# NORTHWEST ATLANTIC FISHERIES ORGANIZATION

# Scientific Council Reports 2014

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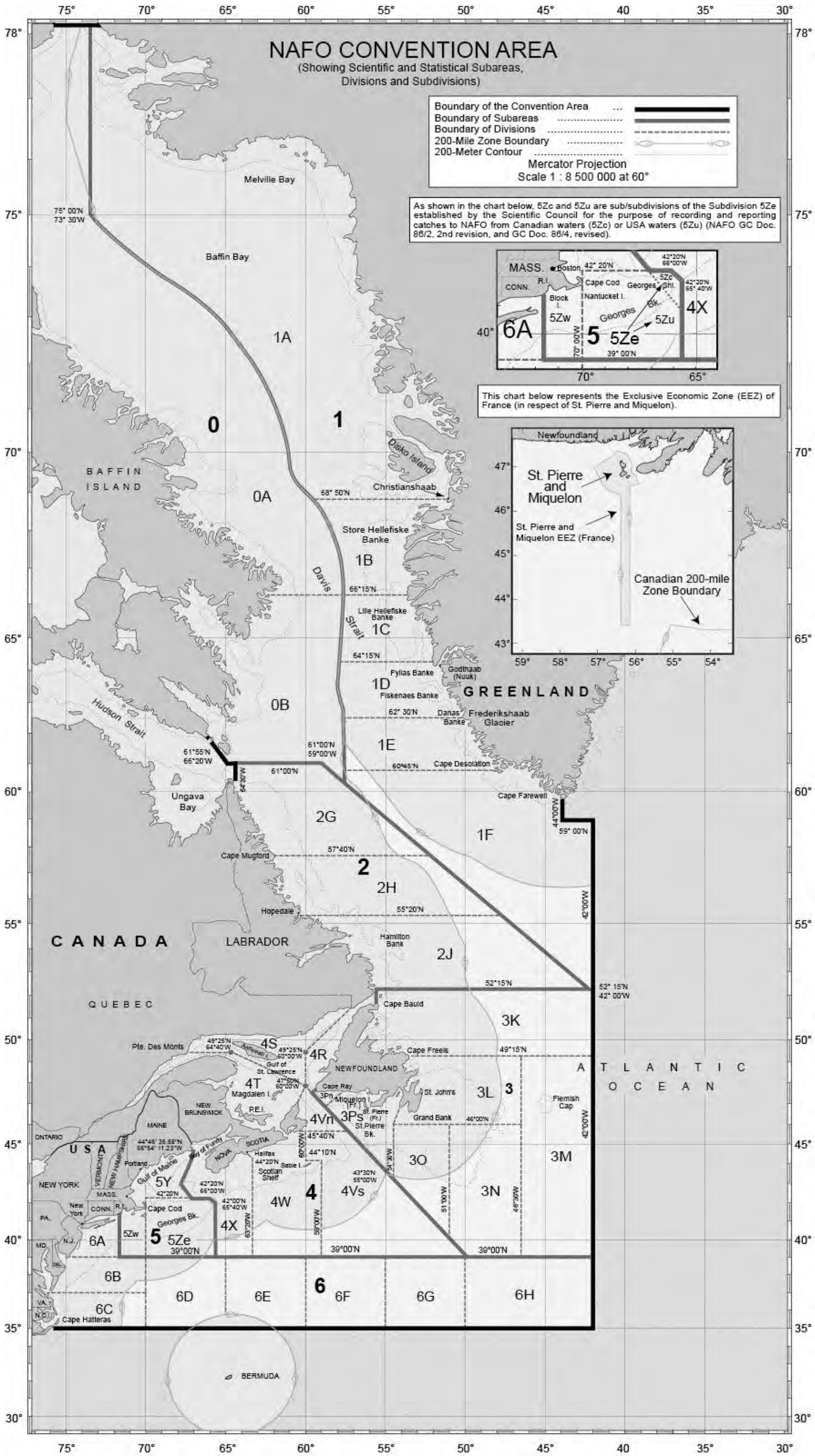
## PREFACE

This thirty-fifth issue of *NAFO Scientific Council Reports* containing reports of Scientific Council Meetings as well as the Joint Fisheries Commission – Scientific Council Meetings held in 2014 is compiled in ten sections: **Part A** – Fisheries Commission and Scientific Council *ad hoc* Working Group on Catch Reporting, 3-4 February 2014; **Part B** – Fisheries Commission and Scientific Council Joint Working Group on Risk-Based Management Strategies, 5-7 February 2014; **Part C** – Scientific Council *ad hoc* Working Group on Catches of Cod in Division 3M – 5 May 2014; **Part D** – Scientific Council *ad hoc* Working Group on Management Strategies for Redfish in Div. 3LN, 13 May 2014; **Part E** – Scientific Council Meeting, 31 May - 12 June 2014; **Part F** – Fisheries Commission and Scientific Council Working Group on the Ecosystem Approach Framework to Fisheries Management, 9-11 July 2014; **Part G** – Scientific Council Meeting, 10-17 September 2014; **Part H** – NAFO/ICES *Pandalus* Assesment Group (NIPAG) Meeting, 10–17 September 2014; **Part I** – Scientific Council Meeting, 22-26 September 2014; and **Part J** – the Agendas, Lists of Research and Summary Documents, List of Representatives, Advisers, Experts and Observers, Merit Awards and List of Recommendations relevant to Parts A-I.

For annexes to the Fisheries Commission and Scientific Council Joint Working Group on Catch Reporting (Part A), Fisheries Commission and Scientific Council Joint Working Group on Risk-Based Management Strategies (Part B) and the Fisheries Commission and Scientific Council Joint Working Group on the Ecosystem Approach Framework to Fisheries Management (Part F), see the original meeting reports, available from the NAFO website.


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°
As shown in the chart below, 5Zc and 5Zu are sub/subdivisions of the Subdivision 5Ze established by the Scientific Council for the purpose of recording and reporting catches to NAFO from Canadian waters (5Zc) or USA waters (5Zu) (NAFO GC Doc. 86/2, 2nd revision, and GC Doc. 86/4, revised).
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
Davis Strait
Hudson Strait
Ungava Bay
GREENLAND
CANADA
LABRADOR
QUEBEC
NEWFOUNDLAND
ATLANTIC OCEAN
USA
BERMUDA
0
1
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3M
3N
3O
3Ps
4R
4S
4T
4Vn
4Vs
4W
4X
5Y
5Ze
5Zw
6A
6B
6C
6D
6E
6F
6G
6H

**CONTENTS**

# PART A. REPORT OF THE FISHERIES COMMISSION AND SCIENTIFIC COUNCIL *AD HOC* WORKING GROUP ON CATCH REPORTING, 3-4 FEBRUARY 2014

## Contents

**Report of the Fisheries Commission and Scientific Council Ad hoc Working Group on Catch Reporting (FC-SC Doc. 14/1)**

**3-4 February 2014**

## 1. Opening

The Scientific Council (SC) Chair Don Stansbury (Canada), opened the meeting at 1000 hrs on Monday, 3 February 2014 at Prince George Hotel in Halifax, Nova Scotia, Canada. The Fisheries Commission (FC) Chair, co-Chair of this ad hoc working group (WG), could not attend. It was determined that for this inaugural meeting an election of a substitute co-Chair would not be necessary.

Representatives from Canada, Denmark (in respect of the Faroe Islands and Greenland), European Union, Japan, Norway, and USA were in attendance. The presence of the newly appointed Executive Secretary of NAFO, Fred Kingston was acknowledged (Part J, this volume).

## 2. Appointment of Rapporteur

Neil Campbell and Ricardo Federizon of the NAFO Secretariat were appointed co-Rapporteurs.

## 3. Adoption of Agenda

The agenda as previously circulated was adopted. Under item 10 - Other matters, discussion on the roles and responsibilities of national scientific observers compared to the current NAFO observer programs was proposed (Part J, this volume).

## 4. Review of Terms of Reference

The terms of reference (ToR) of this ad hoc WG as stipulated in FC Doc 13/24 were reviewed. There was no need to revise the ToR. Concerning ToR 4 it was clarified by the representatives of the Scientific Council (SC) and the presiding Chair that this WG shall report to SC during the June meeting and not necessarily only during September Annual Meeting.

## 5. Review and follow-up to the Peer Review Expert Panel 2013 Recommendations

A review of the Peer Review Expert Panel 2013 Recommendations, which are documented in GC Doc 13/04 Rev, was conducted. In FC-SC CR WP 14/6 Rev which is presented in Annex 3, the NAFO bodies responsible to follow-up, the actions to date and further actions to consider are presented. The reference to SC documents in Annex 3 indicates that specific recommendations addressed to SC have already been addressed. Further responses and details are expected from SC following from its meeting in June 2014.

Some CPs felt that more in-depth discussions on the substance of Annex 3 (FC-SC Doc. 14/1) were required. However, this did not occur due to time constraints. The working paper presented in Annex 3 (FC-SC Doc. 14/1) therefore should be considered preliminary and will be finalized by the WG at a later time.

## 6. Evaluation of potential approaches and data sources (e.g. daily catch data, tow by tow data, log books, etc.) to validate STATLANT 21 data and/or provide catch estimates

The Secretariat described the different catch databases housed at the Secretariat: Monthly Provisional Nominal Catches, at-sea inspection reports, port inspection reports, observer reports, vessel transmitted information (VTI), and STATLANT 21.

The WG evaluated the data sources and discussed their individual limitations and potentials for utility to validate catch data and/or generate catch estimates. It was noted that these data sources are currently collected for fishing compliance purposes and with the exemption of daily catch reports (CAT) as part of VTI, are not available for scientific purposes. Under Article 28.9 of the NCEM, the SC could request such data from the Executive Secretary. Future discussion on possible utilization of the various data sources requires consideration of issues such as accessibility and confidentiality.

Notable in the discussions was how these data can be used in the cross validation of the catch estimates. It was highlighted that for scientific purposes, fishing related data for the whole geographical distribution of the straddling stocks managed by NAFO is desirable. It was subsequently noted that in some cases NAFO data can be complemented by coastal States which can provide information related to fishing in their EEZ. Issues of tow-by-tow logbook data and data from NAFO observers as well as scientific observers were also extensively discussed.

Regarding tow by tow logbook data, fishing masters are required to record the entries but are not required to forward them to the Secretariat. There was general agreement among participants on the potential usefulness of tow-by-tow data for catch estimation, however, some CPs have indicated that there are some practical reasons why these logbooks are not forwarded (e.g. paper submissions are in practice very difficult and for CPs having an Electronic Recording System in place the electronic standards are not defined/compatible with the system at the NAFO Secretariat). It was recognized that future discussions of tow-by-tow data would need to consider practical approaches to make the data available recognizing that it needs to be anonymized and does not necessarily need to be transmitted in real-time to the Secretariat. Regarding the observers data, it was acknowledged that the current NAFO observer program was established primarily for compliance purposes, although there is no formal distinction between "scientific" and "compliance" observers recognized in the NAFO Conservation and Enforcement Measures (NCEM). The level of details in the historical observer's reports is not consistent. Even if there were complete compliance in submitting the reports, the observer data might be of limited utility to the SC.

In 2013, an observer template was adopted by the Fisheries Commission and it was made as a requirement beginning 2014 for the observers to use in reporting. It is hoped that this will considerably improve the quality of the observer reports in terms of utility of the SC. The new observer template includes the collection of length frequencies. However, SC representatives noted that without concurrent age samples, length frequencies collected are of limited utility for stock assessments. Some also reported issues with the use of this new template by compliance observers. On some vessels, scientific observers and compliance observers are now doing the same task. It was noted that the evaluation of the observer template is in the purview of the Standing Committee on International Control (STACTIC) and not this WG. It was also noted that Article 30 of the NCEM currently allows SC to request additional scientific work, e.g. length frequency data collection, be conducted by observers deployed in the NAFO Regulatory Area. All CPs which deploy scientific observers were encouraged to analyze and provide their information as a source of data.

