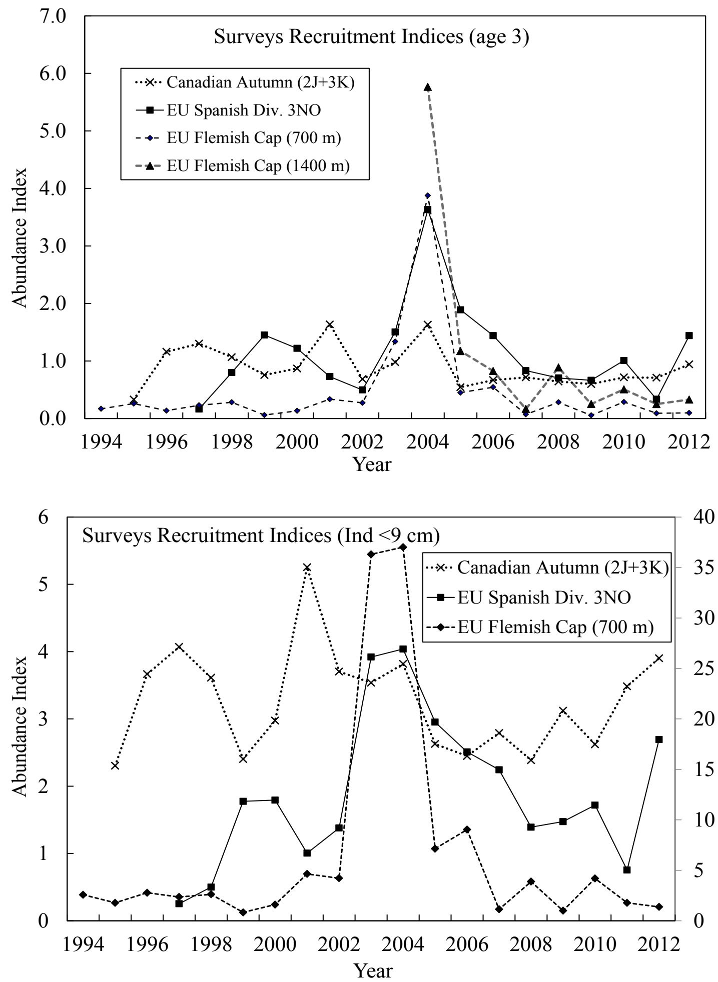


Fig. 18.7. Roughhead grenadier in Subareas 2+3: Canadian autumn (Div. 2J+3K), the EU Div. 3NO, the EU Flemish Cap to 700 m. and the EU Flemish Cap to 1400 m surveys abundance at ages 3. The Canadian Autumn Div. 2J+3K, the EU Div. 3NO and the EU Flemish Cap (700 m) indices for the individuals less than 9 cm.

iv) Biological studies

Age and length structure information for commercial catches and surveys indices were provides. Age and length compositions of the catches show clear differences between sexes. The proportion of males in the catches decreases progressively as length or age increases.

c) Assessment Results

Three different assessments were presented: Extended Survivors Analysis (XSA), a Stock-Production Model Incorporating Covariates (ASPIC) and a qualitative assessment based on survey and fishery information. XSA and ASPIC results were not accepted due to the low Fishing mortality estimated compared with the natural mortality level assumed and the high number of iterations needed to reach the convergence criteria in the case of the XSA and due to the lack of contrast in the data used in the ASPIC case. Biomass indices from the surveys with depth coverage till 1400 meters are considered as the best survey information to monitor trends in resource status because they cover the depth distribution of roughhead grenadier fairly well.

Biomass: An increase can be seen in the period since 1995 until 2004-2008 for all available indices and since then all the indices show a decreasing trend, except the Canadian autumn Div. 2J+3K index.

Fishing Mortality: The catch / biomass (C/B) ratios obtained using different biomass indices show a clear decreasing trend since 1998 till 2006 and since then is more or less stable at very low levels. (Fig. 18.8).

Recruitment: All recruitment indices analysed despite the difficult to follow cohorts strength show a clear recruitment peak around 2004 and the XSA and survey length abundance show other good recruitment in 2012.

State of the Stock: Survey indices indicate a stable or declining stock in recent years. Fishing mortality indices have remained at low levels since 2005. Good recruitment is indicated in 2012 but indices of recruitments have high uncertainty.

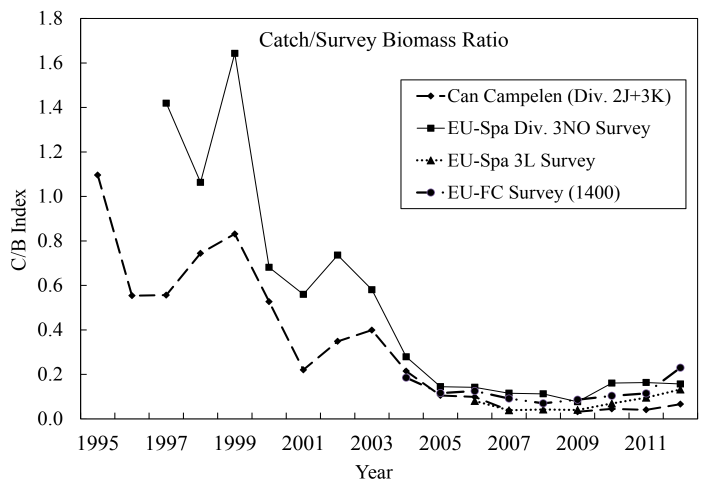


Fig. 18.8. Roughhead grenadier in Subareas 2+3: catch/biomass survey indices based upon Canadian Autumn (Campelen series), EU-Spanish Div. 3NO, EU-Spanish Div. 3L and EU-Flemish Cap to 1400 m.

d) Reference Points

STACFIS is not in a position to provide reference points at this time.

e) Recommendations

STACFIS **recommends** that *further investigation on recruitment indices for roughhead grenadier in Subareas 2 and 3 will be carried out. It was analysed the surveys length distribution and it was decided establish as recruitment* *index the abundance of length less than 9 cm (AFL). This length is equivalent to individuals less than four years old (1-3) and should be equivalent to the recruitment indices for age 3 based on ages.*

Next full assessment will be in 2016.

