NORTHWEST ATLANTIC FISHERIES ORGANIZATION

Scientific Council Reports 2012

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January 2013

PREFACE

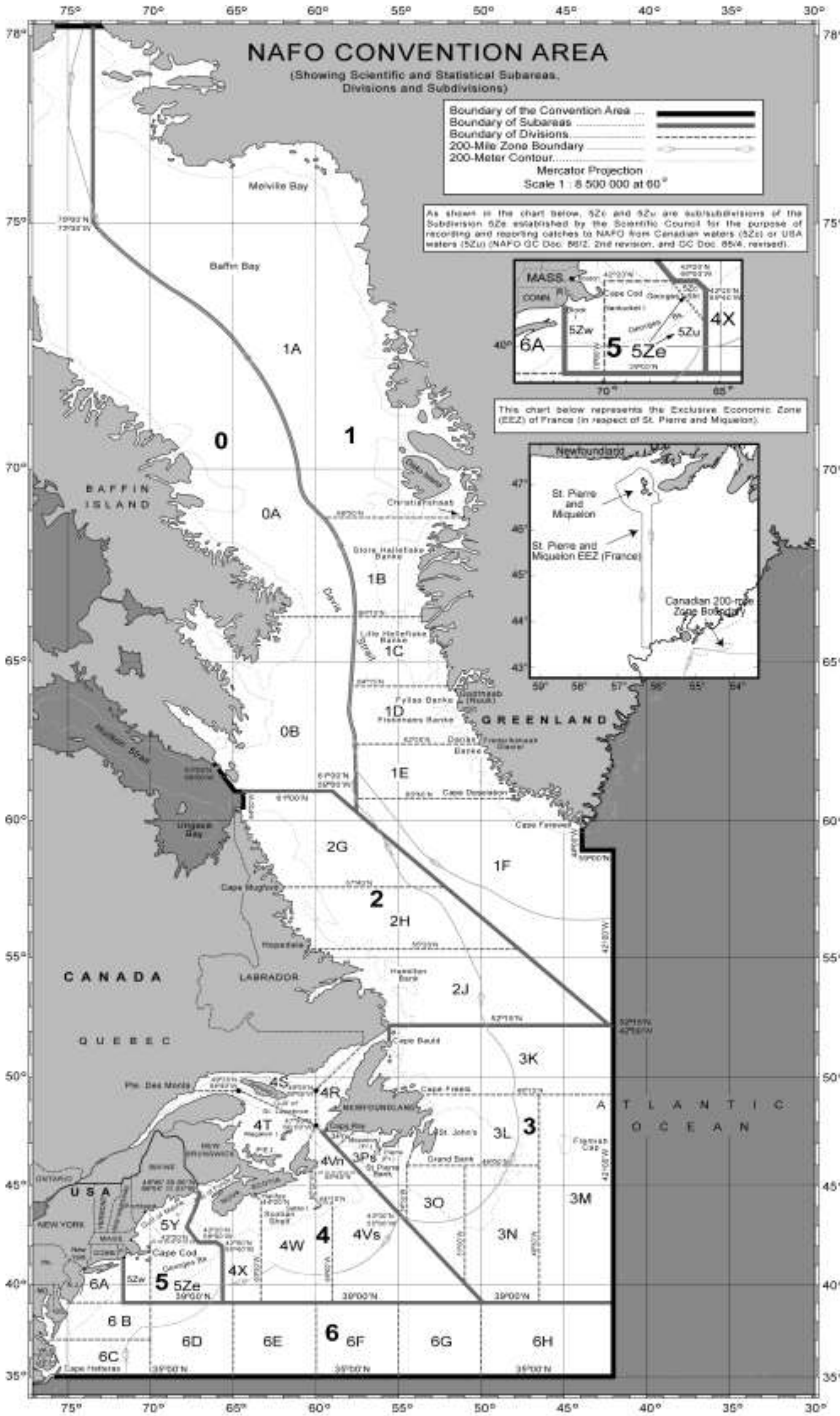
This thirty-third issue of *NAFO Scientific Council Reports* containing reports of Scientific Council Meetings held in 2012 is compiled in five sections: **Part A** - Report of the Scientific Council Meeting during 1-14 June 2012 which addressed most of the annual requests for scientific advice on fisheries management and ecosystem considerations; **Part B -** Report of the Scientific Council Meeting 27 August - 7 September 2012, which provided the updated shrimp advice for consideration at the Annual Meeting; **Part C** - Report of the Scientific Council Annual Meeting during 17-21 September 2012, **Part D** - Report of the Scientific Council Meeting during 17-24 October 2011, which addressed the requests for scientific advice on northern shrimp, **Part E** – Report of the NAFO/ICES *Pandalus* Assessment Group (NIPAG) and **Part F** - the Agendas, Lists of Research and Summary Documents, List of Representatives, Advisers, Experts and Observers, and List of Recommendations relevant to Parts A, B, C, D and E.

In Memoriam

This year Scientific Council noted with sadness the passing of two of its former members; Dr Thomas K. Pitt and Dr Manuel Gómez Larrañeta.

Dr. Pitt passed away on April 5, 2012, aged 88 years, in St. John's, Canada. Dr. Pitt was a member of Scientific Council during its early years, before his retirement in the mid 1980s as a research scientist with the Department of Fisheries and Oceans. He contributed the first analytical assessments on the Grand Bank stocks of American plaice and Yellowtail flounder to Scientific Council. Tom was also a long-time attendee at ICNAF meetings, and wrote numerous papers on flatfish biology and assessment in ICNAF, NAFO, and in the primary literature.

Dr. Larrañeta was born in Tolosa, Spanish Basque Country, and held a degree in Natural Sciences from the University of Barcelona (1946) and a PhD from the same university (1965). He joined the Fisheries Research Institute when it was founded in 1949, and served as laboratory director at Castellon (1954 – 1967) and Vigo (1967 – 1979). In 1969, shortly after arriving in Vigo, Dr. Larrañeta began participating in the ICNAF Scientific Council. Until his retirement in 1989, Dr. Larrañeta was the reference point in Spain for NAFO fisheries. After his retirement in 1989 he continued to attend the institute for ten years, preparing his theoretical work on the stock-recruitment relationship in fish.


NAFO CONVENTION AREA
(Showing Scientific and Statistical Subareas, Divisions and Subdivisions)
Boundary of the Convention Area
Boundary of Subareas
Boundary of Divisions
200-Mile Zone Boundary
200-Meter Contour
Mercator Projection
Scale 1 : 8 500 000 at 60°
This chart below represents the Exclusive Economic Zone (EEZ) of France (in respect of St. Pierre and Miquelon).
St. Pierre and Miquelon
St. Pierre and Miquelon EEZ (France)
Canadian 200-mile Zone Boundary
Newfoundland
Melville Bay
Baffin Bay
BAFFIN ISLAND
GREENLAND
CANADA
LABRADOR
QUEBEC
ATLANTIC OCEAN
0
1
2
3
4
5
6
0A
0B
1A
1B
1C
1D
1E
1F
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3O
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4T
4Vn
4Vs
4W
4X
5Y
5Ze
5Zw
5Zu
6A
6B
6C
6D
6E
6F
6G
6H
Cape Cod
Cape Hatteras
Cape Chidley
Hopedale
Cape Bauld
Cape Freels
St. John's
Grand Bank
Flemish Cap
Cape Farewell
Cape Desolation
Hamilton Bank
Fyllas Banke
Store Hellefiske Banke
Lille Hellefiske Banke
Christianshaab
Ungava Bay
Hudson Strait
Davis Strait
USA
NEW YORK
MAINE
ONTARIO
MASS
CONN
NEW BRUNSWICK
Pte. Des Monts
39°00'N
35°00'N
61°00'N
52°15'N
42°00'W
75°
70°
65°
60°
55°
50°
45°
40°
35°
30°
78°

CONTENTS

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

Contents

Scientific Council Participants during the June 2012 Meeting

SC Chairs and the SC Coordinator

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

REPORT OF SCIENTIFIC COUNCIL MEETING

1–14 JUNE 2012

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSIONS

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

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

The Council was called to order at 1000 hours on 1 June 2012. The provisional agenda was **adopted** with modification. The Scientific Council Coordinator, Neil Campbell, was appointed the rapporteur.

The Council was informed that authorization had been received by the Executive Secretary for proxy votes from Denmark (F&G), EU, Iceland, Japan and USA.

The opening session was adjourned at 1030 hours on 1 June 2012. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda. The Council considered **adopted** the STACFEN report on 13 June 2012, the STACPUB report on 13 June 2012, the STACREC report on 13 June 2012, and the STACFIS report on 13 June 2012.

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

The Council considered and **adopted** the report the Scientific Council Report of this meeting of 1–14 June 2012. The Chair received approval to leave the report in draft form for about two weeks to allow for minor editing and proof-reading on the usual strict understanding there would be no substantive changes.

The meeting was adjourned at 1300 hours on 14 June 2012.

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

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

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

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 2011

VII.1.d) Special Request for Management Advice

v) Management Measures for blue whiting (item 11)

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

STATUS: There is nothing to report.

III. FISHERIES ENVIRONMENT

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

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

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

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

IV. PUBLICATIONS

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

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

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

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

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

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

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

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

V. RESEARCH COORDINATION

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

There were no recommendations arising from STACREC.

VI. FISHERIES SCIENCE

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

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

VII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

1. Fisheries Commission

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

The Scientific Council noted the Fisheries Commission requests for advice on northern shrimp (northern shrimp in Div. 3M and Div. 3LNO (Item 1)) was undertaken during the Scientific Council meeting on 19–26 October 2011. The Scientific Council provided scientific advice on northern shrimp stocks for 2013. Updated advice for 2013 will be provided at the Annual Meeting in 2012 through an interim monitoring report.

a) Request for Advice on TACs and Other Management Measures

The Fisheries Commission at its meeting of September 2010 reviewed the assessment schedule of the Scientific Council and with the concurrence of the Coastal State agreed to request advice for certain stocks on either a two-year or three-year rotational basis. In recent years, thorough assessments of certain stocks have been undertaken outside of the assessment cycle either at the request of Fisheries Commission or by the Scientific Council given recent stock developments.

Scientific Council responded as follows:

Cod in Division 3M

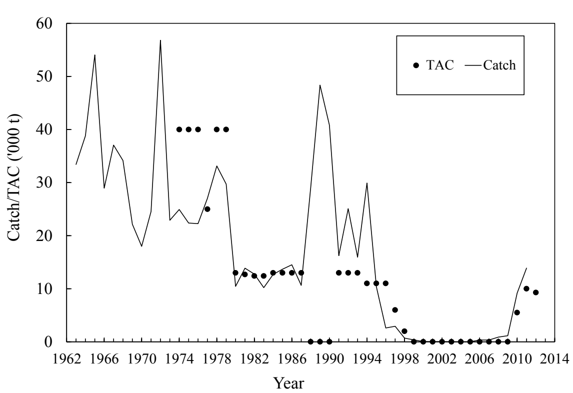
Recommendation: Scientific Council notes that under all the scenarios projected ($F_{0.1}$, F_{max} and F_{2011}) the probability of 2014 SSB being below B_{lim} is low (less than 5%). Estimated F_{2011} is more than twice F_{max}. In the short term the stock can sustain high values of F, however any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

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

Fishery and Catches: The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod has also been taken as bycatch in the directed redfish fishery by Portuguese trawlers. Catches exceeded the TAC from 1988 to 1994. In 1999 the direct fishery was closed. The fishery was reopened in 2010 with 5 500 t TAC and a catch of 9 192 t was estimated by STACFIS. TAC for 2011 was set as 10 000 t. This year, STACFIS only had STATLANT 21A available as estimates of catches, which is inconsistent with the information used in previous assessments. The model used for the assessment of this stock estimated the 2011 catch to be 13 900 t. TAC for 2012 is 9 280 t.

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

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

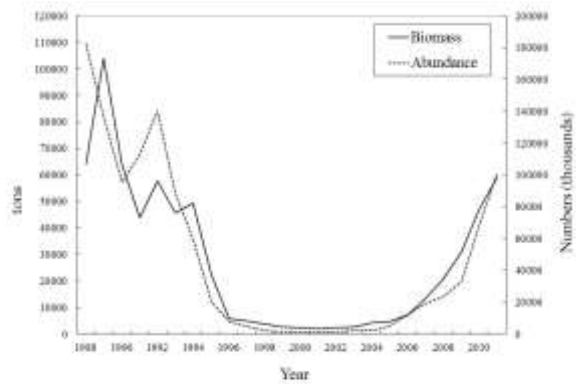


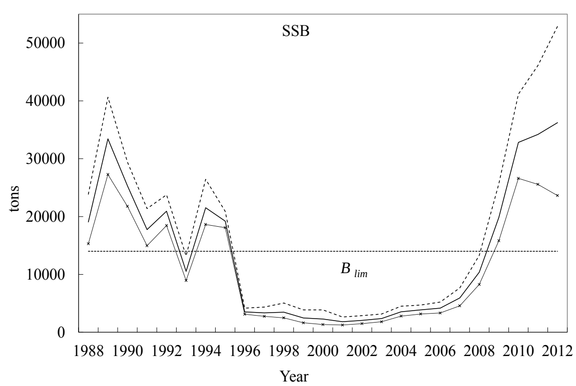
Data: For 2011, length sampling is available from Canada, EU-Estonia, EU-Lithuania, Norway, EU-Portugal, Russia, EU-Spain and EU-UK. Abundance at age indices were available from the EU bottom trawl survey since 1988, covering the whole distribution area of the stock. In 2009–2011 age-length keys from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

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

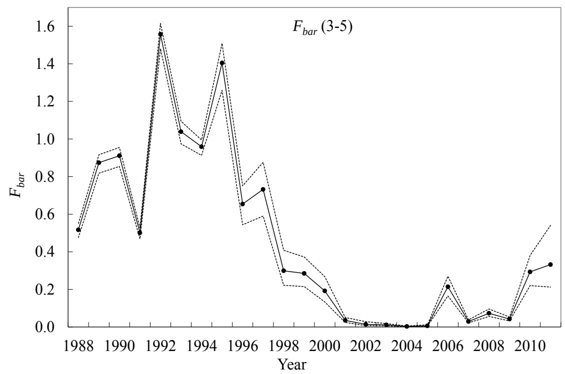
Total Biomass and Abundance: Estimated total biomass and abundance show an increasing trend since the mid-2000s. Both values are this year around the level of the early 90s.

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

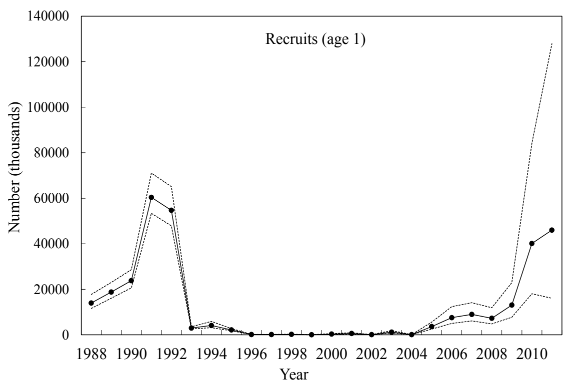




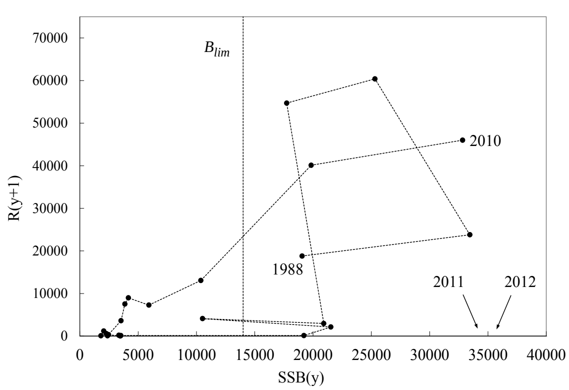
Fishing mortality: *F* increased in 2010 and 2011 with the opening of the fishery. F_{bar} in 2011 (0.339) was more than twice F_{max} (0.135).



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



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

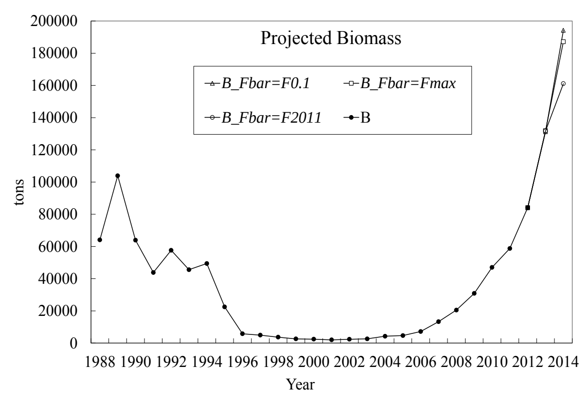


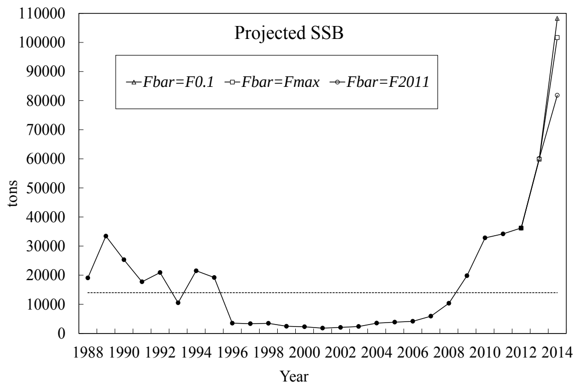
State of the Stock: SSB in 2011 is estimated to be well above B_{lim}. Recent recruitments are among the highest level of the time series, but these estimates are imprecise. Fishing mortality in 2011 is high, at the level of more than twice F_{max}.

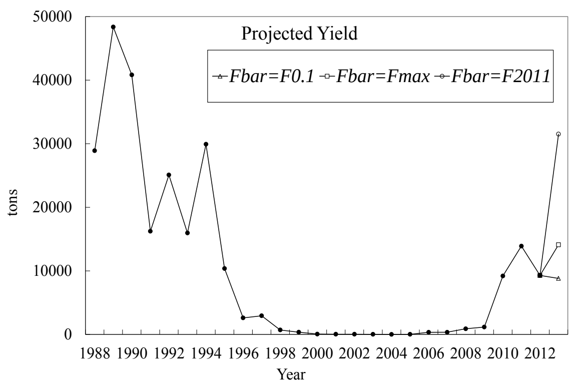
Stock Projections: Stochastic projections to 2014 were conducted for three fishing mortality scenarios: (1) $F_{bar}=F_{0.1}$ (median=0.08); (2) $F_{bar}=F_{max}$ (median=0.135); (3) $F_{bar}=F_{2011}$ (median=0.339). All scenarios assumed that the Yield for 2012 is the established TAC (9 280 t).

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

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







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

As the stock is quickly changing its biological parameters (mean weight at age and maturity at age), it resulted in a change of the SSB of the stock. In the previous assessment, SSB for 2011 was estimated as 50 000 t. This is now revised to 34 000 t because of differences between the maturities assumed for 2011 in the previous assessment and the estimated maturities available this year.

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

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

Redfish in Divisions 3LN

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

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

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

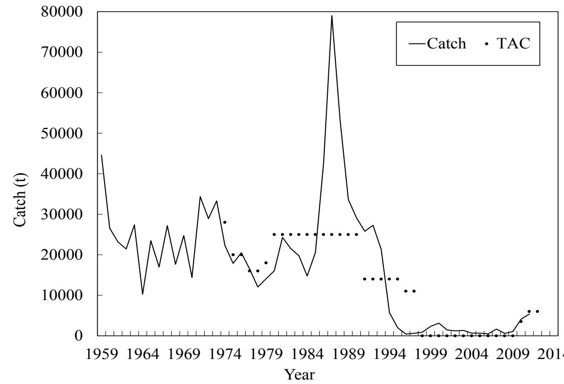
Scientific Council recommended that fishing mortality in 2013 and 2014 should be kept around the current level. Increases of F above $F_{statusquo}$ should be treated with caution.

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

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

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

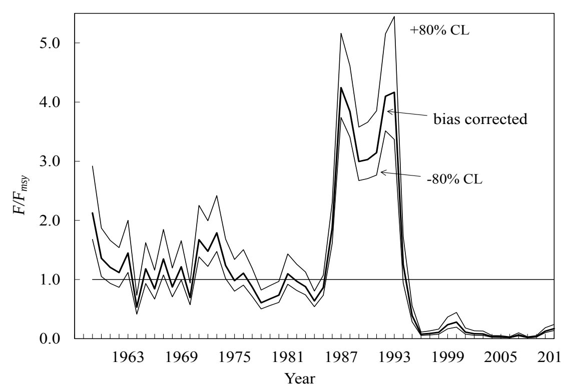
ndf No directed fishing



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

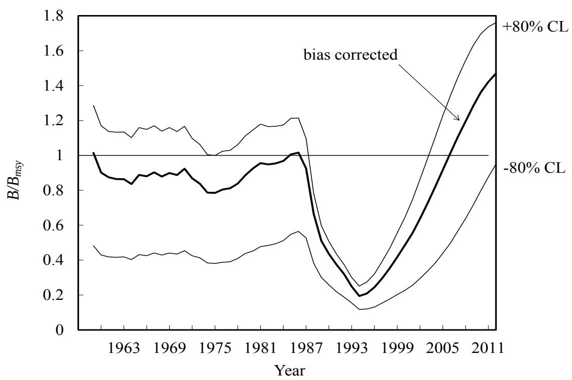
Assessment: An ASPIC model framework, was used to assess the status of the stock. This framework uses a surplus production model to describe stock dynamics.

Fishing Mortality: Fishing mortality has been low since 1995.

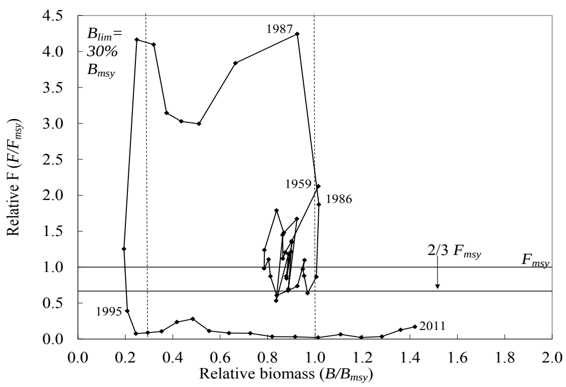


Recruitment: From commercial catch and Canadian survey length data there are signs of recent recruitment of above average year classes to the exploitable stock.

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



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



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

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

The next assessment will be in 2014.

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

Thorny Skate in Divisions 3LNOPs

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

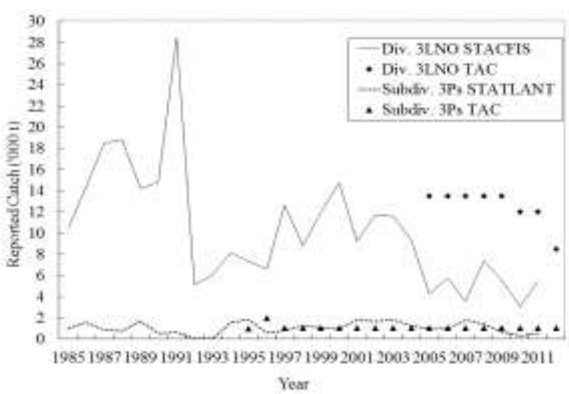
Background: Thorny Skate on the Grand Banks is managed as two units; Skate in Div. 3LNO is managed by NAFO and Skate in Subdiv. 3Ps is managed by Canada and France in their respective EEZs.

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

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

Catches are as follows:

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



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

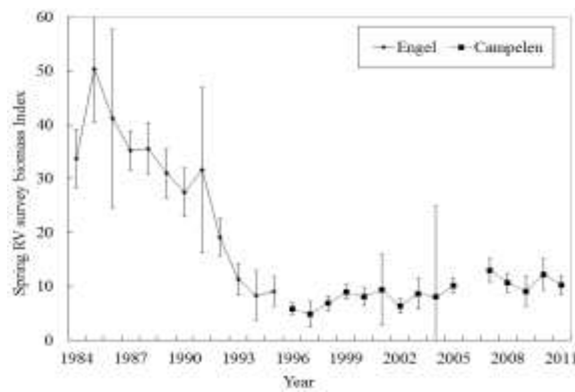
Data: Abundance and biomass indices were available from Canadian spring and autumn surveys since 1984.

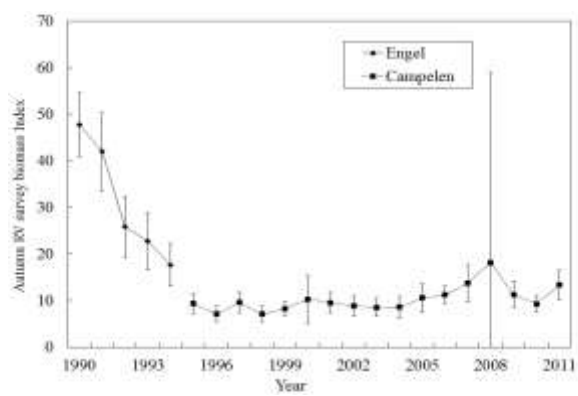
EU-Spain survey indices were available for the NAFO Regulatory Area of Div. 3NO (1997–2011). EU-Spain survey indices in the NRA of Div. 3L are available for 2003–2011.

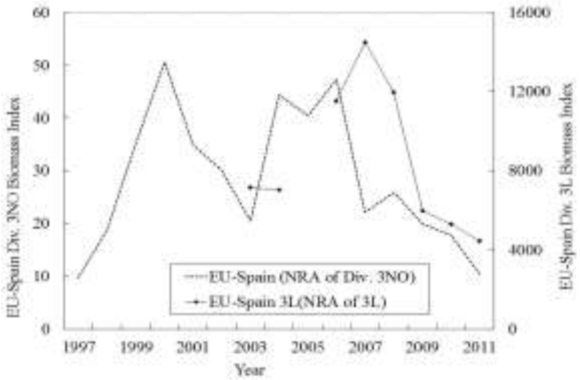
Commercial length frequencies were available for EU-Spain, EU-Portugal, Canada and Russia.

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

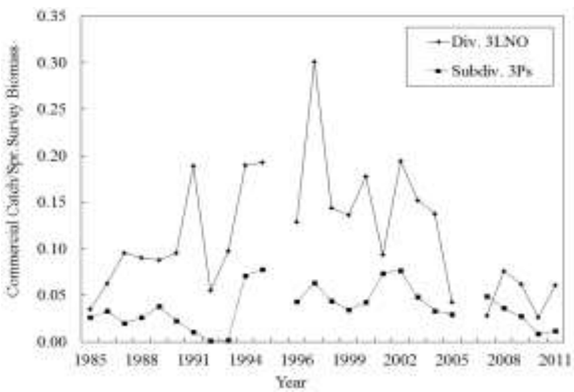
Biomass. The Canadian spring survey biomass indices fluctuated without trend prior to the mid-1980s then declined rapidly until the early-1990s. The Canadian spring Campelen series, 1996 to 2011, has been showing an increasing trend in biomass since 1997. While the Canadian autumn survey shows stability.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



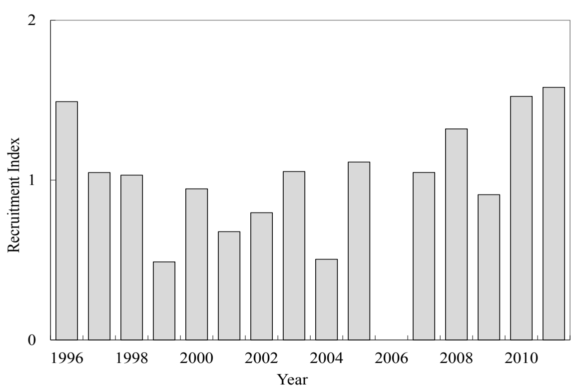




Fishing Mortality. A fishing mortality index (Catch/survey biomass from Canadian spring surveys for Div. 3LNO) has been low since 2005.



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



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

Reference Points: None defined.

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

The next assessment will be in 2014.

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

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

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

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

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

The Scientific Council reviewed the status of the ten stocks (interim monitoring) at this June 2012 meeting, and found no significant change in any of these stocks to alter the multi-year advice previously provided. Accordingly, the Council reiterates this previous advice as follows:

Recommendation for Cod in Div. 3NO: (2010) There should be no directed fishing for cod in Div. 3N and Div. 3O in 2011–2013. Bycatches of cod should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directed for other species.

Recommendation for Redfish in Div. 3O: (2010) Catches have averaged about 13 000 t since 1960 and over the long term, catches at this level appear to have been sustainable. The Scientific Council noted that over the period from 1960 to 2009, a period of 50 years, catches have surpassed 20 000 t in only three years. The Scientific Council noted there is insufficient information on which to base predictions of annual yield potential for this resource. Stock dynamics and recruitment patterns are also poorly understood. Scientific Council is unable to advise on an appropriate TAC for 2011, 2012 and 2013.

Recommendation for Witch flounder in Div. 2J + 3KL: (2010) No directed fishing on witch flounder is recommended in the years 2011 to 2013 in Div. 2J, 3K and 3L to allow for stock rebuilding. Bycatches of witch flounder in fisheries targeting other species should be kept at the lowest possible level.

Recommendation for Northern shortfinned squid in SA 3+4: (2010) Based on available information, including an analysis of the upper range of yields that might be expected under the present low productivity regime (19 000 – 34 000 t), the Council advises that the TAC for 2011 to 2013 be set between 19 000 and 34 000t.

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

Recommendation for American plaice in Div. 3M: (2011) There should be no directed fishery on American plaice in Div. 3M in 2012, 2013 and 2014. Bycatch should be kept at the lowest possible level.

Recommendation for Witch flounder in Div. 3NO: (2011) No directed fishing on witch flounder in 2012, 2013 and 2014 in Div. 3N and 3O to allow for stock rebuilding. Bycatches in fisheries targeting other species should be kept at the lowest possible level.

Recommendation for Redfish in Div. 3M: (2011) In order to sustain the female spawning stock biomass on the short term fishing mortality should be kept at its present low level. This would correspond to an expected average 2012–2013 beaked redfish catch under F status quo of 3 087 t. Catch for all redfish species combined in Div. 3M in 2012 and 2013 should not exceed 6 500 t.

Recommendation for Yellowtail flounder in Div. 3LNO: (2011) F options of up to 85% F_{msy} are considered to have a low risk of exceeding F_{lim} (=F_{msy}) in 2012 and 2013, and are projected to maintain this stock well above B_{msy}.

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

Recommendation for White hake in Div. 3NOPs: (2011) Given the current low level of recruitment, Scientific Council advises that the current TAC of 6 000 t is unrealistic and that catches of white hake in Div. 3NO in 2012 and 2013 should not exceed their current levels.

c) Special Requests for Management Advice

i) Computation of harvest control rule and advice on exceptional circumstances in Greenland halibut in Subarea 2 and Divisions 3KLMNO (Item 4)

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

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

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

Scientific Council responded:

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

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

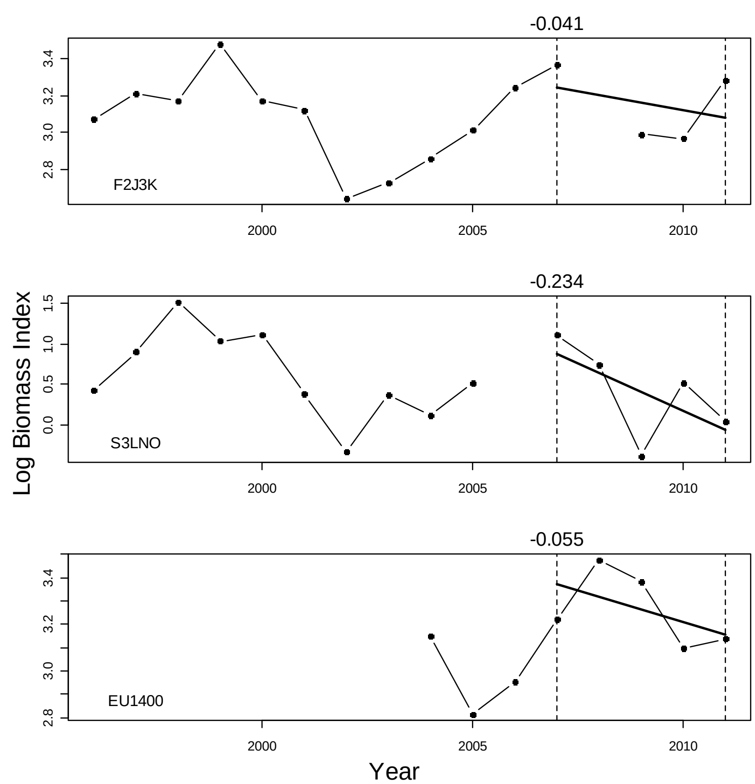


Fig. 1. Survey slopes used in computation of Greenland halibut harvest control rule.

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

Defining Exceptional Circumstances in the context of the Greenland halibut MSE

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

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

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

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

Advise on whether or not an exceptional circumstance is occurring.

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

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

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

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

ii) Mid-water trawl fishery mesh size for redfish in Div. 3LN (Item 5)

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

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

iii) Review and Update Reference points for Div. 3LNO American plaice, Div. 3NO cod (Item 6)

The Fisheries Commission adopted in September 2011, conservation plans and rebuilding strategies for 3NO cod and 3 LNO American plaice and "recognizing that further updates and development of the plans may be required to ensure that the long term objectives are met". The Fisheries Commission requests the Scientific Council to:

a) Provide advice on the addition of a new intermediate reference point (i.e. Bisr) in the NAFO precautionary approach framework to delineate an additional zone between Blim and Bmsy as proposed by the working group

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

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

Scientific Council responded:

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

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

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

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

Scientific Council responded that for Div. 3NO cod:

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

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

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

For Div. 3LNO American plaice:

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

iv) Review of rebuilding plans for American plaice in Div. 3LNO and Cod in Div. 3NO (Item 7)

Fisheries Commission requests the Scientific Council to review the conservation and rebuilding plans of 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5). Through projections and a risk based approach, evaluate the performance of the present rebuilding plans in terms of expected time frames (5 / 10 / 15 years) and associated probabilities to reach indicated limit and target biomass levels and catches. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above B_{lim}.

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

v) Evaluation of the proposed harvest control rule for American plaice in Div. 3LNO and Cod in Div. 3NO (Item 8)

Fisheries Commission requests the Scientific Council to evaluate the Harvest Control Rule (HCR) indicated below as an alternative to the HCR of the 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4, item 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5, item 4) Conservation Plans and Rebuilding Strategies. Through projections and a risk based approach, evaluate the performance of this HCR in terms probabilities associated with maintaining Biomass above B_{lim} *and ensuring continuous SSB growth. SC should provide SSB and associated catch trajectories for 5 / 10 / 15 years. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above* B_{lim}.

Harvest Control Rule:
a) When SSB is below Blim:
i. no directed fishing, and
ii. bycatch should be restricted to unavoidable bycatch in fisheries directing for other species
b) When SSB is above Blim:
*If P y+1 > 0.9 Then Fy+1 = F0.1 * Py+1*
Else
Fy+1 = 0

*TACy+1 = B y+1 * Fy+1*

Where:
Fy+1 = Fishing mortality to project catches for the following year.
Py+1 = Probability of projected Spawning Stock Biomass to be above Blim.
B y+1 = Exploitable biomass projected for the following year.

Scientific Council responded to item 7 and 8 together.

For Div. 3NO cod:

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

For Div. 3LNO American plaice:

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

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

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

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

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

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

vi) Full assessment of Div. 3LNO American plaice in accordance with the rebuilding plan (Item 9)

The Fisheries Commission requests the Scientific Council to conduct a full assessment of 3LNO American Plaice and provide advice in accordance to the rebuilding plan currently in place.

Scientific Council responded:

American plaice in Div. 3LNO

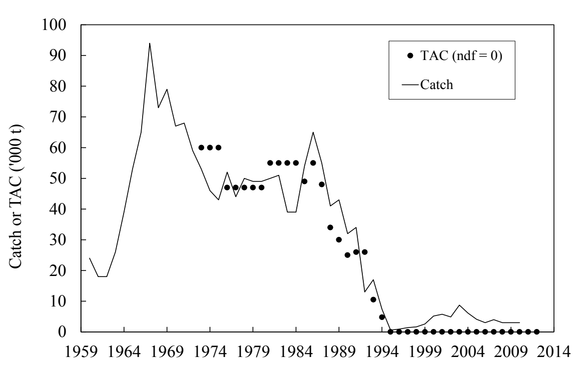
Recommendation: SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11). Scientific Council therefore recommended that in accordance with the rebuilding plan, there should be no directed fishing on American plaice in Div. 3LNO in 2013 and 2014.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

Background: Historically, American plaice in Div. 3LNO has comprised the largest flatfish fishery in the Northwest Atlantic.

Fishery and Catches: In most years the majority of the catch has been taken by offshore otter trawlers. There was no directed fishing in 1994 and there has been a moratorium since 1995. Catches increased after the moratorium until 2003 after which they began to decline. This year, STACFIS only had STATLANT 21A available as estimates of catches in 2011. The inconsistency between the information available to produce catch figures used in the previous years' assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessment for this stock.

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

ndf No directed fishing;
na Not available.



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

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

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

Biomass: Despite the increase in biomass since 1995, the biomass is very low compared to historic levels. SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and at the start of 2011 was 34, 000 t. B_{lim} for this stock is 50 000 t.

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

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

State of the Stock: During the previous assessment in 2011, Scientific Council concluded that: the stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below B_{lim}. Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987–1990 year classes but well below the long-term average. The 2012 assessment does not indicate a change in the status of the stock, based on last year's analytical model and the 2011 survey results.

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

Short Term Considerations: Simulations were carried out in 2011 to examine the trajectory of the stock under 3 scenarios of fishing mortality: F = 0, $F = F_{2010}$ (0.11), and $F_{0.1}$ (0.16).

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

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

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

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

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

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

vii) Examine links between decline of shrimp and recovery of cod and reduction of redfish in Div. 3M (Item 10)

On the Flemish Cap, there seems to be a connection between the most recent decline of the shrimp stock, the recovery of the cod stock and the reduction of the redfish stock. The Fisheries Commission requests the Scientific Council to provide an explanation on the possible connection between these phenomena. It is also requested that Scientific Council advises on the feasibility and the manner by which these three species are maintained at levels capable of producing a combined maximum sustainable yield, in line with the objectives of the NAFO Convention.

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

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

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

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

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

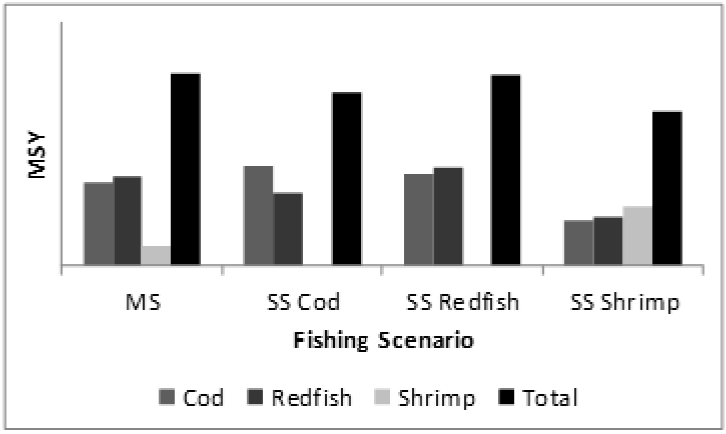


Fig. 2. Illustrative comparison of the MSY for each species and combined under each one of the four MSY scenarios explored.

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

viii) Definition of MSY reference points and a prospective harvest control rule for cod in Div. 3M (Item 11)

Fisheries Commission requests the Scientific Council to define B_{msy} for cod in Division 3M and to propose a Harvest Control Rule (HCR) consistent with the NAFO Precautionary Approach Framework. It also requests the Scientific Council to define the estimated timeframe to reach B_{msy} under different scenarios, consistent with the proposed HCR.

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

ix) Review of bycatch information (Item 12)

The Fisheries Commission requested:

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

The Scientific Council responded:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Species	**Div. 3M**
COD	92%
RED	7%

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

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

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

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

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

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

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

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

x) Trends in biomass and state of the stock for cod in Div. 2J+3KL (Item 13)

For the cod stock in Divisions 2J+3KL, the Scientific Council is requested to comment on the trends in biomass and state of the stock in the most recent Science Advisory Report from the Canadian Science Advisory Secretariat.

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

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

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

Taking note that recent point estimates for Div. 3NO Witch flounder of the Canadian autumn survey are 2–3 times higher than in 1994 when the moratorium was first implemented and are among the highest in the times series, and while more variable, the recent point estimates of the Canadian spring survey are about 50% higher than in 1994.

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

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

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

b) What are plausible reasons for different abundance trends in the spring and autumn surveys of the SAME STRATA, and what are the rationales to support either set of results over the other?

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

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

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

d) What evidence exists (if any) to indicate whether any changes in natural mortality have occurred since the early 1990's, e.g. condition of the fish?

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

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

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

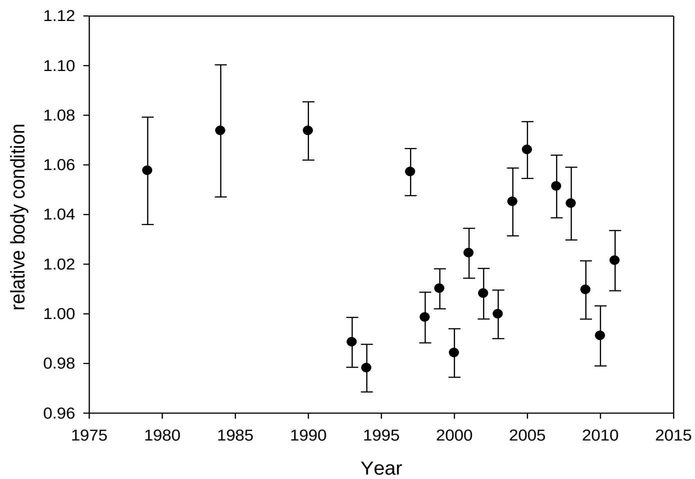


Fig. 3. Relative condition (+ standard error) from spring research vessel survey data for witch flounder in NAFO Div. 3NO.

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

e) Is it plausible there may be a different survey catchability for younger/smaller fish relative to older/larger fish (applicable to witch flounder), and how might this affect our interpretation of stock trends and status?

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

Scientific Council noted there is a recommendation for additional work related to this issue: "STACFIS **recommended** *further investigation of recruitment trends for witch flounder in Div. 3NO.* This should include analysis of trends in abundance in the survey series, as well as examination of areal distribution of small witch flounder, particularly in years where deeper strata are covered by surveys. STACFIS noted that analyses of recruitment will rely on length frequency data, as no ageing has been conducted on this stock since the early 1990s." Analysis has begun on this, but there is no progress to report yet.

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

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

xii) Detailed list of VME Indicator species (Item 15)

As per the recommendation outlined in the report of the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems adopted in September 2011, the Fisheries Commission requests the Scientific Council to produce a detailed list of VME indicator species and possibly other VME elements.

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

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

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

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

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

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

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

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

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

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

xiii) GIS modeling of sponge encounters using VMS data (Item 16)

Given the progress made by Scientific Council on the development of the GIS model for the evaluation of bycatch thresholds for sponges as requested by Fisheries Commission in its 2010 Annual Meeting, and mindful of the need for further refining this modeling framework, as well as exploring its potential utility for its application to other VME-defining species, Fisheries Commission requests the Executive Secretary to provide to the Scientific Council anonymous VMS data in order to further develop the current sponge model as requested by the Fisheries Commission in 2010 and to assess the feasibility of developing similar models for other VME-defining species (e.g. corals).

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

Model Developments

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

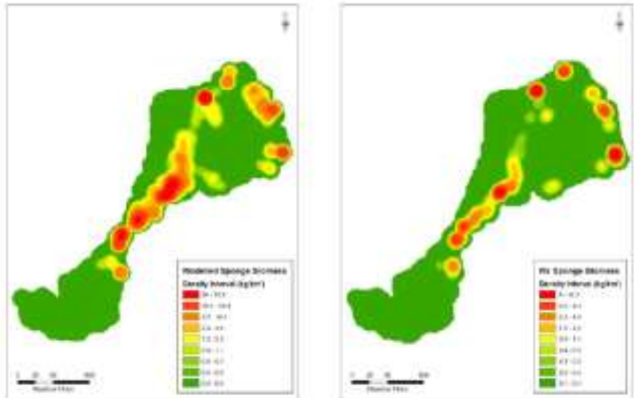


Fig. 4. Sponge biomass (kg/km^2) in the NRA estimated from simulated commercial trawls with random start locations and orientation (left) and from Spanish/EU research vessel catches (right). Note that absolute density values cannot be compared between the two areas due to the different sampling methods.

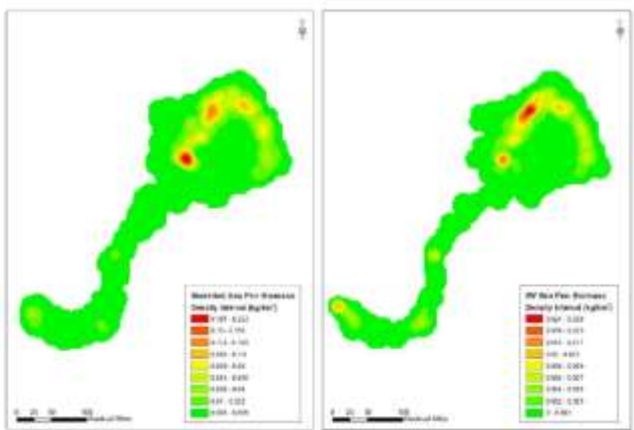
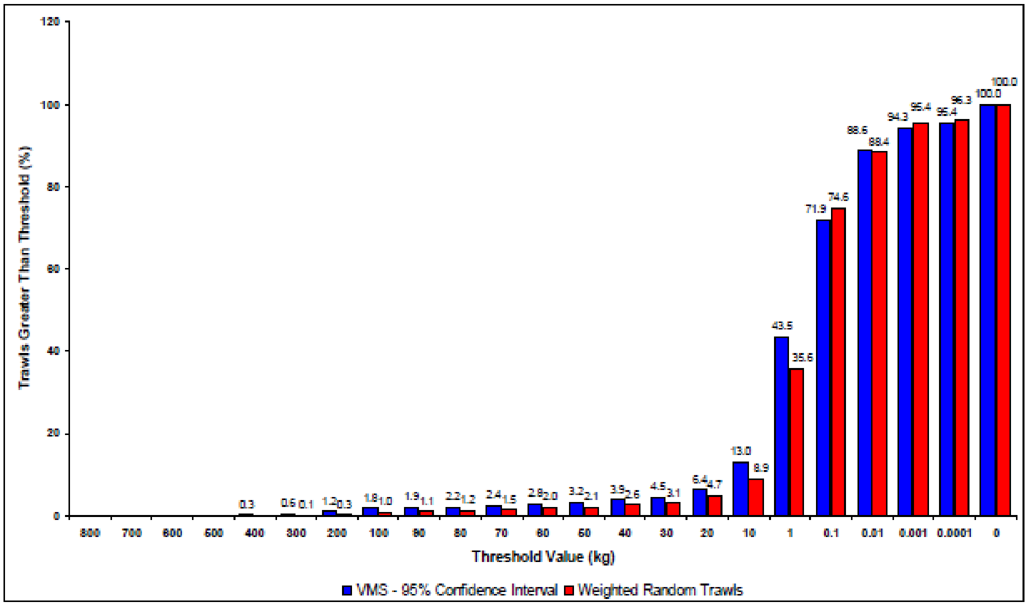


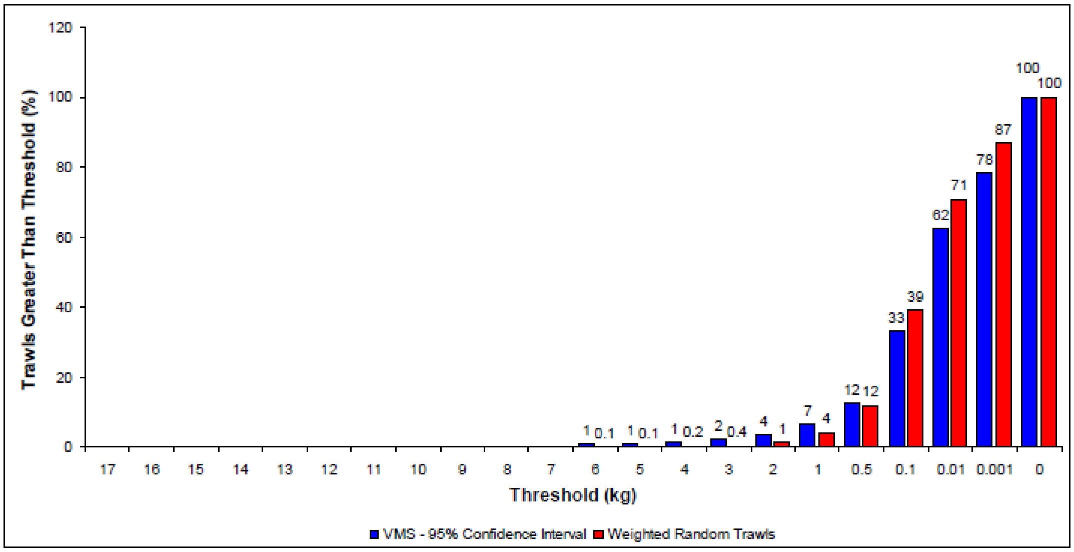
Fig. 5. Sea pen biomass (kg/km2) in the NRA estimated from simulated commercial trawls with random start locations and orientation (left) and from Spanish/EU research vessel catches (right). Note that absolute density values cannot be compared between the two areas due to the different sampling methods.

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



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

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



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

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

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

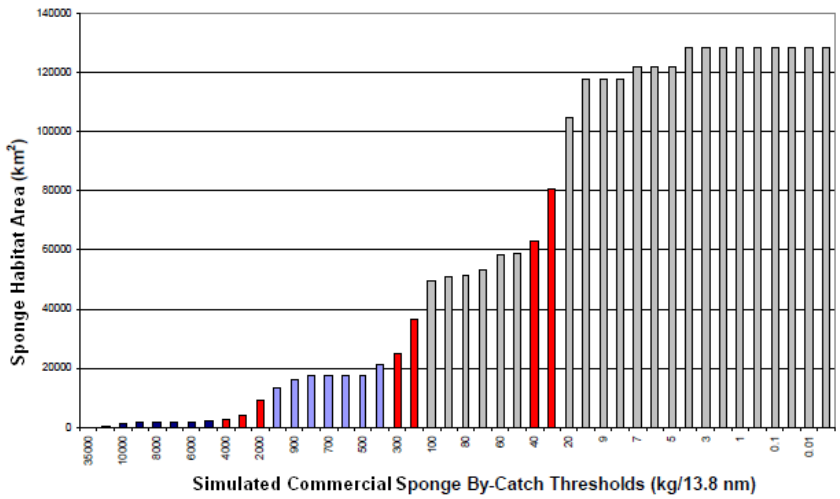


Fig. 8. Sponge habitat area occupied by successive commercial catch thresholds. Red bars indicate the levels where the greatest difference in area occupied occurred between successive catch weight values (greater than 1.3 times the area of the previous threshold). Dark blue bars correspond to the core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

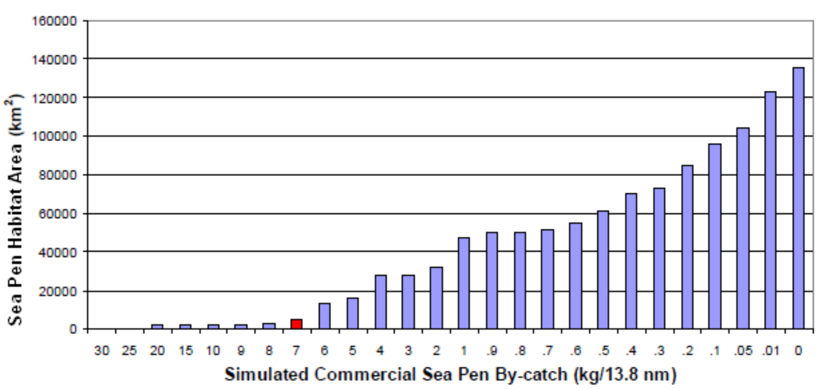


Fig. 9. Sea pen habitat area occupied by successive commercial catch thresholds. Red bars indicate the level where the greatest difference in area occupied occurred between successive catch weight values (≥ 7 kg).

xiv) Encounter thresholds and move on rules (Item 17)

Fisheries Commission requests the Scientific Council to make recommendations for encounter thresholds and move-on rules for groups of VME indicators including sea pens, small gorgonian corals, large gorgonian corals, sponge grounds and any other VME indicator species that meet the FAO Guidelines for VME and SAI. Consider thresholds for 1) inside the fishing footprint and outside of the closed areas and 2) outside the fishing footprint in the NRA, and 3) the exploratory fishing area of sea mounts as applicable.

Scientific Council responded:

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

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

Sponges

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

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

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

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

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

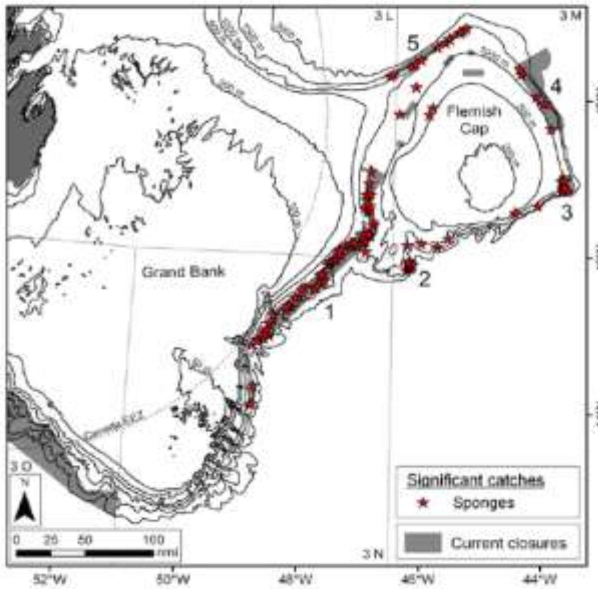


Fig. 10. Map of all significant research vessel trawl sponge catches (> 75 kg) based on Spanish/EU and Canadian bottom trawl groundfish surveys. All areas currently closed to protect significant concentrations of corals and sponges in the Divisions 3LMNO of the NRA are indicated. The numbers 1–5 indicate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

Sea pens

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

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

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

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

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

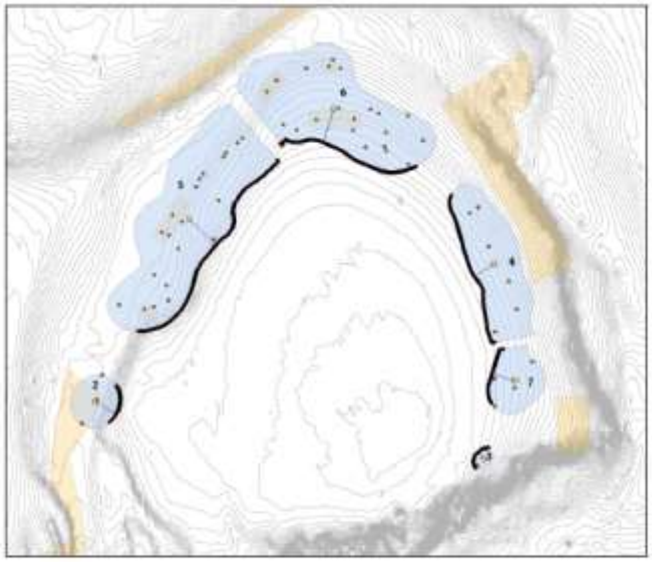


Fig. 11. Location of significant area polygons for sea pens. For each the centroid was calculated (yellow circle) and the distance to the closest edge in shallower water was determined.

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

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

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

Fisheries Commission requested:

Noting Article 4bis - Assessment of bottom fishing of the NAFO Conservation and Enforcement measures. "The Scientific Council, with the co-operation of Contracting Parties, shall identify, on the basis of best available scientific information, vulnerable marine ecosystems in the Regulatory Area and map sites where these vulnerable marine ecosystem are known to occur or likely to occur and provide such data and information to the Executive Secretary for circulation to all Contracting Parties".

Scientific Council responded:

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

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

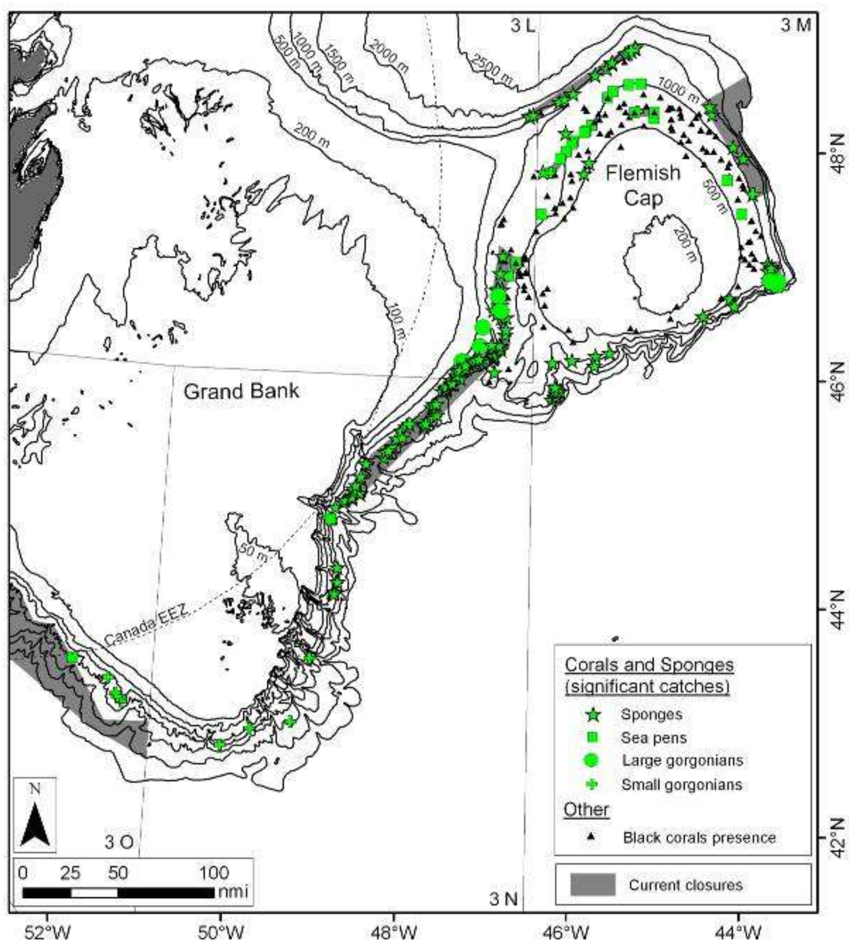


Fig. 12. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch.

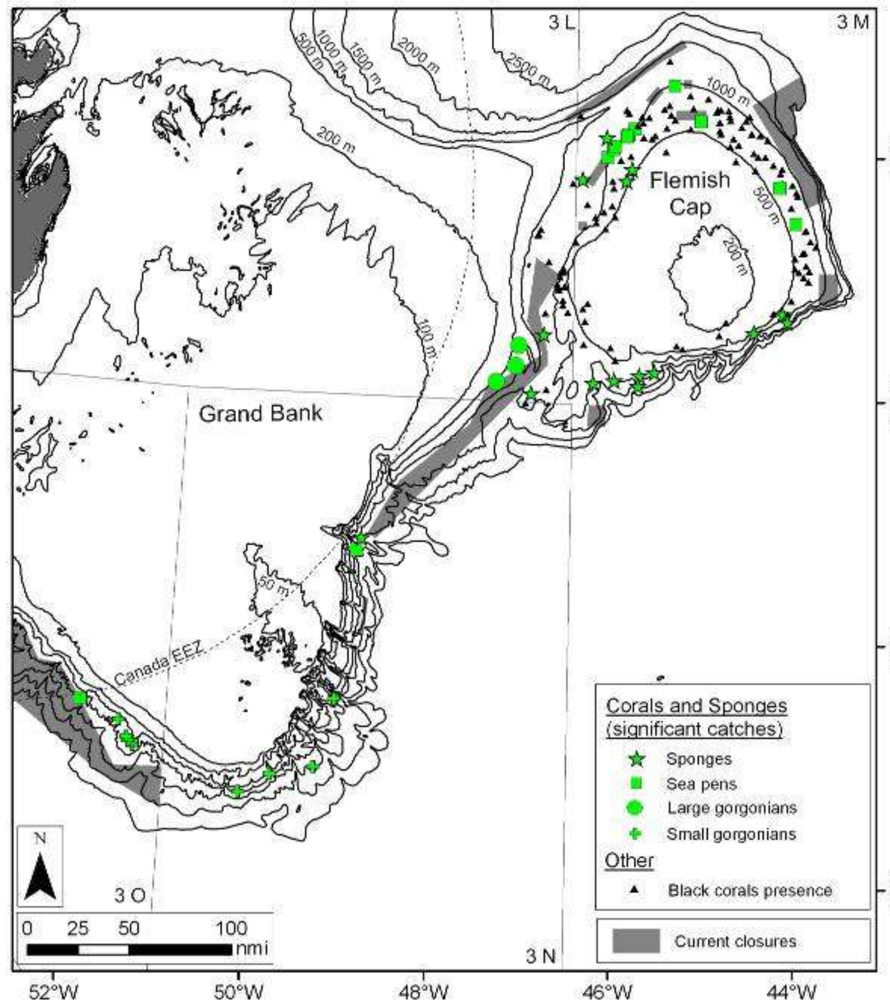


Fig. 13. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch. Data inside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

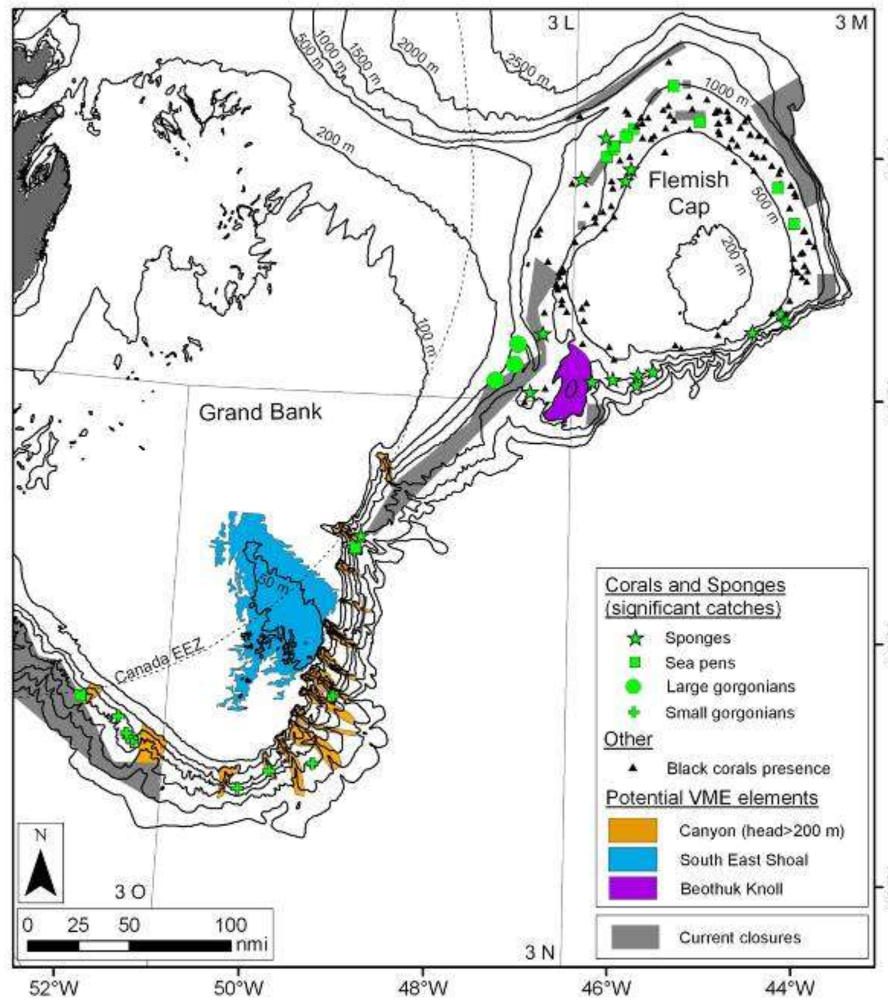


Fig. 14. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch (data inside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

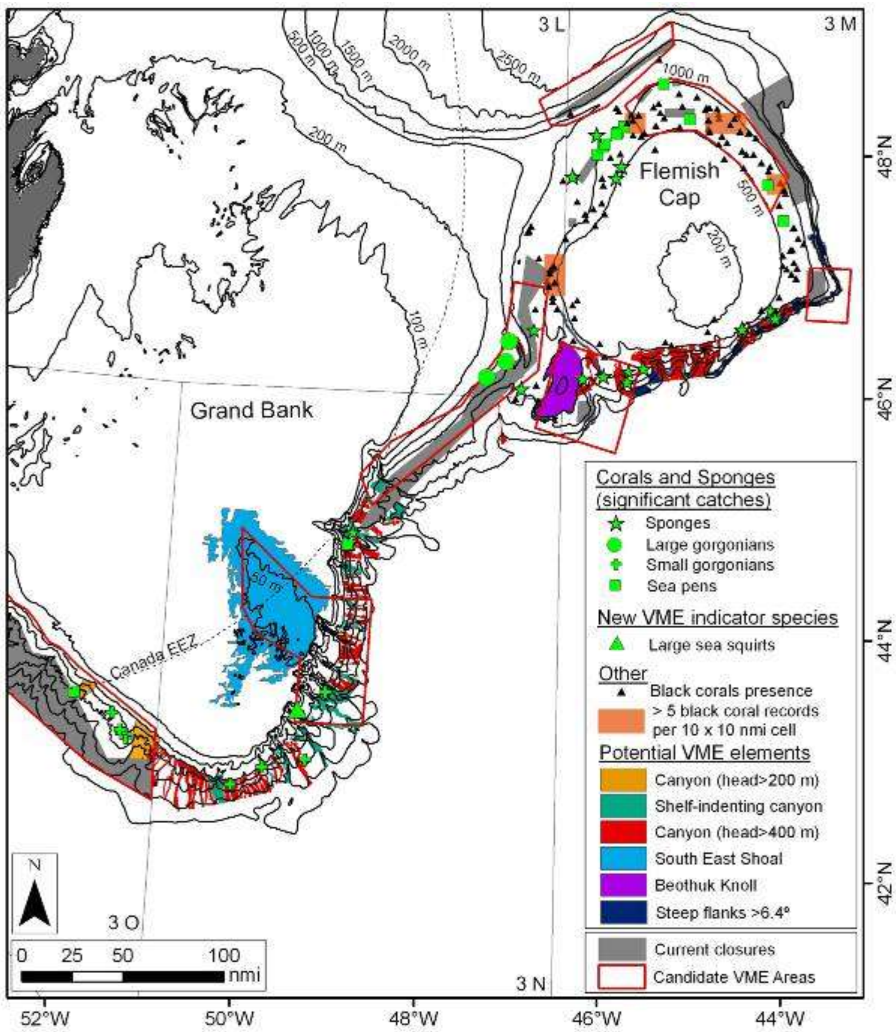


Fig. 15. Location in the NAFO Regulatory Area (Div. 3LMNO) of significant research vessel trawl catches of VME corals and sponges (≥75 kg sponges, ≥ 2 kg large gorgonians, ≥ 0.2 kg small gorgonians, and ≥ 1.6 kg sea pens) and the presence of black corals in the research vessel trawl catch (data inside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

xvi) Development of a work plan for reassessment of VMEs (Item 19)

As stated in the "Reassessment of the Impact of NAFO Managed Fisheries on known or Likely Vulnerable Marine Ecosystems" (NAFO FC WP 11/24), the Scientific Council in collaboration with the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems will conduct a reassessment of NAFO bottom fisheries by 2016 and every 5 years thereafter. In preparation for reassessments, the Fisheries Commission requests the Scientific Council to develop a work plan for completing the initial reassessment and identifying the resources and information to do so.

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

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

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

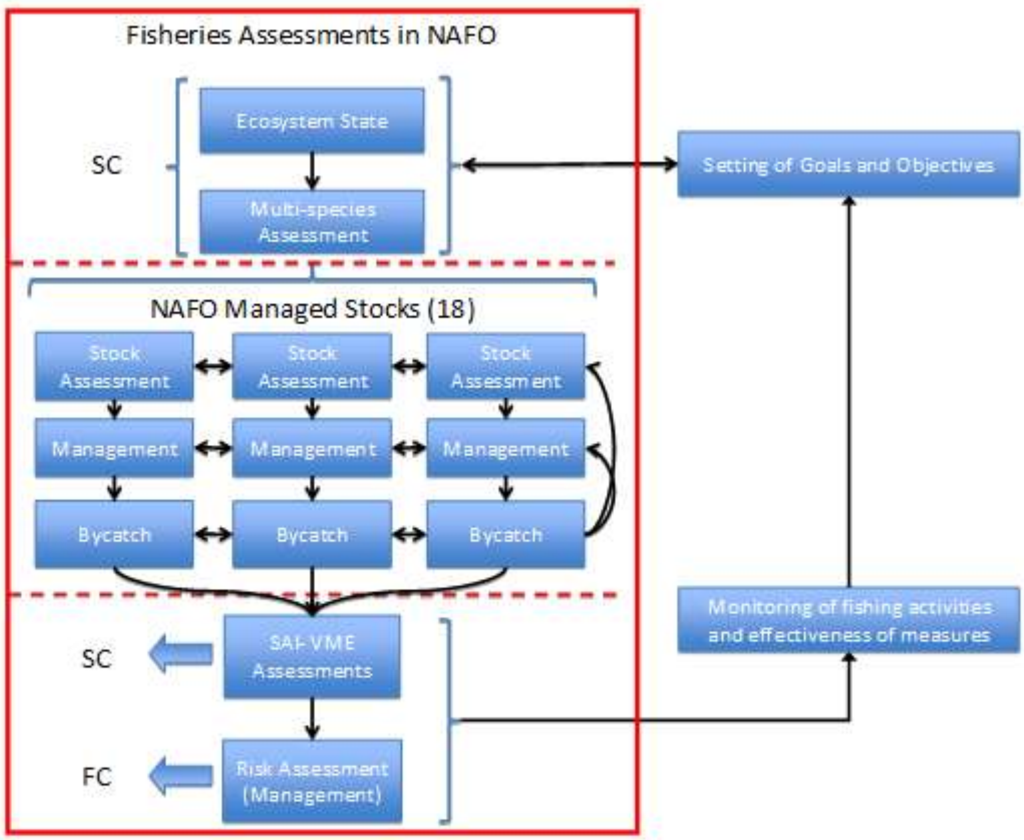


Fig. 16. Schematic representation of the structure and content of SC proposal to develop fisheries assessments. The red rectangle indicates the structure and content for the fisheries assessments themselves, while the boxes outside represent processes/mechanisms to be implemented to transform the static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

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

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

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

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

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

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

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

2. Coastal States

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

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

The Council, is requested to provide an overall assessment of status and trends in the total stock area throughout its range and comment on its management in Subareas 0+1 for 2013, and to specifically advise on appropriate Total Allowable Catch levels for 2013, separately, for Greenland halibut in the offshore area of Divisions 0A+1AB and Divisions 0B+1C–F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.

The Scientific Council responded:

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

Recommendation: Div. 0A+1AB: Considering the increases in TAC from 4 000 t in 2000 to 13 000 t in 2006, the relative stability in biomass and CPUE indices for Greenland halibut in Div. 0A and 1AB Scientific Council advises for Div. 0A and Div. 1A off shore + Div. 1B that the TAC for 2013 remain unchanged and should not exceed 13 000 t.

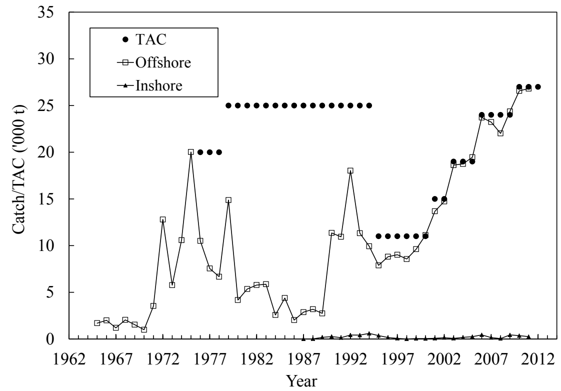
Div. 0B+1C–F: TAC was increased in 2010. The biomass and CPUE indices have been relatively stable. An increase in TAC of 10% or 15% will lead to an increase in Fr (index of fishing mortality) to above the long term mean, therefore an increase in TAC at this time could pose a risk to the sub-stock. Scientific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

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

Fishery and Catches: Due to an increase in offshore effort, catches increased from 3 000 tons in 1989 to 18 000 t in 1992 and remained at about 10 000 t until 2000. Since then catches increased gradually to 26 900 t in 2010 primarily due to increased effort in Div. 0A and in Div. 1A but effort was also increased in Div. 0B and 1CD in 2010. Catches were at the 2010 level in 2011.

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

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

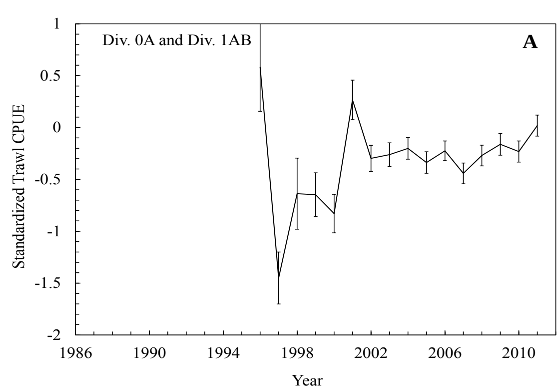


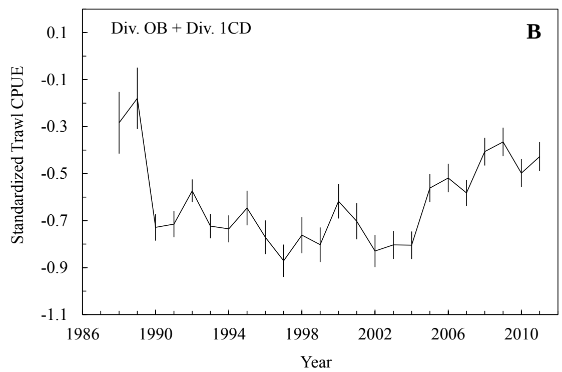
Data: Length distributions were available for assessment from SA0 and SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD. Biomass estimates from deep sea surveys in 2011 were available from Div. 0B and Div. 1CD. Further, biomass and recruitment data were available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

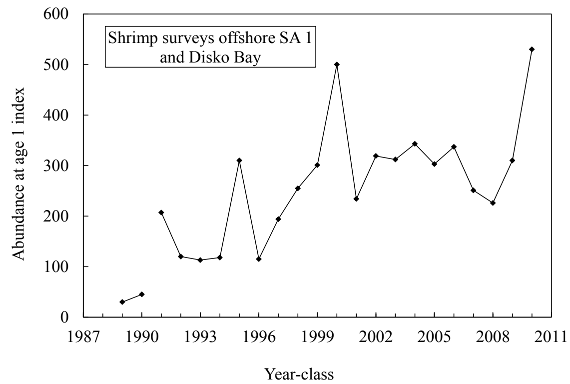
Assessment: No analytical assessment or risk analysis could be performed, therefore only qualitative statements on risk can be provided.

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

The combined Div. 0B and 1CD standardized catch rates have been stable from 2002 to 2004. Since then the standardized catch rates have increased gradually and were in 2009 at the highest level seen since 1989. CPUE decreased in 2010 but increased again in 2011 and is among the highest in the time series.

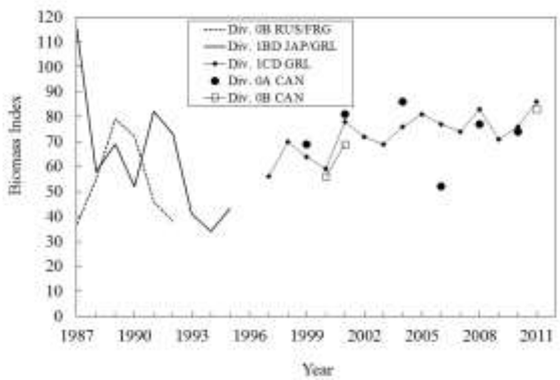






Biomass: The survey biomass index in Div. 0B has increased compared to previous years (2000 and 2001) and was at same level as in Div. 1CD.

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



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

Fishing Mortality: Level not known.

State of the Stock: Div. 0A+1AB: Length compositions in the catches have been stable in recent years. Standardized catch rates have been stable in recent years.

Div. 0B+1C-F: Length compositions in the catches and deep sea surveys have been stable in recent years.

Survey biomass in Div. 1CD and Div. 0B has shown an increasing trend. In Div. 1CD the abundance increased between 1997 and 2001 and has been relatively stable since 2002. In Div. 0B the abundance was lower than in 2001 but higher than in 2000.

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

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

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

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

The next Scientific Council assessment of this stock will be in 2013.

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

ii) Pandalus borealis in Subareas 0 and 1

Scientific Council deferred addressing this request to the September meeting.

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

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

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

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

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

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

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

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

These stocks will next be assessed in 2014.

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

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

Scientific Council responded:

Greenland halibut in Division 1A (inshore)

Recommendation:

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

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

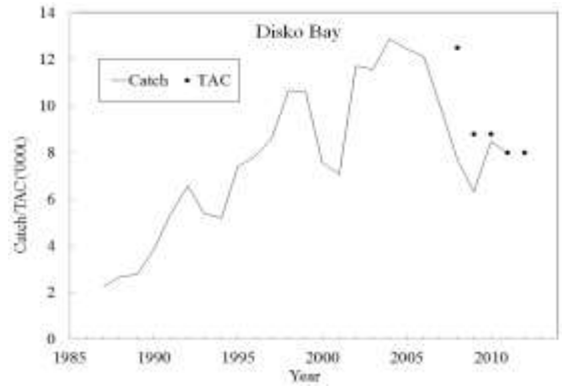
Upernavik: The status of the stock is unclear. Catches have increased substantially since 2002. Scientific Council therefore recommended that there should be no increase in catches beyond the 2009-11 average (6 300 t) in 2013 and 2014.

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

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

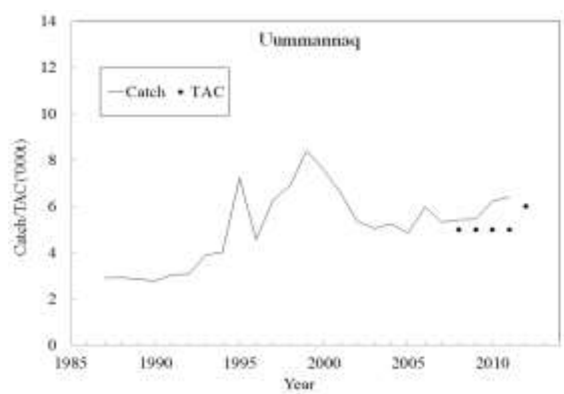
Disko Bay: Landings increased from about 2 000 t in the mid 1980s and peaked in 2004 with more than 12 000 t. From 2006 landings decreased and in 2009 only 6 300 t was landed. However, in 2010 landings increased to 8 500 t and in 2011 8 000 t were landed.

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



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

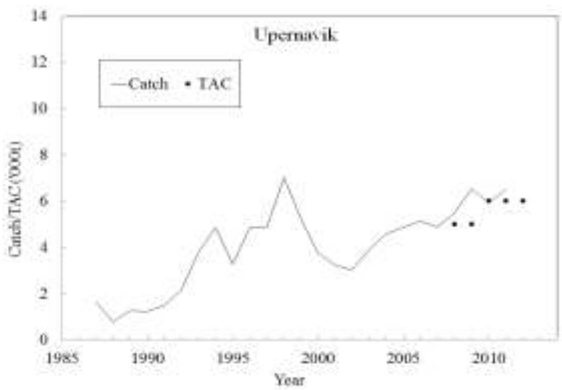
	Catch ('000 t)		TAC ('000 t)	
Year	STACFIS	21	Recommended	Agreed
2009	5.5	-	5.0	5.0
2010	6.2	-	5.0	5.0
2011	6.4	-	5.0	5.0
2012			5.0	6.0



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

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

na - no advice



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

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

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

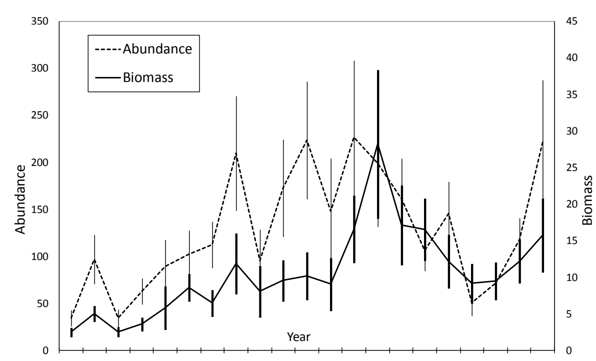
Assessment: No analytical assessment could be performed.

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

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

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

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



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

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

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

State of the stock:

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

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

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

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

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

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

VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

1. Scientific Council, September 2012

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

2. Scientific Council, October 2012

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

3. Scientific Council, June 2013

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

4. Scientific Council, September 2013

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

5. Scientific Council, October 2013

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

6. NAFO/ICES Joint Groups

a) NIPAG, 2012

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

b) NIPAG, 2013

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

c) WGDEC, 2013

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

d) WGHARP

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

7. Scientific Council Working Groups

a) WGEAFM

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

b) WGRP

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

IX. ARRANGEMENTS FOR SPECIAL SESSIONS

1. Topics for Future Special Sessions

a) Joint ICES – NAFO Gadoid Symposium

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The objectives of the conference are to:

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

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

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

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

c) Chilean Observer Conference

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

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

d) Ecosystem Effects of Bottom Fishing

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

X. MEETING REPORTS

1. Working Group on EAFM, December 2011

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

WGEAFM currently operates within a set of long-term Themes and Terms of Reference (ToR) which are being systematically addressed by the group over several meetings. These Themes and ToRs build on the "*Roadmap for Developing an Ecosystem Approach to Fisheries for NAFO*" (Roadmap to EAF).

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

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

Theme 1: Spatial considerations

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

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

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

ToR 1.3. [FC Request # 18] Development of a comprehensive map of the location of VME indicator species and elements in the NRA as defined in the FAO International Guidelines for the Management of Deep Sea Fisheries in the High Seas. This includes canyon heads and spawning grounds and any other VME not protected by the current closures to protect coral and sponge.

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

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

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

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

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

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

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

Theme 3: Practical application of ecosystem knowledge to fisheries management

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

ToR 4.1. [FC Requests # 16 & 17]. Implement and/or further refine the existing GIS simulation/modelling framework, in conjunction with the VMS data supplied by the NAFO Secretariat [FC Request #16], to make recommendations on encounter thresholds and move on rules for groups of VME indicators including sea pens, small gorgonian corals, large gorgonian corals, sponge grounds and any other VME indicator species that meet the FAO Guidelines for VME and SAI. Consider thresholds for 1) inside the fishing footprint and outside of the closed areas and 2) outside the fishing footprint in the NRA, and 3) for the exploratory fishing area of seamounts if applicable.

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

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

Theme 4: Specific requests

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

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

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

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

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

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

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

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

It was proposed that the 5th WGEAFM meeting take place 21-30 November, 2012 at the NAFO Secretariat in Dartmouth, NS, Canada, and that it should continue addressing the long-term ToRs described as:

Theme 1: Spatial considerations

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

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

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

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

Theme 3: Practical application of ecosystem knowledge to fisheries management

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

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

Theme 4: Specific requests

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

More specifically, work during the 5th WGEAFM meeting is proposed to be focused on:

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

It is expected that updates from the NEREIDA project, as well as other surveys, will become available; these new studies will be presented and discussed under this ToR. Other elements to be discussed may include modeling VME distribution using habitat characteristics, as well as analyses of distribution of benthic communities.

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

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

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

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

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

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

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

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

Scientific Council considerations

Scientific Council welcomed the progress made by WGEAFM, and approved the plans for the next meeting 21 – 30 November, 2012 at the NAFO Headquarters.

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

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

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

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

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

(SCS Doc. 12/02)

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

3. Report from WGDEC, Mar 2012

(SCS Doc. 12/18)

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

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

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

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

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

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

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

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

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

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

Recommendations to ICES

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

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

ii. information on gear type;

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

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

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

4. WGRP

(SCS Doc 12/16)

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

5. WGHARP

(SCS Doc. 12/17)

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

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

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

6. WGNARS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7. Meetings Attended by the Secretariat

a) GIS Symposium

George Campanis (IT Manager, NAFO Secretariat) was invited to attend the Fifth International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences in Wellington, New Zealand, 22-26 August. George presented information on the use of VMS data to support management decisions in the NAFO Regulatory Area. In particular, he presented the methods used to delineate NAFO's fishing footprint, and how VMS data are being used to model bycatch thresholds for the management of VME species in the NRA.

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

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

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

b) FAO VME Database Workshop

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

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

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

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

c) CWP

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

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

d) FIRMS

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

e) Science Sustainability Forum

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

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

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

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

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

f) World Fisheries Congress

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

XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

1. Performance Assessment Recommendations to Scientific Council

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

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

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

3. General Plan of Work for September 2012 Annual Meeting

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

4. Other Matters

a) ICES Greenland Halibut Benchmark Process

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

b) ICES Request regarding SA 1 (inshore) cod

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

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

XII. OTHER MATTERS

1. Designated Experts

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

2. Stock Assessment Spreadsheets

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

3. Meeting Highlights for the NAFO Website

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

4. Scientific Merit Awards

No nominations were received.

5. Budget Items

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

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

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

6. Other Business

a) Quality of catch information for assessments

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

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

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

XIII. ADOPTION OF COMMITTEE REPORTS

The Council, during the course of this meeting, reviewed the Standing Committee recommendations. Having considered each recommendation and also the text of the reports, the Council **adopted** the reports of STACFEN, STACREC, STACPUB and STACFIS. It was noted that some text insertions and modifications as discussed at this Council plenary will be incorporated later by the Council Chair and the Secretariat.

XIV. SCIENTIFIC COUNCIL RECOMMENDATIONS TO GENERAL COUNCIL AND FISHERIES COMMISSION

The Council Chair undertook to address the recommendations from this meeting and to submit relevant ones to the General Council and Fisheries Commission.

XV. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 16 June 2011, the Council considered the draft report of this meeting, and adopted the report with the understanding that the Chair and the Secretariat will incorporate later the text insertions related to plenary sessions of 3-16 June 2011 and other modifications as discussed at plenary.

XVI. ADJOURNMENT

The Chair thanked the participants for their hard work and cooperation, noting particularly the efforts of the Designated Experts and the Standing Committee Chairs. The Chair thanked the Secretariat for their valuable support and the Alderney Landing for the excellent facilities. There being no other business the meeting was adjourned at 1300 hours on 16 June 2011.

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

Chair: Gary Maillet Rapporteur: Eugene Colbourne

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, Nova Scotia, Canada, on 4 and 13 June 2012, to consider environment-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Greenland), European Union (France, Germany, Portugal, Estonia, Latvia, Lithuania and Spain), Japan, Russian Federation and USA.

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

- The North Atlantic Oscillation index (NAO), a key indicator of climate conditions over the North Atlantic was negative resulting in weak arctic air outflow and warmer air temperatures during winter 2010/2011 over the NAFO Convention Area.
- In contrast, annual temperature over Southwest Greenland waters was slightly below normal in 2011, reflecting lower mean air temperatures than normal from spring onwards.
- The Labrador Sea experienced warm winter surface air temperatures from approximately 6°C above normal in the northern region near Davis Strait to about 2°C above normal in the southeastern Labrador Sea in 2011.
- Sea surface temperature anomaly was more than +5°C in the Labrador Sea during the winter of 2011 but close to normal throughout the remainder of the year.
- In 2011, wintertime convection in the Labrador Sea was limited to the upper 200 m of the water column, which is very similar to that observed in 2010 and well below normal.
- Sea ice anomalies in the Labrador Sea were negative (below 50% of normal) in January 2011 and remained well below the long-term means for the remainder of the ice season.
- The above normal air temperatures experienced over Newfoundland and Labrador in 2010 decreased significantly in 2011, but remained above normal by <1 Standard Deviation (SD).
- The annual sea ice extent on the NL Shelf remained below normal for the 16th consecutive year reaching a record low in 2011.
- Only three icebergs were detected south of 48°N on the Northern Grand Bank, compared to one in 2010, substantially fewer than the 1981-2010 mean of 767.
- Annual water column averaged temperature at Station 27 off southeastern Newfoundland increased to a record high in 2011 at 3 SD above the long-term mean.
- Station 27 annual bottom temperatures (176 m) were also at a record high at 3.4 SD (1.3°C) above normal.
- Near-surface summer temperatures in the inshore regions along the east coast of Newfoundland were 1-2 SD below normal.
- The annual stratification index at Station 27 decreased to 2 SD below normal, the lowest since 1980.
- The area of the cold intermediate layer (CIL) water mass (<0°C) on the eastern Newfoundland Shelf was at a record low value at 2 SD below normal.
- Spring bottom temperatures across the Div. 3Ps-3LNO region were at a record high in 2011 at about 2 SD above normal.