A summary of discussions on the catch databases are also contained in the working paper FCSC CR WP 14/1 Rev presented in Annex 4(FC-SC Doc. 14/1). Some CPs felt that more in-depth discussions were still required. The working paper therefore should be considered preliminary and will be finalized by the WG at a later time.

The Secretariat made two presentations concerning approach in usage of the STACTIC data in complementing STATLANT 21: 1) methods to compare catch estimates --- STATLANT 21 vs STACTIC, and 2) analysis of Vessel Monitoring System (VMS) and VTI (daily CATch reports) data (Annex 5) (FC-SC Doc. 14/1). In the former, it is recognized that in their respective current form, VTI data is the most useful because of the high level of compliance of the fishing vessels in submitting the daily catch reports and the level of detail which they provide – daily catch by species and by Division (CATs). The latter presentation is a more detailed approach in making quantitative analysis using the VTI-CAT reports. The WG recognized the utility of the STACTIC data and the usefulness of the proposed approach. The SC was encouraged to pursue this further in the stock assessment work, in particular, as a pilot for catch estimation of 3M Cod.

## 7. Prioritization of stocks for initial consideration

In consideration of the importance of the stock to the fishing industry, of the development or update of Conservation Plan and Rebuilding Strategy (CPRS) of certain stocks, and the need for scientific data for stock assessment, the following stocks were identified as priorities: 3M cod, 2 + 3KLMNO Greenland halibut , and 3LNO American plaice (see item 9).

## 8. Consideration of terms of reference (governance, participation) if it is advised that this *ad hoc* WG continues

This WG would operate at least for another year under the same goals and objective as stipulated in FC Doc 13/24. A recommendation to this effect will be forwarded to FC and SC for consideration (see item 9).

## 9. Recommendations to forward to the Fisheries Commission and Scientific Council

It is recommended

1. that this WG continues, with the same goals and objectives, for another year. At the 2015 Annual Meeting FC and SC give consideration to prolonging this joint working group
2. that this WG should meet, either by correspondence or at another meeting preceding the 2014 Annual Meeting, to continue moving towards a transparent and robust method for producing estimates of catch

3. that if agreed by FC and SC the work would continue on priority stocks for the June 2015 SC meeting, and again report at the 2015 Annual Meeting.
4. that a process for catch estimation be constructed by continuing dialogue within this working group, using a suite of available data considered in Annex 4, and any other data, such as scientific observer reports. The process should be fully documented and transparent, including documentation of data selection and validation and tools for data synthesis.
5. that in a timely manner, SC, with assistance from the Secretariat, conducts a pilot exercise to explore and document the use of all available data, focusing on VMS & VTI for all flag states operating in this fishery, for catch estimation of Div. 3M Cod.
6. Results of this exercise may guide the work of this group in the future, especially on other priority stocks, e.g. 2 + 3KLNMO Greenland halibut and Div. 3LNO American plaice.
7. to encourage Contracting Parties to reflect upon the discussions of this working group and be prepared to offer revisions to the existing CEM to improve catch reporting at future FC meetings.

The WG recommends FC give further consideration to:

1. the need for development of best practice/guidelines for data collection and clarification of roles/responsibilities for observers
2. make NAFO Observer catch and biological sampling information, in anonymized form, available to Scientific Council and working groups of FC and SC to support catch validation and development of catch estimates for stock assessment.
3. the provision of NAFO logbook data (NCEM Annex II.A) to the Secretariat by electronic means, and to making it available to Scientific Council and working groups of FC and SC for the purpose of supporting catch validation and development of catch estimates for stock assessment.
4. the available data for straddling stocks which may contribute to the assessment of catch estimates.
5. exchange of catch on entry and exit information with NEAFC to improve reliability, noting the specific role of Joint NEAFC-NAFO Advisory Group on Data Management in this matter.

**10. Other Matters**

The discussion on the overlap of duties between NAFO and Scientific Observer Programmes is reflected in item 6 and in Annex 4 (FC-SC Doc. 14/1).

**11. Adoption of the Report**

This report was adopted through correspondence after the meeting.

**12. Adjournment**

The meeting was adjourned at 1830 hrs, Tuesday 4 February. The presiding Chair thanked the Secretariat for the support and the meeting participants for their cooperation and input. The participants likewise expressed their thanks and appreciation to the presiding Chair for his leadership.

**PART B. REPORT OF THE FISHERIES COMMISSION AND SCIENTIFIC COUNCIL JOINT WORKING GROUP ON RISK-BASED MANAGEMENT STRATEGIES, 5-7 FEBRUARY 2014**

**Report of Fisheries Commission and Scientific Council Joint Working Group on Risk-Based Management Strategies (FC-SC Doc. 14-02)**

**5-7 February 2014**

## 1. Opening

The working group (WG) met at the Prince George Hotel, Halifax, Canada, during 5-7 February 2012. The meeting was attended by representatives from Canada, EU, Japan, Norway, the Russian Federation and the United States of America, as well as from the Scientific Council (SC). The NAFO Executive Secretary, Fisheries Commission (FC) Coordinator and Scientific Council (SC) Coordinator were in attendance. Observers from World Wildlife Fund and Dalhousie Univeristy were present. The meeting was co-chaired by Carsten Hvingel (Norway) and Kevin Anderson (Canada) (Part J, this volume).

The chairs opened the meeting at 10:00 hrs on Wednesday, 5 February.

## 2. Appointment of Rapporteur

With the agreement of the WG, the FC Coordinator, Ricardo Federizon, and SC Coordinator, Neil Campbell, were appointed as joint rapporteurs.

## 3. Adoption of Agenda

A proposal was made to add Div. 3L Shrimp to item 7c of the agenda. This was accepted and the agenda adopted otherwise as previously circulated (Part J, this volume).

## 4. Review of Terms of Reference

The terms of reference of the WG as documented in FC Doc 13/18 were reviewed. The WG considered membership, work form, reporting procedures, observers and future meetings. The chairs informed participants that at the suggestion of SC if the WG breaks from plenary session and reverts to delegation for the purpose of drafting recommendations, individual scientists would remain as part of their delegations and SC as a whole would be represented by the SC Chair or a designated alternate.

## 5. Review and Update of the Precautionary Approach Framework

The NAFO Precautionary Approach Framework (PAF) was reviewed (FC Doc. 04/18). The WG received a presentation from Bill Brodie (Canada) on the history and development of the NAFO Precautionary Approach Framework (PAF) (Annex 3, FC-SC Doc. 14-02). As a matter for consideration in revising the PAF, the co-chair Carsten Hvingel (Norway) introduced a paper and made an accompanying presentation outlining the current scope of the PAF, highlighting discrepancies surrounding risk-based assessment of stocks and the inconsistency in treatment of target and limit reference points for biomass and fishing mortality under the current system (Annex 4, FC-SC Doc. 14-02).

It was emphasised that the PAF forms the basis of risk based management strategies and for this reason it is important to ensure the PAF and the General Framework for Risk Based Management Strategies are well aligned.

It was further recognized that application of PAF is dependent on the existence of reference points and, the importance of SC in determining the reference points for all stocks was underscored.

To initiate the revision of the PAF, it was determined that feedback from the SC is needed particularly regarding the relevance and implications of having $F_{lim}$ at $F_{msy}$ and $F_{msy}$ as a target, and the utility of buffer reference points (see item 9).

The risk values highlighted in the current PAF were discussed. The WG agreed that the noted percentages were not to be interpreted as prescriptive values/ ranges but rather directional amounts. It was also agreed that FC retains flexibility to specify acceptable levels of risk and that the degree of risk tolerance may be context specific.

## 6. Review and Update of existing interim Conservation Plans and Management Strategies

### a) Div. 3NO Cod

A review of the interim 3NO Cod Conservation Plan and Rebuilding Strategy (CPRS), which is embodied in Articles 7.6 – 7.11 of the NAFO Conservation and Enforcement Measures, was conducted. In the absence of $B_{msy}$ reference point, it was proposed that: an interim $B_{target}$ = 185 000 t and an interim $F_{target}$ of $F_{0.1}$ = 0.19 be considered.

Annex 5 (FC-SC Doc. 14-02) reflects the revisions and represents the updated CPRS to be forwarded to FC with a recommendation for adoption (See item 9).

**b) Div. 3LNO American Plaice**

There were no changes proposed to the existing CPRS.

**7. Follow-up to WGFMS-CPRS 2013 Recommendations**

**a) Evaluation and finalization of General Framework on Risk-based Management**

In 2013, the FC adopted the *General Framework on Risk-based Management Strategies.* However, the section *Closing of Directed Fishing* still needed to be elaborated. The WG evaluated and finalized the *General Framework* by removing the brackets in the section and replace the word “fishery” with “stock”. Annex 6 (FC-SC Doc. 14-02) reflects the revision. It will be forwarded to FC with a recommendation for adoption (see item 9).

**b) Discussion on development of alternative strategies for stocks that may not be suited to formulaic rules and/or for stocks where reference points do not exist or cannot be developed.**

Alternative strategies would not be needed if robust reference points are determined. At its June 2013 meeting, SC indicated that reference points can theoretically be constructed for all stocks and that this work is given high priority. The WG agreed to recommend SC provide a status report and possible timeliness for this work for consideration of FC in September 2014 (see item 9).

It was noted that further discussion on alternate strategies for specific stocks may be required if SC’s review determines that robust reference points are not likely to be established in a reasonable period of time.

**c) Development of CPRS**

The process towards management strategies for priority stocks was initiated. Draft plans for 3M cod and 3LN redfish were developed based on the *General Framework on Risk-based Management Strategies*. It was noted that the drafts plans (Annexes 7 and 8, FC-SC Doc. 14-02) represent a first step and may need further elaboration and adjustment once feedback is received from SC and FC. It was also noted that while a framework is in place to guide development of management strategies, the strategies themselves are stock-specific and no single strategy is likely to be appropriate for all stocks.

There was concern expressed by some CPs on the use of $F_{msy}$ (or its proxy) as a target versus a limit as well as consideration of consequences of fishing above this level.

***i) Div. 3NO witch flounder***

There was no progress to report on the development of a risk-based management strategy for this stock. The importance of the upcoming stock assessment, in particular, efforts to develop a limit reference point was noted.

***ii) Div. 3LN redfish***

The WG initiated the development of a risk-based management strategy for 3LN redfish (Annex 7, FC-SC Doc. 14-02). As noted in the preamble, NAFO identified the development of a risk-based strategy for 3LN redfish as a priority in 2012, and reaffirmed that priority in 2013. As next steps, the WG requests SC to evaluate the management strategy relative to the performance statistics prior to the 2014 NAFO Annual Meeting, and to comment on likely by-catch levels associated with the implementation of the proposed Harvest Control Rule (HCR) for this stock (see item 9).

***iii) Div. 3M cod***

The WG initiated the development of a risk-based management strategy for 3M Cod (Annex 8 FC-SC Doc. 14-02). As noted in the *Background,* NAFO identified the development of a risk-based management strategy for Cod in Div. 3M as a priority in 2012, and reaffirmed that priority in 2013. As next step, the WG recommends SC to discuss selection of operating models and evaluate the 3M Cod management strategy prior to the 2015 Annual Meeting (see item 9).

***iv) Div. 3L shrimp***

Recognizing that this stock is currently thought to be near $B_{lim}$, the WG agreed to give further consideration to development of a management strategy, subject to the outcome of the 2014 stock assessment, and requested that the item be retained on the agenda for future meetings.

**8. Approach and workplan to review the Greenland Halibut Management Strategy Evaluation in 2017**

In order to provide the Fisheries Commission with the opportunity to approve the review of the Greenland halibut MSE during its 2017 September meeting, the following work plan was proposed:

1. Until 2016 Scientific Council will continue to evaluate the harvest control rule based on the primary indicators (catches and surveys indices).
2. During its 2016 June meeting Scientific Council should update two assessment models, one XSA based and one SCAA based, and evaluate the development of the stock since the introduction of the MSE.
3. FC/SC WGRBMS should review the results before September 2016 and determine the next steps.
4. In advance of the 2017 Annual Meeting, the working group will develop recommendations on the way forward.