19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL

(SCR Doc. 13/ 39; SCS Doc. 13/7, 9, 13)

a) Introduction

A moratorium on directed fishing on this stock was implemented in 1995 following drastic declines in catch from the mid-70s, and catches since then have been low levels of by-catch in other fisheries. From 1999 to 2004 catches were estimated to be very low, between 300 and 800 tons and from 2005-2012, catches averaged less than 150 tons.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	
STACFIS	0.8	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	

ndf no directed fishing.

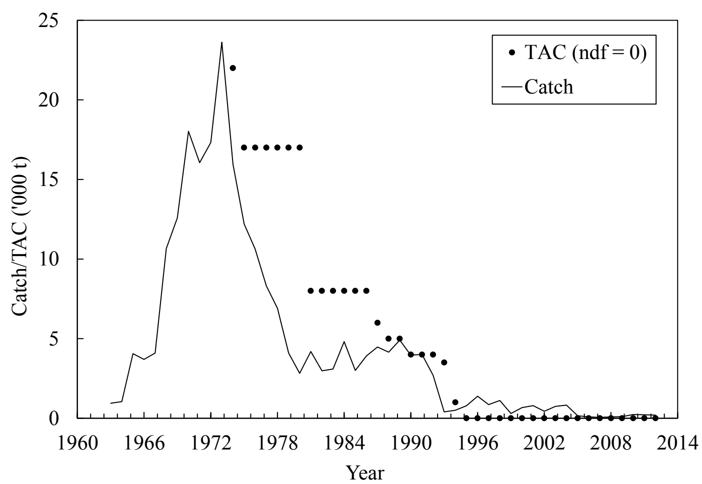


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) Input Data

Abundance and biomass data, as well as mean numbers and weights (kg) per tow from Canadian autumn surveys during 1977-2012 were available. Age based data have not been available since 1993 and none are anticipated in the near future.

i) Research survey data

Canadian stratified–random autumn surveys. Canadian surveys were conducted in Div. 2J+3KL during autumn from 1977-2012 (Fig 19.2). The survey biomass estimates showed an increasing trend from 2003 to 2010, and have since remained stable, although estimates are imprecise. Survey coverage in Div. 3L began in 1984, but was incomplete in 2004 and 2005, and in 2008 there were substantial survey coverage deficiencies in Div. 2J, 3K and 3L (SCR Doc. 09/012). Results in these years may, therefore, not be comparable to other years.

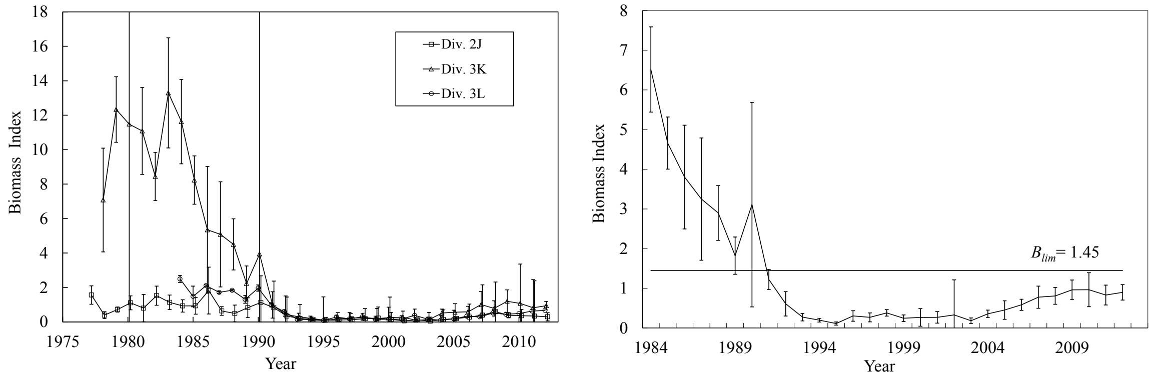


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: Index of biomass (with 95% confidence limits) from Canadian autumn surveys by Division (left panel) and overall (right panel). Values are Campelen units or, prior to 1995, Campelen equivalent units.

Stock Distribution. Survey distribution data from the late 1970s and early 1980s indicated that witch flounder were widely distributed throughout the shelf area in deeper channels around the fishing banks primarily in Div. 3K. By the mid-1980s, however, they were rapidly disappearing and by the early 1990s had virtually disappeared from the area entirely except for some very small catches along the slope and more to the southern area. They now appear to be located only along the deep continental slope area, both inside and outside the Canadian 200-mile fishery zone (Fig. 19.3).

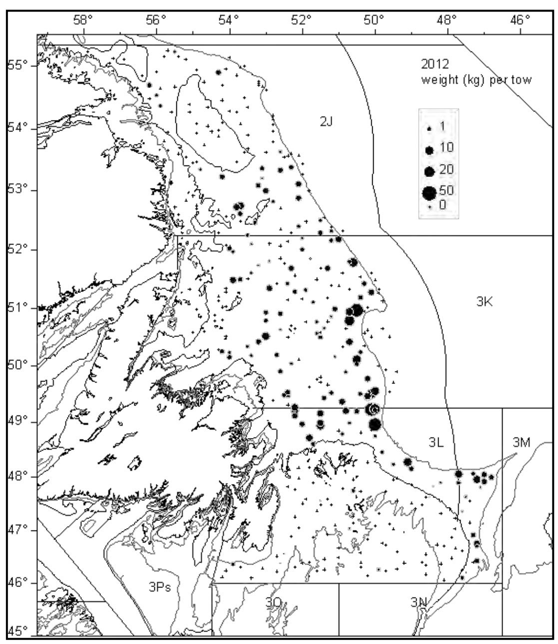


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: weight (kg) per set from the Canadian survey during autumn 2012.

c) Assessment Results

No analytical assessment was possible.