- Autumn bottom temperatures in Div. 2J and 3K were also at a record high value, at 2 and 2.7 SD above normal, respectively.
- A composite climate index derived from 27 meteorological, ice and ocean temperature and salinity time series show a peak in 2006, a declining trend in 2007-09 and a sharp increase in 2010 and 2011 to the 2nd and 4th highest, respectively, indicating warmer than normal conditions throughout the region.
- Air temperatures on the Scotian Shelf and adjacent offshore areas remained above normal by 1-2 SD but decreased over 2010 values.
- Ice coverage and volume on the Scotian Shelf was the third lowest in the 43 year long record in 2011.
- The climate index, a composite of 18 selected, normalized time series, averaged +0.9 SD with 17 of the 18 variables more than 0.5 SD above normal in 2011.
- Bottom temperatures were above normal in 2011 with anomalies for NAFO Div. 4Vn, 4Vs, 4W, 4X of +0.7°C (+1.6 SD), +0.8°C (1.1 SD), +0.3°C (+0.3 SD), and +0.5°C (+0.6 SD) respectively.
- The volume of the CIL on the Scotian Shelf, defined as waters with temperatures <4°C, was 0.6 SD less than the long-term mean in 2011 and similar to that observed in the previous two years.
- Stratification on the Scotian Shelf in 2011 weakened significantly compared to 2010; obtaining a value near that seen in 2002 and a record low since 1986.
- Nitrate inventories were generally above normal within the upper 50m from the Grand Banks extending down to the Scotian Shelf, with near-normal levels observed in the northeast Newfoundland Shelf and southern Labrador Shelf in 2011.
- In contrast, deeper inventories of nitrate that represent the main limiting nutrient for the following year showed a large reduction in 2011 across the region.
- Seasonal monitoring of ocean sections and coastal stations, which provide information throughout the water column, revealed enhanced phytoplankton standing stocks along the eastern and central Scotian Shelf in 2011.
- Coherent trends in the time series of composite satellite indices from 1998 to 2011 were observed between the northern and southern Subareas which suggest the importance of large-scale physical forcing.
- Enhanced abundance of large and small copepods as well as total copepod zooplankton was observed for the northern Subareas in 2011 with 1 to >2 SD above normal, in contrast to 1 to 3 SD below normal across the Scotian Shelf.
- The zooplankton dry weight anomalies were generally below normal across NAFO Subareas 2 to 4 in 2011.

1. Opening

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

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

2. Appointment of Rapporteur

Eugene Colbourne (Canada) was appointed rapporteur.

3. Adoption of the Agenda

The provisional agenda was adopted with no further modifications.

4. Review of Recommendations in 2011

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

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

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

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

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

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

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

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

5. Invited Speaker

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

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

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

- Similar trends and patterns were observed for a number of different stocks across NW Atlantic
- Results illustrate important role of environment of ecosystem dynamics, in addition to fishing exploitation and tropho-dynamic interactions

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

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

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

(SCR Doc. 12/13)

Since 1975, MEDS, now ISDM, has been the regional environmental data centre for ICNAF and subsequently NAFO and as such is required to provide an inventory of all environmental data collected annually by contracting countries of NAFO within the convention area. A review of the ISDM Report for 2011 was presented in **SCR Doc. 12/13**. ISDM is the Regional Environmental Data Center for NAFO and is required to provide an annual inventory of environmental data collected in the NAFO regulatory area to the NAFO Standing Committee on Fisheries Environment (STACFEN). In order for ISDM to carry out its responsibility of reporting to the Scientific Council, the Designated National Representatives are requested to provide ISDM with all marine environmental data collected in the Northwest Atlantic for the preceding years. Provision of a meaningful report to the Council for its meeting in June 2012 required the submission to ISDM of a completed oceanographic inventory form for data collected in 2011, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2011. The data of highest priority are those from the standard sections and stations. Inventories and maps of physical oceanographic observations such as ocean profiles, surface thermosalinographs, drifting buoys, currents, waves, tides and water level measurements for the calendar year 2011 are included. This report will also provide an update on other ISDM activities during 2011. Data that have been formatted and archived at ISDM are available to all members on request. Requests can be made by telephone (613) 990-0243, by e-mail to isdm-gdsi@dfo-mpo.gc.ca, by completing an on-line order form on the ISDM web site at www.meds-sdmm.dfo-mpo.gc.ca/meds/Contact_US/Request_e.asp or by writing to Services, Integrated Science Data Management (ISDM), Dept. of Fisheries and Oceans, 12th Floor, 200 Kent St., Ottawa, Ont. Canada K1A 0E6.

Highlights of the Integrated Science Data Management Report for 2011:

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

i) Hydrographic Data Collected in 2011

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

ii) Historical Hydrographic Data Holdings

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

iii) Thermosalinograph Data

A number of ships have been equipped with thermosalinographs to collect surface temperature and salinity data while the vessels are under way. These are transmitted as station data via satellite and radio links. In 2011, ISDM received surface temperature and salinity data from 1270 discrete stations.

iv) Drifting Buoy Data

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

v) Wave Data

During 2011, ISDM continued to process and archive operational surface wave data on a daily basis around Canada. One-dimensional and directional wave spectra, calculated variables such as the significant wave height and peak period, concurrent wind observations, if reported, and the raw digital time series of water surface elevations were stored. A total of 19 wave buoy stations were operational in the NAFO area during 2011.

vi) Tide and Water Level Data

ISDM continued to process and archive operational tides and water level data that were reported on a daily to monthly basis from the Canadian water level network. ISDM archived observed heights with up to a 1-minute sampling interval, hourly heights and monthly instantaneous extremes collected around Canada. Approximately 1.8 million new readings were updated every month from the Canadian permanent gauge network. The historical tides and water level data archives presently holds over 600 million digital records with the earliest dating back before the turn of the century. Data from 96 tide and water level gauges were processed during 2011 with 26 in the NAFO region. The data is quality controlled using ISDM software and is available for download from ISDM web site: www.isdm.gc.ca/isdm-gdsi/twl-mne/index-eng.htm.

vii) Current Meter Data

In 2011, the Bedford Institute of Oceanography (BIO) recovered and processed data from 7 current meters instruments in the NAFO area. An additional 29 instruments were recovered with data that requires further processing. Data and products are available from BIO at: www.mar.dfo-mpo.gc.ca/science/ocean/database/data_query.html.

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

Subareas 0 and 1. A review of meteorological, sea ice and hydrographic conditions in West Greenland in 2011 was presented in **SCR Doc. 12/02, 12/08** and **SCS Doc. 12/10, 12/13**. In winter 2010/11, the North Atlantic Oscillation (NAO) index was negative describing weakening westerlies over the North Atlantic Ocean. Often this results in warmer conditions over the West Greenland region which was also the case for this winter. The air temperature was higher than normal during winter – especially over the Davis Strait. Time series of mid-June temperatures on top of Fylla Bank show temperatures 0.4°C above average conditions in 2011 and the salinity was 0.2 above average. The presence of Irminger Water in the West Greenland waters was high in 2011. Pure Irminger Water (waters of Atlantic origin) could be traced north to the Maniitsoq section and modified Irminger Water further north to the Sisimiut section. The mean (400–600 m) temperature and salinity was high over the Southwest Greenland Shelf Break. After one single year of decrease, the bottom temperature and salinity off Ilulissat in the Disko Bay has increased again to high values comparable with values observed before mid-1990's. The annual mean air temperature at Nuuk Weather Station was -1.13°C, down from the historic high value observed in the previous year and similar to conditions in 2009. The uppermost layer of the Cape Desolation Station 3 in fall 2011 was occupied by relative fresh surface Polar Water in contrast to the previous two years when no Polar Water was observed there. The water temperature between 100 and 700 m depth was warmer than its long-term mean, and thus continued the series of 'warmer than normal' years started in 1998. Fyllas Bank Station 4 was characterized in fall 2011 by a negative potential temperature anomaly within the uppermost 50 to 100 m and a positive temperature anomaly between 100 and 700 meter water depth. The salinity of Irminger Sea Water at Station 4 was slightly above its long term mean.

Subareas 1 and 2. A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2011 was presented in **SCR Doc. 12/18**. Following the trend of the last three years, the Labrador Sea experienced warm winter surface air temperatures in 2011; temperatures ranged from approximately 6°C above normal in the northern region near Davis Strait to about 2°C above normal in the southeastern Labrador Sea. Sea surface temperature anomaly was more than 5°C in the Labrador Sea during the winter of 2011 but close to normal throughout the remainder of the year. In 2011, wintertime convection was limited to the upper 200 m of the water column, which is very similar to that observed in 2010. Sea ice anomalies were very negative (below 50% of normal) in January 2011 and remained well below the normal long-term mean for the rest of the winter. While the upper layer (10-150m) demonstrates a strong trend of increasing temperature since the mid-1990s, the trend in salinity is much weaker. In the layer impacted by convection (20-2000m), there is a strong increasing trend in both temperature and salinity since the mid-1990s. A strong contrast is observed between the Atlantic Zone Off-Shelf Monitoring Program (AZOMP) 1994 and 2011 surveys of temperature, salinity, density and dissolved oxygen.

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

The NAO index, is a key indicator of climate conditions on the Newfoundland and Labrador Shelf, and after reaching a record low in 2010, remained in the negative phase in 2011. As a result, arctic air outflow to the Newfoundland and Labrador Region remained weak resulting in warmer conditions in most areas in 2011. Annual air temperatures remained above normal at Labrador by 0.7 SD (0.9°C at Cartwright) and at Newfoundland by 0.6 SD (0.5°C at St. John's) but declined significantly from the record highs of 2010. The annual sea ice extent on the NL Shelf remained below normal for the 16th consecutive year reaching a record low in 2011. As a result of these and other factors, local water temperatures on the NL Shelf remained above normal, setting new record highs in some areas. Salinities on the NL Shelf were lower than normal throughout most of the 1990s, increased to above normal during most of the past decade but decreased to fresher-than-normal conditions in many areas from 2009-2011. At a standard coastal monitoring site off eastern Newfoundland (Station 27), the depth-averaged annual water temperature increased to a record high in 2011 at 3 SD above the long-term mean. Annual surface temperatures at Station 27 were above normal by 0.6 SD (0.4°C) while bottom temperatures (176 m) were at a record high at 3.4 SD (1.3°C) above normal. The annual depth-averaged salinities at Station 27 were below normal for the 3rd consecutive year. The annual stratification index at Station 27 decreased to 2 SD below normal, the lowest since 1980. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C on the eastern Newfoundland Shelf (Bonavista Section) during the summer of 2011 was at a record low value at 2 SD below normal, implying warm conditions, while off southern Labrador it was the 4th lowest at 1.5 SD below normal. On the Grand Bank the CIL area was the second lowest on record. The volume of CIL (<0°C) water on the NL shelf during the fall was below normal (4th lowest since 1980) for the 17th consecutive year. Average temperatures along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. All spring bottom temperature measurements in NAFO Divs. 3Ps and 3LNO during 2011 were above 0°C and up to 1°-2°C higher than normal. The gridded average bottom temperature across the 3Ps-3LNO region was at a record high. During the fall, bottom temperatures in Div. 2J and 3K were also at a record high value, at 2 and 2.7 SD above normal, respectively, and in 3LNO they were 1.8 SD above normal. Generally, bottom temperatures were about 1°-2°C above normal in most regions, with very limited areas of the bottom covered by <0°C water. A composite climate index derived from 27 meteorological, ice and ocean temperature and salinity time series show a peak in 2006, a declining trend in 2007-09 and a sharp increase in 2010 and 2011 to the 2nd and 4th highest, respectively, indicating warmer than normal conditions throughout the region.

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

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

Subareas 4-6. Several on-going oceanographic, plankton and benthic studies conducted by the Northeast Fisheries Science Centre (NEFSC) in NAFO Subareas 4 through 6 presented in **SCS Doc. 12/07**. A total of 1839 CTD (conductivity, temperature, depth) profiles were collected and processed on Northeast Fisheries Science Center (NEFSC) cruises during 2011. Of these 1810 were obtained in NAFO Subareas 4, 5, and 6. These data are archived in an oracle database. Cruise reports, annual hydrographic summaries, and data are accessible at: http://www.nefsc.noaa.gov/epd/ocean/MainPage/index.html. Additional water temperature measurements from the EMOLT (see emolt.org) project from 60 fixed stations around the Gulf of Maine and southern New England Shelf revealed that 2011 was one of the warmest years in the last decade. During 2011, zooplankton community distribution and abundance were monitored on five surveys using 575 bongo net tows. Each survey covered all or part of the continental shelf from Cape Hatteras northward, up through the Mid-Atlantic Bight, across Southern New England waters and Georges Bank, and the Gulf of Maine.

8. Interdisciplinary Studies

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

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

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

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

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

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

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

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

In 2003 STACFEN began production of an annual climate status report to describe environmental conditions during the previous year. This web-based annual summary for the NAFO area includes an overview that summarizes the overall general climate changes for the previous year and a regional overview that provided climate indices from each of the Subareas. The climate summary will be updated by the NAFO Secretariat on an annual basis with contributions from each contracting country. Information for 2011 are available from Subareas 1, West Greenland , Subareas 2-3, Grand Banks and Labrador Sea / Shelf , Subareas 4-5, Scotian Shelf and Gulf of Maine , and Subareas 5-6, Georges Bank and Gulf of Maine.

10. The Formulation of Recommendations Based on Environmental Conditions

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

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

11. National Representatives

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

12. Other Matters

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

13. Adjournment

Upon completing the agenda, the Chair thanked the STACFEN members for their excellent contributions, the Secretariat and the rapporteur for their support and contributions. Special thanks again to our invited speaker Dr. Alida Bundy (Bedford Institute of Oceanography, Fisheries and Oceans Canada), and contributions to the interdisciplinary session including Alejandro Buren (Memorial University), Carina Gjerdrum (Environment Canada), and Robert Branton (Dalhousie University).

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

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

Chair: Margaret Treble Rapporteur: Alexis Pacey

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, NS, Canada, on the 2 and 13 June 2012, to consider publication-related topics and report on various matters referred to it by the Scientific Council. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (France, Germany, Spain, Portugal, United Kingdom), Japan, Russian Federation, Ukraine, and the United States of America. The Scientific Council Coordinator was in attendance as were other members of the Secretariat staff.

1. Opening

The Chair opened the meeting at 09:00 hours by welcoming the participants.

2. Appointment of Rapporteur

Alexis Pacey (NAFO Secretariat) was appointed rapporteur.

3. Adoption of Agenda

The Agenda as given in the Provisional Agenda distributed prior to the meeting was adopted with the addition of item 6a, ICNAF Document Digitization, and 6d, Size of the Scientific Council Reports.

4. Review of Recommendations in 2011

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

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

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

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

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

STATUS: This has been implemented.

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

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

5. Review of Publications

a) Annual Summary

i) Journal of Northwest Atlantic Fishery Science (JNAFS)

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

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

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

ii) NAFO Scientific Council Studies

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

iii) NAFO Scientific Council Reports

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

iv) Progress report of meeting documentation CD

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

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

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

v) Historical Documentation DVD

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

***vi)* ASFA**

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

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

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

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

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

6. Other Matters

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

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

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

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

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

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

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

b) New cover designs for JNAFS

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

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

c) Consistency of formatting styles in JNAFS

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

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

d) Increasing size of the NAFO Scientific Council Reports

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

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

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

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

7. Adjournment

The Chair thanked the participants for their valuable contributions, the rapporteur for taking the minutes and the Secretariat for their support. The meeting was adjourned at 16:30 hours on 13 June 2011.

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

Chair: Don Stansbury Rapporteur: Barbara Marshall

The Committee met at Alderney Landing, 2 Ochterloney Street, Dartmouth, NS, Canada, on various occasions throughout the meeting to discuss matters pertaining to statistics and research referred to it by the Scientific Council. Representatives attended from Canada, Denmark (Greenland), European Union (France, Germany, Portugal and Spain), Russian Federation, Ukraine and United States of America. The Scientific Council Coordinator and other members of the Secretariat were in attendance.

1. Opening

The Chair opened the meeting at 1330 hours on 5 June 2012, welcomed all the participants and thanked the Secretariat for providing support for the meeting.

2. Appointment of Rapporteur

Barbara Marshall was appointed as rapporteur.

3. Review of Recommendations in 2011

From June 2011

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

STATUS: No progress was reported but it was agreed that this should be done. The Chair of STACREC will follow-up with Designated Experts during this June meeting to try to compile a table.

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

STATUS: No progress was reported and it was decided not to pursue this any further.

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

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

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

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

4. Fishery Statistics

a) Progress report on Secretariat activities in 2011/2012

i) STATLANT 21A and 21B

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

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

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

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

5. Research Activities

a) Biological Sampling

i) Report on activities in 2011/2012

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

ii) Report by National Representatives on commercial sampling conducted

Canada-Newfoundland (SCS Doc. 12/14, plus information in various SC documents**):** Information was obtained from the various fisheries taking place in all areas from Subareas 0, 2, 3 and portions of Subarea 4. Information was included on fisheries and associated sampling for the following stocks/species: Greenland halibut (SA 0 + 1 (except Div. 1A inshore), SA 2 + Div. 3KLMNO), Atlantic salmon (SA 2+3+4), Arctic charr (SA 2), Atlantic cod (Div. 2GH, Div. 2J+3KL, Div. 3NO, Subdiv. 3Ps), American plaice (SA 2 + Div. 3K, Div. 3LNO, Subdiv. 3Ps), witch flounder (Div. 2J3KL, 3NO, 3Ps), yellowtail flounder (Div. 3LNO), redfish (Subarea 2 + Div. 3K, 3LN, 3O, Unit 2), northern shrimp (Subarea 2 + Div. 3KLMNO), Iceland scallop (Div. 2HJ, Div. 3LNO, Subdiv. 3Ps, Div. 4R), sea scallop (Div. 3L, Subdiv. 3Ps), snow crab (Div. 2J+3KLNO, Subdiv. 3Ps, Div. 4R), squid (SA 3), thorny skate (Div. 3LNOPs), white hake (Div. 3NOPs), lobster (SA 2+3+4), and capelin (SA 2 + Div. 3KL).

Denmark/Greenland. Length frequencies were available from the Greenland trawl fishery in Div. 1A CPUE data were available from the Greenland trawl fishery in Div. 1AB and 1CD. (SCS Doc. 12/10). Length distributions were available from the inshore long line and gill net fishery in inshore in Div. 1A. CPUE data were available from the inshore longline fishery in Div. 1A

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

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

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

Russian Federation (SCS Doc. 12/05): In SA 1+2 Biological data on Greenland halibut from Div.1AD were collected by observers aboard Russian fishing vessels. In SA 3 biological data were collected by NAFO observers aboard fishing vessels for Greenland halibut in Div. 3LMN, roughhead grenadier in Div. 3LN, roundnose grenadier in Div. 3L, American plaice in Div. 3LMN, threebeard rockling in Div. 3L, witch flounder in Div. 3LNO, cod in Div. 3LMN, northern wolffish in Div. 3LN, black dogfish in Div. 3LN, thorny skate in Div. 3LMNO, white hake in Div. 3LN, marlin-spike grenadier in Div. 3LNO, Atlantic halibut in Div. 3LN, blue hake in Div. 3LN, deep-water redfish (*Sebastes mentella*) in Div. 3LMN, golden redfish (*Sebastes marinus*) in Div. 3LMNO and Acadian redfish (*Sebastes fasciatus*) in Div. 3LMNO.

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

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

b) Biological Surveys

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

Canada: Research survey activities carried out by Canada (N) were summarized, and stock-specific details were provided in various research documents associated with the stock assessments. The major multispecies surveys carried out by Canada in 2011 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2HJ3KLMNO (SCR 12/19). The spring survey in Div. 3LNOP was conducted from April to late June, and the portion in Div. 3LNO consisted of 490 tows with the Campelen 1800 trawl, by the research vessel *Alfred Needler*. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to December, and consisted of 564 tows with the Campelen 1800 trawl. Two research vessels were used: *Teleost* and *Alfred Needler,* and this survey continued a time series begun in 1977. Additional surveys during 2011, directed at a number of species using a variety of designs and fishing gears, were described in detail in various documents. Results from Canadian oceanographic surveys were discussed in detail in STACFEN.

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

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

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2011. In July-August 216 research trawl hauls were made in the main distribution area of the West Greenland shrimp stock, including areas in Subarea 0 and the inshore areas in Disko Bay and Vaigat. The surveys also provide information on Greenland halibut, cod, demersal redfish, American plaice, Atlantic and spotted wolffish and thorny skate (SCR Doc.12/16).

A Greenland deep sea trawl survey series for Greenland halibut was initiated in 1997. The survey is a continuing of the joint Japanese/Greenland survey carried out in the period 1987-95. In 1997-2011 the survey covered Div. 1C and 1D between the 3 nautical mile line and the 200 nautical mile line or the midline against Canada at depths between 400 and 1 500 m. In 2011 67 valid hauls were made. (SCR Doc. 12/03).

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

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2011 a total of 50 gillnet settings were made along 4 transect. Each gillnet was composed of four panels with different mesh size (46, 55, 60 and 70 mm stretch meshes). No gill net survey in 2009.

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

In 2003 it was decided to extend the Spanish 3NO survey toward Div. 3L (Flemish Pass). In 2011, the bottom trawl survey in Flemish Pass (Div. 3L) was carry out on board R/V *Vizconde de Eza* using the usual survey gear (Campelen 1800) from 10th to 24th of August. The area surveyed was Flemish Pass to depths up 800 fathoms (1463

m) following the same procedure as in previous years. The number of hauls was 90 of which 89 were valid hauls. Survey results, including abundance indices and length distributions of the main commercial species, are presented as Scientific Council Research documents. Survey results for Div. 3LNO of the northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 11/61. Samples for histological (Greenland halibut, American plaice, roughhead grenadier) and aging (Greenland halibut, American plaice, roughhead grenadier and cod) studies were taken. Feeding studies on demersal species (*Synaphobrachus kaupi*, *Notacanthus chemnitzii*, *Hydrolagus affinis* and *Harriotta raleighana*) were performed and 307 stomach contents were analyzed in depths of 342 to 1419 m. Eighty-four hydrographic profile samplings were made in a depth range of 115–1445 m.

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

USA (SCS Doc. 12/07): The USA Research Report provided an updated summary on the status of 36 finfish and shellfish stocks in US waters of the NAFO Convention Area from four research surveys. These surveys included the spring and fall multispecies bottom trawl survey which cover NAFO areas 4-6, the scallop dredge survey which covers NAFO areas 5 and 6, and the northern shrimp trawl survey which covers NAFO Div. 5Y. Additionally, surveys were conducted in NAFO Areas 5 and 6 to monitor plankton, marine mammals, and herring. Summaries of environmental research are also provided including projects involved with hydrographic work, plankton studies, and benthic investigations. Projects studying biological aspects of several important commercial and recreational species including winter flounder, summer flounder, tomcod, and sturgeon are also highlighted in the report. Other highlights from the report include: decline in thorny skate biomass index to a record low value in 2011; descriptions of research on marine mammals and sharks; inventory of number of ages collected and 102,000 fish aged in 2011; continued observer coverage using At-Sea Monitors and Fisheries Observers; information on stock assessments and salmon; and information on cooperative research, including the analysis of the comparative study of two otter trawl sweeps and a new spiny dogfish tagging project.

ii) Surveys planned for 2011 and early 2012

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

c) Tagging Activities (SCS Doc. 12/15)

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

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

d) Other Research Activities

No other research activities were reported.

6. Review of SCR and SCS Documents

The following papers were presented to STACREC:

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

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

SCR Doc. 12/10 - Esther Román, Concepción González-Iglesias and Diana González-Troncoso - Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2011

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

SCR Doc. 12/14 - Diana González-Troncoso, Elena Guijarro-Garcia and Xabier Paz - Yellowtail flounder, redfish (Sebastes spp.) and witch flounder indices from the Spanish Survey conducted in Divisions 3NO of the NAFO Regulatory Area

SCR Doc. 12/15 – Diana González-Troncoso, Elena Guijarro and Xabier Paz - Biomass and length distribution for roughhead grenadier, thorny skate and white hake from the surveys conducted by Spain in NAFO 3NO

SCR Doc. 12.16 - Rasmus Nygaard and Ole A. Jørgensen - Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the GINR Shrimp Fish Survey, 1988-2011.

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

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

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

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

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

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

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

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

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

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

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

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

7. Other Matters

a) CWP Handbook

Unfortunately the CWP Handbook is not yet available for review.

b) Stock-by-stock Research Vessel Surveys Reported

In Studies No. 34 the Secretariat had compiled a report entitled “Stock-by-stock Research Vessel Surveys Reported, 1999–2000”. In 2011, STACREC noted that in light of discussions about data sharing and making knowledge of data available it would be a good idea to compile this information for 2001-2010.

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

c) Sampling Protocols

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

8. Adjournment

The Chair thanked the participants for their valuable contributions to the Committee. This year the committee met on two occasions to deal with late submissions. Special thanks were extended to the rapporteur and the Scientific Council Coordinator and all other staff of the NAFO Secretariat for their invaluable assistance in preparation and distribution of documents. There being no other business the Chair adjourned the meeting at 1700 hours on 13 June 2012.

ANNEX 1. HISTORICAL CATCH DATA BY SPECIES AND DIVISION

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

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

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

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

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

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

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

Chair: Jean-Claude Mahé Rapporteurs: Various

I. OPENING

The Committee met at the Alderney Landing, 2 Ochterloney Street, Dartmouth, NS, Canada, from 1 to 14 June 2012, to consider and report on matters referred to it by the Scientific Council, particularly those pertaining to the provision of scientific advice on certain fish stocks. Representatives attended from Canada, Denmark (in respect of the Faroe Islands and Greenland), the European Union (France, Germany, Portugal and Spain), Japan, Russian Federation, Ukraine and the United States of America. Various members of the Committee, notably the designated stock experts, were significant in the preparation of the report considered by the Committee.

The Chair, Jean-Claude Mahé (EU-France), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. The provisional agenda was adopted with minor changes.

II. GENERAL REVIEW

1. Review of Recommendations in 2011

STACFIS agreed that relevant stock-by-stock recommendations from previous years would be reviewed during the presentation of a stock assessment or the tabling of an interim monitoring report as the case may be and the status presented in the relevant sections of the STACFIS report.

2. General Review of Catches and Fishing Activity

As in previous years STACFIS conducted a general review of catches in the NAFO SA 0–4 in 2011. STACFIS noted that an ad hoc working group had deliberated on catch estimates before the meeting and the conclusion were presented to STACFIS and discussed. NAFO Scientific Council (STACFIS) has estimated catch for its stock assessments for many years since the 1980s when large discrepancies were observed between various sources of catch information. The goal of this exercise was to use the best information available to provide the best possible assessments and advice. STACFIS has had available estimates from different sources, but not for all fleets or from all Contracting Parties. These various sources of data have repeatedly led STACFIS to the conclusion that catch estimates from STATLANT have been unreliable for a number of stocks. This year, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks. STACFIS notes that it does not have the information and time available to estimate catches during the June meeting and that if these problems continue in the future, the inconsistencies between catch data before and after 2011 will increase and the quality of the assessments will deteriorate. This will lead to greater uncertainty regarding the status of the stocks.

III. STOCK ASSESSMENTS

STOCKS OFF GREENLAND AND IN DAVIS STRAIT: SA0 AND SA1

Environmental Overview

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

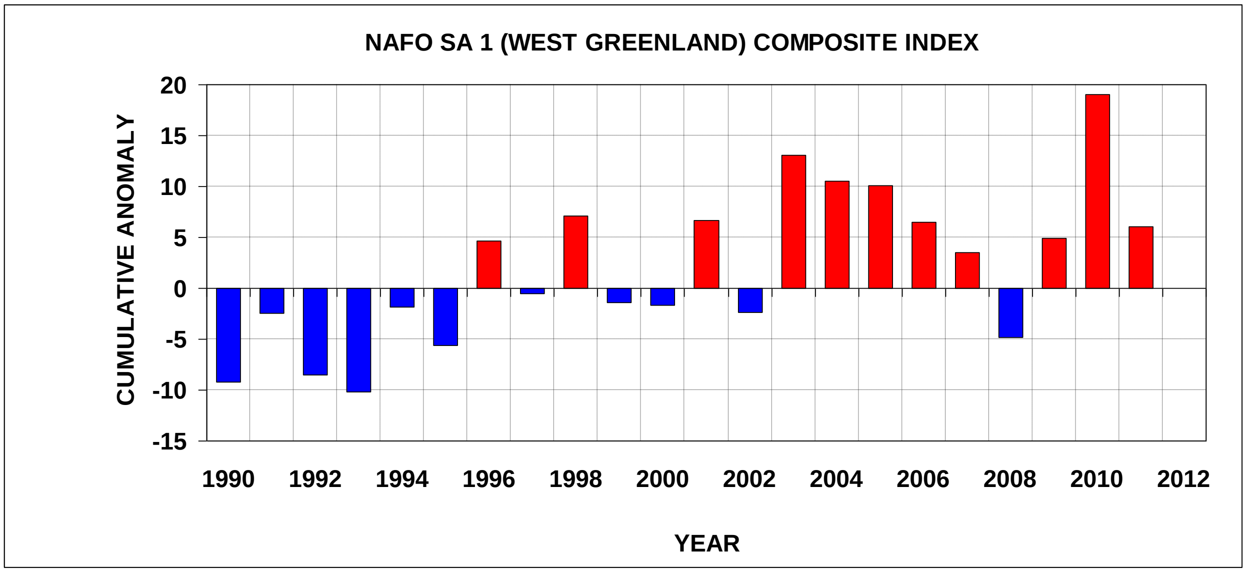


Fig. IV-1. Composite climate index for NAFO Subarea 1 (West Greenland) derived by summing the standardized anomalies of meteorological and ocean conditions.

Hydrographic conditions in this region depend on a balance of atmospheric forcing, advection and ice melt. Winter heat loss to the atmosphere in the central Labrador Sea is offset by warm water carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried south by the east Baffin Island Current. The surface circulation off West Greenland is dominated by the northward flowing West Greenland Current. It is primarily composed of cold low-saline Polar Water (PW) of the Arctic region and the temperate saline Irminger Water (IW) of the Atlantic Ocean. At intermediate depths Labrador Sea Water is found, and at the bottom overflow water from the Nordic Seas are found near the bottom. Within the 1 500 m depth range over much of the Labrador Sea, temperature and salinity have become steadily higher over the past number of years compared with the early 1990s. The low temperature and salinity values in the inshore region of southwest Greenland reflect the inflow of Polar Water carried by the East Greenland Current. Water of Atlantic origin with temperatures >3°C and salinities >34.5 is normally found at the surface offshore off the shelf break in this area.

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

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

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

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

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

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

a) Introduction

The Greenland halibut stock in Subarea 0 + Div. 1A offshore and Div. 1B-1F is part of a common stock distributed in Davis Strait and southward to Subarea 3. Since 2001 advice has been given separately for the northern area (Div. 0A and Div. 1AB) and the southern area (Div. 0B and 1C-F).

During the period 1982-1989 nominal catches of Greenland halibut in Subarea 0 and Div. 1A offshore + Div.1B-1F fluctuated between 300 and 4 500 t. Catches increased from 3 000 t in 1989 to 13 500 t in 1990. Catches remained at that level in 1991 but increased again in 1992 to 18 500. During 1993-2000 catches have fluctuated between 8 300 and 11 800 t. Catches increased to 13 800 t in 2001 and increased further to 19 700 t in 2005. In 2006 catches increased to 24 200 t and remained at that level in 2007-2009. Catches increased from 24 800 t in 2009 to 26 900 t in 2010 and remained at 26 800 t in 2011 (Fig. 1.1).

Between 1979 and 1994 a TAC was set at 25 000 t for SA 0+1, including Div. 1A inshore. In 1994 it was decided to make separate assessments for the inshore area in Div. 1A and for SA 0 + Div. 1A offshore + Div.1B-1F.

From 1995-2000 the advised TAC for SA 0 + Div. 1A offshore + Div.1B-1F was 11 000 t, but the TAC was fished almost exclusively in Div. 0B and Div. 1CD. In 2000 there was set an additional TAC of 4 000 t for Div. 0A+1AB for 2001 and the TAC on 11 000 t was allocated to Div. 0B and Div. 1C-F. The TAC in Div. 0A + 1AB was increased to 8 000 t for 2003. Total advised TAC for 2004 and 2005 remained at 19 000 t. In 2006 the advised TAC for Div. 0A+1AB was increased with further 5 000 t to 13 000 t. Total advised TAC remained at that level – 24 000 t - in 2008 and 2009. In 2010 TAC was increased with 3 000 t allocated to Div. 0B+1C-F. Hence the total TAC is 27 000 t for 2010. The TAC remained at that level in 2011 and 2012.

In Subarea 0 catches peaked in 1992 at 12 800 t, declined to 4 700 t in 1994 and remained at that level until 1999. Catches increased to 5 400 t in 2000 and to 8 100 t in 2001, primarily due to increased effort in Div. 0A. Catches remained at that level in 2002 but increased again in 2003 to 9 200 t and remained at that level in 2004-2005. Catches increased to 12 200 t in 2006 due to increased effort in Div. 0A. Catches decreased slightly to 11 500 t in 2007 and further to 10 400 t in 2008. Catches increased again to 12 400 t in 2009 and further to 13 225 t in 2010 and remained at 13 125 t in 2011.

Catches in Div. 0A increased gradually from a level around 300 t in the late 1990s and 2000 to 4 100 t in 2003, declined to 3 800 t in 2004 but was back at the 2003 level in 2005. In 2006 catches increased to 6 600 t, due to increased effort. Catches decreased slightly in 2007 to 6 200 t and further to 5 300 t in 2008. Catches increased again in 2009 to 6 600 t and remained at 6 300 t in 2011.

Catches in Div. 1A offshore and Div. 1B-1F fluctuated between 1 800 and 2 500 t during the period 1987-1991. Then catches fluctuated between 3 900 and 5 900 t until 2001. Catches increased gradually from 5 700 t in 2001 to 9 500 in 2003, primarily due to increased effort in Div. 1A. Catches remained at that level in 2004 and 2005. In 2006 catches increased to 12 000 due to increased effort in Div. 1A. Catches were at the same level during

2007 – 2009, but increased from 12 400 t in 2009 to 13 700 t in 2010 due to increased effort in Div. 1C-D. Catches remained at that level in 2011.

Prior to 2001 catches offshore in Div. 1A and in Div. 1B were low but they increased gradually from 100 t in 2000 to 4 000 t in 2003 and remained at that level in 2004-2005. Catches in that area increased further in 2006 to 6 200 t and remained at that level in 2007-2008. Catches decreased slightly from 6 700 t in 2009 to 6 400 t in 2010 and remained at 6 500 t in 2011.

The fishery in Subarea 0. Before 1984, USSR and GDR conducted trawl fisheries in the offshore part of Div. 0B. In the late 1980s catches were low and mainly taken by the Faroe Islands and Norway. In the beginning of the 1990s catches taken by these two countries increased and Canada, Russian Federation and Japan entered the fishery. In 1995 a Canadian gillnet fishery began. Since 1998 the fishery in Div. 0B has been executed almost exclusively by Canadian vessels. In 2011, 2 119 t were taken by gillnet, 81 t by longline and 4 665 t by trawl.

Besides Canadian trawlers, a number of different countries participated in the trawler fishery in Div. 0A from 2001 to 2003 through charter arrangements with Canada. Since then all catches have been taken by Canadian vessels. In 2011, trawlers caught 3 089 t and 2 909 t were taken by gillnetters. The longline fishery in the area, which took about 1/3 of the catches in 2003, has apparently ceased.

The fishery in Div. 1A offshore + Div. 1B-1F. Traditionally the fishery in SA 1 has taken place in Div. 1D and to a minor extent Div. 1C. Catches have mainly been taken by trawlers from Japan, Greenland, Norway, Russian Federation, Faroe Islands and EU (mainly Germany). These countries, except Japan and Faroe Islands, were also engaged in the fishery in the area in 2011. A gillnet fishery was started by Greenland in 2000 but the catches only amounted to 87 t in 2004 and there has not been any gill net fishery in the area since then. An offshore longline fishery in Div. 1CD took place during 1994-2002. Since then longline fishery has only taken place irregularly and with small catches. Inshore catches in Div. 1B-Div. 1F amounted to 253 t in 2011, which were mainly taken by gillnets. The offshore catches were taken by single and twin trawl.

Throughout the years there have been a certain amount of research fishing offshore in Div. 1A but the catches have always been less than 200 t per year. Total catches increased gradually from about 100 t in 2000 to about 6 200 t – 6 700 t in 2006-2011. All catches in recent years were taken by trawlers from Greenland, Russian Federation and Faroe Islands.

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

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

[1] Excluding inshore catches in Div.1A
[2] Including 1 366 t reported by error from Div. 1A.
[3] Excluding 2 000 - 4 300 t reported by error from Div. 1D.

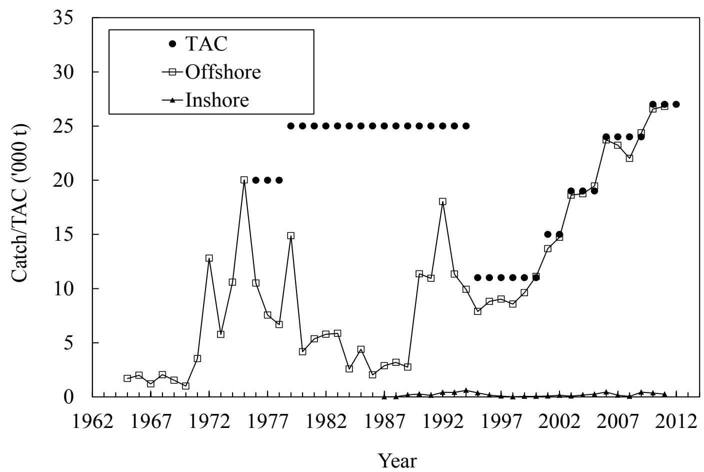


Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

b) Input Data

i) Commercial fishery data

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

Information on length distribution of catches was available from trawlers from Russian Federation and Greenland fishing in Div. 1A and from Russian Federation and Norwegian trawlers fishing in Div. 1D. In Div. 1A the mode was at 47 cm and 49 cm in the Russian and Greenlandic trawl fishery, respectively. In recent years the trawl catches have been dominated by fish on 44-52 cm. In Div. 1D the catches by Russian Federation and Norway showed clear modes around 50-53 cm. The mode in catches has been within this range for several years.

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

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

The combined Div. 0A+1AB standardized CPUE series has shown a slightly increasing trend since 2007, but has been relatively stable since 2002 (Fig 1.2)

The standardized catch rates from Div. 0B decreased gradually from 1995 to 2002, but increased again until 2005. Catch rates have declined slightly during 2006 and 2007, but increased in 2008 and further in 2009 to the highest level seen in the time series, which dates back to 1990. The CPUE decreased between 2009 and 2010 then increased again in 2011.

Standardized catch rates in Div. 1CD decreased gradually from 1989-1997 but increased since then until 2008. In 2011 it increased further to the highest level seen since 1990, but has been relatively stable the last four years.

The combined Div. 0B+1CD standardized CPUE series has been stable in the period 1990-2001; catch rates in 1988 and 1989 are from one 4000 GT vessel fishing alone in the area. Catch rates decreased somewhat in 2002 but has increased again and was in 2006 at the highest level seen since 1989. CPUE decreased very slightly in 2007, but increased significantly in 2008 and increased further to the highest level seen since 1989 in 2009. CPUE decreased slightly in 2010 to increase again in 2011 and is among the highest in the time series. (Fig. 1.2).

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

It is not known how the technical development of fishing gear, etc. has influenced the catch rates. There are indications that the coding of gear type in the log books is not always reliable, which also can influence the estimation of the catch rates. Further, due to the frequency of fleet changes in the fishery in both SA0 and SA1, the catch rates should be interpreted with caution.

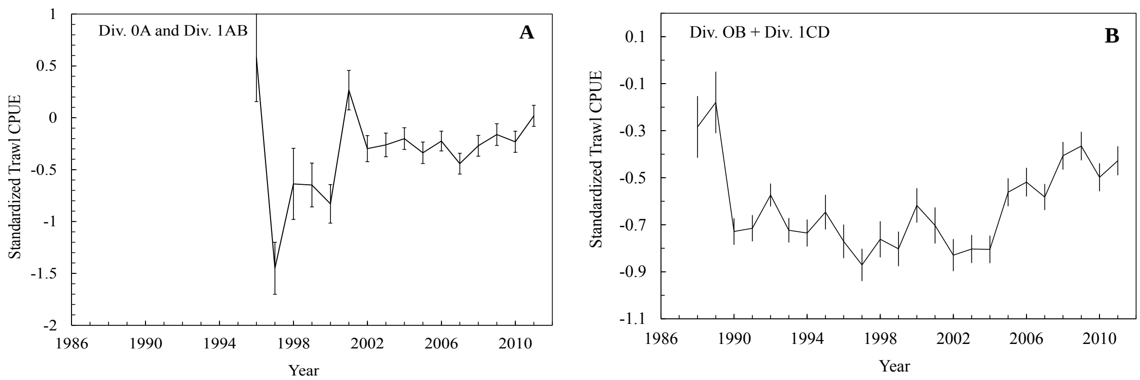


Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Combined standardized trawler CPUE from Div. 0A and Div. 1AB with ± S.E . B: Combined standardized trawler CPUE from Div. 0B and Div. 1CD with ± S.E.

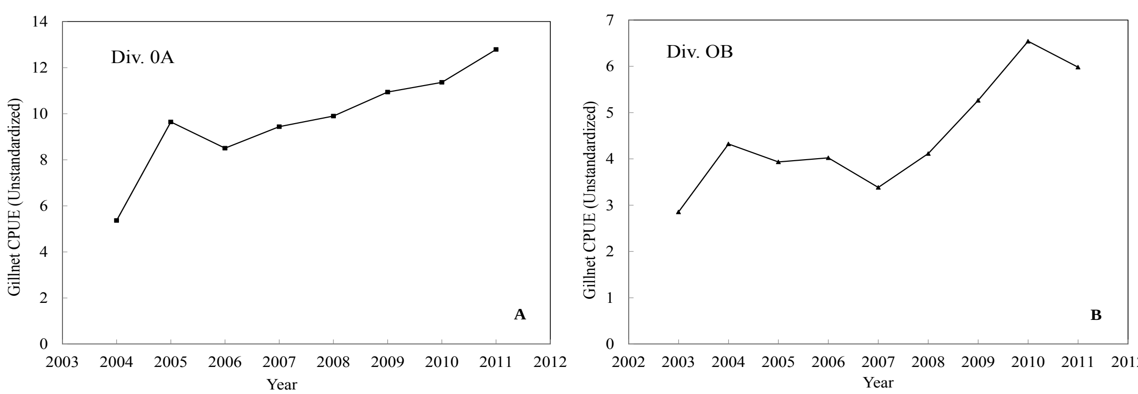


Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): A: Unstandardized gill net CPUE from Div. 0A. B: Unstandardized gill net CPUE from Div. 0B.

ii) Research survey data

Japan-Greenland and Greenland deep sea surveys in Div. 1CD. During the period 1987-95 bottom trawl surveys were conducted in Subarea 1 jointly by Japan and Greenland (the survey area was re-stratified and the biomass estimates were recalculated in 1997). In 1997 Greenland initiated a new survey series covering Div. 1CD. The survey is conducted as a stratified-random bottom trawl survey covering depths between 400 and 1 500 m. The trawlable biomass in Div. 1CD has shown an increasing trend since 1997 and is the highest in the time series in 2011. (Fig. 1.4). The abundance increased between 1997 and 2001 and has been relatively stable since 2002.

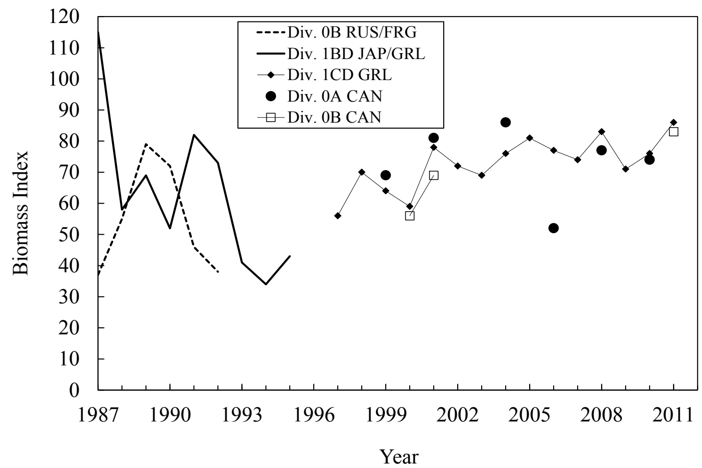


Fig. 1.4. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass indices from bottom trawl surveys. Note, incomplete coverage of the 2006 survey in Div. 0A and that survey indices from Div. 0A do not include surveys in the northern part in 2004 and 2010. Further, the survey indices from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

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

Greenland shrimp survey in Div. 1A-1F. Since 1988 annual surveys have been conducted with a shrimp trawl off West Greenland between 59°N and 72°30'N from the 3-mile boundary to the 600 m depth contour line. The biomass index in the offshore area peaked in 2004. Since then offshore biomass decreased gradually until 2009 but increased again in 2010 and 2011 and the 2011 estimate is the third highest in the time series (Fig. 1.5). The biomass index and abundance index time series were recalculated in 2004 based on better depth information and new strata areas. The survey gear was changed in 2005, but the 2005-2011 figures are adjusted for that.

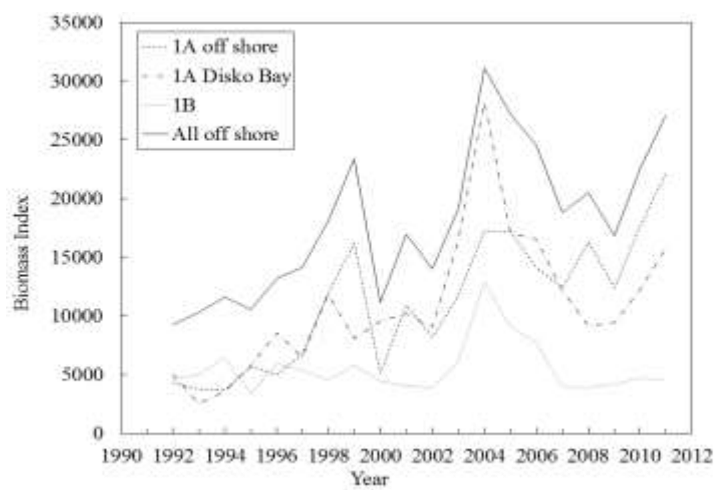


Fig. 1.5. Greenland halibut in Subareas 0+1: Biomass index from the Greenland shrimp survey by most important Divisions and in total offshore (including 1C-1F, which have little biomass). Div. Disko Bay is inshore .

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

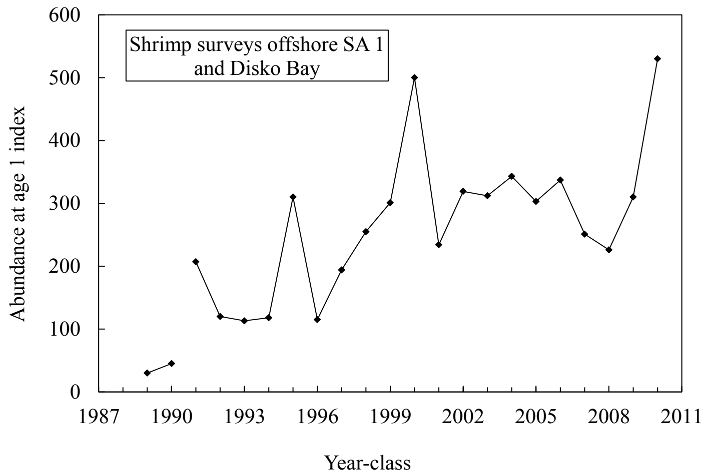


Fig. 1.6. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1).

A recruitment index (number caught per hour of age 1) for the traditional offshore nursery area in Div. 1A(south of 70°37.5'N)-1B has declined since the relatively large 1991 year-class, but the recruitment has been above the level in the 1980s. The recruitment increased again with the 1995-year class, which was the largest on record. The 1996 year-class seemed to be small but the recruitment has increased gradually until the 2000 year-class. Since then the recruitment has been around or a little above average. The 2007 to 2010 year-classes were below average.

c) Estimation of Parameters

An Extended Survivors Analysis (XSA) stock assessment model fitted to the stock data from SA 0+1 was presented in 2003. The analysis was considered to be provisional due to problems with the catch-at-age data and the short time series, but the outcome was considered to reflect the dynamics of the stock. The XSA has not been updated in recent years due to lack of catch-at-age data.

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

An ASPIC was attempted again in 2012, but results were not tabled as the outcome of the analysis did not improve significantly. The ASPIC fails primarily because of lack of contrast in the input data and short time series.

d) Assessment Results

Subarea 0 + Division 1A (offshore) + Divisions 1B-1F

Fishery and Catches: Due to an increase in offshore effort, catches increased from 3 000 t in 1989 to 18 000 t in 1992 and remained at about 10 000 t until 2000 and since then catches increased gradually to 26 900 t in 2010 and remained at that level in 2011. The increase in catches was primarily due to increased effort in Div. 0A and in Div. 1A but effort was also increased in Div. 0B and 1CD in 2010.

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

Assessment: No analytical assessment could be performed.

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

The combined Div. 0B and 1CD standardized catch rates have been stable from 2002 to 2004. Since then the standardized catch rates have increased gradually and were in 2009 at the highest level seen since 1989. CPUE decreased in 2010 but increased again in 2011 and is among the highest in the time series.

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

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

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

Fishing Mortality: Level not known.

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

Div. 0B+1C-F: Length compositions in the catches and deep sea surveys have been stable in recent years. Survey biomass in Div. 1CD and Div. 0B has shown an increasing trend. In Div. 1CD the abundance increased between 1997 and 2001 and has been relatively stable since 2002. In Div. 0B the abundance was lower than in 2001 but higher than in 2000. CPUE indices in Div. 0B and 1CD have shown an increasing trend since 2004, decreased between 2009 and 2010, increased again in 2011 and is among the highest in the time series.

e) Precautionary Reference Points

Age-based or production models were not available for estimation of precautionary reference points. CPUE and survey series were short, showed little variation and covered too little of the assessment area to be used for estimation of reference points.

f) Research Recommendation

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

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

The next assessment will be in 2013.

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

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

a) Introduction

The inshore fishery for Greenland halibut developed in the beginning of the twentieth century, with the introduction of the longline around 1910. The fishery is concentrated in the Disko Bay, the Uummannaq Fjord and in the fjords near Upernavik, all located in division 1A. There is little migration between the subareas and a separate TAC is set for each area. The stocks are believed not to contribute to the spawning stock in Davis Strait, and no significant spawning has been observed in the areas, hence the stocks are dependent on recruitment from offshore spawning areas.

Fisheries and catches

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

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

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

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

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

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

na no advice
ni no increase in effort

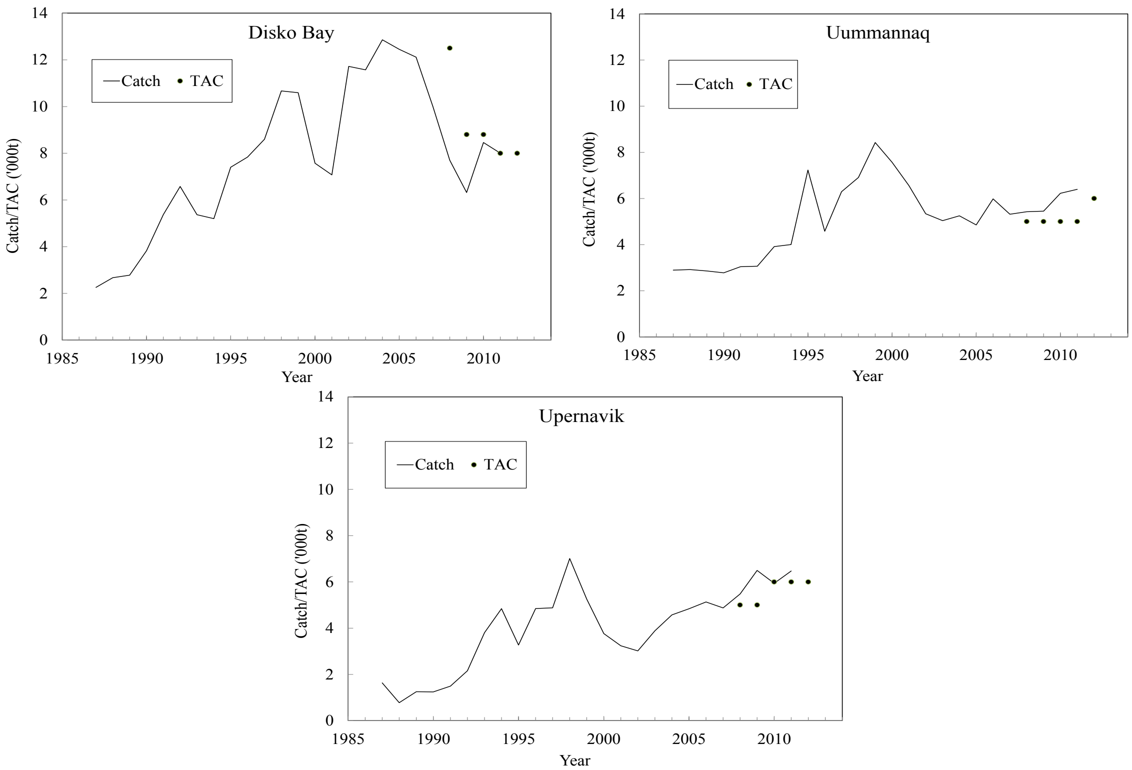


Fig 2.1. Greenland halibut in Div. 1A inshore: catches and TAC in Disko Bay, Uummannaq and Upernavik.

b) Data

i) Commercial fishery data

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

ii) Research survey data

The Greenland Shrimp Fish survey: Annual abundance and biomass indices were derived from the stratified random bottom trawl survey commencing in 1992, covering NAFO SA1 from 50 to 600 m isobaths. This survey includes the Disko bay.

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

c) Assessment

Mean length in the landings.

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

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

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

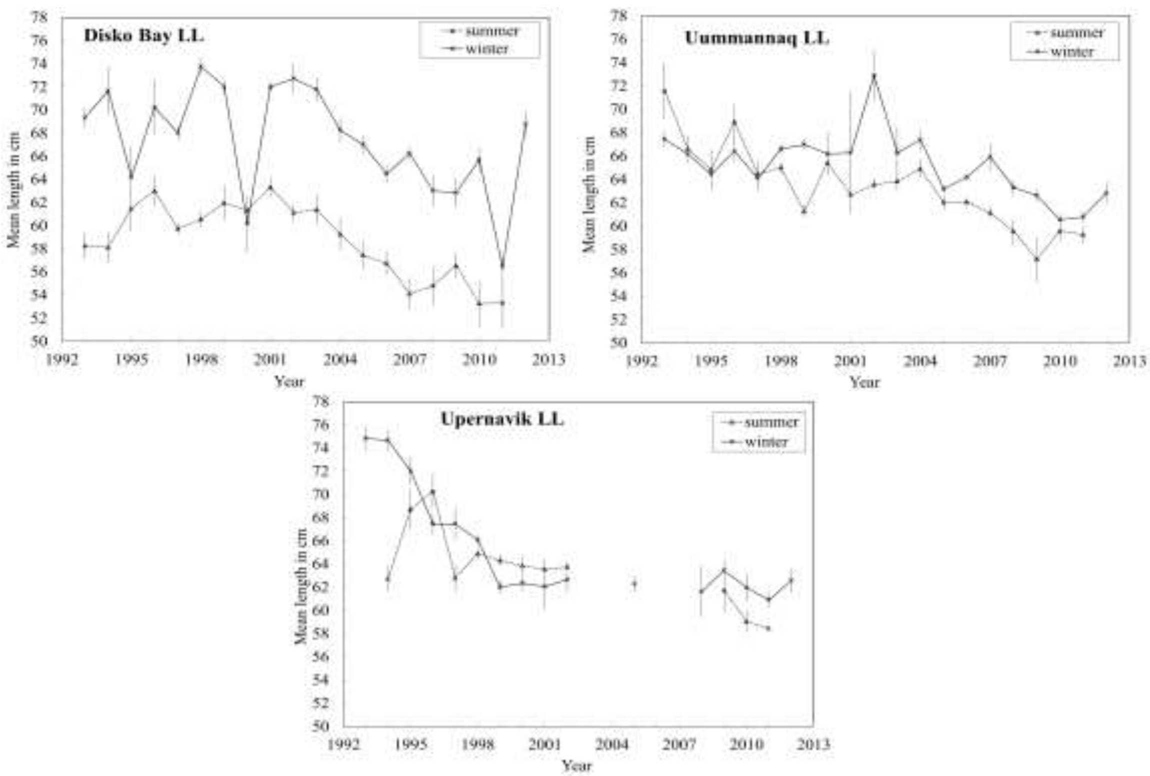


Fig. 2.2. Greenland halibut in Div. 1A inshore: Longline mean length in landings from Ilulissat, Uummannaq and Upernavik.

CPUE index.

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

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

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

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

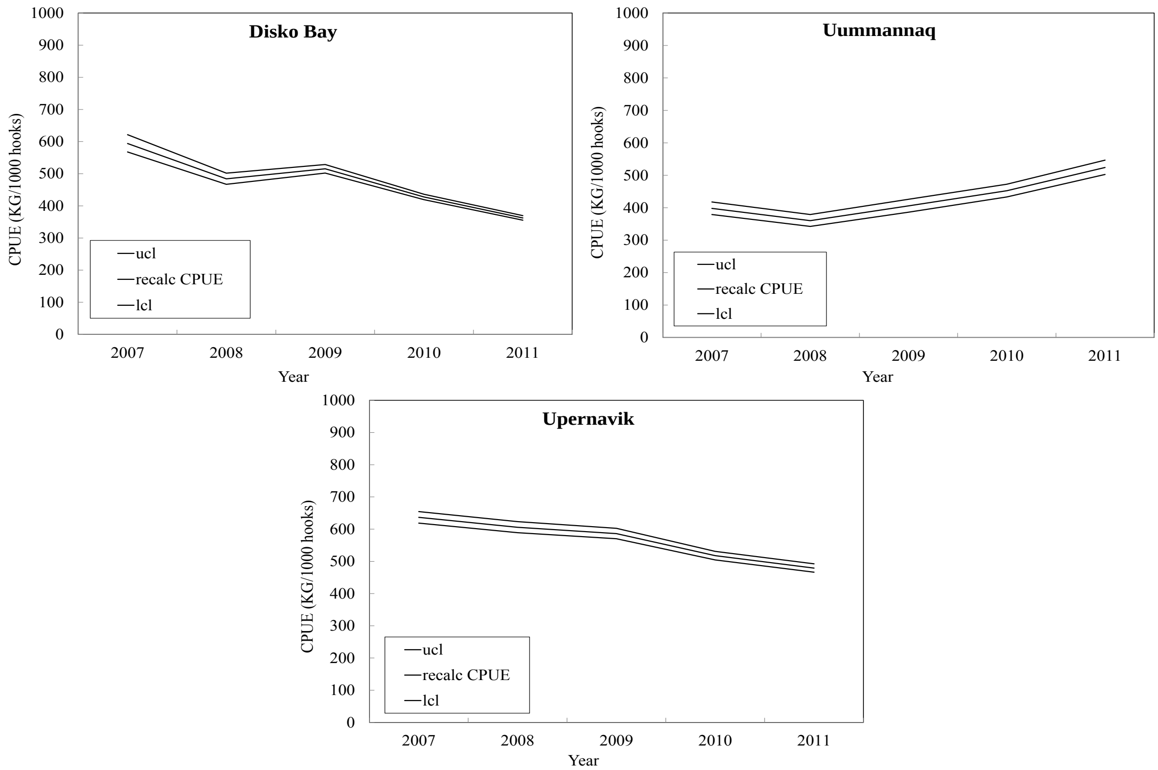


Fig. 2.3 Greenland halibut in Div. 1A inshore: LOGBOOK CPUE =overall mean + year + month + vessel +-1SE.

Survey results

Disko Bay: The Gillnet survey targets the pre-fishery recruits between 35 and 50 cm. Both CPUE and NPUE decreased in 2006 and 2007, but the 2008 and 2010 gillnet CPUE and NPUE estimates were at average levels. The 2011 gillnet survey CPUE (Fig 2.4 left) and NPUE (Fig 2.4 right) indices were the highest recorded for individuals < 50 cm, but also for all sizes (not shown). The increase in 2011 NPUEs is seen to derive mainly from the northern area off Torssukateq, while at the main fishing grounds at Kangia, the NPUEs have remained low. The high numbers of larger fish in 2011 seem not to have any origin in the previous years estimated populations. This may either be due to migration of the larger fish in the area or may simply reflect the uncertainty of the estimates.

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

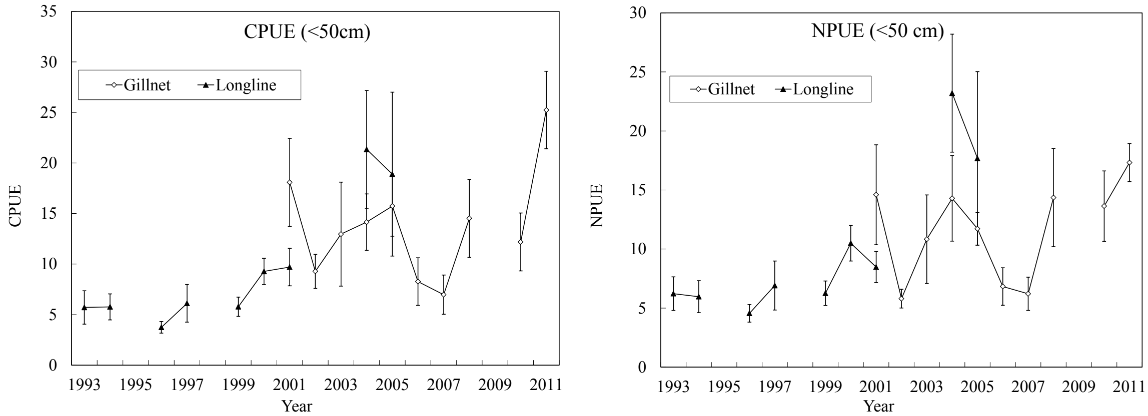


Fig. 2.4. Greenland halibut in Div. 1A inshore: Disko Bay gillnet survey CPUE and NPUE + 95% CI indicated.

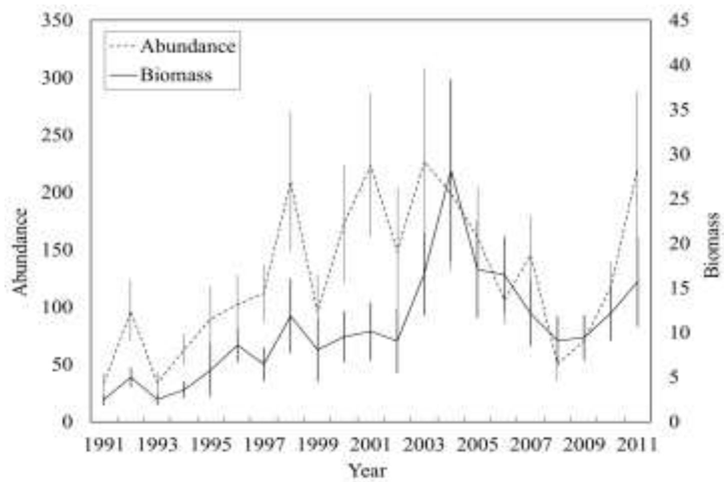


Fig. 2.5. Greenland halibut in Div. 1A inshore: Disko Bay abundance and biomass indices + 95% CI for Greenland halibut in the Greenland Shrimp Fish trawl survey.

d) Assessment results:

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

Fishing mortality: unknown for all of the stocks

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

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

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

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

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

a) Introduction

There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978. Roundnose grenadier is taken as bycatch in the Greenland halibut fishery. A total catch of 10 t was estimated for 2011. Catches of roundnose grenadier have been reported from inshore areas and Div. 1A where roundnose grenadier is known not to occur. These catches must be roughhead grenadier and are therefore excluded from totals for roundnose grenadier, but it is also likely that catches from the offshore areas south of Div. 0A-1A reported as roundnose grenadier may include roughhead grenadier.

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

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

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

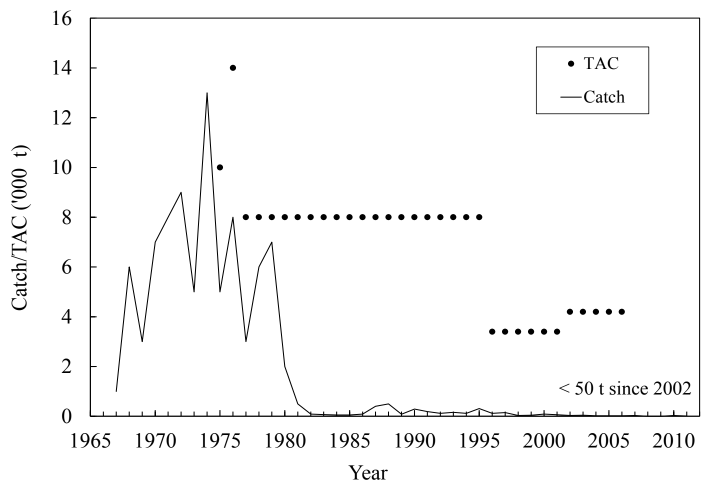


Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2012

b) Data Overview

Research survey data

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

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

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

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

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

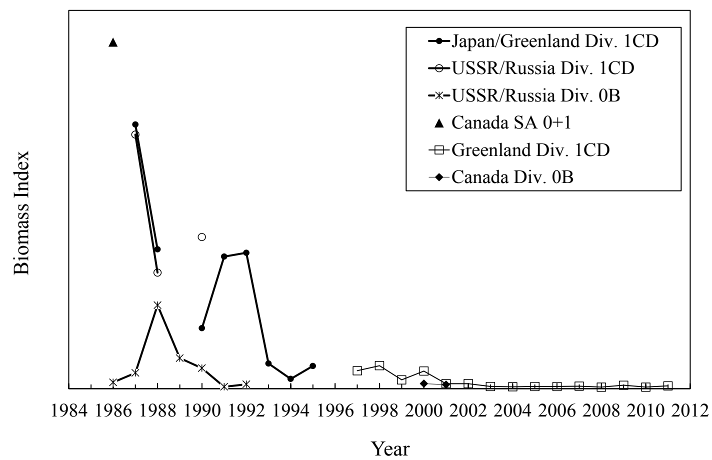


Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/ Greenland, Canadian and Greenland surveys in Div. 0B and Div.

c) Conclusion

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

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

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

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

a) Introduction

There are two demersal redfish species of commercial importance in subarea 1, golden redfish (*Sebastes marinus*) and demersal deep-sea redfish (*Sebastes mentella*). Relationships to other north Atlantic redfish stocks are unclear. Both redfish species are included in the catch statistics, since no species-specific data are available.

Fisheries and Catches

Reported catches of golden redfish and redfish (unspecified) in SA 1 has been less than 1 000 t since 1987 and less than 500 t since 2001. In 2011, 182 t were reported to Greenland including 46 t reported as bycatch in the shrimp fishery (Fig 4.1). Recent catch figures include the reported amount of small redfish discarded by shrimp vessels (from 2007). Sorting grids have been mandatory since October 2000, in order to reduce the amount of juvenile redfish taken as bycatch in the shrimp fisheries. A study conducted in 2006 and 2007 indicated that redfish caught in the Greenland shrimp fishery are composed mainly of small redfish between 6 and 13 cm. A mixture of commercially sized Golden and deep-sea are taken as a bycatch in the inshore fishery, targeting Greenland halibut, cod and shrimp.

Recent catches ('000 t) are as follows:

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

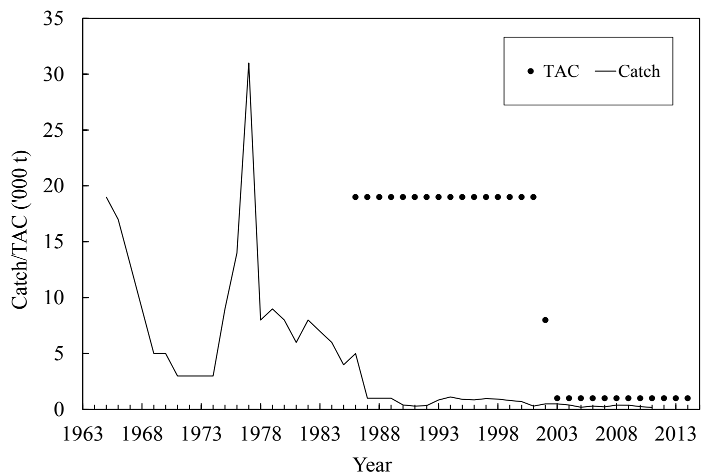


Fig. 4.1. Demersal redfish in Subarea 1: catches and TAC.

b) Data overview

i) Research survey data

Golden redfish (*Sebastes marinus*): The indices of the EU-Germany survey (Div. 1C-F) decreased in the 1980s and were at a very low level in the 1990s. However, the survey has revealed increasing biomass indices of golden redfish (≥17cm) since 2004, and the 2010 and 2011 indices are the highest observed since 1986 (Fig 4.2).

Demersal deep-sea redfish (*Sebastes mentella*): The indices of the EU-Germany survey have fluctuated at a low level throughout the time series, but with very low values since 2007 (fig 4.3). The fluctuating trend could be caused by poor survey overlap with the depth distribution of the demersal deep-sea redfish stock. The joint Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (Div. 1CD, 1997-2010) indices were at a low level from 1993 to 2007, but in 2008 a substantial increase in biomass was found (Fig 4.3). The indices have decreased since then, but are still among the higher values seen since 1990.

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

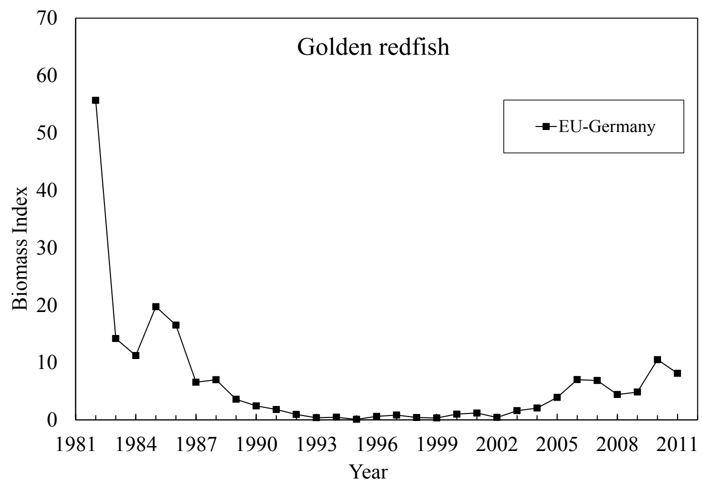


Fig. 4.2. Golden redfish in Subarea 1: redfish (≥17 cm) survey biomass indices derived from the EU-Germany survey.

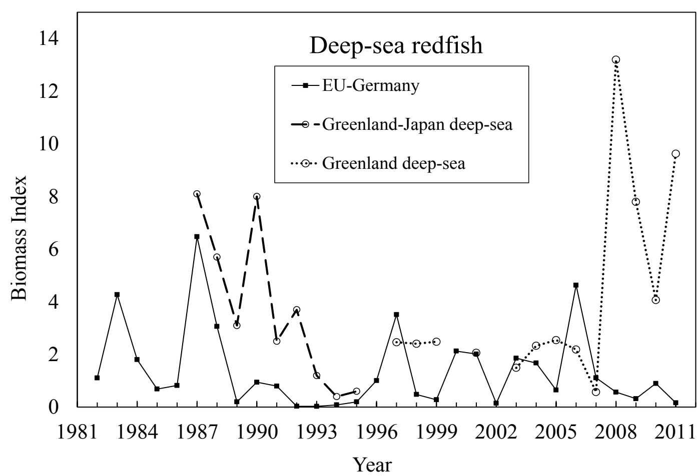


Fig. 4.3. Demersal deep-sea redfish in Subarea 1: (≥17 cm) survey biomass indices derived from the EU-Germany survey (Div. 1C-F) and from the joint Greenland-Japan deep-sea survey (1987-1995) and the Greenland deep-sea survey (Div. 1CD, 1997-2011).

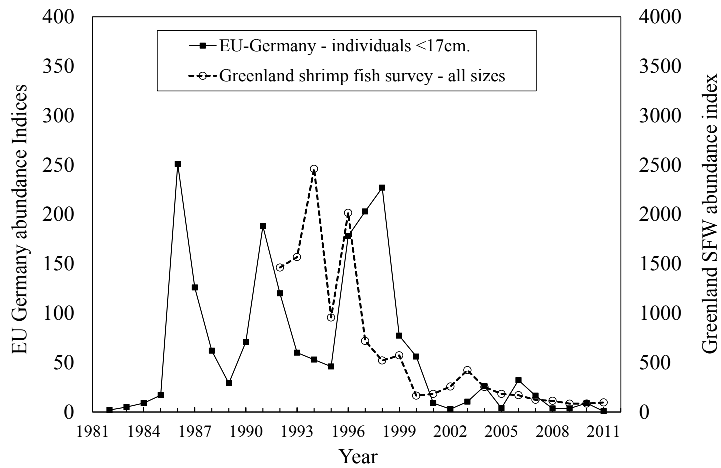


Fig. 4.4. Demersal redfish in Subarea 1: Juvenile deep-sea redfish and golden redfish combined survey abundance indices for EU-Germany survey (Div. 1C-F, individuals <17cm) and the Greenland Shrimp Fish survey (Div. 1A-F, all sizes and both species combined).

c) Conclusion

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

d) Research Recommendations

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

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

This stock will next be assessed in 2014

5. Other Finfish in SA 1

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

5a. Wolffish in Subarea 1

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

a) Introduction

Three species of wolffish exist in Subarea 1, Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*) and Northern wolffish (*Anarhichas denticulatus*). Only the two first are of commercial interest. Atlantic wolffish has its main distribution offshore and spotted wolffish is more connected to the fjord and coastal areas. In the past, these stocks have mainly been taken as a bycatch in the offshore fisheries targeting cod, Greenland halibut and shrimp, but a directed small-boat fishery exists in the West Greenlandic fjords almost exclusively taking spotted wolffish. To reduce the number of juvenile fish discarded in the trawl fishery targeting shrimp, sorting grids have been mandatory since October 2000 (fully implemented offshore in 2002).

i) Fishery and Catches

Catch statistics for wolffish species are combined, since no species-specific data are available from STATLANT, logbooks or factory landings reports. Catches of wolffish in SA1 were at a level around 5 000 t/yr. from 1960 to 1980 (Fig. 5a.1.). Catches then decreased to <100 t/yr. during the 1980s and remained low until 2002. The majority of the catches since 2002 of wolffish originate from factory landing reports implying that catches are mainly taken inshore by small vessels less than 30 feet, since these vessels are not obligated to provide logbooks. Offshore logbook reported catches of wolffish amounts to less 30 t/yr. since 2008 and none as a shrimp fishery bycatch.

Recent nominal catches (t) for wolffish.

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

ndf – No directed fishery
na – No advice

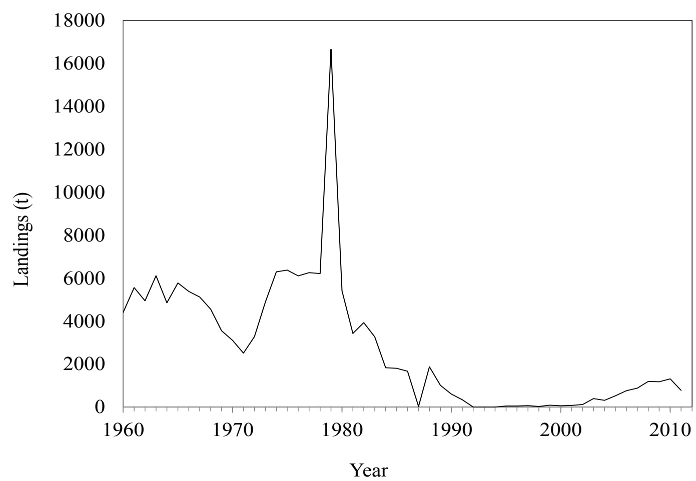


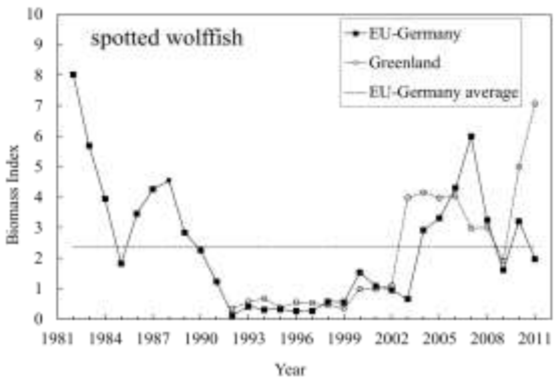
Fig 5a.1. Wolffish in Subarea 1: Catches of Atlantic wolffish and spotted wolffish in SA1 combined from 1960 to 2011.

b) Data Overview

i) Research survey data

Atlantic wolffish: Biomass indices decreased in the 1980s in the EU-Germany survey. From 2002 to 2005 biomass indices increased in both the EU-Germany survey and the Greenland shrimp fish survey to above average levels. After 2005 the biomass has shown a decreasing trend in both surveys (Fig. 5a.2.left). The stock is mainly composed of individuals less than 45 cm with almost no individuals above 60 cm.

Spotted wolffish: Biomass indices decreased in the 1980s in the EU-Germany survey, but increased in both the EU-Germany survey and the Greenland Shrimp fish surveys after 2000 to above average levels (Fig 5a.2.right). No distinct new incoming year classes were observed prior to the increasing biomasses and the surveys may not fully cover the distribution of this stock. The stock consists of all sizes including very large individuals with no signs of distinct year-classes.



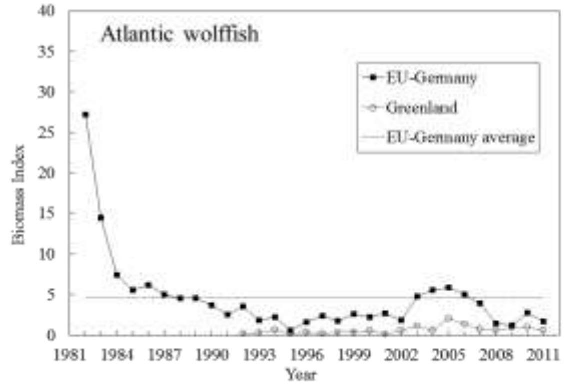


Fig. 5a.2. Wolffish in Subarea 1: wolffish survey biomass indices in SA1.

c) Conclusion

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

d) Research Recommendation

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

STATUS: No progress

Noting the change in the request for other finfish STACFIS **recommended** that *the distribution of wolffish in relation to the main shrimp-fishing grounds in SA1 be investigated, in order to further discover means of reducing the amount of discarded bycatch*.

STATUS: No progress and this recommendation is reiterated.

These stocks will next be assessed in 2014.

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

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

a) Introduction

American plaice in subarea 1 have mainly been taken as a bycatch in fisheries targeting Cod, redfish and shrimp. To reduce the number of juvenile fish discarded in the trawl fishery targeting shrimp, sorting grids have been mandatory since October 2000 (fully implemented offshore in 2002).

i) Fishery and Catches

Catches of American plaice developed during the 1970s, decreased in the beginning of the 1980s and has been at a very low level since then. In the past decade there have been no reported catches or bycatches of American plaice in SA1, but American plaice may be part of the bycatch in other fisheries reported as "fish not specified".

Recent catches (t) are:

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

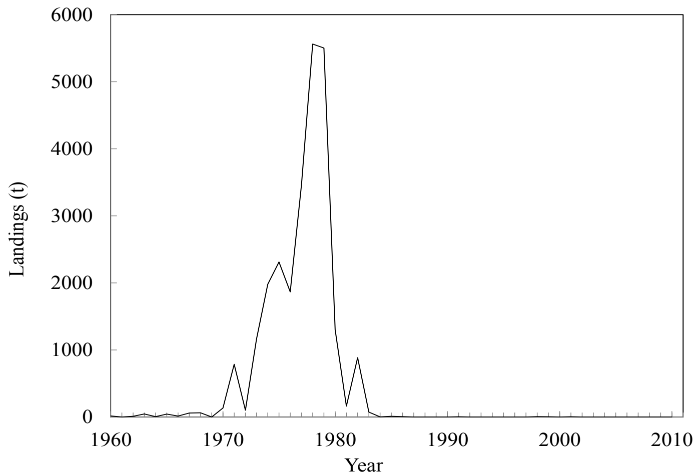


Fig 5b.1. American plaice in Subarea 1: Catches from 1960 to 2010.

b) Data

i) Research survey data

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

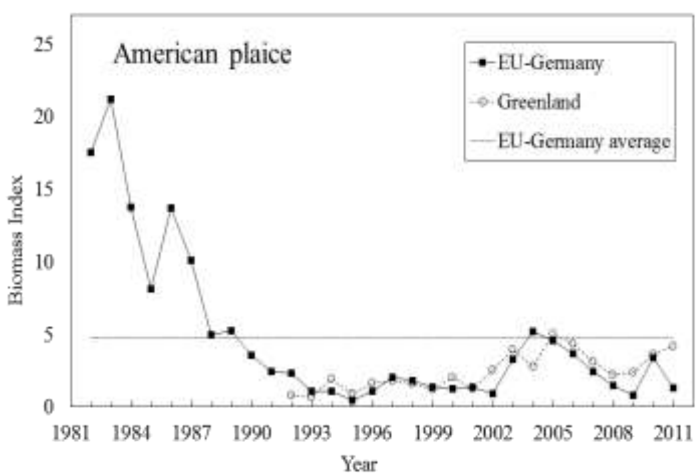


Fig. 5b.2. American plaice in Subarea 1: American plaice survey biomass indices in SA1.

c) Conclusion

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

d) Research Recommendation

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

STATUS: No progress and this recommendation is reiterated.

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

STATUS: No progress

These stocks will next be assessed in 2014

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

Environmental Overview

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

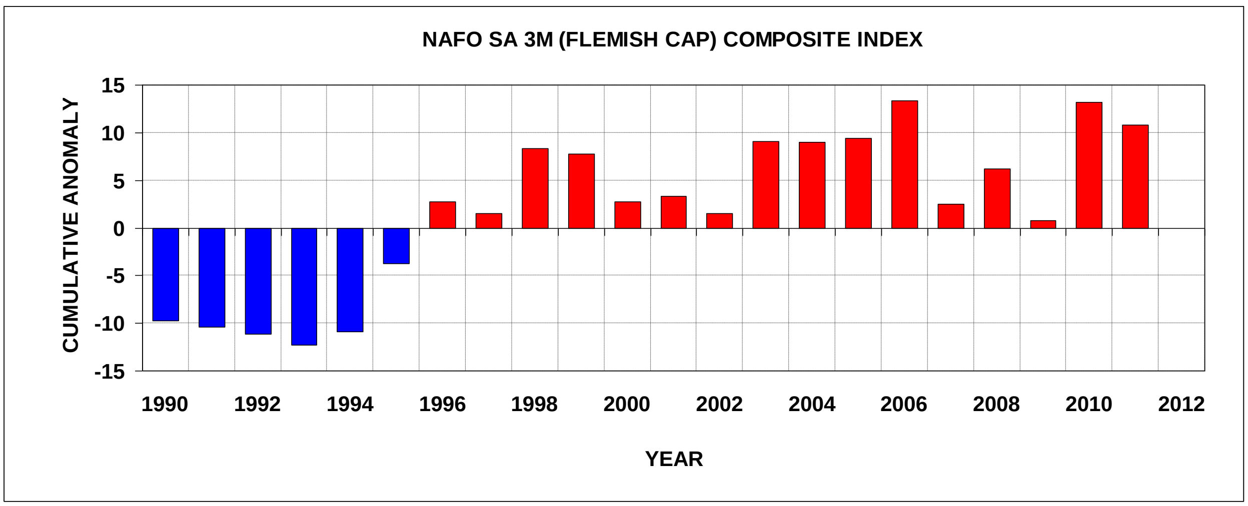


Fig. IV-2. Composite ocean climate index for NAFO Subarea 3 (SA3 Div. 3M) derived by summing the standardized anomalies.

The water masses characteristic of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water, generally warmer and saltier than the sub-polar Newfoundland Shelf waters with a temperature range of 3-4°C and salinities in the range of 34-34.75. The general circulation in the vicinity of the Flemish Cap consists of the offshore branch of the Labrador Current which flows through the Flemish Pass on the Grand Bank side and a jet that flows eastward north of the Cap and then southward east of the Cap. To the south, the Gulf Stream flows to the northeast to form the North Atlantic Current and influences waters around the southern areas of the Cap. In the absence of strong wind forcing the circulation over the central Flemish Cap is dominated by a topographically induced anti-cyclonic (clockwise) gyre. The entrainment of North Atlantic Current water around the Flemish Cap, rich in inorganic dissolved nutrients generally supports higher primary and secondary production compared with the adjacent shelf waters. The stability of this circulation pattern may also influence the retention of ichthyoplankton on the bank and is probably a factor in determining the year-class strength of various fish and invertebrate species, such as cod, redfish and shrimp.

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

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

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

a) Introduction

i) Description of the fishery and catches

The cod fishery on Flemish Cap has traditionally been a directed fishery by Portuguese trawlers and gillnetters, Spanish pair-trawlers and Faroese longliners. Cod has also been taken as bycatch in the directed redfish fishery by Portuguese trawlers. Estimated bycatch in shrimp fisheries is low. Large numbers of small fish were caught by the trawl fishery in the past, particularly during 1992-1994. Catches since 1996 were very small compared with previous years.

From 1963 to 1979, the mean reported catch was 32 000 t, showing high variations between years. Reported catches declined after 1980, when a TAC of 13 000 t was established, but Scientific Council regularly expressed its concern about the reliability of some catches reported in the period since 1963, particularly those since 1980. Alternative estimates of the annual total catch since 1988 were made available in 1995 (Fig. 6.1), including non-reported catches and catches from non-Contracting Parties.

Catches exceeded the TAC from 1988 to 1994, but were below the TAC from 1995 to 1998. In 1999 the direct fishery was closed and catches were estimated in that year as 353 t, most of them taken by non-Contracting Parties according to Canadian Surveillance reports. Those fleets were not observed since 2000. Yearly bycatches between 2000 and 2005 were below 60 t, rising to 339 and 345 t in 2006 and 2007, respectively. In year 2008 and 2009 catches were increasing until 889 and 1 161 t, respectively. The fishery has been reopened in 2010 with a TAC of 5 500 t and a catch of 9 192 t was estimated by STACFIS. For 2011, a 10 000 t TAC was established. This year, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the precious years assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks. However, the model used for the assessment of this stock estimated the 2011 catch to be 13 900 t[1]. TAC for 2012 is 9 280 t.

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

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

ndf No directed fishery
[1] See estimation of parameters

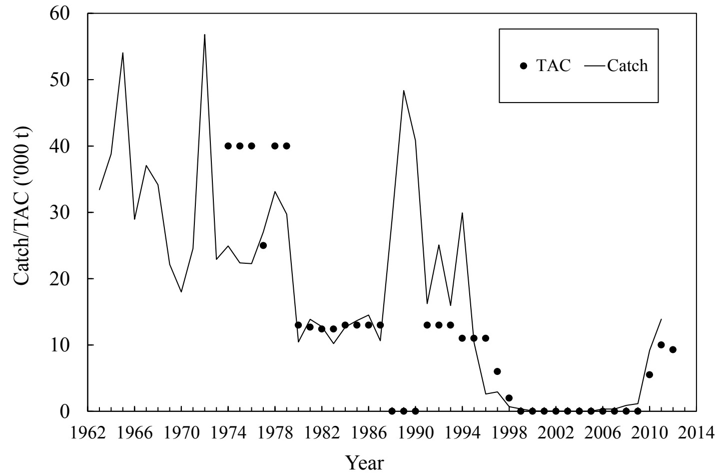


Fig. 6.1. Cod in Div. 3M: catches and TACs. Catch line includes estimates of misreported catches since 1988. No direct fishery is plotted as 0 TAC

b) Input Data

i) Commercial fishery data

Length and age compositions from the 2002 to 2005 commercial catches were not available. That information is available for the 1973 to 2001 period and for years 2006 to 2009, although sampling levels in this last period were low. In 2010-2011, whit the fishery opens, there was a good sampling level. There were length distributions for Canada, EU-Estonia, EU-Lithuania, Norway, EU-Portugal, Russia, EU-Spain and EU-UK. Spain had two types of vessels in 2011 for the fishery of Div. 3M cod, otter trawlers and paired trawlers. The mode for Portugal was 54 cm but 90 cm for UK . Lithuania, Estonia, Canada, Russia and Spain-otter trawlers mode ranges 57-63 cm. The mode for Spanish-paired trawlers was 84 cm. In 2009-2011 age-length keys from Portuguese catches were available. In 2009-2010 age 4 was the most abundant in the catch, whereas it was ages 7 and 8+ in 2011.

ii) Research survey data

Stratified-random bottom trawl surveys have been conducted by the EU (Spain and Portugal) since 1988 covering the whole distribution of the stock. Since 2003 the survey has used a new vessel and in order to make the series comparable fishing trials were performed with both vessels in 2003 and 2004.