Noting the priority given to this stock by the *ad hoc* FC-SC Working Group on Catch Reporting it is expected that catch estimates will be available to carry out the MSE review.

**9. Recommendations to forward to FC and SC**

1. In order for the WG to start the process of revising the PA framework the WG **recommends** SC provide feedback on the following*:*

- Discuss the relevance and implications of:
- having $F_{lim}$ at $F_{msy}$
- $F_{msy}$ as a target

These analyses should include situations where quantitative analysis of uncertainty are limited and situations where uncertainty has been well incorporated into evaluation of Harvest Control Rules.

- Consider the utility of buffers (particularly $B_{buf}$) in the framework and in management plans and provide advice on whether the use of buffers is considered appropriate for stocks which have $B_{lim}$.

Note: the WG recommends that $B_{isr}$ is not considered part of the PA (but may be used as an interim milestone to aid decision making).

- The working group noted that SC, in its 2013 June report, concluded that reference points can theoretically be constructed for all stocks, and that this work is given high priority. The WG recommends SC provide a status report and possible timelines for this work for consideration of Fisheries Commission in September 2014.
- In its assessments and advisory sheets, the working group **recommends** Scientific Council provide a table or list of reference points available for each stock that includes information on their derivation, and if reference points are missing, explain why.

2. The WG **recommends** FC adopt amendments to the interim management plan for Div. 3NO Cod (Annex 5, FC-SC Doc. 14-02).
3. The WG **recommends** FC adopt amendments to the General Framework on Risk Based management (Annex 6, FC-SC Doc. 14-02).
4. The WG **recommends** SC discuss selection of operating models and evaluate the Div. 3LN Redfish management strategy relative to the performance statistics prior to the 2014 Annual Meeting (Annex 7, FC-SC Doc. 14-02).
5. The WG **recommends** SC comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN Redfish (Annex 7, FC-SC Doc. 14-02)

6. The WG **recommends** SC to discuss selection of operating models and evaluate the Div. 3M Cod management strategy prior to the 2015 Annual Meeting (Annex 8, FC-SC Doc. 14-02)

## 10. Other Matters

There were no other matters raised.

## 11. Adoption of the Report

The report was adopted by correspondence following the meeting.

## 12. Adjournment

The meeting adjourned at 1030 hrs on 7 February. The Chairs thanked the Secretariat for their support and the participants for their cooperation and input. The participants in turn voiced their thanks to the Chairs for their leadership.

# PART C: SCIENTIFIC COUNCIL AD HOC WORKING GROUP ON CATCHES OF COD IN DIVISION 3M – 5 MAY 2014

## Contents

# Scientific Council *ad hoc* Working Group on Catches of Cod in Divison 3M

**5 May 2014**

## 1. Opening

An *ad hoc* subgroup of Scientific Council met via WebEx on 5 May 2014 to discuss progress to date and determine a plan of action on the issue of estimating catches for use in the Div. 3M cod assessment. The meeting was overseen by the chair of Scientific Council, Don Stansbury (Canada), and involved the chairs for STACREC (Kathy Sosebee, USA) and STACFIS (Brian Healey, Canada), and representatives of Canada and the European Union (Spain). The NAFO Secretariat was represented by the Scientific Council Coordinator, Neil Campbell, who also acted as rapporteur.

## 2. Review of recommendations

At the Joint FC-SC Working Group on Catch Reporting (3-5 February 2014) it was recommended that, *"due to the requirement for an assessment in 2014, 3M cod will be used by SC as a pilot this spring to try to address lack of estimates for that stock assessment"*.

## 3. Review of catch data

The meeting opened at 0900h with a presentation on the data availability and quality at the Secretariat in recent years which relates to Div. 3M cod. It was noted that while observer data should be reported on a haul-by-haul basis, compliance with this requirement was poor. Reporting at this level of aggregation became mandatory at the start of 2014, and a preliminary investigation suggests observance of this regulation is promising and this may prove to be a useful source of information in the future. Provision of daily catch reports has been good since shortly after their introduction at the start of 2011. Coupled with VMS data to quantify the amount of effort associated with each report, this may be a good tool to examine catch rates by vessel.

Noting that the aim of this exercise was to provide an alternative source of catch data for recent years available in time for the assessment at the June Scientific Council meeting, participants made a number of suggestions for actions which could be pursued.

It was agreed that although the haul-by-haul observer data may be of value in the future, the level of detail available in the existing observer reports from 2011 – 2013 is not sufficient to be of use at present.

The information available for the VMS and daily catch reporting system was considered promising, although it was noted that the totals of the daily catch reports were approximately equivalent to the totals from STATLANT 21. The possibility of identifying vessels which are targeting cod and examining their average catch rates as a means to identify any anomalous values was proposed.

## 4. Plan of work

It was agreed that the Secretariat would prepare an anonymous data file of daily fishing effort, total catch and catch of cod within the 600m isobath of Div. 3M, disaggregated by vessel and flag state, along with some vessel capacity information (length overall and engine size) from the fleet register. This would be provided to Scientific Council for further exploration.

## 5. Other Matters

No other matters were raised.

## 6. Adoption of Report

It was agreed that the Scientific Council Coordinator would compile a report of the meeting and circulate to participants for adoption by correspondence. The issues raised during this meeting would be discussed again at the forthcoming webex meeting on Management Strategies for Div. 3LN Redfish, to raise awareness of the issue with the wider Scientific Council community.

## 7. Adjournment

The meeting adjourned at 1030h.

# PART D: SCIENTIFIC COUNCIL *AD HOC* WORKING GROUP ON MANAGEMENT STRATEGIES FOR REDFISH IN DIV. 3LN, 13 MAY 2014

## Contents

**Scientific Council *ad hoc* Working Group on Management Strategies for Redfish in Div. 3LN**

**13 May 2014**

**1. Opening**

Scientific Council met via WebEx to discuss the ongoing development of a management strategy for redfish in Div. 3LN on 13 May 2014.

**2. Appointment of rapporteur**

The Scientific Council Coordinator, Neil Campbell, was appointed as rapporteur.

The agenda was reviewed. An item on the recent Div. 3M cod catch estimation meeting was added to other business, and the agenda adopted (see Part J, this volume).

**3. Review of recommendations**

The following request for advice was made by Fisheries Commission, to be addressed in June 2014:

*The Fisheries Commission* ***requests*** *the Scientific Council to explore models that could be used to conduct a Management Strategy Evaluation for Div. 3LN redfish and report back through the Working Group on Risk- Based Management Strategies during their next meeting.*

Furthermore, at the recent FC-SC Working Group on Risk Based Management Strategies (WG-RBMS) there were a number of recommendations directed to Scientific Council, including two relating to the ongoing development of a management strategy for Redfish in Div. 3LN:

*The WG* ***recommends*** *SC discuss selection of operating models and evaluate the Div. 3LN Redfish management strategy relative to the performance statistics prior to the 2014 Annual Meeting.*

*The WG* ***recommends*** *SC comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN Redfish.*

**4. Review of operational models**

Details of four operating models were presented to Scientific Council:

**a. ASPIC (current stock assessment model)**

***i. Background***

Currently, a non-equilibrium (dynamic) surplus production model (ASPIC; Prager, 1994) is used to assess the status of the stock. The model is adjusted to the updated surveys series (including 2013 catch and survey data if possible) arranged under the formulation adopted on the "The 2nd Take of the 2008 Assessment of Redfish in NAFO Divisions 3LN," (Ávila de Melo and Alpoim, 2010).

***ii. Data used***

The 2012 input series are summarized below (Ávila de Melo et al., 2012):

- STATLANT catches(1959-2011) and CPUE(1959-1994)
- Spring survey on Div. 3LN combined (1991-2005,2007-2011)
- Autumn survey on Div. 3N (1991, 1993-2011)
- Autumn survey on Div 3L (1985-1986, 1990-1994, 1996-2011)
- Russian survey on Div. 3LN combined (1984-1991)
- Winter survey in Div. 3L (1985-1986,1990)
- Summer surveys in Div. 3L (1978-1979,1981,1984-1985,1990-1991,1993)

This data are to some extent spatially explicit since surveys carried out in one of the Division are related to the total biomass of redfish in Div. 3LN.

In the current assessment some data points considered as outliers are removed from the dataset in order for the ASPIC model to converge (Avila de Melo *et al*., 2012). These years are assumed to have higher values because of one or two large redfish hauls which are not representative of the average density in the stratum. In 2012, the

Spanish spring survey in Div. 3N was tentatively incorporated in the stock assessment but it was decided not to keep these data in the model at that time (Ávila de Melo and Alpoim, 2012).

***iii. Modelling framework:***

The ASPIC package (http://nft.nefsc.noaa.gov/ASPIC.html)was used to fit the logistic form of a surplus production model (Schaefer, 1954) relying on the minimization of an objective function (see Prager, 1994 for detailed description of the algorithm).

ASPIC constrains catchabilities according to the initial values. Is the initial value ($q^{init}$) divided by 100. If $q^{init}$ is higher or equal to 0.5 the catchability is bounded to be smaller than $6 \times q^{init}$. If $q^{init}$ is comprised between 0.1 and 0.5, the catchability is bounded to be smaller than 1.2. if $q^{init}$ is smaller than 0.1 then the catchability is bounded to be smaller than 0.5.

Table 1: Summary of the initial values and minimum and maximum boundaries for all catchabilities in the ASPIC framework

| Catchabilities | $q^{init}$ | $q^{min}$ | $q^{max}$ |
|---|---|---|---|
| $q^{CPUE}$ | $9.007 \times 10^{-6}$ | $9.007 \times 10^{-8}$ | 0.5 |
| $q^{3LN\_sp}$ | $6.58 \times 10^{-1}$ | $6.58 \times 10^{-3}$ | 3.948 |
| $q^{3N\_aut}$ | $7.59 \times 10^{-1}$ | $7.59 \times 10^{-3}$ | 4.554 |
| $q^{3LN\_rus}$ | $6.58 \times 10^{-1}$ | $6.58 \times 10^{-3}$ | 3.948 |
| $q^{3L\_win}$ | $3.22 \times 10^{-1}$ | $3.22 \times 10^{-3}$ | 1.2 |
| $q^{3L\_sum}$ | $2.75 \times 10^{-1}$ | $2.75 \times 10^{-3}$ | 1.2 |
| $q^{3L\_aut}$ | $2.75 \times 10^{-1}$ | $2.75 \times 10^{-3}$ | 1.2 |

Additionally ASPIC allows the user to constrain some of the other parameters. In the 2012 assessment the constraints are MSY is bounded between $5 \times 10^3$ and $5 \times 10^4$, K is bounded between $10^5$ and $10^6$ and F maximum value is 6.

**b. ASPIC-like model in a Bayesian framework (ASPIC-BAYES)**

***i. Background***

The Bayesian framework is very convenient approach for dealing with uncertainties and missing data in a consistent way and also has flexibility to construct and test various models. One of the key elements of this approach is that it considers all unknowns as probability distribution and is therefore very convenient when dealing with risk. This makes this approach a strong candidate for an operating model. This first Bayesian model is as similar as possible to the current stock assessment model. It includes all the constraints applied in the application of ASPIC in the current assessment.

***ii. Data used***

Same datasets as the ASPIC OM.

***iii. Modelling Framework***

The population biomass in 3LN is written as follow:

(Eq. 1) $$Log(P\_3LN_t) = \mu\_3LN_t + \eta_t$$

Where $\mu\_3LN_t$ is the average relative abundance calculated as a surplus model with a Shaefer (1954) functional form:

(Eq. 2) $$\mu\_3LN_t = Log\left(P\_3LN_{t-1} + r \cdot P\_3LN_{t-1} \cdot (1 - P\_3LN_{t-1}) - \frac{C\_3LN_{t-1}}{K\_3LN}\right)$$

Where $P\_3LN_{t-1}$ and $C\_3LN_{t-1}$ denote exploitable biomass (as a proportion 3LN Division's carrying capacity $K\_3LN$) and catch respectively, for year t-1. Carrying capacity, $K\_3LN$, is the level of stock biomass at equilibrium prior to commencement of the fishery (carrying capacity), $r$ is the intrinsic rate of population growth.