Biomass: Survey biomass index showed a rapid downward trend since the mid-1980s and since 1995 has remained at an extremely low level. However, a slightly increasing trend in the total stock survey biomass index was observed from 2003 to 2010, and indices have since remained stable.

Recruitment: Population numbers of juvenile witch flounder (<23 cm) from Canadian autumn surveys from 1996-2012 are given in Fig. 19.4. The 2000-2002 surveys had higher than average (1996-2012) numbers of small fish, and this improved recruitment was followed by a slightly increasing trend in survey biomass index from 2003-2010. Since 2003, the juvenile abundance index has been variable and in the most recent two surveys has been below average.

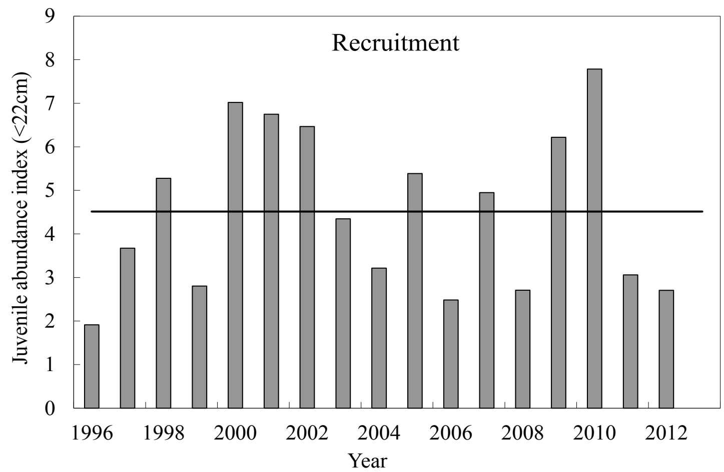


Fig. 19.4. Index of juvenile (<23 cm) abundance in Div. 2J, 3K, and 3L witch flounder from Canadian autumn surveys 1996-2012. Horizontal line is the time series average.

Fishing mortality: A proxy for fishing mortality, the ratio of catch (000t) to Canadian autumn survey biomass index, is given in Figure 19.5. Fishing mortality has been very low since 2005.

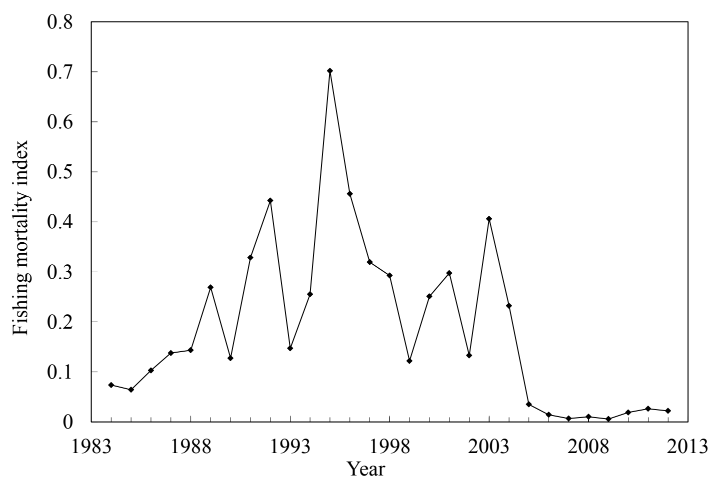


Fig. 19.5. Ratio of witch flounder catch ('000 t) to Canadian autumn survey biomass index in Div. 2J, 3K and 3L.

d) State of the stock

There was an increase in the survey biomass index from 2003 to 2010, nevertheless, the overall stock remains below B_{lim}. Recruitment was above the 1996-2012 average from 2000-2002, in 2009 and 2010, but was below average in 2011 and 2012. Current fishing mortality is low.

e) Reference Points

A proxy for B_{lim} for this stock was previously calculated as 15% of the highest observed survey biomass index because no analytical assessment was available (B_{lim} = 0.98). An analysis of the amount of biomass in index strata, in a previous assessment for this stock, suggested that the survey biomass estimates in the early part of the time series may have been underestimated by about 48% and the proxy for B_{lim} was adjusted for less extensive coverage in the early part of the survey time series. B_{lim} was, therefore, calculated to be 1.45 (B_{lim}=15% of B_{1984}*1.48). The biomass index has been below this reference point (Fig. 19.2) since 1991, and in 2012 was 62% of B_{lim}.

The next full assessment of this stock is scheduled for 2016.

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

(SCR Doc. 13/10, 13, 16, 29, 45; SCS Doc. 13/05, 07, 09, 13; 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 was 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. STACFIS only had STATLANT 21A data for 2011 and 2012 to estimate catch. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for 2011 and 2012 has made it impossible for STACFIS to provide the best assessments for some stocks.

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC	20	19	18.5	16	16	16	16	17.2[1]	16.3[1]	15.5[1]
STATLANT 21	16.0	17.8	17.7	15.3	15.0	14.7	15.7	15.7	15.2	
STACFIS	25.5	23.3	23.5	22.7	21.2	23.2	26.2	na	na	