The EU Flemish Cap survey indices showed a general decline in biomass going from a peak value of 114 in 1989 to the lowest observed level of 1.6 in 2003. Biomass index increased since then, especially from 2006, reaching 106.2 in 2011 (Fig. 6.2). The growth of the strong year classes since 2005 has contributed to the increase in biomass.

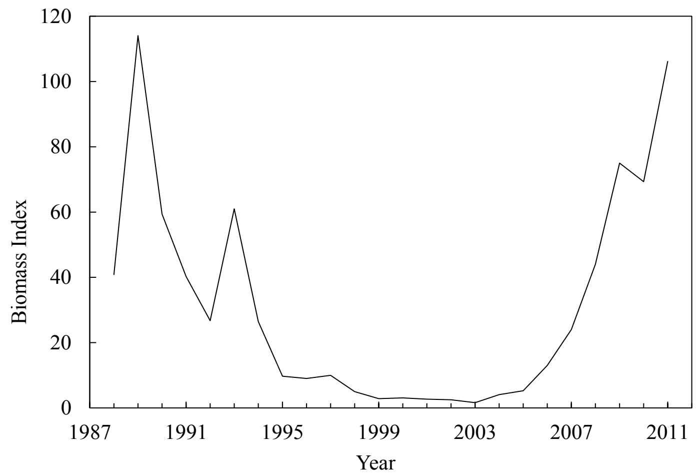


Fig. 6.2. Cod in Div. 3M: survey biomass estimates from EU-Flemish Cap survey

Abundance at age indices were available from the Flemish Cap survey. After several series of above average recruitments (age 1) during 1988-1992, the EU Flemish Cap survey indicates poor recruitments during 1996-2004, even obtaining observed zero values in 2002 and 2004. Since 2005 increased recruitments has been observed. In particular, the age 1 index in 2011 is by far the largest in the EU series (Fig. 6.3).

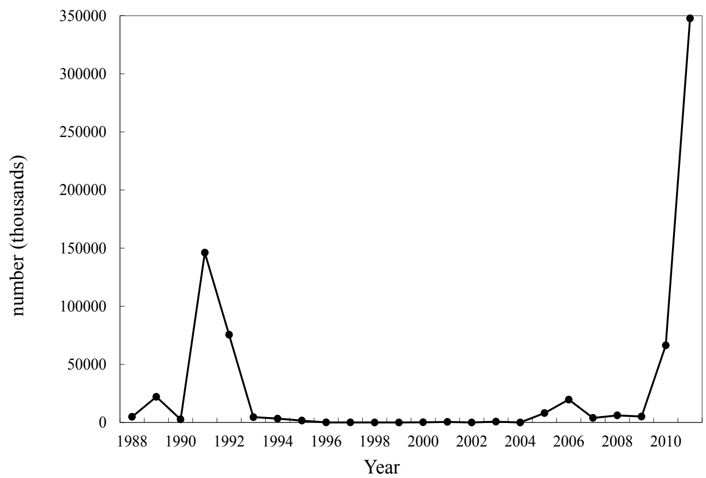


Fig. 6.3. Number at age 1 in the EU survey, 1988-2011

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

iii) Biological data

Mean weight at age in the stock, derived from the EU Flemish Cap survey data, shows a strong increasing trend since the late 1990s, although in 2011 the mean weight of all the ages except 8+ decreased outstandingly with respect to the same ages in the 2009.

There are maturity information from the EU survey for 1990-1998, 2001-2006 and 2008-2011. There has been a continuous decline of the A_{50} (age at which 50% of fish are mature) through the years, going from above 5 years old in the late 1980s to just above 3 years old since about year 2000. However, since 2005 it has been a slight increase in the A_{50}, mostly in 2011, reaching in this year a value of more than 4 years old.

c) Estimation of Parameters

In 2008 onwards a VPA-type Bayesian model was used for the assessment of this stock. The input data for the model are:

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

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

Ages: from 1 to 8+ in both cases

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

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

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

Additional priors: for survivors at age at the end of the final assessment year, for survivors from the last true age in every year, for fishing mortalities at age and total catch weight for years without catch numbers at age, for numbers at age of the survey and for the natural mortality. Prior distributions were set as last year assessment.

The priors are defined as follows:

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

d) Assessment Results

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

Note that estimates of SSB are available for 2012, whereas total biomass estimates are available to 2011 only. This difference arises because there are no age 1 recruitment estimates for 2012, which are an important component of the total, but not spawning biomass.

Total Biomass and Abundance: Estimated total biomass and abundance show an increasing trend since the mid-2000s. Both values are this year around the level of the early 1990s (Fig. 6.4).

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

As the stock is quickly changing its biological parameters (mean weight at age and maturity at age), it resulted in a change of the SSB of the stock. In the previous assessment, SSB for 2011 was estimated as 50 000 t. This is now revised to 34 000 t because of differences between the maturities assumed for 2011 in the previous assessment and the estimated maturities available this year (Fig. 6.5).

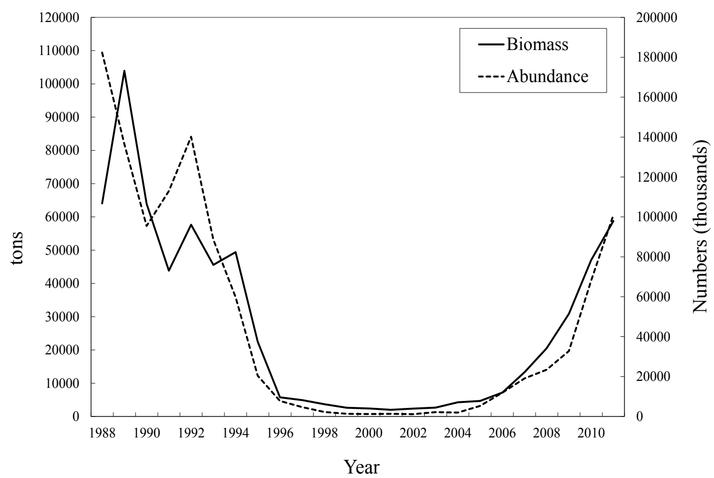


Fig. 6.4. Cod in Div. 3M: Biomass and abundance estimates for years 1988 to 2011

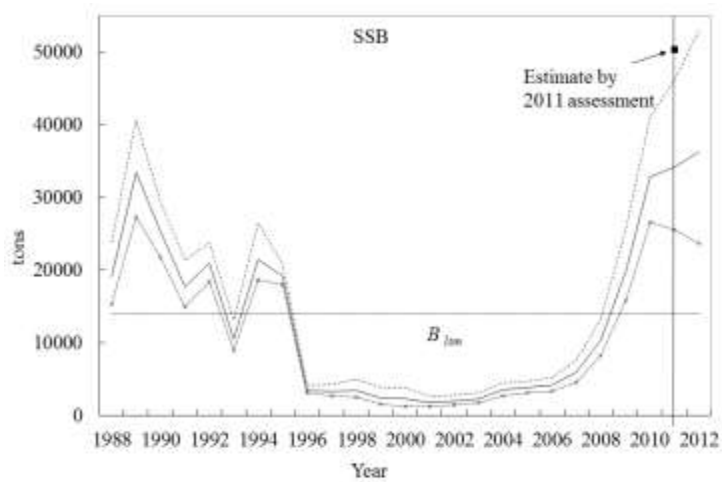


Fig. 6.5. Cod in Div. 3M: Median and 90% probability intervals SSB estimates for years 1988 to 2012. The horizontal dashed line is the B_{lim} level of 14 000 t. The point indicates the 2011 SSB as estimated by the 2011 assessment.

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

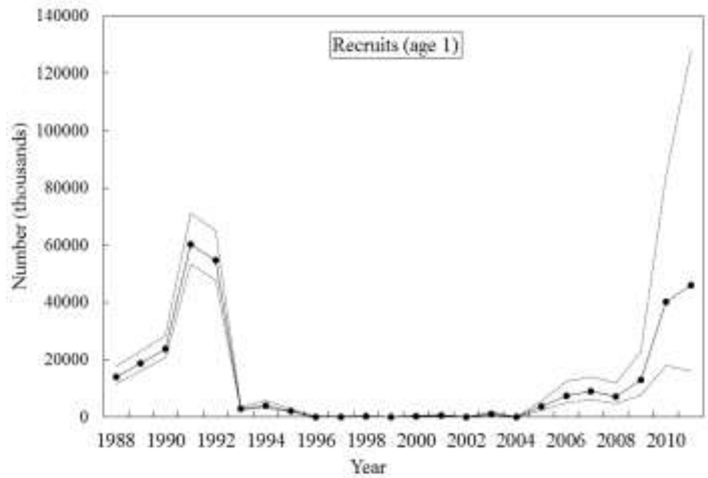


Fig. 6.6. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2011

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

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

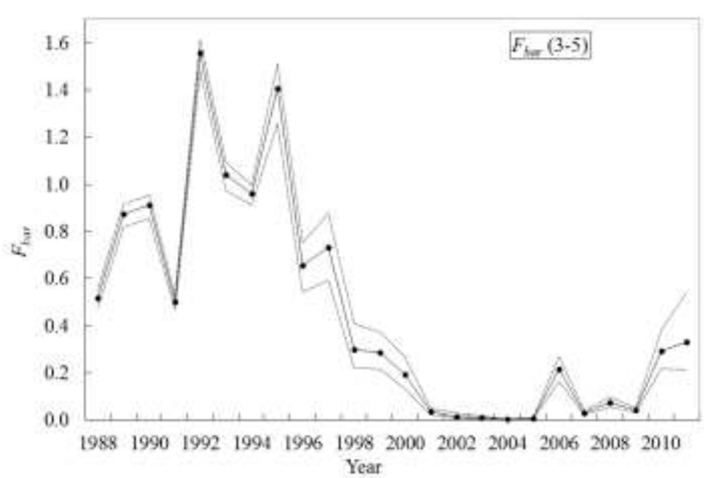


Fig. 6.7. Cod in Div. 3M: F_{bar} (ages 3-5) estimates and 90% probability intervals for years 1988 to 2011

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

e) Retrospective analysis

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

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

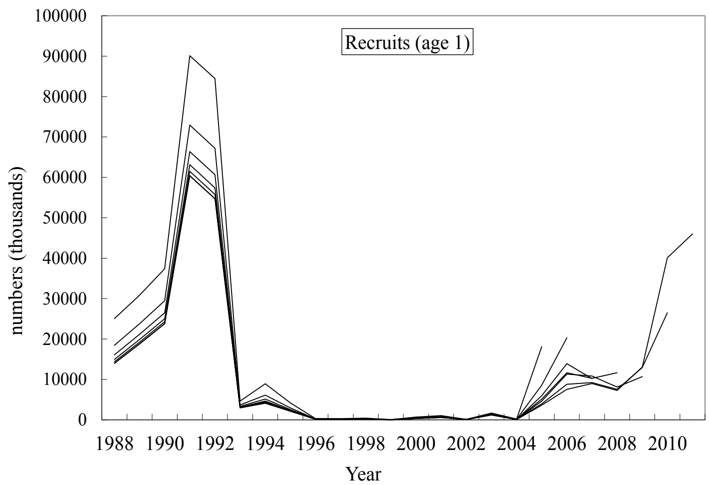


Fig. 6.8. Cod in Div. 3M: Retrospective results for recruitment

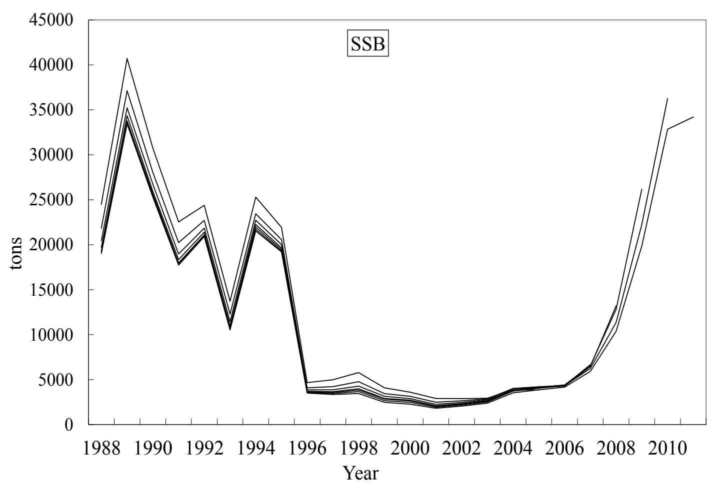


Fig. 6.9. Cod in Div. 3M: Retrospective results for SSB

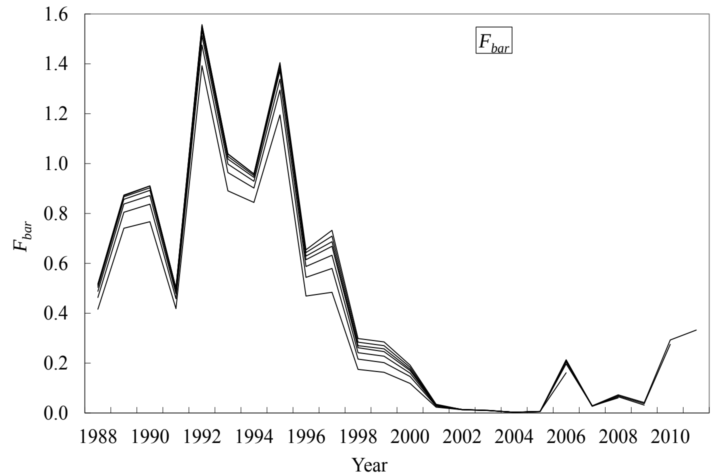


Fig. 6.10. Cod in Div. 3M: Retrospective results for F_{bar}.

f) State of the stock

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

g) Reference Points

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

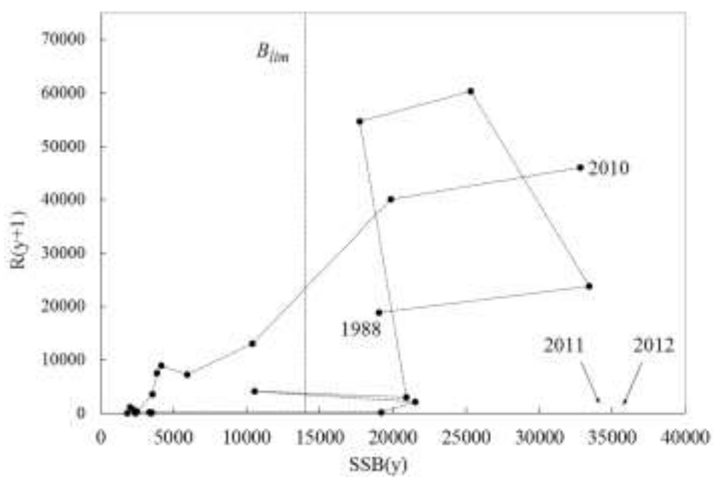


Fig. 6.11. Cod in Div. 3M: Stock-Recruitment (posterior medians) plot

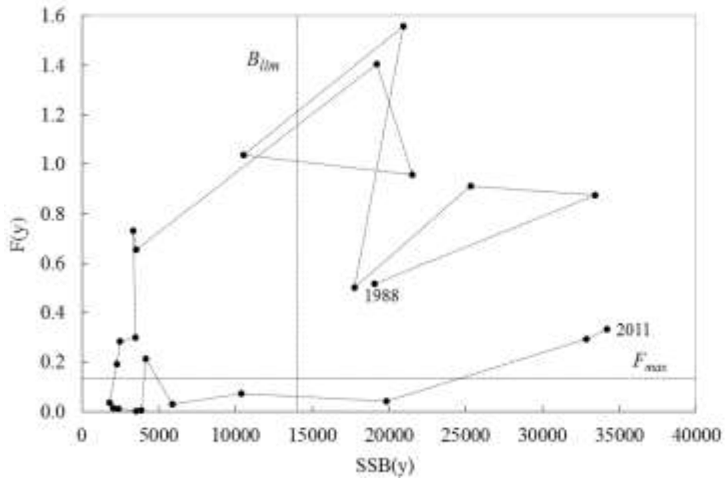


Fig. 6.12. Cod in Div. 3M: Stock-F_{bar}(3-5) (posterior medians) plot. B_{lim} and F_{max} are plotted in the graph.

Figure 6.13 shows the Bayesian yield per recruit with respect to F_{bar}, in which we can see the estimated values for $F_{0.1}$, F_{max} and F_{2011}. $F_{0.1}$ and F_{max} have been revised and they have changed substantially from last year's assessment due to the rapid changes in the values of the exploitation pattern and the biological parameters.

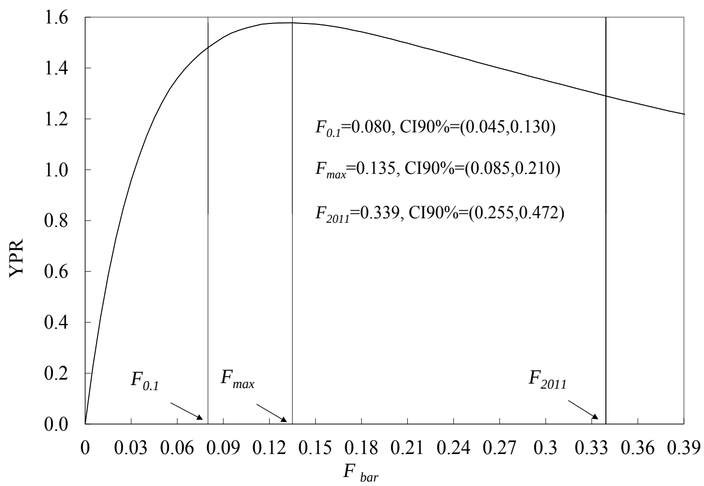


Fig. 6.13. Cod in Div. 3M: Bayesian Yield per recruit

h) Stock projections

Stochastic projections of the stock dynamics over a 3 year period (2013-2015) have been performed. The variability in the input data is taken from the results of the Bayesian assessment. Input data for the projections are as follows:

Numbers aged 2 to 8+ in 2012: estimated from this assessment.

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

Maturity ogive: 2011 maturity ogive.

Natural mortality: 2011 natural mortality from the assessment results.

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

PR at age for 2012-2015: 2011 PR.

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

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

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

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

Figures 6.14 to 6.16 summarize the projection results under the three Scenarios in just one figure. These results indicate that fishing at any of the considered values of F_{bar}, total biomass and SSB during the next 3 years have high probability of reaching levels equal or higher than all of the 1988-2011 estimates (Fig. 6.14 and 6.15). The removals associated with these F_{bar} levels are lower than those in the period before 1995 (Fig. 6.16).

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

Results of the projections are summarized in the following table:

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

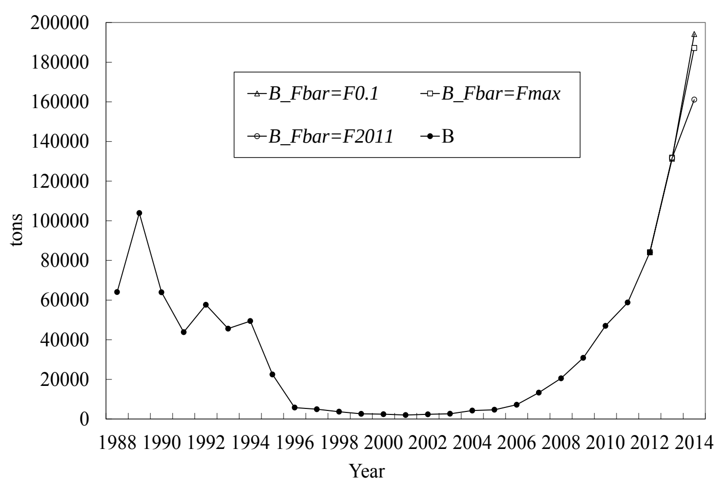


Fig. 6.14. Cod in Div. 3M: Projected Total Biomass under the three Scenarios.

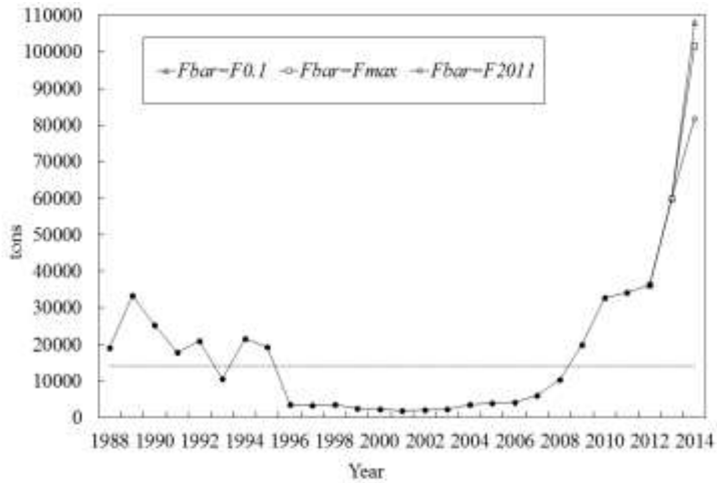


Fig. 6.15. Cod in Div. 3M: Projected SSB under the three Scenarios

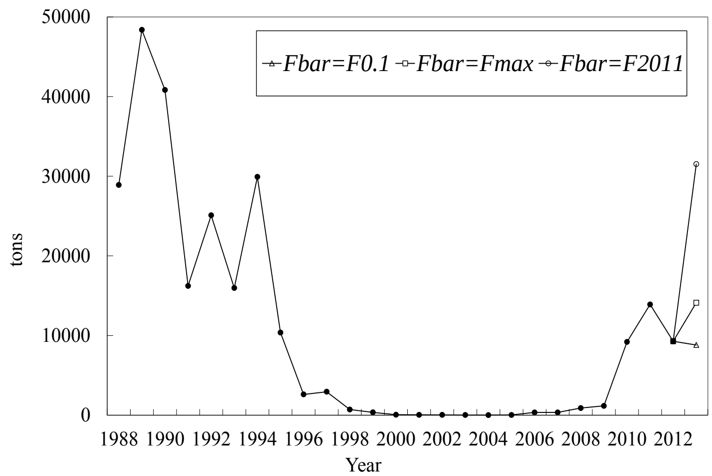


Fig. 6.16. Cod in Div. 3M: Projected removals under the three Scenarios

j) Research recommendations

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

STATUS: No progress and this recommendation is reiterated.

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

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

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

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

a) Introduction

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

i) Description of the fishery

The redfish fishery in Div. 3M increased from 20 000 t in 1985 to 81 000 t in 1990, falling continuously since then until 1998-1999, when a minimum catch around 1 100 t was recorded mostly as bycatch of the Greenland halibut fishery. An increase of the fishing effort directed to Div. 3M redfish is observed during the first years of the present decade, pursued by EU-Portugal and Russia fleets. A new golden redfish fishery occurred on the Flemish Cap bank from September 2005 onwards on shallower depths above 300 m, basically pursued by Portuguese bottom trawl and Russia pelagic trawl. Furthermore, the increase of cod catches and reopening of the Flemish Cap cod fishery in 2010 also contributed to the increase of redfish catch over the most recent years up to 9 700 t in 2011.

This new golden redfish fishery implied a revision of catch estimates, in order to split 2005-2010 redfish catch from the major fleets on Div. 3M into golden and beaked redfish catches. If the 2008-2010 average beaked redfish proportion in the overall redfish catch is maintained in 2011, the predicted catch of beaked redfish in 2011 would be 4 600 t.

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

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

[1] Estimated beaked redfish catch plus estimated redfish bycatch in shrimp fishery
[2] Provisional

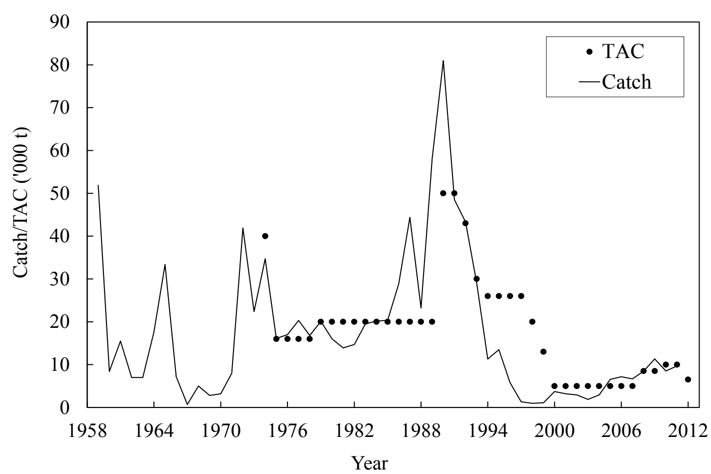


Fig. 7.1. Redfish in Div. 3M: total redfish catches and TACs.

b) Data Overview

Research surveys

Total biomass index given by the Flemish Cap EU survey declined on the first years of the interval until 1990, fluctuating at low level since then until 2003. A sequence of increasingly strong year classes (2000-2002) lead rapidly the stock biomass index to a maximum in 2006. The stock biomass index declined as fast as it went up and was in 2010 in the vicinity of the average level (1988-2011). Last year EU survey results indicate that in 2011 this recent decline has been halted and the stock biomass index was kept at the 2010 level. (Fig. 7.2).

Despite a sequence of abundant year classes and a low to very low exploitation regime over the last fifteen years, survey trends suggest that the beaked redfish stock has not been able to hold its growth and sustain an above average level, suffering instead a severe decline on the second half of the 2000s. This unexpected downward trend on stock size can be attributed to mortality other than fishing mortality.

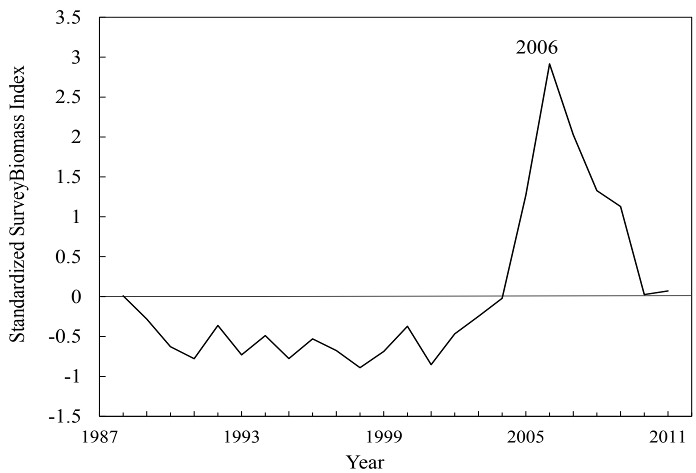


Fig. 7.2. Beaked redfish in Div. 3M: survey standardized total biomass index (1988-2011).

c) Conclusions

The perception of the stock status has not changed.

The next full assessment of the stock is planned for 2013.

d) Research recommendations

STACFIS **recommended** that *an update of the Div. 3M redfish bycatch information be compiled on an annual basis, including the estimated weights and numbers of redfish caught annually in the Div. 3M shrimp fishery as well as tables showing their size distribution.*

STATUS: Since the Div. 3M shrimp fishery is under a moratorium this recommendation is now out of context.

STACFIS **recommended** that, *in order to confirm the most likely redfish depletion by cod on Flemish Cap, and be able to have an assessment independent approach to the magnitude of such impact and to the size structure of the redfish most affected by cod predation, the existing feeding data from the past EU surveys be analyzed and made available*.

This recommendation has been addressed by several ecosystem and feeding studies presented in the Scientific Council 2012 June meeting. The common conclusion of these studies is that redfish consumption by cod in the Flemish Cap bank has increased over the second half of the 2000s up to present.

STATUS: This recommendation has been addressed on this meeting.

For redfish in Div. 3M STACFIS reiterated its **recommendation** that *the important line of ecosystem research based on the feeding sampling routine of the EU survey catch be done on an annual basis*.

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

Interim Monitoring Report (SCR Doc. 12/26; SCS Doc. 12/05, 06, 08)

a) Introduction

A total catch of 64 t was reported for 2011 (Fig. 8.1).

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
STACFIS	0.1	0.1	0.05	0.05	0.1	0.1	0.1	0.1	0.1	

ndf No directed fishing

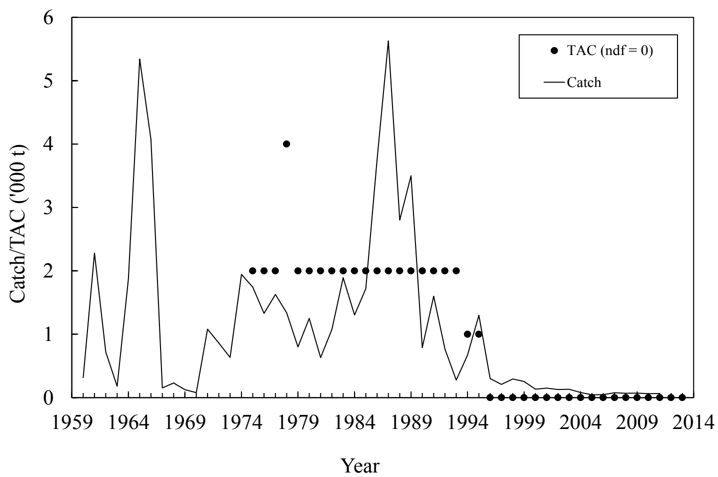


Fig. 8.1. American plaice in Div. 3M: nominal catches and agreed TACs (ndf is plotted as 0 TAC).

b) Data Overview

The EU bottom trawl survey on Flemish Cap was conducted during 2011. The survey estimates remained at low levels as previous years (Fig. 8.2 and 8.3).

Recruitment from 1991 to 2005 was very weak. 2007-2009 surveys show the 2006-2008 year-classes to be stronger than cohorts seen since the early 1990s.

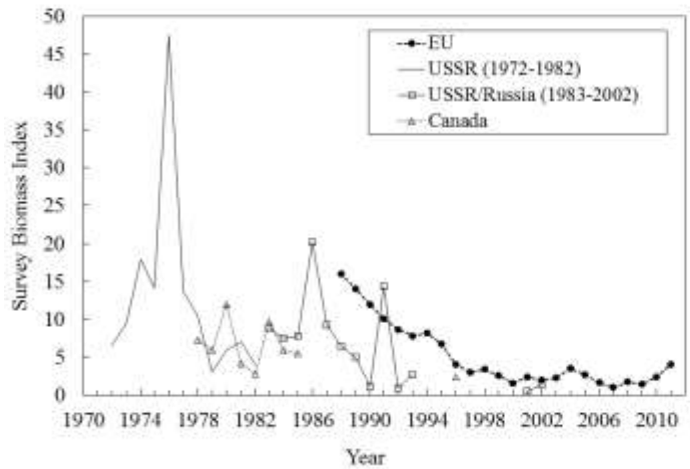


Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys.

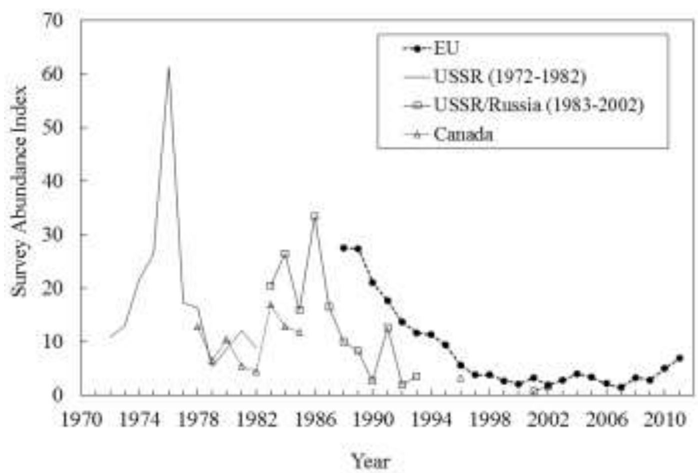


Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys.

c) Conclusion

This stock continues to be in a very poor condition. Recruitment improved recently and these year classes are recruiting to SSB. Although there are signs of improved recruitment, there is no major change to the perception of the stock status.

The next full assessment is expected to be in 2014.

d) Research Recommendations

STACFIS **recommended** that *the utility of the XSA must be re-evaluated and the use of alternative methods (for e.g. survey based models stock production models) continue to be attempted in the next assessment of Div. 3M American plaice.*

For Div. 3M American plaice, some common ages in the catch are outside of the F_{bar} range, therefore STACFIS **recommended** that *others ranges of ages in F_{bar} be explored.*

For Div. 3M American plaice, due to the recent good recruitment at low SSB, STACFIS **recommended** *to explore the Stock/Recruitment relationship and B_{lim}.*

STATUS (for all): Work is been done but no progress to report. All recommendations will be addressed during the next full assessment

C. STOCKS ON THE GRAND BANK: SA 3 AND DIV. 3LNO

Environmental Overview

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

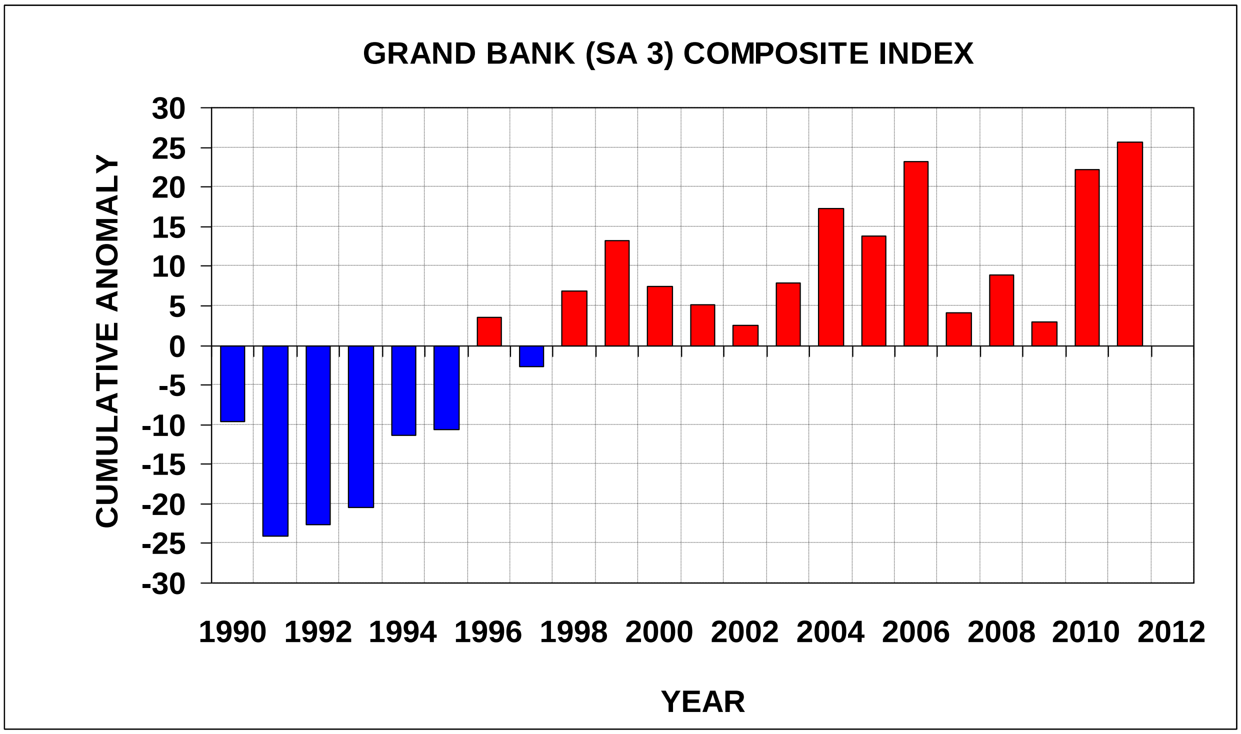


Fig. IV-3. Composite ocean climate index for NAFO Subarea 3 (SA3 Div. 3LNO) derived by summing the standardized anomalies.

The water mass characteristic of the Grand Banks are typical Cold-Intermediate-Layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0°C during spring and through to autumn. The winter-formed CIL water mass is a reliable index of ocean climate conditions in this area. Bottom temperatures increase to 1-4°C in southern regions of Div. 3NO due to atmospheric forcing and along the slopes of the banks below 200 m depth due to the presence of Labrador Slope Water. On the southern slopes of the Grand Banks in Div. 3O bottom temperatures may reach 4-8°C due to the influence of warm slope water from the south. The general circulation in this region consists of the relatively strong offshore Labrador Current at the shelf break and a considerably weaker branch near the coast in the Avalon Channel. Currents over the banks are very weak and the variability often exceeds the mean flow. The proportion of bottom habitat on the Grand Banks covered by <0°C water has decreased from near 50% during the first half of the 1990s to <15% during the mid-2000s and to <10% in 2010/2011.

The composite climate index in Subarea 3 (Div. 3LNO) peaked in 2011 and has remained above normal since the late 1990s following an intense cooling period during the first-half of the 1990's (Fig. IV-3). The annual surface temperature at Station 27 (Div. 3L) having been near-normal or above normal since 2003, reached a 61-year high of 2.2 standard deviation (SD) above their long-term mean in 2006, decreased to near normal in 2007 and increased to above normal from 2008 to 2011. Bottom temperatures at Station 27 were the highest on record in 2011 at +3.3 SD. Bottom temperatures at Station 27 were above normal from 1996-2008, decreased to slightly below normal in 2009 but increased to the 3rd highest in 2010 at +1.7 SD and to the highest on record in 2011 at +3.3 SD. Vertically averaged temperatures also set record highs increasing to the 2nd highest on record in 2010 (+1.9 SD) and to the highest on record in 2011 at +2.9 SD. Annual vertically averaged salinities at Station 27 decreased from +1.0 SD in 2008 to about >1.0 SD below normal in 2010 and 2011, the freshest conditions since 1995. In 2011, the annual mean stratification decreased to the lowest since 1980 at 2.0 SD below normal, although the overall trend has been increasing over the past few decades. During 2011 the annual averaged mixed-layer depth was 1.6 SD deeper than normal. The winter and spring values were deeper than normal by 1 and 1.4 SD, respectively. In 3LNO, spring bottom temperatures were generally higher than normal and the warmest on record in 2011. Bottom temperatures during the autumn in Div. 3LNO generally ranged from <0.5°C on the northern Grand Bank and in the Avalon Channel to 3.5° - 4°C along the shelf edge in 2011. Over the southern areas, bottom temperatures ranged from 2° to 6°C with the warmest bottom waters found on the Southeast Shoal and along the edge of the Grand Bank in Div. 3O. Except for a few isolated areas autumn temperatures were above normal over the entire Div. 3LNO area with anomalies at 0.5° - 2°C above the long term mean.

9. Cod (*Gadus morhua*) in NAFO Div. 3NO

Interim Monitoring Report (SCR 12/12; SCS Doc. 12/05, 06, 08, 09)

a) Introduction

This stock has been under moratorium to directed fishing since February 1994. Since the moratorium catch increased from 170 t in 1995, peaked at about 4 800 t in 2003 then declined to 600 t in 2006. Since 2006 catches have increased steadily to 1 100 t in 2009 then declined to 826 t in 2011.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	1.6	0.9	0.6	0.3	0.7	0.7	0.6	0.8	0.8	
STACFIS	4.3-5.5[1]	0.9	0.7	0.6	0.8	0.9	1.1	0.9	0.8	

[1] STACFIS could not precisely estimate the catch. Figures are the range of estimates.
ndf No directed fishery and bycatches of cod in fisheries targeting other species should be kept at the lowest possible level.

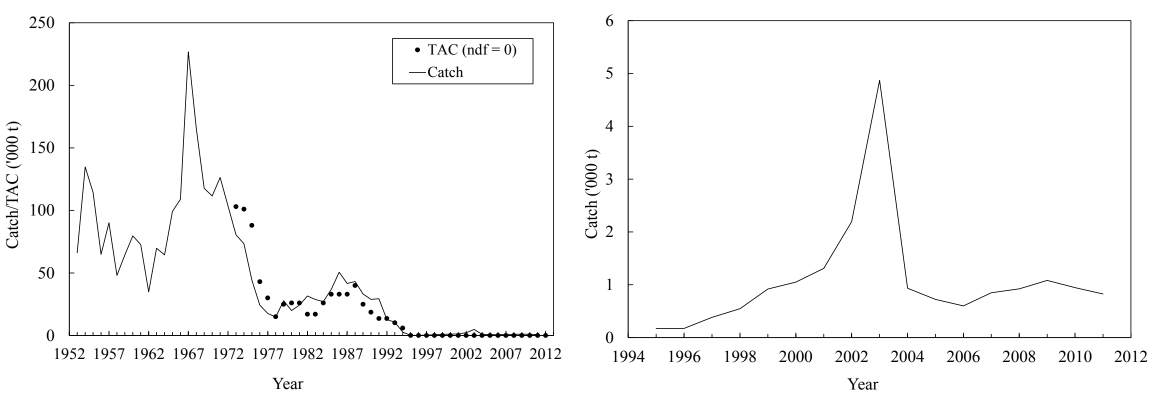


Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

b) Data Overview

Canadian bottom trawl surveys. Canadian spring and autumn surveys were conducted in Div. 3NO during 2011. The spring survey biomass index declined from 1984 to its lowest level in 1995, with the exception of intermittent increases in 1987 (series maximum) and in 1993 (Fig. 9.2). Except for a brief period of improvement from 1998 to 2000 the index remained low to 2008. There was a substantial increase in 2009, the highest in the index since 1993, resulting from improved recruitment from the 2005-2007 year classes. The index declined substantially in 2010 and remained at similar levels in 2011 due to lower estimates of those same year classes. The trend in the autumn biomass index is similar to the spring series (Fig. 9.2).

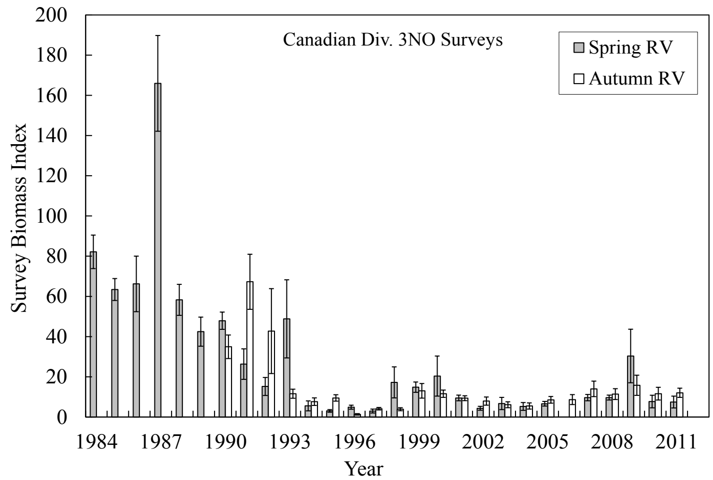


Fig. 9.2. Cod in Div. 3NO: survey biomass index (± 1 sd) from Canadian spring and autumn research surveys.

EU-Spain bottom trawl survey. Stratified-random surveys were conducted by EU-Spain in the NRA area of Div. 3NO in May-June in 2011. The mean weight per tow was relatively low and stable from 1997-2005 with the exception of 1998 and 2001 (Fig. 9.3). Since 2008 there has been a considerable increase in the index, with the highest estimate in the series in 2011. The increase was due to improved recruitment from the 2005-2007 year classes.

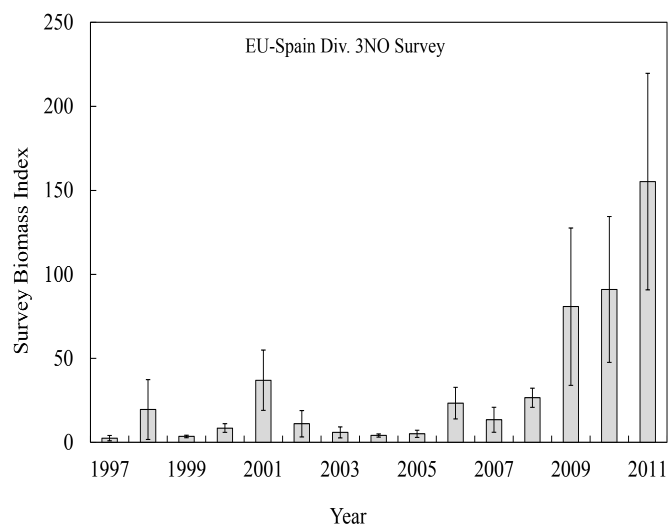


Fig. 9.3. Cod in Div. 3NO: survey biomass index (± 1 sd) from EU-Spain Div. 3NO surveys.

c) Conclusion

The most recent analytical assessment (2010) concluded that SSB was well below B_{lim} (60 000 t) in 2009. Canadian survey indices for 2010 and 2011 suggest a subsequent decline in the overall stock, whereas the EU-Spain survey indices have increased for the portion of the stock outside the Canadian EEZ. Overall, the 2011 surveys indices are not considered to indicate a significant change in the status of the stock.

The next full assessment of this stock is planned to be in 2013.

10. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N

(SCR Doc. 12/14, 32; SCS Doc. 12/5, 6, 8, 9)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3LN; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics.

Between 1959 and 1964 reported catches declined from 45 000 t to 10 000 t, oscillating over the next 21 years (1965-1985) around an average level of 21 000 t. Catches increased afterwards to a 79,000 t high in 1987 and fall steadily to a 450 t minimum reached in 1996. Catches were kept at a low level since then (450-3 000 t), until 2009.The NAFO Fisheries Commission implemented a moratorium on directed fishing for this stock between 1998 and 2009. The fishery reopen in 2010 with a TAC of 3 500 t. The Fisheries Commission endorsed the Scientific Council recommendation from the 2010 analytical assessment and set the TAC for 2011 and 2012 at 6 000 t. Catches increased in 2010 and 2011 to 4 100 t and 5 395 t (Fig. 10.1). Catches from EU-Portugal, Russian and Canadian fleets justified most of the increase on the redfish catch observed on divisions 3L and 3N in 2010 and 2011.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	6.0	6.0
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	3.5	6.0	6.0
STATLANT 21	1.0	0.7	0.4	0.2	0.2	0.4	0.3	3.1	5.4	
STACFIS	1.3	0.6	0.7	0.5	1.7	0.6	1.1	4.1	5.4	

ndf No directed fishery.

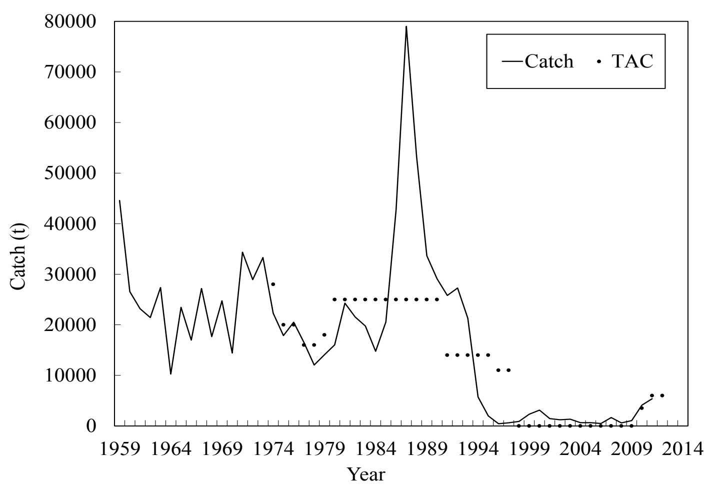


Fig. 10.1. Redfish in Div. 3LN: catches and TACs (No directed fishing is plotted as zero TAC)

b) Input Data

i) Commercial fishery data

Most of the commercial length sampling data available for the Div. 3LN beaked redfish stocks came, since 1990, from the Portuguese fisheries. Length sampling data from EU-Spain and from Russia were used to estimate the length composition of the bycatch for those fleets in several years. Above average mean lengths, an apparent stable length structure of the catch with no clear trends towards smaller or larger length groups and proportions in numbers of small redfish usually below 1%, are observed on most of the years of the 1990-2005 interval. However, well below average mean lengths occurred on most years from 2006 onwards coupled with high proportions of small redfish in the catch. Under a very low exploitation regime, such sudden drop on the mean lengths of the redfish bycatch in Div. 3LN on the most recent years would probably reflect the recruitment of above average year classes to the exploitable stock, from 4-5 years back in time.

ii) Research survey data

From 1978 onwards several stratified-random bottom trawl surveys have been conducted by Canada in various years and seasons in Div. 3L and in Div. 3N. Since 1991 two Canadian series of annual stratified-random surveys covered both Div. 3L and Div. 3N on a regular annual basis: a spring survey (May-Jun.) and an autumn survey (Sep.-Oct. 3N/Nov.-Dec. 3L for most years). No survey was carried out in spring 2006 on Div. 3N.

The design of the Canadian surveys was based on a stratification scheme down to 732 m for Div. 3LN. From 1996 onwards the stratification scheme has been updated to include depths down to 1 464 m (800 fathoms) but only the autumn surveys have swept strata below 732 m depth, most on Div. 3L. Until the autumn of 1995 the Canadians surveys were conducted with an Engels 145 high lift otter trawl with a small mesh liner (29 mm) in the codend and tows planned for 30 minute duration. Starting with the autumn 1995 survey in Div. 3LN, a Campelen 1800 survey gear was adopted with a 12 mm liner in the codend and 15 minute tows The Engel data were converted into Campelen equivalent units in the 1998 assessment.

Since 1983 Russian bottom trawl surveys in NAFO Div. 3LMNO turn to stratified-random, following the Canadian stratification for Subarea 3. On 1984 standard tows were set to half hour at 3.5 knots, with a standard gear. From 1984 until 1990, vessels conducting this survey were of the same tonnage class with the exception of 1985, when a vessel of smaller tonnage class was employed. This smaller category was later employed on the 1991 and 1993 surveys. On 1992 and 1994 Russian survey was carried out only in Div. 3L. On 1995 the Russian bottom trawl series in NAFO Sub area 3 was discontinued.

In 1995 EU-Spain started a new stratified-random bottom trawl spring (May-June) survey on NAFO Regulatory Area of Div. 3NO. Despite changes on the depth contour of the survey, all strata in the NRA to 732m were covered every year following the standard stratification. From 1998 onwards the Spanish survey was extended to 1464 m and in 2004 expanded to the Regulatory Area of Div. 3L. From 1995 until 2000 the survey was carried out by the Spanish stern trawler *C/V Playa de Menduiña* using a *Pedreira* bottom trawl net. In 2001 the *R/V Vizconde de Eza* , trawling with a *Campelen* net, replaced the commercial stern trawler. In order to maintain the data series obtained since 1995, comparative fishing trials were conducted in spring 2001 to develop conversion factors between the two fishing vessel and gear combinations. Former Div. 3NO redfish survey indices from C/V *Playa de Menduíña* have been transformed to R/V *Vizconde de Eza* units, and so the Div. 3N Spanish spring survey series (1995-2011) has been included in the assessment framework since 2010.

The survey biomass series used in the assessment framework and the female SSB survey series were standardized to zero mean and unit standard deviation and so presented on Figure 10.2. From the first half of the 1980s to the first half of the 1990s Canadian survey data in Div. 3L and Russian bottom trawl surveys in Div. 3LN suggests that stock size suffered a substantial reduction. Redfish survey bottom biomass in Div. 3LN remained in general below average level until it started a discrete and discontinuous increase from 2002 onwards. A pronounced increase of the remaining biomass indices has been observed over the most recent years, since 2006. Considering all available bottom trawl survey series occurring in Div. 3L and Div. 3N from 1978 till 2011, 100% of the biomass indices were above the average of their own series on 1978-1985, only 13% on 1986-2005, and 68% on 2006-2011.

Both 1991-2011 spring and autumn standardized female SSB series for Div. 3LN combined showed very similar patterns to correspondent survey biomass series.

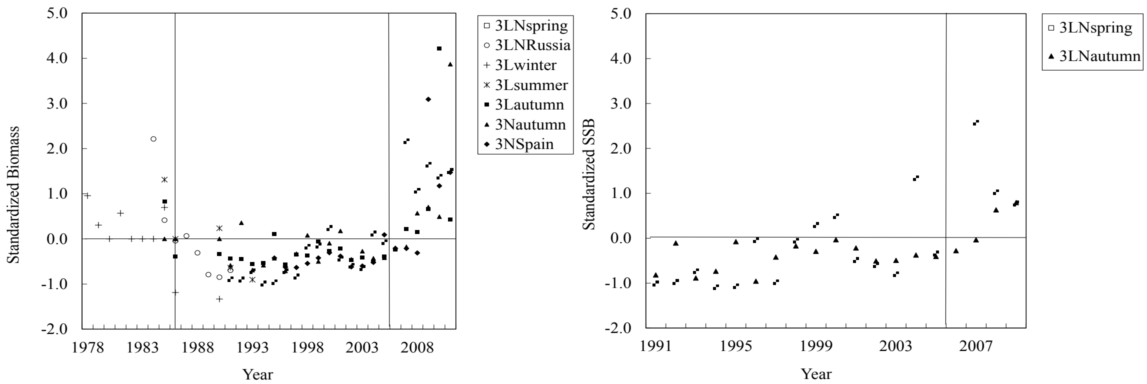


Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2011, left panel) and female spawning biomass (1991-2011, right panel). Each series standardized to zero mean and unit standard deviation.

During the first half of the 1990's on both survey series the mean lengths were below or slightly above average. Mean lengths on most of the years between 1996 and 2004 were well above the mean, reflecting a shift on the stock length structure to larger individuals probably justified by a higher survival of the year classes through this interval. However since 2005 mean lengths generally fall to below average, just as observed on the bycatch and commercial catch of recent years (Fig. 10.3). This below average pattern on surveys and catch at length seems to confirm the occurrence of pulses on recruitment.

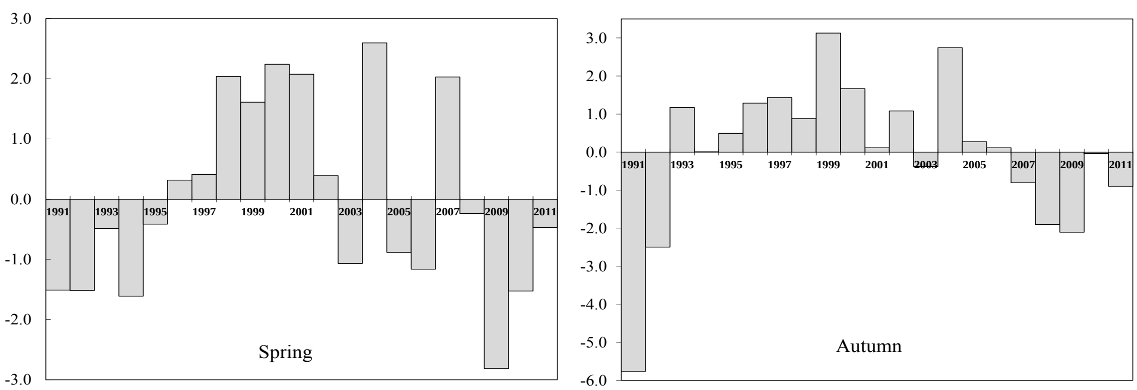


Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2011.

iii) Recruitment

There was a relatively good pulse of recruitment picked up in the 1991-1992 Canadian autumn survey in Div.3LN in the range of 12-14 cm for 1991 and 15-18cm for 1992. From commercial catch and Canadian survey length data there are signs of recent recruitment of above average year classes to the exploitable stock.

c) Assessment Results

An ASPIC model framework (Prager, 1994), was used to assess the status of the stock. This framework uses a non-equilibrium Schaeffer surplus production model to describe stock dynamics. All 1959-2010 catches used in this assessment are the catches adopted by STACFIS for this stock. A catch of 5 768 t, taken from the NAFO STATLANT 21A on May 22nd, was used in this assessment as the redfish catch in Div. 3LN for 2011.

The input data were:

I1 (Statlant CPUE)	Statlant cpue for Div. 3LN,$_{1959\text{-}1994}$ & catch for Div. 3LN $_{1959\text{-}2011}$
I2 (3LN spring survey)	Canadian spring survey biomass for Div. 3LN, $_{1991\text{-}2005,\ 2007\text{-}2011}$
I3 (3N autumn survey)	Canadian autumn survey biomass for Div. 3N, $_{1991,\ 1993\text{-}2011}$
I4 (3LN Power russian survey)	Russian spring survey biomass for Div. 3LN , $_{1984\text{-}1991\ (Power\ and\ Vaskov,1992)}$
I5 (3L winter survey)	Canadian winter survey biomass for Div. 3L, $_{1985\text{-}1986\ and\ 1990}$
I6 (3L summer survey)	Canadian summer survey biomass for Div. 3L$_{,\ 1978\text{-}1979,\ 1981,1984\text{-}1985,\ 1990\text{-}1991and\ 1993}$
I7 (3L autumn survey)	Canadian autumn survey biomass for Div. 3L, $_{1985\text{-}1986,\ 1990\text{-}1994,\ 1996\text{-}2011}$
I8 (3N spring spanish survey)	Spanish survey biomass for Div. 3N, $_{1995\text{-}2011}$

The 2009 Spanish spring biomass index for Div. 3N has an enormously high magnitude, corresponding to more than a ten times fold increase from the previous year. This jump can only be compared to the isolated highs observed in autumn 1992 for Div. 3N and 1995 for Div. 3L, that have been considered outliers of the respective survey biomass series and excluded from the ASPIC framework. But on recent years smaller bumps have also been observed in the other actual series, disturbing the gradual survey biomass increase observed in all of them:

- On 2007 the Div. 3LN spring survey records a 3.3 fold increase from 2005 (no 2006 survey on Div. 3N).
- On 2010 the Div. 3L autumn survey records a 3.7 fold increase from 2009, and
- On 2011 the Div. 3N autumn survey records a 3.6 fold increase from 2010

These substantial increases result from one or two large redfish hauls within a few strata that represent a large proportion of the swept area biomass and the likelihood of their occurrence is expected to increase as stock gets bigger.

Four input options, corresponding to four possible arrangements related with the Spanish survey and with the above mentioned jumps on the spring and both autumn series, were used to test the goodness of fit of the model to the available survey data. An overview of the exploratory analysis under a traffic light rating frame lead to the conclusion that so far the model will perform better without the Spanish survey on Div. 3N and the recent outliers of the Div. 3LN spring survey (2007), of the Div. 3L autumn survey (2010) and of the Div. 3N autumn survey (2011). Also the comparison of key parameters and trajectories with the previous 2010 $ASPIC_{fit}$ assessment confirms that the chosen input option represents the consistent update of the survey data framework adopted on the ASPIC 2008.

Apart the exclusion of the Spanish series and of the 2007 spring Div. 3LN point, two out of the six newly available survey points from the last assessment until now have to be excluded from the 2012 ASPIC framework. STACFIS expressed its concern that if the biomass indices continue to have these large outliers, this model may not be appropriate to capture future stock dynamics.

Different starting values for key parameters, different random number seeds and different magnitudes of last year surveys were used to test the robustness of the $ASPIC_{fit}$ 2012 formulation. The catch and seed related options arrived to the same or very similar solutions, showing that the ASPIC results given by the chosen formulation are insensitive to changes on first value/default inputs chosen to initialize the assessment. Small variability is induced on the trajectories of relative biomass and fishing mortality by variability on last year surveys, in line with the logistic model chosen for biomass growth.

A 2011-2009 $ASPIC_{fit}$ retrospective analysis was carried out. From one year to the next ASPIC assessments over estimate biomass (and F_{msy}) and under estimate fishing mortality (and MSY and B_{msy}) at relatively small rates (4%-9%). These retrospective patterns are the model response to the general increase of the still standing survey series, recorded over the most recent years.

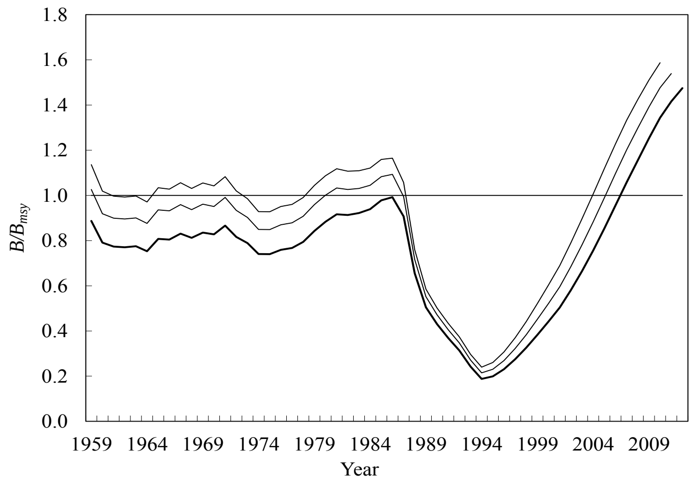


Fig. 10.4a. Redfish in Div. 3LN: Retrospective B/B_{msy} from $ASPIC_{last\ year\ 2011\text{-}2009}$

The ASPIC 2012 input formulation runs on both deterministic (FIT) and bootstrap (BOT) mode with 1000 trials. The previous $ASPIC_{bot}$ 2010 assessment (with the 2010 survey input framework) was also extended to 2010-2011 by a short term projection with the catches from the last couple of years.

Correlation among the majority of possible combinations of surveys is high but the model has a relative poor fit to most input series due to the usual wide inter annual variability of redfish abundance indices. Patterns on residuals between observed and model generated values are observed, as in previous assessments.

Nevertheless these diagnostic features have little impact on the robustness of the $ASPIC_{bot}$ 2012 results, as pointed out by (Fig. 10.4b, 10.4.c and 10.4d; Table 10.1):

- Small bias between the bias corrected and the point estimates (< 10%) for all key parameters,
- B/B_{msy} and F/F_{msy} point estimate trajectories sticking to their bias corrected ones,
- While keeping their un-skew track far from their 80% CL's boundaries (Fig. 9c and 9d),
- Both 2012 and 2010 $ASPIC_{bot}$ assessments gave very similar results.

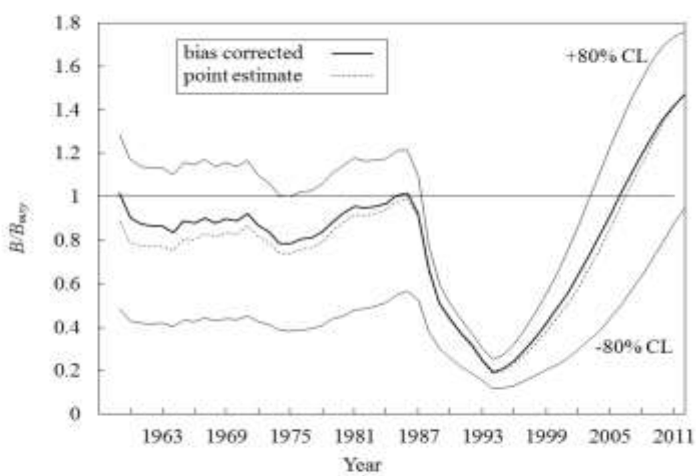


Fig. 10.4b. Redfish in Div. 3LN: B/B_{msy} 1959-2012 trajectories (point estimate and bias corrected with approximate 80% CL's).

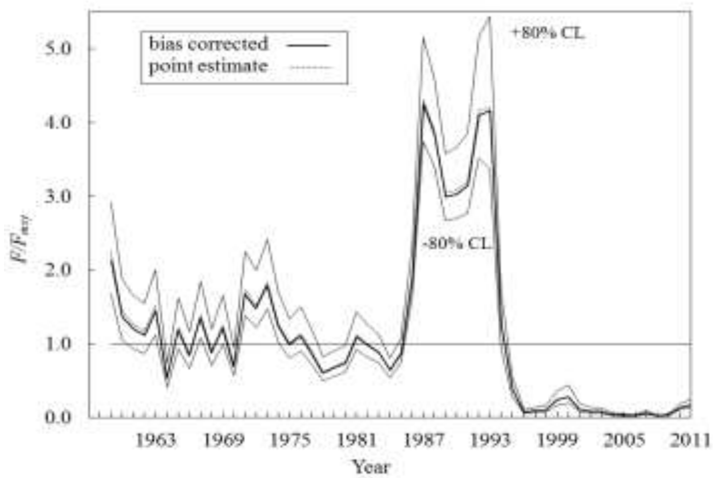


Fig. 10.4c. Redfish in Div. 3LN: F/F_{msy} 1959-2010 trajectories (point estimate and bias corrected with approximate 80% CLs).

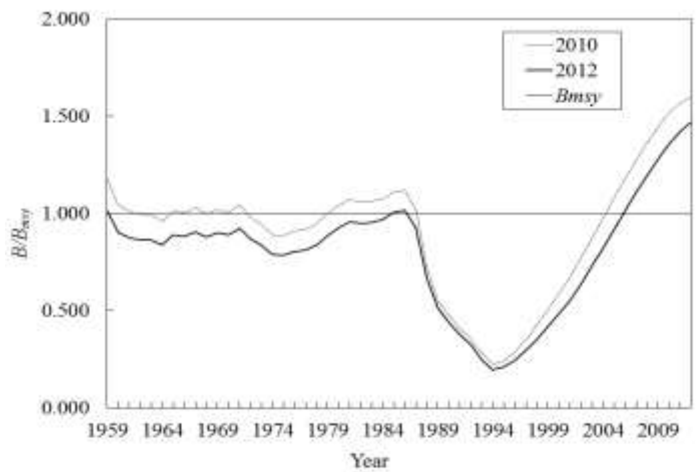


Fig. 10.4d. Redfish in Div. 3LN: B/B_{msy} 1959-2012 trajectories from 2012 and 2010 (extended) $ASPIC_{bot}$ assessments.

Table 10.1. Summary of the ASPIC 2012 results from bootstrapped analysis.

Param. name	ASPIC assessment	Point estimate	Bias corrected	Estimated bias in pt estimate	Estimated relative bias	Bias-corrected approximate confidence limits				Inter-quartile range	Relative IQ range
						80% lower	80% upper	50% lower	50% upper		
B1/K	2012	0.443	**0.507**	0.064	14.37%	0.241	0.643	0.315	0.519	0.204	0.460
K	2012	450300	**466510**	16210	3.60%	351100	747600	398800	608400	209700	0.466
MSY	2012	23700	**24799**	1099	4.64%	21360	31580	22430	26430	4002	0.169
Ye Last year+1	2012	18360	**17642**	-718	-3.91%	10640	32820	14670	26200	11530	0.628
Bmsy	2012	225100	**233203**	8103	3.60%	175600	373800	199400	304200	104800	0.466
Fmsy	2012	0.105	**0.111**	0.006	5.50%	0.082	0.131	0.090	0.116	0.027	0.253
B Last year+1/Bmsy	2012	1.475	**1.470**	-0.005	-0.35%	0.950	1.761	1.164	1.637	0.473	0.321
F Last year/Fmsy	2012	0.168	**0.170**	0.00196	1.16%	0.139	0.241	0.153	0.204	0.050	0.299

The model results suggest a maximum sustainable yield (MSY) of 25 000 t that can be produced with a fishing mortality of 0.11 when stock biomass is at B_{msy} level. Relative biomass was slightly below B_{msy} for most of the former years up to 1987, supporting a fishing mortality at or moderately above F_{msy}. Between 1986 and 1992 catches were higher than MSY (26 000 t-79 000 t), pushing fishing mortality well above F_{msy} from 1986 until 1993. Those eight years of heavy over-fishing determine the fall of biomass from B_{msy} in 1986 to 19% B_{msy} in 1994, when a minimum stock size is recorded. Since 1996 fishing mortality was kept at low to very low levels. Over the moratorium years biomass was allowed to increase and is now above B_{msy}.

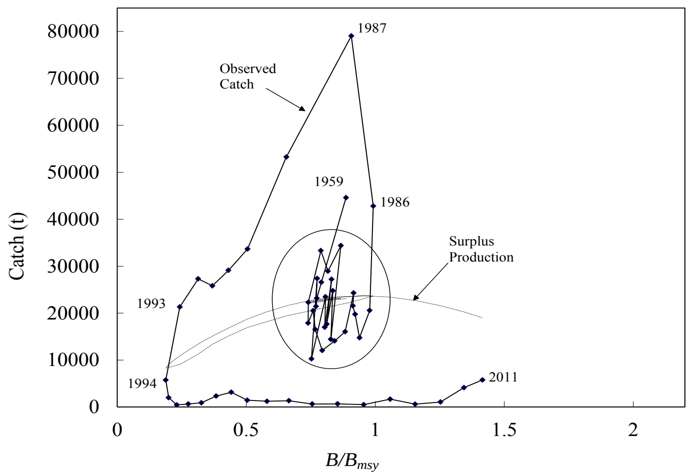


Fig. 10.4e. Redfish in Div. 3LN: Catch versus Surplus Production from $ASPIC_{fit}$ 2012

Catch versus surplus production trajectories are presented on Fig. 10.4e. From 1960 till 1985 catches form a scattered cloud of points around surplus production curve. On 1986-1987 catches rise well above the surplus production and though declining continuously since then were still above equilibrium yield in 1993. Estimated catch has been well below surplus production levels since 1994.

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

Fishing mortality: Fishing mortality has been low since 1995.

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

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

d) Reference Points

The ASPIC bias corrected results were put under the precautionary framework (Fig. 10.5). The trajectory presented shows a stock slightly below B_{msy} under exploitation above F_{msy} through 25 years in a row (1960-1985). The stock rapidly declined afterwards to below B_{lim} in 1993 after fishing mortality rises to well above F_{msy} (1987-1993). Biomass gradually approaches and finally surpasses B_{msy} with fishing mortality being kept at a very low level since 1995.

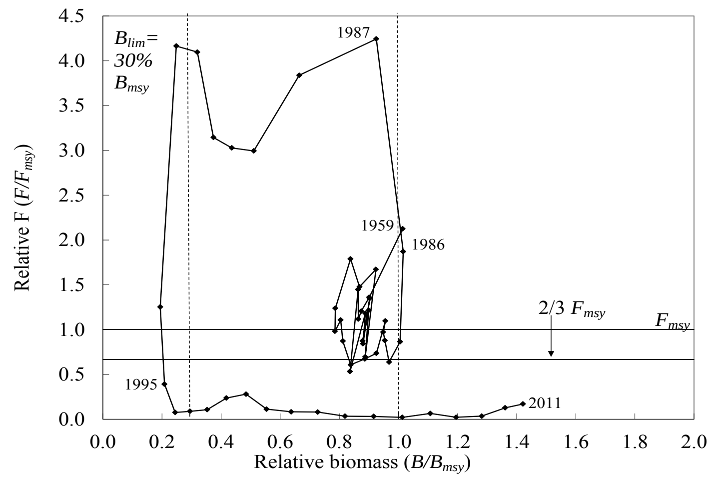


Fig. 10.5. Redfish in Div. 3LN: stock trajectory under a precautionary framework for $ASPIC_{bot}$ 2012.

e) Projections

Four ASPIC short term stochastic projections were carried out assuming a *status quo* catch for 2012, forwarded with increasing options of constant fishing mortality on 2013 and 2014, from $F_{statusquo}$ to 2/3 F_{msy} , stopping at 1/6 F_{msy} and 2/3 F_{msy} in between (Table 10.2a and 10.2b; Fig. 10.6). For all projection options considered the lower 80% confidence limit of the projected relative biomass trajectory being is at or above B_{msy} in 2013-2015.

Table 10.2. Short term projections for redfish in Div. 3LN. The 10^{th}, 50^{th}, and 90^{th} percentiles of projected B/ B_{msy} , F/ F_{msy} and catch (t) are shown, for projected F values of $F_{statusquo}$, 1/6 F_{msy}, 1/3 F_{msy} and 2/3 F_{msy}. *Status quo* catch for 2012.

Fsatutsquo	percentiles		
Year	10	50	90
BIOMASS RELATIVE TO Bmsy			
2012	0.950	**1.470**	1.761
2013	1.023	**1.514**	1.782
2014	1.078	**1.554**	1.797
2015	1.151	**1.588**	1.811
FISHING MORTALITY RELATIVE TO Fmsy			
2012	0.137	**0.164**	0.228
2013	0.139	**0.170**	0.241
2014	0.139	**0.170**	0.241
YIELDS FOR 2013 AND 2014			
2012	5768	**5768**	5768
2013	5915	**6172**	6643
2014	5967	**6346**	7058

1/6 Fmsy	percentiles		
Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy			
2012	0.950	**1.470**	1.761
2013	1.023	**1.514**	1.782
2014	1.079	**1.554**	1.797
2015	1.151	**1.589**	1.811
FISHING MORTALITY RELATIVE TO Fmsy			
2012	0.137	**0.164**	0.228
2013	0.138	**0.169**	0.238
2014	0.138	**0.169**	0.238
YIELDS FOR 2013 AND 2014			
2012	5768	**5768**	5768
2013	5858	**6113**	6579
2014	5910	**6287**	6991

1/3 Fmsy	percentiles		
Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy			
2012	0.950	**1.470**	1.761
2013	1.023	**1.514**	1.782
2014	1.059	**1.528**	1.768
2015	1.120	**1.541**	1.760
FISHING MORTALITY RELATIVE TO Fmsy			
2012	0.137	**0.164**	0.228
2013	0.275	**0.337**	0.477
2014	0.275	**0.337**	0.477
YIELDS FOR 2013 AND 2014			
2012	5768	**5768**	5768
2013	11620	**12126**	13050
2014	11560	**12277**	13650

2/3 Fmsy	percentiles		
Year	10	**50**	90
BIOMASS RELATIVE TO Bmsy			
2012	0.950	**1.470**	1.761
2013	1.023	**1.514**	1.782
2014	1.030	**1.478**	1.711
2015	1.037	**1.450**	1.657
FISHING MORTALITY RELATIVE TO Fmsy			
2012	0.137	**0.164**	0.228
2013	0.550	**0.675**	0.953
2014	0.550	**0.675**	0.953
YIELDS FOR 2013 AND 2014			
2012	5768	**5768**	5768
2013	22850	**23830**	25640
2014	22100	**23397**	26060

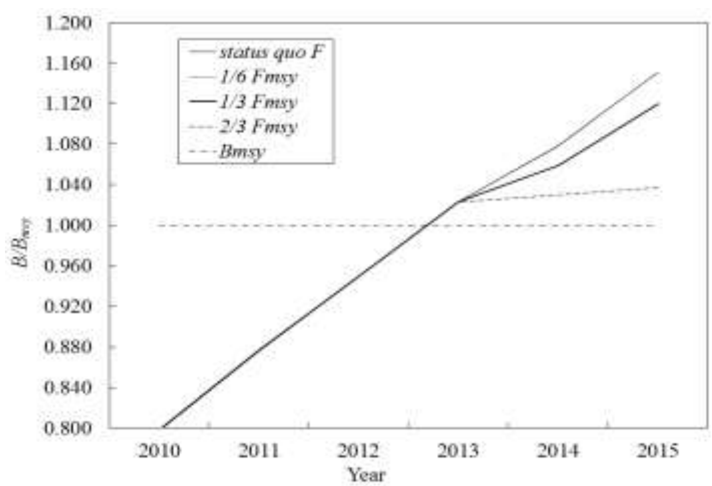


Fig. 10.6. Redfish in Div. 3LN: 2010-2015 bias corrected B/B_{msy} trajectories under several 2013-2014 F/F_{msy} options.

Most recent catches continue to be at a low level on the historical context of this fishery and the response of the stock to a direct fishery of the magnitude of years between the mid-1960s and the mid-1980s is unknown. Therefore, these projection results which indicate substantial increases in projected yield should be treated with caution.

e) Research Recommendations

For redfish in Div. 3LN STACFIS **recommended** that, *in order to prevent increasing unfitness of the ASPIC model to most recent survey data, alternate age based models be explored with the existing data. To undertake such type of assessment Div. 3LN redfish age length keys for the 1990s and 2000s should be provided*.

For redfish in Div. 3LM STACFIS also **recommended**, *in order to allow the fitness of the ASPIC model to the full length of the main survey series, the review of appropriate methods to recalculate survey indices*.

The next full assessment of this stock will be in 2014.

11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO

(SCS Doc. 12/4, 5, 8, 9, 14; SCR Doc. 12/6, 12, 17, 33, 34)

a) Introduction

In most years the majority of the catch has been taken by offshore otter trawlers. There was no directed fishing in 1994 and there has been a moratorium since 1995. Catches increased after the moratorium until 2003 after which they began to decline. This year, STACFIS only had STATLANT 21A available as estimates of catches in 2011. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessment for this stock.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	3.7	2.7	2.4	0.9	1.5	1.9	1.8	2.0	1.2	
STACFIS	6.9-10.6	6.2	4.1	2.8	3.6	2.5	3.0	2.9	na	

[1] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishery
na not available

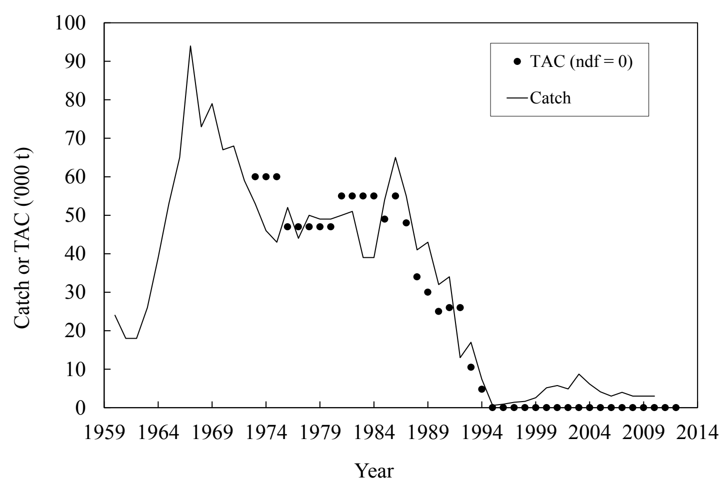


Fig. 11.1. American plaice in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC. There is no catch in plot for 2011.

b) Input Data

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

i) Commercial fishery data

Catch and effort. There were no recent catch per unit effort data available.

Catch-at-age. There was age sampling of the 2011 bycatch in the Canadian fishery and length sampling of bycatch in the Canadian, EU-Spain, EU-Portugal and Russian (only two length frequency samples) fisheries. STACFIS could not estimate total catch for 2011, therefore the 2011 catch-at-age was not calculated.

In 2011 American plaice were taken as bycatch in the Canadian yellowtail fishery, EU-Spain and EU-Portugal skate, redfish and Greenland halibut fisheries. Length frequency data were available from the Canadian bycatch of American plaice in Div. 3LNO, mainly from the yellowtail fishery. Samples were taken from all 3 Divisions, and lengths ranged from 24-70 cm, with a peak around 38 cm. The bycatch for EU-Spain ranged in length from 17-70 cm, with a peak at 34-38 cm. The bycatch in the EU-Portugal fishery consisted of American plaice ranging from 14-56 cm, with a peak at 26-34 cm. The small amount of sampling data available for Russia indicated a peak at 33 cm and another at 43 cm.

ii) Research survey data

Canadian stratified-random bottom trawl surveys. Biomass and abundance estimates for Div. 3LNO from the spring survey declined during the late 1980s-early 1990s. Biomass estimates increased from 1996 to 2008 but declined in 2009 to levels of the late 1990s (Fig. 11.2). The biomass estimate increased in 2010 and again in 2011. The abundance index follows a similar trend. The proportion of fish that are ages 1 to 5 has been increasing and in recent years remain amongst the highest in the time series. However, these ages are probably 'under converted' to varying degrees in the 1985 to 1995 data.

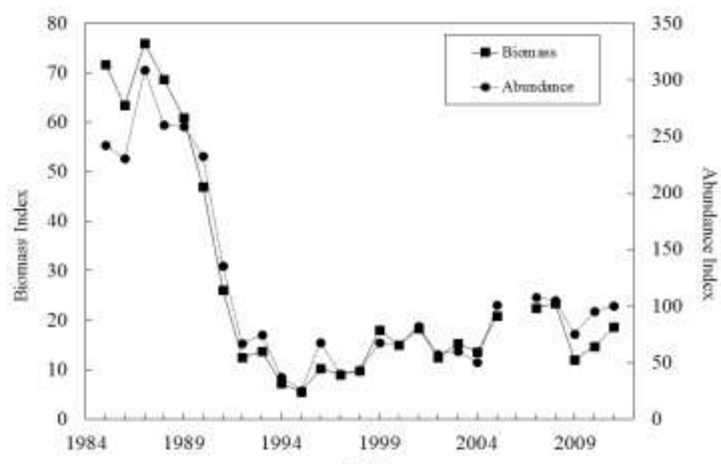


Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys (Data prior to 1996 are Campelen equivalents and since then are Campelen).

Biomass and abundance indices from the autumn survey declined from 1990 to the early-mid 1990s. Both indices have shown an increasing trend since 1995 but remain well below the level of the early-1990s (Fig. 11.3). The proportion of fish aged 0-5 years is somewhat lower in 2011 but still above the average of the time series.

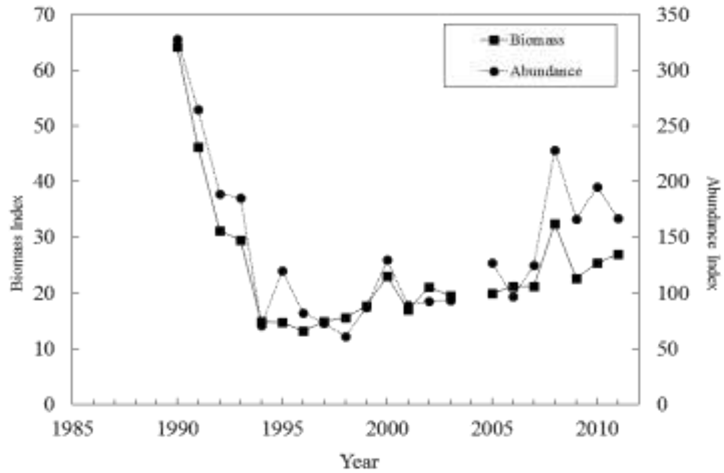


Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys (Data prior to 1995 are Campelen equivalents and since then are Campelen).

Stock distribution for Canadian Surveys. Historically the largest portion of this stock was located in Div. 3L but the highest declines in survey indices were experienced in this region. In more recent years the stock appears more heavily concentrated in Div. 3N in the NAFO Regulatory Area. Results from Canadian spring and autumn surveys both suggest that more than 50% of the stock biomass was located in Div. 3N in 2011.

EU-Spain Div. 3NO Survey. From 1998-2011, surveys have been conducted annually by EU-Spain in the Regulatory Area in Div. 3NO. In 2001, the trawl vessel (CV *Playa de Menduiña*) and gear (*Pedreira*) were replaced by the RV *Vizconde de Eza* using a *Campelen* trawl. Annual Canadian spring RV age length keys were applied to Spanish length frequency data (separate sexes, mean number per tow) to get numbers at age except in 2006 where there were problems with the Canadian spring survey and the combined 1997-2005 age length keys were applied to the 2006 data.

Although variable, generally the biomass and abundance indices declined from 2006-2009 and have been increasing since then.

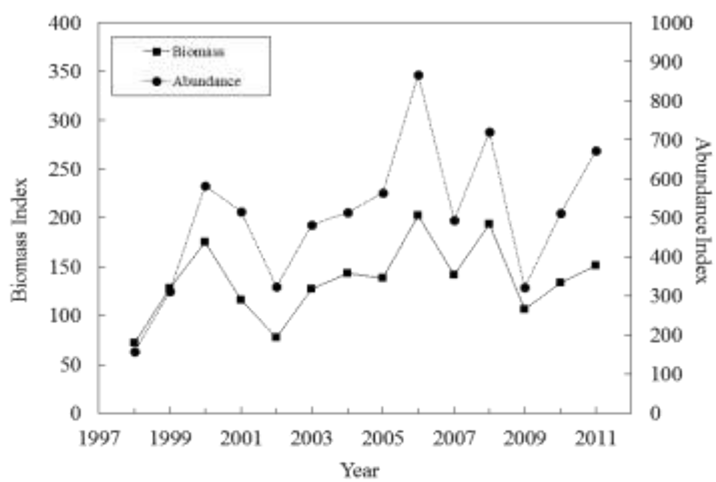


Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from the EU-Spain Div. 3NO survey (Data prior to 2001 are Campelen equivalents and since then are Campelen).

iii) Biological studies

Maturity. Age (A_{50}) and length (L_{50}) at 50% maturity estimates were produced by cohort from spring research vessel data. For males, A_{50} were fairly stable for cohorts of the 1960s to mid-1970s, with perhaps a slight increase over that time period. Male A_{50} then began a fairly steady decline to the 1991 cohort which had an A_{50} of just over 3 years. Male A_{50} has increased somewhat but is still below the 1960s and 1970s with an A_{50} of about 4 years compared to 6 years at the beginning of the time series. For females, estimates of A_{50} have shown a large, almost continuous decline, since the beginning of the time series. For females the A_{50} for recent cohorts is less than 8 years compared to 11 years for cohorts at the beginning of the time series.

L_{50} declined for both sexes but increased in recent cohorts. The recent L_{50} for males of about 19 cm is 3 to 4 cm lower than the earliest cohorts estimated. The L_{50} of most recent cohorts for females is in the range of 33-34 cm, somewhat lower than the 39 cm of the earliest cohorts.

Size-at-age. Mean weights-at-age and mean lengths-at-age were calculated for male and female American plaice for Div. 3LNO using spring survey data from 1990 to 2011. Means were calculated accounting for the length stratified sampling design. Although there is variation in both length and weight-at-age there is little indication of any long-term trend for either males or females.

c) Assessment Results

Since STACFIS was not able to estimate total catch, the analytical assessment using the ADAPTive framework could not be updated in 2012. During the previous assessment in 2011, STACFIS concluded that:

Biomass: Despite the increase in biomass since 1995, the biomass is very low compared to historic levels.

Spawning stock biomass: SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and at the start of 2011 was 34, 000 t. B_{lim} for this stock is 50 000 t.

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

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

State of the Stock: The stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below B_{lim}. Estimated recruitment at age 5 indicates that the 2003 year class is comparable to the 1987-1990 year classes but well below the long term average.

The 2012 assessment does not indicate a change in the status of the stock, based on last year's analytical model and the 2011 survey results.

d) Precautionary Reference Points

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

e) Short Term Considerations

Simulations were carried out in 2011 to examine the trajectory of the stock under 3 scenarios of fishing mortality: $F = 0$, $F = F_{2010}$ (0.11), and $F_{0.1}$ (0.16).

SSB was projected to have a <5% probability of reaching B_{lim} by the start of 2014 when $F = F_{2010}$ (0.11). SSB was projected to have a 50% probability of reaching B_{lim} by the start of 2014 (i.e. end of 2013) when F=0 (Table 13.1). The current projections predicted yield to increase slightly from 2011 to 2012 under $F_{current}$ and $F_{0.1}$ followed by little or no increase in yield in 2013.

Table 13.1 American plaice in Div. 3LNO: Results of stochastic projections under various fishing mortality options. Labels p5, p50 and p95 refer to 5th, 50th and 95th percentiles of each quantity.

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

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

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

The next full assessment of this stock is expected to be in 2014.

f) Research Recommendations

STACFIS **recommended** that *ADAPT model formulations that estimate the F ratio between the plus group and the last true age be investigated and that model fit and resulting retrospective patterns be compared to the current formulation that has an F ratio constraint of 1.*

STATUS: ADAPT model formulations were explored in order to compare the effect of estimating *F*ratio to the current formulation with an *F* ratio constraint of 1. Despite determining that estimating *F*ratio over the survey time period in blocks gave a slightly lower overall mean square residual (MSR) and lower MSR on ages, it was sensitive to the period of time that the stock collapsed and the period of low catches afterward. Output from the model using this formulation indicated that it builds a population in the 1980s which is not consistent with the perception of the stock based on surveys. The retrospective pattern when *F*ratio was estimated was large. Based on these results, and since it was concluded that the current model formulation has a good fit with small error on the population number estimates and a small retrospective pattern, it was recommended that there be no change to the current assessment (NAFO SCR Doc. 12/17).

STACFIS **recommended** that *investigations be undertaken to compare ages obtained by current and former Canadian age readers.*

STATUS: Work is ongoing.

12. Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO

Interim Monitoring Report (SCS 12/05, 12/08, 12/09, 12/14)

a) Introduction

There was a moratorium on directed fishing from 1994 to 1997, and small catches were taken as bycatch in other fisheries. The fishery was re-opened in 1998 and catches increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches from 2001 to 2005 ranged from 11 000 t to 14 000 t. Since then, catches have been below the TAC and in some years, were very low. The low catches since 2006 were related to reduced Canadian effort in the fishery due to various market and economic reasons.

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

	2003[1]	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	14.5	14.5	15.0	15.0	15.5	15.5	< 85% F_{msy}[2]	< 85% F_{msy}[2]	< 85% F_{msy}[2]	< 85% F_{msy}[2]
TAC	14.5	14.5	15.0	15.0	15.5	15.5	17	17	17	17
STATLANT 21	13.3	13.1	13.9	0.6	4.4	11.3	5.9	9.3	5.2	
STACFIS	13.5-14.1	13.4	13.9	0.9	4.6	11.4	6.2	9.4	5.2	

[1] In 2003, STACFIS could not precisely estimate the catch.
[2] SC recommended any TAC up to 85% F_{msy} in 2009 to 2012.