The process errors $\eta_t$ are drawn independently from a Normal distribution centered on $0$ with a random residual variation $\sigma^P$ as follow:

(Eq. 3) $\eta_t | \sigma^P \sim Normal(0, \sigma^P)$

The estimated biomass $P\_3LN_t$ is related to the CPUE and various survey indices:

(Eq. 4a) $I\_CPUE_t = Log(q\_CPUE \cdot P\_3LN_t) + \varepsilon_t^{CPUE}$
(Eq. 4b) $I\_can\_spr\_3LN_t = Log(q\_can\_spr\_3LN \cdot P\_3LN_t) + \varepsilon_t^{Ca\_spr}$
(Eq. 4c) $I\_can\_aut\_3N_t = Log(q\_can\_aut\_3N \cdot P\_3LN_t) + \varepsilon_t^{Ca\_aut\_3N}$
(Eq. 4d) $I\_can\_aut\_3L_t = Log(q\_can\_aut\_3L \cdot P\_3LN_t) + \varepsilon_t^{Ca\_aut\_3L}$
(Eq. 4e) $I\_Rus\_3LN_t = Log(q\_Rus \cdot P\_3LN_t) + \varepsilon_t^{Rus}$
(Eq. 4f) $I\_can\_win\_3L_t = Log(q\_can\_win \cdot P\_3LN_t) + \varepsilon_t^{Ca\_win}$
(Eq. 4g) $I\_can\_sum\_3L_t = Log(q\_can\_sum\_3L \cdot P\_3LN_t) + \varepsilon_t^{Ca\_sum}$

Where $q$ are the catchabilities associated with each survey index and $\varepsilon$ the associated observation error for each surveys. The observation errors are drawn from a Normal distribution as follow:

(Eq. 5a) $\varepsilon_t^{CPUE} | \sigma^{CPUE} \sim Normal(0, \sigma^{CPUE})$
(Eq. 5b) $\varepsilon_t^{Ca\_spr} | \sigma^{Ca\_spr} \sim Normal(0, \sigma^{Ca\_spr})$
(Eq. 5c) $\varepsilon_t^{Ca\_aut\_3N} | \sigma^{Ca\_aut\_3N} \sim Normal(0, \sigma^{Ca\_aut\_3N})$
(Eq. 5d) $\varepsilon_t^{Ca\_aut\_3L} | \sigma^{Ca\_aut\_3L} \sim Normal(0, \sigma^{Ca\_aut\_3L})$
(Eq. 5e) $\varepsilon_t^{Rus} | \sigma^{Rus} \sim Normal(0, \sigma^{Rus})$
(Eq. 5f) $\varepsilon_t^{Ca\_win} | \sigma^{Ca\_win} \sim Normal(0, \sigma^{Ca\_win})$
(Eq. 5g) $\varepsilon_t^{Ca\_sum} | \sigma^{Ca\_sum} \sim Normal(0, \sigma^{Ca\_sum})$

All priors of the model's parameters can be found in Table 2.

Table 2: Prior distribution of the main parameters of the ASPIC-BAYES model. I(a,b) after a distribution indicates a censorship on the left (a) or right (b) side of the distribution.

| Parameters | Prior distribution |
|---|---|
| $r$ | $Gamma(0.01,0.01)$ |
| $Log(K_{3LN})$ | $Unif(11.51,13.82)$ |
| $MSY$ | $LogNormal(10,0.001)I(5000,50000)$ |
| $\sigma^P$ | $Uniform(0,10)$ |
| $q\_CPUE$ | $Uniform(9.007 \cdot 10^{-5}, 0.5)$ |
| $q\_can\_spr\_3LN$ | $Uniform(9.58 \cdot 10^{-3}, 3.948)$ |
| $q\_can\_aut\_3N$ | $Uniform(7.59 \cdot 10^{-3}, 4.554)$ |
| $q\_can\_spr\_3N$ | $Uniform(6.58 \cdot 10^{-3}, 3.948)$ |
| $q\_rus$ | $Uniform(3.22 \cdot 10^{-3}, 1.2)$ |
| $q\_can\_win$ | $Uniform(2.75 \cdot 10^{-3}, 1.2)$ |
| $q\_can\_sum\_3L$ | $Uniform(2.75 \cdot 10^{-3}, 1.2)$ |
| $\sigma^{CPUE}$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_spr}$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_aut\_3N}$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_aut\_3L}$ | $Uniform(0,10)$ |
| $\sigma^{Rus}$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_win}$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_sum}$ | $Uniform(0,10)$ |

**c. ASPIC-like model in a Bayesian framework with all available data (ASPIC-BAYES-FULL)**

***i. Background***

In order to minimise the selection of outliers we designed an OM that has the same structure as ASPIC-BAYES but incorporates all CPUE and survey data available (i.e. no outliers removed) and relaxes the constraints applied in the current ASPIC assessment.

***ii. Data used***

- o STATLANT catches(1959-2011) and CPUE(1959-1994)
- o Spring survey in Div. 3LN combined (1991-2005,2007-2011)
- o Autumn survey in Div. 3N (1991-2011)
- o Autumn survey in Div 3L (1985-1986, 1990-2011)
- o Russian survey in Div. 3LN combined (1984-1991)
- o Winter survey in Div. 3L (1985-1986,1990)
- o Summer surveys in Div. 3L (1978-1979,1981,1984-1985,1990-1991,1993)
- o Spanish surveys in Div. 3N (1995-2011)

***ii. Modelling Framework***

Same equations as the ASPIC-BAYES OM with in addition the relationship between the Spanish surveys and the redfish Biomass in 3LN:

(Eq. 6) $$I\_Spa_t = Log(q\_spa \cdot P\_3LN_t) + \varepsilon_t^{Spa}$$

And the associated observation error:

(Eq. 7) $\varepsilon_t^{Spa}|\sigma^{Spa} \sim Normal(0, \sigma^{Spa})$

Additionally, as mentioned in the background section, prior distributions for the different parameters of the model have been loosened (see Table 3 for comparison).

Table 3: Prior distribution of the main parameters of the ASPIC-BAYES and ASPIC-BAYES-FULL models. I(a,b) after a distribution indicates a censorship on the left (a) or right (b) side of the distribution.

| Parameters | Prior ASPIC BAYES | Prior ASPIC BAYES FULL |
|---|---|---|
| $Log(K_{3LN})$ | $Unif(11.51,13.82)$ | $Unif(11.51,15.82)$ |
| $MSY$ | $LogNormal(10,0.001)\,I(5000,50000)$ | $LogNormal(10,0.001)\ I(1000,)$ |
| $\sigma^P$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $q\_CPUE$ | $Uniform(9.007 \cdot 10^{-5}, 0.5)$ | $Uniform(0,10)$ |
| $q\_can\_spr\_3LN$ | $Uniform(9.58 \cdot 10^{-3}, 3.948)$ | $Uniform(0,10)$ |
| $q\_can\_aut\_3N$ | $Uniform(7.59 \cdot 10^{-3}, 4.554)$ | $Uniform(0,10)$ |
| $q\_can\_spr\_3N$ | $Uniform(6.58 \cdot 10^{-3}, 3.948)$ | $Uniform(0,10)$ |
| $q\_rus$ | $Uniform(3.22 \cdot 10^{-3}, 1.2)$ | $Uniform(0,10)$ |
| $q\_can\_win$ | $Uniform(2.75 \cdot 10^{-3}, 1.2)$ | $Uniform(0,10)$ |
| $q\_can\_sum\_3L$ | $Uniform(2.75 \cdot 10^{-3}, 1.2)$ | $Uniform(0,10)$ |
| | N/A | $Uniform(0,10)$ |
| $\sigma^{CPUE}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_spr}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_aut\_3N}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_aut\_3L}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{Rus}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_win}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{Ca\_sum}$ | $Uniform(0,10)$ | $Uniform(0,10)$ |
| $\sigma^{spa}$ | N/A | $Uniform(0,10)$ |

## d. Spatially disaggregated model (BAYES-SPATIAL)

### *i. Background*

This is an operating model that is structured to be consistent with the spatial structure in the data collection (i.e. look at Division 3L and 3N individually when the survey/catch data allows for it)

### *ii. Data used*

Same datasets as in ASPIC-BAYES-FULL but when possible using split data for 3L and 3N.

- o Catches in 3L from 1959 to 2011 (STATLANT)
- o Catches in 3N from 1959 to 2011 (STATLANT)
- o CPUE for 3LN from 1959 to 1994

- o Canadian surveys:
  - Spring 3L : 1980, 1985, 1991-2011
  - Spring 3N: 1991-2005, 2007-2011
  - Summer 3L from to: 1978-1979, 1981, 1984-1985, 1990-1991 and 1993
  - Summer 3N: 1991, 1993
  - Autumn 3L: 1985-1986, 1990-2011
  - Autumn 3N: 1991-2011
  - Winter 3L: 1985-1986 and 1990
- o Spanish survey in 3N from1995 to 2011
- o Russian survey for 3LN combined from 1984 to 1991 (Power & Vaskov revised)

***iii. Modelling Framework***

This model's equations are similar to the ones in ASPIC-BAYES and ASPIC-BAYES-FULL. The main difference being that biomass for division 3L and 3N are estimated separately as follow:

(Eq. 8a) $Log(P\_3N_t) = \mu\_3N_t + \eta_t$

(Eq. 8b) $Log(P\_3L_t) = \mu\_3L_t + \eta_t$

Where $\mu_3L_t$and $\mu\_3N_t$ are the average relative abundance calculated as a surplus model with a Shaefer (1954) functional form:

(Eq. 9a) $\mu\_3N_t = Log\left(P\_3N_{t-1} + r \cdot P\_3N_{t-1} \cdot (1 - P\_3N_{t-1}) - \frac{C\_3N_{t-1}}{K\_3N}\right)$

(Eq. 9b) $\mu\_3L_t = Log\left(P\_3L_{t-1} + r \cdot P\_3LN_{t-1} \cdot (1 - P\_3L_{t-1}) - \frac{C\_3L_{t-1}}{K\_3L}\right)$

Where $P\_3L_{t-1}$, $P\_3N_{t-1}$ and $C\_3L_{t-1}, C\_3N_{t-1}$ denote exploitable biomass (as a proportion of each division's carrying capacity $K\_3L$ and $K\_3N$) and catch respectively, for year *t-1*. Carrying capacity, $K\_3L$ and $K\_3N$, are the level of stock biomass at equilibrium prior to commencement of the fishery, $r$ is the intrinsic rate of population growth and is assumed to be the same in 3L and 3N.