na – not available
[1] – TAC generated from HCR

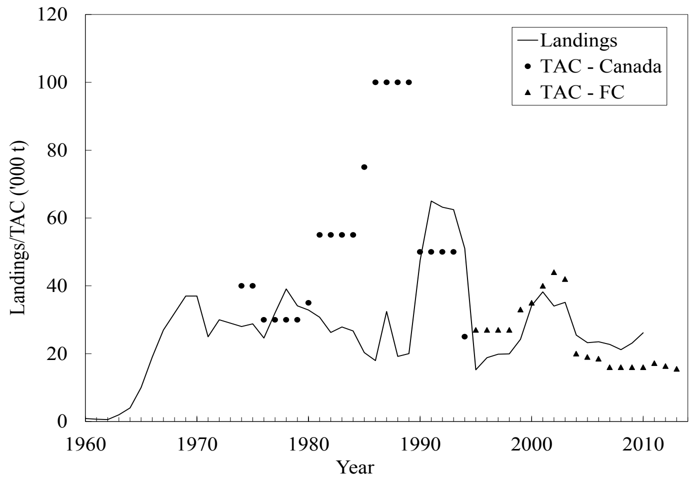


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

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 (1978-2012), EU in Div. 3M (1988-2012) and EU-Spain in Div. 3NO (1995-2012). Commercial catch-at-age data were available from 1975-2010 but were not compiled for 2011 or 2012 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 – 2012 estimates of standardized CPUE for Canadian otter-trawlers indicate a sizeable increase compared to previous years. In 2012, most of the Canadian otter-trawl landings came from Div. 2J.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN over 1988-2012 (SCS Doc. 13/05) declined sharply in 1991 from initial levels. Consistent increases were estimated over the mid-1990s until 2000. The standardized CPUE increased considerably after 2004 to record high levels. CPUE remains at exceptionally high levels over 2007-2012, 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 Doc. 09/22, SCS Doc. 13/07) 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; no update is available. In 2012, 87% 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).

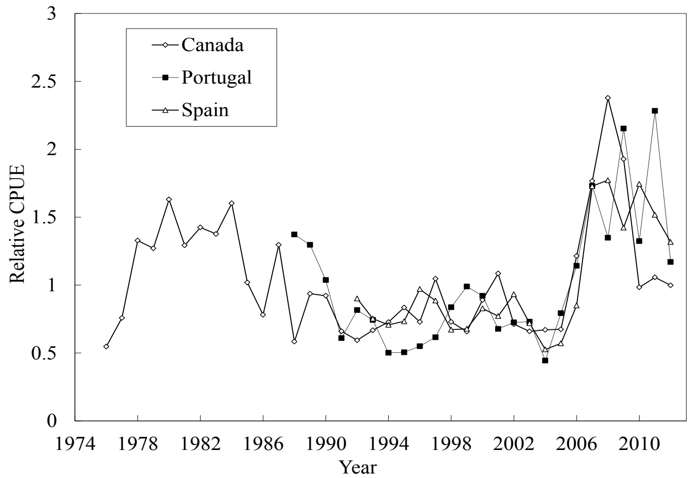


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2012 average.)

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 2012 fishery were provided by 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 or 2012, therefore the 2011 or 2012 catch-at-age was not calculated.

ii) Research survey data

STACFIS reiterated that most research vessel survey series providing information on the abundance of Greenland halibut are deficient in various ways and to varying degrees. Variation in divisional and depth coverage creates problems in comparing results of different years (SCR Doc. 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. 13/29). 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, with declines over 1999-2002. The index continually increased over the next five years. The increasing trend has not continued, though in 2012 the index is near the time-series average. 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. Following improved estimates of abundance in 2010 and 2011, the 2012 index is considerably lower as much fewer age 1 and 2 fish were observed.

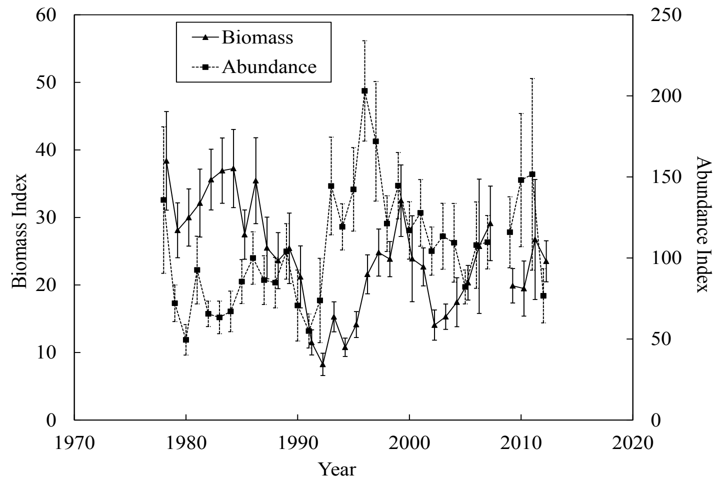


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian autumn surveys in Div. 2J and 3K. The 2008 survey was not completed.

The Canadian autumn survey in Div. 3L has generally shown trends that are consistent with those from Div. 2J+3K. Autumn surveys within Div. 3NO have erratic deep-water coverage and as such are not useful for inferring stock status.

Canadian stratified-random spring surveys in Div. 3LNO. Abundance and biomass indices from the Canadian spring surveys in Div. 3LNO (Fig. 20.4) declined from relatively high values in the late 1990s and has been relatively low in most years thereafter. In 2012, both abundance and biomass were near the time-series average. The abundance of recruits has increased in this survey in the most recent three surveys.

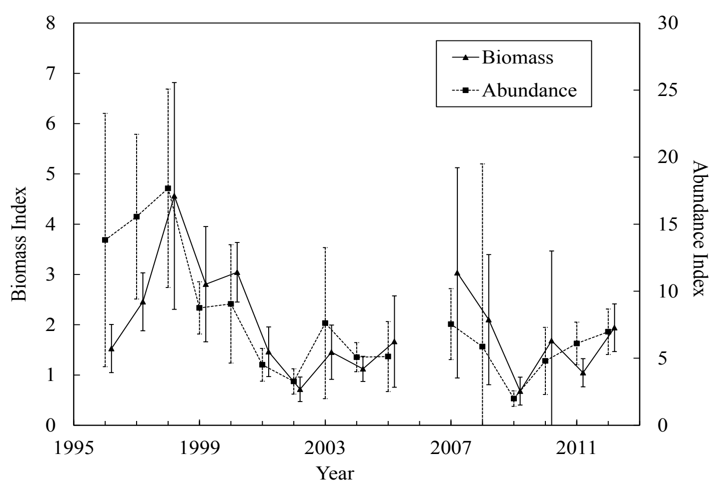


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M (Flemish Cap). Surveys conducted by the EU in Div. 3M during summer (SCR Doc.13/13) 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 2012, 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 but declined thereafter. The 2012 estimate is below the time-series average. Over 2009-2012, recruitment indices from this survey are very low.