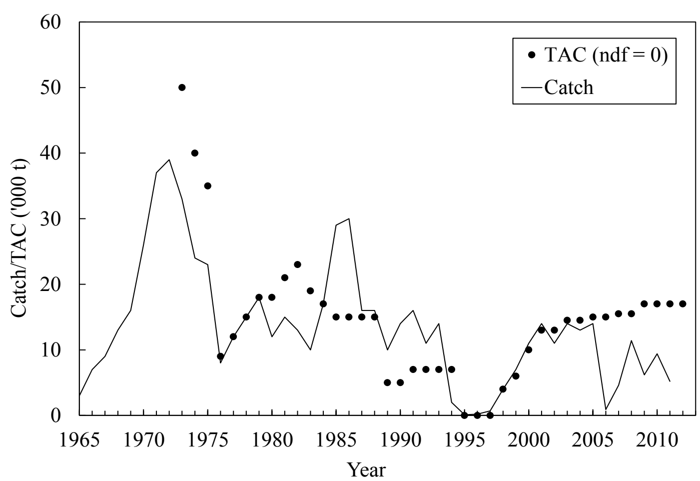


Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

b) Data Overview

i) Research survey data

Canadian stratified-random spring surveys. Problems with the Canadian survey vessel resulted in incomplete coverage, particularly in Div. 3N, in the 2006 spring survey, and survey results in that year may not be comparable with those in other years. The index of trawlable biomass in 2008 was the highest in the series, declined in 2009, but increased in 2010 and 2011. Since 1999, the index of trawlable biomass has been variable, but remains well above the level of the late 1980s and early 1990s.

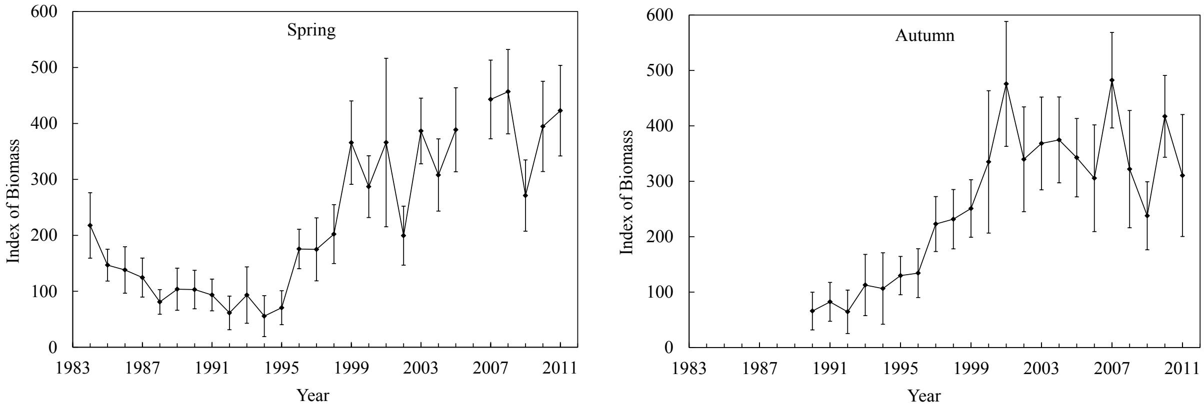


Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approx. 95% confidence intervals, from Canadian spring and autumn surveys.

Canadian stratified-random autumn surveys. The index of trawlable biomass for Div. 3LNO increased steadily from the early-1990s (Fig. 12.2). Following a decline in 2002 from a peak value in 2001, biomass in 2002-2006 remained relatively stable, and then increased to the series high in 2007. The biomass index has since been variable, but was still well above values in the early part of the time series.

EU-Spain stratified-random spring surveys in the NAFO Regulatory Area of Div. 3NO. Beginning in 1995, EU-Spain has conducted stratified-random surveys for groundfish in the NAFO Regulatory Area (NRA) of Div. 3NO. These surveys cover a depth range of approximately 45 to 1 464 m. In 2001, extensive comparative fishing was conducted between the old vessel, C/V *Playa de Menduiňa* (using *Pedreira* trawl) with the new vessel, R/V *Vizconde de Eza*, using a Campelen 1800 shrimp trawl as the new survey trawl.

The biomass of yellowtail flounder increased sharply up to 1999, in general agreement with the Canadian series in Div. 3LNO, was relatively stable from 2000-2008 and has increased slightly thereafter (Fig. 12.3).

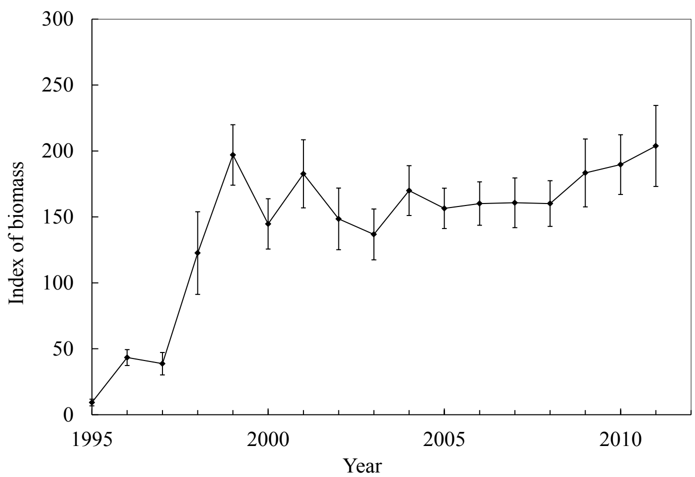


Fig.12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the EU-Spain spring surveys in the Regulatory Area of Div. 3NO. Data are in Campelen equivalents ±1SD.

Stock distribution. In all surveys, yellowtail flounder were most abundant in Div. 3N, in strata on the Southeast Shoal and those immediately to the west (360, 361, 375 & 376), which straddle the Canadian 200 mile limit. Yellowtail flounder appeared to be more abundant in the Regulatory Area of Div. 3N in the 1999-2011 surveys than from 1984-1995, and the stock has continued to occupy the northern portion of its range in Div. 3L, similar to the mid-1980s when overall stock size was also relatively large. The vast majority of the stock was still found in waters shallower than 93 m in both seasons.

Recruitment: Total numbers of juveniles (<22 cm) from spring and autumn surveys by Canada and spring surveys by EU-Spain are given in Fig. 12.4 scaled to each series mean. High catches of juveniles seen in the autumn of 2004 and 2005 were not evident in either the Canadian or EU-Spain spring series. The spring survey by EU-Spain has shown lower than average numbers of small fish in the last five surveys. Although no clear trend in recruitment is evident, the number of small fish in the Canadian surveys has been about average in the last six years. Based on a comparison of small fish (<22 cm) in research surveys, recent recruitment appears to be about average.

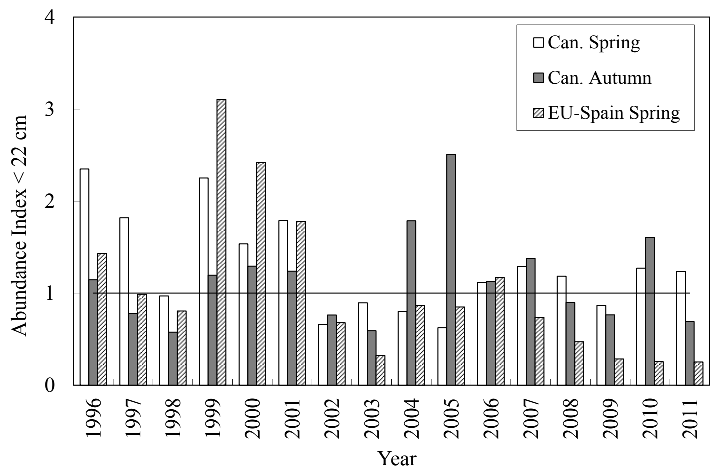


Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile abundance indices from spring and autumn surveys by Canada (Can.) and spring surveys by EU-Spain. Each series is scaled to its mean (horizontal line).

c) Conclusion

Overall, there is nothing to indicate a change in the status of the stock.

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

13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

Interim Monitoring Report (SCR Doc 12/14; SCS Doc. 5, 8, 9, 14)

a) Introduction

Reported catches in the period 1972-84 ranged from a low of about 2 400 t in 1980 and 1981 to a high of about 9 200 t in 1972 (Fig. 13.1). With increased bycatch in other fisheries, catches rose rapidly to about 9 000 t in 1985 and 1986, mainly due to increased effort in Div. 3N. From 1987 to 1993 catches ranged between about 3 700 and 7 500 t and then declined to less than 1 200 t in 1994 t when it was agreed there would be no directed fishing on the stock. Since then, catches have averaged about 500 t; in 2011 the catch was reported as 351 t, taken mainly in the NRA.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.9	0.6	0.3	0.2	0.2	0.2	0.3	0.4	0.4	
STACFIS	0.9-2.2[1]	0.6	0.3	0.5	0.2	0.3	0.4	0.4	0.4	

[1] In 2003, STACFIS could not precisely estimate the catch.
ndf No directed fishery.

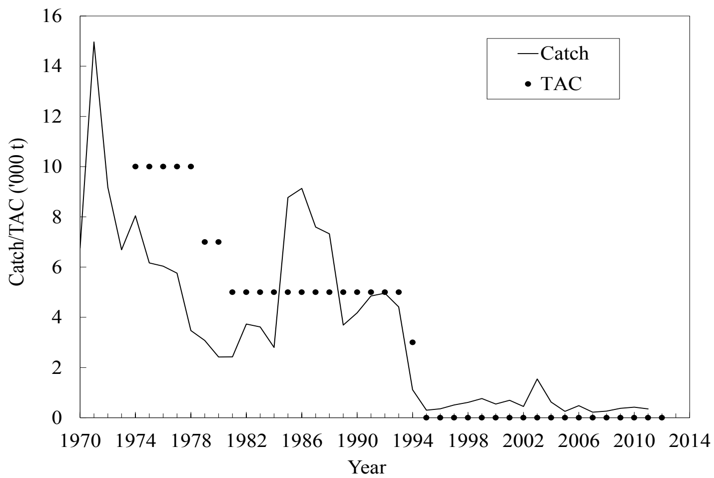


Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as 0 TAC.

b) Data Overview

i) Research survey data

Canadian spring RV survey biomass index. The combined Div. 3NO survey biomass index generally declined until the mid-1990s, then increased slightly, remaining relatively stable since 2004 (Fig. 13.2). The high value in 2003 was largely influenced by one large set; the 2006 survey estimate is biased due to substantial coverage deficiencies and is therefore not included.

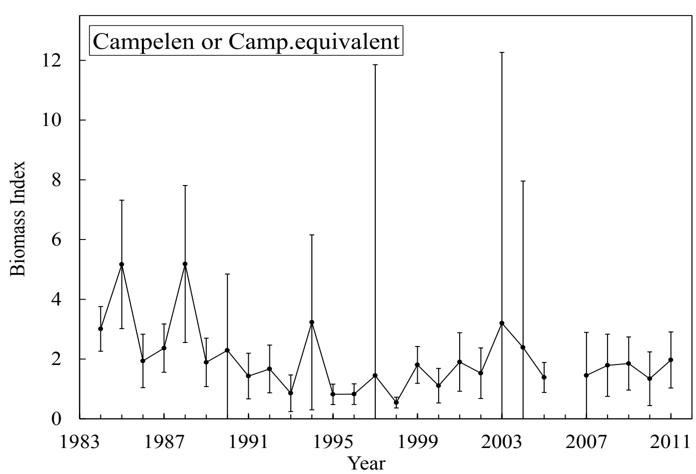


Fig. 13.2. Witch flounder in Div. 3NO: survey biomass index from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units.

Canadian autumn RV survey biomass index. Trends in the autumn survey are complicated slightly by variable coverage of the deeper strata from year to year. With the exception of a low value in 2007, the combined index in Div. 3NO from the autumn survey (Fig. 13.3) has shown a general increasing trend from 1997, reaching the highest value in the time series in 2009, at 7.2. The 2010 value of 5.5 is the second highest in the series, but the index value in 2011 declined to about the level of 2004-2006.

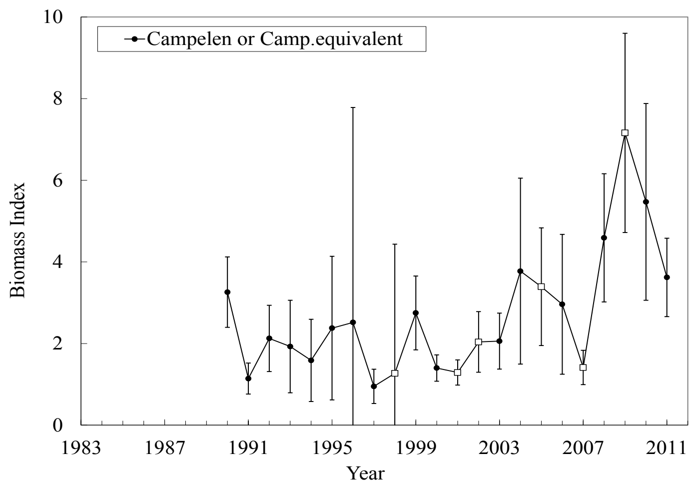


Fig. 13.3. Witch flounder in Div. 3NO: survey biomass index from Canadian autumn surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols indicate years in which more than 50% of the deep water (> 730 m) strata were covered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

Spanish Div. 3NO RV survey biomass index . Surveys have been conducted annually from 1995 to 2011 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1462 m (since 1998). In 2001, the research vessel (R/V *Playa de Menduiña*) and survey gear (Pedreira) were replaced by the R/V *Vizconde de Eza* using a Campelen trawl (SCR Doc. 05/25). Data for witch flounder in Div. 3NO prior to 2001 have not been converted and therefore data from the two time series cannot be compared. In the Pedreira gear time series, the biomass increased from 1995-2000 but declined in 2001; in the Campelen gear time series, the biomass index has been variable, including a high point in 2010, but has been generally decreasing since 2004 (Fig. 13.4).

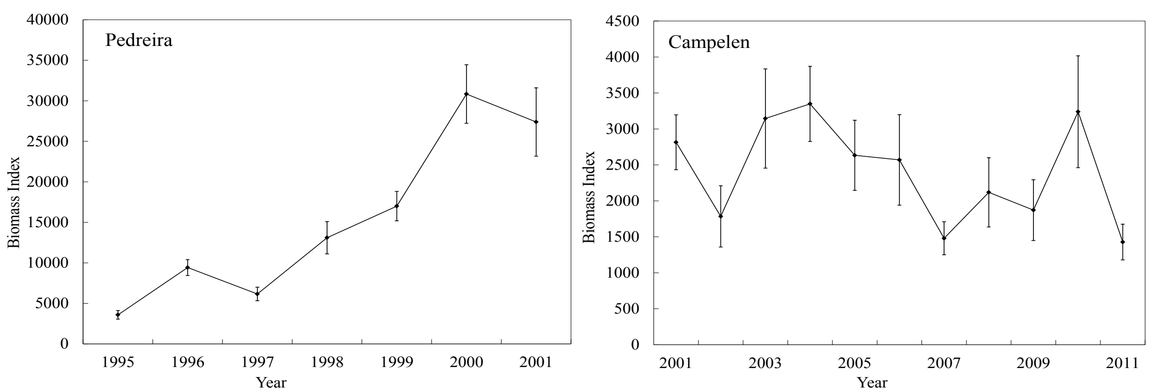


Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from Spanish Div. 3NO surveys (± 1 standard deviation). Data from 1995-2001 are in Pedreira units; data from 2001-2011 are in Campelen units. Both values are present for 2001.

c) Conclusion

Overall, there is nothing to indicate a change in the status of the stock since the 2011 assessment.

The next full assessment of this stock is planned for 2014.

d) Research Recommendation

STACFIS **recommended** *further investigation of recruitment trends for witch flounder in Div. 3NO. This should include analysis of trends in abundance in the survey series, as well as examination of areal distribution of small witch flounder, particularly in years where deeper strata are covered by surveys*. STACFIS noted that analyses of recruitment will rely on length frequency data, as no ageing has been conducted on this stock since the early 1990s.

STATUS: Some analysis has been started, but there is no progress to report at this time. This recommendation is reiterated.

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

Interim Monitoring Report

a) Introduction

The fishery for capelin started in 1971 and catches were high in the mid-1970s with a maximum catch of 132 000 t in 1975. The directed fishery was closed in 1992 and the closure has continued through 2011 (Fig. 14.1). No catches have been reported for this stock since 1993.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	na	na	na	na	na	na	na	na	na	na
Catch[1]	0	0	0	0	0	0	0	0	0	

[1] No catch reported or estimated for this stock

na no advice possible

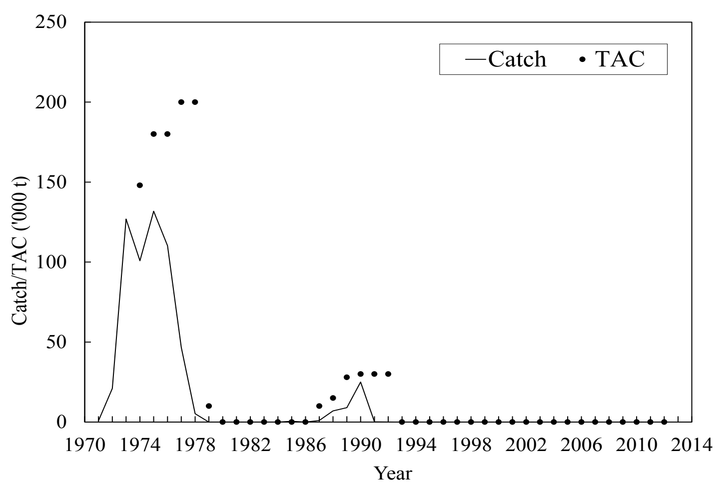


Fig. 14.1. Capelin in Div. 3NO: catches and TACs

b) Data Overview

Trawl acoustic surveys of capelin on the Grand Bank previously conducted by Russia and Canada on a regular basis have not been repeated since 1995. In recent years, STACFIS has repeatedly recommended investigation of the capelin stock in Div. 3NO utilizing trawl-acoustic surveys to allow comparison with historical time series. However, this recommendation has not been acted upon. The only indicator of stock dynamics currently available is capelin biomass indices obtained during Canadian stratified-random spring trawl surveys. In 1996-2011, when Campelen trawl was used as a sampling gear, survey biomass of capelin in Div. 3NO varied on a scale of 4 to 119 (Fig.14.2). In 2008 the biomass index sharply increased to its maximum. In next three years the biomass decreased. In 2011 the survey biomass is the lowest in the time series. To be consistent with the methodology used in previous years, the 2010 biomass estimate has been revised from last year's assessment.

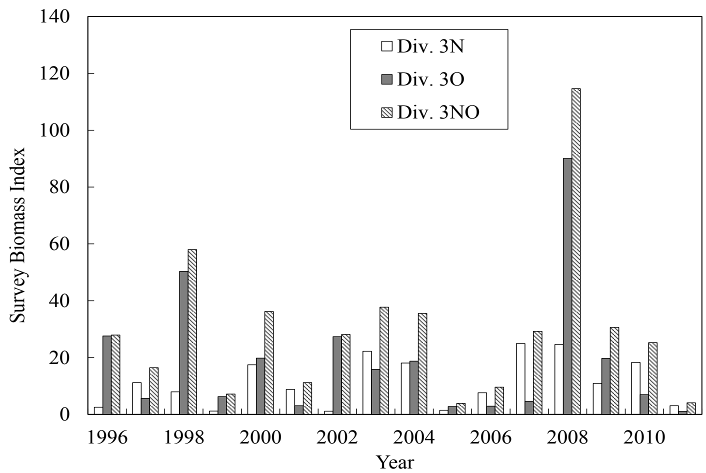


Fig. 14.2. Capelin in Div. 3NO: survey biomass estimates in 1996-2011.

c) Estimation of Stock Condition

Since interpolation by density of bottom trawl catches to the area of strata for pelagic fish species such as capelin can lead to significant deviation of the total biomass, the average value of all non-zero catches was used as an index for evaluation of the stock biomass in 1990-2011. However, if the proportion of zero and non-zero catches change, the index may not be comparable between years.

Survey catches were standardized to 1 km^2 for combining Engel and Campelen trawl data. Trawl sets which did not contain capelin were not included in the account. The confidence intervals around the average catch index were obtained by bootstrapping of standardized catch values. According to data from 1996-2011, the mean catch varied between 0.009 and 1.56 t/km^2. In 2011, this parameter was the lowest in the period and equaled 0.009 (Fig. 14.3). Years when the stock supported a fishery had this index valuing 2 or more.

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

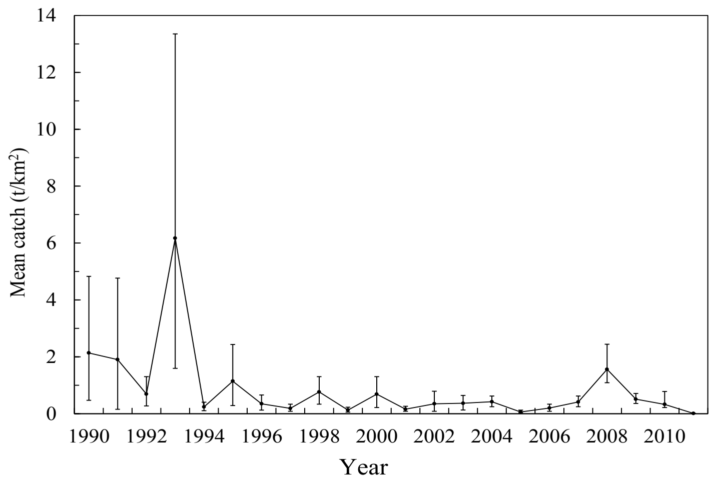


Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km2) in 1990-2011.

d) Assessment Results

Based on available data, there is nothing to indicate a change in the status of this stock.

e) Precautionary Reference Points

STACFIS is not in a position to determine biological reference points for capelin in Div. 3NO.

f) Research recommendations

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

The next full assessment of the stock is planned for 2013.

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

Interim Monitoring Report (SCS Doc. 12/05, 06, 08, 09, 14)

a) Introduction

There are two species of redfish that have been commercially fished in Div. 3O; the deep-sea redfish *(Sebastes mentella)* and the Acadian redfish *(Sebastes fasciatus*). The external characteristics are very similar, making them difficult to distinguish, and as a consequence they are reported collectively as "redfish" in the commercial fishery statistics and RV surveys. Within Canada's fishery zone redfish in Div. 3O have been under TAC regulation since 1974 and a minimum size limit of 22 cm since 1995, whereas catch was only regulated by mesh size in the NRA of Div. 3O. In September 2004, the Fisheries Commission adopted TAC regulation for redfish in Div. 3O, implementing a level of 20 000 t per year for 2005-2008. This TAC applies to the entire area of Div. 3O.

Nominal catches have ranged between 3 000 t and 35 000 t since 1960 and have been highly variable with several distinct periods of rapid increase and decrease (Fig. 15.1). Up to 1986 catches averaged 13 000 t, increased rapidly and peaked at 35 000 t in 1988, then declined to 5 100 t by 1997. Catches increased to 20 000 t in 2001, declined to 4 000 t by 2008 and have since ranged between 5 200 t to 6 500 t with the 2011 reported catch at 6 500 t.

Nominal catches and TACs ('000 t) for redfish in the recent period are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC			NR	NR	NR	NR	NR	NR	NR	NR
TAC[1]	10	10	20	20	20	20	20	20	20	20
STATLANT 21	21.6	6.5	11.9	11.0	7.5	5.1	6.3	6.5	6.5	
STACFIS	17.2	3.8	11.3	12.6	5.2	4.0	6.4	5.2	6.5	

[1] 2003-2004 only applied within Canadian EEZ.
NR: Scientific Council unable to advise on an appropriate TAC

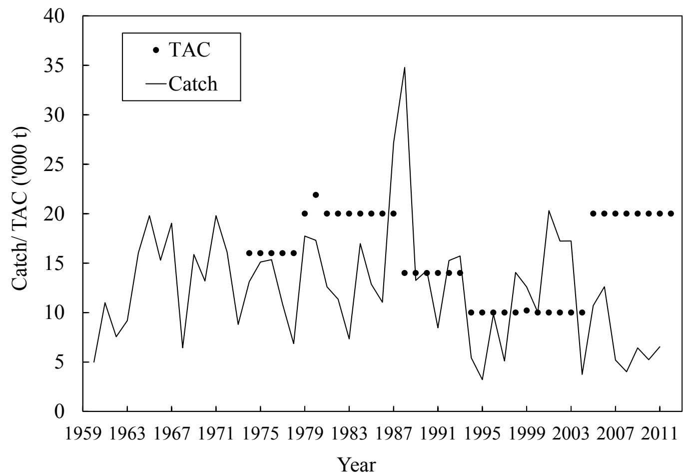


Fig. 15.1. Redfish in Div. 3O: catches and TACs. The TAC for 1974-2004 applied only within the Canadian EEZ

b) Data Overview

Surveys

Canadian spring and autumn surveys were conducted in Div. 3O during 2011. Results of bottom trawl surveys for redfish in Div. 3O have at times indicated a considerable amount of variability, both between seasons and years, making it difficult to interpret year to year changes in the estimates. In general, the survey biomass index has been increasing in both indices since the mid-2000s (Fig. 15.2). For each survey series the average over 2009-2011 represents an increase in the range of 400% to 600% compared to the average over 2001-2003, a period that includes some of the lowest estimates for each series. The recent trend in abundance from the surveys is very similar to the trend in biomass.

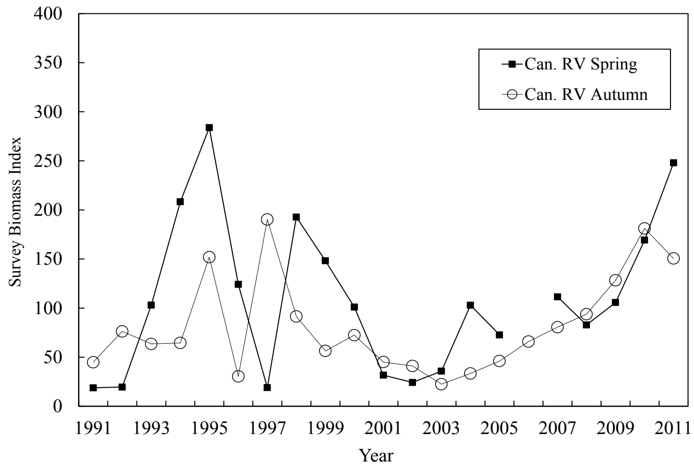


Fig. 15.2. Redfish in Div. 3O: Mean survey biomass index from Canadian surveys in Div. 3O (Campelen equivalent estimates prior to autumn 1995).

c) Conclusion

Catches were stable from 2009 to 2011 while survey indices have increased. Overall, this indicates improvement in the status of the stock that will be evaluated in detail at the next assessment.

The next full assessment of this stock is planned to be in 2013.

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

(SCR Doc. 12/10, 15, 21, 28; SCS Doc. 12/ 05, 08, 09)

a) Introduction

Thorny skate on the Grand Banks was first assessed by Canada for the stock unit 3LNOPs. Subsequent Canadian assessments also provided advice for Div. 3LNOPs. However, Subdivision 3Ps is presently managed as a separate unit by Canada and France in their respective EEZs, and Div. 3LNO is managed by NAFO.

Catch History

Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skate species taken in the Canadian and EU-Spain catches. Thus, the skate fishery on the Grand Banks can be considered a fishery for thorny skate. In Subdivision 3Ps, Canada has established a TAC of 1 050 t. In 2005, NAFO Fisheries Commission established a TAC of 13 500 t for thorny skate in Div. 3LNO. For 2010 and 2011, the TAC for Div. 3LNO was reduced to 12 000 t. The TAC was further reduced to 8 500 t for 2012.

Catches for NAFO Div. 3LNO increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this new fishery were EU-Spain, EU-Portugal, Russia, and Canada. Catches by all countries in Div. 3LNOPs over 1985-1991 averaged 18 066 t; with a peak of 29 048 t in 1991 (STATLANT 21A). From 1992-1995, catches of thorny skate declined to an average of 7 554 t, however there are substantial uncertainties concerning reported skate catches prior to 1996. Average STACFIS catch in Div. 3LNO for 2005-2010 was 4 947 t. STACFIS catch in 2011 was 5 389 t for Div. 3LNO. STATLANT catch in Subdivision 3Ps was 517 t.

Recent nominal catches and TACs (‘000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Div. 3LNO:										
TAC			13.5	13.5	13.5	13.5	13.5	12	12	8.5
STATLANT 21	14.3	11.8	3.5	5.5	6.2	7.1	5.7	5.4	5.4	
STACFIS	11.6	9.3	4.2	5.8	3.6	7.4	5.6	3.1	5.4	
Subdiv. 3Ps:										
TAC			1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
STATLANT 21	1.8	1.3	1.0	1.0	1.8	1.4	0.6	0.3	0.5	
Div. 3LNOPs:										
STATLANT 21	16.1	13.1	4.5	6.5	8.0	8.5	6.4	5.7	5.9	
STACFIS	13.4	10.6	5.2	6.8	5.4	8.8	6.2	3.4	5.9	

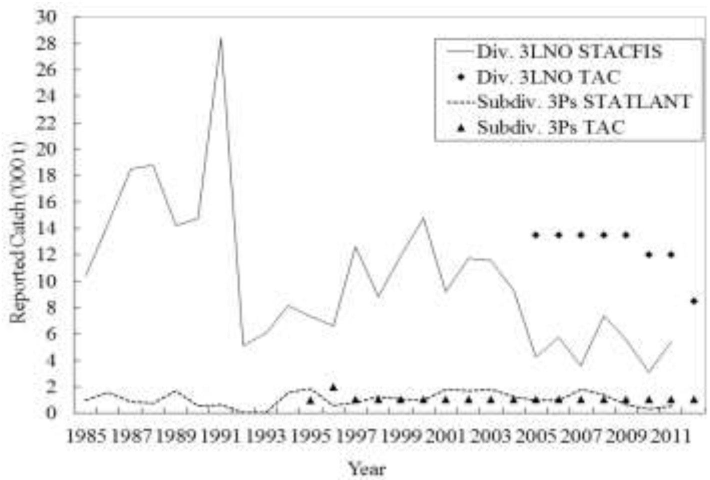


Fig. 16.1. Thorny skate in Div. 3LNOPs: catches and TAC.

b) Data Overview

i) Commercial fisheries

Thorny skates from either commercial or research survey catches are currently not aged.

Commercial length frequencies of skates were available for EU-Spain (1985-1991, 1997-2011), EU-Portugal (2002-2004, 2006-2011), Canada (1994-2008, 2010), and Russia (1998-2008, 2011).

In 2008-2011, commercial length distributions from EU-Portugal, EU-Spain, and Russia in skate-directed trawl fisheries (280 mm mesh) of Div. 3LNO in the NRA indicated that the range of sizes caught were similar to those reported in previous years. One exception was the distribution of skates caught by EU-Portugal in Div. 3NO in 2009: a 25-45 cm range with a mode of 42 cm TL was significantly smaller than those of EU-Spain and Russia (27-95 cm; with a mode of 66 cm). In 2011, EU-Portugal directed for skates with a smaller codend mesh size (200 mm). Thorny skate ranged from 32-82 cm, with a mode of 60 cm.

In other trawl fisheries (130-135 mm mesh) of Div. 3LNO (NRA) in 2008-2009, length distributions of skate bycatch also did not vary between EU-Spain and Russia. In 2008, the size range of skate bycatch reported by EU-Portugal was similar to that of Russian trawlers (28-104 cm with a mode of 58 cm); although Russia also reported a small catch of 12-18 cm young-of-the-year skates. EU-Portugal caught an abbreviated range of smaller skates in 2009, a 24–84 cm range with a mode of 46 cm (2009). In 2011, EU-Portugal the length distribution ranged from 30-84 with a mean length of 61.9cm. Russia only sampled 38 skates in 2011; while Canada did not measure skate lengths for Div. 3LNO in 2011 to compare with those of previous years.

No standardized commercial catch per unit effort (CPUE) exists for thorny skate.

ii) Research surveys

Canadian spring surveys. Stratified-random research surveys have been conducted by Canada in Div. 3L, 3N, 3O, and Subdiv. 3Ps in spring; using a Yankee-41.5 otter trawl in 1972-1982, an Engel-145 otter trawl in 1983-1995, and a Campelen-1800 shrimp trawl in 1996-2009. Maximum depth surveyed was 366 m before 1991, and ~750 m since then. Subdivision 3Ps was not surveyed in 2006; nor was the deeper portion (>103 m) of Div. 3NO in that year, due to mechanical difficulties on Canadian research vessels.

Indices for Div. 3LNOPs in 1972-1982 (Yankee series) fluctuated without trend (Fig. 16.2a).

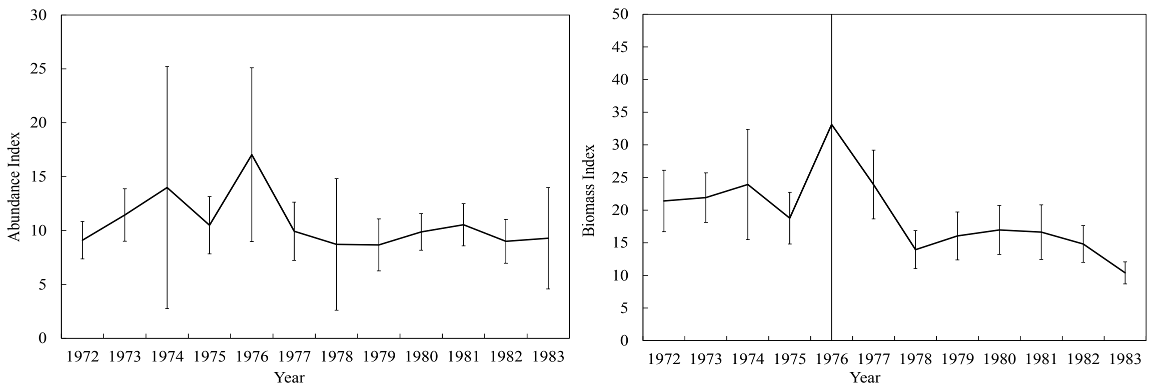


Fig. 16.2a. Thorny skate in Div. 3LNOPs: 1972-1982 abundance and biomass indices from Canadian spring surveys.

Standardized mean number and weight per tow are presented in Figure 16.2 for Div. 3LNOPs. Catch rates of thorny skate in Div. 3LNOPs declined from the mid-1980s until the early 1990s. Since 1997, biomass indices have been slowly increasing while abundance indices remain relatively stable at low levels (Fig. 16.2b).

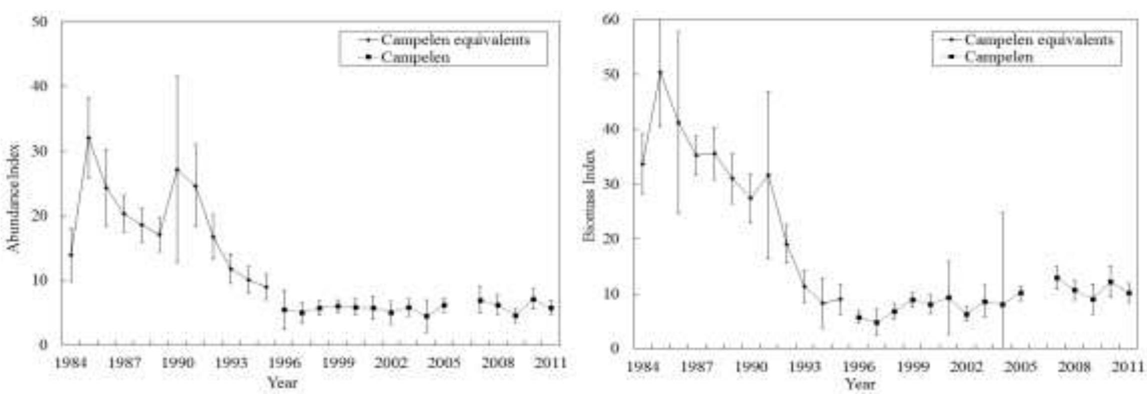


Fig. 16.2b. Thorny skate in Div. 3LNOPs: 1984-2011 abundance (left) and biomass (right) indices from Canadian spring RV surveys. Survey in 2006 was incomplete

Canadian autumn surveys. Stratified-random autumn surveys have been conducted by Canada in Div. 3L, 3N, and 3O; using an Engel-145 otter trawl in 1990-1994, and a Campelen-1800 shrimp trawl in 1995-2011 to depths of ~1 450 m.

Autumn survey catch rates, similar to spring estimates, declined over the early 1990s. Catch rates have been stable since 1995 (Fig. 16.3). Autumn estimates of abundance and biomass are on average higher than spring estimates. This is expected, because thorny skates are found at depths exceeding the maximum depths surveyed in spring (~750 m), and are more deeply distributed during winter/spring.

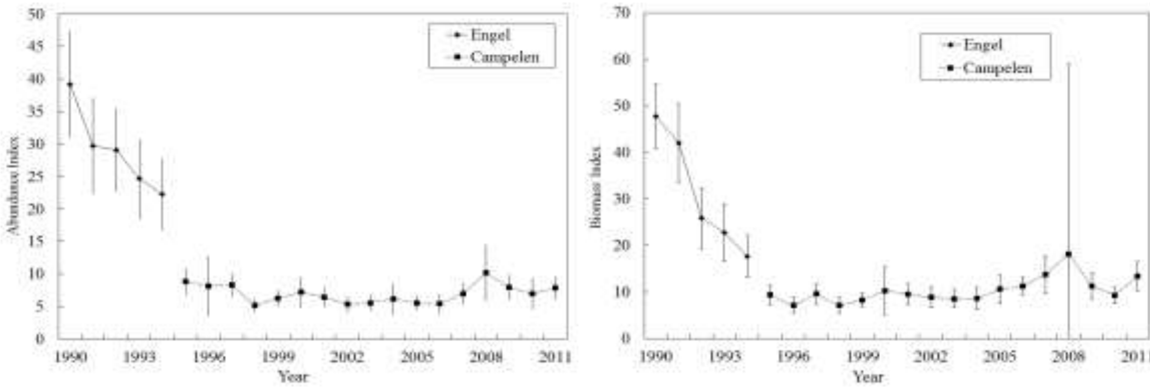


Fig. 16.3. Thorny skate in Div. 3LNO, 1990-2011, abundance (right) and biomass (left) indices from Canadian autumn surveys. Note that Engel trawl data in 1990-1994 and Campelen trawl data in 1995-2011 are not directly comparable.

EU-Spain Div. 3NO survey. The biomass trajectory from the EU-Spain surveys was very similar to that of Canadian spring surveys until 2006 (Fig. 16.4). Since 2007 the two indices have been divergent with the EU-Spain index declining, while the Canadian 3NO index is generally fluctuating within a narrow biomass range. A comparison of common strata found little difference between the time series between 1997-2005 and 1997-2010. Differences in the survey indices appear to result from poor catch rates in the EU-Spain survey in deeper strata not sampled in Canadian surveys.

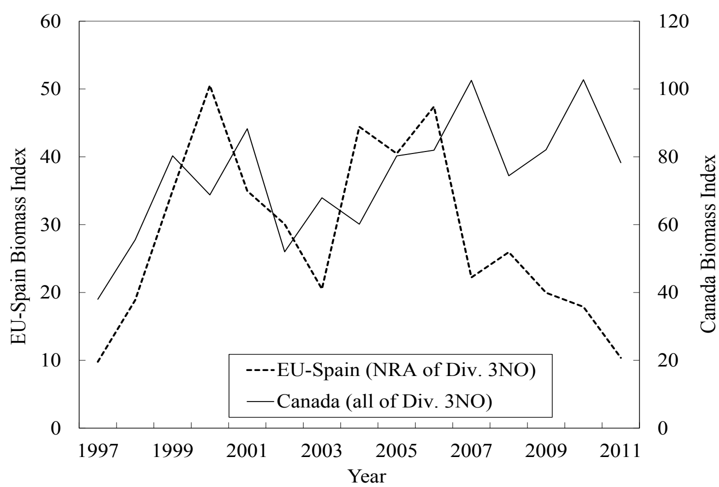


Fig. 16.4. Thorny skate in Div. 3NO: estimates of biomass from EU-Spain spring surveys and Canadian RV spring surveys from 1997-2011.

EU-Spain 3L survey. EU-Spain survey indices in the NRA of Div. 3L are available for 2003-2011 (excluding 2005). The stratified random spring bottom trawl survey is conducted by the R/V *"Vizconde de Eza"* using a Campelen bottom trawl. The survey only occurs in the NAFO Regulatory Area (Flemish Pass), and does not cover the entire divisions. The EU-Spain Div. 3L index has been in decline since 2007 which is similar to the Canadian autumn Div. 3L survey index, while the Canadian spring Div. 3L index fluctuates within a narrow biomass range throughout the time period (Fig. 16.5).

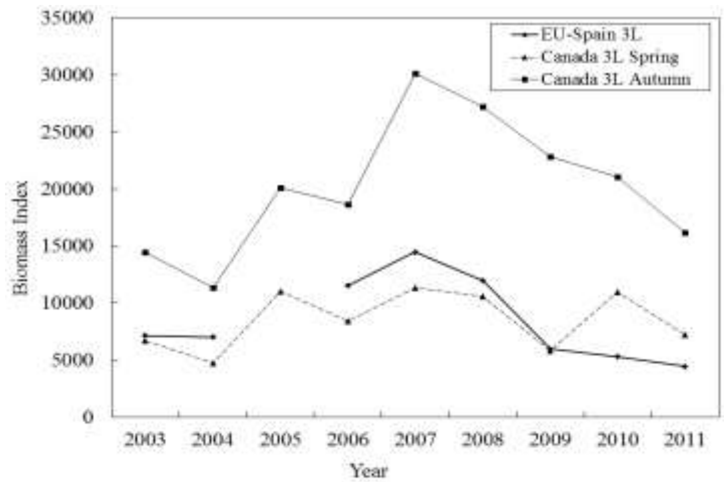


Fig. 16.5. Thorny skate in Div. 3L: Biomass indices from the EU-Spain Div. 3L survey and the Canadian autumn and spring RV surveys for NAFO Div. 3L from 2003-2011.

iii) Biological studies

Based on Canadian Campelen spring surveys in Div. 3LNOPs, various life stages of thorny skate underwent different changes in abundance over time. In 1996-2011, the abundance of thorny skate recruits (5-20 cm TL) appeared to be relatively stable, estimates of male and female immature skates fluctuated along decreasing trends, and estimates of mature skates fluctuated along an increasing trend.

Recruitment index (skate < 21cm) has been fluctuating without any clear trend from 1996-2009. The index in 2010 and 2011 is however 50% above average. Thorny skates have low fecundity and long reproductive cycles. These characteristics result in low intrinsic rates of increase, and suggest low resilience to fishing mortality.

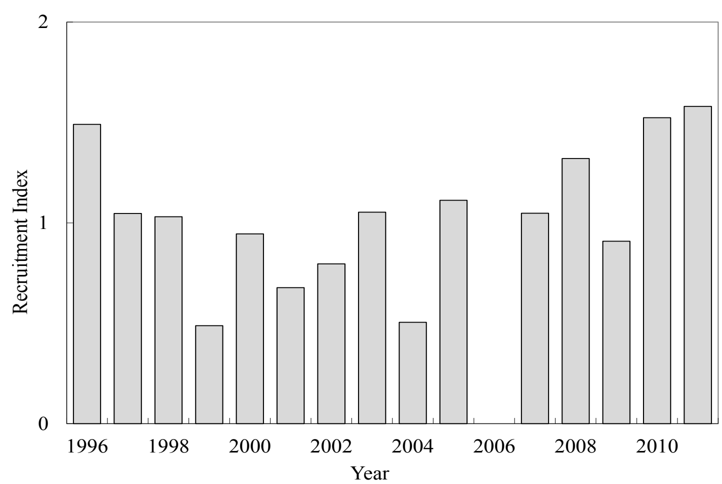


Fig. 16.6. Thorny skate in Div. 3LNOPs: Standardized recruitment index from Canadian spring surveys in Div. 3LNOPs, 1996-2011. Survey in 2006 was incomplete.

c) Assessment Results

Assessment Results: No analytical assessment was performed.

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

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

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

Reference Points: None defined. .

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

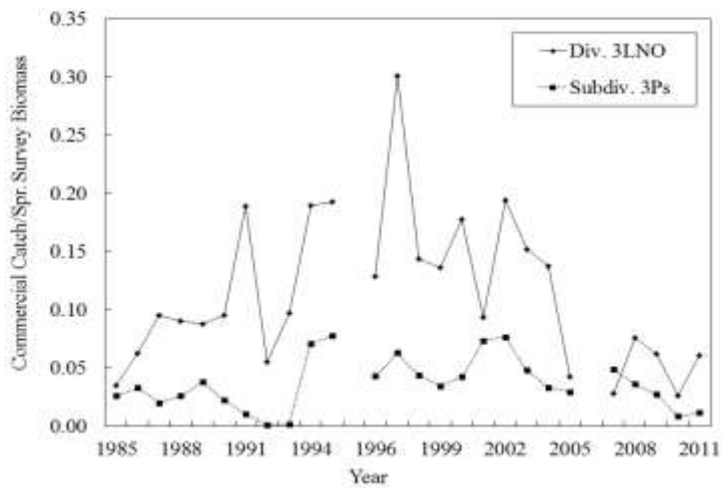


Fig. 16.7. Thorny skate in Div. 3LNOPs: Fishing Mortality Index (catch/spring survey biomass) for Div. 3LNO and Subdiv. 3Ps in 1985-2011. Commercial catch estimates are STACFIS-agreed numbers; biomass indices are from Canadian Campelen spring research surveys. Survey in 2006 was incomplete.

d) Research Recommendations

For thorny skate in Div. 3LNOPs STACFIS **recommended** that *further work be conducted on development of a quantitative stock model. Exploration of Bayesian surplus production models has been initiated.*

STACFIS **recommended** that *due to the divergence in EU-Spain and Canadian spring surveys that analysis of the Canadian and EU-Spain indices be conducted for consistency and variation in relationship to spatial extent.*

STATUS: Analysis was conducted, differences in the survey indices appear to result from poor catch rates in the EU-Spain survey in deeper strata not sampled in Canadian surveys. .

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

Interim Monitoring Report (SCR Doc. 12/15; SCS Doc. 12/05, 08, 09)

a) Introduction

The advice requested by Fisheries Commission is for NAFO Div. 3NO. Previous studies indicated that white hake constitute a single unit within Div. 3NOPs, and that fish younger than 1 year, 2+ juveniles, and mature adults distribute at different locations within Div. 3NO and Subdiv. 3Ps. This movement of fish of different stages between areas must be considered when assessing the status of white hake in Div. 3NO. Therefore, an assessment of Div. 3NO white hake is conducted with information on Subdiv. 3Ps included.

Canada commenced a directed fishery for White Hake in 1988 in Div. 3NO and Subdiv. 3Ps. All Canadian landings prior to 1988 were as bycatch in various groundfish fisheries. EU-Spain and EU-Portugal commenced a directed fishery in 2002, and Russia in 2003, in the NRA of Div. 3NO; resulting in the 2003-2004 peak. There were no directed fisheries by EU-Spain in 2004 or by EU-Spain, EU-Portugal, or Russia in 2005-2011. In 2003-2004, 14% of the total catch of White Hake in Div. 3NO and Subdiv. 3Ps were taken by Canada, but increased to 93% by 2006; primarily due to the absence of a directed fishery for white hake by other countries. A TAC for white hake in the NRA of Div. 3NO was first implemented by Fisheries Commission in 2005 at 8 500 t, and then reduced to 6 000 t for 2010 and 2011. The TAC in Div. 3NO for 2012 is 5 000 t.

From 1970-2009, white hake catches in Div. 3NO fluctuated, averaging approximately 2 000 t, exceeding 5 000 t in only three years during that period. Catches peaked in 1985 at approximately 8 100 t (Fig. 17.1). With the restriction of fishing by other countries to areas outside Canada's 200-mile limit in 1992, non-Canadian landings fell to zero. Average catch was low in 1995-2001 (464 t), then increased to 6 718 t in 2002 and 4 823 t in 2003; following recruitment of the large 1999 year-class. STACFIS-agreed catches decreased to an average of 677 t in 2005-2010, and was 152 t for 2011 in Div. 3NO.

Commercial catches of white hake in NAFO Subdiv. 3Ps were less variable, averaging 1 114 t in 1985-93, then decreasing to an average of 619 t in 1994-2002 (Fig. 17.1). Subsequently, catches increased to an average of 1 174 t in 2004-2007, then decreased to a 468-t average in 2008-2010; with 202 t for 2011.

Recent nominal catches and TACs (000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Div. 3NO:										
TAC	-	-	8.5	8.5	8.5	8.5	8.5	6	6	5
STATLANT 21	6.2	1.9	1.0	1.2	0.7	0.9	0.5	0.3	0.2	
STACFIS	4.8	1.3	0.9	1.1	0.6	0.9	0.4	0.2	0.2	
Subdiv. 3Ps:										
STATLANT 21	1.1	1.4	1.6	1.5	1.3	0.7	0.4	0.4	0.2	

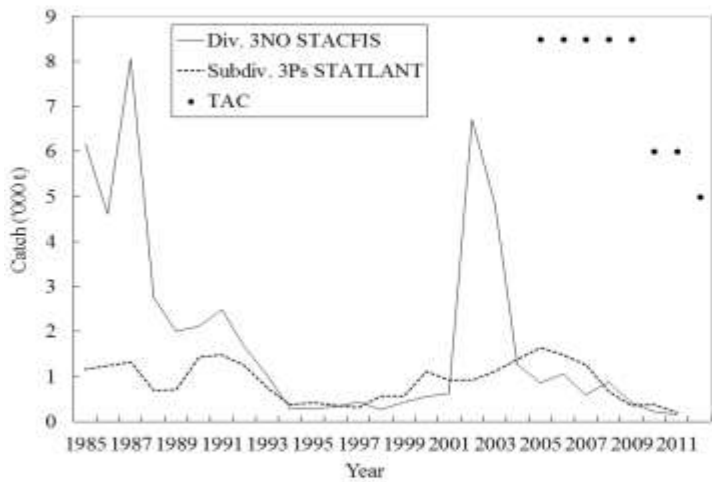


Fig. 17.1. White hake in Div. 3NO and Subdiv. 3Ps: Total catch of white hake in NAFO Division 3NO (STACFIS) and Subdivision 3Ps (STATLANT-21A). The Total Allowable Catch (TAC) in the NRA of Div. 3NO is indicated on the graph.

b) Data Overview

i) Research survey data

Canadian stratified-random bottom trawl surveys. Data from spring research surveys in NAFO Div. 3N, 3O, and Subdiv. 3Ps were available from 1972 to 2011. In the 2006 Canadian spring survey, most of Subdiv. 3Ps was not surveyed, and only shallow strata in Div. 3NO (to a depth of 77 m in Div. 3N; to 103 m in Div. 3O) were surveyed; thus the survey estimate for 2006 was not included. Data from autumn surveys in NAFO Div. 3NO were available from 1990 to 2010. Canadian spring surveys were conducted using a Yankee 41.5 bottom trawl prior to 1984, an Engel 145 bottom trawl from 1984 to 1995, and a Campelen 1800 trawl thereafter. Canadian autumn surveys in Div. 3NO were conducted with an Engel 145 trawl from 1990 to 1994, and a Campelen 1800 trawl from 1995-2011. There are no survey catch rate conversion factors between trawls for white hake; thus each gear type is presented as a separate time series.

Abundance and biomass indices of white hake from the Canadian spring research surveys in Div. 3NOPs are presented in Fig. 17.2a. In 2003-2011, the population remained at a level similar to that previously observed in the Campelen time series for 1996-1998. The dominant feature of the white hake abundance time series was the peak abundance observed over 2000-2001. This peak in abundance was also reflected in the very large 1999 year-class in Canadian autumn research surveys of Div. 3NO (Fig. 17.2b). Autumn indices have since declined to levels similar to those of 1996-1998. Autumn survey catch rates in Div. 3NO remained at levels comparable to those observed from 1995 to 1998 in the Campelen time series.

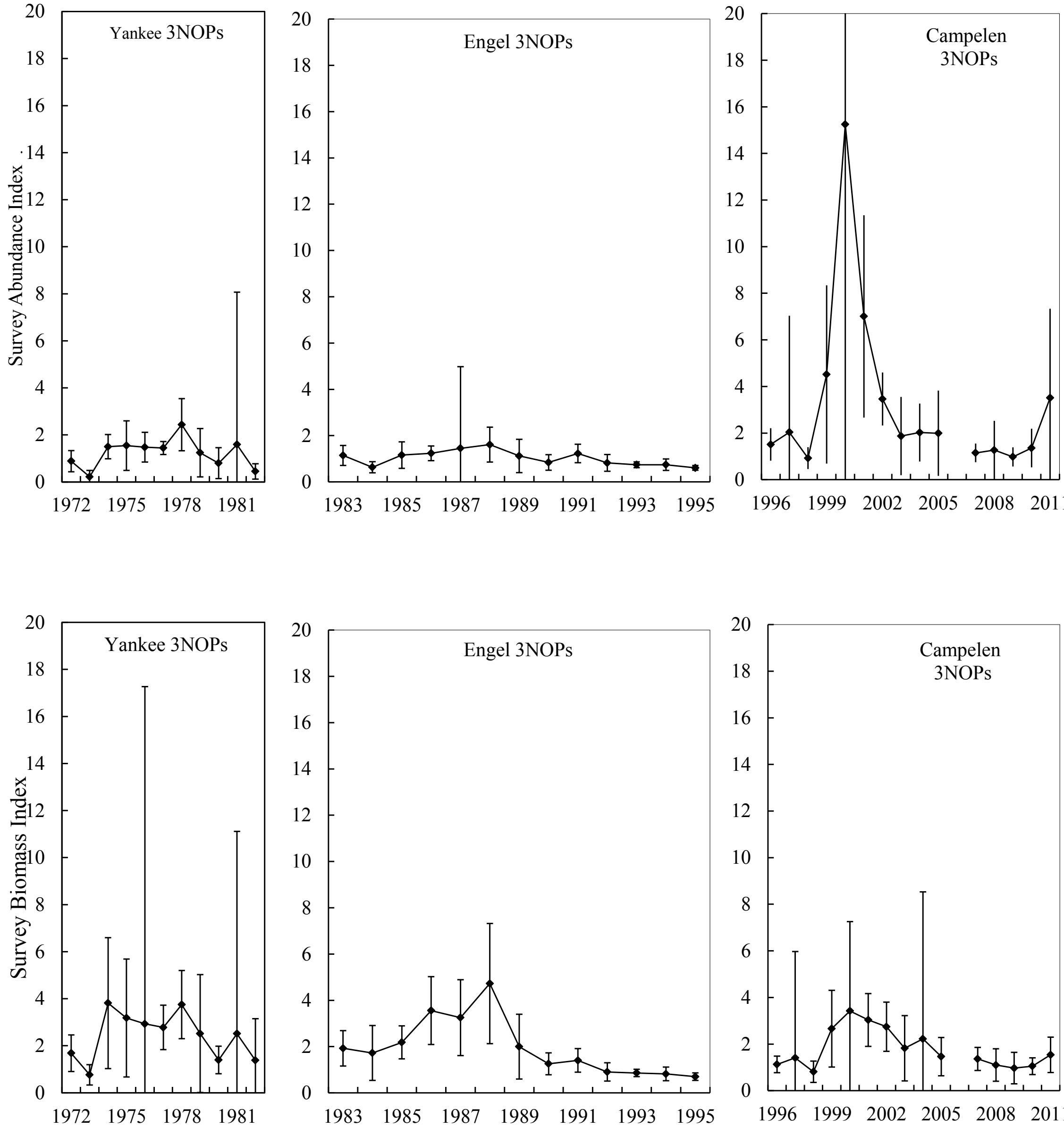


Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: abundance and biomass indices from Canadian spring research surveys, 1972-2011. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. The Yankee, Engel, and Campelen time series are not standardized, and are thus presented on separate panels. Error bars are 95% confidence limits.

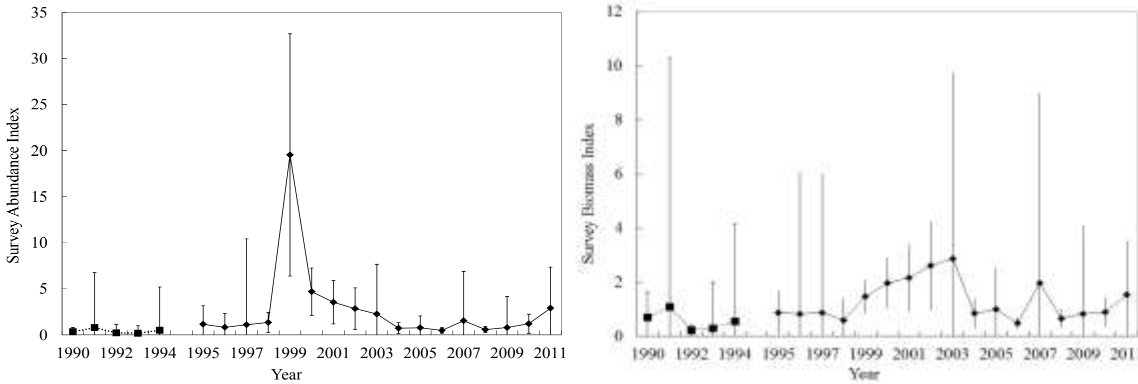


Fig. 17.2b White hake in Div. 3NO: abundance (left panel) and biomass indices (right panel) from Canadian autumn surveys, 1990-2011. The Engel (■, 1990-1994) and Campelen (♦, 1995-2011) time series are not standardized. Error bars are 95% confidence limits.

EU-Spain stratified-random bottom trawl surveys in the NRA. EU-Spain biomass indices in the NAFO Regulatory Area of Div. 3NO were available for white hake in 2001-2011 (Fig. 17.3). EU-Spain surveys were conducted with Campelen gear (similar to that used in Canadian surveys) in the spring to a depth of 1 400 m. The EU-Spain biomass index was highest in 2001, then declined to 2003, peaked slightly in 2005, and then declined to its lowest level in 2008. In 2009 and 2010, the EU-Spain index increased slightly relative to 2008. In 2011 the EU-Spain index increased. The overall trend is similar to that of the Canadian spring survey index (Fig. 17.3).

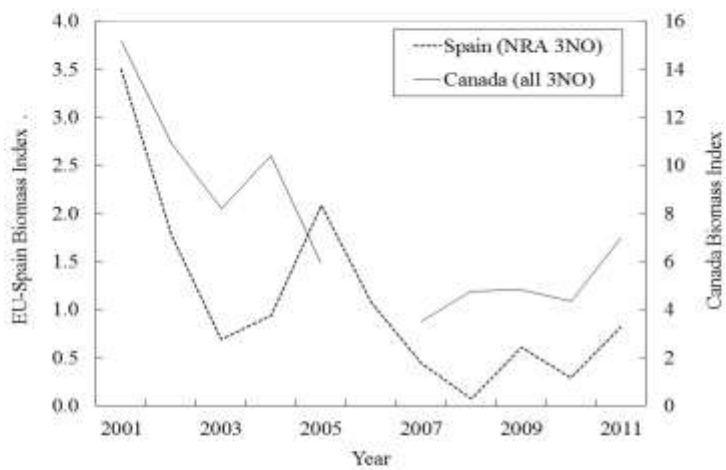


Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from EU-Spain Campelen spring surveys in 2001-2011 compared to Canadian spring survey indices in all of Div. 3NO. Estimates from 2006 Canadian survey are not shown, since survey coverage in that year was incomplete.

Recruitment. In Canadian spring research surveys, the number of white hake less than 27 cm in length is assumed to be an index of recruitment at age-1. The 1999 and 2000 year-classes were large, but no similar large year classes were observed during intervening years. The index of recruitment for 2011 is comparable to that seen in 1999.

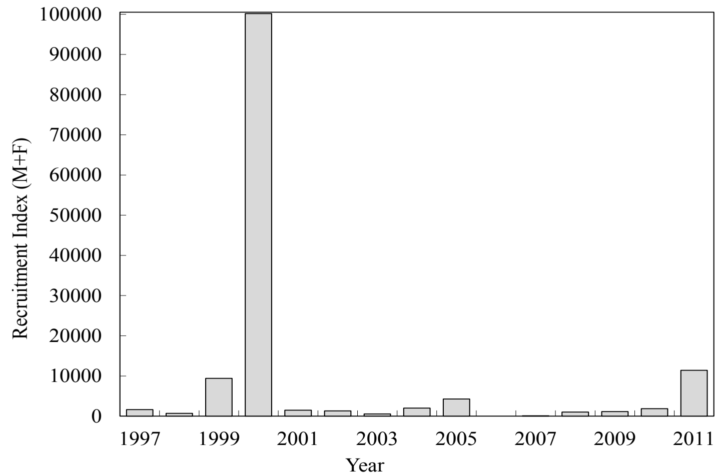


Fig. 17.4. White hake in Div. 3NO and Subdiv. 3Ps: recruitment index from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2011. Estimates from 2006 are not shown, since survey coverage in that year was incomplete.

c) Conclusion

Based on current information there is no significant change in status of this stock.

The next full assessment of this stock is planned for 2013.

d) Research Recommendations

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

STATUS: Genetic studies are completed and results will be presented during the next full assessment therefore this recommendation is reiterated.

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2011+); thereby allowing age-based analyses of this population*.

STATUS: Otoliths are being collected but have yet to be aged. This recommendation is reiterated

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *survey conversion factors between the Engel and Campelen gear be investigated for this stock*.

STATUS: No progress to date. This recommendation is reiterated.

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *the maturity time series be analyzed to investigate any potential annual changes in maturity*.

STATUS: No progress to date. This recommendation is reiterated.

D. WIDELY DISTRIBUTED STOCKS: SA 2, SA 3 AND SA 4

Environmental Overview

(SCR Doc. 11/16, 11/13, and 11/14)

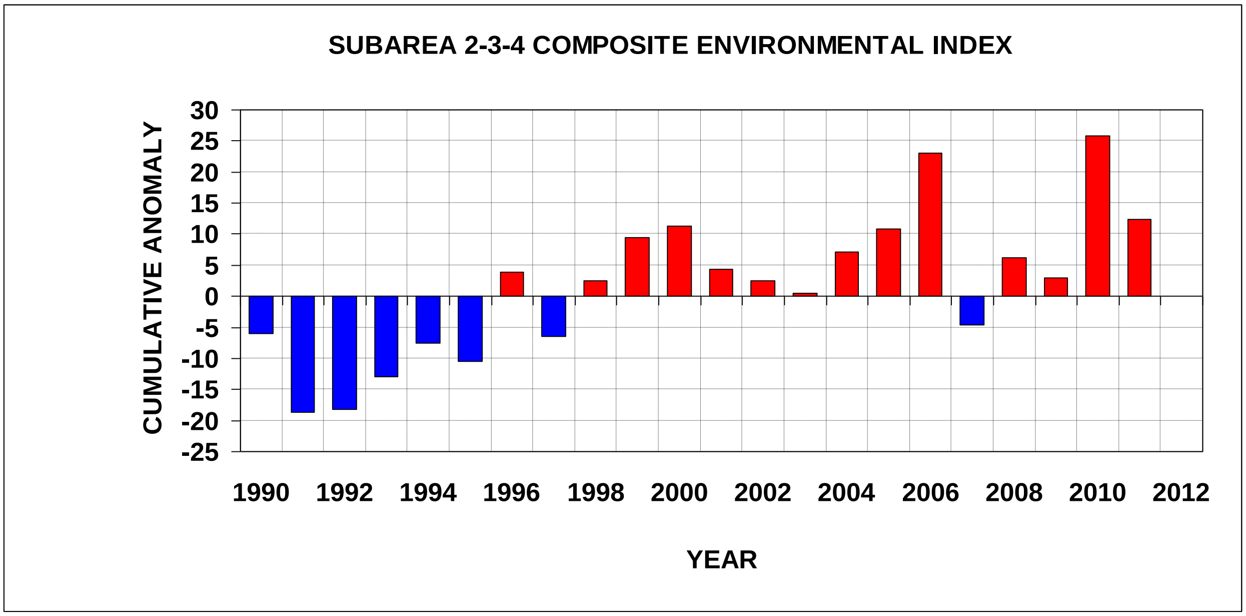


Fig. IV-4. Composite ocean climate index for NAFO Subarea 2-3-4 (widely distributed stocks) derived by summing the standardized anomalies.

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1-2ºC and salinities of 32-33.5. Labrador Slope Water flows southward along the shelf edge and into the Flemish Pass region, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3º-4ºC and salinities in the range of 34-34.75. On average bottom temperatures remain <0°C 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 3-4°C. Throughout most of the year the cold, relatively fresh water overlying the shelf is separated from the warmer higher-density water of the continental slope region by a strong temperature and density front. This winter-formed water mass is generally referred to as the Cold Intermediate Layer (CIL) and is considered a robust index of ocean climate conditions. In general, shelf water masses undergo seasonal modification in their properties due to the seasonal cycles of air-sea heat flux, wind-forced mixing and ice formation and melt, leading to intense vertical and horizontal gradients particularly along the frontal boundaries separating the shelf and slope water masses. Temperature and salinity conditions over the Scotian Shelf are largely determined by advection of water from southern Newfoundland and the Gulf of St. Lawrence as well as offshore slope waters. In the northeast regions of the Scotian Shelf the bottom tends to be covered by relatively cold waters (1-4°C) whereas the basins in the central and southwestern regions have bottom temperatures that typically are 8-10°C.

The composite climate index across the widely distributed stocks in Subareas 2 to 4 has remained above normal in recent years (2008-2011) showing a peak in 2010 (Fig. IV-4). The below normal levels observed during the early to mid-1990s were moderated somewhat by the less intense cooling observed in Subarea 1 (West Greenland). Water temperatures on the Newfoundland and Labrador Shelf remained above normal, setting new record highs in some areas in 2011. Salinities on the NL Shelf were fresher-than-normal in many areas from 2009-2011. At a standard monitoring site off eastern Newfoundland (Station 27), the depth-averaged annual water temperature increased to a record high in 2011 at 3 SD above the long-term mean. Annual surface temperatures at Station 27 were above normal by 0.6 SD (0.4°C) while bottom temperatures (176 m) were at a record high at 3.4 SD (1.3°C) above normal. The annual depth-averaged salinities at Station 27 were below normal for the 3rd consecutive year. The annual stratification index at Station 27 decreased to 2 SD below normal, the lowest since 1980. The area of the CIL water mass with temperatures <0°C on the eastern Newfoundland Shelf (Bonavista Section) during the summer of 2011 was at a record low value at 2 SD below normal, implying warm conditions, while off southern Labrador it was the 4th lowest at 1.5 SD below normal. On the Grand Bank (Flemish Cap Section) the CIL area was the second lowest on record. The volume of CIL (<0°C) water on the NL shelf during the autumn was below normal (4th lowest since 1980) for the 17th consecutive year. Average temperatures along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. Spring bottom temperature in 3LNO during 2011 was above 0°C and up to 1°-2°C higher than normal. During the autumn, bottom temperatures in 2J and 3K were also at a record high value, at 2 and 2.7 SD above normal, respectively, and in 3LNO they were 1.8 SD above normal. Generally, bottom temperatures were about 1°-2°C above normal in most regions, with very limited areas of the bottom covered by <0°C water.

Above normal ocean temperature also prevailed further south on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas. The climate index, a composite of 18 selected, normalized time series, averaged +0.9 SD with 17 of the 18 variables more than 0.5 SD above normal; compared to the other 42 years, 2011 ranks as the 6th warmest. Bottom temperatures were above normal in NAFO Subarea 4 with anomalies ranging from 0.3 to 0.8 °C above normal. Stratification on the Scotian Shelf weakened significantly in 2011 compared to 2010. The change was mainly due to a decrease in sea surface temperature, although surface salinity was the lowest in a decade. Since 1950, there has been a slow increase in stratification on the Scotian Shelf, resulting in a change in the 0-50 m density difference of 0.36 kg m^{-3} over 50 years. The density difference due to the decrease in surface salinity accounted for 48% of the change in stratification.

18. Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3

Interim Monitoring Report (SCR Doc. 12/15; SCS Doc. 12/05, 06, 08, 09 and 14)

a) Introduction

The stock structure of this species in the North Atlantic remains unclear because there is little information on the number of different populations that may exist and their relationship. Roughhead grenadier is distributed throughout NAFO Subareas 0 to 3 in depths between 300 and 2 000 m. However, for assessment purposes, NAFO Scientific Council considers the population of Subareas 2 and 3 as a single stock.

A substantial part of the grenadier catches in Subarea 3 previously reported as roundnose grenadier has been roughhead grenadier. To correct the catch statistics STACFIS revised and approved roughhead grenadier catch statistics since 1987 for assessment purposes. The misreporting has not yet been resolved in the official statistics before 1996, but the species are considered to be reported correctly since 1997. Catches of roughhead grenadier increased sharply from 1989 (333 t) to 1992 (6 725 t); since then until 1997 total catches have been about 4000 t. In 1998 and 1999 catches increased and were near the level of 7 000 t. From then, catches decreased to 3000–4000 t in 2001–2004 and to 700 t in 2007. In the 2007-2012 period catches were at similar low level. A total catch of 931 t was estimated for 2011 (Fig. 18.1). In the catch series available, less than 2% of the yearly catch has been taken in Subarea 2.

Recent catches ('000 t) are as follow:

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
STATLANT 21	1.7	1.8	1.7	1.3	0.6	0.5	0.5	0.7	0.8	0.9
STACFIS	3.7	4.2-3.8[1]	3.2	1.5	1.4	0.7	0.8	0.6	0.9	0.9

[1] In 2003, STACFIS could not precisely estimate the catch.

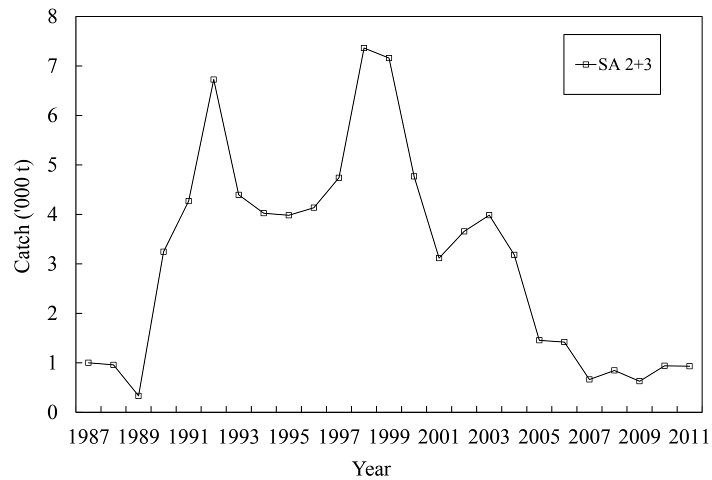


Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches.

b) Data Overview

Surveys

There is no survey index covering the total distribution, in depth and area, of this stock. The Canadian autumn survey series (Div. 2J+3K) and the EU-Spanish Div. 3NO are considered the best survey indicators of stock biomass as they are the longest series extending 1500 meters. Both indices show a general increase trend since the beginning of the series up to mid-2000s. Since then the Canadian Div. 2J+3K series has continued to increase while the Spanish Div. 3NO index has decreased (Fig. 18. 2).

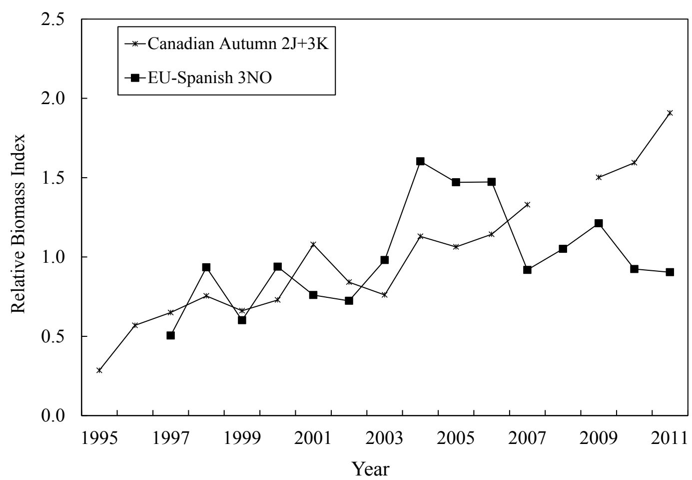


Fig. 18.2. Roughhead grenadier in Subareas 2+3: Relative (to the mean of the period) biomass indices from the Canadian autumn (Div. 2J+3K) survey and EU- Spanish 3NO survey.

The catch/biomass (C/B) ratios have a clear decline trend in the period 1995-2005 and since then are stable at low levels (Fig. 18.3). This is due to the fact that all surveys indices are relatively high and catches remain low.

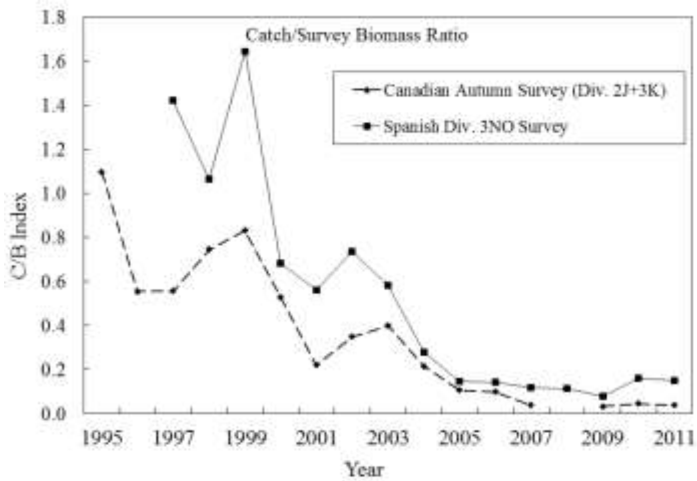


Fig. 18.3. Roughhead grenadier in Subareas 2+3: The catch/biomass (C/B) ratios from the Canadian autumn (Div. 2J+3K) survey and EU-Spanish 3NO survey.

c) Conclusion

Based on overall indices for the current year, there is no significant change in the status of the stock.

The next full assessment of this stock is planned to be in 2013.

d) Research Recommendation

In 2010 STACFIS recommended that *further investigation on recruitment indices for roughhead grenadier in Subarea 2 and 3 will be carried out.*

STATUS: New information was not available in this matter.

In 2011 STACFIS recommended *to study the possibility of including in future assessments all surveys series for roughhead grenadier before 1995.*

STATUS: New information was not available in this matter.

Both recommendations will be addressed next year during the full assessment.

19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL

Interim Monitoring Report (SCS Docs. 12/05, 12/08, 12/09, 12/14)

a) Introduction

The fishery for witch flounder in NAFO Divisions 2J, 3K and 3L began in the early 1960s and increased steadily from about 1 000 t in 1963 to a peak of over 24 000 t in 1973 (Fig. 19.1). Catches declined rapidly to 2 800 t by 1980 and subsequently fluctuated between 3 000 and 4 500 t to 1991. The catch in 1992 declined to about 2 700 t, the lowest since 1964; and further declined to around 400 t by 1993. Until the late 1980s, the fishery was conducted by Poland, USSR and Canada mainly in Div. 3K. Since then, the regulated fishery had been mainly Canadian although EU (Portugal and Spain) has taken increased catches in the Regulatory Area of Div. 3L since the mid-1980s. Although a moratorium on directed fishing was implemented in 1995, the catches in 1995 and 1996 were estimated to be about 780 and 1 370 t, respectively. However, it is believed that these catches could be overestimated by 15-20%. The catches in 1997 and 1998 were estimated to be about 850 and 1 100 t, respectively, most of which was reported from the Regulatory Area of Div. 3L. From 1999 to 2004 catches were estimated to be between 300 and 800 t. From 2005-2010, catches averaged less than 200 t and in 2011, 219 t were taken.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf	ndf
STATLANT 21	0.5	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.2	
STACFIS	0.7	0.8	0.2	0.1	0.1	0.1	0.1	0.2	0.2	

ndf no directed fishing.

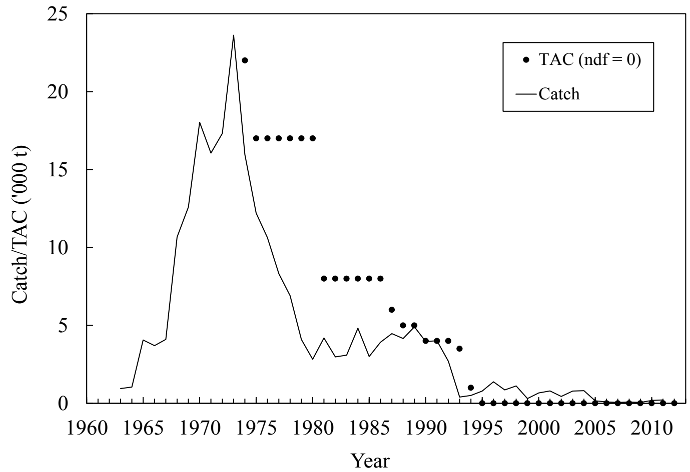


Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

b) Data Overview

i) Surveys

Canadian surveys were conducted in Divs. 2J3KL during autumn 2011 (Fig 19.2). The survey biomass estimates showed an increasing trend from 2003 to 2009, and have since remained stable, although estimates are imprecise. Survey coverage in Div. 3L was incomplete in 2004 and 2005, and in 2008 there were substantial survey coverage deficiencies in 2J, 3K and 3L (SCR 09/012). Results in these years may, therefore, not be comparable to other years.

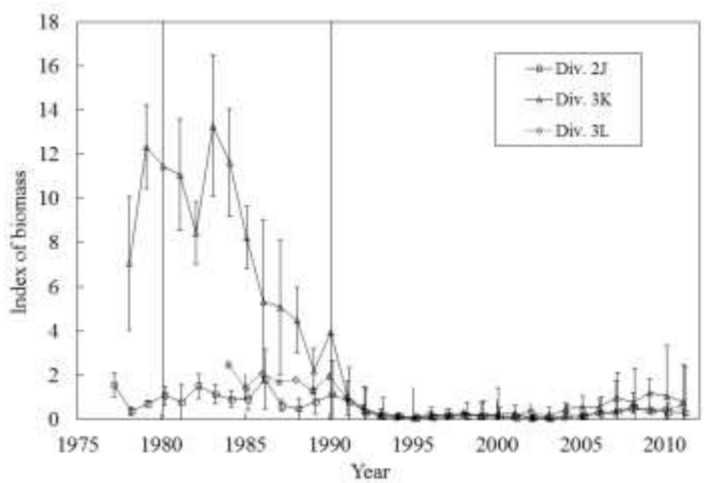


Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: Index of biomass (with 95% confidence limits) from Canadian autumn surveys. Values are Campelen units or, prior to 1995, Campelen equivalent units.

c) Conclusion

Based on survey indices for the current year, there is nothing to indicate a change in the status of the stock.

The next full assessment of this stock is scheduled for 2013.

d) Research Recommendations

Witch flounder catch reported as taken in NAFO Div. 3M has the potential to belong to the Div. 2J3KL witch flounder stock, therefore STACFIS **recommended** that *the origin of the catch of witch flounder reported as caught in NAFO Div. 3M be explored.*

Bowering and Vazquez (SCR Doc. 02/075) explored the distribution and abundance of witch flounder on the Flemish cap and in the Flemish pass based on research vessel survey data in order to address a similar research recommendation in the past. They concluded that the witch flounder resource in Div. 3L did not appear to be strongly linked to that in Div. 3M and that, based on the distribution and abundance of witch in the deep water of the Flemish pass, bycatch from this area would have to be extremely small. For this current recommendation, then, catch taken in Div. 3M and survey data from Canadian autumn surveys and EU summer surveys from 2003-2011 were examined (SCR Doc. 12/040). Catch of witch flounder in Div. 3M has remained relatively small and in recent years has been below 340 t. In recent years, trends in the EU summer survey of Div. 3M are similar to the trends in reported catch from Div. 3M. Distributions of witch flounder in the more recent surveys of Div. 3M are much like those reported in SCR Doc. 02/75, with very few of the sets in the Flemish Pass containing witch flounder. There is potential for Div. 2J3KL witch flounder to be caught in the area of the Grand Bank that extends into Div. 3M on the western side of the Flemish Pass (the Sackville Spur). As well, there is a portion of the Flemish Cap that extends into Div. 3L, and witch from Div. 3M could potentially be caught in Div. 3L. Survey catches in both of these areas have been negligible in recent years, however, and commercial catches from these areas would likely be very low. There is nothing in the recent catch or survey data to refute the previous conclusions concerning the relationship of witch flounder in this area, and STACFIS still considers that the witch flounder population in Div. 3M is not strongly linked to the Div. 2J3KL witch flounder stock.

STACFIS **recommended** that *methods to improve the estimates of abundance and biomass from the Canadian autumn surveys be explored (for example excluding strata from the estimate where witch flounder are known not to occur).*

Biomass estimates of witch flounder in Div. 2J3KL were produced from the Canadian autumn RV (1984-2011) survey data using only information from strata which have contained witch flounder in at least one year. Although there was a slight increase in mean number and weight per tow using these index strata, the confidence limits around the estimates were not improved, and in some years remained quite large.

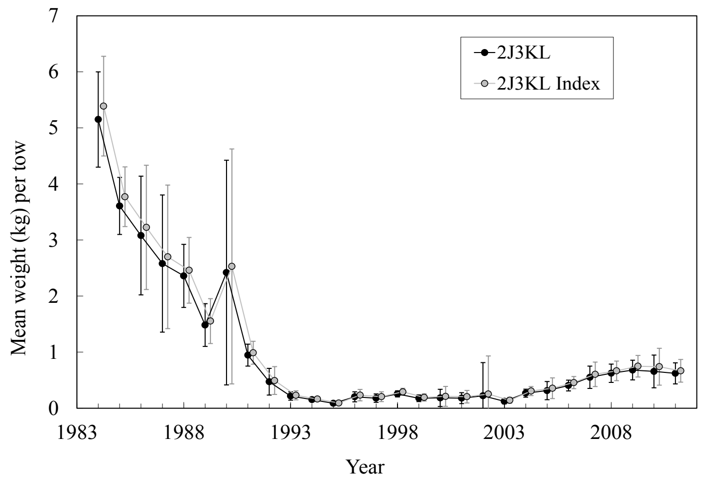


Fig. 19.3. Witch flounder in Div. 2J, 3K and 3L: Mean weight (kg) per tow (with 95% confidence limits) from Canadian autumn surveys for all strata (Div. 2J3KL) and index strata (Div. 2J3KL Index). Values are Campelen units or, prior to 1995, Campelen equivalent units.

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

(SCR Doc. 12/06, 12, 19, 21, 24, 26, 30; SCS Doc. 12/05, 06, 08, 09, 12; FC Doc. 03/13, 10/12)

a) Introduction

Fishery and Catches: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by NAFO Fisheries Commission (FC). Catches increased sharply in 1990 due to a developing fishery in the NAFO Regulatory Area in Div. 3LMNO and continued at high levels during 1991-94. The catch was only 15 000 to 20 000 t per year in 1995 to 1998. The catch increased since 1998 and by 2001 was estimated to be 38 000 t, the highest since 1994. The estimated catch for 2002 was 34 000 t. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 t to 38 500 t. In 2003, a fifteen year rebuilding plan was implemented by Fisheries Commission for this stock (FC Doc. 03/13). Though much lower than values of the early 2000s, estimated catch over 2004-2010 has exceeded the TAC by considerable margins. TAC over-runs have ranged from 22%-64%, despite considerable reductions in effort. The STACFIS estimate of catch for 2010 is 26 170 t (64% over-run). In 2010, Fisheries Commission implemented a survey-based harvest control rule (FC Doc. 10/12) to generate annual TACs over at least 2011-2014. For 2011, STACFIS only had STATLANT 21A available as estimates of catches. The inconsistency between the information available to produce catch figures used in the previous year's assessments and that available for the 2011 catches has made it impossible for STACFIS to provide the best assessments for some stocks.

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Recommended TAC	36	16	nr*	nr*	nr*	nr*	<10.5[*,2]	<8.8[*,2]	<14.5[*,2]	16.3†
TAC	42	20	19	18.5	16	16	16	16	17.2 †	16.3 †
STATLANT 21	30.6	16.0	17.8	17.7	15.3	15.0	14.7	15.7	15.7	
STACFIS	32-38[1]	25.5	23.3	23.5	22.7	21.2	23.2	26.2	na	

nr – no recommendation
na – not available
* – evaluation of rebuilding plan
† – TAC generated from HCR
[1] In 2003, STACFIS could not precisely estimate the catch.
[2] SC recommended that "fishing mortality should be reduced to a level not higher than $F_{0.1}$". Tabulated values correspond to the $F_{0.1}$ catch levels.

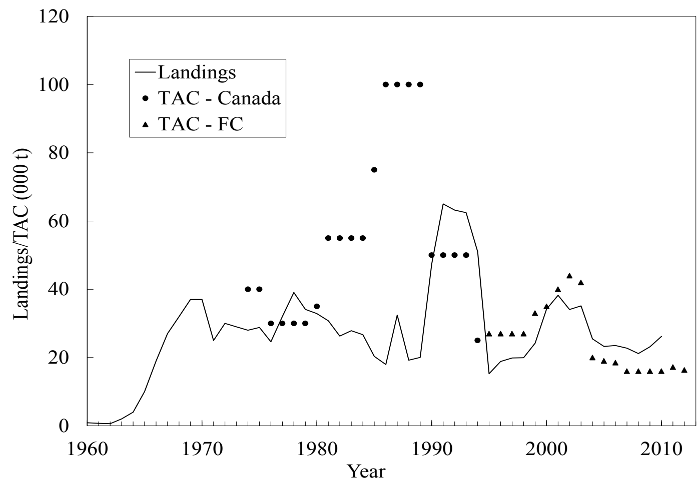


Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: catches and TACs.

b) Input Data

Standardized estimates of CPUE were available from fisheries conducted by Canada, EU- Spain and EU-Portugal. Abundance and biomass indices were available from research vessel surveys by Canada in Div. 2+3KLMNO (1978-2011), EU in Div. 3M (1988-2011) and EU-Spain in Div. 3NO (1995-2011). Commercial catch-at-age data were available from 1975-2010 but were not computed for 2011 because STACFIS could not estimate total catch.

i) Commercial fishery data

Catch and effort. Analyses of otter trawl catch rates from Canadian vessels operating inside of the Canadian 200 mile limit indicated a general decline from the mid-1980s to the mid-1990s. The 2007 – 2009 estimates of standardized CPUE for Canadian otter-trawlers indicate a sizeable increase compared to previous years. However, the 2010 and 2011 values are approximately 50% lower than the 2007 – 2009 estimates. At present, most of the Canadian landings come from Divs. 2J3K.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMN over 1988-2011 (SCS 12/08) declined sharply in 1991 from initial levels. Consistent increases were estimated over the mid-1990s until 2000. The standardized CPUE remained at exceptionally high levels over 2007-2011, though with much inter-annual variation. Most of the Portuguese catch in recent years is taken in Divs. 3LM.

Spatial analysis of catch and effort trends of the Spanish fleet (SCR 09/22, SCS 12/09) indicated the area being fished by this fleet contracted as effort has been substantially reduced since 2003 under the FC rebuilding plan. Fishing is now concentrated within Div. 3LM. The standardized CPUE for the Spanish fleet has also increased considerably after 2005.

Unstandardized catch rates from the Russian fleet over 1998-2009 (SCS Doc. 10/05) indicate similar patterns as in the other fleets. In 2010, 89% of the catch by Russia came from Div. 3L.

A comparison of the available standardized CPUE estimates from the Canadian, Spanish and Portuguese fleets indicates consistency in the timing and relative magnitude of the increases described above over the 2004-2007 period, but less consistency thereafter. (Fig 20.2).

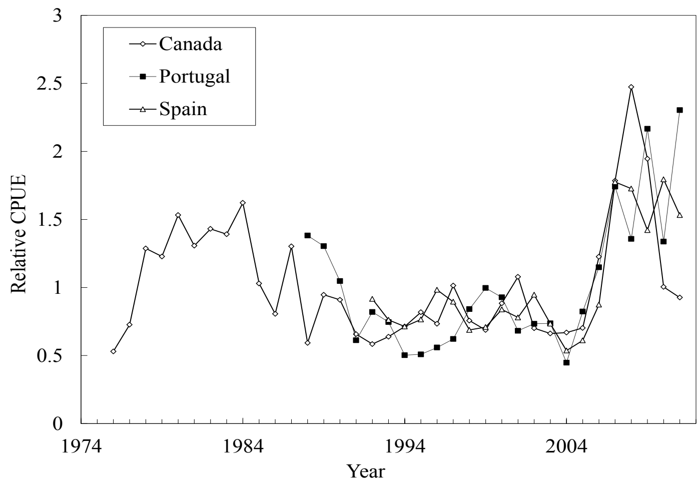


Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2011 average.)