We assume the variability in the biological process are similar in the two divisions occupied by the population. Therefore the process errors $\eta_t$ are shared for both divisions drawn independently from a Normal distribution centered on $0$ with a random residual variation $\sigma^P$ as follow:

(Eq. 10) $\eta_t|\sigma^P \sim Normal(0, \sigma^P)$

The total population abundance for 3LN is calculated as follow

(Eq. 11) $P\_3LN_t = P\_3L_t + P\_3N_t$

The estimated biomass $P\_3L_t$ and $P\_3N_t$ are related to various survey index:

For 3L Division:

(Eq. 12a) $I\_can\_spr\_3L_t = Log(q\_can\_spr\_3L \cdot P\_3L_t) + \varepsilon_t^{Ca\_spr}$

(Eq. 12b) $I\_can\_sum\_3L_t = Log(q\_can\_sum\_3L \cdot P\_3L_t) + \varepsilon_t^{Ca\_sum}$

(Eq. 12c) $I\_can\_aut\_3L_t = Log(q\_can\_aut\_3L \cdot P\_3L_t) + \varepsilon_t^{Ca\_aut}$

(Eq. 12d) $I\_can\_win\_3L_t = Log(q\_can\_win \cdot P\_3L_t) + \varepsilon_t^{Ca\_win}$

For 3N Division:

(Eq. 13a) $I\_can\_spr\_3N_t = Log(q\_can\_spr\_3N \cdot P\_3N_t) + \varepsilon_t^{Ca\_spr}$

(Eq. 13b) $I\_can\_sum\_3N_t = Log(q\_can\_sum\_3N \cdot P\_3N_t) + \varepsilon_t^{Ca\_sum}$

(Eq. 13c) $I\_can\_aut\_3N_t = Log(q\_can\_aut\_3N \cdot P\_3N_t) + \varepsilon_t^{Ca\_aut}$

(Eq. 13d) $I\_spa\_3N_t = Log(q\_spa \cdot P\_3N_t) + \varepsilon_t^{Spa}$

For 3LN Div. combined:

(Eq. 14) $I\_Rus\_3LN_t = Log(q\_Rus \cdot P\_3LN_t) + \varepsilon_t^{Rus}$

Where $q$ are the catchabilities associated with each survey index (catchabilities are assumed to be different over 3L and 3N for a survey taking place at the same time) and $\varepsilon$ the associated observation error. It is assumed that there are no differences in the observation process for the same survey carried out in 3L or 3N (e.g. the observation error for $I\_can\_sum\_3L$ and $I\_can\_sum\_3N$ are the same). The observation errors are drawn from a Normal distribution as follow:

(Eq. 15a) $\varepsilon_t^{Ca\_spr} | \sigma^{Ca\_spr} \sim Normal(0, \sigma^{Ca\_spr})$

(Eq. 15b) $\varepsilon_t^{Ca\_sum} | \sigma^{Ca\_sum} \sim Normal(0, \sigma^{Ca\_sum})$

(Eq. 15c) $\varepsilon_t^{Ca\_aut} | \sigma^{Ca\_aut} \sim Normal(0, \sigma^{Ca\_aut})$

(Eq. 15d) $\varepsilon_t^{Ca\_win} | \sigma^{Ca\_win} \sim Normal(0, \sigma^{Ca\_win})$

(Eq. 15e) $\varepsilon_t^{Spa} | \sigma^{Spa} \sim Normal(0, \sigma^{Spa})$

(Eq. 15f) $\varepsilon_t^{Rus} | \sigma^{Rus} \sim Normal(0, \sigma^{Rus})$

All priors of the model's parameters can be found in Table 4. Note that the model was slightly re-parameterised and a prior was attributed to $r$ instead of $MSY$ for better convergence purposes ($MSY = r \times (K\_3L + K\_3N)/4$)

Equations 8-15 can be represented graphically in a Directed Acyclic Graph (DAG, Fig. 1) to visualise the model's structure.

Table 4: Prior distribution of the main parameters of the model. I(a,b) after a distribution indicates a censorship on the left (a) or right (b) side of the distribution.

| Parameters | Prior distribution |
|---|---|
| $r$ | $Gamma(0.01, 0.01)$ |
| $K\_3L$ | $LogNormal(1, 0.001) I(, 10^6)$ |
| $K\_3N$ | $LogNormal(1, 0.001) I(, 10^6)$ |
| $\sigma^P$ | $Uniform(10^{-3}, 10)$ |
| $q\_can\_spr\_3L$ | $Uniform(0, 10)$ |
| $q\_can\_sum\_3L$ | $Uniform(0, 10)$ |
| $q\_can\_aut\_3L$ | $Uniform(0, 10)$ |
| $q\_can\_spr\_3N$ | $Uniform(0, 10)$ |
| $q\_can\_sum\_3N$ | $Uniform(0, 10)$ |
| $q\_can\_aut\_3N$ | $Uniform(0, 10)$ |
| $q\_can\_win$ | $Uniform(0, 10)$ |
| $q\_spa$ | $Uniform(0, 10)$ |
| $q\_rus$ | $Uniform(0, 10)$ |
| $\sigma^{Ca\_spr}$ | $Uniform(10^{-3}, 10)$ |
| $\sigma^{Ca\_sum}$ | $Uniform(10^{-3}, 10)$ |
| $\sigma^{Ca\_aut}$ | $Uniform(10^{-3}, 10)$ |
| $\sigma^{Ca\_win}$ | $Uniform(10^{-3}, 10)$ |
| $\sigma^{Spa}$ | $Uniform(10^{-3}, 10)$ |
| $\sigma^{Rus}$ | $Uniform(10^{-3}, 10)$ |

## 5. Discussion on alternate HCRs

It was proposed that the EU-Spanish Div. 3L survey results be included in the fourth operating model, and their performance be evaluated at or after the June meeting, once an accepted assessment is in place.

## 6. Review of performance statistics

The objectives and performance statistics, as defined by WG-RBMS, are as follows:

a. Objective

   a: Maintain the stock at or above $B_{msy}$, achieve a TAC of 20 000 t within 7 years, and maintain a TAC at or above[1] 20,000t for subsequent years.

b. Performance Statistics:

   a. Low (30%) probability of exceeding $F_{msy}$ in any year

   b. Very low (10%) probability of declining below $B_{lim}$ in the next 7 years

   c. Less than 50% probability of declining below 80% $B_{msy}$ in the next 7 years

[1] Evaluating at 5 000t increments, *i.e.* 25 000, 30 000, etc.

Some concerns were expressed that evaluating the performance of the management strategy over seven years was not suitable for a long-lived species such as redfish, and as a consequence it was suggested that performance of the management strategy over 30 years also be evaluated. Further discussion of this issue was deferred to the June meeting.

**7. Discussion of exceptional circumstances**

Discussion of this process was deferred to the June meeting.

**8. Discussion of review process (*i.e.* biennial assessment of the stock)**

Discussion of this process was deferred to the June meeting.

**9. Other Matters**

Scientific Council were informed of the outcomes of the WebEx meeting on estimation of Div. 3M cod catches, namely that the Secretariat were to provide SC with daily catch and effort data for 2011 – 2013 for exploration of trends in catch rate.

**10. Adoption of Report**

The SC Coordinator was asked to prepare a report of the meeting and circulate it to participants for adoption by correspondence.

**11. Adjournment**

The Chair thanked participants for their efforts, and noted the concerns expressed by a number of delegates that this manner of *ad hoc* webex meeting was not the ideal way to conduct work. The meeting was adjourned at 1200h.

## ANNEX I. REFERENCES

Ávila de Melo, A.M. and Alpoim, R., 2010. The 2nd take of 2008 assessment of redfish in NAFO Divisions 3LN: going further on the exploratory analysis of ASPIC formulations. NAFO SCR Doc. 10/29, Serial No. N5787, 21 pp.

Ávila de Melo, A.M. and Alpoim, R., 2012. 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?). NAFO SCR Doc. 12/039, Serial No. N6059, 63 pp.

Power, D. and Vaskov, A.A., 1992. Abundance and biomass estimates of redfish (*S. mentella*) in Div. 3LN from Russian groundfish surveys from 1984-91. NAFO SCR Doc. 92/59. Serial No. N2113. 9 pp.

Prager, M.H., 1994. A suite of extensions to no-equilibrium surplus-production model. Fish. Bull. U.S., 92: 374-389.

Schaefer, M.B., 1954. Some aspects of the dynamics of populations important to management of the commercial marine fisheries. Bull. Inter-Am. Trop. Tuna Comm. 1(2): 27-56.

# PART E: SCIENTIFIC COUNCIL MEETING, 31 MAY - 12 JUNE 2014

## Contents

Participants of the 30 May-12 June Scientific Council Meeting

Left to right: Don Stansbury SC Chair, Brian Healey – STACFIS Chair, Neil Campbell, SC Coordinator, Margaret Treble – STACPUB Chair, Mariano Koen-Alonso - WGESA Co-Chair, Andrew Kenny - WGESA Co-Chair, Katerine Sosebee – STACREC Chair, Estelle Couture – STACFEN Chair

**Report of Scientific Council Meeting**

**31 May-12 June 2014**

Chair: Don Stansbury Rapporteur: Neil Campbell

## I. PLENARY SESSIONS

The Scientific Council met at the Sobey Building, Saint Mary's University, Halifax, NS, Canada, during 30 May – 12 June 2014, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), the European Union (Germany, Portugal, Spain and the United Kingdom), France (St Pierre et Miquelon), Japan, the Russian Federation and the United States of America. Observers from WWF, Ecology Action Center and Dalhousie University were also present. The Executive Secretary, Scientific Council Coordinator and other members of the Secretariat were in attendance.

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

The Council was called to order at 1000 hours on 30 May 2014. The provisional agenda was **adopted** with modification. The Scientific Council Coordinator was appointed the rapporteur.

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

To improve the flow of work, Scientific Council discussed a change in its working procedures. Currently, many of stocks under the purview of the Scientific Council are not conducted annually, but rather on a multi-year assessment schedule. In years without a stock assessment, Scientific Council conducts a brief review of each stock. Designated Experts are responsible to alert the Council if any new data warrants elevating the review from an interim monitoring update to a potential re-opening of the full assessment. Since implementing the multi-year assessment schedule in 2000, there have been no such instances where it was deemed necessary to re-open any of the assessments.

Scientific Council produces 'interim monitoring reports' (IMR) in any year when there is no full assessment for a given stock. Given the very heavy work load of the Council it was decided at this meeting to not consider the IMR within plenary discussions. This differs from the previous working procedure of Scientific Council when each IMR was fully reviewed in plenary. In a revision to its working procedures, Scientific Council agreed that after first determining that new data did not warrant reopening the assessment, the IMR would be drafted by the respective DE and then subjected to a review process first by a 'Designated Reviewer', and finally, by the chair of STACFIS.

The designated reviewers were responsible for ensuring the content of the IMR was consistent with the conclusions of the most recent assessment for that stock, as well as ensuring that all updates to documentation were consistent with pre-agreed Scientific Council conventions.

A checklist was developed to ensure consistency amongst reviews and to provide guidance to Designated Experts and the Designated Reviewers. This checklist was developed to complement the full review conducted on each IMR, and was completed by each reviewer. This is also a means to raise any concerns that the STACFIS chair would consider during final review.

The opening session was adjourned at 1230 hours on 30 May 2014. Several sessions were held throughout the course of the meeting to deal with specific items on the agenda. The Council considered **adopted** the STACFEN, STACPUB, STACFIS and STACREC reports on 12 June 2014.

The concluding session was called to order at 0900 hours on 12 June 2014.

The Council considered and **adopted** the report the Scientific Council Report of this meeting of 30 May-12 June 2014. 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 1500 hours on 12 June 2014.

The Reports of the Standing Committees as adopted by the Council are appended as follows: Appendix I - Report of the Standing Committee on Fisheries Environment (STACFEN), Appendix II - Report of Standing Committee on

Publications (STACPUB), Appendix III - Report of Standing Committee on Research Coordination (STACREC), and Appendix IV - Report of Standing Committee on Fisheries Science (STACFIS).

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

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

## II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS IN 2013

There were no recommendations to Scientific Council in 2013.

## III. FISHERIES ENVIRONMENT

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

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

- STACFEN **recommends** that *consideration of support for one invited speaker to address emerging issues and concerns for the NAFO Convention Area during the June Meeting.*
- STACFEN **recommends** that *further studies be directed toward integration of environmental information with changes in the distribution and abundance of resource populations.*

## IV. PUBLICATIONS

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

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

- STACPUB **recommends** that *in order for* authors to receive an SCR number they must submit a Title, Author and Abstract or Description of the document.
- STACPUB **recommends** that an excerpt from the Scientific Council meeting report that contains the advice and answers to the Fisheries Commission and coastal states requests be prepared and placed in a prominent place on the public website for easy accessibility.
- STACPUB **recommends** that the Secretariat work on providing direct links to key pages of the NAFO website and continue to provide easier access to documents and other information. STACPUB asked that these tasks be given a high priority by the Secretariat.
- **STACPUB *recommends that the*** NAFO Secretariat investigate options to promote the journal using social media.
- **STACPUB *recommends* that the** NAFO Secretariat improve the visibility of the Journal by placing a prominent link directly on the NAFO website's homepage.