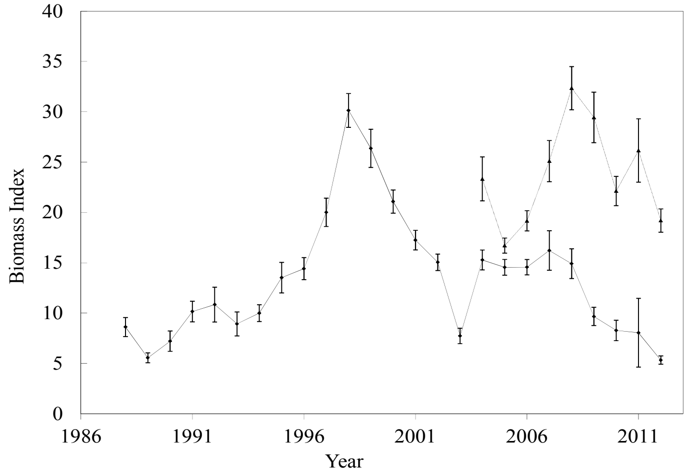


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (± 1 S.E.) from EU Flemish Cap surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

EU-Spain stratified-random surveys in NAFO Regulatory Area of Div. 3NO. The biomass index for this survey of the NRA (SCR Doc. 13/10) generally declined over 1999 to 2006 (Fig. 20.6) but increased four-fold over 2006-2009. Survey results for 2011 and 2012 are 50% lower than the 2009-2010 level, but remain above the time-series average.

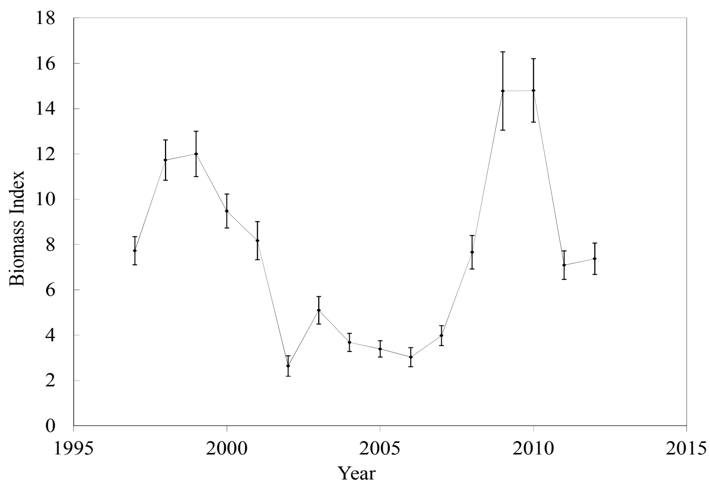


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in the NRA of Div. 3NO.

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). Results since 2004 shows greater divergence which complicates interpretation of overall status, but generally suggest stability in stock biomass over 2008-2012.

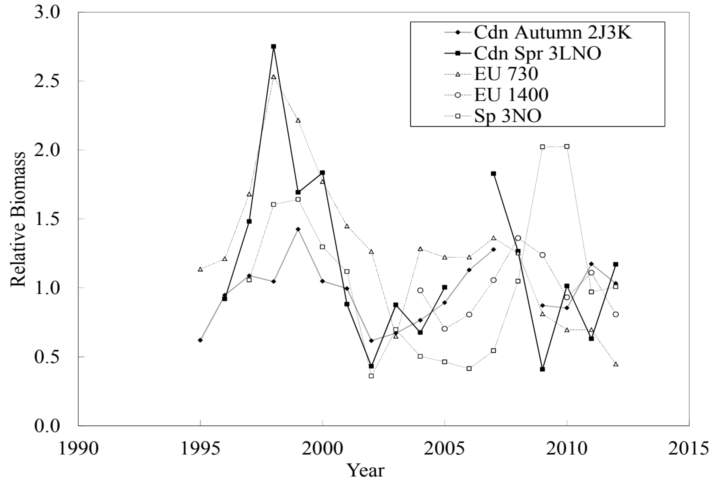


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices from Canadian autumn surveys in Div. 2J3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and EU-Spain surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2012 average.

c) State of the Stock:

Biomass: Survey data from 2008-2012 are variable but indicate stability. Current values remain below the levels of the late 1990s-early 2000s.

Recruitment: Results of recent Canadian surveys indicate average recruitment though estimates from the 2012 autumn survey are very low. Indices of recent recruitment from the EU Flemish cap survey are very low.

Fishing Mortality: Unknown, as estimates of total catch were unavailable.

d) Other Studies

Age Validation (SCR Doc. 13/45). A comparison of age reading methods was carried out on samples from SA 2+3KLMNO. Results indicated that ages determined from whole otoliths and thin sections were the same up to the age of 9 (about 60 cm), after which whole otoliths underestimated age. This bias increases with fish size. Bomb radiocarbon analysis (Kalish, 1995) validated the use of thin sections for determining accurate ages, on average, for the largest fish (>60 cm) in the population. This study concluded that Greenland halibut in SA 2+3KLMNO are slower growing and longer lived than was previously believed based on ages from whole otoliths. They reach a maximum age of approximately 35 years, and growth slows after age 10 (based on newly validated ages) in both males and females, with females reaching a larger maximum size than males.

Preliminary examination of the age distribution from the last assessment of this stock indicated that the overall effect of revising these ages on the assessment may be limited. During the 2006 assessment, sensitivity analyses indicated that model results were robust for differing choices of the plus-group age (down to as low as ages 11+), but future work should focus on how to incorporate this new knowledge into the assessment and/or any review of the management strategy for this stock.

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

Kalish, J. M. 1995. Radiocarbon and fish biology. *In* Recent Developments in Fish Otolith Research. Edited by: D. H. Secor, J. M. Dean and S. E. Campana. University of South Carolina Press, Columbia, South Carolina, SC. pp. 637-653.