STACFIS previously recognized that trends in commercial catch per unit effort for Greenland halibut in Subarea 2 and Div. 3KLMNO should not be used as indices of the trends in the stock (*NAFO Sci. Coun. Rep.*, 2004, p.149). It is possible that by concentration of effort and/or concentration of Greenland halibut, commercial catch rates may remain stable or even increase as the stock declines.

Catch-at-age and mean weights-at-age

Length samples of the 2011 fishery were provided by EU-Estonia, EU-Spain, EU-Portugal, Russia and Canada. Aging information was available for Russian, Spanish and Canadian fisheries.

STACFIS could not estimate total catch for 2011, therefore the 2011 catch-at-age was not calculated.

Mean weights-at-age exhibit variable patterns in the earliest period likely due to poor sampling. Mean weights-at-age for age groups 5-7 during the recent period have increased slightly. For older fish (ages 8+) they were variable but generally indicate a declining trend over the past decade.

ii) Research survey data

STACFIS reiterated that most research vessel survey series providing information on the abundance of Greenland halibut are deficient in various ways and to varying degrees. Variation in divisional and depth coverage creates problems in comparing results of different years (SCR 12/19). A single survey series which covers the entire stock area is not available. A subset of standardized (depth and area) stratified random survey indices have been used to monitor trends in resource status, and are described below.

Canadian stratified-random autumn surveys in Div. 2J and 3KLMNO

The Canadian autumn survey index provides the longest time-series of abundance and biomass indices (Fig. 20.3) for this resource (SCR Doc. 12/30). Biomass declined from relatively high estimates of the early 1980s to reach an all-time low in 1992. The index increased substantially due to the abundant 1993-1995 year-classes, but this increase was not sustained, and the index decreased by almost 60% from 1999-2002. The index continually increased over the next five years. The increasing trend has not continued in 2009 and 2010; the biomass index has declined by approximately 30% from the 2007 level. Mean numbers per tow were stable through the 1980s, but increased substantially in the mid-1990s, again due to the presence of the 1993-1995 year-classes. After this, abundance declined to the late 1990s and had been relatively stable except for the decline in 2005. The 2008 survey was not fully completed as many deep water areas important to Greenland Halibut indices were not surveyed, and estimates are not directly comparable with previous years. The improvements in the last two surveys are resulting from indications of recruitment in Divs. 2J3K.

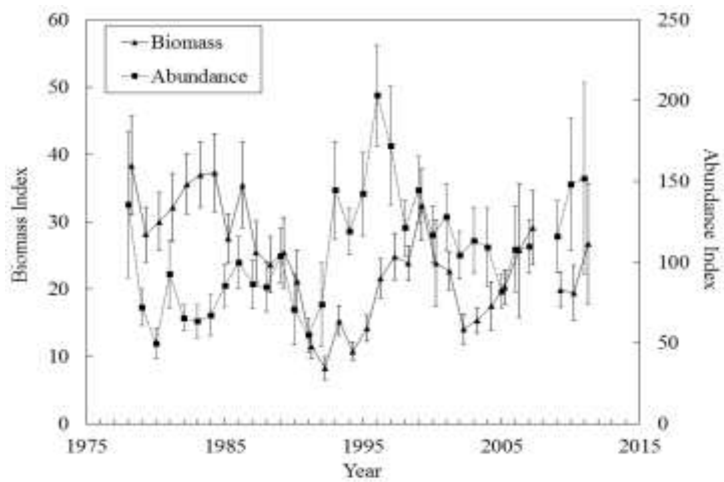


Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian autumn surveys in Div. 2J and 3K.

The Canadian autumn survey in Div. 3L has generally shown trends that are consistent with those from Div. 2J+3K. Autumn surveys within Div. 3NO have erratic deep-water coverage and as such are not useful for inferring stock status.

STACFIS previously noted (NAFO, 1993) an apparent redistribution of the resource in the early 1990s. Thus, the declining trend in the Canadian autumn surveys in Div. 2J and 3K from the mid-1980s to the early 1990s might have been more a reflection of Greenland halibut emigrating from the survey area to the deep waters of the Flemish Pass as opposed to a severe decline in the stock. However, since the mid-1990s, survey indices in the Regulatory Area and in Div. 2J and 3K has generally shown similar trends suggesting that emigration does not currently appear be an influential factor to the overall trends in the indices. Given these observations, STACFIS concluded that it is inappropriate to use the Canadian autumn Div. 2J and 3K survey index prior to the mid-1990s as a calibration index in VPA based assessments.

Canadian stratified-random spring surveys in Div. 3LNO

Abundance and biomass indices from the Canadian spring surveys in Div. 3LNO (Fig. 20.4) during 2007 and 2008 were slightly higher than values over 2002-2005, although these estimates were relatively imprecise. Both the abundance and biomass values of 2011 are below the time-series average. The abundance of recruits has increased in this survey in the most recent three surveys.

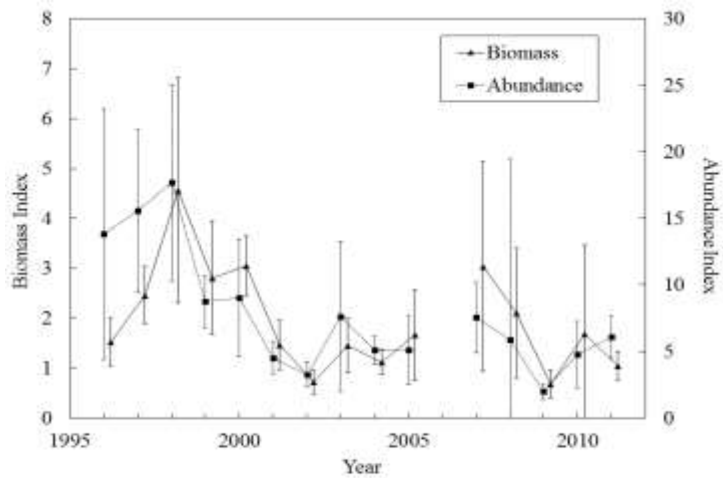


Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian spring surveys in Div. 3LNO.

EU stratified-random surveys in Div. 3M (Flemish Cap)

Surveys conducted by the EU in Div. 3M during summer (SCR 12/26) indicate that the Greenland halibut biomass index in depths to 730 m, increased in the 1988 to 1998 period (Fig. 20.5) to a maximum value in 1998. This biomass index declined continually over 1998-2002. The 2002 – 2008 results were relatively stable, with the exception of an anomalously low value in 2003. In 2009 to 2011, the index has decreased and is presently relatively low. The Flemish Cap survey was extended to cover depths down to 1460 m beginning in 2004. Biomass estimates over the full depth range doubled over 2005-2008 and remained high in 2009. The 2011 estimate is above the time-series average. Over 2009-2011, recruitment indices from this survey are very low.

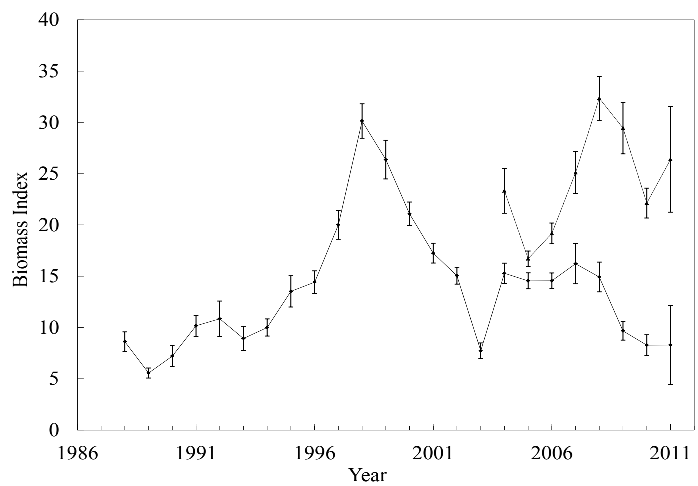


Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (± 1 S.E.) from EU summer surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

EU-Spain stratified-random surveys in NAFO Regulatory Area of Div. 3NO

The biomass index for this survey of the NRA (SCR Doc. 12/12) generally declined over 1999 to 2006 (Fig. 20.6) but increased four-fold over 2006-2009. Survey results for 2011 have declined 50% from the 2010 level, but remain above the time-series average.

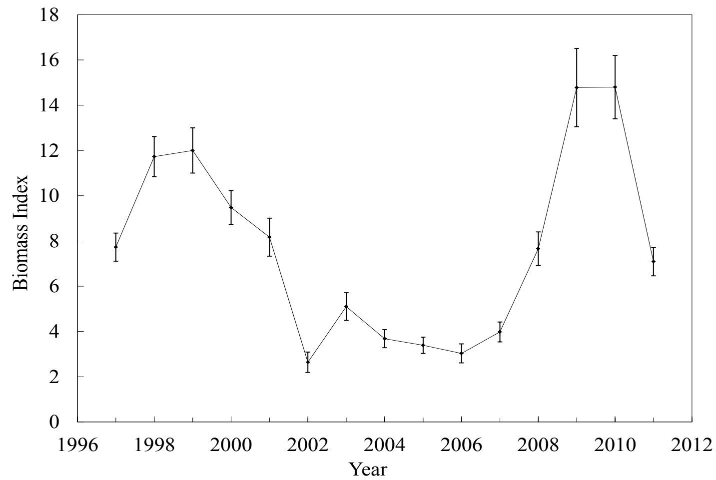


Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in the NRA of Div. 3NO.

Summary of research survey data trends

These surveys provide coverage of the majority of the spatial distribution of the stock and the area from which the majority of catches are taken. Over 1995-2003, indices from the majority of the surveys generally provided a consistent signal in stock biomass (Fig. 20.7). The trend since 2004 shows greater divergence, yet generally suggest declines in stock biomass over 2008-2011. These discrepancies complicate interpretations of overall resource status.

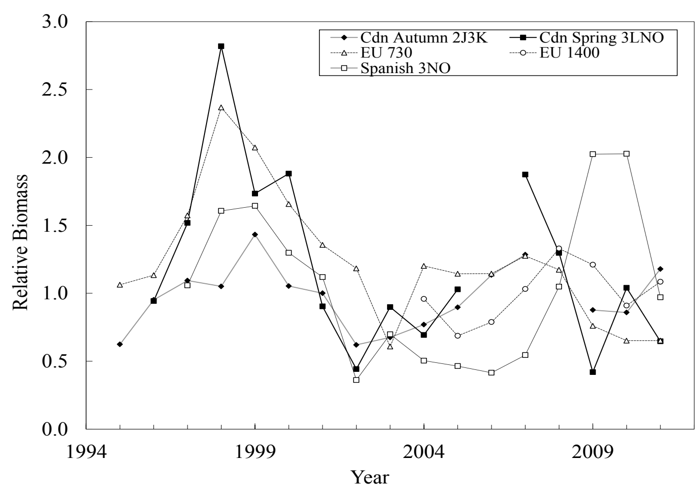


Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices from Canadian autumn surveys in Div. 2J3K, Canadian spring surveys in Div. 3LNO, EU surveys of Flemish Cap (to both 730m, and since 2004, 1400m), and EU-Spain surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2011 average.

c) Estimation of Parameters

The eXtended Survivors Analysis (XSA) methodology which has been used to estimate the status of the stock using survey data augmented by catch information could not be updated during the current assessment as STACFIS could not estimate the total catch.

State of the Stock: During the previous assessment of this stock, STACFIS noted that: Biomass increased over 2004-2008 with decreases in fishing mortality. However, it has shown decreases over 2008-2011, in part due to weaker year-classes recruiting to the biomass. The 10+ biomass peaked in 1991 and although it remains well below that peak, it has tripled over 2006-2011. Average fishing mortality (over ages 5-10) has decreased considerably since 2003. The 2010 estimate of fishing mortality has increased due to higher catches coupled with the poor recruitment to the exploitable biomass. Year-classes about to recruit to the exploitable biomass are well below average strength.

Information from surveys used to compute the HCR over the past four years has been variable but generally shows a declining trend. Although the Canadian autumn survey has been somewhat stable over this period, the Canadian spring and EU Flemish Cap surveys have declined. The recruitment signal is also not consistent among these surveys – both Canadian surveys have shown some increases whereas the recruitment signal from the EU survey is quite pessimistic.

d) Other Studies

Distribution of spawning and sex ratio in Greenland halibut (SCR Doc. 12/24)

Spawning area and time and sex ratio by depth were examined from data collected from the commercial fisheries of Canada and Spain and by research vessel surveys conducted by Canada and the EU. The data from commercial fisheries indicate that the proportion female increases with depth. This is particularly evident for depths greater than 600 m. However, the interpretation of the change in sex ratio with depth is complicated by issues of gear selectivity. Spawning fish were found in all areas and in all months. There tended to be a higher proportion of females in spawning condition in the northern areas. Canadian data indicate that spawning is in the summer and autumn while data from Spain seem to indicate more year round spawning. The ability to determine peak spawning time and area is hampered by the lack of sampling throughout the year in all areas.

e) Reference Points

i) Precautionary approach reference points

Precautionary approach reference points could not be determined for this stock at this time.

ii) Yield per recruit reference points

During the previous assessment of this resource, F_{max} was computed to be 0.41 and $F_{0.1}$ was 0.22.

References

NAFO 1993. STACFIS REPORT.

NAFO 2004. STACFIS REPORT.

f) Research Recommendations

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

STATUS: No progress. This recommendation is reiterated.

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

STATUS: Research ongoing, and this issue is also discussed further in the STACREC Report. This recommendation is reiterated.

There is no synoptic survey which covers the full range of this stock. In addition, very few age 10+ fish are captured in either commercial fisheries or in trawl surveys. STACFIS **recommended** *expansion of surveys to cover the entire* *stock distribution and/or exploratory surveys be conducted with gears other than those currently deployed to complement the existing survey data.*

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

STATUS: A tagging experiment was conducted by Canada during early 2012, and additional experiments are planned for 2013. This recommendation is reiterated.

This stock will be next assessed during June 2013.

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

Interim Monitoring Report (SCR Doc. 98/59; 98/75; 02/56; 10/31)

a) Introduction

The species has a lifespan of less than one year. The Subareas 3+4 and Subareas 5+6 stock components are assessed and managed separately by NAFO and the U.S. Mid-Atlantic Fishery Management Council, respectively. Indices of relative biomass and mean body size, computed using data from the Div. 4VWX surveys conducted during July by the Canada Division of Fisheries and Oceans, and relative fishing mortality indices are used to assess whether the stock was at a low or high productivity level during the previous year. The Subareas 3+4 stock component has been in a low productivity period since 1982.

Since 1999, there has been no directed fishery for *Illex* in Subarea 4 and most of the catches from Subareas 3+4 have been from Subarea 3. Since 2003, catches from Subareas 3+4 have been low during most years and ranged between 120 t in 2010 to about 7, 000 t in 2006 (Fig. 21.1). Similar to 2010, the catch in Subareas 3+4 was 123 t in 2011 and was mostly taken from Subarea 3 (73%).

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

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC SA 3+4	34	34	34	34	34	34	34	34	34	34
STATLANT 21 SA 3+4	1.1[1]	2.6	0.6	7.0[1]	0.2[1]	0.5	0.7	0.1	0.1[1]	
STATLANT 21 SA 5+6[2]										
STACFIS SA 3+4	1.1	2.6	0.6	7.0	0.2	0.5	0.7	0.1	0.1	
STACFIS SA 5+6	6.4	26.1	12.0	14.0	9.0	15.9	18.4	15.8	18.8	
STACFIS Total SA 3-6	7.5	28.7	12.6	21.0	9.2	16.4	19.1	15.9	18.9	

[1] Includes amounts (ranging from 18-37 t) reported as Unspecified Squid from Subarea 4.

[2] Catches from Subareas 5+6 are included because there is no basis for considering separate stocks in Subareas 3+4 and Subareas 5+6

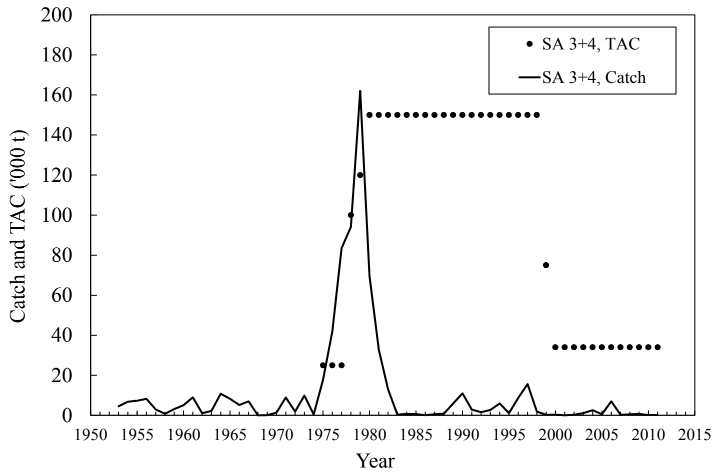


Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

b) Data Overview

The relative biomass indices, derived using the Div. 4VWX July Canadian surveys, have fluctuated widely since 2003. The third and fourth highest indices in the time series occurred during 2004 and 2006, but both years were followed by very low indices. Similar to the 2010 index, the 2011 index was below the 1982-2010 average for the low productivity period (Fig. 21.2).

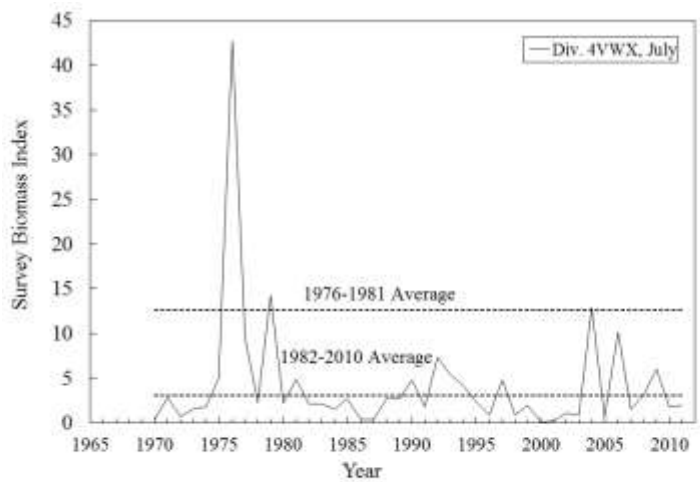


Fig. 21.2. Northern shortfin squid in Subareas 3+4: survey biomass indices from the July survey in Div. 4VWX.

Mean body weights of squid caught during the Div. 4VWX surveys have gradually declined since 2006, and in 2011, mean body weight (83 g) was slightly above the 1982-2010 average for the low productivity period (81g, Fig. 21.3).

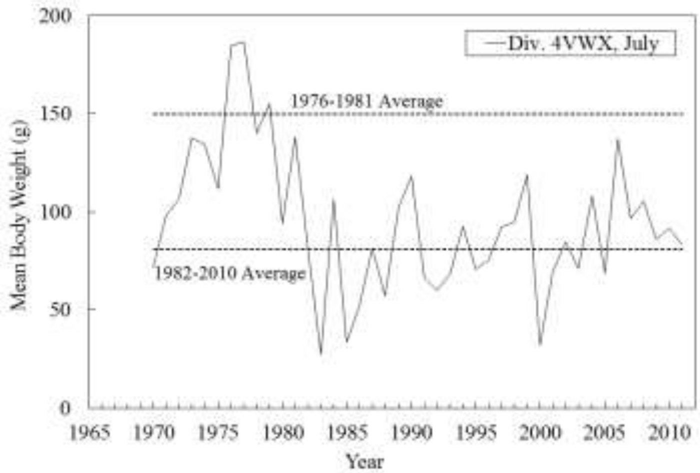


Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX.

Catch/biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index) have been well below the 1982-2010 average (0.14) during most years since 2001and the ratio was 0.01 in 2011 (Fig. 21.4).

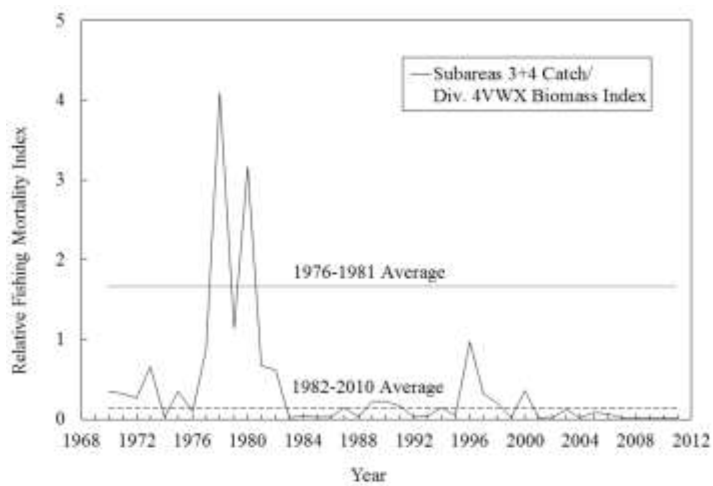


Fig. 21.4. Northern shortfin squid in Subareas 3+4: catch/biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index).

c) Conclusion

In 2011, the biomass index from the Div. 4VWX survey was below and mean body weight was slightly above the 1982-2010 mean for the low productivity period, but continued to remain below the average for the high productivity period. Catch/biomass ratios have also been very low during most years since 2001. In 2011, the stock remained in a state of low productivity.

The next full assessment of the stock is scheduled for 2013.

d) Research Recommendation

In 2010, STACFIS **recommended** that *abundance and biomass indices from the Canadian multi-species bottom trawl surveys conducted during spring and autumn in Div. 3LNO, beginning with 1995, be derived using the two subsets of strata listed in SCR Doc. 06/45 in order to improve the precision of the indices.*

STATUS: No progress has been made. This recommendation is reiterated.

IV. STOCKS UNDER A MANAGEMENT STRATEGY EVALUATION

1. Greenland halibut in SA2 and Div. 3KLMNO

This stock is taken under D. Widely Distributed Stocks: SA 2, SA 3 and SA 4.

V. OTHER MATTERS

1. FIRMS Classification for NAFO Stocks

STACFIS reviewed the assessments of stocks managed by NAFO in June 2012. Based on the available information and the most recent assessments, STACFIS found no reason to modify the classification made at the June meeting in 2011. STACFIS reiterates that the Stock Classification system is not intended as a means to convey the scientific advice to Fisheries Commission, and should not be used as such. Its purpose is to respond to a request by FIRMS to provide such a classification for their purposes. The category choices do not fully describe the status of some stocks. Scientific advice to the Fisheries Commission is to be found in the Scientific Council report in the summary sheet for each stock.

Stock Size (incl. structure)	Fishing Mortality			
	None–Low	Moderate	High	Unknown
Virgin–Large		3LNO Yellowtail flounder		
Intermediate	3M Redfish 3LN Redfish	3LNO Northern shrimp[1] SA0+1 Northern shrimp[1] DS Northern shrimp[1]	3M Cod	Greenland halibut in Uummannaq[2] Greenland halibut in Upernavik[2] Greenland halibut in Disko Bay[2]
Small	SA3+4 Northern shortfin squid	SA2+3KLMNO Greenland halibut		3NOPs White hake 3LNOPs Thorny skate
Depleted	3M American plaice 3LNO American plaice 2J3KL Witch flounder 3NO Cod 3NO Witch flounder 3M Northern shrimp[1,3]			SA1 Redfish SA0+1 Roundnose grenadier
Unknown	SA2+3 Roughhead grenadier 3NO Capelin 3O Redfish	0&1A Offsh. & 1B–1F Greenland halibut		SA2+3 Roundnose grenadier

[1] Shrimp will be re-assessed in October 2012
[2]Assessed as Greenland halibut in Div. 1A inshore
[3]Fishing mortality may not be the main driver of biomass for Div. 3M Shrimp

2. Other Business

There was no other business.

VI. ADJOURNMENT

STACFIS Chair thanked the Designated Experts for their competence and very hard work and the Secretariat for its great support. The STACFIS Chair also thanked the Chair of Scientific Council, and the Scientific Council Coordinator for their support and help. The meeting was adjourned at 1600 on 15^{th} June.

PART B: SCIENTIFIC COUNCIL MEETING 27 AUGUST - 7 SEPTEMBER 2012

CONTENTS

REPORT OF SCIENTIFIC COUNCIL MEETING

27 August – 7 September 2012

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSION

The Scientific Council met by correspondence via SharePoint and WebEx video conference during 27 August - 7 September 2012 to address the Fisheries Commission request to update advice on NAFO Div. 3LN and Div. 3M shrimp stocks for 2013, in advance of the 2012 Annual Meeting. Representatives and participants attended from Canada, European Union (Estonia, France and Spain) and Norway. The Scientific Council Coordinator was in attendance. No applications were received from observers to attend this meeting.

The provisional agenda was circulated to Contracting Parties by email on 16 July 2012 and posted on the SharePoint site. The report for this meeting was developed throughout the course of the meeting and was available on the SharePoint report area for comment.

The SharePoint site for this meeting was opened on 31 August 2012. Access to the SharePoint site, and hence participation in the meeting, was given to members of Scientific Council Executive and Members nominated by Contracting Parties. The Chair asked Representatives to post any comments on the agenda by 29 August. Participants were also asked to upload relevant documents to the SharePoint site and to discuss these documents on the discussion area. The opening session of the WebEx meeting of Council was called to order on at 0900 ADT on 7 September 2012. The report was adopted on 10 September 2012

The Chair welcomed all participants to this meeting by correspondence and thanked the Designated Experts for their preparatory work.

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

II. 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 I.

III. SPECIAL REQUESTS FROM THE FISHERIES COMMISSION

1. From September 2010

a) Update to 3LNO and 3M shrimp advice

The Fisheries Commission with the concurrence of the Coastal State as regards to the stocks below which occur within its jurisdiction ("Fisheries Commission") requests that the Scientific Council provide advice in advance of the 2012 Annual Meeting, for the management of Northern shrimp in Div. 3M, 3LNO in 2013. The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation).

Noting that Scientific Council will meet in October of 2011 for 2013 TAC advice, Fisheries Commission requests the Scientific Council to update its advice on shrimp stocks in 2012 for 2013 TAC.

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

Scientific Council responded:

In October 2011 the Scientific Council provided advice for 2013 for shrimp in Div. 3M and 3LNO. The Council reviewed the status of these stocks at this September 2012 meeting, and found no significant change in either to warrant any update of the advice previously provided.

Accordingly, the Council reiterates its advice for 2013 as follows:

Recommendation for Northern Shrimp (*Pandalus borealis*) in Div. 3M:

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

Recommendation for Northern Shrimp (*Pandalus borealis*) in Div. 3LNO:

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

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

[1] FC TAC for 2013

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

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

With respect to Northern shrimp (Pandalus borealis) in Div. 3LNO, noting the NAFO Framework for Precautionary Approach and recognizing the desire to demonstrate NAFO's commitment to applying the precautionary approach, Fisheries Commission requests the Scientific Council to:

a) identify F_{msy}

b) identify B_{msy}

c) provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf}*)*

Scientific Council responded:

Current scientific advice for the management of Div. 3LNO shrimp is based on the relationship between trends in research vessel survey indices and the commercial landings. There is no accepted assessment model. 15% of the highest survey observation of female biomass (SSB) is currently accepted as a proxy for B_{lim}. There is no current proxy for F_{lim}. Fisheries commission has requested advice on the identification of F_{msy}, B_{msy} and advice on the appropriate selection of an upper reference point for biomass. Such advice is best provided using an accepted assessment model fit to the data. Progress has been made in fitting surplus production models using both maximum likelihood and Bayesian approaches. The Bayesian model will be further refined and presented in 2012 as a potential assessment model for the stock.

IV. ADOPTION OF REPORT

The draft report of this meeting was circulated by email to participants for consideration. The report was adopted in full on 10 September 2012.

V. ADJOURNMENT

The meeting was adjourned by the Chair of Scientific Council after the report was adopted in principle. Participants and the NAFO Secretariat were thanked for their contributions.

APPENDIX I. REPORT OF THE STANDING COMMITTEE ON FISHERIES SCIENCE (STACFIS)

Chair: Jean-Claude Mahé Rapporteur: Various

The Committee met by correspondence during 27 August-7 September 2011 via SharePoint and with a WebEx conference to consider the various items on its Agenda on 7 September 2011. Representatives attended from Canada, European Union (Estonia, France and Spain) and Norway. The Scientific Council Coordinator was in attendance.

I. Opening

The Chair, Jean-Claude Mahé, opened the meeting by welcoming participants. The provisional agenda was reviewed and adopted, and a plan of work developed for the meeting.

II. Interim Monitoring Updates

STACFIS was asked to update the assessments of Northern shrimp in Div. 3M and Northern shrimp in Div. 3LNO that had been reviewed at the meeting of NIPAG in October 2011.

1. Northern Shrimp (*Pandalus borealis*) in Div. 3M

(SCR 12/42)

a) Introduction. The shrimp fishery in Div. 3M is now under moratorium. This fishery began in 1993. Initial catch rates were favorable and, shortly thereafter, vessels from several nations joined. Catches peaked at over 60 000 t in 2003 and declined thereafter.

i) Fishery and catches. The effort allocations were reduced by 50% in 2010 and a moratorium was imposed in 2011. Catches are expected to be close to zero in 2012. Recent catches were as follows:

	2006	2007	2008	2009	2010	2011	2012
STACFIS	18 000	21 000	13 000	5 000	2 000	0	0
21A	15 191	17 642	13 431	5 374	1 976	0	0[1]
Recommended TAC	48 000	48 000	17 000 – 32 000	18 000 – 27 000	ndf	ndf	ndf
Effort (Agreed Days)	10 555	10 555	10 555	10555	5 227	0	0

[1] To September 2012

[2] Effort regulated

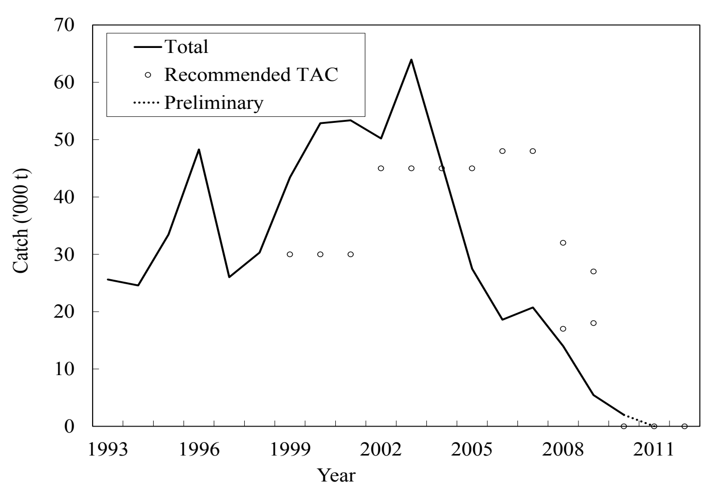


Fig. 1.1 Northern shrimp in Div. 3M: Catches and TACs.

b) Input Data

i) Commercial fishery data

Catch, effort and biological data were available from several Contracting Parties. Time series of size and sex composition data were available mainly from two countries between 1993 and 2005 and survey indices were available from EU research surveys (1988-2011). Catch data were updated for 2012. Because of the moratorium catch and effort data were not available from 2011. Therefore the standardized CPUE series was not updated from 2012.

ii) Research Survey Data

Stratified-random surveys have been conducted on Flemish Cap by the EU in July from 1988 to 2012, using a Lofoten trawl. A new vessel was introduced in 2003 which continued to use the same trawl employed since 1988. In addition, there were differences in cod-end mesh sizes utilized in the 1994 and 1998 surveys that have likely resulted in biased estimates of total survey biomass. Nevertheless, for this assessment, the series prior to 2003 were converted into comparable units with the new vessel based on the methodology accepted by STACFIS in 2004 (NAFO 2004 SC Rep., SCR Doc. 04/77). The index was stable at a high level from 1998 to 2007. Since then the survey biomass index declined and in 2011 was the lowest in the survey series, well below B_{lim}.

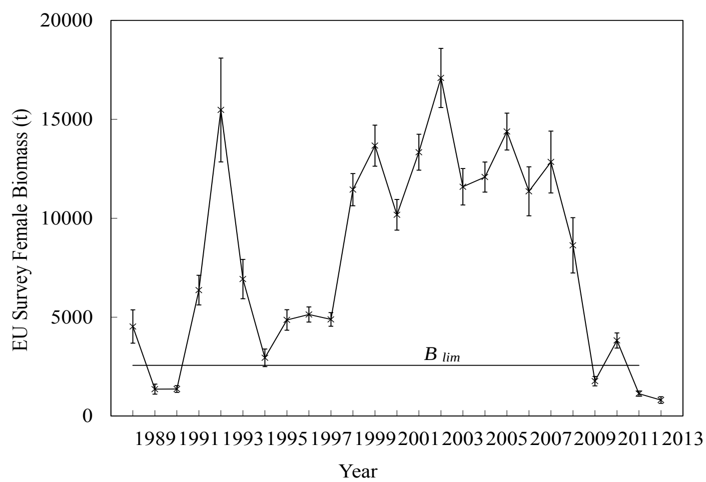


Fig. 1.2. Northern shrimp in Div. 3M: EU survey index of female biomass, 1988-2012

c) Assessment

No analytical assessment is available and fishing mortality is unknown. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

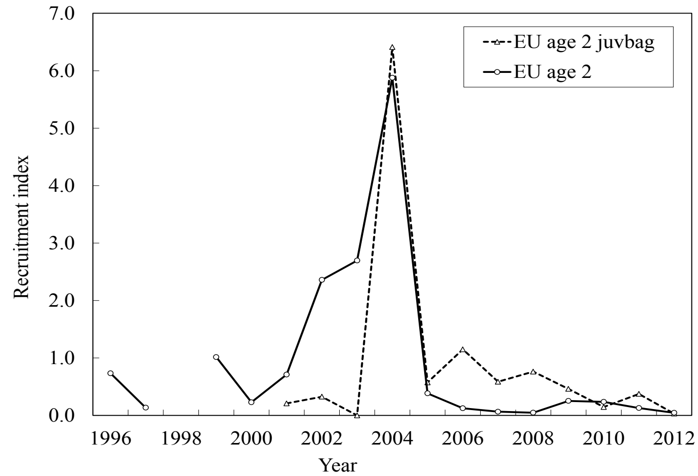


Fig. 1.3. Northern shrimp in Div. 3M: Abundance indexes at age 2 obtained in EU Flemish Cap surveys from Lofoten gear (black line) and juvenile bag (dotted line). Each series was standardized to its mean.

Recruitment: All year-classes after the 2002 cohort (i.e. age 2 in 2004) have been weak.

SSB: The survey female biomass index was at a high level from 1998 to 2007, and has declined to its lowest level in 2012, well below B_{lim}.

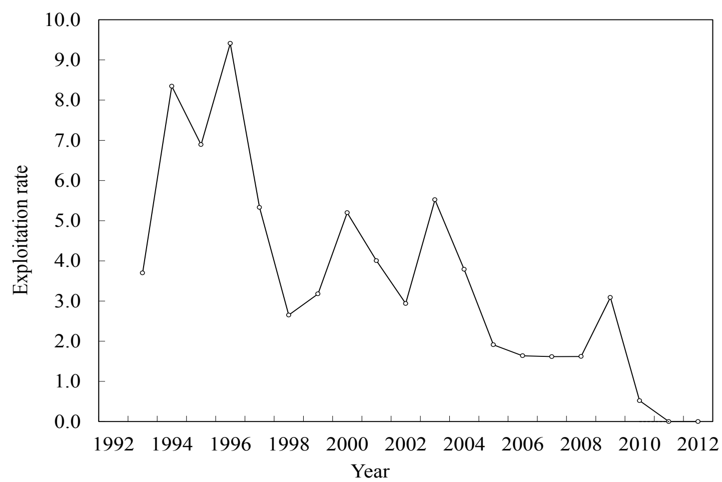


Fig. 1.4. Northern shrimp in Div. 3M: Exploitation rates as nominal catch divided by the EU survey biomass index of the same year.

Exploitation rate: From 2005 to 2008 exploitation rates (nominal catch divided by the EU survey biomass index of the same year) remained stable at relatively low values and increased in 2009. Because catches in 2010 were low, while the female biomass estimate increased slightly, the exploitation rate declined to its lowest observed level. From 2011 no catches were recorded due to the moratorium and the exploitation rate is 0 or very close to 0.

d) State of the Stock. The low values of the Total and Female biomass indexes in 2009 continued in 2010 and well below the B_{lim} proxy in 2011 and 2012, confirming the strong decrease of this stock caused by the weak recruitments in the last eight years and the increase of cod stock, one of their most important predators. STACFIS concluded that there was no change in the status of the stock.

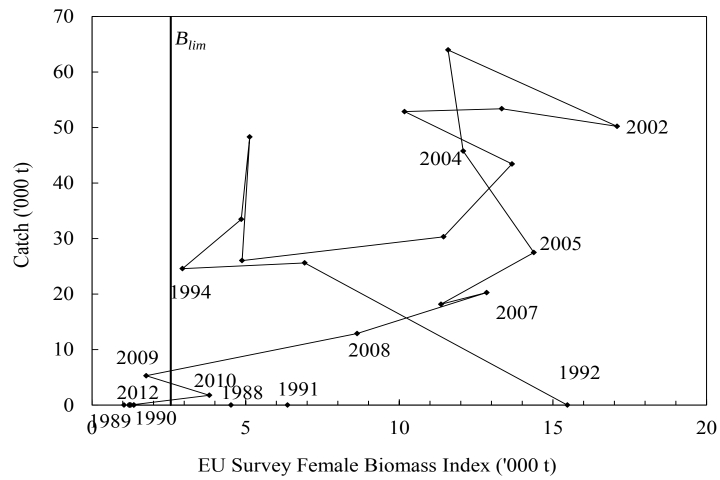


Fig. 1.5. Northern shrimp in Div. 3M: Catch plotted against female biomass index from EU survey. Line denoting B_{lim} is drawn where biomass is 85% lower than the maximum point in 2002. Due to moratorium on shrimp fishery the expected catch in 2011 and 2012 is 0 t.

e) Reference Points. Scientific Council considers that the point at which a valid index of stock size has declined by 85% from its maximum observed level provides a proxy for B_{lim}. This is 2 564 t for northern shrimp in Div. 3M. The index in 2011 and 2012 is below B_{lim}. It is not possible to calculate a limit reference point for fishing mortality.

f) Conclusions. The low values of the Total and Female biomass indexes in 2009 continued in 2010 and well below the B_{lim} proxy in 2011 and 2012, confirming the strong decrease of this stock caused by the weak recruitments in the last eight years and the increase of cod stock, one of their most important predators. STACFIS concludes that there was no change in the status of the stock.

2. Northern Shrimp (*Pandalus borealis*) in Div. 3LNO

(SCR Doc. 12/43)

a) Introduction

This shrimp stock is distributed around the edge of the Grand Bank mainly in Div. 3L. The fishery began in 1993 and came under TAC control in 2000 with a 6 000 t TAC and fishing restricted to Div. 3L. Annual TACs were raised several times between 2000 and 2009 reaching a level of 30 000 t for 2009 and 2010 before decreasing to 12 000 t in 2012 and 9 3500 t in 2013. A total catch of 8 233 t was taken up to September 2012 (Fig. 2.1).

Recent catches and TACs (t) for shrimp in Div. 3LNO (total) are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC as set by FC	13 000[1]	13 000[1]	22 000[1]	22 000[1]	25 000[1]	30 000[1]	30 000[1]	19 200[1]	12 000[1]	9 350
STATLANT 21	11 937	13 533	21 426	21 5431	21 121	24 142[2]	16 310[2]	12 836[2]	8 233[3]	
NIPAG	13 204	14 775	25 696	23 530	26 649	27 914	20 090	13 041		

[1] Denmark with respect to Faroes and Greenland did not agree to the quotas of 144 t (2003–2005), 245 t (2006–2007), 278 t (2008), or 334 t (2009) and set their own TACs of 1 344 t (2003–2005), 2 274 t (2006–2008), 3 106 t (2009), 532 t (2010), 1 985 t (2011) and 1 241 t (2012). The increase is not included in the table.
[2] Provisional catches.
[3] Estimated catches to September 2012.

Since this stock came under TAC regulation, Canada has been allocated 83% of the TAC. This allocation is split between a small-vessel (less than 500 GT and less than 65 ft.) and a large-vessel fleet. By September 2012, the small- and large-vessel fleets had taken 6 206 t and 1 654 t of shrimp respectively in Div. 3L. In all years, most of the Canadian catch occurred along the northeast slope in Div. 3L. The annual quota within the NAFO Regulatory Area (NRA) is 17% of the total TAC.

The use of a sorting grid to reduce bycatches of fish is mandatory for all fleets in the fishery. The sorting grid cannot have a bar spacing greater than 22 mm.

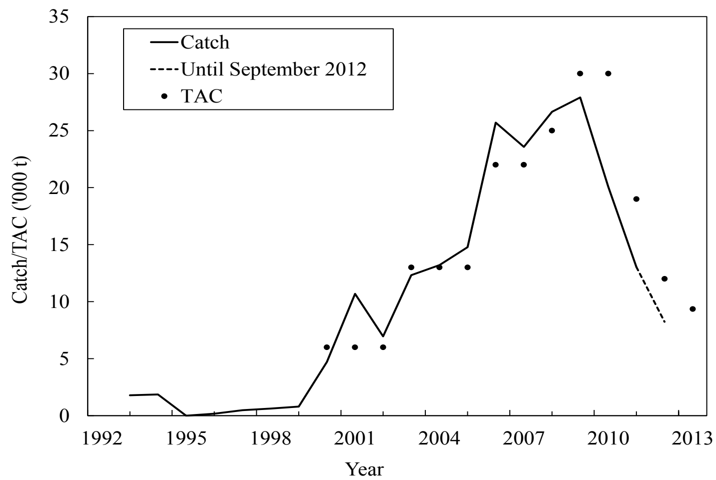


Fig. 2.1. Shrimp in Div. 3LNO: catches (to September 2012) and TAC as set by Fisheries Commission.

b) Input Data

i) Commercial fishery data

Effort and CPUE. No updated information at this time.

Catch composition. No updated information at this time.

ii) Research survey data

Canadian multi-species trawl survey. Canada has conducted stratified-random surveys in Div. 3LNO, using a Campelen 1800 shrimp trawl, from which shrimp data is available for spring (1999–2011) and autumn (1996–2010). The autumn survey in 2004 was incomplete and therefore of limited use for the assessment.

Spanish multi-species trawl survey. No updated information at this time.

Biomass. In Canadian surveys, over 90% of the biomass was found in Div. 3L, distributed mainly along the northeast slope in depths from 185 to 550 m. There was an overall increase in the both spring and autumn indices to 2007 after which they decreased by about 75% to 2012 (Fig. 2.2). Confidence intervals from the spring surveys are usually broader than from the autumn surveys.

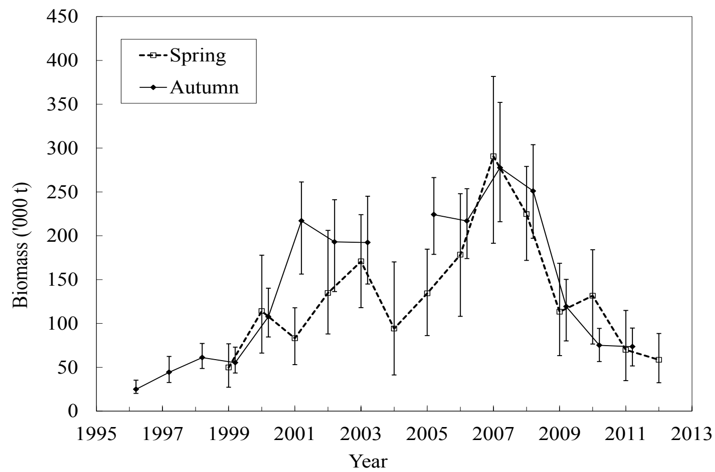


Fig. 2.2. Shrimp in Div. 3LNO: biomass index estimates from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Stock composition. No updated information at this time.

Female biomass (SSB) indices. The autumn 3LNO female biomass index showed an increasing trend to 2007 but decreased 72% by 2012. The spring SSB index decreased by 84% between 2007 and 2012 (Fig. 2.3).

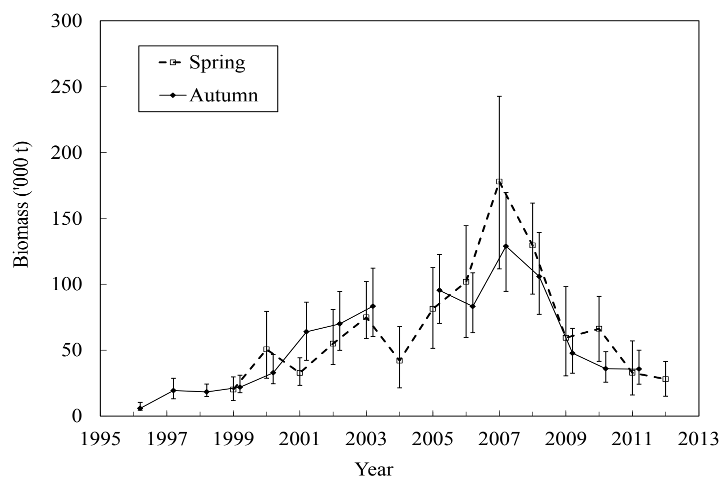


Fig. 2.3. Shrimp in Div. 3LNO: Female biomass indices from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Recruitment indices. No updated information at this time.

Fishable biomass and exploitation indices. There had been an increasing trend in Canadian spring and autumn survey fishable biomass indices (shrimp >17 mm carapace length) until 2007. The autumn fishable biomass showed an increasing trend until 2007 then decreased by 76% through to 2010 and remaining near that level in 2011. Similarly, the spring fishable biomass index increased to 2007 but has since decreased by 82 % through to 2012 (Fig. 2.4).

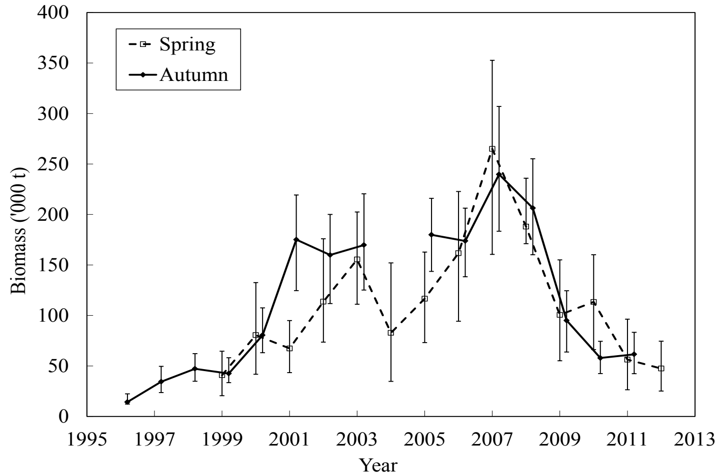


Fig. 2.4. Shrimp in Div. 3LNO: fishable biomass index. Bars indicate 95% confidence limits.

An index of exploitation was derived by dividing the catch in a given year by the fishable biomass index from the previous autumn survey. The catch series was updated in the September 2012. The exploitation index has been below 0.15 until 2010 when it increased to 0.21. By September 2012, the 2012 exploitation rate index was 0.13. Based upon the autumn 2011 fishable biomass of 61 5100 t, if the entire 12 000 t quota was to be taken, the exploitation rate index would increase to 0.20 (Fig. 2.5).

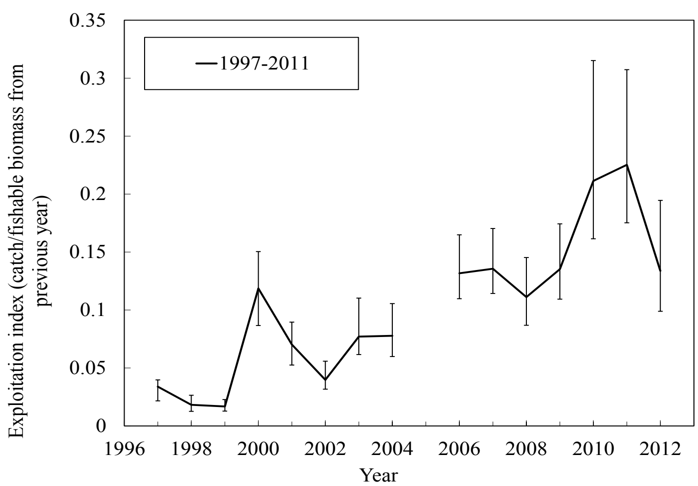


Fig. 2.5. Shrimp in Div. 3LNO: exploitation rates calculated as year’s catch divided by the previous year's autumn fishable biomass index. The 2012 exploitation rate index is based upon incomplete catch data. Bars indicate 95% confidence limits.

c) Assessment Results

Recruitment. No updated information at this time.

Biomass. Spring and autumn biomass indices generally increased, to record levels by 2007, but decreased substantially by 2010 and remained near that level in 2011. The spring biomass indices remained at a low level in 2012.

Exploitation. The index of exploitation has remained below 0.15 until 2010 but has since increased.

State of the Stock. The predicted decline in the 2011 autumn survey biomass did not occur. However, the decreased levels of biomass in the Canadian survey series since 2007 are a reason for concern. The biomass is likely to be above B_{lim}.

d) Precautionary Reference Points

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} (approximately 19 000 t) for northern shrimp in Div. 3LNO (SCS Doc. 04/12). Currently, the female biomass index is estimated to be above B_{lim} (Fig. 2.6). It is not possible to calculate a limit reference point for fishing mortality. A safe zone has not been determined in the precautionary approach for this stock.

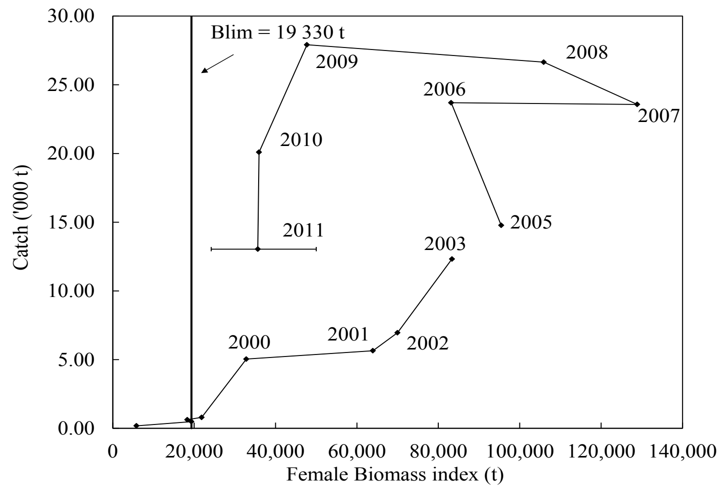


Fig. 2.6. Shrimp in Div. 3LNO: Catch against female biomass index from Canadian autumn survey. Line denoting Blim (approximately 19 000 t) is drawn where female biomass is 85% lower than the maximum point in 2007.

e) Conclusion

The predicted decline in the 2011 autumn survey biomass did not occur. However, the decreased levels of biomass in the Canadian survey series since 2007 are a reason for concern. The biomass is likely to be above B_{lim}. STACFIS concluded that there was no change in the status of the stock.

PART C: SCIENTIFIC COUNCIL MEETING – 17-21 SEPTEMBER 2012

Contents

SCIENTIFIC COUNCIL MEETING PARTICIPANTS SEPTEMBER 2012

Back room (left to right): Ivan Tretiakov, Alexander Fomin, Herlé Goraguer, Bill Brodie, Estelle Couture, Joanne Morgan, Jean-Claude Mahé, Neil Campbell, Antonio Vázquez, Ricardo Alpoim, Mar Sacau, Carsten Hvingel, Mariano Koen-Alonso, Don Stansbury, Ellen Kenchington, Javier Murillo

Front Row: Vladimir Babayan, Maria Pochtar, Vladimir Zabavnikov, Jean Landry, Alexi Orlov, Fernando Gonzalez, Diana Gonzalez-Troncoso, Silver Sirp, Andy Kenny, Gary Maillet

REPORT OF SCIENTIFIC COUNCIL MEETING

17-21 September 2011

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at the Park Inn Pribaltiskya, St Petersburg, Russia, during 17-21 September 2012, to consider the various matters in its agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal, Spain and the United Kingdom), France (with respect to St. Pierre et Miquelon), Japan, Norway, the Russian Federation and Ukraine. The Scientific Council Coordinator 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 opening session of the Council was called to order at 0940 hours on 17 September 2012.

The Chair welcomed participants to the 34th Annual Meeting and thanked the representatives of the Russian Federation for their hospitality in hosting this event.

The provisional agenda was adopted with minor additions. The Council appointed Neil Campbell, the Scientific Council Coordinator, as rapporteur. The Chair welcomed the WWF, as observers to this annual meeting.

The Council and its Standing Committees met through 17-21 September 2012 to address various items in its agenda. The Council considered and adopted the reports of the STACFIS and STACREC Standing Committees on 20 September 2012. The final session was called to order at 0915 hours on 21 September 2012. The Scientific Council then considered and adopted its report of this meeting. The meeting was adjourned at 0930 hours on 21 September 2012.

The Reports of the Standing Committees as adopted by the Council are appended as follows: Appendix I - Report of Standing Committee on Research Coordination (STACREC), and Appendix II - Report of Standing Committee on Fisheries Science (STACFIS).

The Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Representatives, Advisers and Experts, are given in Part E, this volume. The Scientific Council plan of action in response to the NAFO Performance Assessment is given in Annex 1.

II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS

From Scientific Council Meeting, 1-14 June 2012

XII. OTHER MATTERS

6. Other Business

a) Quality of catch information for assessments

Scientific Council noted the concerns expressed by STACFIS regarding the quality of catch data available to perform assessments.

Contracting Parties have the responsibility to report accurate catches to NAFO via STATLANT 21 submissions, and Scientific Council has the responsibility to “compile” these catches for NAFO. Scientific Council considered that it is not its responsibility to provide the best catch figures, nevertheless Scientific Council requests clarification on which NAFO body is responsible for validating the quality of the STATLANT catch figures submitted, to enable the

Scientific Council to carry out assessments in a timely manner. If it is the job of Scientific Council, Scientific Council recognizes that the availability of more information will improve the catch quality, for example inspection reports, daily catch reports and VMS data, may be required for this task.

Scientific Council **recommended** that *General Council clarify the responsibilities of NAFO bodies and Contracting Parties with respect to determining the quality of STATLANT 21 data.*

STATUS: No progress to date.

III. 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 at Appendix I.

IV. 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 II.

V. SPECIAL REQUESTS FROM THE FISHERIES COMMISSION

The following requests were received during the current meeting (FC WP 12/12). Scientific Council noted that these responses are only for the clarification of the advice and do not in any way alter or change the advice published in the previous reports of the Scientific Council.

1. 3M Cod

Scientific Council noted that the 3M cod Spawning Stock Biomass (SSB) has increased to the highest value of the time series and is now well above B_{lim}*. What is the risk of decline in spawning stock biomass to values below* B_{lim} *in the next two years if fishing mortality is at the level of* F_{max} *in 2013?*

Scientific Council responded:

Based on the current assessment results, the risk of the stock going below B_{lim} by the end of 2013 while fishing at F=0.135 (equal to the 2012 estimate of F_{max}) is less than 0.1%.

2. 3LN Redfish and 3LNO Shrimp

The fishing mortality of 3LN redfish is at historical low levels and biomass is at high levels and well above B_{lim}*. The Scientific Council advises that the fishing mortality should be maintained around current levels and that increases should be taken with caution. The Fisheries Commission requests the Scientific Council to provide information on:*

1) What levels of increase would be considered as cautious by the SC? Could a TAC increase of 15% or 25% be considered as cautious?

Scientific Council responded:

Scientific Council is at the moment not able to quantify the level of “cautiousness” related to the various TAC increases. This is a newly opened fishery and the information available in the data regarding stock response to exploitation in combination with the limitations in the current modeling framework used does not allow this.

2) Noting the biological interactions between redfish, cod and shrimp in the Flemish Cap and that such interactions are likely to occur in the Grand Banks, what would be the level of improvement of the 3LNO shrimp stock expected *by increasing the harvesting of redfish? By lowering the natural mortality over the 3LNO shrimp stock, could it be expected that sustainable harvesting levels of shrimp would be higher than in previous years?*

Scientific Council responded:

The available diet information for the Newfoundland shelf and Grand Bank indicates that shrimp is an important prey for redfish, but it is also an important prey for other groundfish species like cod, American plaice, and Greenland halibut. The Grand Bank has a more complex food web structure than the Flemish Cap, so predicting the outcome of a reduction of redfish on shrimp, even in a semi-quantitative manner, is not possible at this time. A reduction of predation mortality from just one of these predators may not necessarily have detectable effects on the shrimp stock. Work towards developing multispecies models to explore these issues is one of the components of the SC Roadmap to EAF.

3. 3LNO Thorny Skate

The scientific council indicated that Canadian spring surveys that cover the NRA show an increasing trend of thorny skate since 1997 and that the autumn surveys are stable. In spite of the increase, survey indices are low compared to historical levels of the 1980s. On the other hand, the index of fishing mortality has been low since 2005 and recruitment index is 50% above average in the last two years. There is no analytical assessment for this stock.

1) Considering the low exploitation rates, has the Scientific Council identified other sources of mortality besides fishing, which could be driving the dynamics of this stock?

Scientific Council responded:

No specific causes of natural mortality have been identified for this stock.

2) The high survey values in the 1980s and the lower indices since 1997 were obtained with a distinct survey method (Engel and Campelen). Could this different method be influencing the perception of stock size throughout the whole time series?

Scientific Council responded:

The biomass index of Div. 3LNO thorny skate showed a large decline from the mid-1980s to the mid-1990s. This decline in population size occurred prior to the change in survey gear which occurred in autumn 1995 at the low point in stock size. There has been some increase since that time but the stock remains at a low level. The change in survey gear is not considered a factor in the perception of stock status.

4. 3NO Witch

Does SC have information on the bycatch of 3NO witch in the yellowtail fishery, and if so does it consider this level of bycatch to be harmful to the recovery of the 3NO witch stock?

Scientific Council responded:

The bycatch of 3NO witch in the Canadian yellowtail fishery ranged from 11 to 40 tons/year from 2007-2011 (SCS 12/19, page 28). Over this period, this represents on average, about 8.9% of the total annual estimated bycatch of 3NO witch. SC does not have estimates of fishing mortality for 3NO witch, but considers it unlikely that catches of that magnitude would have a major impact on the recovery of the resource

5. 3NO Cod

What is the basis of different survey trends apparent in Div. 3NO cod between Canadian and EU surveys and what are the implications for the view of status of the stock?

Scientific Council responded:

Div. 3NO Canadian spring and autumn surveys cover most of the total distribution of the stock while the Div. 3NO EU-Spain survey is only outside off the Canadian EEZ (in the NAFO Regulatory Area) and covers only a smaller part of stock distribution.

The EU-Spain survey series is poorly fitted by the assessment model used and is not included in the actual assessment of the stock.

VI. MEETING REPORTS

1. Fisheries Commission WGFMS-CPRS

This Fisheries Commission Working Group met by WebEx, on 4 September 2012, and was chaired by Jean-Claude Mahé (EU-France). The Scientific Council was advised of progress in this group by the Chair in his presentation of the report to Fisheries Commission.

2. Fisheries Commission WGFMS-VME

This Fisheries Commission Working Group met at the Directorate of Fisheries, Bergen, Norway, during 10 – 13 September 2012, and was chaired by Bill Brodie (Canada). The Scientific Council was advised of progress in this group during the Chair's presentation of the report to Fisheries Commission. The Chair also informed Scientific Council that he was stepping down from this role. Scientific Council thanked him for the valuable service he performed during his tenure.

3. Meetings Attended by the Secretariat

The annual meeting of the FAO Aquatic Science and Fisheries Abstracts meeting was held at the Marine Institute, Galway, Ireland, during 25 – 29 June 2012, and was attended by Alexis Pacey, NAFO Publications Manager. A full report of this meeting was deferred until the next meeting of STACPUB in June 2013.

VII. REVIEW OF FUTURE MEETING ARRANGEMENTS

1. Scientific Council / NIPAG, October 2012

The Scientific Council noted that the dates and venue of the next Scientific Council /NIPAG meeting will be held from 17-24 October 2012 at the Marine Institute, Tromsø, Norway.

2. WGEAFM, November 2012

WGEAFM will meet at the NAFO Secretariat, Dartmouth, Canada, during 21-30 November 2012.

3. WGDEC, March 2013

The ICES – NAFO Working Group on Deepwater Ecosystems will meet at the ICES Headquarters during 25 – 29 March 2013.

4. Scientific Council, June 2013

The Scientific Council June meeting will be held on 7-20 June 2013 at the Alderney Landing, Dartmouth, NS, Canada.

5. Scientific Council, September 2013

Scientific Council noted that the Annual Meeting will be held on 23-27 September 2013 at the Westin Hotel, Halifax, NS, Canada, unless an invitation to host the meeting is extended by a Contracting Party.

6. Scientific Council / NIPAG, October 2013

The need, timing and location for this meeting will be discussed at the October 2012 meeting.

7. Scientific Council, June 2014

Scientific Council agreed that its June meeting will be held during 6 - 19 June 2014 with the meeting venue being the Alderney Landing, Dartmouth, Nova Scotia, Canada, or as decided at the 2013 meeting.

8. Scientific Council, September 2014

Scientific Council noted that the Annual Meeting will be held on 22-26 September 2014 at the Westin Hotel, Halifax, NS, Canada, unless an invitation to host the meeting is extended by a Contracting Party.

VIII. FUTURE SPECIAL SESSIONS

Scientific Council will support two special sessions in 2013.

1. ICES/NAFO Gadoid Symposium

NAFO Scientific Council agreed, jointly with ICES, to co-sponsor a symposium on Gadoid fisheries: the ecology and management of rebuilding, to be held at the Algonquin Hotel, St. Andrews, New Brunswick, during 15-18 October 2013. The organizing committee is being co-convened by Ed Trippel (Canada) and Fritz Köster (Denmark), and is comprised of Jason Link (USA), Olav Kjesbu (Norway), Doug Swain (Canada), and Jonna Tomkiewicz (Denmark). A flyer announcing the conference will be published now that funding has been agreed, and abstracts will be due end of April 2013.

2. World Conference on Stock Assessment Methods

NAFO has been involved with the ICES Strategic Initiative on Stock Assessment Methods since its inception in 2010, and supported the attendance of Brian Healey at a workshop organized under this initiative. A conference on stock assessment methods will be held in Boston, USA, during 15 – 19 July 2013, and the NAFO Secretariat has been informed of developments by the chair of the Steering Committee. The steering committee consists of Mark Dickey-Collas, Doug Butterworth, Steve Cadrin, Carmen Fernández, Jean-Jacques Maguire, Richard Methot, José De Oliveira, Ana Parma, Cathy Dichmont, Victor Restrepo, Yimin Ye and Laurie Kell. A questionnaire for designated experts has been submitted to the Secretariat and will be circulated to Designated Experts for completion. Members of Scientific Council are encouraged to seek support for participation in this conference.

IX. OTHER MATTERS

1. Matters arising from the NAFO Performance Assessment

Scientific Council discussed the recommendations to the Council from the Performance Assessment Report (GC WP 11/09 (Rev.)) and those produced by the General Council Working Group in March 2012 (GC Doc. 12/1). Scientific Council addressed the appropriateness of the bodies each recommendation was directed to, as well as the assigned priority, and produced a set of specific actions to be taken in order to proceed with implementation of the Panel's recommendations (Appendix VII). This will be forwarded to the chairs of General Council and Fisheries Commission for their consideration.

2. Report of the Peer Review of STACFIS Catches

Scientific Council received the progress report prepared by the Peer Review of STACFIS Catches. The issues raised can be broken into short- and longer term objectives.

Two perspectives:

1. Long term solution: secure that reliable catch data are submitted to Scientific Council.

2. Short term solution: provide fix to secure that 2013 stock assessment can be performed and management advice derived.

Ad. 1. Scientific Council has discussed various options which they intend to promote through the peer review group on the method of catch estimation for NAFO stocks.

Ad. 2. The only option at this stage is to assume that the STATLANT data represents an inaccurate estimate of catch for some stocks. When used in the assessment this will translate into increased uncertainty which will be reflected in the assessment results and hence requires more precaution in the advice.

Scientific Council **recommended** that *DE's meet with the chairs of STACFIS and STACREC to prepare a way to deal with these challenges in advance of the June Scientific Council meeting*.

3. Report of the Joint FC/SC Meeting

As recommended by the General Council Working Group (GC Doc. 12/1), an informal joint session of Scientific Council and Fisheries Commission was held during the Annual Meeting. This session was attended by the Chairs of Scientific Council and Fisheries Commission, the Chairs of STACFEN, STACREC STACFIS, WGFMS-VME and –CPRS, along with representatives and delegates from the Contracting Parties. The SC Chair reported the main outcomes to the Council in plenary.

It was noted that much of the interaction between SC and FC takes place in WG-VME and WG-CPRS working groups. Both SC and FC supported the proposal to extend the terms of reference for these groups and the idea that they will become joint FC/SC groups, with co-chairs from each body, and will report back to both. WG-CPRS will be expanded to address revisions to the PA framework and describing management objectives for all stocks, while WG-VME will be expanded to cover the EAFM and fisheries assessments. The reporting structure around these groups needs to be properly defined to avoid duplication of efforts, and this is something that will be addressed inter-sessionally.

It was agreed to hold a similar meeting at the 2013 Annual Meeting, and CPs, SC and FC are welcome to make suggestions as to the topics which need to be discussed.

4. Merit Award Nominations

Scientific Council was advised that after a long and productive career, Antonio Vázquez (EU – Spain) was planning to retire in 2013. 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. The EU Delegation proposed that Scientific Council award Antonio a Merit Award. This proposal was warmly supported by members of Scientific Council. The award will be formally presented during the June Scientific Council meeting.

X. ADOPTION OF REPORTS

1. Committee Reports of STACREC and STACFIS

The Council reviewed and adopted the Reports of the Standing Committees (STACREC and STACFIS).

2. Report of Scientific Council

The Council at its concluding session on 21 September 2012 considered and adopted its own report.

XI. ADJOURNMENT

There being no other business, the meeting was adjourned at 1030 hours on 21 September 2011.

Annex 1. Scientific Council plan of action in response to the NAFO Performance Assessment.

PRP	Recommendation	Responsible Body	Priority	GC Proposal	Prospective SC Action
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 Doc. 12-18).*
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		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.*

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 ST	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 analyze it.*

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.*
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*
3 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; 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	*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.*

				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*	*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 bycatch 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.*
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*

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 way in which CCAMLR has approached the issue in terms of developing a unified regulatory framework.	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 for all potential new and exploratory fisheries.	*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 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/ CPs	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.*
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.*
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 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	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), 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.	*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 key terms, would be beneficial.* *Recognising the need for transparency, further steps, such as the public archiving of assessment data, could be considered.*

	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.				
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.*
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.*
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.*

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.*
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.				*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.*
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.				*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.*
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.				*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.*
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.				*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.*

APPENDIX I. REPORT OF STANDING COMMITTEE ON RESEARCH COORDINATION (STACREC)

Chair: Don Stansbury Rapporteur: Barbara Marshall

The Committee met at the Park Inn, Pribaltiskya St. Petersburg. Russia, during 19 September 2012, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal and Spain), France (with respect to St. Pierre et Miquelon), Norway, Russian Federation and USA. The Scientific Council Coordinator was in attendance.

1. Opening

The Chair opened the meeting and welcomed everyone. Barbara Marshall was appointed the Rapporteur.

2. Fisheries Statistics

a) Progress Reports on Secretariat Activities

There were no activities to report.

b) Review of STATLANT 21

The following table updates the situation with the submission of STATLANT. There are still a few outstanding submissions but in general the submission rate is acceptable.

TABLE 1. Dates of receipt of STATLANT 21A and 21B reports for 2008-2010 up to 19 September 2012.

Country/Component	STATLANT 21A (deadline, 1 May)			STALANT 21B (deadline 31 August)		
	2009	2010	2011	2009	2010	2011
CAN-CA	31 Mar 10	31 Mar 11	24 Apr 12	30 Aug 10	8 Aug 11	
CAN-M CAN-SF CAN-G	14 May 10 2 Jun 10	28 Apr 11 29 Apr 11	14 May 12 29 Apr 12	21 May 10 1 Sep 2010	10 June 11 27 July 11	
CAN-N	29 Apr 10	29 Apr 11	30 Mar 12	3 Sep 10	31 Aug 11	31 Aug 12
CAN-Q	11 Mar 11			11 Mar 11		
CUB			4 May 12			
E/EST	30 Apr 10	27 Apr11	17 May 12	26 Aug 10	31 Aug 11	1 Aug 12
E/DNK	24 May 10		18 May 12	24 May 10		31 Jul 12*
E/FRA-M			21 May 12			7Jul 12
E/DEU	27 Apr 10	28 Apr 11	26 Apr 12	31 Aug 10	23 Aug 11	4 Jul 12
E/NLD						
E/LVA	2 Jun 10	14 Apr 11	17 May 12	2 Jun 10	16 Aug 11	2 Aug 12
E/LTU			2 May 12	22 Mar 11		1 Sep 12
E/POL	22 Jul 10 (no fishing)		26 Apr 12 (no fishing)			31 Aug 12 (no fishing)

Country/Component	STATLANT 21A (deadline, 1 May)			STALANT 21B (deadline 31 August)		
	2009	2010	2011	2009	2010	2011
E/PRT	11 May 10	27 Apr 11	8 May 12 (revised 29 May 12)	31 Aug 10	31 Aug 11	7 Sep 12
E/ESP	3 Jun 10		30 May 12	3 Jun 10	11 May 11	31 Aug 12
E/GBR	2 Jun 10	1 Jun 11	26 Apr 12	2 Jun 10	16 Aug 11	
FRO	1 Jun 10	6 May 11	30 Apr 12	1 Jun 10	6 May 11	30 Apr 12
GRL	28 Jun 10	27 Apr 11	19 Apr 12		29 Apr 11	24 Aug 12
ISL	9 Jun 10 (no fishing)	4 May 11	31 May 12		1 Sep 11	31 May 12
JPN			25 Apr 12 (no fishing)			25 Apr 12 (no fishing)
KOR						
NOR	15 Apr 10	28 Apr 11	27 Apr 12	31 Aug 10	19 Aug 11	26 Aug 12
RUS	3 Jun 10	27 Apr 11	29 Apr 12	21 Jun10 (Revised 13 Apr 11)	26 Jul 11	27 Aug 12
USA	26 May 10	16 May 11	21 May 12			
FRA-SP	2 Jun 10	29 Apr 11	14 May 12	1 Sep 10	4 Aug 11	7 Jul 12
UKR		20 Jan 11 (no fishing)				

* Effort only

3. Research Activities

a) Surveys Planned for 2012 and Early-2013

Designated Experts were requested to check and update the information contained in SCS Doc. 12/12.

4. Other Matters

a) Review of SCR and SCS Documents

SCR Doc. 12/1 was not able to be reviewed in June. This document was not reviewed during this meeting. The Secretariat will contact the author, explain the policy and see if he wishes to resubmit it next year.

b) Other Business

i) Stock-by-stock Research Vessel Surveys Reported

In Studies No. 34 the Secretariat had compiled a report entitled “Stock-by-stock Research Vessel Surveys Reported, 1991-2000”. In 2011, STACREC noted that in light of discussions about data sharing and making knowledge of data available it would be a prudent to compile this information for 2001-2010.

The Secretariat has begun the compilation of this and should have a draft ready to be reviewed. The Secretariat will circulate the compilation to each DE and they are requested to review the information before it is published next year.

5. Adjournment

The meeting was adjourned at 1430 on 19 September 2011.

APPENDIX II. REPORT OF STANDING COMMITTEE ON FISHERIES SCIENCE (STACFIS)

Chair : Jean-Claude Mahé Rapporteur: Various

The Committee met at the Park Inn, St. Petersburg, Russia, during 17-21 September 2012, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal, Spain and the United Kingdom), France (with respect to St. Pierre et Miquelon), Norway, Russian Federation and USA. The Scientific Council Coordinator was in attendance.

1. Opening

The Chair opened the meeting by welcoming participants. The provisional agenda was reviewed and adopted, and a plan of work developed for the meeting.

2. Any matter outstanding from the WebEx SC Meeting, 27 August-7 September 2012

a) Northern Shrimp in Div. 3M and Div. 3LNO

The Chair informed the meeting that the assessments for Div. 3M and Div. 3LNO Northern shrimp had been updated during a SharePoint and WebEx meeting of STACFIS. The assessments were completed at that time and there were no outstanding issues.

3. Nomination of Designated Experts

There are likely to be some changes in Designated Experts for stocks over the next year. The current list of Designated Experts is given below and will be nominated again. The relevant institutes will be contacted to confirm the Designated Experts.

The nominated Designated Experts for 2013 are:

From the Science Branch, Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans, P. O. Box 5667, St. John's, NL, Canada A1C 5X1, Canada (Fax: + 709-772-4188)

Cod in Div. 3NO	Rick Rideout	Tel: +1 709-772-4935	rick.rideout@dfo-mpo.gc.ca
Redfish Div. 3O	Rick Rideout	Tel: +1 709-772-4935	rick.rideout@dfo-mpo.gc.ca
American Plaice in Div. 3LNO	Karen Dwyer	Tel: +1 709-772-6975	karen.dwyer@dfo-mpo.gc.ca
Witch flounder in Div. 3NO	Bill Brodie	Tel: +1 709-772-3288	bill.brodie@dfo-mpo.gc.ca
Witch flounder in Div. 2J+3KL	Dawn Maddock Parsons	Tel: +1 709-772-2495	dawn.parsons@dfo-mpo.gc.ca
Yellowtail flounder in Div. 3LNO	Dawn Maddock Parsons	Tel: +1 709-772-2495	dawn.parsons@dfo-mpo.gc.ca
Greenland halibut in SA 2+3KLMNO	Brian Healey	Tel: +1 709-772-8674	brian.healey@dfo-mpo.gc.ca
Northern shrimp in Div. 3LNO	David Orr	Tel: +1 709-772-7343	david.orr@dfo-mpo.gc.ca
Thorny skate in Div. 3LNO	Mark Simpson	Tel: +1 709-772-4148	mark.r.simpson@dfo-mpo.gc.ca
White hake in Div. 3NO	Mark Simpson	Tel: +1 709-772-4148	mark.r.simpson@dfo-mpo.gc.ca

From the Instituto Español de Oceanografia, Aptdo 1552, E-36200 Vigo (Pontevedra), Spain (Fax: +34 986 49 2351)

Roughhead grenadier in SA 2+3	Fernando Gonzalez-Costas	Tel: +34 986 49 2111	fernando.gonzalez@vi.ieo.es
Roundnose grenadier in SA 2+3	Fernando Gonzalez-Costas	Tel: +34 986 49 2111	fernando.gonzalez@vi.ieo.es
Cod in Div. 3M	Diana Gonzalez-Troncoso	Tel: +34 986 49 2111	diana.gonzalez@vi.ieo.es
Shrimp in Div. 3M	Jose Miguel Casas Sanchez	Tel: +34 986 49 2111	mikel.casas@vi.ieo.es

From the Instituto Nacional de Recursos Biológicos (INRB/IPIMAR), Av. de Brasilia, 1449-006 Lisbon, Portugal (Fax: +351 21 301 5948)

American plaice in Div. 3M	Ricardo Alpoim	Tel: +351 21 302 7000	ralpoim@ipimar.pt

Redfish in Div. 3M	Antonio Avila de Melo	Tel: +351 21 302 7000	amelo@ipimar.pt
Redfish in Div. 3LN	Antonio Avila de Melo	Tel: +351 21 302 7000	amelo@ipimar.pt

From the Greenland Institute of Natural Resources, P. O. Box 570, DK-3900 Nuuk, Greenland (Fax: +299 36 1212)

Redfish in SA1	Rasmus Nygaard	Tel: +299 36 1200	rany@natur.gl
Other Finfish in SA1	Rasmus Nygaard	Tel: +299 36 1200	rany@natur.gl
Greenland halibut in Div. 1A	Rasmus Nygaard	Tel: +299 36 1200	rany@natur.gl
Northern shrimp in SA 0+1	Michael Kingsley	Tel: +299 36 1200	mcsk@natur.gl
Northern shrimp in Denmark Strait	Nanette Hammeken	Tel: +299 36 1200	nanette@natur.gl

From the Danish Institute for Fisheries Research, Charlottenlund Slot, DK-2920, Charlottenlund, Denmark (Fax: +45 33 96 33 33)

Roundnose grenadier in SA 0+1	Ole Jørgensen	Tel: +45 33 96 33 00	olj@dfu.min.dk
Greenland halibut in SA 0+1	Ole Jørgensen	Tel: +45 33 96 33 00	olj@dfu.min.dk

From Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich Street, Murmansk, 183763, Russia (Fax: +7 8152 47 3331)

Capelin in Div. 3NO	Ivan Tretiakov	Tel: +7 8152 450568	tis@pinro.ru

From National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543

Northern Shortfin Squid in SA 3 & 4	Lisa Hendrickson	Tel: +1 508 495-2285	lisa.hendrickson@noaa.gov

4. Other Matters

a) Review of SCR and SCS Documents

There were no papers presented to STACFIS.

b) Other Business

There being no other business STACFIS Chair thanked the Designated Experts for their competence and very hard work and the Secretariat for its great support. The STACFIS Chair also thanked the Chair of Scientific Council, and the Scientific Council Coordinator for their support and help. The meeting was adjourned at 1315 on 20 September.

PART D: SCIENTIFIC COUNCIL MEETING, 17-24 OCTOBER 2012

CONTENTS

SC-NIPAG Participants 2012

Back Row: Michael Kingsley, Peter Shelton, Miquel Casas, Nannette Hammeken-Arboe, Carsten Hvingel, Don Stansbury, Neil Campbell, Ole Eigaard, Mats Ulmestrand, Dennis Zakharov

Front Row: Anders Nielsen, Jean-Claude Mahé, Helle Siegstad, Dave Or, Silver Sirp, Ole Ritzau Eigaard

NIPAG Co-Chairs – Peter Shelton and Jean-Claude Mahé, SC Chair – Carsten Hvingel and SC Coordinator – Neil Campbell

REPORT OF SCIENTIFIC COUNCIL MEETING

17-24 October 2012

Chair: Carsten Hvingel Rapporteur: Neil Campbell

I. PLENARY SESSIONS

The Scientific Council met at the Institute of Marine Research, Tromsø, Norway during 17-24 October 2012, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), European Union (Denmark, Estonia, France, Spain and Sweden), Norway and Russia. The Scientific Council Coordinator, Neil Campbell, was in attendance.

The Executive Committee met at 0900 to discuss a plan of work. The opening session of the Council was called to order at 0930 hours on 17 October 2012.

The Chair welcomed representatives, advisers and experts to the opening session of Scientific Council. The Chair noted that the primary reason for this meeting was to provide advice on shrimp stocks based on the assessments provided by the joint NAFO/ICES *Pandalus* Assessment Group (NIPAG). ICES members of NIPAG were granted observer status at the Scientific Council meeting, and the Chair wished all NIPAG members a productive and successful meeting.

The Scientific Council Coordinator, Neil Campbell, was appointed Rapporteur.

This opening session was adjourned at 1000 hours. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda.

The concluding session was convened at 0900 hours on 23 October 2012. The Council then considered and adopted Sections III.1–4 of the "Report of the NAFO/ICES *Pandalus* Assessment Group" (NAFO SCS Doc. 12/23, ICES CM 2012/ACOM:14). The Council, having considered the results of the assessments of the NAFO stocks, provided advice and recommendations and noted the requests of the Fisheries Commission and Coastal States had been addressed. The Council then considered and adopted its own report of the 17-24 October 2012 meeting.

The meeting adjourned at 1600 hours on 23 October 2012.

The revised Agenda, List of Research (SCR) and Summary (SCS) Documents, and the List of Representatives, Advisers and Experts, are given in Appendix I, II and III, respectively.

II. REVIEW OF RECOMMENDATIONS IN 2011 AND IN 2012

These were reviewed in the appropriate STACFIS sections below.

III. NAFO/ICES *PANDALUS* ASSESSMENT GROUP

NIPAG has assessed four stocks of relevance to NAFO: Northern shrimp in Div. 3M, Northern shrimp in Div. 3LNO, Northern shrimp in Subareas 0 and 1, and Northern shrimp in Denmark Strait and off East Greenland. The Scientific Council summary sheets and conclusions for these stocks are presented in Section IV of this report. The full NIPAG report is available in NAFO SCS Doc. 12/23 and ICES CM 2012/ACOM:14

IV. FORMULATION OF ADVICE (SEE ANNEXES 1, 2 AND 3)

1. Request from Fisheries Commission

The Fisheries Commission Request for Advice from the September 2010 meeting (Annex 1d) for shrimp in Div. 3M and Div. 3LNO regarding stock assessment (Item 1) is given, respectively, under IV.1.a and IV.1.b below.

Scientific Council responded:

In October 2011 the Scientific Council provided advice for 2013 for shrimp in Div. 3M and 3LNO. The Council reviewed the status of these stocks in September 2012 meeting, and found no significant change in either to warrant any update of the advice previously provided.

Scientific Council noted that due to the change in the timing of future NIPAG meetings these stocks will be fully assessed in September 2013 in advance of the next Annual Meeting.

2. Requests from Coastal States

a) Northern shrimp in Subareas 0 and 1

Recommendation: Recent catches are not estimated to be sustainable. Scientific Council therefore recommended that catches in 2013 should be substantially lower.

The risk of exceeding Z_{msy} in 2013 at a catch level of 80 000 t with an effective cod stock at the 2012 level (22 700 t) is estimated to be around 34%. Model results estimate catches at that level in the medium term to be associated with an increasing stock above B_{msy}.

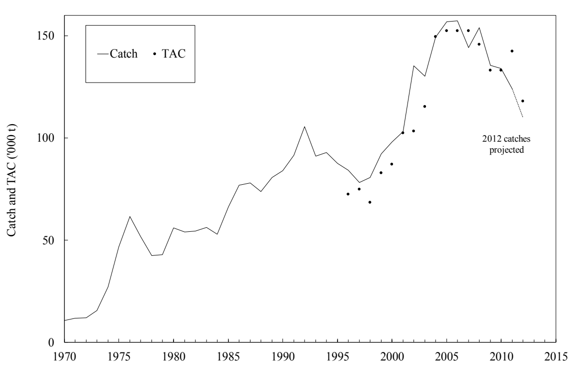
Given the level of risk which was accepted in 2012, Scientific Council recommended that catches in 2013 should not exceed 80 000 t.

Background: The shrimp stock off West Greenland is distributed in Subarea 1 and Div. 0A east of 60°30'W. A small-scale inshore fishery began in SA 1 in the 1930s. Since 1969 an offshore fishery has developed.

Fishery and Catches: The fishery is prosecuted mostly by Greenland in SA 1 and Canada in Div. 0A. Canada did not fish in 2008 and fished little in 2009, but has since resumed fishing. Recent catches are:

Year	Catch ('000 t)		TAC ('000 t)	
	NIPAG	STATLANT 21	Advised	Actual[2]
2009	135.5	134.0	110	133.0
2010	134.0	129.2[1]	110	133.0
2011	124.0	122.1[1]	120	142.4
2012	110.0[3]		90	117.9

[1] Provisional.
[2] Total of TACs set independently by Greenland and Canada.
[3] Predicted to year end by industry observers.



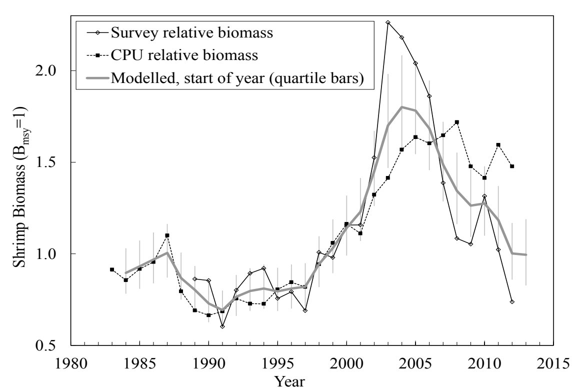
Data: Catch, effort, and position data were available from all vessels. Indices of how widely the stock and the fishery were distributed were calculated from catch positions in the fishery and the survey.

Series of biomass and recruitment indices and size- and sex-composition data were available from research surveys. Series of cod biomass and cod consumption were also available.

Assessment: An analytical assessment framework was used to describe stock dynamics in terms of biomass (*B*) and mortality (*Z*) relative to biological reference points.

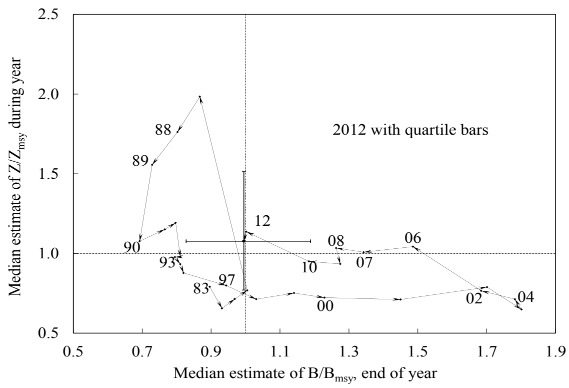
The model used was a stochastic version of a surplus production model including an explicit term for predation by Atlantic cod, stated in a state-space framework and fitted by Bayesian methods. *MSY* (Maximum Sustainable Yield) defines maximum production, and B_{msy} is the biomass level giving *MSY*.

A precautionary limit reference point for stock biomass (B_{lim}) is 30% of B_{msy} and the limit reference point for mortality (Z_{lim}) is Z_{msy}. Recent CPUE values have stayed high, while the area fished has contracted and survey biomass indices have decreased, and CPUE is not now considered a reliable index of biomass. The weight given to it in the model was therefore reduced in 2011. The median estimate of *MSY* in 2012 was 132 000 t/yr.

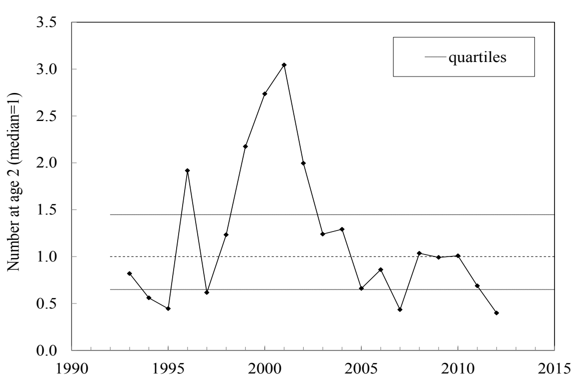


Biomass. A stock-dynamic model showed a maximum biomass in 2003 with a continuing decline since; the probability that biomass will be below B_{msy} in 2012 with projected catches at 110 000 t was estimated at 51%; of its being below B_{lim} at 1–2%.

Mortality. The mortality caused by fishing and cod predation (*Z*) is estimated to have stayed below the upper limit reference (Z_{msy}) from 1996 to 2005, but is estimated to have averaged 2.6% over the limit value in 2006 - 2012. With catches projected at 110 000 t the risk that total mortality in 2012 would exceed Z_{msy} was estimated at about 56%. Atlantic cod is, in 2012, more concentrated in southerly areas where shrimps are now scarce, and predation is expected to be moderate or low.



Recruitment. The stock structure in 20121 is deficient in shrimps of intermediate size 15–22 mm CPL fishable males, presaging poor short-term recruitment to both the fishable and spawning stocks. . Shrimps at 14–16.5 mm CPL are abundant relative to survey biomass, promising some short-term recruitment to the fishable biomass. Pre-recruits (CL 14–16.5 mm), expected to enter the fishery in 2013; have been few since 2008 in absolute terms. Numbers at age 2 in 2011 2012 have declined from the level of the 3 foregoing years to 55% of the series mean, their lowest-ever level, so medium-term recruitment is also expected to be poor.



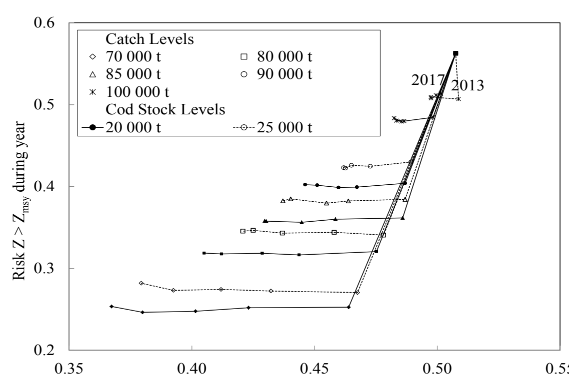
State of the Stock. Modelled biomass is estimated to have been declining since 2004. At the end of 2012 biomass is projected to be close to B_{msy}. Total mortality is projected to exceed Z_{msy}. Recruitment to the fishable and spawning stock in the short- and medium-term is expected to remain low.