## V. RESEARCH COORDINATION

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

There were no recommendations for Scientific Council from STACREC.

## VI. FISHERIES SCIENCE

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

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

- STACFIS **recommends** that the Secretariat use the information from VMS data to construct measures of effort (e.g. as in SCR 13/01) and compare this information to effort reported via DCR, as a means to validate these effort records.

Furthermore, the Council endorsed recommendations specific to each stock and they are highlighted under the relevant stock considerations in the STACFIS report (Appendix IV).

## VII. MANAGEMENT ADVICE AND RESPONSES TO SPECIAL REQUESTS

### 1. Fisheries Commission

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

The Scientific Council noted the Fisheries Commission requests for advice on Northern shrimp (Northern shrimp in Div. 3M and Div. 3LNO (Item 1)) will be undertaken during the Scientific Council meeting on 10-17 September 2014.

#### 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.

**Witch flounder in Divisions 3NO** Advice June 2014 for 2015

Recommendation for 2015

The biomass has increased since 2010, and the 2013 point estimate is above Blim. The probability that the 2013 biomass is below Blim is 0.14. Considering this uncertainty and the variable nature of this index, there is no scope for large increases in catch at this time. Future removals, if allowed to increase, should only increase in an adaptive, gradual manner from current catch levels. Due to the uncertainty associated with the data the Scientific Council recommends that the stock should undergo another full assessment in 2015.

**Management objectives**

2013 management objectives stipulated no directed fishing on this stock since 1994 to permit stock rebuilding. Bycatches in commercial fisheries directed for other species should be kept to a minimum. General convention objectives (GC Doc. 08/3) are applied.

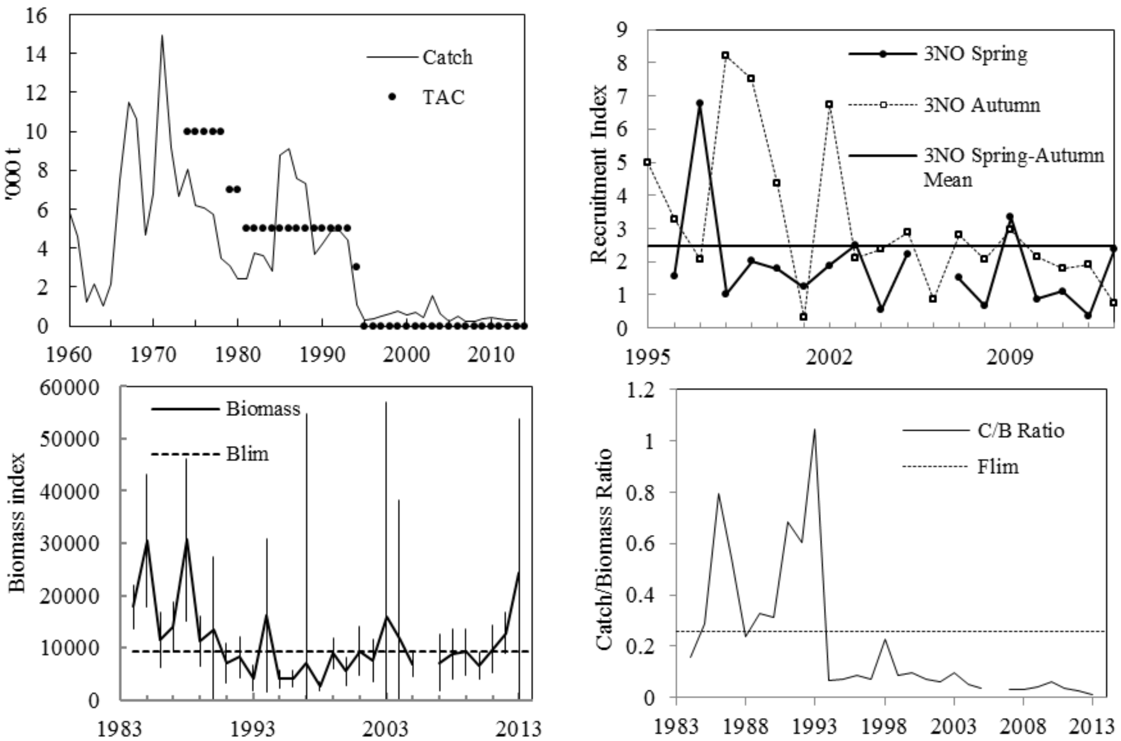
| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | | B>$B_{lim}$ with high uncertainty |
| Eliminate overfishing | | No directed fishery, *F* has been below $F_{lim}$ since 1993 |
| Apply Precautionary Approach | | Proxy reference points for fishing mortality and biomass established. Currently no directed fishery. |
| Minimise harmful impacts on living marine resources and ecosystems | | No specific measures, general VME closures in effect |
| Preserve marine biodiversity | | Cannot be evaluated |

OK
Intermediate
Not accomplished
Unknown

**Management unit**

The management unit is NAFO Divs. 3NO. The stock mainly occurs in Div. 3O along the southwestern slopes of the Grand Bank. In most years the distribution is concentrated toward this slope but in certain years, a higher percentage is distributed in shallower water.

**Stock status**



**Stock status (cont.)**
A proxy for $B_{lim}$ was calculated to be 9 200. The stock has increased since 2010 and is likely to be above $B_{lim}$ since 2011, although the current status is measured with high uncertainty.

**Reference points**

| | |
|---|---|
| $B_{msy}$ proxy: | 30 654 |
| $B_{lim}$ proxy: | 9 200 |
| $F_{lim}$ proxy: | 0.26 |

Reference points were derived at the June 2014 Scientific Council meeting.

**Projections and risk analyses.**
There were no projections or risk analyses produced for 3NO witch flounder in 2014.

**Assessment**
Based upon a qualitative evaluation of research vessel survey series and bycatch data from commercial fisheries.

Although not due until 2017, in light of the uncertainty in the estimate of current stock size, Scientific Council will conduct an assessment of its own accord in 2015.

*Human impact*

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

*Biological and environmental interactions*

Witch flounder is distributed more along the southwestern slopes of the Grand Bank in spring and further out in the shallower waters of the bank in autumn. It has been fished mainly in winter and springtime on spawning concentrations. There was an indication that juvenile (less than 21 cm) witch flounder had similar distribution.

**Fishery**
Witch flounder are caught via bottom trawl as bycatch mainly in otter trawl fisheries of skate and Greenland halibut.

Recent catch estimates and TACs are:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21 | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.4 | 0.4 | 0.3 | 0.3 | |
| STACFIS | 0.3 | 0.5 | 0.2 | 0.3 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | |

ndf - no directed fishing.

**Effects of the fishery on the ecosystem**
No specific information available. General impacts of bottom trawl gear on the ecosystem should be considered.

**Special comments**
Survey estimates are highly variable and associated with high uncertainty, particularly in 2013.

**Sources of Information**
SCR Docs 14/05; 14/029; SCS Docs. 14/6, 10, 13, 14.

**Redfish in Divisions 3LN** Advice June 2014 for 2015-16

**Recommendation for 2015 and 2016**

Fishing mortality up to 1/3 $F_{msy}$ corresponding to a catch of 10 200 t in 2015 and 2016 has low risk (<10%) of exceeding $F_{lim}$, and is projected to maintain the stock at or above $B_{msy}$. Fishing mortality up to 2/3 $F_{msy}$ also has low risk of exceeding $F_{lim}$, and maintaining the stock at or above $B_{msy}$. However given the uncertainties in the assessment, a higher TAC should be reached by a stepwise increase from the current catch level.

**Management objectives**

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

| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | | Stock increasing, $B>B_{msy}$ |
| Eliminate overfishing | | $F<F_{msy}$ |
| Apply Precautionary Approach | | Reference Points defined, Harvest control rules in development |
| Minimise harmful impacts on living marine resources and ecosystems | | No specific measures, general VME closures in effect |
| Preserve marine biodiversity | | Cannot be evaluated |

OK

Intermediate

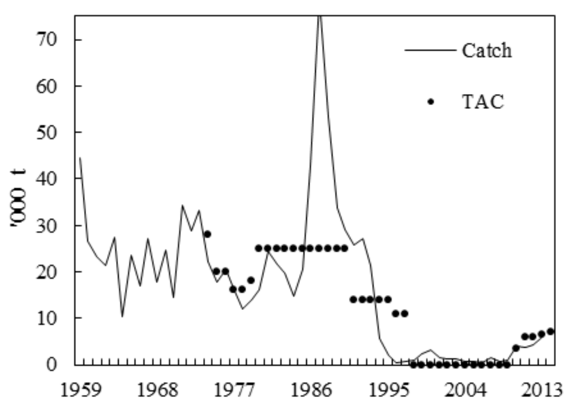
Not accomplished

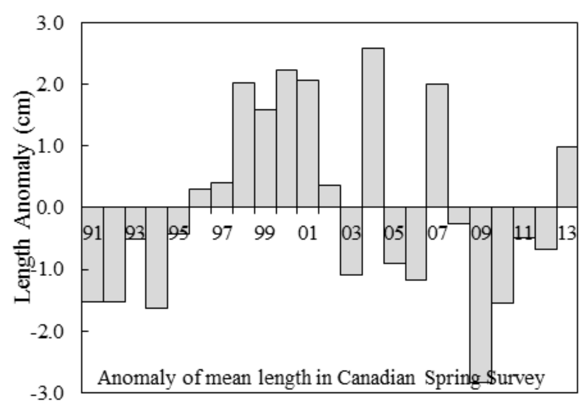
Unknown

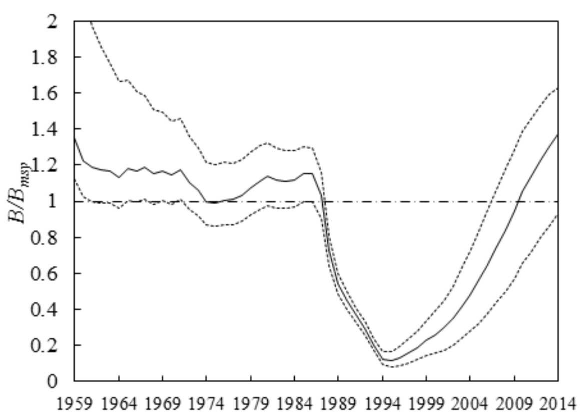
**Management unit**

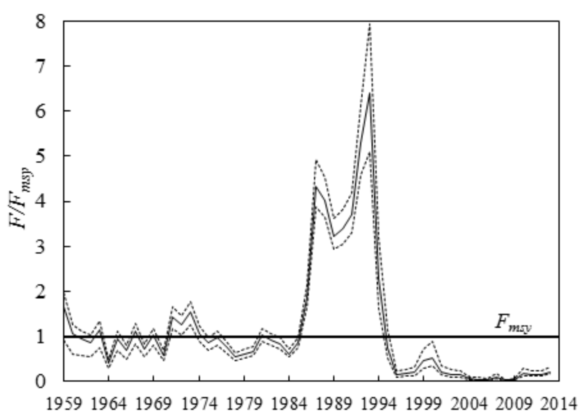
There are two species of redfish, *Sebastes mentella* and *Sebastes fasciatus*, which occur in Div. 3LN and are managed together as one management unit.

**Stock status**



**Stock status (cont.)**
The stock is estimated to be at 1.4 x $B_{msy.}$ There is a low risk of the stock being below $B_{msy}$. Fishing mortality is below $F_{msy}$ (0.22 $F_{msy}$), and the probability of being above $F_{msy}$ is very low. Recent recruitment (2005 – 2013) appears to be above average.

**Reference points**

$B_{lim}$: 30% $B_{msy}$
$F_{lim}$: $F_{msy}$

Reference points were derived during the 2004 Scientific Council meeting.