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 in part due to unavailability of catch data. 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: Age validation studies have recently been completed, and results will be incorporated in future assessments.

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

STATUS: Tagging experiments have been conducted by Canada in 2012 and 2013.

This stock will be next assessed during June 2014.

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

(SCR Doc. 98/59, 75, 06/45, 13/31)

a) Introduction

i) Description of the Fisheries

Fisheries for Northern shortfin squid consist of a Canadian inshore jig fishery in Subarea 3, and prior to 1999, an international bottom trawl fishery for silver hake, shortfin squid and argentine operated in Subarea 4. Since 1999, there has been no directed squid fishery in Subarea 4 and catches have mainly been from bycatch in Canadian small-mesh bottom trawl fisheries (e.g., silver hake). Total catches from Subareas 3-6 were primarily from Subareas 3+4 during 1976-1981 and have been primarily from the USA offshore bottom trawl fishery in Subareas 5+6 since then. Prior to the mid-1980s, international bottom trawl and midwater trawl fleets participated in directed squid fisheries in Subareas 3, 4 and 5+6.

In Subareas 3+4, a TAC of 150 000 t was in place during 1980-1998. The TAC was 75 000 t in 1999 and has been 34 000 t since then. Occasionally, very low catches occur in Subarea 2 and these catches have been included with Subarea 3 for convenience. Subareas 3+4 catches were highest during 1976-1981, with a peak of 162 100 t in 1979, but then declined sharply to 400 t in 1983 and were less than 1 000 t through 1988. During 1989-1998, catches in Subareas 3+4 ranged between 1 100 t in 1995 and 15 600 t in 1997; the latter being the highest level since 1981. Since 1999, catches from Subareas 3+4 have been much lower, and with no directed fishery in Subarea 4, were primarily from the Subarea 3 inshore jig fishery. During 1999-2006, catches in Subareas 3+4 ranged between less than 100 t in 2001 and 7 000 t in 2006. Thereafter, Subareas 3+4 catches ranged from 700 t in 2009 to less than 50 t in 2012; the lowest level since 1953 (SCR Doc. 13/31).

Since this annual species is considered to constitute a single stock throughout Subareas 2 to 6 (SCR Doc. 98/59), catch trends in Subareas 3+4 must be considered in relation to those in Subareas 5+6.

During 1972-1982, the period of highest catches by the international squid fishing fleets, catches in Subareas 5+6 ranged from 15 600 t in 1981 to 24 900 t in 1977. After 1982, the international fleets were phased out and an offshore domestic squid fishery developed. Catches in Subareas 5+6 averaged 12 400 t during 1983-2011 and reached the highest catch on record in 2004 (26 100 t). The Subareas 5+6 catch totaled 11 700 t in 2012 (Fig. 21.1).

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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC SA 3+4	34	34	34	34	34	34	34	34	34	34
STATLANT 21 SA 3+4	2.6	0.6	7.0[1]	0.2[1]	0.5	0.7	0.1	0.1[1]	<0.1	
STATLANT 21 SA 5+6[2]	26.1	12.0	13.9	9.0	15.9	18.4	15.8	18.8	11.7	
STACFIS SA 3+4	2.6	0.6	7.0	0.2	0.5	0.7	0.1	0.1	<0.1	
STACFIS SA 5+6	26.1	12.0	13.9	9.0	15.9	18.4	15.8	18.8	11.7	
STACFIS Total SA 3-6	28.7	12.6	20.9	9.2	16.4	19.1	15.9	18.9	11.7	

[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

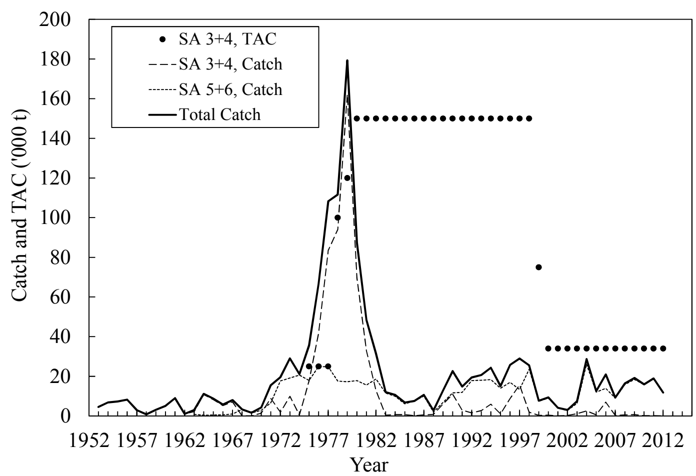


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs in relation to catches from Subareas 5+6 and the total stock.

b) Input Data

i) Commercial fishery data

Nominal catches were available for Subareas 3+4, during 1953-2012, and for Subareas 5+6 during 1963-2012. Catches from Subareas 5+6, prior to 1976, may not be accurate because distant-water fleets did not report all squid catch by species so the shortfin squid catches were prorated. The accuracy of the Subareas 3+4 catches prior to the mid-1970s is unknown. Subarea 4 catches include catches obtained by the Canadian Observer Program Database, during 1987-1998, a period of 100% fishery coverage plus catches from the Canadian MARFIS Database.