Short-term predictions: Estimated risks for 2013 with an "effective" (the amount of cod biomass overlapping the shrimp biomass) 25 000 t cod stock are:

25 000 t cod Risk of transgressing (%):	Catch option ('000 t) 70	75	80	85	90	95	100
Bmsy, end 2013	47	48	48	49	49	50	51
Blim, end 2013	1	1	1	1	1	1	2
Zmsy, in 2013	27	31	34	38	43	47	51
Zmsy, in2014	27	31	34	38	42	47	51

Medium-term Predictions: Projected probabilities of transgressing precautionary reference levels after 3 years in the fishery for Northern Shrimp on the West Greenland shelf with 'effective' cod stocks assumed at 20 000 t (20Kt) and 25 000 t (25Kt) were estimated at:

Catch (Kt/yr.)	Prob. biomass < B_{MSY} (%)		Prob. biomass < B_{lim} (%)		Prob. mort > Z_{msy} (%)	
	20 Kt	25 Kt	20 Kt	25 Kt	20 Kt	25 Kt
70	40	41	2	3	25	27
75	41	43	2	3	28	31
80	43	44	2	3	32	34
85	44	45	3	3	36	38
90	46	47	3	3	40	43
95	47	49	3	3	44	46
100	48	50	3	3	48	51



Special Comments: Scientific Council notes that the fishable biomass offshore comprises a high proportion of females, so fishing on this stock in this state will disproportionately reduce the spawning stock biomass. Recruitment in absolute terms is expected to be low in both the short and medium term.

Scientific Council notes that there are indications of factors other than fishery that may be involved in the current decline of the stock.

Sources of Information: SCR Docs 04/75, 04/76, 08/62, 12/44, 12/45, 12/46, 12/48, 12/57, SCS Doc. 04/12.

b) Northern shrimp in Denmark Strait and off East Greenland

Recommendation: Scientific Council finds no basis to change its previous advice at this time and recommended that catches should remain below 12 400 tons in 2012.

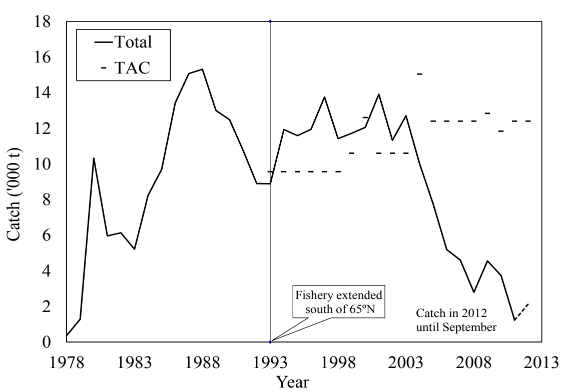
Scientific Council notes that stock indicators have declined after 2009. If this trend continues, future catch levels may need to be reduced.

Background: The fishery began in 1978 in areas north of 65°N in Denmark Strait, where it occurs on both sides of the midline between Greenland and Iceland. Areas south of 65°N in Greenlandic waters have been exploited since 1993. Until 2005 catches in the area south of 65°N accounted for 50 - 60% of the total catch but since 2006 catches in the southern area has decreased and since 2008 accounted for about 10% of the total catch.

Fishery and Catches: Greenland, EU (Denmark) and EU (Estonia) participated in the fishery in 2012. Catches in the Icelandic EEZ decreased from 2002-2005 and since 2006 no catches have been taken. Recent catches and recommended TACs are as follows:

	Catch ('000 t)	TAC ('000 t)		
Year	NIPAG	Recom-mended	Greenland EEZ	Iceland EEZ[1]
2008	2.8	12.4	12.4	
2009	4.6	12.4	12.8	
2010	3.7	12.4	11.8	
2011	1.2	12.4	12.4	
2012	2.1[2]	12.4	12.4	

[1] Fishery unregulated in Icelandic EEZ;
[2] Catch till September 2012.

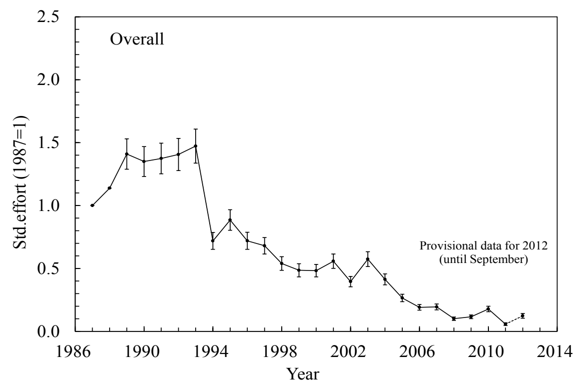


Data: Catch and effort data were available from trawlers of several nations. Annual surveys have been conducted since 2008.

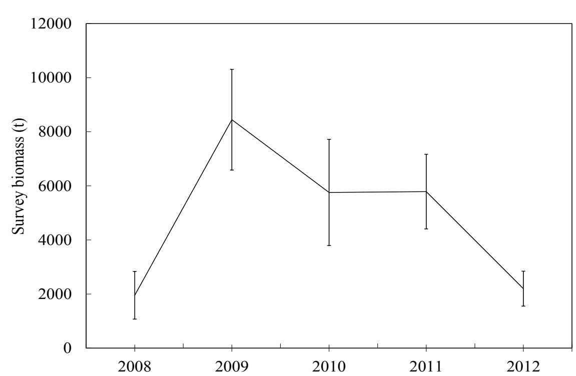
Assessment: No analytical assessment is available. Evaluation of the status of the stock is based on analysis of commercial fishery data and survey data.

Recruitment: No recruitment estimates were available.

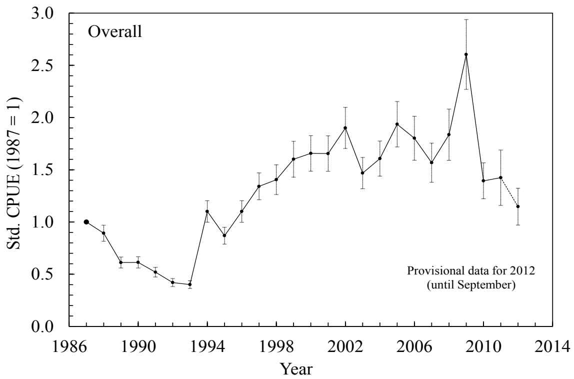
Exploitation rate: Since the mid-1990s exploitation rate index (standardized effort) has decreased, reaching the lowest levels seen in the time series from 2008 - 2012.



Biomass: The survey biomass index has decreased since 2009 and is now at the level seen at the beginning of the short time series in 2008.



CPUE: The combined standardized catch rate index for the total area remained at a high level from 2000 to 2009. Since then the combined index has been declining and is now lower than seen during the 2000s.



State of the Stock: Indices of stock biomass indicate a decline during the last 3 years. The biomass is now believed to be slightly lower than the relatively high level seen during most of the 2000s.

Special Comments: Effort has decreased in recent years. This decrease may be related to the economics of the fishery.

Sources of Information: SCR Doc. 12/62, 12/63.

V. OTHER MATTERS

1. Scheduling of Future Meetings

At the 2011 October meeting, Scientific Council noted the proposed change in timing of the Annual Meeting in 2013, the duplication of effort which occurs when updates to advice are produced intersessionally and the time-lag between assessments and the implementation of advice based on them. Scientific Council agreed to reflect upon holding the Scientific Council / NIPAG meeting earlier in the annual cycle in future years.

Having considered the various logistical issues in changing the timing of the meeting, Scientific Council resolved to hold the next NIPAG meeting at the NAFO Secretariat, Dartmouth, Canada, during 12 – 19 September, 2013, in advance of the NAFO Annual Meeting, to produce advice for shrimp stocks in 2014. It is envisaged that the NAFO stocks (*Pandalus borealis* in Div. 3M and 3LNO) will be addressed in the first days of the meeting, allowing the advice to be circulated to Contracting Parties one week in advance of the NAFO Annual Meeting.

2. Topics for Future Special Sessions

No special sessions were proposed.

3. Items arising from the NAFO Performance Assessment

At its September meeting, Scientific Council developed a plan of action to address the recommendations of the NAFO Performance Assessment. Of relevance to this group was the recommendation that shorter, more concise reports be produced. Scientific Council discussed a suggestion that the NIPAG report be separated into two sections, with one volume covering Barents Sea (ICES Divs. I-II), Skagerrak and Norwegian Deep (ICES Divs. IIIa and IVa East) and Fladen (ICES Div. IVa), and the other addressing West Greenland (NAFO SA 0 + 1), Denmark Strait and East Greenland (ICES Divs. XIVb and Va), Flemish Cap (NAFO Div. 3M) and Grand Bank (NAFO Divs. 3LN). Scientific Council felt that this idea detracted from the intention of this to be a joint NAFO-ICES working group, and expressed a desire to see all stocks reflected in the report. The Executive Committee will work in conjunction with the Secretariat to develop a proposal on streamlining publications to be presented to Scientific Council at the June 2013 meeting.

4. Other Business

Scientific Council were informed of results from two research projects focusing on the genetic stock structure of northern shrimp in respectively the whole North Atlantic (POPBOREALIS) and the Skagerrak/North Sea area (Sustainable shrimp fishing in Skagerrak). As the data set from the North Sea/Skagerrak is not yet finalized, and since the statistical analyses are still ongoing, the results are still preliminary. However, the results indicate that shrimp in some areas, especially around Iceland, Jan Mayen and in Gulf of Maine, and possibly also on Flemish Cap, constitute isolated populations, while shrimp in other areas, such as the Barents Sea and the eastern coast of Canada constitute distinct, but large, interbreeding populations. The genetic differences between samples within Skagerrak and the North Sea are small compared with the differences across the North Atlantic as a whole. A finalized data set is expected before the end of 2012 such that conclusions on the stock structure in Skagerrak and the North Sea can be drawn as part of the ICES process for benchmarking stock assessments. Samples from the Gulf of St. Lawrence and east of Greenland would provide a more complete picture of global stock identity.

VI. ADOPTION OF SCIENTIFIC COUNCIL AND NIPAG REPORTS

The Council at its session on 24 October 2012 considered and adopted Sections III.1-4 of the "Report of the NAFO/ICES *Pandalus* Assessment Group" (SCS Doc. 12/23, ICES CM 2012/ACOM:14). The Council then considered and adopted its own report of the 17-24 October 2012 meeting.

VII. ADJOURNMENT

The Chair thanked the participants for their hard work and contribution to the success of this meeting, and welcomed the peer review and constructive comments received in formulating the scientific advice. The Chair thanked the Scientific Council Coordinator, Neil Campbell, and Barbara Marshall, Information Officer for their support during the meeting. The Chair then thanked the ICES and NAFO Secretariats for their support in general and Institute for Marine Resources for hosting the Scientific Council and NIPAG meetings. All participants were then wished a safe journey home and the meeting was adjourned at 1600 hours.

PART E: NAFO/ICES *PANDALUS* ASSESSMENT GROUP MEETING, 17–24 OCTOBER 2012

CONTENTS

REPORT OF NIPAG MEETING

17–24 October 2012

Co-Chairs: Jean-Claude Mahé and Peter Shelton Rapporteurs: Various

I. OPENING

The NAFO/ICES *Pandalus* Assessment Group (NIPAG) met at the Institute of Marine Research, Tromsø, Norway during 17-24 October 2014 to review stock assessments referred to it by the Scientific Council of NAFO and by the ICES Advisory Committee. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), European Union (Denmark, Estonia, France, Spain and Sweden), Norway, Russian Federation. The NAFO Scientific Council Coordinator was also in attendance.

II. GENERAL REVIEW

1. Review of Research Recommendations in 2011

These are given under each stock in the "stock assessments" section of this report.

2. Review of Catches

Catches and catch histories were reviewed on a stock-by-stock basis in connection with each stock.

III. STOCK ASSESSMENTS

1. Northern Shrimp on Flemish Cap (NAFO Div. 3M)

Environmental Overview

The water masses characteristic of the Flemish Cap area are a mixture of Labrador Current Slope Water and North Atlantic Current Water and are generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3-4°C and salinities in the range of 34-34.75. The general circulation in the vicinity of the Flemish Cap consists of the offshore branch of the Labrador Current which flows through the Flemish Pass on the Grand Bank side and a component that flows eastward north of the Cap and then southward east of the Cap. To the south, the Gulf Stream flows to the northeast to form the North Atlantic Current and influences waters around the southern areas of the Cap. In the absence of strong wind forcing the circulation over the central Flemish Cap is dominated by a topographically induced anticyclonic gyre. During April of 2012 near bottom temperatures around the Cap were about 4°C which ranged from 0.5°-1°C above the long term average. Upper layer temperatures during April ranged from 4°-5°C, also above normal by up to 1°-2°C. Satellite SST during spring and summer months were above normal by 1.5°C and 2.5°C, respectively. The summer SST on the Flemish Cap was the highest observed in the time series going back to 1985.

a) Introduction

The shrimp fishery in Div. 3M is now under moratorium. This fishery began in 1993. Initial catch rates were favorable and, shortly thereafter, vessels from several nations joined. Catches peaked at over 60 000 t in 2003 and declined thereafter.

Fishery and catches: The effort allocations were reduced by 50% in 2010 and a moratorium was imposed in 2011. Catches are expected to be close to zero in 2012.

Recent catches were as follows:

	2006	2007	2008	2009	2010	2011	2012
NIPAG	18 000	21 000	13 000	5 000	2 000	0	0
STATLANT 21	15191	17642	13431	5374	1976	0	0[1]
Recommended TAC	48 000	48 000	17 000 – 32 000	18 000 – 27 000	ndf	ndf	ndf
Effort[2] (Agreed Days)	10555	10555	10555	10555	5227	0	0

[1] To October 2012
[2] Effort regulated

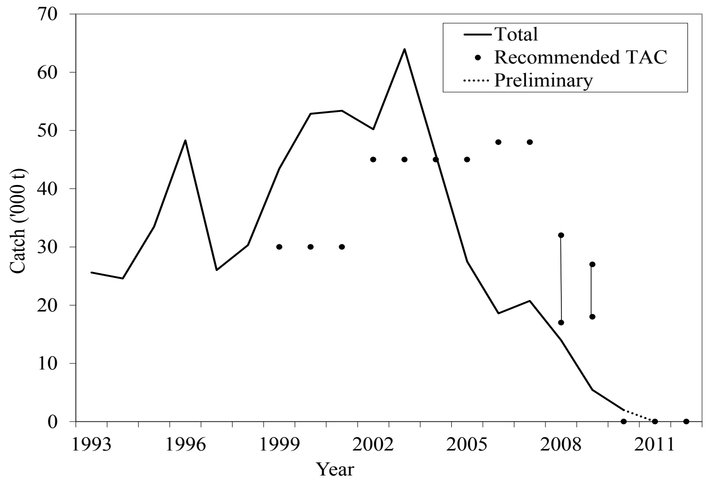


Fig. 1.1. Shrimp in Div. 3M: Catches (t) of shrimp on Flemish Cap and TACs recommended in the period 1993-2012. Due to a moratorium, the shrimp catch is expected to be zero in 2012.

b) Input Data

i) Commercial fishery data

Catch, effort and biological data were available from several Contracting Parties. Time series of size and sex composition data were available mainly from two countries between 1993 and 2005 and survey indices were available from EU research surveys (1988-2011). Catch data were updated for 2012. Because of the moratorium catch and effort data were not available for 2011 and 2012. Therefore the standardized CPUE series was not updated from 2012.

ii) Research survey data

Stratified-random surveys have been conducted on Flemish Cap by the EU in July from 1988 to 2012, using a Lofoten trawl. A new vessel was introduced in 2003 which continued to use the same trawl employed since 1988. In addition, there were differences in cod-end mesh sizes utilized in the 1994 and 1998 surveys that have likely resulted in biased estimates of total survey biomass. Nevertheless, for this assessment, the series prior to 2003 were converted into comparable units with the new vessel based on the methodology accepted by STACFIS in 2004 (NAFO 2004 SC Rep., SCR Doc. 04/77). The index was stable at a high level from 1998 to 2007. After 2007 the survey biomass index declined and in 2012 was the lowest in the survey series, well below B_{lim}.

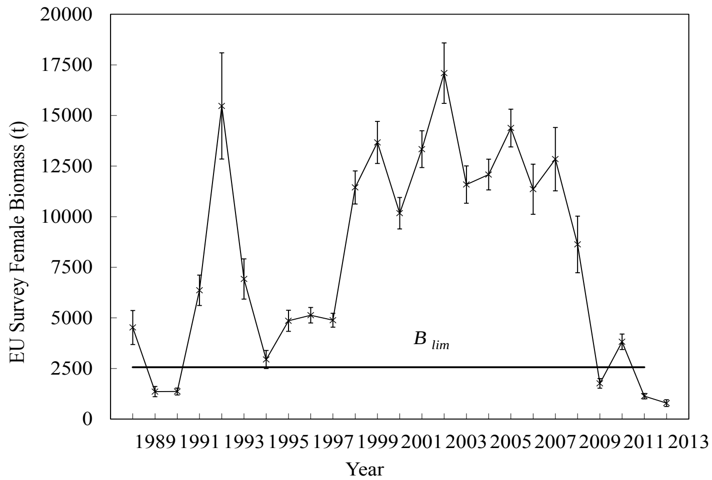


Fig. 1.2. Shrimp in Div. 3M: Female biomass index from EU trawl surveys, 1988-2012. Error bars are 1 std. err.

c) Assessment

No analytical assessment is available and fishing mortality is unknown. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

Recruitment: All year-classes after the 2002 cohort (i.e. age 2 in 2004) have been weak.

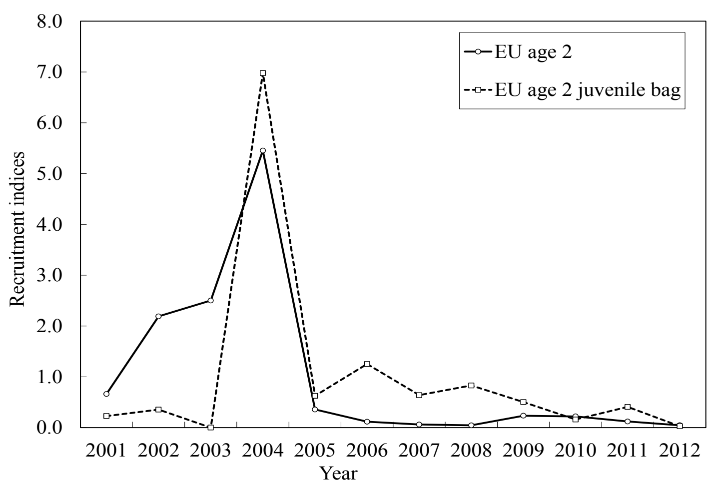


Fig. 1.3. Shrimp in Div. 3M: Abundance indices at age 2 from the EU survey. Each series was standardized to its mean.

SSB: The survey female biomass index was at a high level from 1998 to 2007, and has declined to its lowest level in 2012, well below B_{lim}.

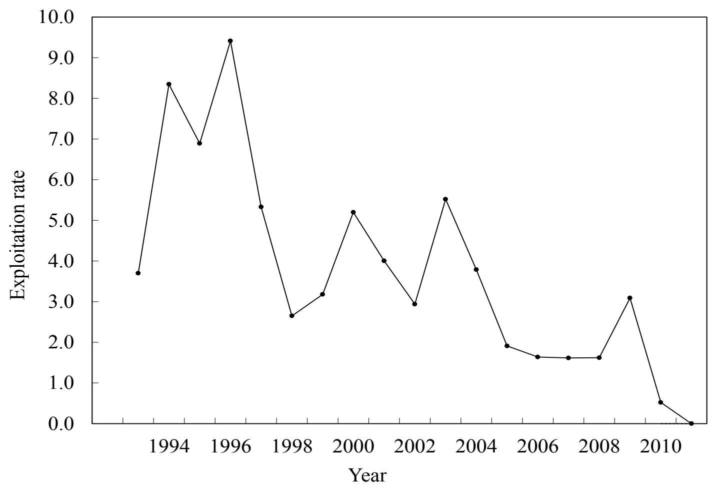


Fig. 1.4. Shrimp in Div. 3M: exploitation rate as derived by catch divided by the EU survey biomass index of the same year.

Exploitation rate: From 2005 to 2008 exploitation rates (nominal catch divided by the EU survey biomass index of the same year) remained stable at relatively low values and increased in 2009. Because catches in 2010 were low, while the female biomass estimate increased slightly, the exploitation rate declined to its lowest observed level. From 2011 no catches were recorded due to the moratorium and the exploitation rate is 0 or very close to 0.

d) State of the Stock

The low values of the total and female biomass indexes in 2009 continued in 2010 and are well below the B_{lim} proxy in 2011 and 2012, confirming the strong decrease of this stock caused by the weak recruitments in the last eight years and the increase of cod stock, one of their most important predators. NIPAG concluded that there was no change in the status of the stock.

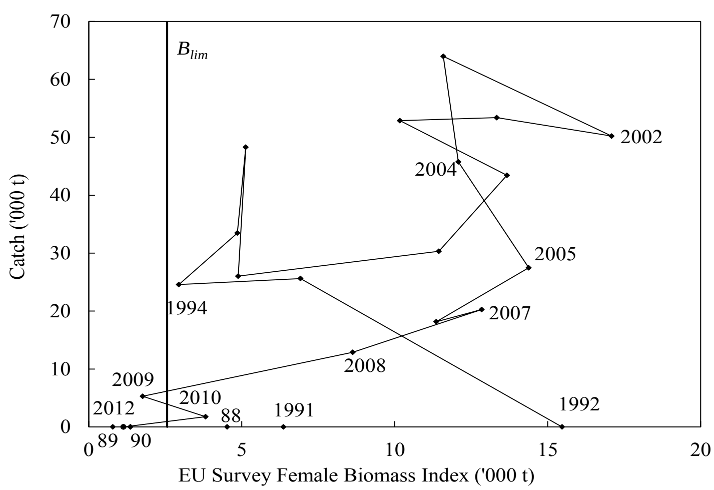


Fig. 1.5. Shrimp in Div. 3M: Catch plotted against female biomass index from EU survey. Line denoting B_{lim} is drawn where biomass is 85% lower than the maximum point in 2002. Due to the moratorium on shrimp fishing the expected catch in 2012 is 0 t.

e) Reference Points

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from its maximum observed level provides a proxy for B_{lim}. This is 2 564 t for northern shrimp in Div. 3M. The index in 2011 and 2012 is below B_{lim}. It is not possible to calculate a limit reference point for fishing mortality.

f) Ecosystem considerations

The drastic decline of shrimp biomass since 2008 coincided with the increase of the cod stock in recent years.

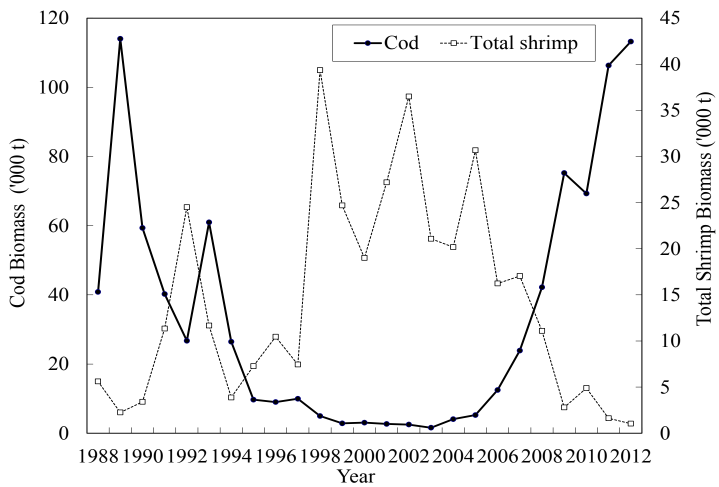


Fig. 1.6. Shrimp in Div. 3M: Cod and total shrimp biomass from EU trawl surveys, 1988-2012.

The consumption rate of shrimp by cod increased after the increase of shrimp biomass, showing a high consumption rate in the period 1999-2006. After that, despite the consumption rate decreasing, the shrimp biomass declined in conjunction with the increase of the cod biomass.

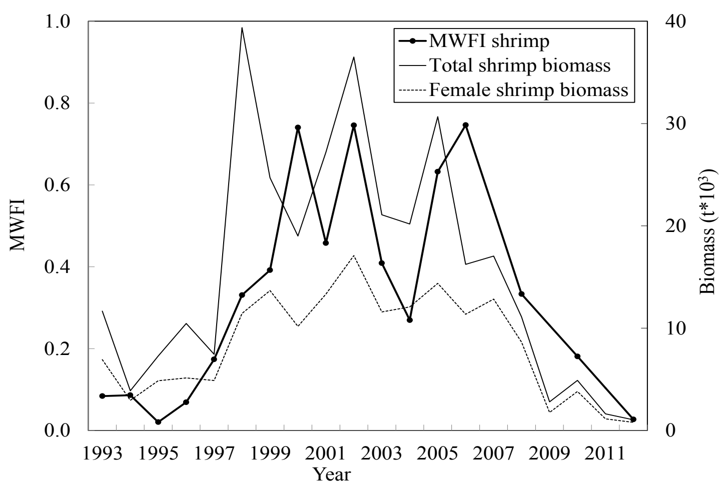


Fig. 1.7. Shrimp in Div. 3M: Shrimp consumption rate by cod along the years; Mean Weight Fullness Index (MWFI), and Total and Female biomass.

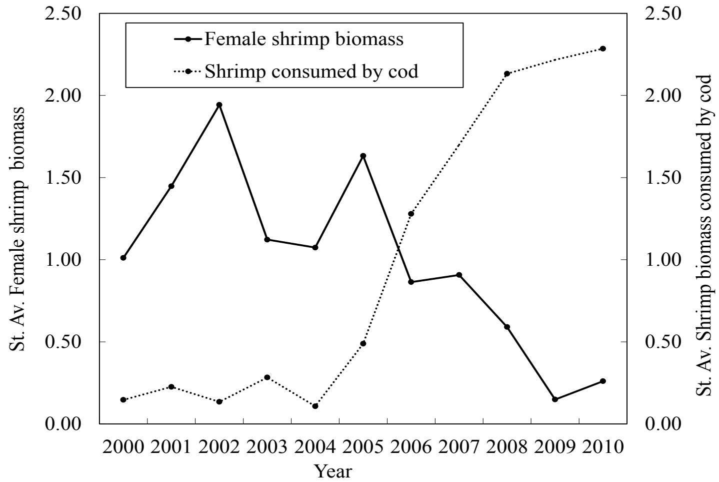


Fig. 1.8. Shrimp in Div. 3M: Standardized female shrimp biomass and shrimp biomass consumed by cod between 2000 and 2010 (values for shrimp predated in 2007, 2009 and 2011 were not available because the food sampling was not carried out in those years).

g) Conclusions

The low values of the total and female biomass indexes in 2009 continued in 2010 and were well below the B_{lim} proxy in 2011 and 2012, confirming the strong decrease of this stock caused by the weak recruitments in the last eight years and the increase of cod stock, one of their most important predators. STACFIS concludes that there was no change in the status of the stock.

2. Northern Shrimp in Divisions 3LNO

(SCR Doc. 12/047, 054, 056 and 058)

Environmental Overview

The water masses characteristic of the Grand Banks are typical Cold-Intermediate-Layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0°C during spring and through to autumn. The general circulation in this region consists of the relatively strong offshore Labrador Current at the shelf break and a considerably weaker branch near the coast in the Avalon Channel. Currents over the banks are very weak and the variability often exceeds the mean flow. The proportion of bottom habitat on the Grand Banks covered by <0°C water has decreased from near 50% during the first half of the 1990s to <15% during recent years. The cross-sectional area of cold intermediate water (CIL) along the 47°N section across the Grand Bank is a reliable index of ocean climate conditions in this area. During the spring of 2012 the CIL area increased over the record low value of 2011 but remained below normal for the 3rd consecutive year. Bottom temperatures on the northern Grand Bank during the spring of 2012 generally ranged from 0°-3°C about 0.5°-1°C (1-2 standard deviations) above normal over most areas of Div. 3L. However, these represent a decreased of up to 1.5°C from the warm spring conditions of 2011. The January to June average surface temperature at Station 27 off eastern Newfoundland remained above the long-term mean by 1.2 standard deviations, while bottom temperatures were above normal by 1.8 standard deviations.

a) Introduction

This shrimp stock is distributed around the edge of the Grand Bank mainly in Div. 3L. The fishery began in 1993 and came under TAC control in 2000 with a 6 000 t TAC and fishing restricted to Div. 3L. Annual TACs were raised several times between 2000 and 2009 reaching a level of 30 000 t for 2009 and 2010 before decreasing to 12 000 t in 2012 and 8 600 t in 2013. A total catch of 8 947 t was taken up to September 30, 2012 (Fig. 2.1).

Recent catches and TACs (t) for shrimp in Div. 3LNO (total) are as follows:

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TAC as set by FC	13 000[1]	13 000[1]	22 000[1]	22 000[1]	25 000[1]	30 000[1]	30 000[1]	19 200[1]	12 000[1]	8 600
STATLANT 21	11 937	13 533	21 426	21 543[1]	21 121[1]	24 142[1]	16 310[1]	12 836[2]	8 561[3]	
NIPAG[4]	13 204	14 775	25 699	23 570	26 649	27 527	20 536	12 286		

[1] Denmark with respect to Faroes and Greenland did not agree to the quotas of 144 t (2003–2005), 245 t (2006–2007), 278 t (2008), or 334 t (2009) and set their own TACs of 1 344 t (2003–2005), 2 274 t (2006–2008), 3 106 t (2009), 532 t (2010), 1 985 t (2011) and 1 241 t (2012). The increase is not included in the table.
[2] Provisional catches.
[3] Estimated catches to September 2012.
[4] NIPAG catch estimates have been updated using various data sources (see p. 15, SCR Doc. 12/47).

Since this stock came under TAC regulation, Canada has been allocated 83% of the TAC. This allocation is split between a small-vessel (less than 500 GT and less than 65 ft.) and a large-vessel fleet. By September 30, 2012, the small- and large-vessel fleets had taken 6 183 t and 1 684 t of shrimp respectively in Div. 3L. In all years, most of the Canadian catch occurred along the northeast slope in Div. 3L. The annual quota within the NAFO Regulatory Area (NRA) is 17% of the total TAC.

The use of a sorting grid to reduce bycatches of fish is mandatory for all fleets in the fishery. The sorting grid cannot have a bar spacing greater than 22 mm.

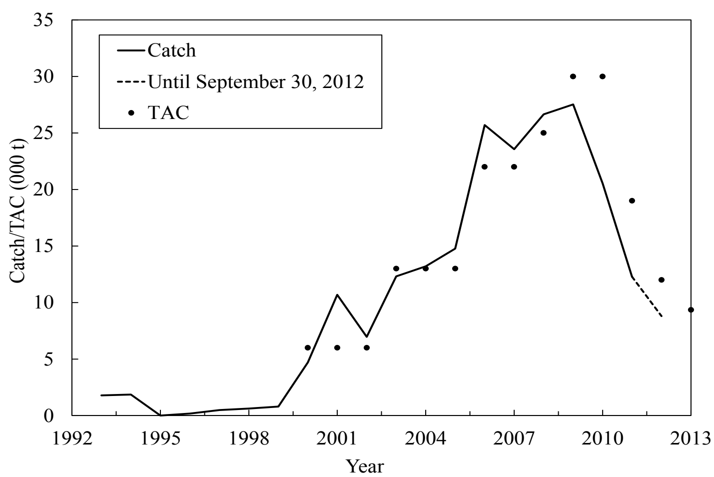


Fig. 2.1. Shrimp in Div. 3LNO: catches (to September 2012) and TAC as set by Fisheries Commission.

b) Input Data

i) Commercial fishery data

Effort and CPUE.

Catch and effort data have been available from vessel logbooks and observer records since 2000. Data for the time series have been updated for these analyses. CPUE models were standardized to 2001 values rather than the last year of the fishery. The 2012 index for small vessel CPUEs were significantly lower than the long term mean and were similar to the 2001 values while the large vessel CPUEs were the lowest in the time series (Fig. 2.2).

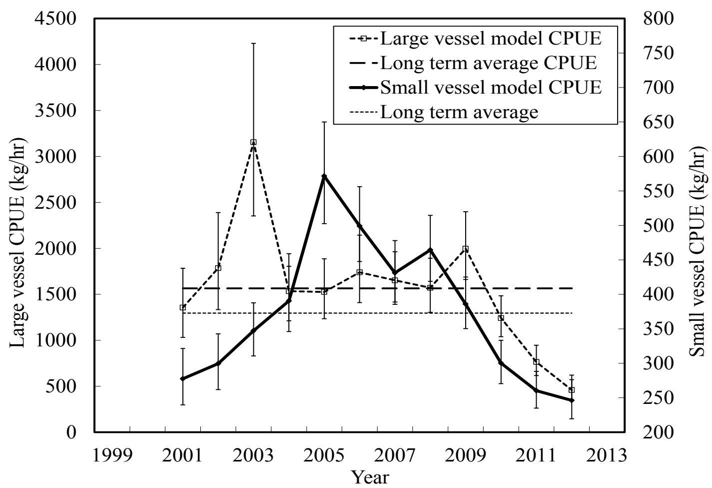


Fig. 2.2. Shrimp in Div. 3LNO: Standardized CPUE for the Canadian large-vessel (>500 t) and small-vessel (≤500 t; LOA<65') fleets fishing shrimp in Div. 3L within the Canadian EEZ.

Logbook data were available for the shrimp fishery within the NRA, in 2012, but this came from only Estonia. The data was insufficient to produce a standardized CPUE model.

Catch composition. Length compositions were derived from Canadian, Spanish and Estonian observer datasets from 2003 to 2012, 2011 and 2010 – 2012 respectively. Catches appeared to be represented by a broad range of size groups of both males and females.

ii) Research survey data

Canadian multi-species trawl survey. Canada has conducted stratified-random surveys in Div. 3LNO, using a Campelen 1800 shrimp trawl, from which shrimp data is available for spring (1999–2012) and autumn (1996–2011). The autumn survey in 2004 was incomplete and therefore of limited use for the assessment.

Spanish multi-species trawl survey. EU-Spain has been conducting a spring stratified-random survey in Div. 3NO within the NRA since 1995; the survey has been extended to include the NRA in Div. 3L since 2003. From 2001 onwards data were collected with a Campelen 1800 trawl. There was no Spanish survey in 2005 in Div. 3L.

Biomass. In Canadian surveys, over 90% of the biomass was found in Div. 3L, distributed mainly along the northeast slope in depths from 185 to 550 m. There was an overall increase in the both spring and autumn indices to 2007 after which they decreased by about 75% to 2012 (Fig. 2.3). Confidence intervals from the spring surveys are usually broader than from the autumn surveys.

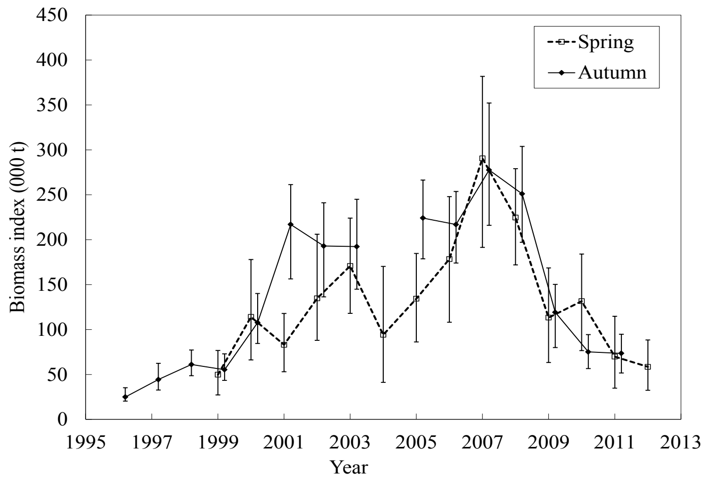


Fig. 2.3. Shrimp in Div. 3LNO: biomass index estimates from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Spanish survey biomass indices for Div. 3L, within the NRA, increased from 2003 to 2008 followed by a 93% decrease by 2012 (Fig. 2.4).

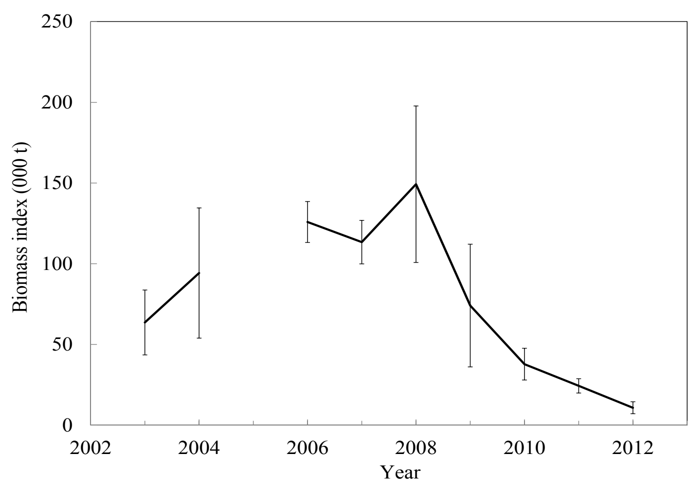


Fig. 2.4. Shrimp in Div. 3LNO: biomass index estimates from EU - Spanish multi-species surveys (± 1 s.e.) in the 3L NRA.

Female Biomass (SSB) indices. The autumn 3LNO female biomass index showed an increasing trend to 2007 but decreased 72% by 2012. The spring SSB index decreased by 84% between 2007 and 2012 (Fig. 2.5).

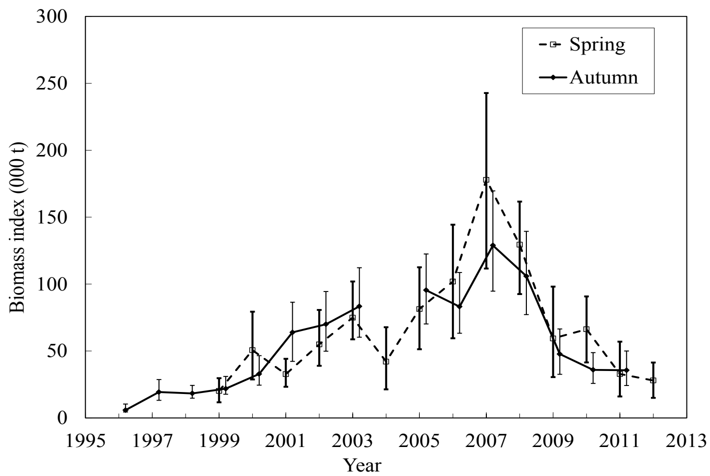


Fig. 2.5. Shrimp in Div. 3LNO: Female biomass indices from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Stock composition. The autumn surveys showed an increasing trend in the abundance of female (transitional + females) shrimp up to 2007 and remained high in 2008 then decreased by 72% through to 2011. Similarly, spring female abundance series increased until 2007, remained high in 2008 then decreased by 84% through to 2012. Male autumn abundance index peaked in 2001 and remained high until 2008 before decreasing by 74% by 2011. The spring male abundance index followed trends similar to their respective female index (Fig. 2.6).

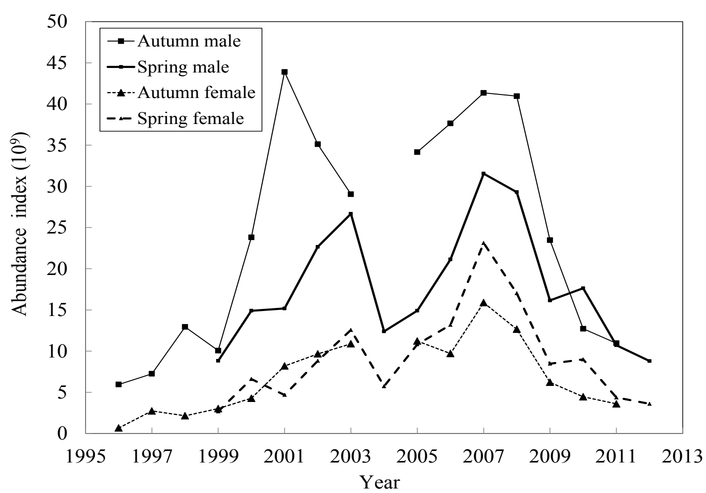


Fig. 2.6. Shrimp in Div. 3LNO: Abundance indices of male and female shrimp within Div. 3LNO as estimated from Canadian multi-species survey data.

Both males and females showed a broad distribution of lengths in recent surveys indicating the presence of more than one year class. It is worth reiterating that since 2008 the abundances at all length classes were greatly reduced from those found in previous Canadian surveys (Fig. 2.7).

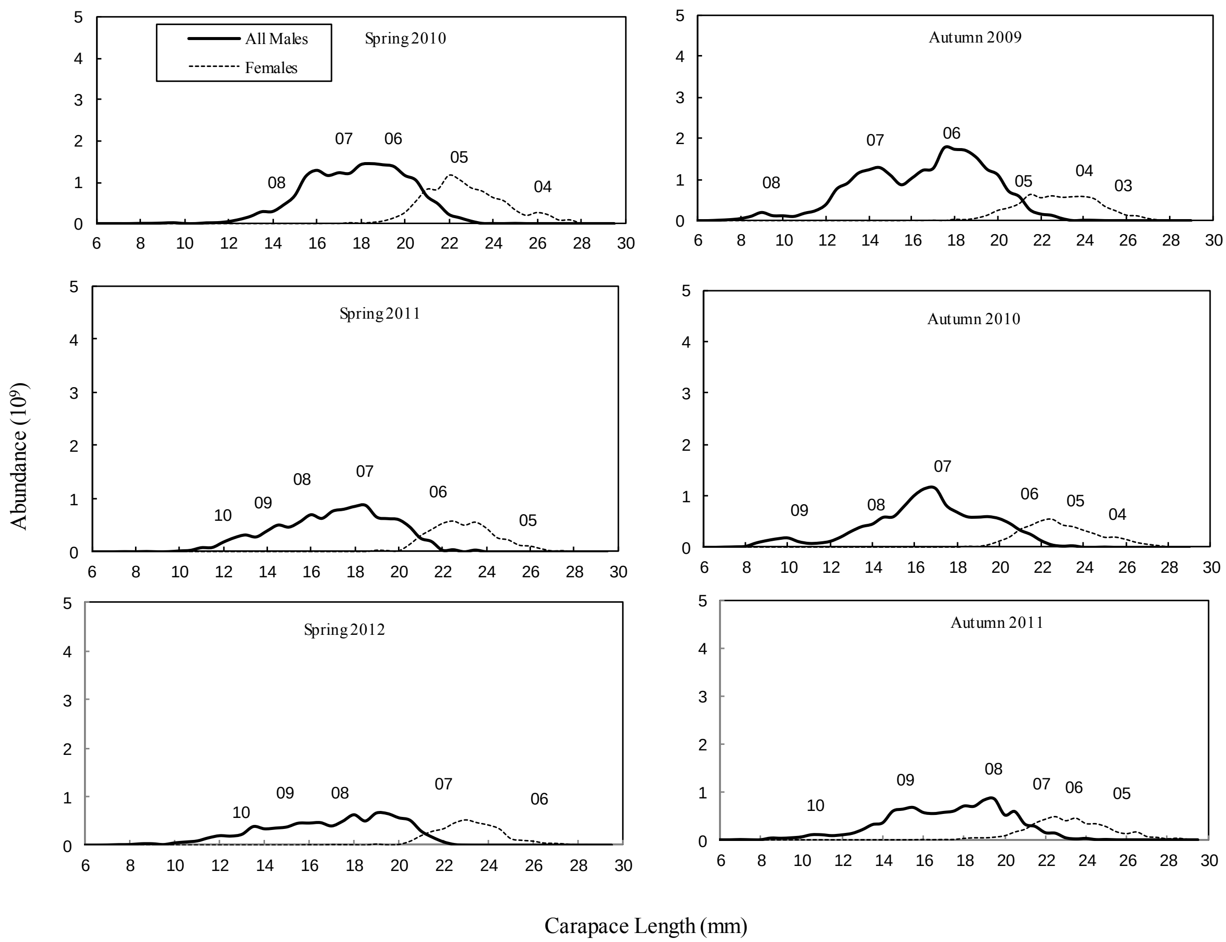


Fig. 2.7. Shrimp in Div. 3LNO: abundance at length (smoothed) for northern shrimp estimated from Canadian multi-species survey data. Numbers within charts denote year-classes.

Recruitment indices. The recruitment indices were based upon abundances of all shrimp with carapace lengths of 11.5 – 17 mm from Canadian survey data. The 2006 – 2008 recruitment indices were among the highest in both spring and autumn time series. Both indices decreased through to spring 2012 (Fig. 2.8).

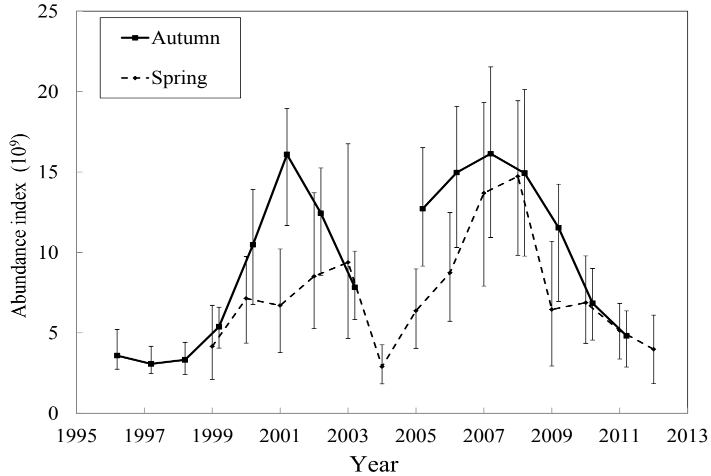


Fig. 2.8. Shrimp in Div. 3LNO: Recruitment indices derived from abundances of all shrimp with 11.5 – 17 mm carapace lengths from Canadian spring and autumn bottom trawl survey (1996–2012) data.

Fishable biomass and exploitation indices. There had been an increasing trend in Canadian spring and autumn survey fishable biomass indices (shrimp >17 mm carapace length) until 2007. The autumn fishable biomass showed an increasing trend until 2007 then decreased by 76% through to 2010 and remaining near that level in 2011. Similarly, the spring fishable biomass index increased to 2007 but has since decreased by 82% through to 2012 (Fig. 2.9).

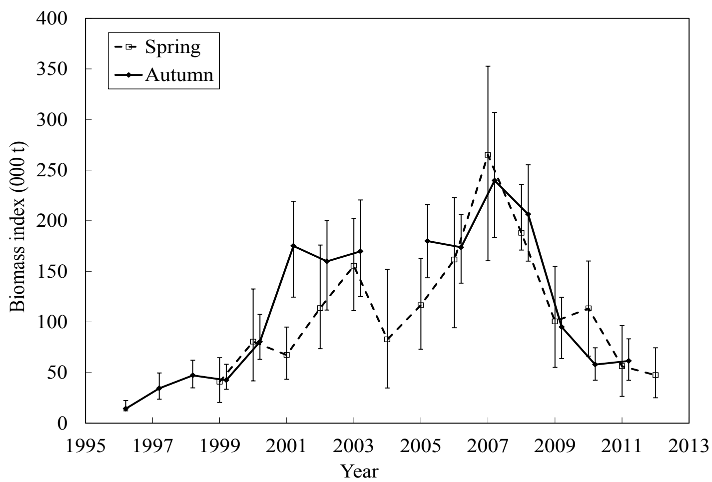


Fig. 2.9. Shrimp in Div. 3LNO: fishable biomass index. Bars indicate 95% confidence limits.

An index of exploitation was derived by dividing the catch in a given year by the fishable biomass index from the previous autumn survey. The catch series was updated in the September 2012. The exploitation index has been below 0.15 until 2010 when it increased to 0.21. By September 30, 2012, the 2012 exploitation rate index was 0.14. Based upon the autumn 2011 fishable biomass of 61 500 t, if the entire 12 000 t quota was to be taken, the exploitation rate index would increase to 0.20 (Fig. 2.10).

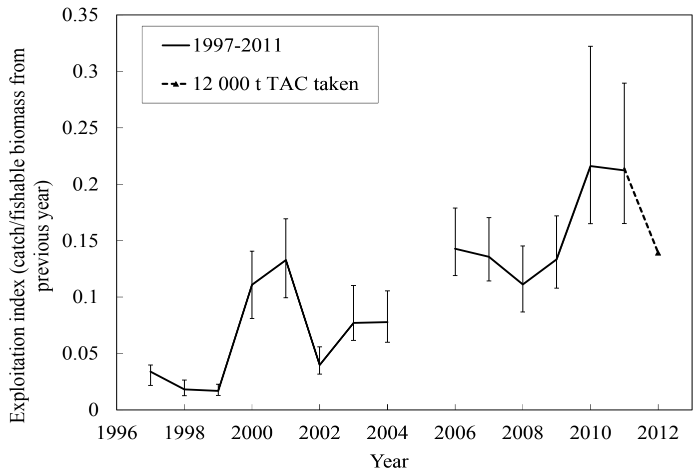


Fig. 2.10. Shrimp in Div. 3LNO: exploitation rates calculated as year's catch divided by the previous year's autumn fishable biomass index. The 2012 exploitation rate index is based upon incomplete catch data. Bars indicate 95% confidence limits.

c) Assessment Results

Recruitment. Recruitment indices from 2006 – 2008 were among the highest in the spring and autumn time series but have decreased since and are now close to the lowest observed values.

Biomass. Spring and autumn biomass indices generally increased, to record levels by 2007, but decreased substantially by 2010 and remained near that level in 2011. The spring biomass indices remained at a low level in 2012.

Exploitation. The index of exploitation has remained below 0.15 until 2010 but has since increased.

State of the Stock. The predicted decline in the 2011 autumn survey biomass did not occur. However, the decreased levels of biomass in the Canadian survey series since 2007 are a reason for concern. The biomass is likely to be above B_{lim}.

d) Precautionary Reference Points

Scientific Council considers that the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for B_{lim} (approximately 19 000 t) for northern shrimp in Div. 3LNO (SCS Doc. 04/12). Currently, the female biomass index is estimated to be above B_{lim} (Fig. 2.11). It is not possible to calculate a limit reference point for fishing mortality. A safe zone has not been determined in the precautionary approach for this stock.

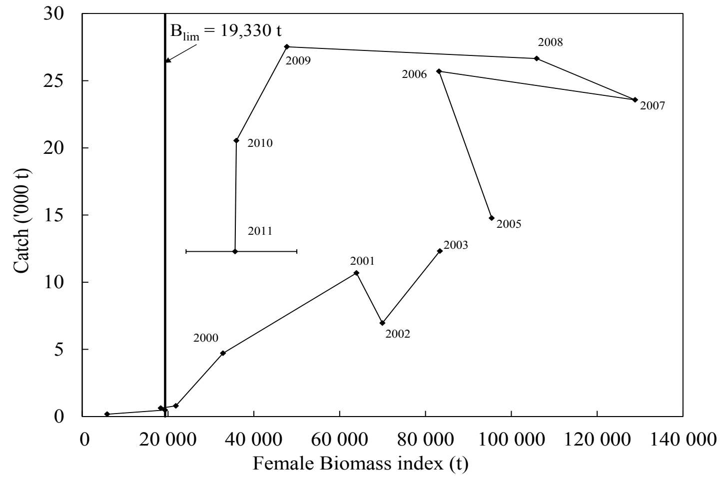


Fig. 2.11. Shrimp in Div. 3LNO: Catch against female biomass index from Canadian autumn survey. Line denoting B_{lim} (approximately 19 000 t) is drawn where female biomass is 85% lower than the maximum point in 2007.

e) Conclusion

The predicted decline in the 2011 autumn survey biomass did not occur. However, the decreased levels of biomass in the Canadian survey series since 2007 are a reason for concern. The biomass is likely to be above B_{lim}. NIPAG concluded that there was no change in the status of the stock.

f) Other Studies

Yield per Recruit model. A yield per recruit model for NAFO Div. 3LNO Northern Shrimp was presented at this assessment meeting. The main inputs for the model are those data presented in (SCR Doc. 12/47) and the software used is from the Woods Hole NFT Toolbox (VBYPRLen version 2.1 http://nft.nefsc.noaa.gov/Download.html). The model was able to produce $F_{0.1}$ and F_{max} reference points, however, NIPAG agreed that in the absence of an age or length based analytical assessment, Yield per Recruit reference points are of no use in providing advice to managers.

g) Review of Recommendations from 2011

NIPAG **recommended** that *research continue into fitting production models to data for northern shrimp in Div. 3LNO including studies of stock structure and continued investigation of stock assessment models for Pandalus borealis in NAFO Div. 3LNO. This may help provide estimations of* B_{MSY} *and* F_{MSY}.

STATUS: Sensitivity analysis was presented for a Bayesian surplus production model but led to no conclusion for selection of a final model to determine stock status for 2012. Preliminary analysis of genetic studies by Norway showed promise in determining stock structure (see Scientific Council Report Section V.4)

It was concluded to continue with the work using a Bayesian surplus production model, to help provide estimates of B_{MSY} and F_{MSY} for the meeting in September 2013. Specifically:

1. Determine appropriate priors
2. Investigate the efficacy of an alternate parameterization of the model in terms of intrinsic rate of growth (r).
3. Incorporate both Canadian spring and autumn survey series.

3. Northern shrimp (Subareas 0 and 1)

(SCR Doc. 04/75, 04/76, 08/62, 12/44, 12/45, 12/46, 12/48, 12/57; SCS Doc. 04/12)

a) Introduction

The shrimp stock off West Greenland is distributed mainly in NAFO Subarea 1 (Greenland EEZ), but a small part of the habitat, and of the stock, intrudes into the eastern edge of Div. 0A (Canadian EEZ). Canada has defined 'Shrimp Fishing Area 1' (Canadian SFA1), to be the part of Div. 0A lying east of 60°30'W, i.e. east of the deepest water in this part of Davis Strait.

The stock is assessed as a single population. The Greenland fishery exploits the stock in Subarea 1 (Div. 1A–1F). Since 1981 the Canadian fishery has been limited to Div. 0A.

Three fleets, one from Canada and two from Greenland (offshore and coastal) have participated in the fishery since the late 1970s. The Canadian fleet and the Greenland offshore fleet have been restricted by areas and quotas since 1977. The Greenland coastal fleet has privileged access to inshore areas (primarily Disko Bay and Vaigat in the north, and Julianehåb Bay in the south). Coastal licenses were originally given only to vessels under 80 t, but in recent years much larger vessels have entered the coastal fishery. Greenland allocates a quota to EU vessels in Subarea 1; this quota is usually fished by a single vessel which for analyses is treated as part of the Greenland offshore fleet. Mesh size is at least 44 mm in Greenland, 40 mm in Canada. Sorting grids to reduce bycatch of fish are required in both of the Greenland fleets and in the Canadian fleet. Discarding of shrimps is prohibited.

The TAC advised for the entire stock for 2004–2007 was 130 000 t, reduced for 2008–2010 to 110 000 t and increased again for 2011 to 120 000 t. The quantitative model used in the assessment was modified in 2011 (SCR Doc. 11/58) and as a result the TAC advised for 2012 was reduced to 90 000 t. For 2012, Greenland enacted a TAC of 101 675 t for Subarea 1. Of this, 4000 t was allocated (by contract) to the EU, 55 675 t to the Greenland sea-going fleet and 42 000 t to the coastal fleet. Canada enacted a TAC of 16 921 t for SFA 1.

Greenland requires that logbooks should record catch live weight. For shrimps sold to on-shore processing plants, a former allowance for crushed and broken shrimps in reckoning quota draw-downs was abolished in 2011 to bring the total catch live weight into closer agreement with the enacted TAC. However, the coastal fleet catching bulk shrimps does not log catch weights of *P. montagui* separately from *P. borealis;* weights are estimated by catch sampling at the point of sale and the price adjusted accordingly, but the weight of *P. montagui* is not deducted from the quota (SCR Doc. 11/53). Logbook-recorded catches can therefore still legally exceed quotas. Instructions for reporting *P. montagui* in logbooks have been changed in 2012, with a view to improve the reporting.

The table of recent catches was updated (SCR Doc. 12/45). Total catch increased from about 10 000 t in the early 1970s to more than 105 000 t in 1992 (Fig. 3.1). Moves by the Greenlandic authorities to reduce effort, as well as fishing opportunities elsewhere for the Canadian fleet, caused catches to decrease to about 80 000 t by 1998. Total catches increased to average over 150 000 t in 2005–08, but have since decreased, to 110 000 t (projected) in 2012.

Recent catches, projected catches for 2012 and recommended and enacted TACs (t) for Northern Shrimp in Div. 0A east of 60°30'W and in Subarea 1 are as follows:

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TAC										
Advised	100 000	130 000	130 000	130 000	130 000	110 000	110 000	110 000	120 000	90 000
Enacted[4]	115 167	149 519	152 452	152 380	152 417	145 717	132 987	132 987	142 597	118 596
Catches (NIPAG)										
SA 1	123 036[1]	142 311	149 978	153 188	142 245	153 889	135 029	128 108	122 655	*110 000*[2]
Div. 0A (SFA 1)	7137	7021	6921	4127	1945	0	429	5882	1 330	*0*
TOTAL SA1–Div.0A	130 173	149 332	156 899	157 315	144 190	152 749	135 458	133 990	123 985	*110 000*[2]
STATLANT 21										
SA 1	78 436	142 311	149 978	153 188	142 245	148 550	133 561	123 973[3]	121 207[3]	
Div. 0A	2170	6861	6410	3788	1878	0	429	5206[3]	859[3]	

[1] Catches before 2004 corrected for underreporting
[2] Total catches for the year as predicted by industry observers.
[3] Provisional
[4] Canada and Greenland set independent autonomous TACs.

Until 1988 the fishing grounds in Div. 1B were the most important. The offshore fishery subsequently expanded southward, and after 1990 catches in Div. 1C–D, taken together, began to exceed those in Div. 1B. However, since about 1996 catch and effort in southern West Greenland have continually decreased, and since 2008 effort in Div. 1F has been virtually nil (SCR Doc. 12/48).

The Canadian catch in SFA1 was stable at 6 000 to 7 000 t in 2002–2005, about 4–5% of the total catch, but since 2007 fishing effort has been sporadic and catches variable, averaging about 1 600 t in 2007–12.

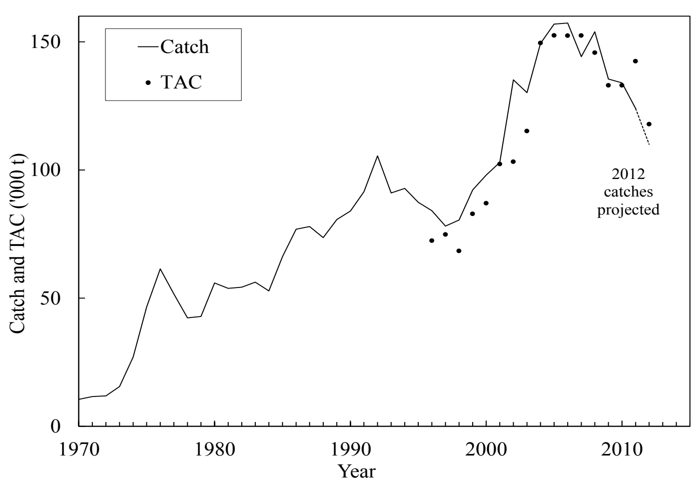


Fig. 3.1. Northern shrimp in Subarea 1 and Canadian SFA1: enacted TACs and total catches (2012 predicted for the year).

b) Input Data

i) Fishery data

Fishing effort and CPUE. Catch and effort data from the fishery were available from logbooks from Canadian vessels fishing in Canadian SFA 1 and from Greenland logbooks for Subarea 1 (SCR Doc. 12/48). In recent years both the distribution of the Greenland fishery and fishing power have changed significantly: for example, larger vessels have been allowed in coastal areas; the coastal fleet has fished outside Disko Bay; the offshore fleet now commonly uses double trawls; and the previously rigid division between the offshore and coastal quotas has been relaxed and quota transfers are now allowed. A change in legislation effective since 2004 requiring logbooks to record catch live weight in place of a previous practice of under-reporting would, by increasing the recorded catch weights, have increased apparent CPUEs since 2004; this discontinuity in the CPUE data was corrected in 2008.

CPUEs were standardised by linearised multiplicative models including terms for vessel effect, month, year, and statistical area; the fitted year effects were considered to be series of annual indices of total stock biomass. Series for the Greenland fishery after the end of the 1980s were divided into 2 fleets, a coastal and an offshore; for those ships of the present offshore fleet that use double trawls, only double-trawl data was used. A series for 1976–1990 was constructed for the KGH (Kongelige Grønlandske Handel) fleet of sister trawlers and a series for 1987–2007 and 2010 for the Canadian fleet fishing in SFA1. The CPUE indices from the Greenland coastal and the Greenland offshore fleets remained closely in step from 1988 to 2004 (Fig. 3.2), then diverged more from each other in 2005 and 2007, but in 2008–2012 their trajectories have again agreed. CPUE in the Canadian fishery in SFA1 has always varied more from year to year and has never stayed closely in step with the Greenland fleets, although over time its overall trend has been similar and it has also increased between the 1990s and the most recent values.

The four CPUE series were unified in a separate step to produce a single series that was input to the assessment model. This all-fleet standardised CPUE was variable, but on average moderately high, from 1976 through 1987, but then fell to lower levels until about 1997, after which it increased markedly to plateau in 2004–08 at about twice its 1997 value (Fig. 3.2). Values for 2009 to 2011 have been lower (SCR Doc. 12/48).

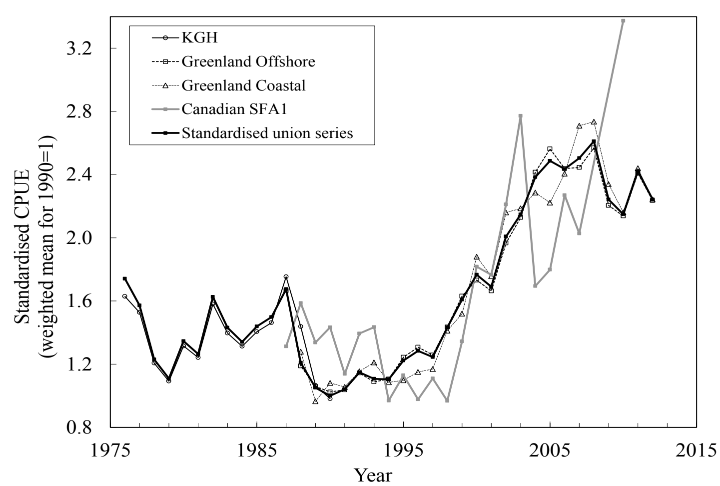


Fig. 3.2. Northern shrimp in Subarea 1 and Canadian SFA1: standardised CPUE index series 1976–2012.

The distribution of catch and effort among NAFO Divisions was summarised using Simpson's diversity index to calculate an 'effective' number of Divisions being fished as an index of how widely the fishery is distributed (Fig 3.3). (In interpreting the index, it should be remembered that NAFO Divisions in Subarea 1, designed for the management of groundfish fisheries, are of unequal size with respect to shrimp grounds, and those recently abandoned by the fishery are the smaller ones.) The fishery area has contracted and continues to do so; NIPAG has for some years been concerned for effects of this contraction on the relationship between CPUE and stock biomass, and in particular that relative to earlier year's biomass might be overestimated by recent CPUE values.

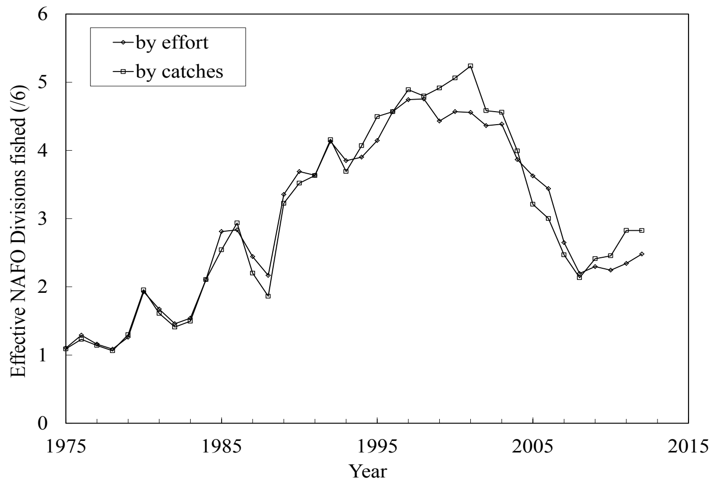


Fig. 3.3. Northern shrimp in Subarea 1 and Canadian SFA1: indices for the distribution of the Greenland fishery among NAFO Divisions in 1975–2012.

From the end of the 1980s there was a significant expansion of the fishery southwards and in 1996–98 areas south of Holsteinsborg Deep (66°00'N) accounted for 65% of the Greenland catch. The effective number of Divisions of SA 1 being fished peaked at about 4.5–5 in 1995–2003. Since then the range of the fishery has contracted northwards and the effective number of Divisions being fished has decreased. Since 2007 the areas south of Holsteinsborg Deep have yielded only about 10% of the catch, and Julianehåb Bay no longer supports a fishery.

Catch composition. There is no biological sampling program from the fishery that is adequate to provide catch composition data to the assessment.

ii) Research survey data

Greenland trawl survey. Stratified semi-systematic trawl surveys designed primarily to estimate shrimp stock biomass have been conducted since 1988 in offshore areas and since 1991 also inshore in Subarea 1 (SCR Doc. 12/44). From 1993, the survey was extended southwards into Div. 1E and 1F. A cod-end liner of 22 mm stretched mesh has been used since 1993. From its inception until 1998 the survey only used 60-min. tows, but since 2005 all tows have lasted 15 min. In 2005 the *Skjervøy 3000* survey trawl used since 1988 was replaced by a *Cosmos 2000* with rock-hopper ground gear, calibration trials were conducted, and the earlier data was adjusted.

The survey average bottom temperature increased from about 1.7°C in 1990–93 to about 3.1°C in 1997–20011 (SCR Doc. 12/44). About 80% of the survey biomass estimate is in water 200–400 m deep. In the early 1990s, about ¾ of this was deeper than 300 m, but after about 1995 this proportion decreased and since about 2001 has been about ¼, and most of the biomass has been in water 200–300 m deep (SCR Doc. 12/44). The proportion of survey biomass in Div. 1E–F has decreased in recent years and the distribution of survey biomass, like that of the fishery, has become more concentrated and more northerly.

Biomass. The survey index of total biomass remained fairly stable from 1988 to 1997 (c.v. 18%, downward trend 4%/yr.). It then increased by, on average, 19%/yr. until 2003, when it reached 316% of the 1997 value. Subsequent values were consecutively lower, by 2008–2009 less than half the 2003 maximum (Fig. 3.4) and 9% below the series mean. In 2010 the survey biomass index increased by nearly 24%, but in 2011 it returned to below the 2009 level and in 2012 decreased by a further 23% (SCR Doc. 12/44). Of the survey biomass, 48%, an exceptionally high proportion, was in Disko Bay and Vaigat, about 7% of the survey area.

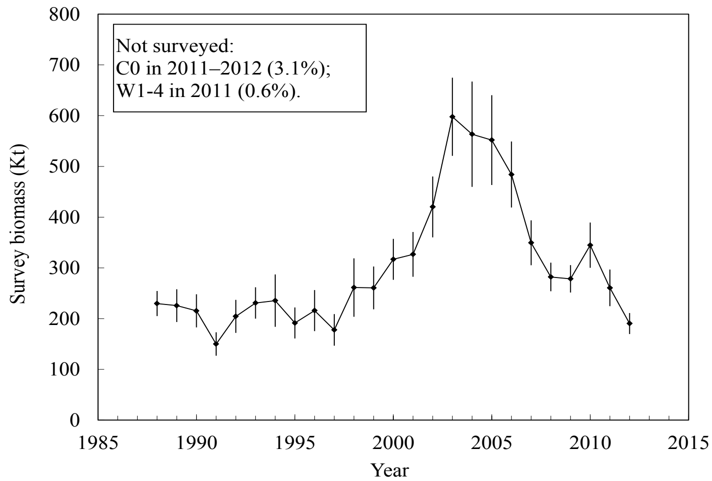


Fig. 3.4. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey indices of stock biomass 1988–2012 (SCR Doc. 12/44) (error bars 1 s.e.)

Length and sex composition (SCR Doc. 12/44). In 2008 modes at 12 mm and 15 mm CL could be observed suggesting two- and three-year-olds; the two-year-old class in particular appeared stronger than in 2007. The 2009 distribution of lengths appeared very similar to that for 2008; cohorts could be distinguished at 11–13 mm and at 15.5–18 mm. The supposed 2-year-old class appears to have numbered about the same in 2009 and 2010 as in 2008, but in 2011 numbered 68% of the 2008–10 mean and 55% of the series mean (Fig. 3.5). Numbers at age 2 are well below the 20-year lower quartile in 2012; given that survey biomass is about as low as has ever been observed; absolute numbers at age 2 are therefore very low.

Estimated numbers of males and females in 2009 - 41.5 and 12.2 bn - were close to those for 2008 and still below their series means. In 2010 the number of males was about 40% higher at 56.2 bn while the number of females increased by only about 16% to 14.4 bn; in 2011 total numbers at 49.8 bn are 30% less than in 2010, but almost all the decrease is in numbers of males, while females remain at 96% of the 2010 number. In 2011 the stock was estimated to have its highest-ever proportion of females both by number (26%) and by weight (43%), but to be short of shrimps at 15 - 22 mm CPL. The fishable proportion was estimated at 91.4%, close to its average level.

In 2012 overall the fishable biomass at 91.1% of total was a little below its 20-year median, but comprised an exceptionally high proportion of females. Pre-recruits (14 - 16.5 mm) have been few since 2008 in absolute numbers.

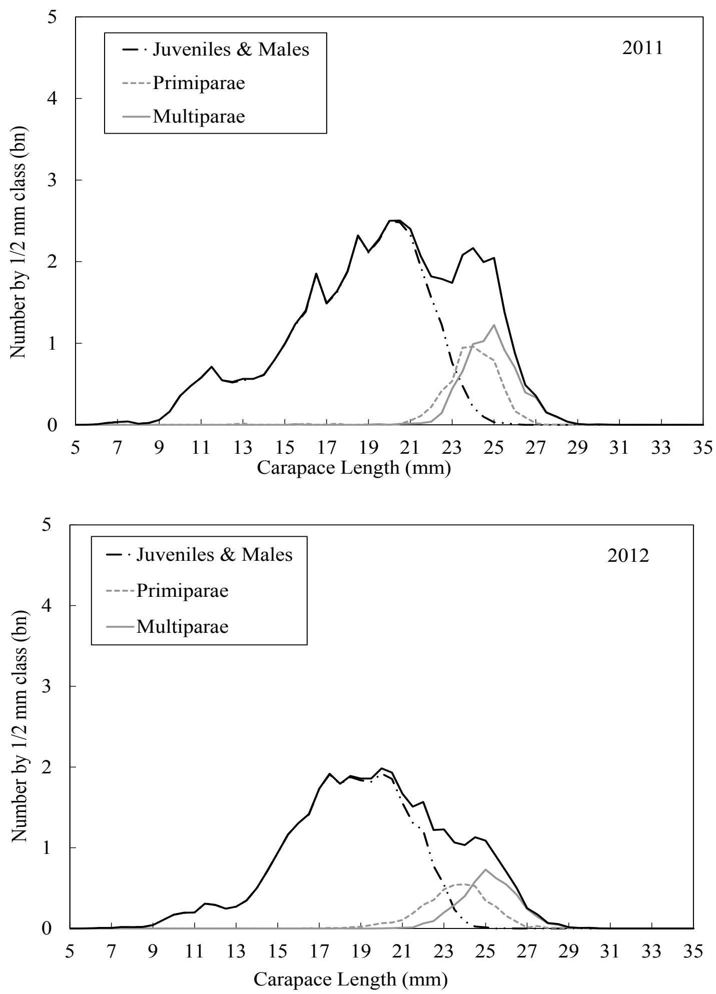


Fig. 3.5. Northern Shrimp in Subarea 1 and Canadian SFA 1: length frequencies in the West Greenland trawl survey in 2011–2012.

Recruitment Index. The number at age 2 is a possible predictor of fishable biomass 2–4 years later (SCR Doc. 03/76). This recruitment index was high in 2001, but decreased continually to 2007. From 2008 to 2010 estimated numbers at age 2 were higher than in 2007 and about stable near 78% of the series mean, but in 2011 decreased to 55% of the mean and in 2012 to the lowest level ever. A relative lack of fishable males in 2012 presages poor immediate recruitment to the spawning stock.

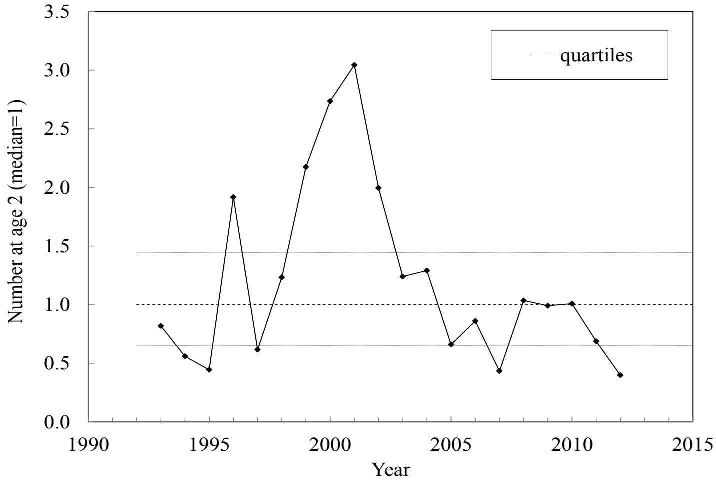


Fig. 3.6. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey index of numbers at age 2, 1993–2012.

iii) Predation index

Estimates of cod biomass from the German groundfish survey at West Greenland are used in the assessment of shrimp in SA 1 and in Div. 0A east of 60°30′W, but the results from the German survey for the current year are not available in time for the assessment. Although the West Greenland trawl survey is not primarily directed towards groundfish, the cod biomass index it produces for West Greenland offshore waters is well correlated with that from the German groundfish survey (r^2 = 0.86). The index of cod biomass is adjusted by a measure of the overlap between the stocks of cod and shrimp in order to arrive at an index of 'effective' cod biomass, which is entered in the assessment model. In recent years cod stocks have fluctuated, and a great increase in biomass in 2006–07 was short-lived (Fig. 3.7). In 2011 cod was widely distributed along the West Greenland shelf and the index of overlap between the distributions of cod and shrimp increased to 88.8%, giving an effective biomass of 21.8 Kt. In 2012 the overlap decreased as the biomass increased and the effective biomass was 22.7 Kt.

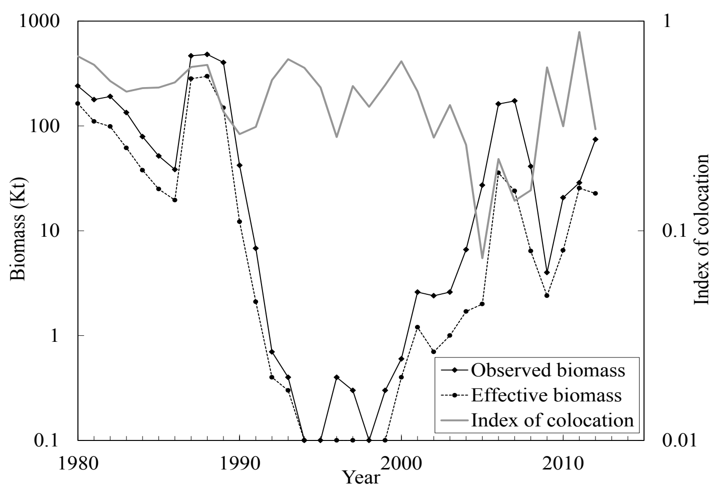


Fig. 3.7. Northern shrimp in Subarea 1 and Canadian SFA1: Indices of the biomass of Atlantic cod, including its index of colocation with the stock of Northern shrimp, 1980–2012

c) Results of the Assessment

i) Estimation of Parameters

A Schaefer surplus-production model of population dynamics was fitted to series of CPUE, catch, and survey biomass indices (SCR Doc. 12/46). The model included a term for predation by Atlantic cod and the series of 'effective' cod biomass values was included in the input data. Total catches for 2012 were assumed to be 110 000 t. The assessment model was slightly modified in 2012 to include the uncertainty of projecting the current year's catches.

In 2011 the previously accepted assessment model had been constrained to fit the biomass trajectory at least as closely to the survey index as to the CPUE index: i.e. the survey CV should be no greater than the CPUE CV. The model was run with data series shortened to 30 years to speed up the running; the effect of shortening the data series was checked and found not significant. The result was a biomass trajectory that tracked between the survey index and the CPUE index instead of closely following the CPUE index; the survey CV was estimated at 13% and that of the CPUE at 15%. The process error and the error associated with the predation term both increased considerably, so predictions became more uncertain. The biomass was then considered to have decreased, as the survey index did, between 2003 and 2011 under the influence of the high catches of 2004–2008, instead of staying high like the CPUE index. In consequence, the model estimated the MSY lower in 2011 than in previous assessments, at 135 Kt/yr.

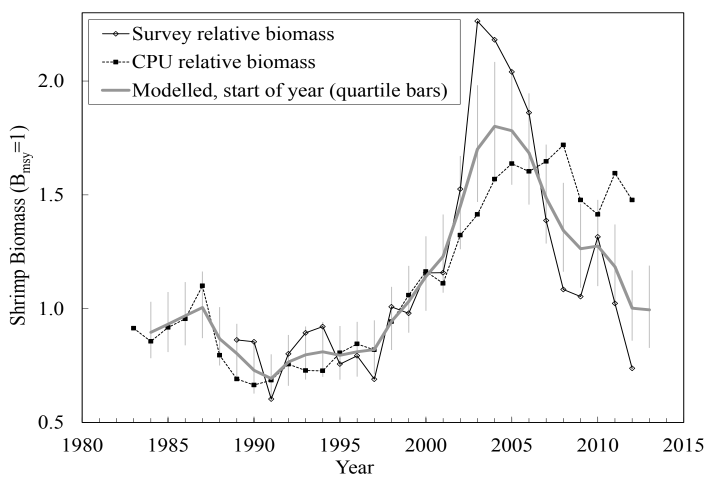


Fig. 3.8: Northern Shrimp in SA 1 and Canadian SFA1: trajectory of the median estimate of relative stock biomass at start of year 1983–2013, with median CPUE and survey indices; 30 years' data with constrained CVs.

Table 3.1 Estimates of stock-dynamic and fit parameters from fitting a Schaefer stock-production model, with constrained CVs, to 30 years' data on the West Greenland stock of the northern shrimp in 2012, with median values from 2011 assessment:

	2012 assessment						2011 assessment
	Mean	S.D.	25%	Median	75%	Est. Mode	Median
Max.sustainable yield	139	67	108	132	160	118	136
B/Bmsy, end current year (proj.)	1.02	0.29	0.83	1.00	1.19	0.95	1.08
Biom. risk, end current yr (%)	51	50					
Z/Zmsy, current year (proj.)	2.86	26.82	0.77	1.08	1.51	—	1.09
Carrying capacity	3776	3418	1861	2767	4427	749	2661
Max. sustainable yield ratio (%)	10.7	6.3	6.0	10.1	8.9	8.9	10.7
Survey catchability (%)	20.5	13.7	10.3	17.4	11.2	11.2	20.3
CV of process (%)	12.2	2.9	10.2	11.9	14.0	11.3	11.0
CV of survey fit (%)	14.5	2.0	13.2	14.5	15.8	14.4	13.1
CV of CPUE fit (%)	17.2	2.5	15.5	16.9	18.6	16.3	14.9

ii) Assessment Summary

Recruitment. The stock structure in 2012 is deficient in fishable males, presaging poor short-term recruitment to the spawning stock. Pre-recruits (CL 14–16.5 mm), expected to enter the fishery in 2013, have been few since 2008 in absolute terms. Numbers at age 2 in 2012 have declined to their lowest-ever level, so medium-term recruitment is also expected to be poor.

Biomass. A stock-dynamic model showed a maximum biomass in 2003 with a continuing decline since; the probability that biomass will be below B_{msy} in 2012 with projected catches at 110 000 t was estimated at 51%; of its being below B_{lim} at 1–2%.

Mortality. The mortality caused by fishing and cod predation (Z) is estimated to have stayed below the upper limit reference (Z_{msy}) from 1996 to 2005, but is estimated to have averaged 2.6% over the limit value since 2006. With catches projected at 110 000 t the risk that total mortality in 2012 would exceed Z_{msy} was estimated at about 56%. Atlantic cod is, in 2012, more concentrated in southerly areas where shrimps are now scarce, and predation is expected to be moderate or low.

State of the Stock. Modelled biomass is estimated to have been declining since 2004. At the end of 2012 biomass is projected to be close to B_{msy}. Total mortality is projected to exceed Z_{msy}. Recruitment to the fishable and spawning stock in the short- and medium-term is expected to remain low.

d) Precautionary Approach

The fitted trajectory of stock biomass showed that the stock had been below its MSY level until the late 1990s, with mortalities mostly near the MSY mortality level except for an episode of high mortality associated with a short-lived resurgence of cod in the late 1980s. In the mid-1990s, with cod stocks at low levels, biomass started to increase at low mortalities to reach about 1.6 times B_{msy} in 2003–05. Recent increases in the cod stock coupled with high catches have been associated with higher mortalities and continuing decline in the modelled biomass, although the biomass is still estimated at near B_{msy}.

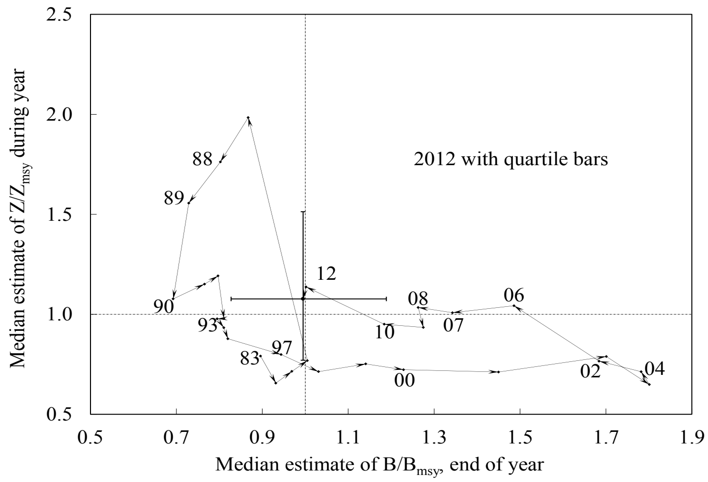


Fig. 3.9: Northern shrimp in Subarea 1 and Canadian SFA1: trajectory of relative biomass and relative mortality, 1983–2012.

e) Projections

Predicted probabilities of transgressing precautionary reference points in 2013 and 2014 (risk table) under seven catch options and subject to predation by a cod stock with an effective biomass of 25 000 t:

25 000 t cod	Catch option ('000 t)						
Risk of:	70	75	80	85	90	95	100
falling below B_{msy} end 2013 (%)	46.8	47.6	47.8	48.7	48.9	49.8	50.9
falling below B_{lim} end 2013 (%)	1.4	1.4	1.4	1.4	1.4	1.5	1.6
exceeding Z_{msy} during 2013 (%)	27.1	30.9	34.1	38.4	43.0	47.2	50.7
exceeding Z_{msy} during 2014 (%)	27.2	30.8	34.4	38.2	42.5	46.7	50.9

In the medium term, with a 25 000 t effective biomass of cod, model results estimate catches of 95 000 t/yr to be associated with a stationary stock close to B_{msy}.

Predicted probabilities of transgressing precautionary reference points after 3 years in the fishery for Northern Shrimp on the West Greenland shelf with 'effective' cod stocks assumed at 20 000 t and 25 000 t.

Catch (Kt/yr.)	Prob. biomass < B_{msy} (%)		Prob. biomass<B_{lim} (%)		Prob. mort > Z_{msy} (%)	
	20 Kt	25 Kt	20 Kt	25 Kt	20 Kt	25 Kt
70	40.2	41.2	2.3	2.6	24.8	27.4
75	41.4	42.8	2.5	2.6	28.0	30.8
80	42.9	43.7	2.3	2.7	31.9	34.3
85	44.5	45.5	2.6	2.8	35.6	38.0
90	46.0	46.5	2.8	2.8	39.9	42.6
95	47.3	48.5	2.6	3.2	43.9	46.5
100	48.3	49.8	3.0	3.3	48.0	50.8

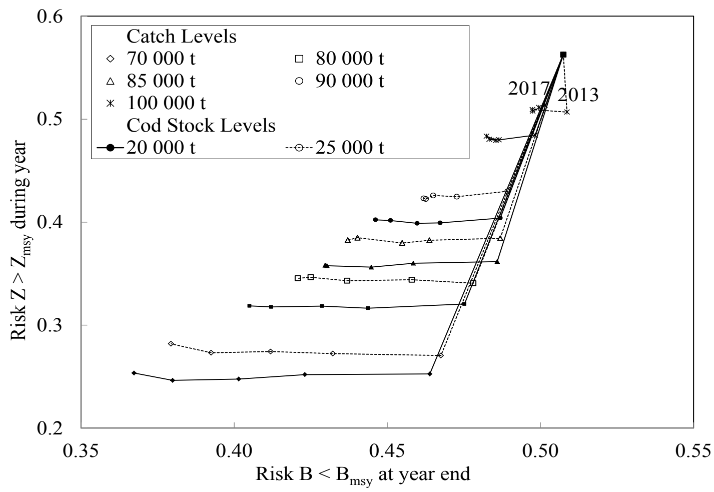


Fig. 3.10. Northern shrimp in Subarea 1 and Canadian SFA1: Risks of transgressing mortality and biomass precautionary limits for catches at 70 000–100 000 t projected over five years with an 'effective' cod stock assumed at 20 000 or 25 000 t.

Medium-term projections were summarised by plotting the risk of exceeding Z_{msy} against the risk of falling below B_{msy} over 5 years for 5 catch levels, considering also two possible levels for the 'effective' cod stock (Fig. 3.9). The immediate biomass risk is relatively insensitive to catch level but changes with time, upwards or downwards depending on catch level and cod-stock level; the mortality risk depends immediately upon the assumed future catch and cod-stock levels, but changes little with time. For catches of 70 000 t to 90 000 t the mortality risk is 25–40% and nearly constant over the projection period, while the biomass risk decreases as the model projects the stock to grow. At a catch level of 100 000 t the stock is nearly stationary above B_{msy} if the effective cod stock is assumed near 20 000 t, but if the cod stock increases to an effective biomass of 25 000 t catches of 100 000 t/yr. are predicted to be associated with a decreasing biomass.

f) Review of Research Recommendations

NIPAG **recommended** in 2010 that, for shrimp off West Greenland (NAFO Subareas 0 and 1):

- *the estimate of the biomass of Atlantic cod from the W. Greenland trawl survey should be explicitly included in the stock-production model used for the assessment.*

STATUS: no progress has been made on this recommendation.

g) Research Recommendations

For shrimp off West Greenland (NAFO Subareas 0 and 1), NIPAG **recommended** that:

- *Given that the CPUE series for the Greenland sea-going and coastal fleets continue to agree while neither agrees with changes in the survey estimates of biomass since 2002, possible causes for change in the relationship between fishing efficiency and biomass should be investigated.*

- *More robust methods of including biomass index series in the quantitative assessment model should be investigated.*

4. Northern shrimp (in Denmark Strait and off East Greenland) – NAFO Stock

(SCR Doc. 03/74, 12/62, 12/63)

a) Introduction

Northern shrimp off East Greenland in ICES Div. XIVb and Va is assessed as a single population. The fishery started in 1978 and, until 1993, occurred primarily in the area of Stredebank and Dohrnbank as well as on the slopes of Storfjord Deep, from approximately 65°N to 68°N and between 26°W and 34°W.

In 1993 a new fishery began in areas south of 65°N down to Cape Farewell. From 1996 to 2005 catches in this area accounted for 50 - 60% of the total catch. In 2006 and 2007 catches in the southern area only accounted for 25% of the total catch. Since 2008 about 10% of the total catch has been taken in the southern area.

A multinational fleet exploits the stock. During the recent ten years, vessels from Greenland, EU-Denmark, the Faroe Islands and Norway have fished in the Greenland EEZ. Only Icelandic vessels are allowed to fish in the Icelandic EEZ. At any time access to these fishing grounds depends strongly on ice conditions.

In the Greenland EEZ, the minimum permitted mesh size in the cod-end is 44 mm, and the fishery is managed by catch quotas allocated to national fleets. In the Icelandic EEZ, the mesh size is 40 mm and there are no catch limits. In both EEZs, sorting grids with 22-mm bar spacing to reduce bycatch of fish are mandatory. Discarding of shrimp is prohibited in both areas.

As the fishery developed, catches increased rapidly to more than 15 000 tons in 1987-88, but declined thereafter to about 9000 t in 1992-93. Following the extension of the fishery south of 65°N catches increased again reaching 11 900 t in 1994. From 1994 to 2003 catches fluctuated between 11 500 and 14 000 t (Fig. 4.1). Since 2004 the catches decreased continually from 10 000 t down to 1 235 t in 2011. Catches in the Iceland EEZ decreased from 2002-2005 and since 2006 no catches have been taken.