**Projections**

| | | $F_{status\ quo}$ | | | 1/3 $F_{msy}$ | | | 2/3 *Fmsy* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Percentile | 10 | 50 | 90 | 10 | 50 | 90 | 10 | 50 | 90 |
| $B/B_{msy}$ | 2014 | 0.931 | 1.371 | 1.632 | 0.931 | 1.371 | 1.632 | 0.931 | 1.371 | 1.632 |
| | 2015 | 0.997 | 1.429 | 1.665 | 0.997 | 1.429 | 1.665 | 0.997 | 1.429 | 1.665 |
| | 2016 | 1.062 | 1.481 | 1.695 | 1.045 | 1.464 | 1.676 | 0.966 | 1.415 | 1.625 |
| | 2017 | 1.120 | 1.528 | 1.720 | 1.088 | 1.494 | 1.685 | 0.997 | 1.403 | 1.594 |
| $F/F_{msy}$ | 2014 | 0.188 | 0.221 | 0.321 | 0.188 | 0.221 | 0.321 | 0.188 | 0.221 | 0.321 |
| | 2015 | 0.177 | 0.214 | 0.318 | 0.277 | 0.333 | 0.496 | 0.553 | 0.667 | 0.991 |
| | 2016 | 0.177 | 0.214 | 0.318 | 0.277 | 0.333 | 0.496 | 0.553 | 0.667 | 0.991 |
| Yield | 2014 | 6 500 | 6500 | 6500 | 6500 | 6500 | 6500 | 6500 | 6500 | 6500 |
| | 2015 | 6254 | 6529 | 6361 | 9708 | 10130 | 10650 | 19100 | 19900 | 20790 |
| | 2016 | 6353 | 6752 | 6901 | 9762 | 10360 | 11100 | 18700 | 19720 | 20770 |

**Assessment**
A surplus production model was used; model settings have been changed with an MSY constraint at the average level of 21 000 t for the 1960-1985 period; the results were consistent with the previous assessments. Input data comes from research surveys and the fishery. The next assessment is scheduled for 2016.

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

*Biology and Environmental interactions*

Redfish are long living slow growing species with low recruitment over relatively long periods of time. Furthermore redfish are important prey species in the ecosystem and can be subjected to unexpected and important increases on natural mortality.

**Fishery**
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. Catches increased with the reopening of the fishery in 2010 and have reached 6 000 t in 2013, the highest level recorded in 20 years.

Recent catch estimates and TACs are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | 3.5 | 6 | 6 | 6.5 | 7 |
| STATLANT 21 | 0.4 | 0.2 | 0.2 | 0.4 | 0.3 | 3.1 | 5.4 | 4.3 | 6.0 | |
| STACFIS | 0.7 | 0.5 | 1.7 | 0.6 | 1.1 | 4.1 | 5.4 | 4.3 | 6.0 | |

ndf - no directed fishing.

**Effects of the fishery on the ecosystem**

Fishing intensity on redfish has impacts on Div. 3NO cod, Div. 3LNO American plaice and SA 2 + Div. 3KLMNO Greenland Halibut through by-catch.

**Special comments**

The modeling framework previously used was not able to provide reliable results when allowed to run without constraints on MSY. Therefore MSY was fixed in the model and the results are conditioned on this assumption. Management decisions based on this assessment should take into account this added uncertainty.

Scientific Council notes that a variety of HCRs have been tested for this stock (see section VII.1.c.vii) through a management strategy evaluation.

**Sources of information**

SCR Doc. 14/006, 14/022; SCS Doc. 14/10, 14/13

**American plaice in Divisions 3LNO** Advice June 2014 for 2015-16

**Recommendation for 2015-2016**

SSB remains below $B_{lim}$, therefore Scientific Council recommends that, in accordance with the rebuilding plan, there should be no directed fishing on American plaice in Div. 3LNO in 2015 and 2016. Bycatches of American plaice should be kept to the lowest possible level and restricted to unavoidable bycatch in fisheries directing for other species.

**Management objectives**

In 2010 FC adopted an "Interim 3LNO American Plaice Conservation Plan and Rebuilding Strategy" (FC Doc. 10/13). There is a Harvest Control Rule (HCR) in place for this stock.

| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | 🔴 | $B<B_{lim}$ |
| Eliminate overfishing | 🟡 | No directed fishery, current bycatches are delaying recovery |
| Apply Precautionary Approach | 🟢 | Reference points defined |
| Minimise harmful impacts on living marine resources and ecosystems | 🟡 | VME closures in effect, no specific measures. |
| Preserve marine biodiversity | ⚪ | Cannot be evaluated |

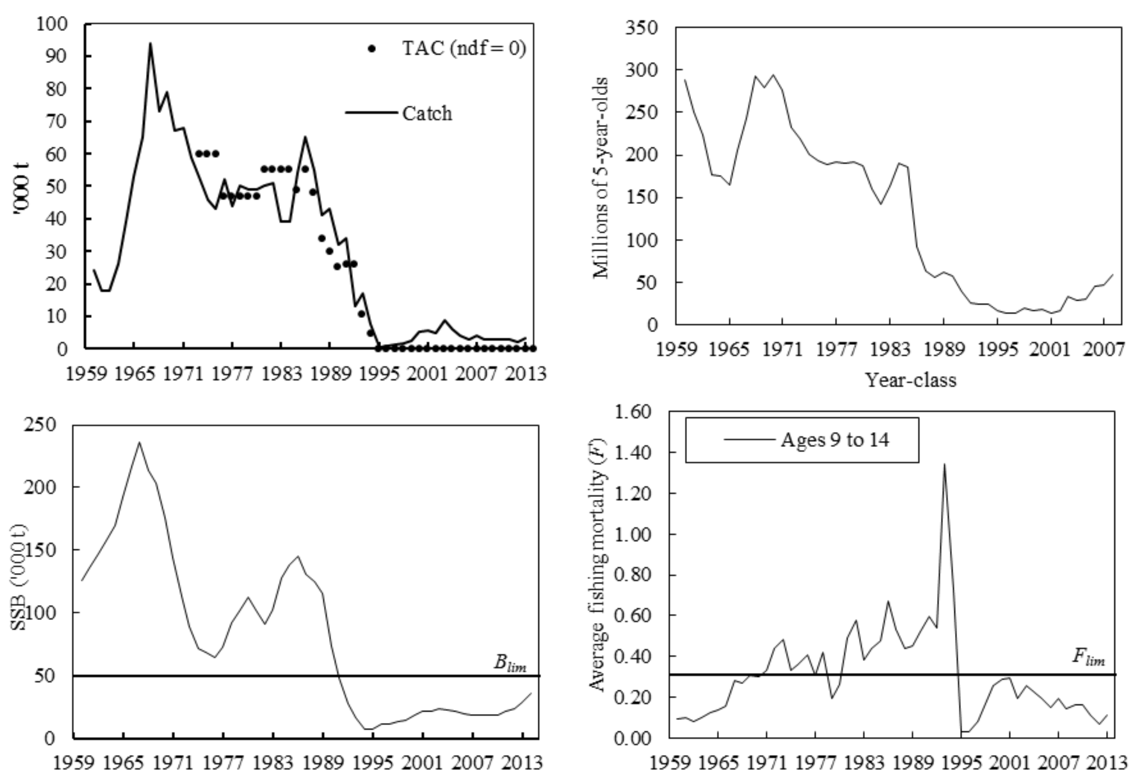
🟢 OK
🟡 Intermediate
🔴 Not accomplished
⚪ Unknown

**Management unit**

American plaice in Div. 3LNO is considered a separate stock.

**Stock status**

The stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below $B_{lim}$. Although estimated recruitment at age 5 has been higher from 2004-2009 than from 1995-2003, recruitment has been low since the late 1980s.



**Reference points**

$B_{lim}$: 50 000 t of spawning biomass (Scientific Council Report, 2003)
$B_{msy}$: 242 000 t of spawning biomass (Scientific Council Report 2011)
$F_{lim}$: 0.31 (Scientific Council Report, 2011)

**Projections**

| | ***F* = 0** | | |
|---|---|---|---|
| | SSB ('000 t) | | |
| | $p10$ | $p_{50}$ | $p_{90}$ |
| 2014 | 31 | 34 | 38 |
| 2015 | 39 | 44 | 48 |
| 2016 | 47 | 53 | 60 |
| 2017 | 54 | 62 | 71 |

| | ***F*<sub></sub>** $F_{2013}$ **= 0.1** | | | | | |
|---|---|---|---|---|---|---|
| | SSB ('000 t) | | | Yield ('000 t) | | |
| | $p_{10}$ | $p_{50}$ | $p_{90}$ | $p_{10}$ | $p_{50}$ | $p_{90}$ |
| 2014 | 31 | 34 | 38 | 3.5 | 3.9 | 4.3 |
| 2015 | 36 | 40 | 44 | 4.0 | 4.5 | 5.0 |
| 2016 | 40 | 45 | 51 | 4.2 | 4.7 | 5.5 |
| 2017 | 41 | 47 | 55 | | | |

| | Yield | | | $P$(SSB>$B_{lim}$) | | | |
|---|---|---|---|---|---|---|---|
| Fishing Mortality | 2014 | 2016 | 2017 | 2015 | 2016 | 2017 | $p$(SSB2017 > SSB2014) |
| $F = 0$ | - | - | - | 0.05 | 0.76 | 0.95 | 1.00 |
| $F_{2013} = 0.13$ | 3910 | 4456 | 4732 | <0.05 | 0.13 | 0.30 | 1.00 |

Under no removals, spawning stock biomass is projected to increase, with $p$(SSB>$B_{lim}$) in 2017 of >0.95. SSB was projected to have a probability of 0.30 of being greater than $B_{lim}$ by the start of 2017 when $F = F_{2013}$ (0.10). Current fishing mortality is delaying the recovery of this stock.

**Assessment**

An analytical assessment using the ADAPTive framework tuned to the Canadian spring, Canadian autumn and the EU-Spain Div. 3NO survey was used. A virtual population analysis (VPA) was conducted based on the 2011 assessment formulation, with updated data.

The next full assessment is planned for 2016.

*Human impact*

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

*Biological and environmental interactions*

Capelin and sandlance as well as other fish and invertebrates are important prey items for American plaice. There has been a decrease in age at 50% maturity over time, possibly brought about by some interaction between fishing pressure and environmental/ecosystem changes during that period.

**Fishery**

American plaice in recent years is caught as bycatch mainly in otter trawl fisheries of yellowtail flounder, skate, Greenland halibut and redfish. The stock has been under moratorium since 1995. To estimate catch for 2011-2013 for Div. 3N information on effort from NAFO observers and logbook data was used where possible with the assumption that CPUE has not changed substantially from 2010. To estimate catch the ratio of effort in year y+1 to year y was multiplied by the estimated catch in year y to produce catch in year y+1. For example for 2011 this was $Catch_{2011} = (Effort_{2011}/Effort_{2010})*Catch_{2010}$. Effort for 2013 was considered provisional so this catch estimate could change if revised. This method is unlikely to be useful in future as CPUE is likely to change as the plaice population increases and as other fishing opportunities change.

Recent catch estimates and TACs are:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21 | 2.4 | 0.9 | 1.5 | 1.9 | 1.8 | 1.5 | 1.2 | 1.3 | 2.1 | |
| STACFIS | 4.1 | 2.8 | 3.6 | 2.5 | 3.0 | 2.9 | 2.9[1] | 3.0[1] | 3.1[1] | |

ndf - no directed fishing.
[1] Catch was estimated using fishing effort ratio.

**Effects of the fishery on the ecosystem**

Not applicable, no directed fishery.

**Special comments**

Total catch was estimated for 2011-13 using an assumption about constant CPUE which is unlikely to hold in the future, and may not be useful in future years.

**Sources of information**

SCS Doc. 14/6, 10, 11, 13, 14; SCR Doc. 14/5, 12, 31, 34

**Thorny skate in Divisions 3LNO** Advice June 2014 for 2015-2016

**Recommendation for 2015-2016**

The stock has shown little improvement at recent catch levels (approximately 5 000 t, over 2006 - 2013), therefore Scientific Council advises no increase in catches.