ii) Research survey data

For Subarea 4, indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were derived using data from stratified, random bottom trawl surveys conducted by Canada on the Scotian Shelf and in the Bay of Fundy (Div. 4VWX) during July, since 1970, and in the southern Gulf of St. Lawrence (Div. 4T) during September of 1971-2012. Different vessels were used to conduct the Div. 4VWX surveys during the periods of: 1970-1981 (RV *A. T. Cameron*); 1982 (RV *Lady Hammond*); 2004 (CCGS *Teleost*); and 1983-2003 and 2005-2012 (CCGS *Alfred Needler*). A survey gear change occurred in 1982, but there are no gear or vessel conversion coefficients available with which to standardize the shortfin squid indices prior to 2004. However, a comparative fishing study, conducted during July of 2005, found no significant vessel effect between the CCGS *Teleost* and CCGS *Needler*. The Div. 4VWX survey occurs before or near the start of the shortfin squid fisheries in all Subareas, so the indices are assumed to represent pre-fishery measures of relative abundance and biomass. Indices were also available for bottom trawl surveys conducted by the USA in Subareas 5+6 during September-October, since 1967, and in Div. 4T during September since 1971. Indices from the Subareas 5+6 and Div. 4T surveys were standardized for all vessel and gear changes. The 4T survey indices were also standardized for diel changes in catchability. Surveys conducted in Div. 4T and Subareas 5+6 occur at or near the end of the shortfin squid fisheries and both time series are assumed to represent post-fishery measures of relative abundance and biomass. Survey biomass indices for Div. 4VWX and Subareas 5+6, during 1970-1997 (Fig. 21.2), were positively correlated and the indices were also positively correlated with the total catches from Subareas 3-6 during the same time period (SCR Doc. 98/59).

For Subarea 3, relative abundance and biomass indices for Canadian surveys conducted in Div. 3LNO, mainly during May-June and October-December during 1995-2012, were revised using catches from the strata sets identified in SCR Doc. 06/45. The same type of gear was used during both surveys and the multiple ships used to conduct each of the surveys were assumed to have similar catchabilities. The revised sets of biomass indices for Div. 3LNO were still very low, when compared with the Div. 4VWX biomass indices, probably due to low availability of the species to the spring and fall surveys during periods when Northern shortfin squid are migrating on and off the Grand Bank, respectively (Hendrickson 2006). In addition, the spring 3LNO biomass indices did not show the same trends as the July Div. 4VWX biomass indices and the fall 3LNO biomass indices did not show the same trends as any of the other fall survey biomass indices (SCR Doc. 13/31). Thus, the 3LNO indices were not considered to represent good indicators of the relative biomass of Northern shortfin squid in Subareas 3+4. However, it is unknown whether the distribution patterns from these two surveys reflect *Illex* abundance or the timing of the surveys in relation to the species' annual migrations through the survey areas. Although lower in magnitude than the 4VWX biomass indices, the Div. 4T biomass indices show trends similar to those for the Div. 4VWX surveys despite the fact that the 4T survey area covers only a portion of shortfin squid habitat in Subarea 4 (Fig. 21.2). Indices of minimum biomass and abundance were also derived using catches from the EU surveys of the Flemish Cap (Div. 3M), which has been conducted mainly in July since 1988. The time series of 3M survey indices was standardized for the vessel change that occurred in 2003. Biomass indices for the Div. 3M surveys were very low (< 100 tons during most years) and were similar to the trends in the Div. 4VWX indices only during periods of high biomass in Div. 3M (SCR Doc. 13/31), probably because the Flemish Cap represents marginal *Illex* habitat during most years.

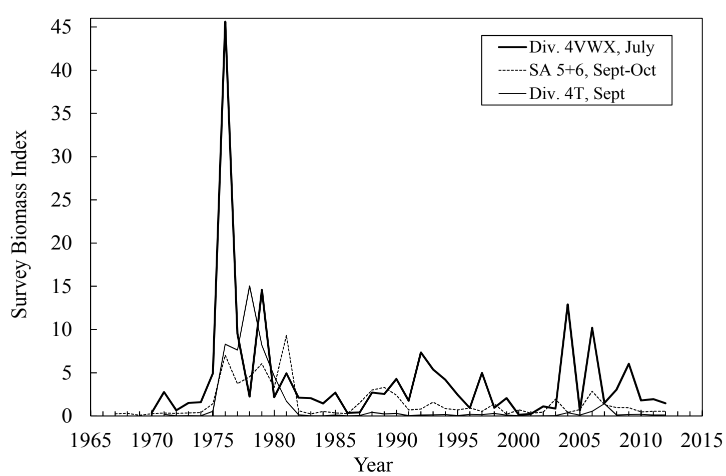


Fig. 21.2. Northern shortfin squid in Subareas 3+4: research survey biomass indices in Div. 4VWX during July, in Div. 4T during September, and in Subareas 5+6 during September-October.

iii) Biological studies

Mean body weights of shortfin squid caught in the July Div. 4VWX surveys were highest during 1976-1981, averaging 150 g, and much lower, averaging 80 g, during 1982-2011 (Fig. 21.3). Mean weights were much larger in the Subareas 5+6 surveys (average of 284 g) than in the Div. 4VWX surveys (average of 150 g) during 1976-1981. However, this size disparity subsequently decreased after 1994 due to a gradual decline in the mean size of squid caught in the Subareas 5+6 surveys, such that squid from both surveys were of similar size (about 70-90 g) during 1995-2003. The average body weight of squid caught in the Div. 4VWX surveys declined after 2006 and averaged (93 g) during 2007-2011, while the mean weight of squid from the Subareas 5+6 surveys averaged less, 85 g, during the same time period. In 2012, the mean weight of squid caught in the Div. 4VWX survey was 87 g, slightly above the 1982-2011 mean of 80 g.