Recent recommended and actual TACs (t) and nominal catches are as follows:

	2003[1]	2004	2005	2006	2007	2008	2009	2010	2011	2012[2]
Recommended TAC, total are	9600	12400	12400	12400	12400	12400	12400	12400	12400	12400
Actual TAC, Greenland	10600	15043	12400	12400	12400	12400	12835	12400	12400	12400
North of 65°N, Greenland EE	5480	4654	3987	3887	3314	2529	3945	3321	1146	1911
North of 65°N, Iceland EEZ	703	411	29	0	0	0	0	0	0	0
North of 65°N, total	6183	5065	4016	3887	3314	2529	3945	3321	1146	1911
South of 65°N, Greenland EE	6522	4951	3737	1302	1286	266	610	413	89	221
TOTAL NIPAG	12705	10016	7753	5189	4600	2794	4555	3735	1235	2132

[1] Estimates corrected for "overpacking".
[2] Catches until September 2012

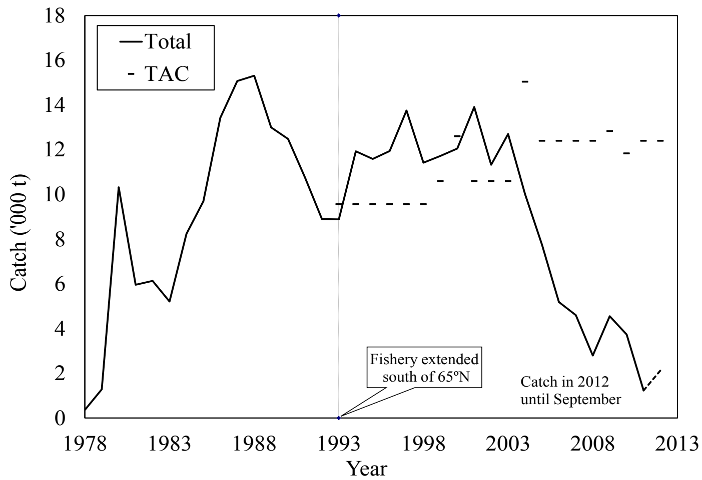


Fig. 4.1. Shrimp in Denmark Strait and off East Greenland: Total catches (2012 catches until September).

b) Input Data

i) Commercial fishery data

Fishing effort and CPUE. Data on catch and effort (hours fished) on a haul by haul basis from logbooks from Greenland, Iceland, Faroe Islands and EU-Denmark since 1980, from Norway since 2000 and from EU-France for the years 1980 to 1991 are used . Until 2005, the Norwegian fishery data was not reported in a compatible format and were not included in the standardized catch rates calculations. In 2006 an evaluation of the Norwegian logbook data from the period 2000 to 2006 was made and since then these data have been included in the standardized catch rate calculations. Since 2004 more than 60% of all hauls were performed with double trawl and the 2012 assessment included both single and double trawl in the standardized catch rate calculations.

Catches and corresponding effort are compiled by year for two areas, one area north of 65°N and one south thereof. Standardised Catch-Per-Unit-Effort (CPUE) was calculated and applied to the total catch of the year to estimate the total annual standardised effort. Catches in the Greenland EEZ are corrected for "overpacking" (SCR Doc. 03/74).

The Greenlandic fishing fleet, catching 40% of the total catch from 1998 to 2005 and between 0% and 30% from 2006, has decreased its effort in recent years, and this creates some uncertainty as to whether recent values of the indices accurately reflect the stock biomass. There could be several reasons for decreasing effort, some possibly related to the economics of the fishery. The fishing opportunities off West Greenland seem to have been adequate in recent years and the fishing grounds off East Greenland are a less desirable fishing area because of lower prices for large shrimps, which were the target of the fishery, and higher prices for fuel. Even though both effort and catches in East Greenland have declined, the catch rates (CPUE's) are still high; however, this could be partly because the fleet can concentrate effort in areas of high densities of sought-after size classes of shrimp.

North of 65°N standardized catch rates based on logbook data from Danish, Faroese, Greenlandic, Norwegian and Icelandic vessels declined continuously from 1987 to 1993 but showed a significant increase between 1993 and 1994. Since then rates have varied but shown a slightly increasing trend until 2008. From 2008 to 2009 the catch rate increased by 50%. Since then the index has been going down reaching the values seen in the late nineties and early 2000s (Fig. 4.2).

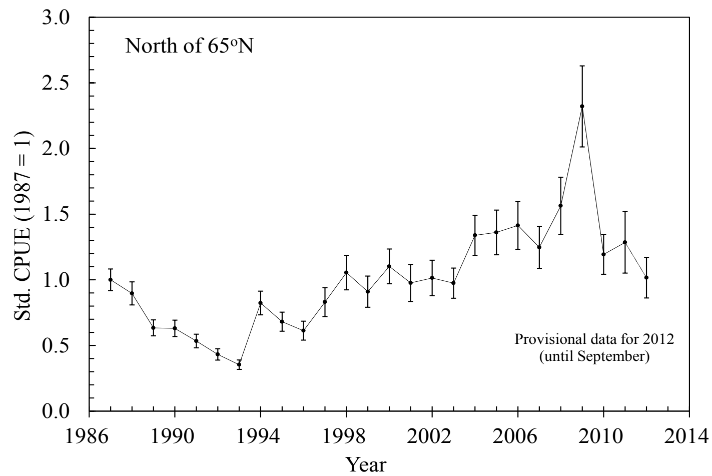


Fig. 4.2. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1987 = 1) with ±1 SE calculated from logbook data from Danish, Faeroese, Greenland, Icelandic and Norwegian vessels fishing north of 65°N.

In the southern area a standardized catch rate series from the same fleets, except the Icelandic, increased until 1999, and has since then fluctuated without a trend (Fig. 4.3). No index for the southern area was calculated in 2011 and 2012, due to a low number of hauls (7 in 2011 and 47 in 2012).

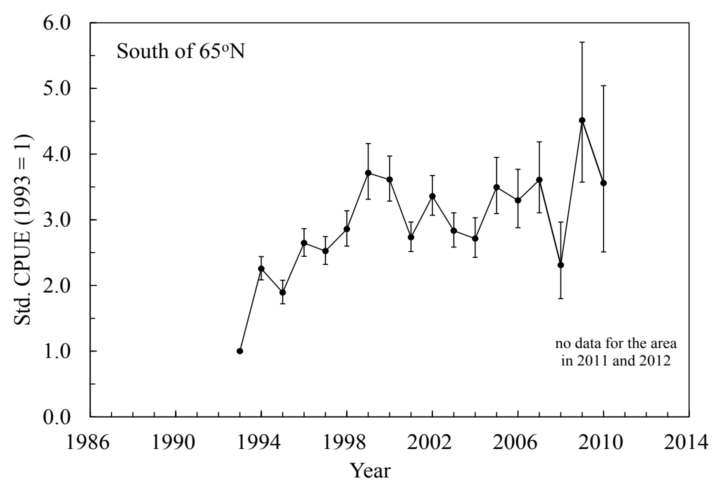


Fig. 4.3. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1993 = 1) with ±1 SE calculated from logbook data from Danish, Faeroese, Greenland and Norwegian vessels fishing south of 65°N.

The combined standardized catch rate index for the total area decreased steadily from 1987 to 1993, and then showed an increasing trend until the beginning of the 2000s. The index stayed at or around this level until 2008, but nearly doubled in 2009. Since then the combined index has been declining and is now lower than during the 2000s. (Fig. 4.4).

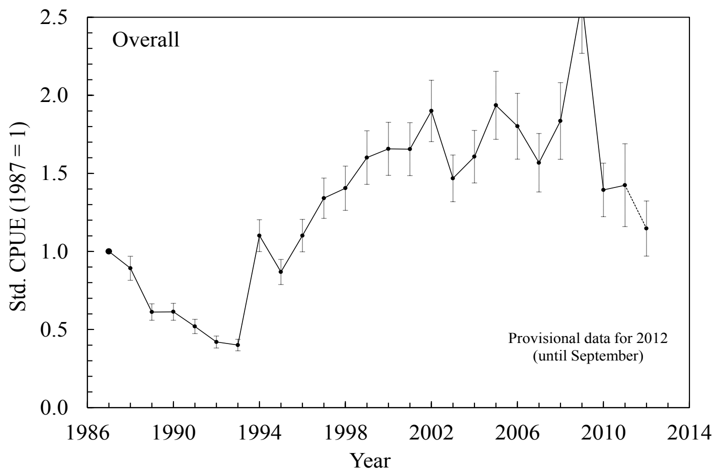


Fig. 4.4. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE-indices (1987 = 1) with ± 1 SE combined for the total area.

Standardized effort indices (catch divided by standardized CPUE) as a proxy for exploitation rate for the total area shows a decreasing trend since 1993. Recent levels are the lowest of the time series (Fig. 4.5).

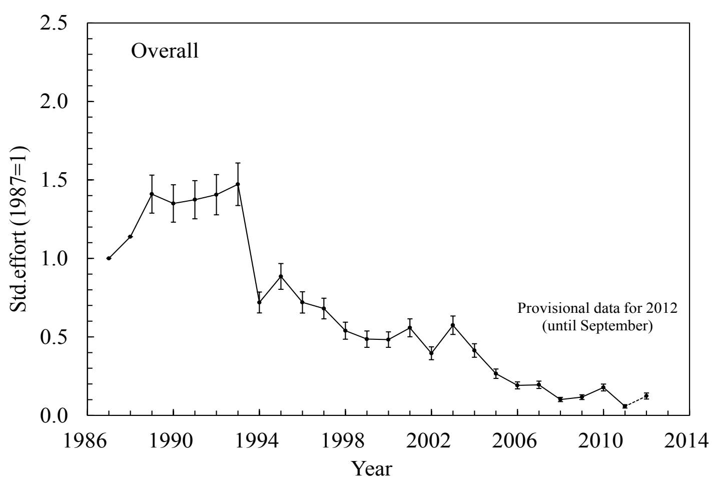


Fig. 4.5. Shrimp in Denmark Strait and off East Greenland: annual standardized effort indices, as a proxy for exploitation rate (± 1 SE; 1987 = 1), combined for the total area.

Biological data. There are no biological data available from the commercial fishery.

ii) Research survey data

Stratified-random trawl surveys have been conducted to assess the stock status of northern shrimp in the East Greenland area since 2008 (SCR Doc. 12/62). The main objectives were to obtain indices for stock biomass, abundance, recruitment and demographic composition. The area was also surveyed in 1985-1988 (Norwegian survey) and in 1989-1996 (Greenlandic survey). The historic survey is not directly comparably with the recent survey due to different areas covered, survey technique and trawling gear. However, the 1989-1996 survey estimated biomass and abundance at the same level as the 2008-2012 survey. The two Greenlandic surveys also showed similar overall size distributions. Absence of the smaller shrimp in the survey area stresses that the total area of distribution and recruitment patterns of the stock are still unknown.

Biomass estimate. The biomass estimates (t) for the entire survey area are given in Fig. 4.6.

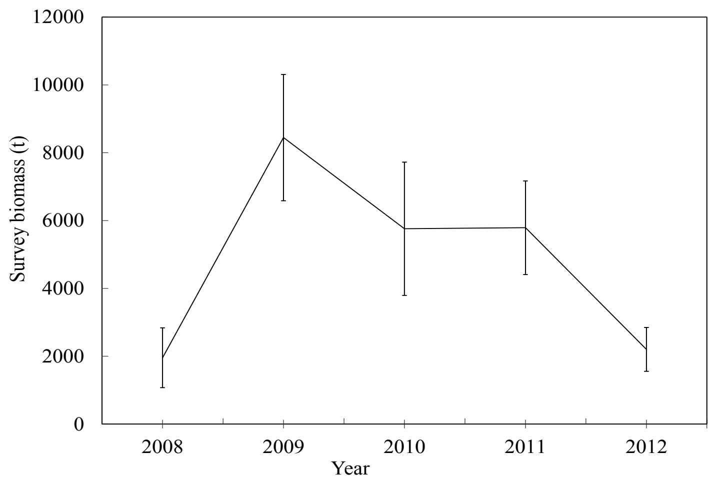


Fig. 4.6. Shrimp in Denmark Strait and off East Greenland: Survey biomass (t) from 2008- 2012(± 1 SE).

The surveys conducted since 2008 shows that the shrimp stock is concentrated in the area North of 65°N.

Stock composition. Total number of shrimp in 2012 was estimated to be 194 million and the lowest in the five year time series which have an average of almost 500 million. Female abundance in 2012 was record low at 77 million compared to roughly 200 million between 2009 and 2011. The abundance of males declined from 700 million in 2009 to 300 million in 2010 and 2011 but declined drastically in 2012 to 100 million (Fig 4.7).

There were very few male shrimp smaller than 20mm CL in the East Greenland survey length distribution (Fig. 4.8), which means that no recruitment index is available.

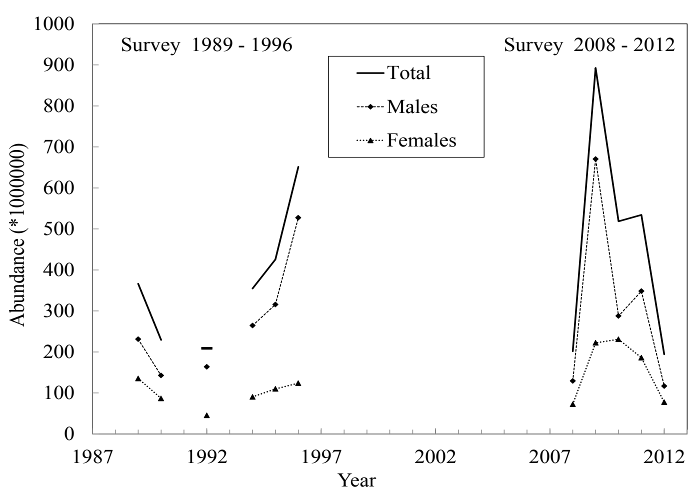


Fig. 4.7. Shrimp in Denmark Strait and off East Greenland. Abundance of males and females in two different surveys series from 1989-1995 and 2008-2012 for the areas North of 65°N. The two survey series are not directly comparable due to gear differences

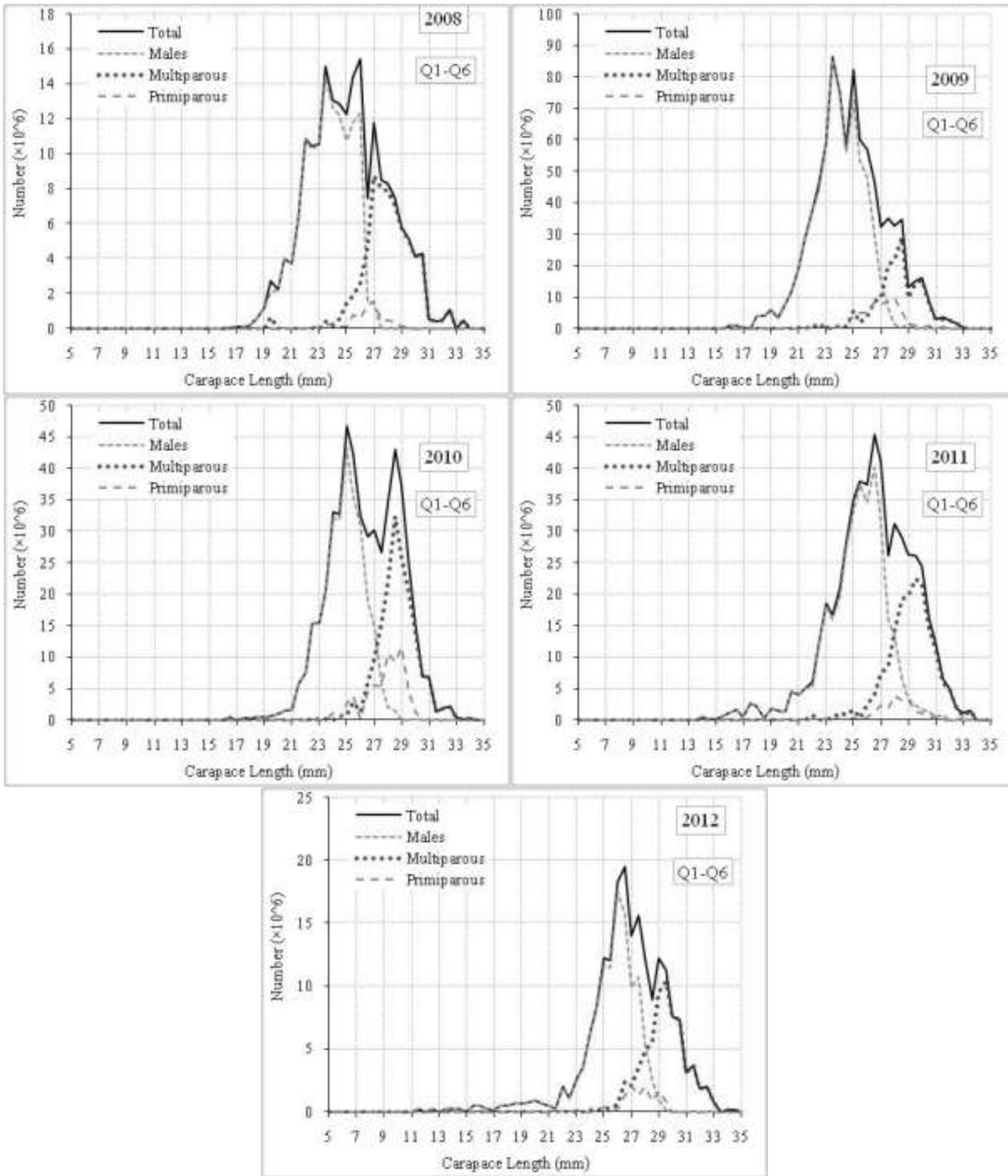


Fig.4.8. Shrimp in Denmark Strait and off East Greenland. Numbers of shrimp by length group (CL) in the total survey area in 2008 - 2012 based on pooling of samples weighted by catch and stratum area.

c) Assessment Results

CPUE: The combined standardized catch rate index for the total area remained at a high level from 2000 to 2009. Since then the combined index has been declining and is now lower than seen during the 2000's

Recruitment. No recruitment estimates were available.

Biomass. The survey biomass index has decreased since 2009 and is now at the level seen at the beginning of the short time series in 2008.

Exploitation rate. Since the mid-1990s exploitation rate index (standardized effort) has decreased, reaching the lowest levels seen in the time series from 2008 - 2012.

State of the stock. Indices of stock biomass indicate a decline during the last 3 years. The biomass is now believed to be slightly lower than the relatively high level seen during most of the 2000s.

5. Northern shrimp in Skagerrak and Norwegian Deep (ICES Div. IIIa and IVa East) – ICES Stock

Background documentation (equivalent to stock annex) is found in SCR Doc. 12/59, 61, 64, 65, 66; 11/069; 08/75; 10/70.

a) Introduction

The shrimp in the northern part of ICES Div. IIIa (Skagerrak) and the eastern part of Div. IVa (Norwegian Deep) is assessed as one stock and is exploited by Norway, Denmark and Sweden. The Norwegian and Swedish fisheries began at the end of the 19th century, while the Danish fishery started in the 1930s. All fisheries expanded significantly in the early 1960s. By 1970 the landings had reached 5 000 t and in 1981 they exceeded 10 000 t. Since 1992 the shrimp fishery has been regulated by a TAC, which was around 16 500 t in 2006-2009, but decreased to 12 380 t in 2011 and further to 10 115 t in 2012 (Fig. 5.1, Table 5.1). In the Swedish and Norwegian fisheries approximately 50% of catches are boiled at sea, and almost all catches are landed in home ports. Since 2002 an increasing number of the Danish vessels have started boiling the shrimp on board and landing the product in Sweden to obtain a better price. In 2011 around 35% of Danish landings were boiled. Most of the Danish catches are, however, still landed fresh in home ports. The overall TAC is shared according to historical landings, giving Norway 60%, Denmark 26%, and Sweden 14% in 2011 and 2012. The recommended TACs until 2002 were based on catch predictions. However, since 2003 when the cohort based analytical assessment was abandoned no catch predictions have been available, and the recommended TACs have been based on perceived stock development in relation to recent landings. The shrimp fishery is also regulated by mesh size (35 mm stretched), and by restrictions in the amount of landed bycatch. The Nordmøre selective grid with un-blocked fish openings can reduce bycatch significantly (SCR Doc. 12/65), and is used voluntarily by an increasing number of vessels in the Norwegian and Danish fleet. However, at present it is mandatory only in Swedish national waters. Of the total Swedish landings, the percentage taken with grid trawls increased from 9% in 2002 to 32% in 2009 and has thereafter dropped to 20% in 2011. Currently it is under discussion between EU and Norway whether a grid should be mandatory in all shrimp fisheries in Skagerrak and the North Sea (see section on Bycatch and ecosystem effects below).

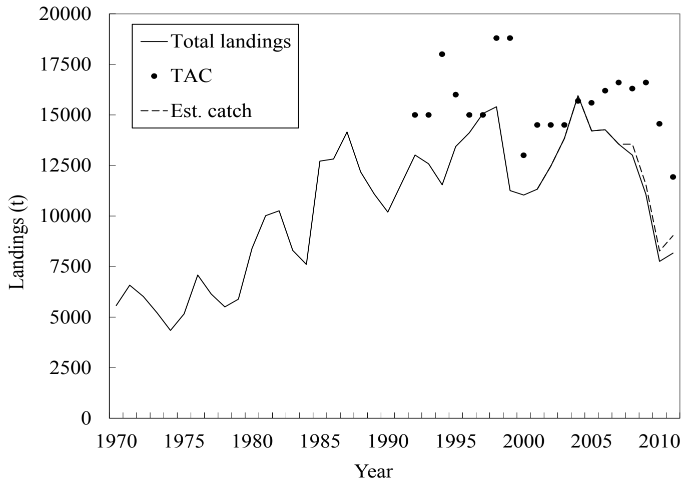


Fig. 5.1. Northern shrimp in Skagerrak and Norwegian Deep: TAC, total landings by all fleets, and total estimated catch including estimated Swedish discards for 2008-2011, Norwegian discards for 2007-2011 and Danish discards for 2009-2011.

Total landings have varied between 7 500 and 16 000 t during the last 30 years. In the total catch estimates the boiled fraction of the landings has been raised by a factor of 1.13 to correct for weight loss caused by boiling. Total catches are estimated as the sum of landings and discards and have varied between 11 000 and 18 000 t in 2001-2009, but decreased to around 8 500 t in 2010-2011. (Table 5.1 and Fig. 5.1).

Table 5.1. Northern shrimp in Skagerrak and Norwegian deep: TACs, landings and estimated catches (t).

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Recommended TAC	19000	11500	13400	12600	14700	15300	13000	14000	14000	15000	15000	13000	6500
Agreed TAC	18 800	13 000	14 500	14 500	14 500	15 690	15 600	16 200	16 600	16 300	16 600	14 558	11 928
Denmark	2 072	2 371	1 953	2 466	3 244	3 905	2 952	3 061	2 380	2 259	2 155	1 229	1 600
Norway	6 739	6 444	7 266	7 703	8 178	9 544	8 959	8 669	8 686	8 260	6 364	4 673	4 800
Sweden	2 445	2 225	2 108	2 301	2 389	2 464	2 257	2 488	2 445	2 479	2 483	1 781	1 768
Total landings	11 256	11 040	11 328	12 474	13 837	15 952	14 208	14 268	13 553	13 013	11 071	7 755	8 168
Est. Danish discards											36	53	123
Est. Swedish high-grading										540	337	386	504
Est. Norwegian discards											115	75	235
Total catch			11 328	12 474	13 837	15 952	14 208	14 268	13 553	13 553	11 560	8 269	9 030

The Danish and Norwegian fleets have undergone major restructuring during the last 25 years. In Denmark, the number of vessels targeting shrimp has decreased from 138 in 1987 to 24 in 2006 and only 13 in 2011. It is mostly the small (< 24 m LOA) trawlers which have left the fishery and in 2011 the Danish fleet consisted of vessels with an average length of 26 m and average engine power of 700 hp (SCR Doc. 11/69). The efficiency of the fleet has also increased due to the introduction of twin trawl technology and increased trawl size.

In Norway the number of vessels participating in the shrimp fishery has decreased from 423 in 1995 to 217 in 2011. The number of smaller vessels (10-10.99 m LOA) has increased from the mid-1990s until present, while the number of larger vessels (11-20.99 m LOA) has decreased. The length group 10-10.99 m LOA has been the numerically dominant one since 2005 (37% of all vessels in 2011), owing to the fact that vessels < 11 m do not need a license to fish. Vessels ≥ 21 m LOA constitute only 13% of the fleet, which illustrates the difference between the Norwegian and Danish fleets. Twin trawl was introduced around 2002, and the use is increasing. In 2011 twin trawls are estimated to be in use by half of the Norwegian trawlers larger than 15 meters, whereas the smaller vessels most likely are using single trawls

The Swedish specialized shrimp fleet (catch of shrimp ≥ 10 t/yr.) has been at around 40-50 vessels for the last decade and there has not been any major change in single trawl size or design according to the Swedish net manufacturer, but during the last six years the number of twin trawlers has increased from 5 to 23. These twin trawlers have 40- 80% higher catch rates compared to the vessels using single rigged trawls (SCR Doc. 12/65).

Catch and discards. Discarding of shrimp may take place in two ways: 1) discards of shrimp <15 mm CL which are not marketable, and 2) high-grading discards of medium-sized and lower-value shrimp. The Swedish fishery has regularly been constrained by the national quota, which may have resulted in 'high-grading' of the catch. Based on on-board sampling high-grading and discards in the Swedish fisheries was estimated to be between 12 and 22% of total catch for the years 2008 -2011, and Danish discards were estimated to be between 2 and 7% for the years 2009-2012 (SCR Doc. 12/65). Previous estimates of Swedish high-grading based on comparison of length distributions of Swedish landings with Danish landings (assuming no discards in the Danish fishery) have been omitted in this year's report as these estimates are considered less accurate than the ones resulting from on-board sampling. As there are no observer data for Norwegian discards, these have been estimated indirectly by comparing the length distributions of Norwegian unprocessed commercial catches with those of Norwegian sorted landings (SCR Doc. 12/65). The 2010 and 2011 discards from Skagerrak were also estimated applying the Danish discards-to-landings ratio to the Norwegian landings, yielding discards of 63 t and 229 t, respectively. These figures are considered the most reliable. There is no Danish on-board sampling in the Norwegian Deep. Assuming that Norwegian discards are mainly made up of non-marketable shrimp < 15 mm CL, comparison of length distributions yielded discards of respectively 12 and 6 t from the Norwegian Deep in 2010 and 2011.

Bycatch and ecosystem effects. Shrimp fisheries in the North Sea and Skagerrak have bycatches of 10-22% (by weight) of commercially valuable species (Table 5.2). Since 1997, trawls used in Swedish national waters must be equipped with a Nordmøre grid, with a bar spacing of 19 mm, which excludes fish > approx. 20 cm from the catch. Logbook information shows that landings delivered by vessels using this grid consist of 98-99% shrimp compared to only 78-84% in landings from trawls without grid (Table 5.2). In the area outside of Swedish national waters the grids are not mandatory, however, the grid is to some extent used voluntarily by fishers from all three countries in order to sort the landable part of the bycatch (SCR Doc. 12/65).

The effects of shrimp fisheries on the North Sea ecosystem have not been the subject of special investigation. It is known that deep-sea species such as argentines, roundnose grenadier, rabbitfish, and sharks are frequently caught in shrimp trawls in the deeper parts of Skagerrak and the Norwegian Deep. No quantitative data on this mainly discarded catch component is available and the impact on stocks is difficult to assess, but it is currently under discussion between EU and Norway whether a grid should be mandatory in all shrimp fisheries in Skagerrak and the North Sea – such a grid would be expected to substantially reduce by catch of the above mentioned species. It has also been decided to introduce a discard ban in Skagerrak during 2014. Norwegian vessels are already subject to a discard ban. The details are still not decided (e.g. exceptions for certain gears and species) and it is difficult to predict what consequences a Skagerrak discard ban will have for the *Pandalus* fishery.

Table 5.2. Northern shrimp in Skagerrak and Norwegian Deep: Landings by the Pandalus fishery in 2011. Combined data from Danish and Swedish logbooks and Norwegian sale slips (t).

	Sub-Div. IIIa, no grid		Sub-Div. IIIa, grid		Sub-Div. IVa East, no grid	
Species:	Total (t)	% of total catch	Total (t)	% of total catch	Total (t)	% of total catch
Pandalus	5249	78.4	326	98.5	2028	84.3
Norway lobster	31	0.5	2	0.6	9	0.4
Angler fish	44	0.7	0	0.0	60	2.5
Whiting	12	0.2	0	0.0	3	0.1
Haddock	56	0.8	0	0.0	8	0.3
Hake	24	0.4	0	0.0	27	1.1
Ling	47	0.7	0	0.0	39	1.6
Saithe	623	9.3	1	0.2	93	3.9
Witch flounder	67	1.0	0	0.0	2	0.1
Norway pout	1	0.0	0	0.0	0	0.0
Cod	358	5.4	0	0.1	65	2.7
Other market fish	180	2.7	2	0.5	72	3.0

Environmental considerations. The effect of temperature changes in recent years on Northern shrimp in the North sea area is not known. The cold winter in 2009 to 2010 caused a cooling of the surface water which sank into the deeper part of the Norwegian Deep. Bottom water temperatures were still unusually cold in January 2011, with the mean bottom temperature in the Skagerrak 1.5–2°C below the mean during 2006-2010. A similar situation with unusual cold bottom water occurred in mid-1960s and coincided with a sharp decline in the *Pandalus* stock (see SCR Doc 12/65 and 12/59).

b) Assessment Data

i) Commercial fishery data:

The Danish catch and effort data from logbooks have been analyzed and standardized (SCR Doc. 08/75, 12/65) to provide indices of stock biomass. A GLM standardization of the LPUE series was performed on all shrimp fishing trips (value of shrimp landings at least 50% of total trip landing value) conducted in the period 1987-2012:

$$ln(LPUE) = ln(LPUEmean) + ln(a*Hp) + ln(area) + ln(year) + ln(season) + error$$

where a is the linear coefficient of the relationship between LPUE and the vessel engine power (horsepower), the 'year' factor covers the period 1987-2012, 'area' covers Norwegian Deep and Skagerrak, 'season', in this case month, covers possible seasonal variation, and the variance of the error term is assumed to be normally distributed.

In the standardization of the Norwegian LPUE (2000-2012) (SCR Doc. 12/64) a similar model was applied, but gear type (single and twin trawl) was also included as a variable:

$$ln(LPUE) = ln(LPUEmean) + ln(vessel) + ln(area) + ln(year) + ln(month) + ln(gear) + error$$

Information on gear use recorded in Norwegian logbooks (single or twin trawl) was prior to 2011 corrected by interviews with fishers. However, in the electronic logbooks compulsory for all vessels ≥15 m introduced in 2011, information on the use of single and twin trawl is included. Data from vessels <15 m are still missing in the logbooks.

A similar standardization of Swedish lpue - with a slightly different combination of explanatory variables - was carried out for data from 1997 to 2011:

$$ln(LPUE) = ln(LPUEmean) + ln(year*month) + ln\ (gear\ code) + ln\ (number\ of\ gears) + ln(a*kW) + error$$

where a is the linear coefficient of the relationship between LPUE and kW. Gear code is trawl 1) without grid, 2) with grid (unblocked fish opening) or 3) with grid and large square mesh fish tunnel in order to retain marketable fish. Number of gears is either single or twin trawl (SCR Doc. 12/65). Additional work is underway to model the Swedish LPUE series from 1963 onwards, but is not yet completed.

Since the mid-1990s the Danish standardised LPUE has fluctuated without long term trends (Fig. 5.2). For the last decade the three time series show similar fluctuations, increasing from 2000 to 2004, decreasing in 2005 and then increasing again until 2007. All three LPUE indices have decreased since 2008.

In previous assessments harvest rates (H.R.) were estimated from landings and corresponding biomass indices from the Norwegian survey. Since the new survey only covers six years, time series of standardised effort indices (total landings/Danish, Swedish and Norwegian standardised LPUE indices) have been estimated in addition to H.R. estimates for 2006-2011 (Fig. 5.3) Standardised effort seems to have been fluctuating without any clear trend since the mid-1990s indicating stability in the exploitation of the stock. It should be noted that CPUE series are standardised to the first year for which data are available.

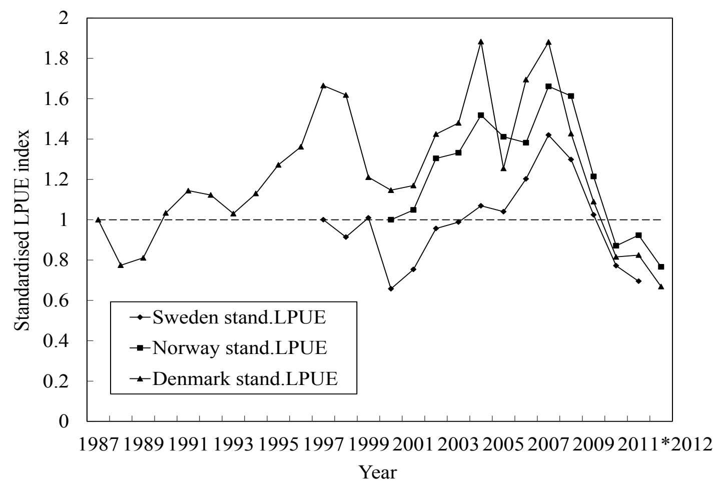


Fig. 5.2. Northern shrimp in Skagerrak and Norwegian Deep: Danish, Norwegian and Swedish standardised LPUE until 2012. *2012 is not complete

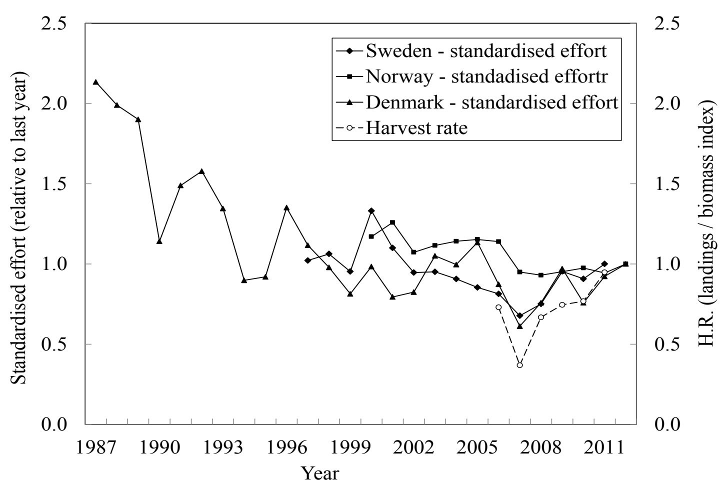


Fig. 5.3. Northern shrimp in Skagerrak and Norwegian Deep: Harvest rate (total landings/survey indices of biomass) and estimated standardised effort based on total landings and Danish, Norwegian and Swedish standardised LPUE.

ii) Sampling of landings.

Numbers and weight at age from 1985 – 2011 are shown in Table 5.3 and the length frequencies of the catch are shown in Fig. 4 of SCR Doc 12/61. Information on size and subsequently age distribution of the landings are obtained by sampling. The samples also provide information on sex distribution and maturity (SCR Doc. 12/65). This substantial amount of information has not been used in the current assessment, but is used in the ongoing benchmark assessment of the Skagerrak and Norwegian Deep shrimp stock (end date 1st March 2013) intended to provide NIPAG with a full analytical assessment model for the 2013 meeting.

Table 5.3. Numbers (in millions) at age in total landings, 1985-2011.

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	17.7	7.4	2.7	14.1	31.3	0.0	3.9	25.5	27.2	0.7	2.7	61.1	19.7	12.7
1	1200.8	1146.4	1260.5	1086.6	2083.6	2250.1	1231.8	1071.4	1889.6	671.9	646.0	1211.6	2175.6	903.4
2	1305.4	1029.7	1205.6	923.9	385.5	910.8	1035.8	1289.2	803.8	1380.4	970.5	991.4	1181.9	1597.9
3	187.9	482.7	390.2	300.2	173.8	121.1	326.7	569.1	262.7	143.0	851.5	454.6	295.6	468.1
+gp	52.3	25.1	203.2	146.7	13.6	31.3	25.6	57.5	15.5	30.5	42.0	69.5	29.8	48.2
Total	2764.1	2691.3	3062.1	2471.5	2687.9	3313.3	2623.8	3012.7	2998.7	2226.4	2512.5	2788.2	3702.6	3030.2

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
0	4.6	88.1	0.1	3.9	2.4	5.7	13.7	4.8	0.1	1.2	0.1	4.9	0.1
1	1436.1	1270.7	904.7	922.3	668.7	1062.9	749.4	1021.4	433.1	701.9	555.1	297.9	304.4
2	720.1	836.3	824.5	858.4	1466.5	1251.4	1172.7	1149.2	1349.9	915.0	853.2	787.6	1136.5
3	318.3	199.3	390.0	581.8	283.8	477.6	410.1	379.0	220.1	673.7	592.9	238.2	221.3
+gp	43.3	39.2	68.3	101.8	0.0	50.4	0.0	28.5	0.0	0.0	16.5	0.0	0.0
Total	2522.4	2433.5	2187.6	2468.3	2421.4	2847.9	2345.9	2582.8	2003.1	2291.9	2017.8	1328.6	1662.3

iii) Survey data

The Norwegian shrimp survey went through large changes in the years 2003-06 with changes in vessel and timing (SCR Doc. 12/59) resulting in four different survey series, lasting from one to nineteen years. ICES (2004) strongly recommended the survey to be conducted in the 1st quarter as it gives good estimates of the 1-group (recruitment) and female biomass (SSB). Thus, a new time series at the most optimal time of year was started in 2006. It was noted that the first, third and fourth survey series tracked the standardised Danish LPUE series.

Biomass indices from the first time series were recalculated in 2012 in order to provide SE's. The recalculated indices corresponded well with the old ones. The biomass index increased from 1988 to this time series' maximum in 1997. A decrease in 1998-2000 was followed by an increase in 2001-2002, when this series was discontinued (Fig. 5.4). In 2003 the survey was carried out with a different trawl in use only that year. The 2004 and 2005 mean values of a new biomass index series were not statistically different. The new biomass index series peaked in 2007. Since 2008 the index has shown a steady decline, to the time series' minimum in 2012.

The abundance of age 1 shrimp in 2006 was equal to the abundance of age 1 shrimp in 2007. From 2007 to 2010 recruitment (age 1) showed a steady decline to a low level of only 1/10 of the 2006 and 2007 indices (Fig 5.5). Recruitment increased in both 2011 and 2012.

SSB (female biomass) has been calculated for the years 2006-2012 (Fig. 5.6). The index follows the overall biomass index, increasing from 2006 to 2007, then declining back to the 2006-level in 2008 and further declining in 2009-2012.

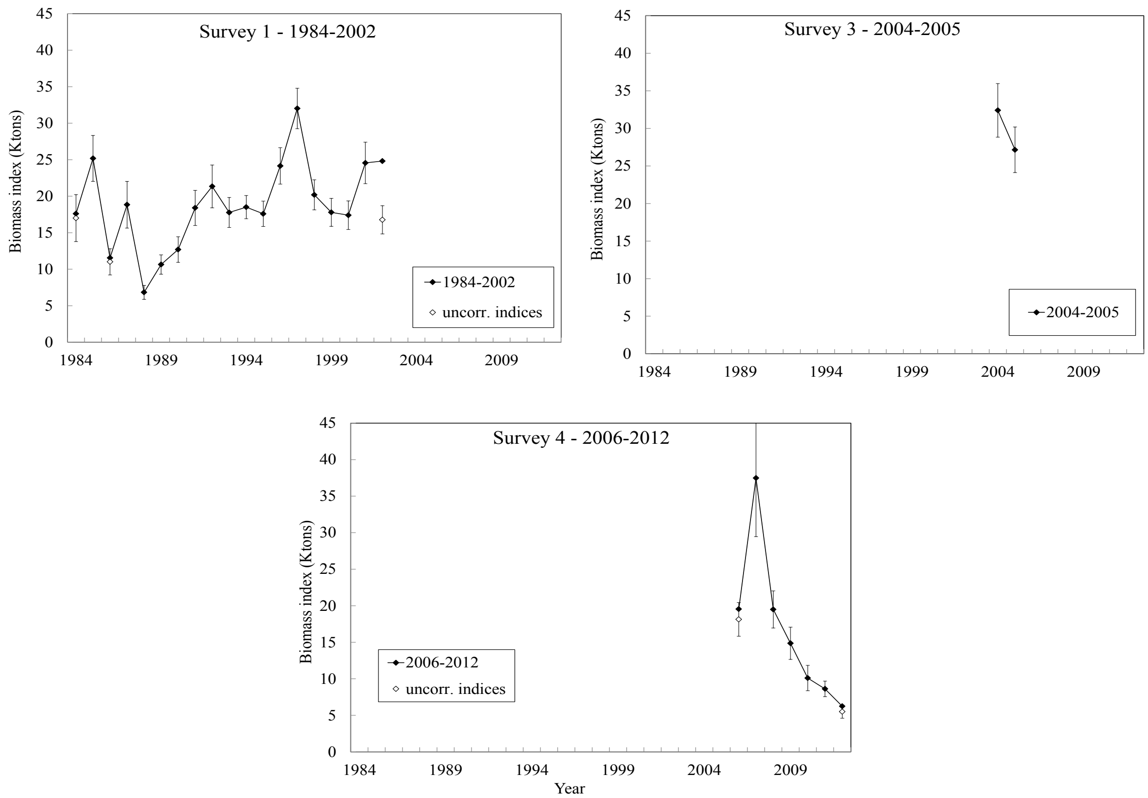


Fig. 5.4. Northern shrimp in Skagerrak and Norwegian Deep: Estimated survey biomass indices in 1984 to 2012. The 1984 – 2005 indices were re-calculated in 2012, providing SEs for the whole time series. Survey 1: October/November 1984-2002 with Campelen trawl; Survey 2: October/November 2003 with shrimp trawl 1420 (not shown); Survey 3: May/June 2004-2005 with Campelen trawl; Survey 4: January/February 2006-2012 with Campelen trawl.

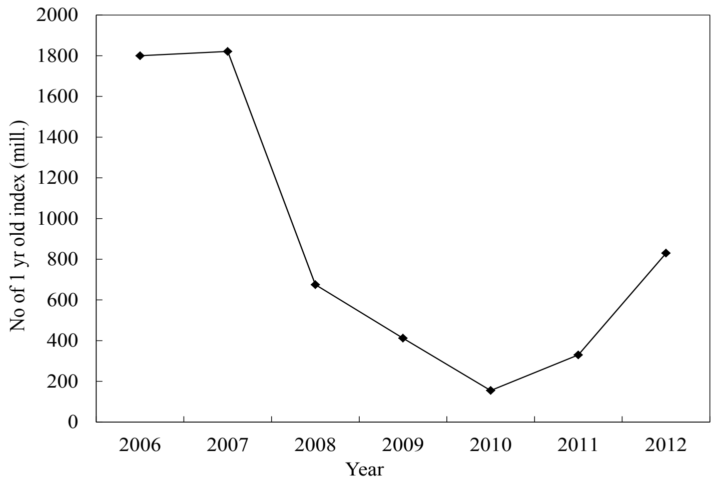


Fig. 5.5. Northern shrimp in Skagerrak and Norwegian Deep: Estimated recruitment indices from 2006-2012. The recruitment index is calculated as the abundance of age 1 shrimp (the first mode, approx. 9-13mm, in the length frequency distribution).

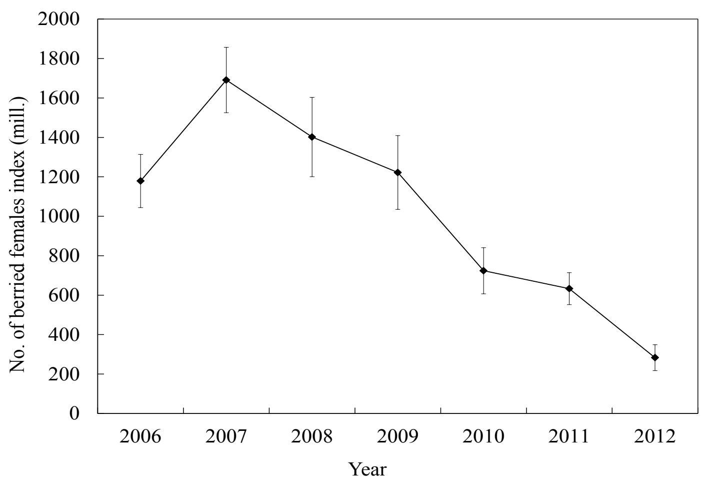


Fig. 5.6. Northern shrimp in Skagerrak and Norwegian Deep: SSB abundance from the Norwegian shrimp surveys in 2006-2012. The abundance index of the spawning stock is calculated as the abundance of berried females. Error bars are SE.

The large inter-annual variation in the predator biomass index is mainly due to variations in the saithe and roundnose grenadier indices. The sizes of these indices are heavily influenced by which stations are trawled as saithe is found on the shallowest stations and roundnose grenadier on the deepest ones. An index without these species is shown at the bottom of Table 5.4. The total index of shrimp predator biomass excluding saithe and roundnose grenadier has been at the same level during the 5 last years (Table 5.4).

Table 5.4. Northern shrimp in Skagerrak and Norwegian Deep: Estimated indices of predator biomass (catch in kg per towed nautical miles) from the Norwegian shrimp survey in 2006-2012.

Species	biomass index							
English	2006	2007	2008	2009	2010	2011	2012	mean
Blue whiting	0.13	0.13	0.12	1.21	0.27	0.62	3.30	
Saithe	7.33	39.75	208.32	53.89	18.53	7.52	5.66	
Cod	0.51	1.28	0.78	2.01	1.79	1.66	1.26	
Roundnose Grenadier	3.22	6.85	19.02	19.03	10.05	4.99	4.43	
Rabbit fish	2.24	2.15	3.41	3.26	3.51	2.73	2.22	
Haddock	0.97	4.21	1.85	3.18	3.46	5.82	5.75	
Redfish	0.18	0.40	0.26	0.43	0.80	1.02	0.37	
Velvet Belly	1.31	2.58	1.95	2.42	2.52	1.47	1.59	
Skates, Rays	0.41	0.95	0.64	0.17	0.60	0.88	0.98	
Long Rough Dab	0.22	0.64	0.42	0.28	0.47	0.51	0.56	
Hake	0.98	0.78	0.64	2.56	1.60	0.56	0.52	
Angler	0.15	0.91	0.87	1.25	1.70	0.92	0.17	
Witch	0.24	0.74	0.54	0.16	0.13	0.24	0.29	
Dogfish	0.31	0.19	0.28	0.14	0.11	0.21	0.60	
Black-mouthed dogfish	0.00	0.05	0.05	0.15	0.09	0.09	0.09	
Whiting	0.35	1.01	1.35	3.02	2.42	3.07	1.64	
Blue Ling	0	0	0	0	0	0	0	
Ling	0.04	0.11	0.34	0.79	0.64	0.24	0.17	
Four-bearded Rockling	0.06	0.14	0.04	0.03	0.05	0.03	0.09	
Cusk	0.20	0	0.02	0.05	0.13	0.29	0.04	
Halibut	0.08	0.07	3.88	0.09	0.20	0.05	0.19	
Pollack	0.06	0.25	0.03	0.13	0.12	0.15	0.07	
Greater Forkbeard	0	0	0	0.01	0.04	0.02	0.05	
Total	18.99	63.19	244.81	94.26	49.23	33.09	30.04	76.23
Total (except saithe and roundnose grenadier)	8.44	16.59	17.47	21.34	20.65	20.58	19.95	17.86

Exploratory model work

Two assessment models developed in the ongoing ICES inter benchmark assessment (end date 1st March 2013) were presented to the NIPAG expert group; a stochastic length-based assessment model (SCR Doc. 12/61) and a Bayesian surplus production model (SCR 12/66). Biological reference points and short term forecasts from the two models were produced, presented and discussed during the NIPAG meeting and both models were evaluated as capable of delivering a full analytical assessment. The two models also demonstrated some agreement in the long term trends of SSB and *F* estimates, although discrepancies of individual years were somewhat pronounced (Fig. 5.7). It was, however, decided by the expert group to await completion of the entire benchmark process before implementing any new model. This decision was to some degree based on the model discrepancies and the need to update the length distribution time series from the Norwegian shrimp survey, which informs one of the models. This update to length distribution was performed during the NIPAG meeting, but not in time to redo and re-evaluate full analytical assessments from the two benchmark models.

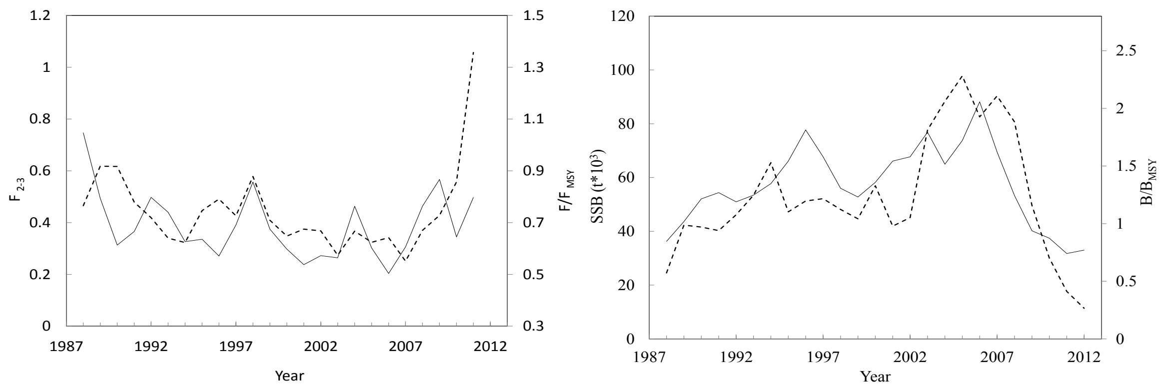


Fig. 5.7 Overlayed outputs of $F_{2\text{-}3}$ and SSB from the length-based model (dashed line), and F/F_{msy} and B/B_{msy} from the Bayesian model (solid line).

c) Assessment Results

This year's assessment was based on evaluation of Danish, Norwegian and Swedish standardised LPUEs, standardised effort from the fishery in 1987–2011, and the survey indices of recruitment and biomass in 2006-2012.

LPUE: All three standardised LPUEs have shown similar fluctuations since 2000 (Fig. 5.2). The indices have decreased since 2007, and are now below their respective long term means.

Recruitment: The recruitment index (age 1) has declined to 1/10 from 2007 to 2010, but has increased by 112% in 2011 and 152% in 2012.

Survey biomass: The biomass index has decreased with 87% from 2007 to 2012.

State of the stock: Indices of stock biomass indicate a decline from 2007 to 2012.The recruitment index has shown an increasing trend since 2010 and recruitment to the fishable stock may lead to an increase in 2013.

According to ICES' implementation of RGLIFE advice on Data Limited Stocks (DLS) *Pandalus* in Skagerrak and Norwegian Deep is to be considered as a Category 3 stock. Following the 3.2.0 guidelines the catch advice is derived as follows:

Catch advice for Data Limited Stocks

Category 3 - Stocks for which survey-based assessments indicate trends

Method 3.2.05. If there are survey data on abundance (e.g. CPUE over time), but there is no survey-based proxy for MSY $B_{trigger}$ and F values or proxies are not known,

1. Determine catch advice from the survey-adjusted status-quo catch:

Average landings 2009-2011	8 998 t
Average Survey Biomass 2011 – 2012	7 435 t
Average Survey Biomass 2008 – 2010	14 830 t
Ratio	0.5
Catch Advice	0.5 * 8 998 = 4 499 t

This change is greater than the 20% constraint rule, therefore the uncertainty cap and precautionary buffer were applied.

2. Apply the 20% Uncertainty Cap to the catch advice (see above Methods -- Definition of common terms and methods).

Uncertainty Cap:

Average landings 2009-2011		8 998 t
Catch Advice	-20%	7 199t

3. Then apply the Precautionary Buffer to the catch advice (see above Methods -- Definition of common terms and methods).

Precautionary Buffer:

Catch Advice	-20%	5 759 t

The justifications for these calculations are not fully understood by NIPAG.

d) Biological Reference Points

No reference points were provided in this assessment.

e) Management Recommendations

NIPAG **recommended** that, for shrimp in Skagerrak and Norwegian Deep:

- *sorting grids or other means of facilitating the escape of fish should be implemented in this fishery.*
- *all Norwegian vessels should be required to complete and provide log books.*

f) Research Recommendations

NIPAG **recommended** that for shrimp in Skagerrak and Norwegian Deep:

- *that a stock annex be written for this stock.*

g) Research Recommendations from the 2009-2011 meetings

- *The Norwegian survey time series indices from 1984 - 2003 should be recalculated in order to provide confidence intervals and length frequency distributions.*

STATUS: Completed.

- *the Swedish effort data should be standardised*

STATUS: The Swedish effort data have been standardised and included in the basis for assessing stock status

- *the Stochastic assessment model as described in SCR Doc.10/70 should be implemented and MSY reference points should be established.*

STATUS: The length based modelling framework, along with a Bayesian surplus production model, were further explored at the NIPAG 2012 meeting Conclusions on an appropriate analytical assessment will be drawn by the benchmark meeting.

- *A benchmark assessment is carried out before next NIPAG meeting as suggested by the 2009 Review Group.*

STATUS: Benchmark assessment is ongoing (end date 1st of March 2013)

- *collaborative efforts should be made to standardise a means of predicting recruitment to the fishable stock.*

STATUS: No progress

- *the Norwegian shrimp survey should be continued on an annual basis*

STATUS: The survey will most likely be conducted annually.

- *Differences in recruitment and stock abundance between Skagerrak and the Norwegian Deep should be explored.*

STATUS: This forms part of the research projects described below

- *the ongoing genetic investigations to explore the relation/connection/mixing between the shrimp (stock units) in Skagerrak and the Norwegian Deep on the one hand and the Fladen Ground shrimp on the other hand should be continued until these relationships have been clarified.*

STATUS: Results from the two research projects focusing on the genetic stock structure of northern shrimp in respectively the whole North Atlantic (POPBOREALIS) and the Skagerrak/North Sea area (Sustainable shrimp fishing in Skagerrak), were presented to the working group. As the data set from the North Sea/Skagerrak is not yet finalized, and since the statistical analyses are still ongoing, the results are still preliminary. However, the results indicate that shrimp in some areas, especially around Iceland, Jan Mayen and in Gulf of Maine, and possibly also on Flemish Cap, constitute isolated populations, while shrimp in other areas, such as the Barents Sea and the eastern coast of Canada constitute distinct, but large, interbreeding populations. The genetic differences between samples within Skagerrak and the North Sea are small compared with the differences across the North Atlantic as a whole. A finalized data set is expected before the end of 2012 such that conclusions on the stock structure in Skagerrak and the North Sea can be drawn as part of the ICES process for benchmarking stock assessments. Samples from the Gulf of St. Lawrence and east of Greenland would provide a more complete picture of global stock identity.

6. Northern Shrimp in Barents Sea and Svalbard area (ICES SA I and II) – ICES Stock

Background documentation (equivalent to stock annex) is found in SCR Doc 12/49, 50, 51, 60; 06/64, 08/56, 07/86, 07/75, 06/70.

a) Introduction

Northern shrimp (*Pandalus borealis*) in the Barents Sea and in the Svalbard fishery protection zone (ICES Sub-areas I and II) is considered as one stock (Fig. 6.1). Norwegian and Russian vessels exploit the stock in the entire area, while vessels from other nations are restricted to the Svalbard fishery zone and in the “Loop Hole” (Fig. 6.1).

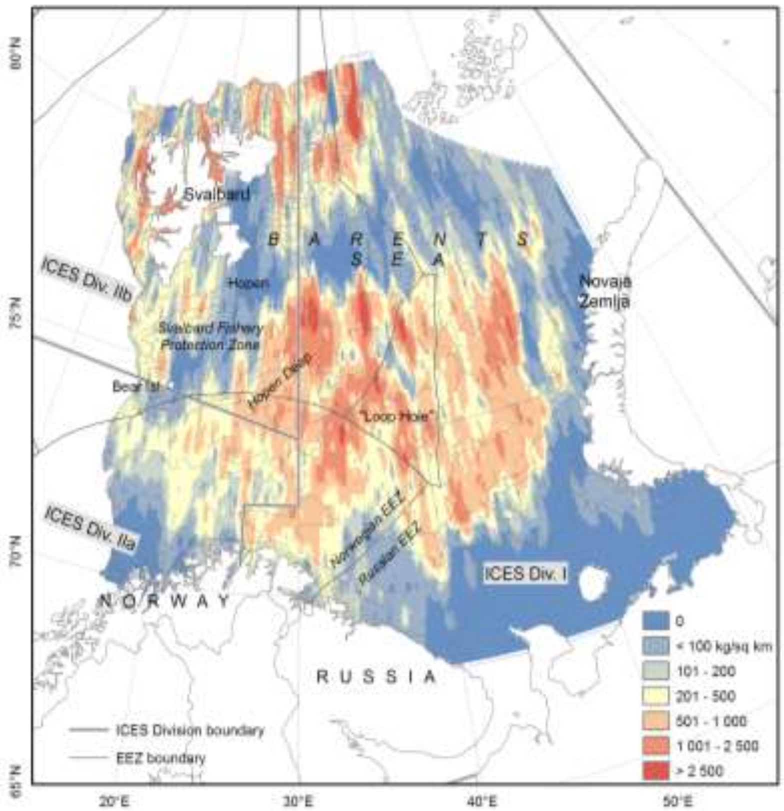


Fig. 6.1. Shrimp in the Barents Sea: stock distribution, mean density index (kg/km^2), based on survey data 2000-2010.

Norwegian vessels initiated the fishery in 1970. As the fishery developed, vessels from several nations joined and the annual catch reached 128 000 t in 1984 (Fig. 6.2). In the recent 10-year period catches have varied between 20 000 and 60 000 t/yr, about 67–92% of these were taken by Norwegian vessels and the rest by vessels from Russia, Iceland, Greenland and the EU (Table 6.1).

There is no TAC established for this stock. The fishery is partly regulated by effort control, and a partial TAC (Russian zone only). Licenses are required for the Russian and Norwegian vessels. The fishing activity of these license holders are constrained only by bycatch regulations whereas the activity of third country fleets operating in the Svalbard zone is also restricted by the number of effective fishing days and the number of vessels by country. The minimum stretched mesh size is 35 mm. Bycatch is limited by mandatory sorting grids and by the temporary closing of areas where excessive bycatch of juvenile cod, haddock, Greenland halibut, redfish or shrimp <15 mm CL is registered.

Catch. Overall catches have ranged from 5 000 to 128 000 t/yr. (Fig. 6.2) since 1970. The most recent peak was seen in 2000 at approximately 83 000 t. Catches thereafter declined to about 30 000 t in 2011 partly due to reduced profitability of the fishery. Based on information from the industry and catch statistics until August the 2012 catches are predicted to reach 20 000 t.

Table 6.1. Shrimp in ICES SA I and II: Recent catches (2001–2012) in metric tons, as used by NIPAG for the assessment (minor revisions made in 2012).

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012[1]
Recommended TAC	-	-	-	41 299[2]	40 000	50 000	50 000	50 000	50 000	60 000	60 000
Norway	48799	34172	35918	37253	27352	25558	20662	19784	16779	19923	13000
Russia	3790	2776	2410	435	4	192	417	0	0	0	0
Others	8899	2277	4406	4930	2271	4181	7109	7488	8419	9867	7000
Total	61488	39225	42734	42618	29627	29931	28188	27272	25198	29790	20000

[1] Catches projected to the end of the year;
[2] Should not exceed the 2004 catch level (ACFM, 2004).

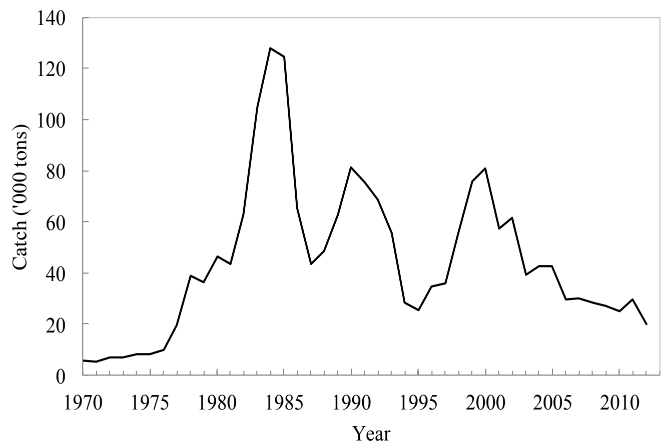


Fig. 6.2. Shrimp in ICES SA I and II: total catches 1970–2012 (2012 projected to the end of the year).

Discards and bycatch. Discard of shrimp cannot be quantified but is believed to be small as the fishery is not limited by quotas. Bycatch rates of other species are estimated from surveillance and research surveys and are corrected for differences in gear selection pattern (SCR Doc. 07/86). The bycatch rates in specific areas are then multiplied by the corresponding shrimp catch from logbooks to give the overall bycatch.

Since the introduction of the Nordmøre sorting grid in 1992, only small cod, haddock, Greenland halibut, and redfish in the 5–25 cm size range are caught as bycatch. The bycatch of small cod ranged between 2–67 million individuals/yr. and redfish between 2–25 million individuals/yr. since 1992, while 1–9 million haddock/yr. and 0.5–14 million Greenland halibut/yr. were registered in the period 2000–2004 (Fig. 6.3). In recent years there has been a decline in bycatch following a reduced effort in the shrimp fishery. Details of bycatch is no longer reported by the ICES Arctic Fisheries Working Group. NIPAG will from now on take over this task and update bycatch information starting at its 2013 meeting.

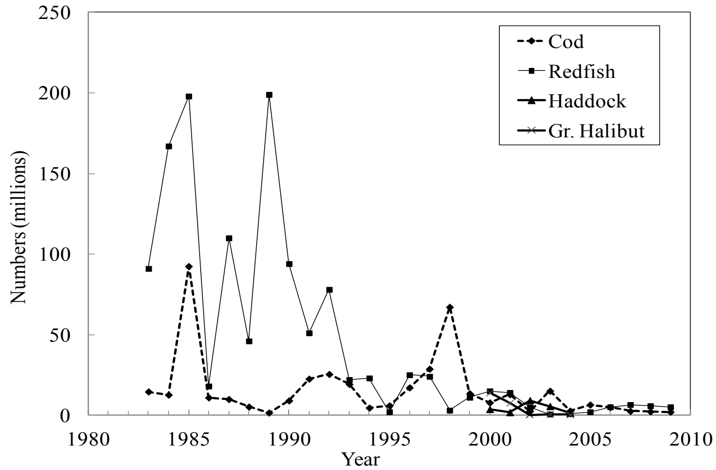


Fig. 6.3. Shrimp in ICES SA I and II: Estimated bycatch of cod, haddock, Greenland halibut and redfish in the Norwegian shrimp fishery (million individuals). No data available for 2010-12.

b) Input Data

i) Commercial fishery data

A major restructuring of the shrimp fishing fleet towards fewer and larger vessels has taken place since the mid-1990s. At that time an average vessel had around 1 000 HP; 10 years later this value had increased to more than 6 000 HP (Fig. 6.4). Until 1996 the fishery was conducted by using single trawls only. Double trawls were then introduced, and in 2002 approximately ⅔ of the total effort (trawl-time) spent was by using two trawls simultaneously. In 2000 a few vessels started to experiment with triple trawls: 58% of the effort in 2010 is accounted for by this fishing method (Fig. 6.5). An individual vessel may alternate between single and multiple trawling depending on what is appropriate on given fishing grounds.

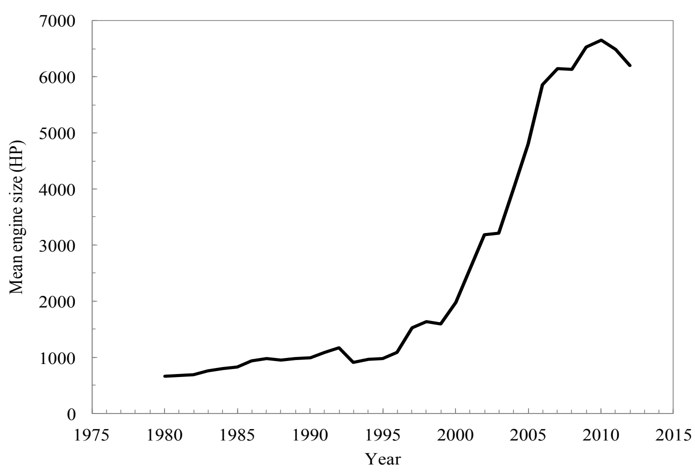


Fig. 6.4. Shrimp in ICES SA I and II: Mean engine power (HP) weighted by trawl-time, in the years 1980–2012.

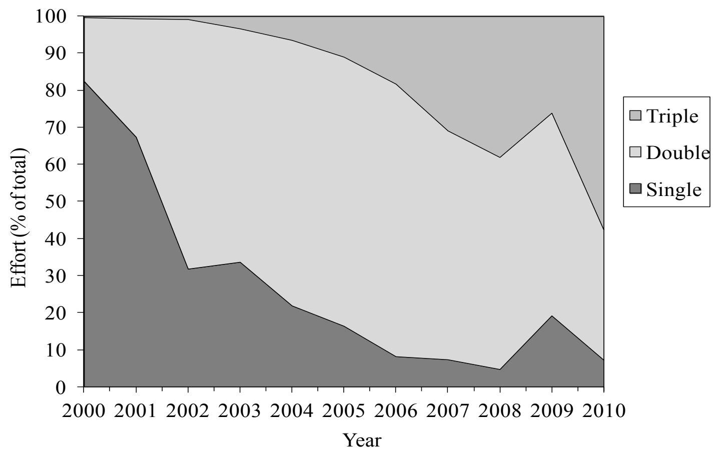


Fig. 6.5. Shrimp in ICES SA I and II: Percentage of total fishing effort spent by using single, double or triple trawls 2000–2010 (Norwegian data).

The fishery is conducted mainly in the central Barents Sea and on the Svalbard Shelf (Fig. 6.6). The fishery takes place throughout the year but may in some years be restricted by ice conditions. The lowest effort is generally seen in October through March, the highest in May to August.

Logbook data from 2009 to 2012 show decreased activity in the Hopen Deep, coupled with increased effort further east in international waters in the so-called “Loop Hole” (Fig 6.6). Information from the industry points to decreasing catch rates and area closures due to bycatch of juvenile fish on the traditional shrimp fishing grounds as the main reasons for the observed change in fishing pattern.

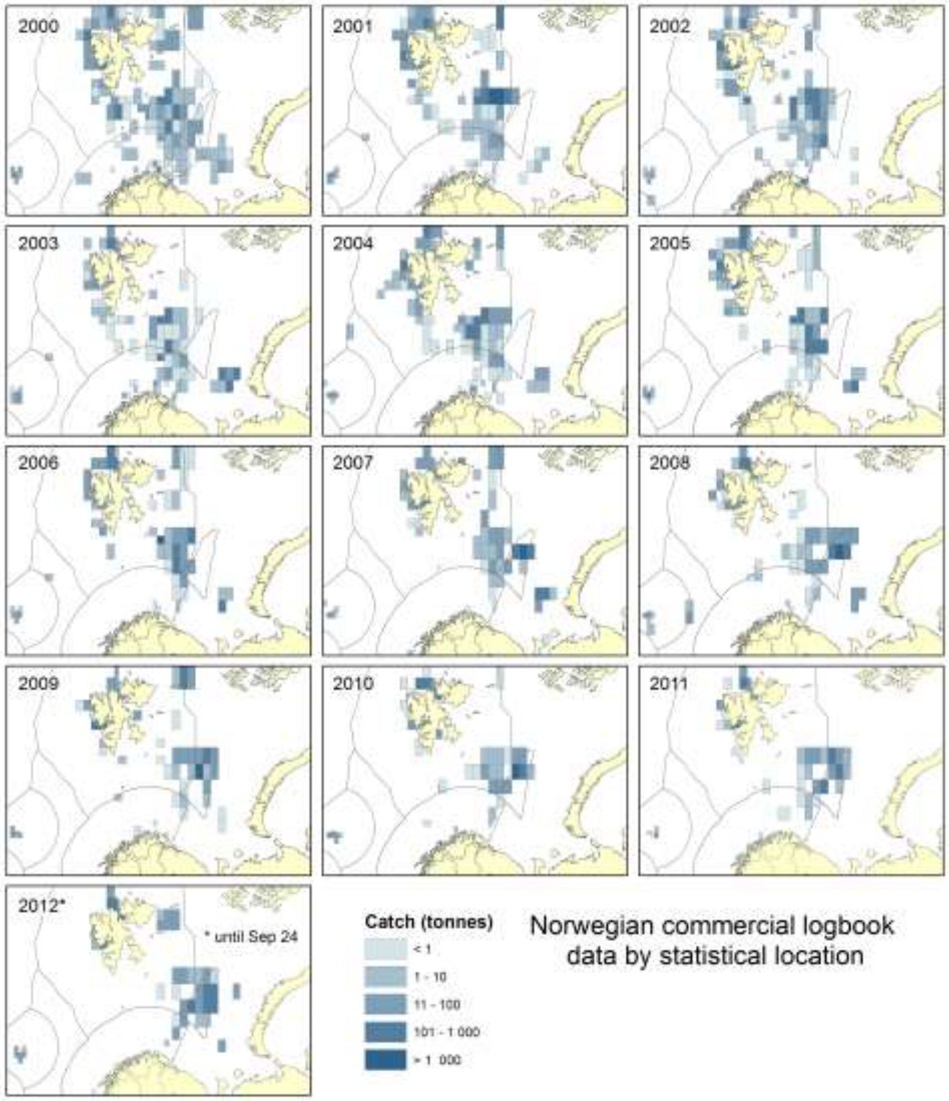


Fig. 6.6. Distribution of catches by Norwegian vessels 2000-2012 based on logbook information.

Norwegian logbook data were used in a multiplicative model (GLM) to calculate standardized annual catch rate indices (SCR Doc. 12/51). A new index series based on individual vessels rather than vessel groups was introduced in 2008 (SCR Doc. 08/56) in order to take into account the changes observed in the fleet. The GLM model to derive the CPUE indices included the following variables: (1) vessel, (2) season (month), (3) area, and (4) gear type (single, double or triple trawl). The resulting series is assumed to be indicative of the biomass of shrimp ≥17 mm CL, *i.e.* females and older males.

The standardized CPUE declined by 60% from a maximum in 1984 to the lowest value of the time series in 1987 (Fig. 6.7). Since then it has showed an overall increasing trend. A new peak was reached in 2006 and the 2007 to 2011 mean values have fluctuated above the average of the series thereafter. In 2012 the index decreased significantly to just below average. The standardized effort (Fig. 6.8) has shown a decreasing trend since 2000.

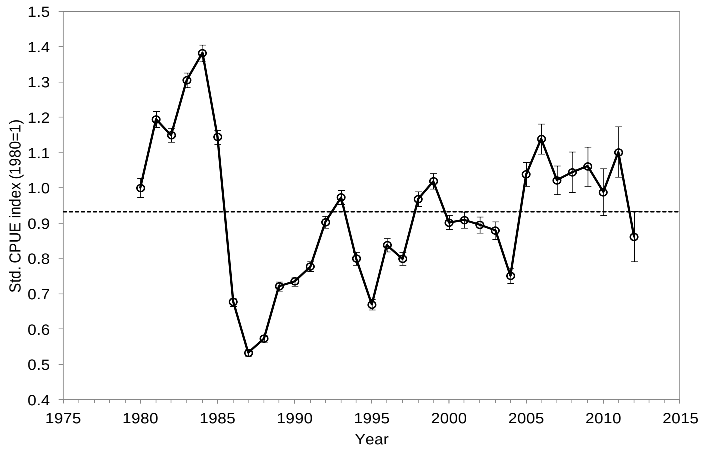


Fig. 6.7. Shrimp in ICES SA I and II: standardized CPUE based on Norwegian data. Error bars represent one standard error; dotted line is the overall mean of the series.

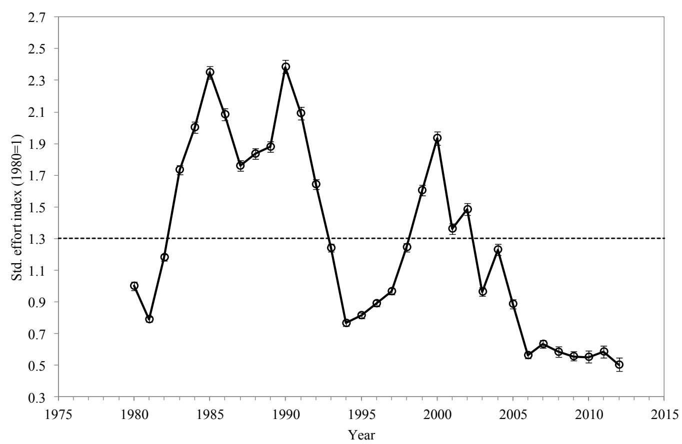


Fig. 6.8. Shrimp in ICES SA I and II: Standardized effort (Catch divided with standardized CPUE). Error bars represent one standard error; dotted line is the overall mean of the series.

ii) Research survey data

Russian and Norwegian shrimp surveys have been conducted in their respective EEZs of the Barents Sea since 1982 to assess the status of the northern shrimp stock (SCR Doc. 06/70, 07/75, 12/50). The main objectives were to obtain indices for stock biomass, abundance, recruitment and demographic composition. In 2004, these surveys were replaced by the joint Norwegian-Russian "Ecosystem survey" which monitors shrimp along with a multitude of other ecosystem variables in the entire area. Details of the survey design are contained in SCR Doc. 12/50.

Biomass. The Biomass indices of the Norwegian and Russian shrimp surveys (survey 1 and 2) varied without trend between 1982 and 2005 (Fig. 6.9). The Joint Russian-Norwegian Ecosystem survey (survey 3) increased by about 66% from 2004 to 2006 and then decreased back to the 2004-value in 2008 (Fig. 6.9). The 2010 to 2012 values is back up close to that of 2006.

The geographical distribution of the stock in 2009-2012 is more easterly compared to that of the previous years (Fig. 6.10).

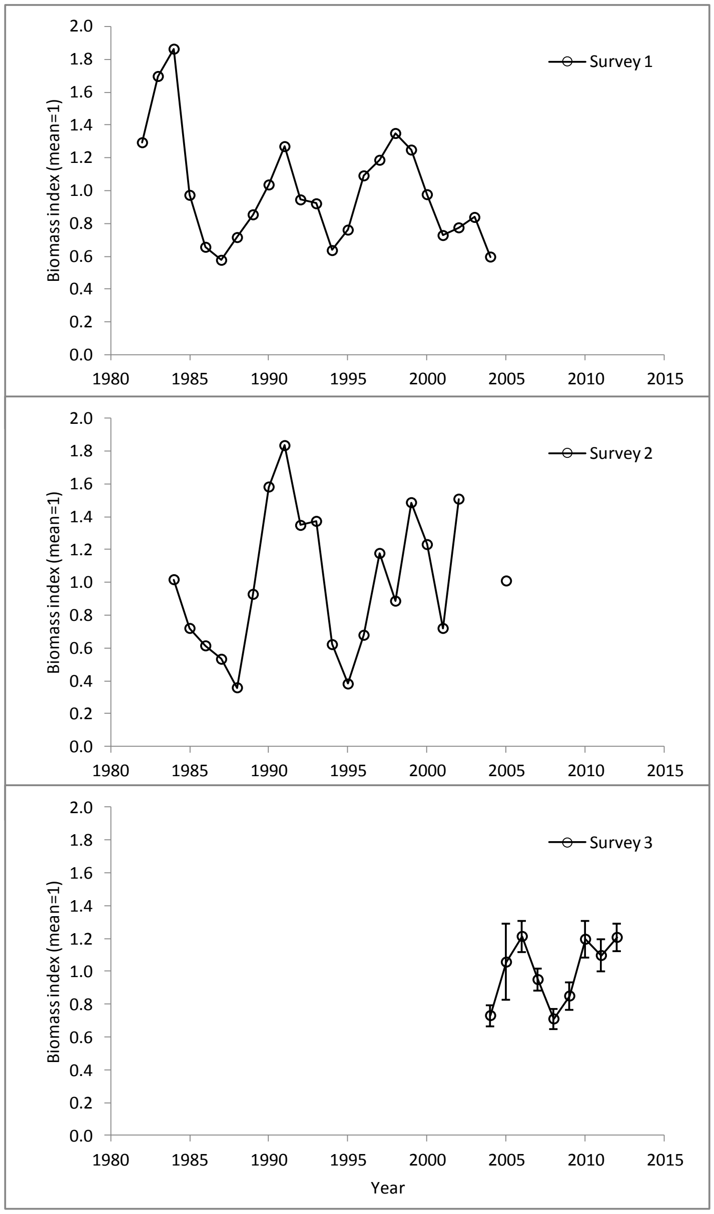


Fig. 6.9. Shrimp in ICES SA I and II: Indices of total stock biomass from the (1) 1982-2004 Norwegian shrimp survey, (2) the 1984-2005 Russian survey, and (3) the joint Russian-Norwegian ecosystem survey. Error bars represent one standard error.

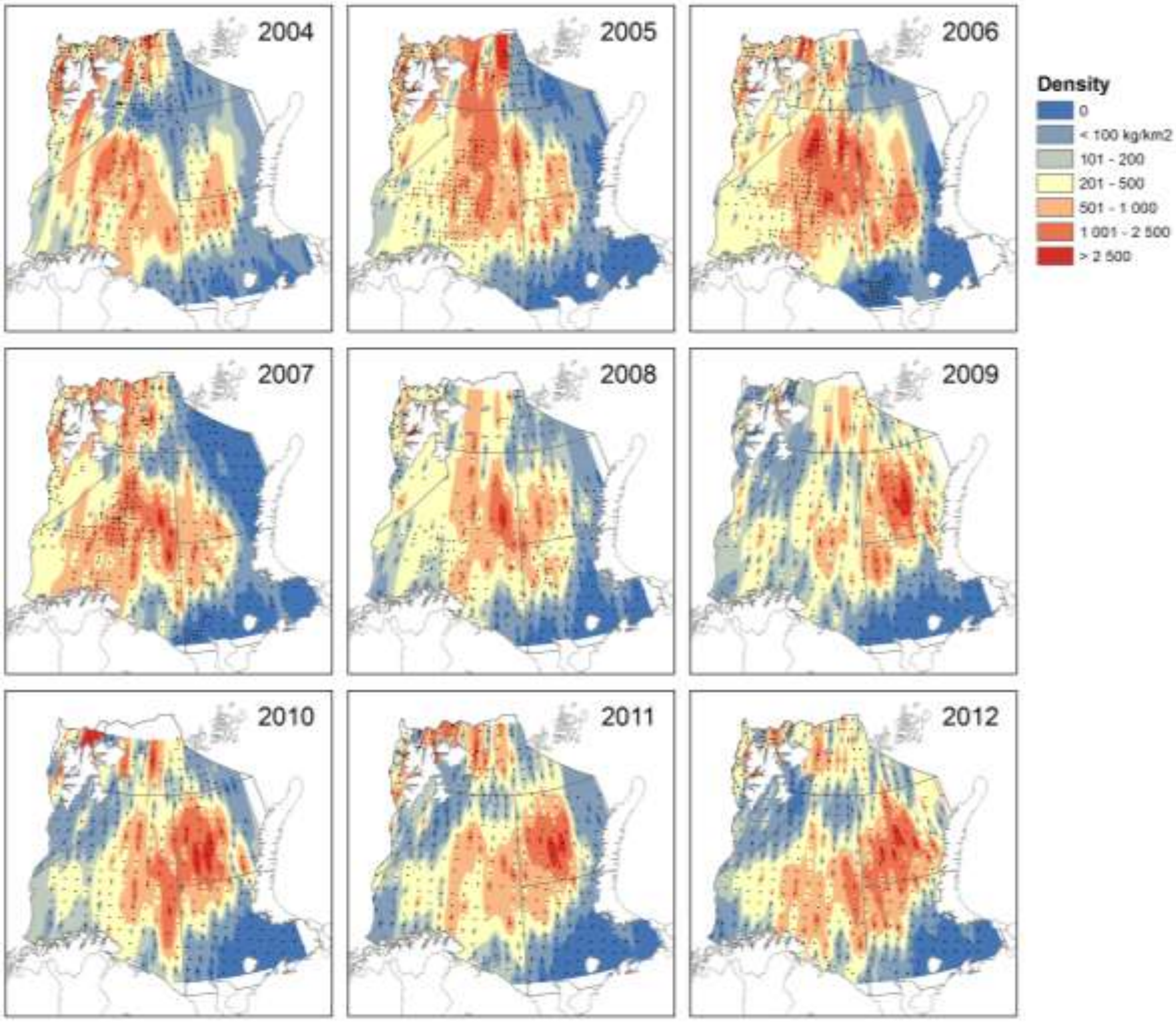


Fig. 6.10. Shrimp in ICES SA I and II: Shrimp density (kg/km^2) as calculated from the Ecosystem survey data 2004–2012).

Recruitment indices. Two recruitment indices were derived from the overall size distributions based on Russian and Norwegian samples (SCR Doc. 12/60 and 12/50 respectively) as estimated abundance of shrimp at 13 to 16 mm CL. Shrimp at this size will probably enter the fishery in the following one to two years. Recruitment indices showed no major changes in the period 2004 – 2012 (Fig. 6.11).

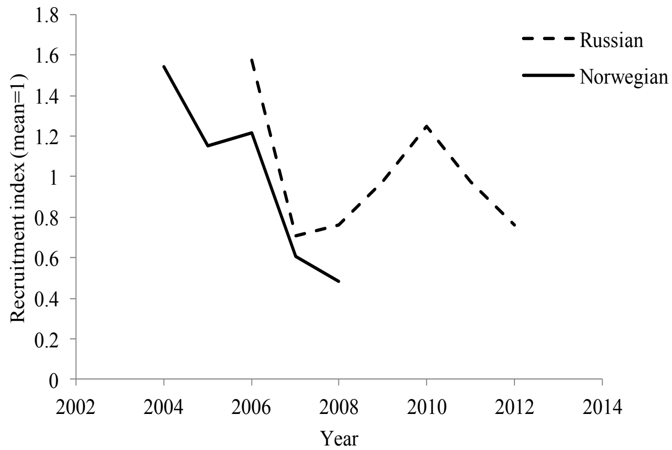


Fig. 6.11. Shrimp in ICES SA I and II: Indices of recruitment: abundance of shrimp at size 13–16 mm CL based on Norwegian survey samples 2004-2008 and Russian survey samples 2006-2012.

Environmental considerations. Temperatures in the Barents Sea have been high since 2004, largely due to increased inflow of warm water masses from the Norwegian Sea. An increase from 2011 to 2012 was observed in near-bottom temperatures primarily in the north and northwestern parts of the Barents Sea, but also in the southwest where temperatures at the bottom were the highest on record since 1951 (pers. comm. R. Ingvaldsen/A. Trofimov). In 2012 temperatures in the rest of the water column were largely unchanged, while temperatures near the surface were substantially lower than in 2011, probably due to a marked shift in the large wind and pressure field in the northernmost parts of the Barents Sea/Arctic Ocean (SCR Doc. 12/49).

Shrimps were only caught in areas where bottom temperatures were above 0°C (Fig. 6.4). Highest shrimp densities were observed between zero and 4°C, while the limit of their upper temperature preference appears to lie at about 6-8°C. The changes in shrimp distribution eastwards may be associated with the temperature changes observed (Fig. 6.12).

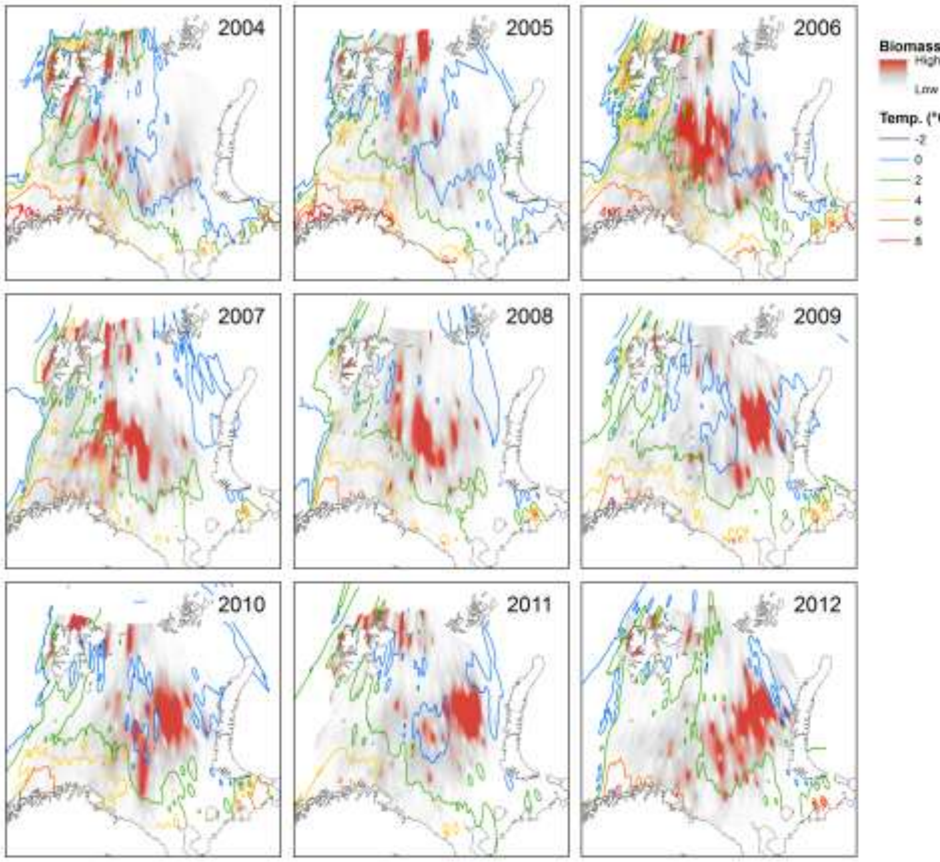


Fig. 6.12. Shrimp in ICES SA I and II: Bottom temperature contour overlays from the 2004 to 2012 ecosystem surveys on shrimp density distributions (SCR Doc. 12/50).

c) Estimation of Parameters

The modelling framework introduced in 2006 (SCR Doc. 06/64) was used for the assessment. Model settings were the same as ones used in previous years except that the historic Russian 1984-2005 survey biomass series is now included as input data (Fig 6.9, survey 2).

Within this model, parameters relevant for the assessment and management of the stock are estimated, based on a stochastic version of a surplus-production model. The model is formulated in a state-space framework and Bayesian methods are used to derive "posterior" likelihood distributions of the parameters (SCR Doc. 12/49).

The model synthesized information from input priors, four independent series of shrimp biomass indices and one series of shrimp catch. The biomass indices were: a standardized series of annual commercial vessel catch rates for 1980–2012 (Fig. 6.7, SCR Doc. 12/51); and trawl-survey biomass indices for 1982–2004, 1984–2005 and for 2004–present (Fig, 6.9, SCR Doc. 12/50). These indices were scaled to true biomass by catchability parameters, *q*, and lognormal observation errors were applied. Total reported catch in ICES Div. I and II since 1970 was used as yield data (Fig. 6.2, SCR Doc. 12/51). The fishery being without major discarding problems or variable misreporting, reported catches were entered into the model as error-free.

Absolute biomass estimates had relatively high variances. For management purposes, it was therefore desirable to work with biomass on a relative scale in order to cancel out the uncertainty of the "catchability" parameters (the parameters that scale absolute stock size). Biomass, *B,* was thus measured relative to the biomass that would yield Maximum Sustainable Yield, B_{msy}. The estimated fishing mortality, *F*, refers to the removal of biomass by fishing and is scaled to the fishing mortality at MSY, F_{msy}. The state equation describing stock dynamics took the form:

$$P_{t+1} = \left(P_t - \frac{C_t}{B_{MSY}} + \frac{2\,MSY\,P_t}{B_{MSY}}\left(1 - \frac{P_t}{2}\right)\right) \cdot \exp(\nu_t)$$

where P_t is the stock biomass relative to biomass at MSY ($P_t = B_t/B_{MSY}$) in year t. This frames the range of stock biomass on a relative scale where $B_{MSY} = 1$ and the carrying capacity (K) equals 2. The 'process errors', v, are normally, independently and identically distributed with mean 0 and variance σ_P^2.

The observation equations had lognormal errors, ω, κ, η and ε, for the series of standardised CPUE ($CPUE_t$), Norwegian shrimp survey ($survR_t$), The Russian shrimp survey ($survRu_t$) and joint ecosystem survey ($survE_t$) respectively giving:

$$CPUE_t = q_C B_{MSY} P_t \exp(\omega_t)\,,\; survR_t = q_R B_{MSY} P_t \exp(\kappa_t)\,,\; survRu_t = q_{Ru} B_{MSY} P_t \exp(\eta_t)\,,\; survE_t = q_E B_{MSY} P_t \exp(\varepsilon_t)$$

The observation error terms, ω, κ, η and ε are normally, independently and identically distributed with mean 0 and variance (observation error) σ_C^2, σ_R^2, σ_{Ru}^2 and σ_E^2 respectively. Summaries of the estimated posterior probability distributions of selected parameters are shown in Table 6.2. Values are similar to the ones estimated in the 2011 assessment.