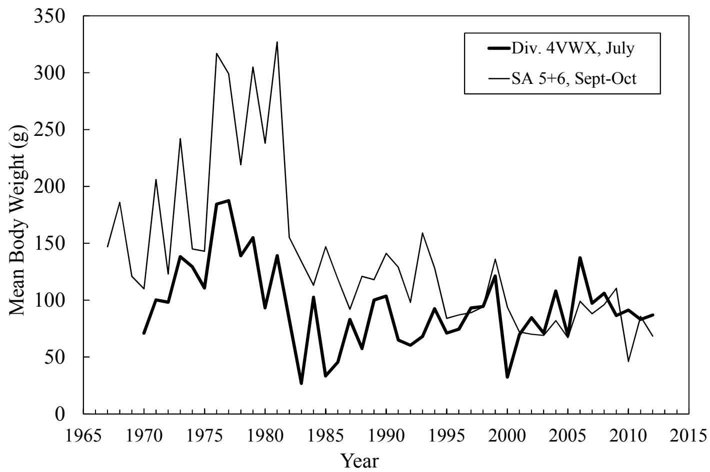


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weight of squid in the Div. 4VWX surveys during July and in the Subareas 5+6 surveys during September-October.

iv) Relative fishing mortality indices

Relative fishing mortality indices for Subareas 3+4 were computed as the Subareas 3+4 nominal catch divided by the Div. 4VWX July survey biomass index which is then scaled by dividing this value by 10 000 (SCR Doc. 98/75). The indices were highest during 1977-1982, reaching a peak of 4.20 in 1978 and averaging 1.78 (Fig. 21.4). During 1983-2011, relative fishing mortality indices were much lower, averaging 0.12, with a peak of 0.96 in 1996. During 2009-2012, relative fishing mortality indices were at the lowest levels on record (≤ 0.01).

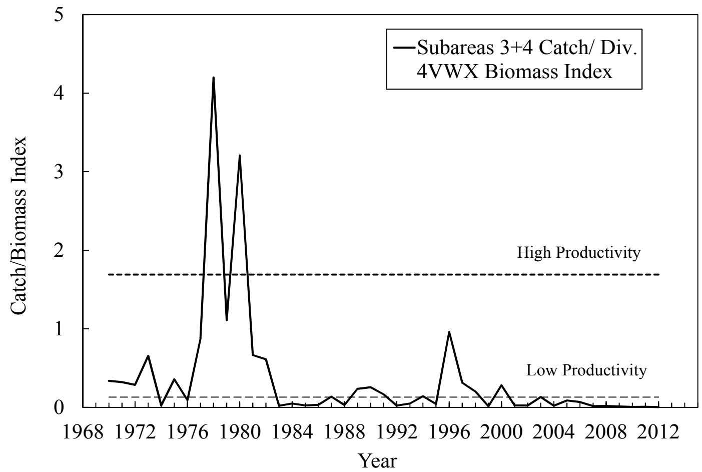


Fig. 21.4. Northern shortfin squid in Subareas 3+4: relative fishing mortality indices.

c) Assessment Results

Trends in fishery and research vessel survey data indicate that a period of high productivity (1976-1981) occurred in Subareas 3+4 between two low productivity periods (1970-1975 and 1982-2011). During 2010-2012, relative biomass indices from the Division 4VWX surveys remained at levels ranging from 1.5-1.9 kg per tow, which were well below the average for the low productivity period (3.0 kg per tow). The high productivity period was associated with a larger mean body size (averaging 150 g) than the 1982-2011 low productivity period (averaging 80 g). The mean body weight of squid caught during the 2012 survey in Div. 4VWX (87 g) was slightly above the 1982-2011 average. Relative fishing mortality indices for Subareas 3+4 were highest during 1977-1982 and have been much lower since 1982. During 2009-2012, relative fishing mortality indices were at the lowest levels on record. Based on these trends, the Subareas 3+4 stock component remained in a state of low productivity during 2012.

d) Reference Points

Illex illecebrosus is an annual, semelparous species. Recruitment is strongly influenced by environmental conditions, and as a result, the Subareas 3+4 stock component has experienced low and high productivity states (SCR Doc. 98/75). Since the onset of the 1982 low productivity period, the magnitude of the Div. 4VWX biomass index has not consistently reflected the magnitude of the fishery removals during each respective year. Given the inconsistent response of the annual relative biomass indices to fishery removals and the lack of a stock-recruitment relationship, limit reference points or proxies thereof are not currently estimable for the Subareas 3+4 stock component. Limit reference points may not be appropriate for the northern stock component given the life history of this short-lived species. The current management advice for this stock component is based on the potential yield given whether the stock is in a low or high productivity state. The method used to compute potential yield only applies to the low productivity period, does not account for effects of environmental conditions on squid yield, and assumes that the high relative fishing mortality indices which occurred during 1976-1981 (which were followed by a rapid decline in the Div. 4VWX biomass indices) are appropriate for the current time period. Potential yields for the low productivity period were computed as 1.) the average catch during 1976-1981*(average Div. 4VWX biomass index during 1982-1997/average biomass index during 1976-1981) = 19 000 t and 2.) the catch during 1979*(average Div. 4VWX biomass index during 1982-1997/biomass index during 1979) = 34 000 t. Both potential yields are assumed to represent limit reference points (SCR Doc. 98/75; 10/31).

e) Research Recommendations

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: This research recommendation was addressed during the 2013 assessment in SCR Doc. 13/31. The revised biomass indices for both Div. 3LNO surveys were much lower than biomass indices from other surveys used to assess Northern shortfin squid. In addition, trends in the revised time series of relative biomass indices derived from the Canadian spring surveys conducted in Div. 3LNO biomass indices did not show the same trends as those for the Div. 4VWX biomass indices (SCR Doc. 13/31).

STACFIS **recommends** that *gear/vessel conversion factors be computed to standardize the 1970-2003 relative abundance and biomass indices from the July Div. 4VWX surveys.*

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 2013. Based on the available information and the most recent assessments, STACFIS found no reason to modify the classification made at the June meeting in 2012. 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 September 2013
[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

a) Greenland halibut Genetics Study

Results from a study entitled "Local selection in a background of high gene flow: Greenland halibut (*Reinhardtius hippoglossoides*) in the Northwest Atlantic" by Denis Roy, David C. Hardie, Margaret A. Treble, James D.Reist, Daniel. E. Ruzzante was presented. The authors found that Greenland halibut (*Reinhardtius hippoglossoides*) exhibit extremely low levels of population genetic differentiation throughout the Northwest Atlantic (and likely beyond), which cannot be statistically differentiated from panmixia using twelve highly variable polymorphic microsatellite markers. This work is currently at review and STACFIS will be updated on the status of this research at the 2014 June meeting.

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 0900 on 21st June.