Table 6.2. Shrimp in ICES SA I and II : Summary of parameter estimates: mean, standard deviation (sd) and 25, 50, and 75 percentiles of the posterior distribution of selected parameters (symbols are as in the text; r = intrinsic growth rate, P0 = the 'initial" stock biomass in 1969).

	Mean	sd	25 %	Median	75 %
MSY (ktons)	267	192	125	214	358
K (ktons)	3269	1829	1883	2851	4217
r	0.34	0.17	0.22	0.33	0.45
q_R	0.13	0.09	0.07	0.10	0.17
q_{Ru}	0.33	0.23	0.16	0.26	0.42
q_E	0.20	0.14	0.10	0.16	0.25
q_C	4.8E-04	3.3E-04	2.4E-04	3.8E-04	6.0E-04
P_0	1.50	0.26	1.33	1.50	1.68
P_{2012}	1.90	0.51	1.58	1.87	2.18
σ_R	0.17	0.03	0.15	0.17	0.19
σ_{Ru}	0.34	0.05	0.30	0.34	0.37
σ_E	0.17	0.04	0.15	0.17	0.19
σ_C	0.13	0.02	0.12	0.13	0.14
σ_P	0.19	0.03	0.17	0.19	0.21

Reference points. In 2009 ICES adopted a "Maximal Sustainable Yield (MSY) framework" (ACOM. ICES Advice, 2010. Book 1. Section 1.2) for deriving advice. There are three reference points to be considered: F_{msy}, $B_{trigger}$ and B_{lim}. In the MSY management approach the F_{lim} is somewhat redundant, however, recent discussions on the setting of an F_{lim} reference can be found in the 2009 NIPAG report. F_{msy} and the probability of exceeding it can be estimated, as well as the risk of exceeding B_{lim} which is set at 30% B_{msy} (NIPAG, 2006), F_{lim} suggested to be 170% of F_{msy} (NIPAG, 2009) and $B_{trigger}$ set at 50% B_{msy} (p.56, NIPAG, 2010).

d) Assessment Results

The results of this year's model run are similar to those of the previous years (model introduced in 2006). The sensitivity of model results to the setting of the priors for initial stock biomass and carrying capacity has previously been investigated (SCR Doc. 06/64 and 07/76) and found to have little effect on the conclusions drawn from the model.

Stock size and fishing mortality. Since the 1970s, the estimated median relative biomass (B/B_{msy}) has been above 1 (Fig. 6.13, upper panel) and the probability that it had ever been below $B_{trigger}$ was small.

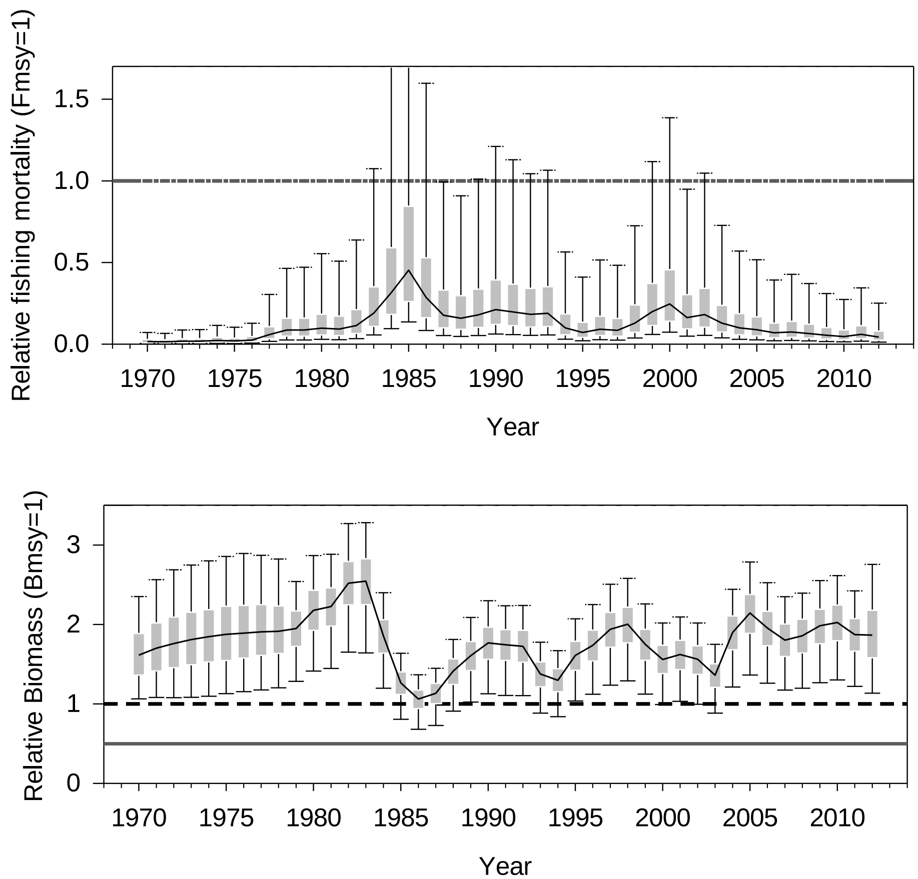


Fig. 6.13. Shrimp in ICES SA I and II: estimated relative biomass (B_t/B_{msy}) and fishing mortality (F_t/F_{msy}) for the years (t) 1970–2012. Boxes represent inter-quartile ranges and the solid black line at the (approximate) centre of each box is the median; the arms of each box extend to cover the central 90% of the distribution. The Green lines are the $B_{trigger}$ and F_{msy} references respectively

A steep decline in stock biomass was noted in the mid-1980s following some years with high catches and the median relative biomass went close to 1 (Fig. 6.13, upper). Since the late 1990s the stock has varied with an overall increasing trend and reached a level estimated to be close to K in 2005. The estimated risk of stock biomass being below B_{MSY} in 2011 and 2012 was 3% (Table 6.3). The median relative fishing mortality (F/F_{MSY}) has been well below 1 throughout the series (Fig. 6.13 lower). In 2012 there is a low 1% risk of exceeding F_{MSY} (Table 6.3).

Table 6.3. Shrimp in ICES SA I and II: stock status for 2011 and predicted to the end of 2012 assuming a total catch of 18 ktons. (170% F_{MSY} = fishing mortality that corresponds to a B_{lim} at $0.3B_{MSY}$).

Status	2011	2012*
Risk of falling below Blim (0.3Bmsy)	<1 %	<1 %
Risk of falling below Btrig (0.5Bmsy)	<1 %	<1 %
Risk of falling below Bmsy	3 %	3 %
Risk of exceeding Fmsy	1 %	1 %
Risk of exceeding 1.7Fmsy	<1 %	<1 %
Stock size (B/Bmsy), median	1.87	1.87
Fishing mortality (F/Fmsy), median	0.06	0.04
Productivity (% of MSY)	24 %	25 %

Estimated median biomass has been above $B_{trigger}$ and fishing mortality ratio has been below F_{msy} throughout the time series (Fig. 6.14). At the end of 2011 there is less than 1% risk that the stock would be below $B_{trigger}$, and that F_{msy} will be exceeded (Table 6.3).

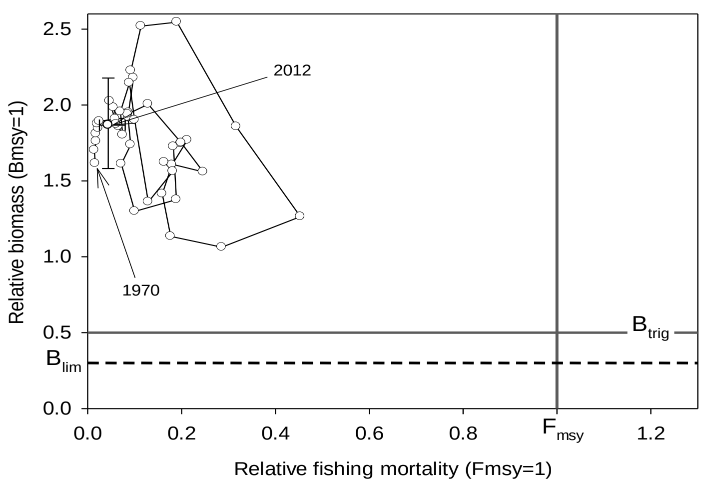


Fig. 6.14. Shrimp in ICES SA I and II: Estimated annual median biomass-ratio (B/B_{MSY}) and fishing mortality-ratio (F/F_{MSY}) 1970–2012. The MSY reference points for stock biomass, $B_{trigger}$, and fishing mortality, F_{msy}, are indicated by green lines. The PA reference B_{lim} is the broken line. Error bars on the 2012 value are inter-quartile range.

Predictions. Assuming a catch of 18 kt for 2012, catch options up to 60 kt for 2013 have a low risk (<5%) of exceeding F_{MSY} (Table 6.4) and is likely to maintain the stock at its current high level.

Table 6.4. Shrimp in ICES SA I and II: Predictions of risk and stock status associated with six optional catch levels for 2013. (170% F_{MSY} = fishing mortality that corresponds to a B_{lim} at $0.3B_{MSY}$).

Catch option 2013 (ktons)	30	40	50	60	70	90
Risk of falling below Blim (0.3Bmsy)	<1 %	<1 %	<1 %	<1 %	<1 %	<1 %
Risk of falling below Btrig (0.5Bmsy)	<1 %	<1 %	<1 %	<1 %	<1 %	<1 %
Risk of exceeding Fmsy	1 %	2 %	3 %	4 %	6 %	8 %
Risk of exceeding 1.7Fmsy	1 %	1 %	1 %	2 %	3 %	4 %
Stock size (B/Bmsy), median	1.86	1.85	1.84	1.83	1.83	1.80
Fishing mortality (F/Fmsy),	0.08	0.10	0.13	0.15	0.18	0.23
Productivity (% of MSY)	27 %	28 %	30 %	30 %	32 %	36 %

The risks associated with ten-year projections of stock development assuming annual catch of 30 000 to 90 000 t were investigated (Fig. 6.15). For all options the risk of the stock falling below $B_{trigger}$ in the medium term (10 years) is less than 5% (Fig. 6.13). Catch options up to 60 000 t, have a low risk (<5%) of exceeding F_{MSY} in the short term (Fig. 6.14).

Taking 90 000 t/yr will increase the risk of going above F_{msy} to more than 10% during the ten years of projection (Fig. 6.15). However, the risk of going below $B_{trigger}$ remains under 5%.

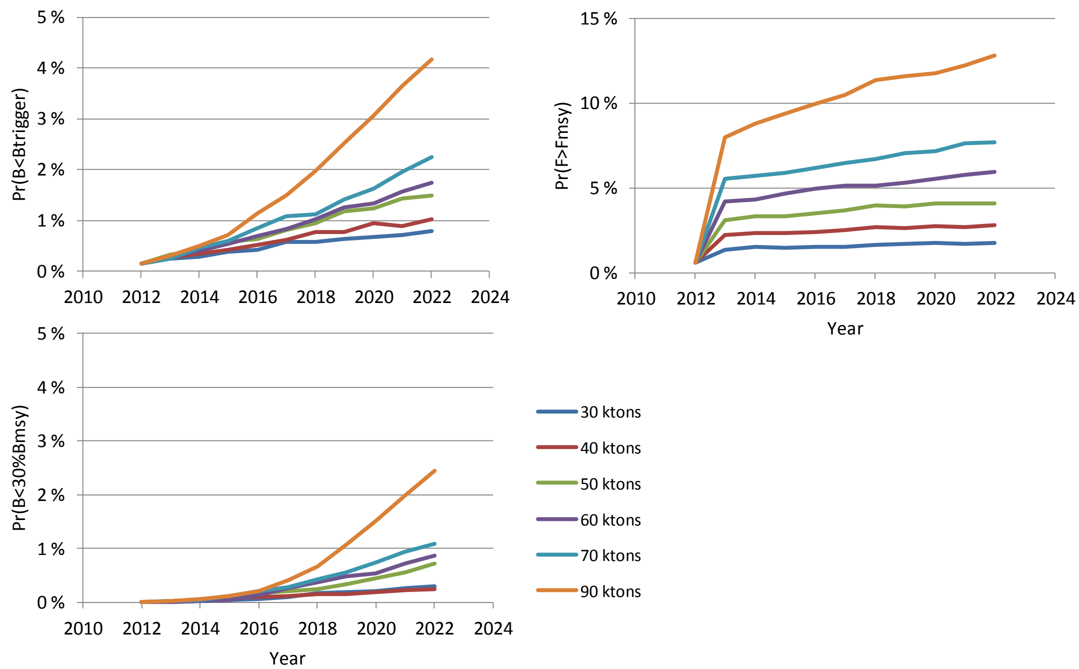


Fig. 6.15. Shrimp in ICES SA I and II: Projections of estimated risk of going below $B_{trigger}$ and of exceeding F_{msy} (top) and going below B_{lim} (bottom) given different catch options (see legend).

Yield predictions can be made for various levels of fishing mortalities (e.g. at target fishing mortality=F_{MSY}) but such estimates have high uncertainties as absolute biomass can only be estimated with relatively high variances (see section on "estimation of parameters") and therefore such point estimates should be interpreted with caution. Instead we estimate yield at risk level of exceeding the target of F_{MSY} (Table 6.5) and managers may pick their preferred risk level from this.

Table 6.5. Shrimp in ICES SA I and II: Yield predictions (kt) at five risk levels of exceeding F_{msy}.

	Risk of exceeding F_{msy}				
Year	2.5 %	5 %	10 %	25 %	50 %
2013	45	70	107	190	338
2014	45	71	106	189	336
2015	45	66	100	172	305
2016	41	64	94	162	281
2017	42	62	89	153	267
2018	40	60	85	146	255
2019	41	57	82	141	246
2020	38	56	81	137	238
2021	37	54	78	133	230
2022	35	53	77	132	228

Additional considerations

Model performance. The model was able to produce good simulations of the observed data (Fig. 6.16). The observations did not lie in the extreme tails of their posterior distributions (Table 6.6.). There is little retrospective pattern in the model (NIPAG, 2011).

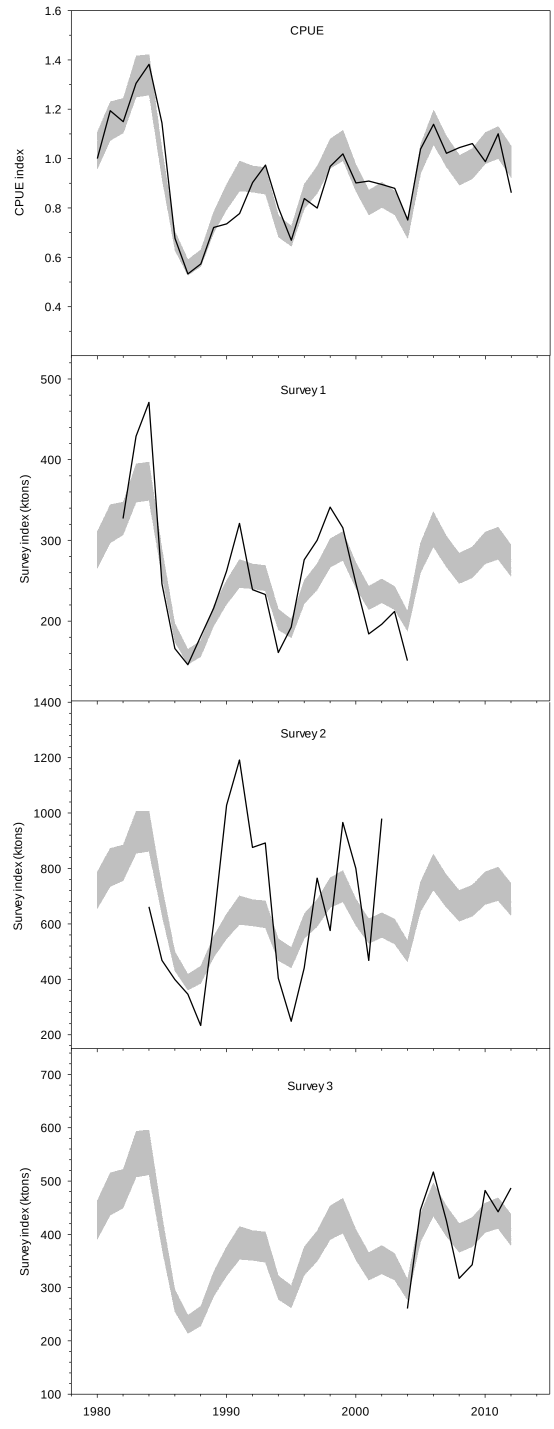


Fig. 6.16. Shrimp in ICES SA I and II: Observed (solid line) and estimated (shaded) series of the included biomass indices: the standardized catch-per-unit-effort (CPUE), the 1982–2004 shrimp survey (survey 1), a Russian survey index discontinued in 2005 (Survey 2) and the joint Norwegian-Russian Ecosystem survey (survey 3). Grey shaded areas are the inter-quartile range of their posteriors.

Table 6.6 Model diagnostics: residuals (% of observed value) and probability of getting a more extreme observation (pr; pr=0.5 means the observations is in the center of its predicted distribution while values close to 1 or 0 means that it is in the tail).

	CPUE		Survey 1		Survey 2		Survey 3	
Year	resid (%)	Pr	resid (%)	Pr	resid (%)	Pr	resid (%)	Pr
1980	3.64	0.43	-	-	-	-	-	-
1981	-3.31	0.59	-	-	-	-	-	-
1982	2.37	0.46	0.25	0.50	-	-	-	-
1983	2.29	0.45	-13.30	0.77	-	-	-	-
1984	-2.83	0.58	-20.61	0.88	41.94	17.08	-	-
1985	-14.44	0.84	10.88	0.31	46.22	15.21	-	-
1986	-1.41	0.55	11.95	0.29	16.87	33.16	-	-
1987	5.00	0.38	6.74	0.38	13.00	36.62	-	-
1988	4.25	0.40	-8.11	0.68	79.11	5.53	-	-
1989	2.99	0.44	-4.15	0.59	-13.85	67.59	-	-
1990	15.26	0.20	-9.86	0.71	-42.36	93.67	-	-
1991	19.85	0.14	-19.13	0.86	-45.36	95.24	-	-
1992	1.80	0.47	7.09	0.37	-26.69	81.62	-	-
1993	-6.41	0.67	8.93	0.34	-28.60	83.57	-	-
1994	-9.19	0.74	25.64	0.13	25.63	26.84	-	-
1995	2.63	0.44	-0.95	0.52	93.42	3.83	-	-
1996	1.33	0.48	-14.34	0.79	34.49	20.63	-	-
1997	14.87	0.20	-14.82	0.80	-16.20	69.89	-	-
1998	5.59	0.38	-16.45	0.83	24.10	28.10	-	-
1999	3.54	0.42	-7.03	0.66	-23.70	78.29	-	-
2000	2.35	0.45	4.07	0.43	-19.39	73.50	-	-
2001	-9.42	0.74	24.59	0.14	22.90	29.55	-	-
2002	-4.58	0.63	21.46	0.17	-39.05	92.37	-	-
2003	-6.66	0.67	7.89	0.35	-	-	-	-
2004	-4.35	0.62	32.48	0.08	-	-	13.73	0.27
2005	-3.61	0.60	-	-	6.68	43.55	-7.25	0.65
2006	-0.80	0.53	-	-	-	-	-9.74	0.70
2007	0.88	0.48	-	-	-	-	-0.04	0.52
2008	-8.52	0.72	-	-	-	-	24.42	0.15
2009	-7.54	0.69	-	-	-	-	18.13	0.21
2010	5.78	0.36	-	-	-	-	-10.45	0.72
2011	-2.97	0.59	-	-	-	-	-0.18	0.51
2012	15.00	0.21	-	-	-	-	-16.01	0.81

Predation. Both stock development and the rate at which changes might take place can be affected by changes in predation, in particular by cod, which has been estimated to consume large amounts of shrimp. If predation on shrimp were to increase rapidly outside the range previously experienced by the shrimp stock within the modelled period (1970–2011), the shrimp stock might decrease in size more than the model results have indicated as likely. The cod stock has recently increased (ICES AFWG, 2012). Continuing investigations to include cod predation as an explicit effect in the assessment model has not so far been successful as it has not been possible to establish a relationship between shrimp/cod densities.

Recruitment/reaction time of the assessment model. The model used is best at describing trends in stock development but shows some inertia in its response to year-to-year changes. Large and sudden changes in recruitment may therefore not be fully captured in model predictions however such changes have not been observed in the recent period.

Rebuilding potential. Although the stock is in a healthy state it should be noted that at 30% B_{msy} (B_{lim}) production is reduced to 50% of its maximum The estimate of the *r* (intrinsic rate of increase) had 80% confidence interval ranging from 0.13 to 0.56. Thus without a fishery it would take 4-14 years to rebuild the stock from B_{lim} to B_{msy}.

e) Summary

Mortality. The fishing mortality has been below F_{MSY} throughout the exploitation history of the stock. The risk that F will exceed F_{MSY} in 2012 is estimated to be less than 1%.

Biomass. The stock biomass estimates have been above B_{MSY} throughout the history of the fishery. Biomass at the end of 2012 is estimated to be well above $B_{trigger}$.

Recruitment. Recruitment indices showed no major changes in the period 2004 – 2012

State of the Stock. The Stock is estimated to be close to the carrying capacity. The risk of stock biomass being below $B_{trigger}$ and fishing mortality above F_{MSY} at end 2012 is less than 1%.

Yield. Catch options up to 60 000 t/yr, have a low risk (<5%) of exceeding F_{MSY} in the coming 3 years. At a higher risk tolerance larger yield may be achieved.

f) Review of Recommendations from 2011

There were no recommendations.

g) Research Recommendations

For the shrimp stock in Barents Sea and Svalbard (ICES Div. I and II), NIPAG **recommended** that *the technical basis for the assessment in various SCR Docs. be collated into a single technical stock annex*.

NIPAG reiterated its **recommendations** from 2010 that, *for the shrimp stock in Barents Sea and Svalbard (ICES Div. I and II):*

- *Demographic information (length, sex and stage etc.) be collected also from the Norwegian part of* ***the Barents Sea ecosystem survey.***
- *Collaborative efforts should be made to standardize a means of predicting recruitment to the fishable stock.*
- *Work to include explicit information on recruitment in the assessment model should be continued.*

7. Northern shrimp in Fladen Ground (ICES Division IVa)

From the 1960s up to around 2000 a significant shrimp fishery exploited the shrimp stock on the Fladen Ground in the northern North Sea. A short description of the fishery is given, as a shrimp fishery could be resumed in this area in the future. The landings from the Fladen Ground have been recorded from 1972 (SCR Doc. 09/69, Table 9). Total reported landings since 1997 have fluctuated between zero in 2006 to above 4000 t (Table 6.1). The Danish fleet accounts for the majority of these landings, with the Scottish fleet landing a minor portion. The fishery took place mainly during the first half of the year, with the highest activity in the second quarter. Since 2006 no landings have been recorded from this stock.

Since 1998 landings have decreased steadily and since 2004 the Fladen Ground fishery has been virtually non-existent with total recorded landings being less than 25 t. Interview information from the fishing industry obtained in 2004 gives the explanation that this decline is caused by low shrimp abundance, low prices on the small shrimp which are characteristic of the Fladen Ground, and high fuel prices. This stock has not been surveyed for several years, and the decline in this fishery may reflect a decline in the stock.

Table 7.1. Northern shrimp in Fladen Ground: Landings of *Pandalus borealis* (t) from the Fladen Ground (ICES Div. IVa) estimated by NIPAG.

Country/Fleet	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Denmark	2 900	1 005	1 482	1 263	1 147	999	23	10	0	0	0	0	0	0
Norway	3	9		18	9	8	0	0	0	0	0	0	0	0
Sweden						1	0	0	0	0	0	0	0	0
UK (Scotland)	1 365	456	378	397	70		0	0	0	0	0	0	0	0
Total	4 268	1 470	1 860	1 678	1 226	1 008	23	10	0	0	0	0	0	0

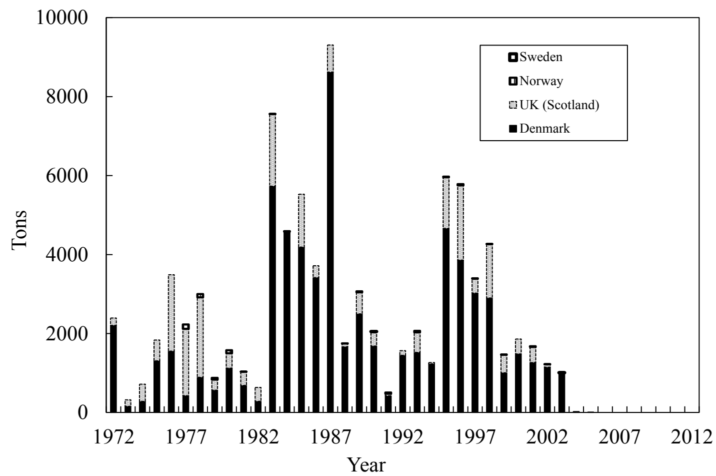


Fig. 7.1. Northern shrimp in Fladen Ground: Catches

IV. OTHER BUSINESS

Future Meetings

An invitation was made to the group from Greenland to host the September 2014 SC / NIPAG meeting in Nuuk. This suggestion was warmly received by NIPAG.

V. ADJOURNMENT

The NIPAG meeting was adjourned at 1630 hours on 23 October 2012. The Co-Chairs thanked all participants, especially the Designated Experts and Stock Coordinators, for their hard work. The Co-Chairs thanked the NAFO and ICES Secretariats for all of their logistical support. Thanks were also given to the Norwegian host for the excellent facilities supplied for the meeting.

PART F: MISCELLANEOUS

AGENDA I - SCIENTIFIC COUNCIL MEETING, 1-14 JUNE 2012

I. Opening (Scientific Council Chair: Carsten Hvingel)
   1. Appointment of Rapporteur
   2 Presentation and Report of Proxy Votes
   3. Adoption of Agenda
   4. Attendance of Observers
   5. Appointment of Designated Experts
   6. Plan of Work
   7. Housekeeping issues

II. Review of Scientific Council Recommendations in 2011

III. Fisheries Environment (STACFEN Chair: Gary Maillet)
   1. Opening
   2. Appointment of Rapporteur
   3. Adoption of Agenda
   4. Review of Recommendations in 2011
   5. Invited speakers
   6. Integrated Science Data Management (ISDM) Report for 2011
   7. Review of the physical, biological and chemical environment in the NAFO Convention Area during 2011 Contributions from:
   8. Interdisciplinary studies
   9. An update of the on-line annual ocean climate status summary for the NAFO Convention Area
   10 Formulation of recommendations based on environmental conditions during 2011
   11. National Representatives
   12. Other Matters
   13. Adjournment

IV. Publications (STACPUB Chair: Margaret Treble)
   1. Opening
   2. Appointment of Rapporteur
   3. Adoption of Agenda
   4. Review of Recommendations in 2011
   5. Review of Publications
      a) Annual Summary
         i) Journal of Northwest Atlantic Fishery Science (JNAFS)
         ii) Scientific Council Studies
         iii) Scientific Council Reports
   6. Other Matters
      a) Update on digitization of NAFO historical documents
      b) Alternative cover designs for JNAFS
      c) Consistency of formatting styles in JNAFS
      d) Performance Assessment Recommendation / Growing size of SC Reports
   7. Adjournment

V. Research Coordination (STACREC Chair: Don Stansbury)
   1. Opening
   2. Appointment of Rapporteur
   3. Review of Recommendations in 2011
   4. Fishery Statistics
      a) Progress report on Secretariat activities in 2011/2012

i) STATLANT 21A and 21B

5. Research Activities
    a) Biological sampling
        i) Report on activities in 2011/2012
        ii) Report by National Representatives on commercial sampling conducted
        iii) Report on data availability for stock assessments (by Designated Experts)
    b) Biological surveys
        i) Review of survey activities in 2011 (by National Representatives and Designated Experts)
        ii) Surveys planned for 2012 and early 2013
            - The international bottom trawl survey (organized by EU-Spain)
            - Other surveys
    c) Tagging activities
    d) Other research activities
6. Review of SCR and SCS Documents
7. Other Matters
    a) Review of the updated CWP Handbook
    b) Summary of progress on previous recommendations
8. Adjournment

VI. Fisheries Science (STACFIS Chair: Jean-Claude Mahé)

1. Opening
2. General Review
    a) Review of Recommendations in 2011
    b) General Review of Catches and Fishing Activity
3. Stock Assessments
    a) Certain Stocks in Subareas 2, 3 and 4; as Requested by the Fisheries Commission with the Concurrence of the Coastal States (Annex 1)
        i) Thoroughly assessed stocks (Item 2, Annex 1):
            - Cod in Div. 3M
            - Redfish in Div. 3LN
            - American plaice in Div. 3LNO (item 9)
            - Thorny skate in Div. 3LNOPs
        ii) Monitored stocks[1] (Item 2, Annex 1):
            - American plaice in Div. 3M
            - Capelin in Div. 3LNO
            - Cod in Div. 3NO
            - Redfish in Div. 3M
            - Redfish in Div. 3O
            - Witch flounder in Div. 2J3KL
            - Witch flounder in Div. 3NO
            - Yellowtail flounder in Div. 3LNO
            - White hake in Div. 3NOPs
            - Northern shortfin squid in Subarea 3+4

[1] Monitored stocks to be provided in the agreed format (NAFO Sci. Coun. Rep., 2005, Part A, Appendix IV, 2.i)

b) Certain Stocks in Subareas 0 and 1, as Requested by Denmark (Greenland) (Annex 3):
   i) Thoroughly assessed stocks
      - Greenland halibut in Div. 1A inshore
   ii) Monitored stocks:
      - Demersal redfish and other finfish in SA 1
      - Roundnose grenadier in SA0+1
c) Stocks Overlapping the Fishery Zones in Subareas 0 and 1, as Requested by Canada and by Denmark (Greenland) (Annexes 2 and 3 respectively):
   i) Thoroughly assessed stocks:
      - Greenland halibut in the offshore area of Divisions 0A+lAB and Divisions 0B+lC-F (Annex 2, Item 1; Annex 3, Item 3)

4. Stocks under a Management Strategy Evaluation (FC Item 4a)
   a) Greenland halibut in SA 2 and Div. 3KLMNO
5. Other Matters
   a) FIRMS Classification for NAFO Stocks
   b) Other Business
6. Adjournment

VII. Management Advice and Responses to Special Requests

1. Fisheries Commission (Annex 1)
   a) Request for Advice on TACs and Other Management Measures (Item 2, Annex 1))
      <u>For 2013 and 2014</u>
      - Cod in Div. 3M
      - American Plaice in Div. 3LNO
      - Redfish in Div. 3LN
      - Thorny skate in Div. 3LNOPs
   b) Monitoring of Stocks for which Multi-year Advice was provided in 2010 or 2011 (Item 2)
      - Cod in Div. 3NO
      - Redfish in Div. 3M
      - Redfish in Div. 3O
      - Witch flounder in Div. 2J3KL
      - Witch flounder in Div. 3NO
      - Yellowtail flounder in Div. 3LNO
      - White hake in Div. 3NOPs
      - Northern shortfin squid in SA 3 + 4
   c) Special Requests for Management Advice
      i) Harvest Control Rules for Greenland halibut (Item 4a)
      ii) Exceptional circumstances in the Greenland halibut management strategy (Item 4b)
      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)
      iv) Review and Update Reference points for Div. 3LNO American plaice, Div. 3NO cod (Item 6)
      v) Review of rebuilding plans for American plaice in Div. 3LNO and Cod in Div. 3NO (Item 7)
      vi) Evaluation of the proposed harvest control rule for Cod in Div. 3NO (Item 8)
      vii) Full assessment of Div. 3LNO American plaice in accordance with the rebuilding plan (Item 9)
      viii) Examine links between decline of shrimp and recovery of cod and reduction of redfish in Div. 3M (Item 10)
      ix) Definition of MSY reference points and a prospective harvest control rule for cod in Div. 3M (Item 11)

x) Review of bycatch information (Item 12)
xi) Trends in biomass and state of the stock for cod in Div. 2J+3KL (Item 13)
xii) Variability in indicators of stock status and recruitment for Witch flounder in Div. 3NO (Item 14)
xiii) Detailed list of VME Indicator species (Item 15)
xiv) GIS modeling of sponge encounters using VMS data (Item 16)
xv) Encounter thresholds and move on rules (Item 17)
xvi) Mapping of VME indicator species and elements (Item 18)
xvii) Development of a work plan for reassessment of VMEs (Item 19)

2. Coastal States
   a) Request by Canada for Advice on Management in 2013 (Annex 2)
      i) Greenland halibut in Div. 0B + Div. 1C-1F (Item 1)
      ii) *Pandalus borealis* in Subareas 0 and 1 (Item 2)
   b) Request by Denmark (Greenland) for Advice on Management in 2013 (Annex 3)
      i) Roundnose grenadier in SA 0+1 (Item 1)
      ii) Redfish and other finfish in SA 1 (Item 2)
      iii) Greenland halibut in the offshore area of Div. 0A and Div. 1A plus Div. 1B (Item 3a)
      iv) Greenland halibut in Div. 0B + Div. 1C-1F (Item 3b)
      v) Greenland halibut in inshore areas of Div. 1A (Item 4)
      vi) *Pandalus borealis* in SA 0 + 1 (Item 5)
      vii) *Pandalus borealis* east of Greenland and in the Denmark Strait (in conjunction with ICES). (Item 5)
3. Scientific Advice from Council on its own Accord
   a) Roughhead grenadier in SA2+3 (monitor)

VIII. Review of Future Meetings Arrangements

1. Scientific Council, Sep 2012
2. Scientific Council, Oct 2012
3. Scientific Council, Jun 2013
4. Scientific Council, Sep 2013
5. Scientific Council, Oct/Nov 2013
6. NAFO/ICES Joint Groups
   a) NIPAG, 17-25 Oct 2012
   b) NIPAG, 2013
7. WGEAFM
8. WGDEC
9. WGRP
10. WGHARP

IX. Arrangements for Special Sessions

1. Topics for future Special Sessions
   a) Joint ICES – NAFO Gadoid Symposium
   b) SISAM Conference
   c) Observer Scheme Conference, Chile.
   d) ICES IMR Bottom Trawl Symposium, Tromso, Norway

X. Meeting Reports

1. Working Group on EAFM, Dec 2011
2. Ad hoc Working Group on Exceptional Circumstances, Jan – Mar 2012
3. Report from WGDEC, Mar 2012
4. WGRP

5. WGHARP
6. WGNARS
7. Meetings attended by the Secretariat:
   a) GIS Symposium
   b) FAO VME Database
   c) CWP
   d) FIRMS
   e) Science and Sustainability Forum
   f) World Fisheries Congress

XI. Review of Scientific Council Working Procedures/Protocol

1. Performance assessment recommendations to Scientific Council (Annex 4)
2. Issues arising from the GC Working Group on the Plan of Action
3. General Plan of Work for September 2012 Annual Meeting
4. Other Matters
   a) ICES invitation to participate in GHL benchmark meetings
   b) Scientific Council position on ICES advice relating to Cod in SA1(inshore).

XII. Other Matters

1. Designated Experts
2. Stock Assessment spreadsheets
3. Meeting Highlights for NAFO Website
4. Scientific Merit Awards
5. Budget items
6. Other Business

XIII. Adoption of Committee Reports

1. STACFEN
2. STACREC
3. STACPUB
4. STACFIS

XIV. Scientific Council Recommendations to General Council and Fisheries Commission

XV. Adoption of Scientific Council Report

XVI. Adjournment

AGENDA II - SCIENTIFIC COUNCIL MEETING, 27 AUGUST – 7 SEPTEMBER 2012

I. Opening (Chair: Carsten Hvingel)

1. Appointment of Rapporteur
2. Adoption of Agenda
3. Attendance of Observers
4. Plan of Work

II. Fisheries Science (STACFIS Chair: Jean-Claude Mahé)

1. Opening
2. Interim Monitoring Updates
   - a) Northern Shrimp in Div. 3M
   - b) Northern Shrimp in Div. 3LNO

III. Special Requests from the Fisheries Commission

1. From September 2011
   - a) Update on Advice for Northern Shrimp in Division 3M (Item 1)
   - b) Update on Advice for Northern Shrimp in Divisions 3LNO (Item 1)
   - c) PA Reference Points for shrimp in Div. 3LNO (Item 3)

IV. Adoption of Reports

1. Committee Report of STACFIS
2. Report of Scientific Council

V. Adjournment

AGENDA III. SCIENTIFIC COUNCIL MEETING, 17-21 SEPTEMBER 2012

I. Plenary Session
   1. Opening
   2. Appointment of Rapporteur
   3. Adoption of Agenda
   4. Plan of Work

II. Review of Scientific Council Recommendations

III. Research Coordination
   1. Opening
   2. Fisheries Statistics
      a) Progress Reports on Secretariat Activities
      b) Review of STATLANT21
   3. Research Activities
      a) Surveys Planned for 2012 and early 2013
   4. Other Matters
      a) Review of SCR and SCS Documents
      b) Other Business

IV. Fisheries Science
   1. Opening
   2. Any matter outstanding from the WebEx SC meeting, 7 September.
      a) Northern Shrimp in Div. 3M and Div. 3LNO
   3. Nomination of Designated Experts
   4. Other Matters
      a) Review of SCR and SCS Documents
      b) Other Business

V. Special Requests from the Fisheries Commission
   1. *Ad hoc* Requests from Current Meeting

VI. Meeting Reports
   1. Fisheries Commission WGFMS-CPRS
   2. Fisheries Commission WGFMS-VME
   3. Meetings Attended by the Secretariat

VII. Review of Future Meeting Arrangements

VIII. Future Special Sessions
   1. ICES/NAFO Gadoid Symposium
   2. World Conference on Stock Assessment Methods

IX. Other Matters
   1. Matters Arising from the NAFO Performance Assessment
   2. Report of the Peer Review of STACFIS Catches
   3. Report of the Joint FC/SC Meeting
   4. Merit Award Nominations

X. Adoption of Reports
   1. Committee Reports of STACFIS and STACREC
   2. Report of Scientific Council

XI. Adjournment

AGENDA IV - SCIENTIFIC COUNCIL MEETING, 17-24 OCTOBER 2012

I. Opening (Chair: Carsten Hvingel)

1. Appointment of Rapporteur
2. Adoption of Agenda[1]
3. Attendance of Observers
4. Plan of Work

II. Review of Recommendations in 2011 and in 2012

III. NAFO/ICES *Pandalus* Assessment Group (Co-chairs Jean-Claude Mahé and Peter Shelton)

IV. Formulation of Advice (see Annexes 1–3 of Appendix I)

1. Request from Fisheries Commission (Items 3, 4 and 5 of Annex I)
   a) Northern shrimp (Div. 3M)
   b) Northern shrimp (Div. 3LNO)
2. Requests from Coastal States (Items 1 and 2 of Annex II, item 5 of Annex IIIa, Annex IIIb and IIIc)
   a) Northern shrimp (Subareas 0 and 1)
   b) Northern shrimp (in Denmark Strait and off East Greenland)

V. Other Matters

1. Scheduling of Future Meetings
2. Topics for Future Special Sessions
3. Items arising from the NAFO Performance Assessment
4. Other Business

VI. Adoption of Scientific Council and NIPAG Reports

VII. Adjournment

[1] Agenda to include relevant outcomes of the SC Shrimp Advice Update Meeting and the NAFO Annual Meeting on 17–21 September 2012.

AGENDA V - NIPAG MEETING, 17–24 OCTOBER 2012

I. Opening (Co-chairs: Jean-Claude Mahé and Peter Shelton)

1. Appointment of Rapporteur
2. Adoption of Agenda[1]
3. Plan of Work

II. General Review

1. Review of Recommendations in 2010 and in 2011
2. Review of Catches

III. Stock Assessments

- Northern shrimp (Division 3M)
- Northern Shrimp (Divisions 3LNO)
- Northern shrimp (Subareas 0 and 1)
- Northern shrimp (in Denmark Strait and off East Greenland)
- Northern shrimp in Skagerrak and Norwegian Deep (ICES Divisions IIIa and IVa East)
- Northern Shrimp in Barents Sea and Svalbard area (ICES Sub-areas I & II)
- Northern shrimp in Fladen Ground (ICES Division IVa)

IV. Other Business

V. Adjournment

[1] Agenda to include relevant outcomes of the Scientific Council Shrimp Advice Update Meeting and the NAFO Annual Meeting on 17–21 September 2012.

Annex 1. Fisheries Commission's Request for Scientific Advice on Management in 2013 and Beyond of Certain Stocks in Subareas 2, 3 and 4 and Other Matters

1. The Fisheries Commission with the concurrence of the Coastal State as regards to the stocks below which occur within its jurisdiction ("Fisheries Commission") requests that the Scientific Council provide advice in advance of the 2012 Annual Meeting, for the management of Northern shrimp in Div. 3M, 3LNO in 2013. The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation).

   Noting that Scientific Council will meet in October of 2011 for 2013 TAC advice, Fisheries Commission requests the Scientific Council to update its advice on shrimp stocks in 2012 for 2013 TAC.

   Fisheries Commission further requests that SC provide advice in accordance to Annex 1.

2. Fisheries Commission requests that the Scientific Council provide advice for the management of the fish stocks below according to the following assessment frequency (unless Fisheries Commission requests additional assessments):

Two year basis	Three year basis
American plaice in Div. 3LNO	American plaice in Div. 3M
Capelin in Div. 3NO	Cod in Div. 3NO
Cod in Div. 3M	Northern shortfin squid in SA 3+4
Redfish in Div 3LN	Redfish in Div. 3O
Redfish in Div. 3M	Witch flounder in Div. 2J+3KL
Thorny skate in Div. 3LNOPs	Witch flounder in Div. 3NO
White hake in Div. 3NOPs	
Yellowtail flounder in Div. 3LNO	

   To continue this schedule of assessments, the Scientific Council is requested to conduct the assessment of these stocks as follows:

   In 2012, advice should be provided for 2013 and 2014 for Redfish in Div. 3LN and Thorny skate in Div. 3LNOPs and for 2013, 2014 and 2015 Northern shortfin squid in SA 3+4.

   In addition, advice should be provided in 2012 for cod Div. 3M.

   The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation). Additionally, Fisheries Commission requests that SC provide advice in accordance to Annex 1.

   The Fisheries Commission also requests the Scientific Council to continue to monitor the status of all these stocks annually and, should a significant change be observed in stock status (e.g. from surveys) or in bycatches in other fisheries, provide updated advice as appropriate.

3. With respect to Northern shrimp (*Pandalus borealis*) in Div. 3LNO, noting the NAFO Framework for Precautionary Approach and recognizing the desire to demonstrate NAFO's commitment to applying the precautionary approach, Fisheries Commission requests the Scientific Council to:

   a) identify F_{msy}

   b) identify B_{msy}

c) provide advice on the appropriate selection of an upper reference point for biomass (e.g. B_{buf})

4. The Fisheries Commission adopted in 2010 an MSE approach for Greenland halibut stock in Subarea 2 + Division 3KLMNO (FC Working Paper 10/7). This approach considers a survey based harvest control rule (HCR) to set a TAC for this stock on an annual basis for the next four year period. The Fisheries Commission requests the Scientific Council to:

   a) Monitor and update the survey slope and to compute the TAC according to HCR adopted by the Fisheries Commission according to Annex 1 of FC Working Paper 10/7.

   b) Advise on whether or not an exceptional circumstance is occurring.

5. Fisheries Commission requests the Scientific Council to examine the consequences resulting from a decrease in mesh size in the mid-water trawl fishery for redfish in Div. 3LN to 90mm or lower.

6. The Fisheries Commission adopted in September 2011, conservation plans and rebuilding strategies for 3NO cod and 3 LNO American plaice and "recognizing that further updates and development of the plans may be required to ensure that the long term objectives are met". The Fisheries Commission requests the Scientific Council to:

   a) Provide advice on the addition of a new intermediate reference point (i.e. B_{isr}) in the NAFO precautionary approach framework to delineate an additional zone between B_{lim} and B_{msy} as proposed by the proposed by the working group

   b) Taking into consideration the new reference point B_{isr}, provide advice on an updating NAFO PA framework and provide a description for each zone.

   c) Provide advice on an appropriate selection of the B_{isr} value for Div. 3NO cod and Div. 3 LNO American plaice.

   d) Review B_{msy} and F_{msy} provided in 2011 for both stocks and quantify uncertainty surrounding these estimates.

7. Fisheries Commission requests the Scientific Council to review the conservation and rebuilding plans of 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5). Through projections and a risk based approach, evaluate the performance of the present rebuilding plans in terms of expected time frames (5 / 10 / 15 years) and associated probabilities to reach indicated limit and target biomass levels and catches. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above Blim.

8. Fisheries Commission requests the Scientific Council to evaluate the Harvest Control Rule (HCR) indicated below as an alternative to the HCR of the 3LNO American Plaice (NAFO/FC Doc. 11/4, Annex 4, item 4) and 3NO Cod (NAFO/FC Doc. 11/4, Annex 5, item 4) Conservation Plans and Rebuilding Strategies. Through projections and a risk based approach, evaluate the performance of this HCR in terms probabilities associated with maintaining Biomass above B_{lim} and ensuring continuous SSB growth. SC should provide SSB and associated catch trajectories for 5 / 10 / 15 years. Projections should assume appropriate levels of recruitment and the status quo fishing mortality (3-year average scaled and unscaled) until reaching biomass levels above B_{lim}.

Harvest Control Rule:

a) When SSB is below B_{lim}:

i. no directed fishing, and
ii. bycatch should be restricted to unavoidable bycatch in fisheries directing for other species

b) When SSB is above B_{lim}:

If P y+1 > 0.9 Then Fy+1 = F0.1 * Py+1

Else

Fy+1 = 0

TACy+1 = B y+1 * Fy+1

Where:

Fy+1 = Fishing mortality to project catches for the following year.

Py+1 = Probability of projected Spawning Stock Biomass to be above B_{lim}.

B y+1 = Exploitable biomass projected for the following year.

9. The Fisheries Commission requests the Scientific Council to conduct a full assessment of 3LNO American Plaice and provide advice in accordance to the rebuilding plan currently in place.

10. On the Flemish Cap, there seems to be a connection between the most recent decline of the shrimp stock, the recovery of the cod stock and the reduction of the redfish stock. The Fisheries Commission requests the Scientific Council to provide an explanation on the possible connection between these phenomena. It is also requested that SC advises on the feasibility and the manner by which these three species are maintained at levels capable of producing a combined maximum sustainable yield, in line with the objectives of the NAFO Convention.

11. Fisheries Commission requests the Scientific Council to define B_{msy} for cod in Division 3M and to propose a Harvest Control Rule (HCR) consistent with the NAFO Precautionary Approach Framework. It also requests the Scientific Council to define the estimated timeframe to reach B_{msy} under different scenarios, consistent with the proposed HCR.

12. Scientific Council is asked to provide, where available, qualitative and quantitative information including possible comparisons on bycatches of various species in directed fisheries on stocks under NAFO management.

13. For the cod stock in Divisions 2J+3KL, the Scientific Council is requested to comment on the trends in biomass and state of the stock in the most recent Science Advisory Report from the Canadian Science Advisory Secretariat.

14. Taking note that recent point estimates for 3NO Witch flounder of the Canadian Autumn survey are 2-3 times higher than in 1994 when the moratorium was first implemented and are among the highest in the times series ,

and while more variable the recent point estimates of the Canadian Spring survey are abut 50% higher than in 1994:

a) What are the relative strengths and weaknesses of all the indices of abundance of witch?

b) What are plausible reasons for different abundance trends in the spring and autumn surveys of the SAME STRATA, and what are the rationales to support either set of results over the other?

c) How might the confidence intervals around the point estimates over the time series affect the interpretations of stock trend and current status?

d) What evidence exists (if any) to indicate whether any changes in natural mortality have occurred since the early 1990's, e.g. condition of the fish?

e) Is it plausible there may be a different survey catchability for younger/smaller fish relative to older/larger fish (applicable to witch flounder), and how might this affect our interpretation of stock trends and status?

f) What might be reasonable options for reference point proxies, with associated rationale, including those based on one or a combination of survey indices?

15. As per the recommendation outlined in the report of the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystems adopted in September 2011, the Fisheries Commission requests the Scientific Council to produce a detailed list of VME indicator species and possibly other VME elements.

16. Given the progress made by Scientific Council on the development of the GIS model for the evaluation of bycatch thresholds for sponges as requested by Fisheries Commission in its 2010 Annual Meeting, and mindful of the need for further refining this modelling framework, as well as exploring its potential utility for its application to other VME-defining species, Fisheries Commission requests the Executive Secretary to provide to the Scientific Council anonymous VMS data in order to further develop the current sponge model as requested by the Fisheries Commission in 2010 and to assess the feasibility of developing similar models for other VME-defining species(e.g. corals).

17. Fisheries Commission requests the Scientific Council to make recommendations for encounter thresholds and move on rules for groups of VME indicators including sea pens, small gorgonian corals, large gorgonian corals, sponge grounds and any other VME indicator species that meet the FAO Guidelines for VME and SAI. Consider thresholds for 1) inside the fishing footprint and outside of the closed areas and 2) outside the fishing footprint in the NRA, and 3) for the exploratory fishing area of seamounts if applicable.

18. Noting Article 4bis (now Article 12 in the 2012 NCEM) - Assessment of bottom fishing of the NAFO Conservation and Enforcement measures. “ The Scientific Council, with the co-operation of Contracting Parties, shall identify, on the basis of best available scientific information, vulnerable marine ecosystems in the Regulatory Area and map sites where these vulnerable marine ecosystem are known to occur or likely to occur and provide such data and information to the Executive Secretary for circulation to all Contracting Parties”.

    The Fisheries Commission requests the Scientific Council to produce a comprehensive map of the location of VME indicator species and elements in the NRA as defined in the FAO International Guidelines for the Management of Deep Sea Fisheries in the High Seas. This includes canyon heads and spawning grounds and any other VME not protected by the current closures to protect coral and sponge. This will be used by Contracting Parties to complete impact assessments

19. As stated in the "Reassessment of the Impact of NAFO Managed Fisheries on known or Likely Vulnerable Marine Ecosystems" (NAFO FC WP 11/24), the Scientific Council in collaboration with the Working Group of Fishery Managers and Scientists on Vulnerable Marine Ecosystem will conduct a reassessment of NAFO bottom fisheries by 2016 and every 5 years thereafter. In preparation for reassessments, the Fisheries Commission requests the Scientific Council to develop a workplan for completing the initial reassessment and identifying the resources and information to do so.

Annex1 – Additional guidance in regards to questions 1 and 2.

Mindful of the desire to move to a risk-based approach in the management of fish stocks, Fisheries Commission requests the Scientific Council to provide a range of management options as well as a risk analysis for each option as outlined in the provisions below, rather than a single TAC recommendation.

1. The Fisheries Commission request the Scientific Council to consider the following in assessing and projecting future stock levels for those stocks listed above. These evaluations should provide the information necessary for the Fisheries Commission to consider the balance between risks and yield levels, in determining its management of these stocks:

   a) The preferred tool for the presentation of a synthetic view of the past dynamics of an exploited stock and its future development is a stock assessment model, whether age-based or age-aggregated.

   b) For those stocks subject to analytical-type assessments, the status of the stocks should be reviewed and catch options evaluated in terms of their implications for fishable stock size in both the short and long term. As general reference points, the implications of fishing at $F_{0.1}$ and F_{2011} in 2013 and subsequent years should be evaluated. The present stock size and spawning stock size should be described in relation to those observed historically and those expected in the longer term under this range of options.

   c) For those stocks subject to general production-type assessments, the time series of data should be updated, the status of the stock should be reviewed and catch options evaluated in the way described above to the extent possible. In this case, the level of fishing effort or fishing mortality (F) required to take two-thirds MSY catch in the long term should be calculated.

   d) For those resources for which only general biological and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of management requirements for long-term sustainability and the advice provided should be consistent with the precautionary approach.

   e) Spawning stock biomass levels considered necessary for maintenance of sustained recruitment should be recommended for each stock, defined in relation to both long-term productivity regimes, and current productivity regimes to the extent these may differ. In those cases where present spawning stock size is a matter of scientific concern in relation to the continuing reproductive potential of the stock, options should be offered that specifically respond to such concerns.

   f) Information should be provided on stock size, spawning stock sizes, recruitment prospects, fishing mortality, catch rates and catches implied by these management strategies for the short and the long term in the following format:

      I. For stocks for which analytical-type assessments are possible, graphs should be provided of all of the following for the longest time-period possible:

      - historical yield and fishing mortality;

- spawning stock biomass and recruitment levels;
- catch options for the year 2013 and subsequent years over a range of fishing mortality rates (for as many years as the data allow)
- (F) at least from $F_{0.1}$ to F_{max};
- spawning stock biomass corresponding to each catch option;
- yield-per-recruit and spawning stock per recruit values for a range of fishing mortalities.

II. For stocks for which advice is based on general production models, the relevant graph of production as a function of fishing mortality rate or fishing effort should be provided. Age aggregated assessments should also provide graphs of all of the following for the longest time period possible:

- exploitable biomass (both absolute and relative to B_{MSY})
- yield/biomass ratio as a proxy for fishing mortality (both absolute and relative to F_{MSY})
- estimates of recruitment from surveys, if available.

III. Where analytical methods are not attempted, the following graphs should be presented, for one or several surveys, for the longest time-period possible:

- time trends of survey abundance estimates, over:
- an age or size range chosen to represent the spawning population
- an age or size-range chosen to represent the exploited population
- recruitment proxy or index for an age or size-range chosen to represent the recruiting population.
- fishing mortality proxy, such as the ratio of reported commercial catches to a measure of the exploited population.

For age-structured assessments, yield-per-recruit graphs and associated estimates of yield-per-recruit based reference points should be provided. In particular, the three reference points, actual F, $F_{0.1}$ and F_{max} should be shown.

2. Noting the Precautionary Approach Framework as endorsed by Fisheries Commission, the Fisheries Commission requests that the Scientific Council provide the following information for the Annual Meeting of the Fisheries Commission for all stocks under its responsibility requiring advice:

a) the limit and precautionary reference points as described in Annex II of the UN Fisheries Agreement indicating areas of uncertainty (for those stocks for which precautionary reference points cannot be determined directly, proxies should be provided);

b) the stock biomass and fishing mortality trajectory over time overlaid on a plot of the PA Framework (for those stocks where biomass and/or fishing mortality cannot be determined directly, proxies should be used);

c) information regarding the current Zone the stock is within as well as proposals regarding possible harvest strategies which would move the resource to (or maintain it in) the Safe Zone, including medium term considerations and associated risk or probabilities which will assist the Commission in developing the management strategies described in paragraphs 4 and 5 of Annex II in the Agreement.

3. The following elements should be taken into account by the Scientific Council when considering the Precautionary Approach Framework:

a) References to “risk” and to “risk analyses” should refer to estimated probabilities of stock population parameters falling outside biological reference points.

b) Where reference points are proposed by the Scientific Council as indicators of biological risk, they should be accompanied by a description of the nature of the risk associated with crossing the reference point such as recruitment overfishing, impaired recruitment, etc.

c) When a buffer reference point is identified in the absence of a risk evaluation in order to maintain a low probability that a stock, measured to be at the buffer reference point, may actually be at or beyond the limit reference point, the Scientific Council should explain the assumptions made about the uncertainty with which the stock is measured.

d) Wherever possible, short and medium term consequences should be identified for various exploitation rates (including no fishing) in terms of yield, stability in yield from year to year, and the risk or probability of maintaining the stock within, or moving it to, the Safe Zone. Whenever possible, this information should be cast in terms of risk assessments relating fishing mortality rates to the trends in biomass (or spawning biomass), the risks of stock collapse and recruitment overfishing, as well as the risks of growth overfishing, and the consequences in terms of both short and long term yields.

e) When providing risk estimates, it is very important that the time horizon be clearly spelled out. By way of consequence, risks should be expressed in timeframes of 5, 10 and 15 years (or more), or in terms of other appropriate year ranges depending on stock specific dynamics. Furthermore, in order to provide the Fisheries Commission with the information necessary to consider the balance between risks and yield levels, each harvesting strategy or risk scenario should include, for the selected year ranges, the risks and yields associated with various harvesting options in relation to B_{lim}.

Annex 2. Canadian Request for Scientific Advice on Management in 2013 of Certain Stocks in Subareas 0 to 4

Canada requests that the Scientific Council, at its meeting in advance of the 2012 Annual Meeting of Northwest Atlantic Fisheries Organization, subject to the concurrence of Denmark (on behalf of Greenland), provide advice on the scientific basis for management in 2013 of the following stocks:

1. Greenland halibut (Subareas 0 and 1)

The Scientific Council has noted previously that there is no biological basis for conducting separate assessments for Greenland halibut throughout Subareas 0-3, but has advised that separate Total Allowable Catch be maintained for different areas of the distribution of Greenland halibut.

a) The Council is therefore, subject to the concurrence of Denmark (on behalf of Greenland) as regards Subarea 1, to provide an overall assessment of status and trends in the total stock area throughout its range and comment on its management in Subareas 0+1 for 2013, and to specifically advise on appropriate Total Allowable Catch levels for 2013, separately, for Greenland halibut in the offshore area of Divisions 0A+1AB and Divisions 0B+1C-F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.

b) Recognizing that only general biological advice and/or catch data are available, few standard criteria exist on which to base advice and risk implications. The stock status should be evaluated in the context of the management requirements for long-term sustainability and management options should be provided in risk-based terms. The Scientific Council is therefore asked to provide risk implications, to the extent possible, for a range of total allowable catch options, from -5% to +15% of the current total allowable catch.

c) Presentation of the results should include the following:

- a graph of historical catch for the longest time period possible;
- a graph of the biomass index for the longest time period possible; and
- any other graph the Scientific Council feels is relevant.

2. Shrimp (Divisions 0A and Subarea 1)

Canada requests the Scientific Council to consider the following options in assessing and projecting future stock levels for Shrimp in Subareas 0 and 1:

a) The status of the stock should be reviewed and management options evaluated in terms of their implications for fishable stock size, spawning stock size, recruitment prospect, catch rate and catch in both the short and long term. The implications of catch options ranging from 50,000 t to the catch corresponding to Z_{msy}, in 10,000 t increments, should be forecast for 2013 through 2017 if possible, and evaluated in relation to precautionary reference points of both mortality and fishable stock biomass. The present stock size and fishable stock size should be described in relation to those observed historically and those to be expected in the longer term under this range of fishing mortalities, and any other options Scientific Council feels worthy of consideration.

b) Management options should be provided within the Northwest Atlantic Fisheries Organization Precautionary Approach Framework. Uncertainties in the assessment should be evaluated and presented in the form of risk analyses related to the limit reference points of B_{lim} and Z_{MSY}.

c) Presentation of the results should include the following:

- a graph and table of historical yield and fishing mortality for the longest time period possible;
- a graph of biomass relative to B_{msy},and recruitment levels for the longest time period possible.

- a graph of the stock trajectory compared to B_{lim} and/or B_{MSY} and Z_{MSY};

- graphs and tables of total mortality (Z) and fishable biomass for a range of projected catch options (as noted in 2 a) for the years 2013 to 2017 if possible. Projections should include both catch options and a range of cod biomass levels considered appropriate by SC. Results should include risk analyses of falling below B_{MSY} and B_{lim}, and of exceeding Z_{MSY};

- a graph of the total area fished for the longest time period possible; and

- any other graph or table the Scientific Council feels is relevant.

NOTE**:** With respect to shrimp, it is recognized that the Council may, at its discretion, delay providing advice until later in the year, taking into account data availability, predictive capability, and the logistics of additional meetings.

Annex 3. Denmark (Greenland) Request for Scientific Advice on Management in 2013 of Certain Stocks in Subarea 0 and 1

Denmark (on behalf of Greenland) request Advice from Scientific Council on Management in 2013 of Certain Stocks in Subarea 0 and 1

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.

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.

3. Subject to the concurrence of Canada as regards Subareas 0 and 1, the Scientific Council is requested to provide advice on appropriate TAC levels for 2013 separately for Greenland halibut in:

a) The offshore area of NAFO Division 0A and Division 1A plus Division 1B

b) NAFO Division 0B plus Divisions 1C-1F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.

4. Advice for Greenland halibut in Division 1A inshore was in 2010 given for 2011-2012. Denmark (on behalf of Greenland), requests the Scientific Council for advice for Greenland halibut in Division 1A inshore for 2013-2014.

5. Subject to the concurrence of Canada as regards Subarea 0 and 1, Denmark (on behalf of Greenland) further requests the Scientific Council, before December 2012, provide advice on the scientific basis for management of Northern shrimp (Pandalus borealis) in Subarea 0 and 1 in 2013 and for as many years ahead as data allows for.

6. Furthermore, the Scientific Council is in cooperation with ICES requested to provide advice on the scientific basis for management of Northern shrimp (Pandalus borealis) in Denmark Strait and adjacent waters east of southern Greenland in 2013 and for as many years ahead as data allows.

Additional Request

7. With respect to a condition imposed by the Marine Stewardship Council on its certification of the Northern shrimp (*Pandalus borealis*) fishery, Scientific Council is requested to include in its advisory document a summary that shows how the harvest control rule specified in the management plan is being applied to generate the desired exploitation consistent with NAFO advice.

Annex 4. ICES ToRs for NIPAG

From 2011 ACOM and ACOM Expert Group ToR's
(http://ices.dk/iceswork/recs/2011%20Resolutions/ACOM%20Resolutions%202011.pdf)

Generic ToRs for Regional and Species Working Groups The following ToRs apply to: AFWG, HAWG, NWWG, NIPAG, WGWIDE, WGBAST, WGBFAS, WGNSSK, WGCSE, WGDEEP, WGHMM, WGEF and WGHANSA.

The working group should focus on:

ToRs a) to g) for stocks that will have advice (or biennial first year),

ToRs b) to d) and f) for stocks with biennial advice in the second year

a) Produce a first draft of the advice on the fish stocks and fisheries under considerations according to ACOM guidelines and implementing the generic introduction to the ICES advice (Section 1.2).

b) Update, quality check and report relevant data for the working group:

   i) Load fisheries data on effort and catches (landings, discards, bycatch, including estimates of misreporting when appropriate) in the INTERCATCH database by fisheries/fleets. Data should be provided to the data coordinators at deadlines specified in the ToRs of the individual groups. Data submitted after the deadlines can be incorporated in the assessments at the discretion of the Expert Group chair;

   ii) Abundance survey results;

   iii) Environmental drivers.

   iv) Propose specific actions to be taken to improve the quality of the data (including improvements in data collection). Where relevant suggest improvement for the revision of the DCF.

c) Produce an overview of the sampling activities on a national basis based on the INTERCATCH database and report the use of InterCatch;

d) In cooperation with the Secretariat, update the description of major regulatory changes (technical measures, TACs, effort control and management plans) and comment on the potential effects of such changes including the effects of newly agreed management and recovery plans. Describe the fleets that are involved in the fishery.

e) For each stock update the assessment by applying the agreed assessment method (analytical, forecast or trends indicators) as described in the stock annex. If no stock annex is available this should be prepared prior to the meeting.

f) Produce a brief report of the work carried out by the Working Group. This report should summarise for the stocks and fisheries where the item is relevant:

   i) Input data (including information from the fishing industry and NGO that is pertinent to the assessments and projections);

   ii) Where misreporting of catches is significant, provide qualitative and where possible quantitative information and describe the methods used to obtain the information;

   iii) Stock status and catch options for next year;

   iv) Historical performance of the assessment and brief description of quality issues with the assessment;

   v) Mixed fisheries overview and considerations;

   vi) Species interaction effects and ecosystem drivers;

   vii) Ecosystem effects of fisheries;

   viii) Effects of regulatory changes on the assessment or projections;

g) In the autumn, where appropriate, check for the need to reopen the advice based on the summer survey information and the guidelines in AGCREFA2 (2012 report).

NIPAG – Joint NAFO/ICES Pandalus Assessment Working Group

2011/2/ACOM15 The **Joint NAFO/ICES *Pandalus* Assessment Working Group** (NIPAG), chaired by Peter Shelton, Canada (ICES) and Jean-Claude Mahé, France (NAFO), will meet at IMR in Tromsø, Norway, 17–24 October 2012 to:

a) Address generic ToRs for Fish Stock Assessment Working Groups (see table below);

b) Consider shrimp stocks as decided by NAFO Sc. C.

c) Compile, update, analyse and document time-series of bycatches in the shrimp fishery

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. This will be coordinated as indicated in the table below. Material and data relevant for the meeting must be available to the group no later than 14 days prior to the starting date.

NIPAG will report by 29 **October 2012 on the ICES shrimp stocks for the attention of** ACOM.

Fish Stock	Stock Name	Stock Coordinator	Assessment Coord. 1	Assessment Coord. 2	Perform assessment	Advice
pand-barn	Northern Shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea)	Norway	Norway	Norway	Y	Update
pand-sknd	Northern shrimp (*Pandalus borealis*) in Division IIIa West and Division IVa East (Skagerrak and Norwegian Deeps)	Denmark	Norway	Sweden	Y	Update
pand-flad	Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)	Denmark	Denmark	Denmark	Y	Same advice as last year

LIST OF RESEARCH AND SUMMARY DOCUMENTS, 2012

SCR Documents

Doc No.	Serial No	Author	Title
SCR 12/001	withdrawn		
SCR 12/002	N6017	Mads Hvid Ribergaard	Oceanographic Investigations off West Greenland 2011
SCR 12/003	N6020	O.A. Jørgensen	Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2011
SCR 12/004	N6026	D. Hebert, R. G. Pettipas and B. Petrie	Physical Oceanographic Conditions on the Scotian Shelf and in the eastern Gulf of Maine (NAFO areas 4V,W,X) during 2011
SCR 12/005	N6029	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 1982-2011
SCR 12/006	N6030	Esther Román, Ángeles Armesto and Diana González-Troncoso	Results for the Spanish Survey in the NAFO Regulatory Area of Division 3L for the period 2003-2011
SCR 12/007	N6031	G. Maillet, P. Pepin, C. Johnson, B. Casault, C. Caverhill, S. Fraser, G. Harrison, H. Maass, C. Porter, G. Redmond, T. Shears, J. Spry	Biological and Chemical Oceanographic Conditions on the Newfoundland and Labrador Shelf, Grand Banks, Scotian Shelf, and the Gulf of Maine During 2011
SCR 12/008	N6032	A. Akimova and B. Cisewski	Hydrographic conditions off West Greenland in 2011.
SCR 12/009	N6033	E. B. Colbourne, J. Craig, C. Fitzpatrick, D. Senciall, P. Stead and W. Bailey	An Assessment of the Physical Oceanographic Environment on the Newfoundland and Labrador Shelf in NAFO Subareas 2 and 3 during 2011
SCR 12/010	N6034	Esther Román, Concepción González-Iglesias and Diana González-Troncoso	Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2011
SCR 12/011	N6035	J. Brattey, B. P. Healey, D. Parsons, E. Murphy, D. Power, M. J. Morgan, and K. Dwyer	Update on trends in biomass and state of the stock of northern (2J+3KL) cod
SCR 12/012	N6036	Diana González-Troncoso, Esther Román and Xabier Paz	Results for Greenland halibut, American plaice and Atlantic cod of the Spanish survey in NAFO Div. 3NO for the period 1997-2011
SCR 12/013	N6037	Bruce Bradshaw, Luc Bujold, Diana Cardoso, Graham Glenn, Claude Guay, Mathieu Ouellet, Krista Sun	Integrated Science Data Management NAFO Report 2012
SCR 12/014	N6038	Diana González-Troncoso, Elena Guijarro-Garcia and Xabier Paz	Yellowtail flounder, redfish (*Sebastes* spp) and witch flounder indices from the Spanish Survey conducted in Divisions 3NO of the NAFO Regulatory Area
SCR 12/015	N6039	Diana González-Troncoso, Elena Guijarro and Xabier Paz	Biomass and length distribution for roughhead grenadier, thorny skate and white hake from the surveys conducted by Spain in NAFO 3NO

SCR 12/016	N6040	Rasmus Nygaard and Ole A. Jørgensen	Biomass and Abundance of Demersal Fish Stocks off West Greenland Estimated from the GINR Shrimp Fish Survey, 1988-2011.
SCR 12/017	N6041	K.S. Dwyer, B.P. Healey, and M.J. Morgan, and R. M. Rideout	Investigations into ADAPT formulations for estimation of F_{ratio} (F between plus group and the last true age) for American plaice in Div. 3LNO
SCR 12/018	N6042	I. Yashayaev and B.J.W. Greenan	Environmental Conditions in the Labrador Sea during 2011
SCR 12/019	N6043	B.P. Healey, W.B. Brodie, D.W. Ings, and D.J. Power	Performance and description of Canadian multi-species surveys in NAFO subarea 2 + Divisions 3KLMNO, with emphasis on 2009-2011.
SCR 12/020	N6044	Fernando González-Costas and Diana González-Troncoso	Biological Reference Points for Cod 3NO
SCR 12/021	N6045	Fernando González-Costas	Spanish fisheries in NAFO Subarea 3
SCR 12/022	N6046	Paramonov V.V., Korzun Yu.V., Rebik S.T., Kukharev N. N.	On historical experience of the Ukraine fishery in the Northwest Atlantic
SCR 12/023	N6047	M. A. Treble	Analysis of data from a trawl survey in NAFO Division 0B
SCR 12/024	N6050	M. Joanne Morgan Dolores Garabana and Fran Saborido-Rey	Distribution of spawning and sex ratio in Greenland halibut
SCR 12/025	N6051	Adriana Nogueira Gassent, Xabier Paz and Diana González-Troncoso	Persistence and Variation on the Groundfish Assemblages on the Southern Grand Banks (NAFO Divisions 3NO): 2002-2011
SCR 12/026	N6052	Antonio Vázquez	Results from Bottom Trawl Survey on Flemish Cap of July 2011
SCR 12/027	N6053	González Iglesias, C., González–Costas, F and González–Troncoso, D.	Atlantic cod predation on redfish in Flemish Cap
SCR 12/028	N6054	M.R. Simpson and C.M. Miri	Assessment of Thorny Skate (*Amblyraja radiata* Donovan, 1808) in NAFO Divisions 3LNO and Subdivision 3Ps
SCR 12/029	N6055	Carina Gjerdrum, Karel Allard, and François Bolduc	Pelagic seabird monitoring and research in the northwest Atlantic
SCR 12/030	N6056	B. P. Healey	Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Subarea 2 and Divisions 3KLMNO: Stock Trends based on annual Canadian Research Vessel survey results during 1978-2011
SCR 12/031	N6057	O.A. Jørgensen and M. A. Treble	Assessment of the Greenland Halibut Stock Component in NAFO Subarea 0 + Division 1A Offshore + Divisions 1B-1F
SCR 12/032	N6059	A. M. Ávila de Melo, R. Alpoim, and Diana González Troncoso	An ASPIC Based Assessment of Redfish (S. mentella and S. fasciatus) in NAFO Divisions 3LN (can a surplus production model cope with bumpy survey data?)
SCR 12/033	N6060	K.S. Dwyer, M.J. Morgan, D. Maddock Parsons, W.B. Brodie, B.P. Healey, and R. Rideout	An assessment of American plaice in NAFO Div. 3LNO

SCR 12/034	N6061	M. Joanne Morgan	Bayesian surplus production models applied to American plaice in NAFO Div. 3LNO
SCR 12/035	N6062	Antonio Vázquez and Mónica Mandado	A stochastic VPA of the Flemish Cap cod stock
SCR 12/036	N6063	Rasmus Nygaard and Jesper Boje	An Assessment of the Greenland Halibut Stock Component in NAFO Division 1A Inshore
SCR 12/037	N6064	Diana González-Troncoso1,Carsten Hvingel, Antonio Vázquez and Fran Saborido	Assessment of the Cod Stock in NAFO Division 3M
SCR 12/038	N6065	Vinnichenko V.I., Fomin K.Yu., Pochtar M.V.,	Some Results from Russian Studies on Diet of Redfishes (*Sebastes* spp.) and Cod (*Gadus morhua*) on the Flemish Cap
SCR 12/039	N6066	Antonio Vázquez	On recruitment of the Flemish Cap cod stock
SCR 12/040	N6069	D. Maddock Parsons	Update on the distribution and abundance of witch flounder (*Glyptocephalus cynoglossus)* on the Flemish Cap and in the Flemish Pass based on Canadian and EU research vessel surveys 2003-2011
SCR 12/041	N6070	M. Joanne Morgan and P.A. Shelton	Evaluation of an alternative harvest control rule for 3LNO American plaice
SCR 12/042	N6075	J.M. Casas Sánchez	Division 3M Northern shrimp (*Pandalus borealis*) – Interim Monitoring Update
SCR 12/043	N6076	D.C. Orr and D.J. Sullivan	Divisions 3LNO Northern Shrimp (*Pandalus borealis*) – Interim Monitoring Update
SCR 12/044	N6099	Michael C.S. Kingsley, Helle Siegstad and Kai Wieland	The West Greenland trawl survey for Pandalus borealis, 2012, with reference to earlier results
SCR 12/045	N6106	Michael C.S. Kingsley and Nanette Hammeken Arboe	Catch Table Update for the West Greenland Shrimp Fishery
SCR 12/046	N6107	Michael C. S. Kingsley	A Provisional Assessment of the Shrimp Stock off West Greenland in 2012
SCR 12/047	N6108	D. C. Orr and D. J. Sullivan	The 2012 assessment of the Northern Shrimp (*Pandalus borealis*, Kroyer) resource in NAFO Divisions 3LNO
SCR 12/048	N6109	Nanette Hammeken Arboe	The Fishery for Northern Shrimp (*Pandalus borealis*) off West Greenland, 1970–2012
SCR 12/049	N6111	C. Hvingel	Shrimp (*Pandalus borealis*) in the Barents Sea – Stock assessment 2012
SCR 12/050	N6112	C. Hvingel and T. Thangstad	Research survey information regarding northern shrimp (*Pandalus borealis*) in the Barents Sea and Svalbard area 2004-2012
SCR 12/051	N6113	Carsten Hvingel and Trude Thangstad	The Norwegian fishery for northern shrimp (Pandalus borealis) in the Barents Sea and round Svalbard 1970-2012
SCR 12/052	N6114	J. M. Casas	Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2012

SCR 12/053	N6115	J. M. Casas	Northern Shrimp (*Pandalus borealis*) on Flemish Cap Surveys 2012
SCR 12/054	N6116	J. M. Casas	The Spanish Shrimp Fishery on NAFO area (Division 3L) in 2011
SCR 12/055	N6117	González Iglesias, C. and Casas, J. M.	Atlantic Cod Predation on Northern shrimp in Flemish Cap (NAFO Div. 3M)
SCR 12/056	N6118	Casas, J.M., E. Román, J. Teruel, and G. Ramilo	Northern Shrimp (*Pandalus borealis*, Krøyer) from Spanish Bottom Trawl Survey 2012 in NAFO Div. 3LNO
SCR 12/057	N6119	Anja Retzel	A preliminary estimate of Atlantic cod (*Gadus morhua*) biomass in West Greenland offshore waters (NAFO Subarea 1) for 2012 and recent changes in the spatial overlap with Northern shrimp (*Pandalus borealis*)
SCR 12/058	N6120	Silver Sirp	Estonian Shrimp Fishery in 3L in 2010-2012
SCR 12/059	N6121	G. Søvik and T. Thangstad	Results of the Norwegian Bottom Trawl Survey for Northern Shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east) in 2012
SCR 12/060	N6122	Zakharov D.V. and Lyubin P.A.	Results of Russian investigations of the northern shrimp in the Barents Sea in 2004-2012
SCR 12/061	N6123	Anders Nielsen, Sten Munch-Petersen, Ole Eigaard, Sovik Guldborg, and Mats Ulmestrand	A stochastic length-based assessment model for the Pandalus stock in Skagerrak and the Norwegian Deep
SCR 12/062	N6124	Helle Siegstad	Results of the Greenland Bottom Trawl Survey for Northern shrimp (*Pandalus borealis*) Off East Greenland (ICES ubarea XIV b), 2008-2012
SCR 12/063	N6125	Nanette Hammeken Arboe and Helle Siegstad	The Fishery for Northern Shrimp (*Pandalus borealis*) in Denmark Strait / off East Greenland – 2012
SCR 12/064	N6126	G. Søvik and T. Thangstad	The Norwegian Fishery for Northern Shrimp (Pandalus borealis) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east), 1970-2012
SCR 12/065	N6127	M. Ulmestrand, O. Eigaard, G. Søvik and Sten Munch-Petersen	The Northern shrimp (Pandalus borealis) Stock in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa East)
SCR 12/066	N6128	Carsten Hvingel	North Sea Pandalus benchmark stock assessment - a Bayesian surplus production model
SCR 12/067	N6135	Pepin	Ecoregions
SCR 12/068	N6136	Francisco Saborido-Rey and Alfonso Pérez-Rodríguez	Food consumption of Flemish Cap cod *Gadus morhua* and redfish *Sebastes* sp. using generic bioenergetic models

SCS Documents

Doc No.	Serial No	Author	Title
SCS 12/01	N6009		FC Request for Advice
SCS 12/02	N6010		Report of the NAFO ad hoc Working Group on Exceptional Circumstances, January – April 2012
SCS 12/03	N6012		Greenland Request for Advcie
SCS 12/04	N6013		Canada Request for Advcie
SCS 12/05	N6018	M. Pochtar and K. Fomin	Russian Research Report for 2011
SCS 12/06	N6019	S.Sirp	Estonian Research Report for 2011
SCS 12/07	N6021	K.A. Sosebee	United States Research Report for 2011
SCS 12/08	N6022	J. Vargas, R. Alpoim, E. Santos and A. M. Ávila de Melo	Portuguese Research Report for 2011
SCS 12/09	N6023	F. González-Costas, D. González-Troncoso, G. Ramilo, E. Román, J. Lorenzo, M. Casas, C. Gonzalez, A. Vázquez, and M. Sacau	Spanish Research Report for 2011
SCS 12/10	N6024	Greenland Institute of Natural Resources	Denmark/Greenland Research Report for 2011
SCS 12/11	N6025	NAFO Secretariat	Biological Sampling for 2011
SCS 12/12	N6027		Report of the catch estimation working group meeting
SCS 12/13	N6028	H. O. Fock and A. Akimova	German Research Report for 2011
SCS 12/14	6048	N. D. Templeman, Margaret Treble, Tim Siferd and Bill Brodie	Canadian Research Report
SCS 12/15	N6049	NAFO Secretariat	Tagging
SCS 12/16	N6058		Report of the NAFO Scientific Council Working Group on Reproductive Potential
SCS 12/17	N6067	Garry B. Stenson	Report of the Joint NAFO/ICES Working Group on Harp and Hooded Seals (WGHARP)
SCS 12/18	N6068	Odd Aksel Bergstad	Report to the NAFO Scientfic Council - ICES/NAFO Joint Working Group on Deep-water Ecology (WGDEC)
SCS 12/19	N6072	NAFO	Report of the Scientific Council, 1-14 June 2012
SCS 12/20	N6077	NAFO	Report of the Scientific Council, 27 August – 7 September 2012
SCS 12/21	N6079		Available Data from the Commercial Fisheries Related to Stock Assessment (2010) and Inventory of Biological Surveys Conducted in the NAFO Area in 2010 and Biological Surveys Planned for 2011 and Early-2012
SCS 12-22	N6100	NAFO	Report of the Scientific Council, 17-21 September 2012
SCS 12/23	N6132	NAFO	Report of NIPAG, 17-24 October 2012

SCS 12/24	N6133	NAFO	Report of the Scientific Council, 17-21 October 2012
SCS 12/25	N6134		Year-to-Year Survey Information
SCS 12/26	N6137	WGEAFM	Report of the WGEAFM Meeting, 21-20 November 2012

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A – 1-14 Jun
B – 27 Aug – 7 Sep
C – 17-21 Sep
D – 17-24 Oct

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LIST OF RECOMMENDATIONS

Scientific Council 1-14 June 2012

FISHERIES ENVIRONMENT

The Council **adopted** the Report of the Standing Committee on Fisheries Environment (STACFEN), as presented by the Chair, Gary Maillet. The full report of STACFEN is in Appendix I.

The recommendations made by STACFEN for the work of the Scientific Council as **endorsed** by the Council, are as follows:

STACFEN **recommended** *input from Scientific Council for development of new time series and data products and to identify candidate species that could be evaluated in relation to the environment*.

STACFEN **recommended** that *consideration of support for one invited speaker to address emerging issues and concerns for the NAFO Convention Area during the June Meeting*.

PUBLICATIONS

The Council **adopted** the Report of the Standing Committee on Publication (STACPUB) as presented by the Chair, Margaret Treble. The full report of STACPUB is in Appendix II.

The recommendations made by STACPUB for the work of the Scientific Council as **endorsed** by the Council, are as follows:

STACPUB **recommended** that *an obituary be included in Volume. 44 of* the *Journal of the Northwest Atlantic Fishery Science for Spanish scientist, Dr. Laranneta, in English and Spanish*.

STACPUB **recommended** that the *Secretariat make further enquiries into how authorship is assigned (i.e. actual vs. corporate) when entering NAFO SC documents into the ASFA database in order to ensure that they can be located when searching using the actual authors name.*

STACPUB **recommended** that *digitizing the Sampling Yearbooks would be necessary, but not urgent*.

STACPUB **recommended** that *the Secretariat look to see if options for the current map projection are available and bring this to the next June meeting*.

STACPUB **recommended** that *a comprehensive and concise style sheet be followed for the Journal of Northwest Atlantic Fishery Science.*

STACPUB **recommended** that *the Secretariat initiate a review of the Scientific Council Reports format and to present to Scientific Council in September 2012 examples of format changes and information on whether a two volume approach would be a reasonable option to address concerns about the growing size of the Report.*

X. MEETING REPORTS

1. Working Group on EAFM, December 2011

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.*

STACFIS

4. Redfish in SA 1

d) Research Recommendations

STACFIS **recommended** that *the species composition and quantity of redfish discarded in the shrimp fishery in SA 1 be further investigated*.

STATUS: No progress in 2011. This recommendation is reiterated.

5a. Wolffish in Subarea 1

d) Research Recommendation

Noting the change in the request for other finfish STACFIS **recommended** that *the species composition and quantity of wolffish discarded in the shrimp fishery in SA1 be further investigated*.

STATUS: No progress

Noting the change in the request for other finfish STACFIS **recommended** that *the distribution of wolffish in relation to the main shrimp-fishing grounds in SA1 be investigated, in order to further discover means of reducing the amount of discarded bycatch*.

STATUS: No progress and this recommendation is reiterated.

5b. American plaice in Subarea 1

d) Research Recommendation

STACFIS **recommended** that *the species composition and quantity of American plaice and other fish species discarded in the shrimp fishery in SA1 be further investigated.*

STATUS: No progress and this recommendation is reiterated.

STACFIS **recommended** that *the distribution of these species in relation to the main shrimp-fishing grounds in SA1 be investigated, in order to further discover means of reducing the amount of discarded bycatch*.

STATUS: No progress

6. Cod in Div. 3M

j) Research recommendations

For Cod in Div. 3M STACFIS **recommended** that *an age reader comparison exercise be conducted*.

STATUS: No progress and this recommendation is reiterated.

For Cod in Div. 3M STACFIS **recommended** that *the most recent catch at age figures be revised*.

7. Redfish in Div. 3M

d) Research recommendations

For redfish in Div. 3M STACFIS reiterated its **recommendation** that *the important line of ecosystem research based on the feeding sampling routine of the EU survey catch be done on an annual basis*.

8. American plaice in Div. 3M

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 (for all): Work is been done but no progress to report. All recommendations will be addressed during the next full assessment

10. Redfish in Div. 3LN

e) Research Recommendations

For redfish in Div. 3LN STACFIS **recommended** that*, in order to prevent increasing unfitness of the ASPIC model to most recent survey data, alternate age based models be explored with the existing data. To undertake such type of assessment Div. 3LN redfish age length keys for the 1990s and 2000s should be provided*.

For redfish in Div. 3LM STACFIS also **recommended***, in order to allow the fitness of the ASPIC model to the full length of the main survey series, the review of appropriate methods to recalculate survey indices*.

13. Witch flounder in Div. 3NO

d) Research Recommendation

STACFIS **recommended** *further investigation of recruitment trends for witch flounder in Div. 3NO. This should include analysis of trends in abundance in the survey series, as well as examination of areal distribution of small witch flounder, particularly in years where deeper strata are covered by surveys*. STACFIS noted that analyses of recruitment will rely on length frequency data, as no ageing has been conducted on this stock since the early 1990s.

STATUS: Some analysis has been started, but there is no progress to report at this time. This recommendation is reiterated.

14. Capelin in Div. 3NO

f) Research recommendations

STACFIS reiterates its **recommendation** *that initial investigations to evaluate the status of capelin in Div. 3NO should utilize trawl acoustic surveys to allow comparison with the historical time series.*

17. White hake in Div. 3NOPs

d) Research Recommendations

STACFIS **recommended** that *the genetic analyses of Div. 3NO versus Subdiv. 3Ps be continued; in order to help determine whether Div. 3NOPs White Hakes comprise a single breeding population*.

STATUS: Genetic studies are completed and results will be presented during the next full assessment therefore this recommendation is reiterated.

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2011+); thereby allowing age-based analyses of this population*.

STATUS: Otoliths are being collected but have yet to be aged. This recommendation is reiterated

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *survey conversion factors between the Engel and Campelen gear be investigated for this stock*.

STATUS: No progress to date. This recommendation is reiterated.

For White hake in Div. 3NO and Subdiv. 3Ps STACFIS **recommended** that *the maturity time series be analyzed to investigate any potential annual changes in maturity*.

STATUS: No progress to date. This recommendation is reiterated.

18. Roughhead grenadier in SA 2+3

d) Research Recommendation

In 2010 STACFIS recommended that *further investigation on recruitment indices for roughhead grenadier in Subarea 2 and 3 will be carried out.*

STATUS: New information was not available in this matter.

In 2011 STACFIS recommended *to study the possibility of including in future assessments all surveys series for roughhead grenadier before 1995.*

STATUS: New information was not available in this matter.

Both recommendations will be addressed next year during the full assessment.

20. Greenland halibut in SA 2 + Div. 3KLMNO

f) Research Recommendations

STACFIS **recommended** *ongoing investigations into the assessment methods used*. This should include further explorations with the statistical catch at age model.

STATUS: No Progress. This recommendation is reiterated.

STACFIS **recommended** that *research continue on age determination for Greenland halibut in Subarea 2 and Div. 3KLMNO to improve accuracy and precision.*

STATUS: Research ongoing, and this issue is also discussed further in the STACREC Report. This recommendation is reiterated.

There is no synoptic survey which covers the full range of this stock. In addition, very few age 10+ fish are captured in either commercial fisheries or in trawl surveys. STACFIS **recommended** *expansion of surveys to cover the entire stock distribution and/or exploratory surveys be conducted with gears other than those currently deployed to complement the existing survey data.*

Tagging experiments could provide information on movement, growth rates and validate the current aging methods. STACFIS **recommended** that *tagging experiments of Greenland Halibut in Sub-Area 2 and Divisions 3KLMNO be conducted*.

STATUS: A tagging experiment was conducted by Canada during early 2012, and additional experiments are planned for 2013. This recommendation is reiterated.

21. Northern shortfin squid in SA 3+4

d) Research Recommendation

In 2010, STACFIS **recommended** that *abundance and biomass indices from the Canadian multi-species bottom trawl surveys conducted during spring and autumn in Div. 3LNO, beginning with 1995, be derived using the two subsets of strata listed in SCR Doc. 06/45 in order to improve the precision of the indices.*

STATUS: No progress has been made. This recommendation is reiterated.

SEPTEMBER

IX. OTHER MATTERS

2. Report of the Peer Review of STACFIS Catches

Scientific Council received the progress report prepared by the Peer Review of STACFIS Catches. The issues raised can be broken into short- and longer term objectives.

Two perspectives:

3. Long term solution: secure that reliable catch data are submitted to Scientific Council.

4. Short term solution: provide fix to secure that 2013 stock assessment can be performed and management advice derived.

Ad. 1. Scientific Council has discussed various options which they intend to promote through the peer review group on the method of catch estimation for NAFO stocks.

Ad. 2. The only option at this stage is to assume that the STATLANT data represents an inaccurate estimate of catch for some stocks. When used in the assessment this will translate into increased uncertainty which will be reflected in the assessment results and hence requires more precaution in the advice.

Scientific Council **recommended** that *DE's meet with the chairs of STACFIS and STACREC to prepare a way to deal with these challenges in advance of the June Scientific Council meeting*.

NIPAG

3. Northern shrimp off West Greenland (NAFO Subareas 0 and 1),

NIPAG **recommended** that:

- *Given that the CPUE series for the Greenland sea-going and coastal fleets continue to agree while neither agrees with changes in the survey estimates of biomass since 2002, possible causes for change in the relationship between fishing efficiency and biomass should be investigated.*

- *More robust methods of including biomass index series in the quantitative assessment model should be investigated.*