**Management objectives**

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

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

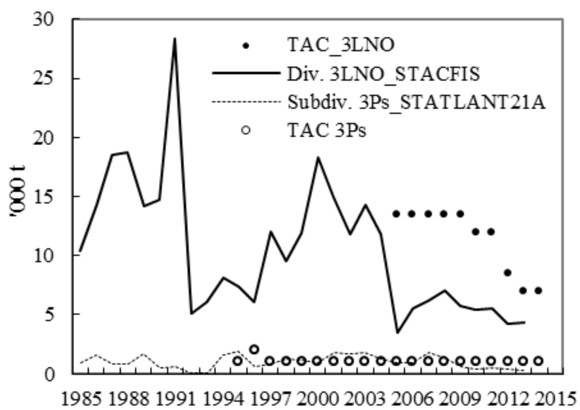
OK
Intermediate
Not accomplished
Unknown

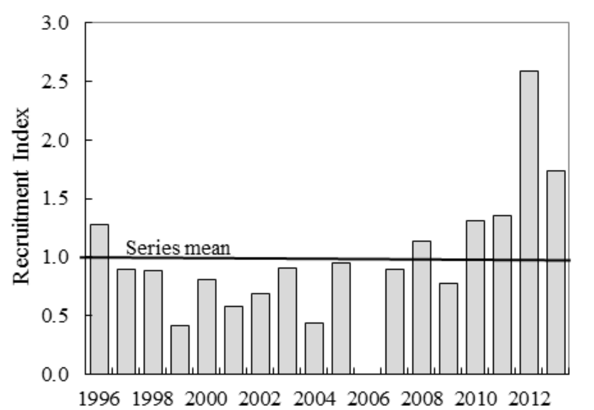
**Management unit**

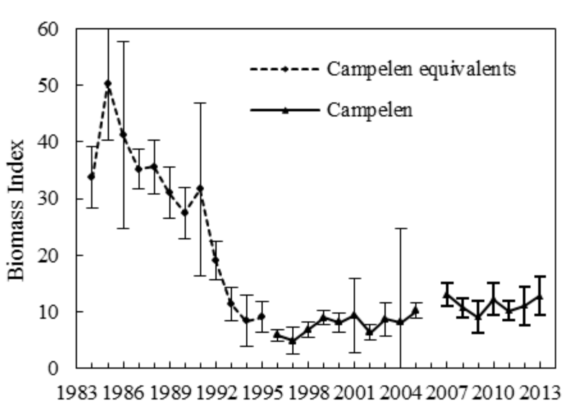
The management unit is confined to NAFO Div. 3LNO, which is a portion of the stock that is distributed in NAFO Div. 3LNO and Subdivision 3Ps.

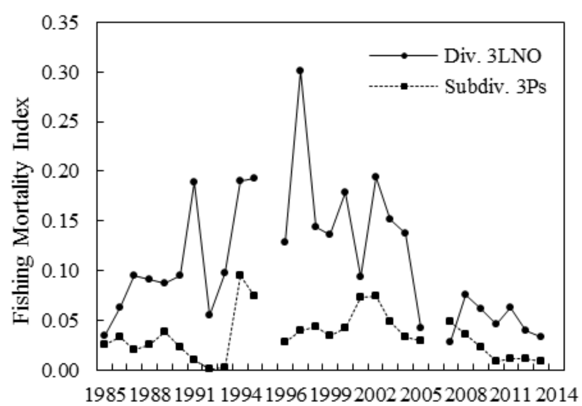
**Stock status**

The stock has been increasing very slowly from low levels since the mid-1990s. Recruitment in 2010-2013 is above average.



**Reference points**
Not defined. Work in progress.

**Assessment**
Based upon a qualitative evaluation of stock biomass trends and recruitment indices, the assessment is considered data limited and as such associated with a relatively high uncertainty. Input data are research survey indices and fishery data. The next full assessment of this stock will be in 2016.

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

*Biology and Environmental interactions*
Thorny skate are found over a broad range of depths (down to 840 m) and bottom temperatures (-1.7 - 11.5ºC). Thorny skate feed on a wide variety of prey species, mostly on crustaceans and fish. Recent studies have found that polychaete worms and shrimp dominate the diet of thorny skates in Div. 3LNO, while hyperiids, snow crabs, sand lance, and euphausiids are also important prey items.

**Fishery**
Thorny skate is caught in directed gillnet, trawl and long-line fisheries. In directed thorny skate fisheries, cod, monkfish, American plaice and other species are landed as bycatch. In turn, Thorny skate are also caught as bycatch in gillnet, trawl and long-line fisheries directing for other species. The fishery in NAFO Divs. 3LNO is regulated by quota.

Recent catch estimates and TACs for Div. 3LNO are:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 13.5 | 13.5 | 13.5 | 13.5 | 13.5 | 12 | 12 | 8.5 | 7 | 7 |
| STATLANT 21 | 3.5 | 5.5 | 6.2 | 7.1 | 5.7 | 5.4 | 5.5 | 4.3 | 4.4 | |
| STACFIS | 4.2 | 5.8 | 3.6 | 7.4 | 5.6 | 3.1 | 5.4 | 4.3 | 4.4 | |

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

**Special comments**
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.

**Sources of Information**
SCR Doc. 14/07, 12, 23; SCS Doc. 14/06, 10, 13, 14.

**American plaice in Division 3M** Advice June 2014 for 2015 – 2017

**Recommendation for 2015 – 2017**

There should be no directed fishery on American plaice in Div. 3M in 2015, 2016 and 2017. Bycatch should be kept at the lowest possible level.

**Management objectives**

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

| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | 🔴 | $B_{msy}$ unknown, stock at a low level |
| Eliminate overfishing | 🟢 | NDF. Fishing mortality thought to be low |
| Apply Precautionary Approach | 🔴 | Reference points not defined, No HCRs |
| Minimise harmful impacts on living marine resources and ecosystems | 🟡 | VME closures in effect, no specific measures. |
| Preserve marine biodiversity | ⚪ | Cannot be evaluated |

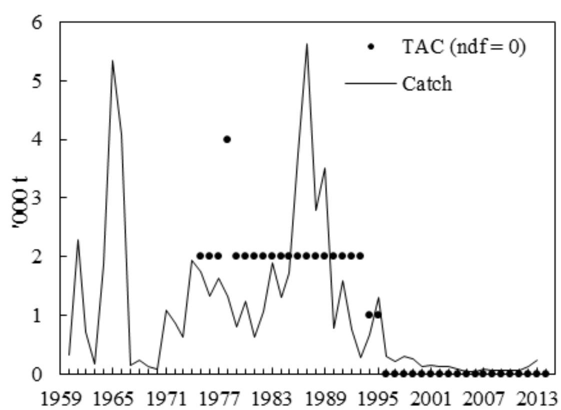
🟢 OK
🟡 Intermediate
🔴 Not accomplished
⚪ Unknown

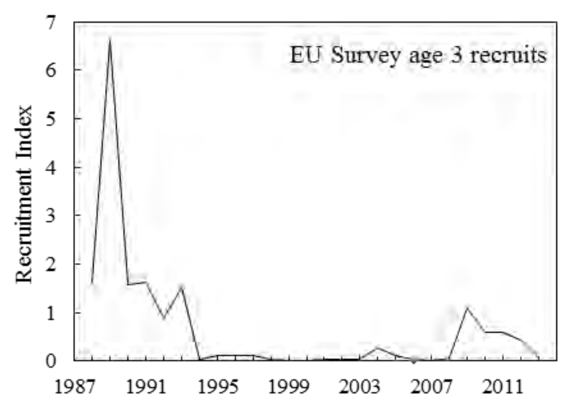
**Management unit**

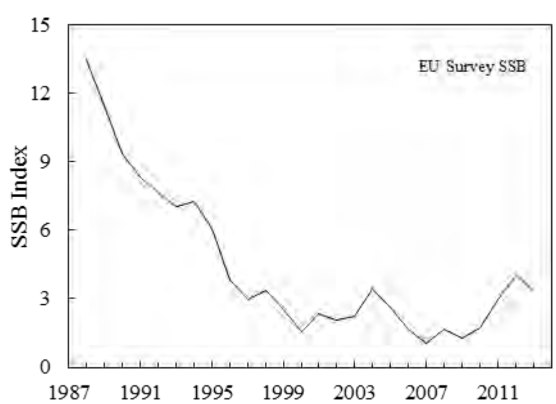
The American plaice stock in Flemish Cap (Div. 3M) is considered to be a separate population.

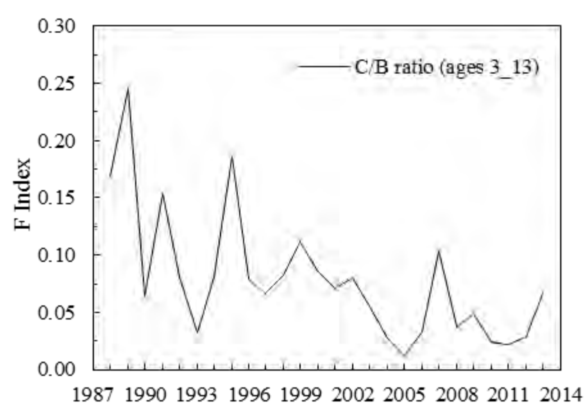
**Stock status**

Although the stock has increased slightly in recent years due to improved recruitment since 2009 (2006 Year-Class) it continues to be in a poor condition. Although the level of catches since 1996 is low, all the analysis indicates that this stock remains at a low level.



**Reference points**

Scientific Council is not in a position to provide proxies for biomass reference points at this time.

The yield-per-recruit analysis gave $F_{0.1} = 0.163$ and $F_{max} = 0.347$.

**Projections**

Not available

**Assessment**

This assessment is based upon a qualitative evaluation of research vessel survey series and bycatch data from commercial fisheries.

The next full assessment is planned for 2017.

*Human impact*

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

*Biological and environmental interactions*

The stock occurs mainly at depths shallower than 600 m on Flemish Cap. Main stomach contents are echinoderms, shrimp and hyperiids.

**Fishery**

American plaice is caught as bycatch in otter trawl fisheries, mainly the cod and redfish fisheries. From 1979 to 1993 a TAC of 2 000 t was in effect for this stock. A reduction to 1 000 t was agreed for 1994 and 1995 and a moratorium was agreed to thereafter.

Recent catch estimates and TACs are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 0.2 | |
| STACFIS | 0.05 | 0.05 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | |

ndf - no directed fishing.

**Effects of the fishery on the ecosystem**

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

**Special comments**

No special comments

**Sources of information**

SCR Doc. 14/17, 36; SCS Doc. 11/4, 5; 12/5, 8; 13/5; 14/6, 10, 13

### b) Monitoring of Stocks for which Multi-year Advice was Provided in 2013

The assessments (interim monitoring) found nothing to indicate a significant change in the status of the eight stocks for which multi-year advice was provided in 2013. However, there was some review of 2013 survey results of Redfish in Div. 3O. During 2013, biomass indices for Redfish in Div. 3O in Canadian spring and autumn RV surveys fell to 38% and 57%, respectively, of average values over 2010-2012 and SC considered whether these declines warranted a re-opening of the assessment. Information on recent size structure, relative fishing mortality, and surveys by EU-Spain were also considered. Scientific Council concluded that given the high and persistent variability in the research survey indices, the observed declines in 2013 did not warrant a new assessment or advice.

Accordingly, Scientific Council reiterates its previous advice as follows:

**Recommendation for Redfish in Div. 3M** (2013): For 2014 and 2015: Because of weaker incoming recruitment and uncertainty regarding current levels of natural mortality, Scientific Council recommends not increasing the current TAC (6 500 t) for 2014 and 2015.

**Recommendation for Cod in Div. 3NO** (2013): For 2014 and 2015: No directed fishery.

**Recommendation for Redfish in Div. 3O** (2013): For 2014, 2015 and 2016: Catches have averaged about 13 000 t since the 1960s and over the long term, catches at this level appear to have been sustainable.

**Recommendation for Yellowtail flounder in Div. 3LNO** (2013): For 2014 and 2015: Fishing mortality up to 85% $F_{msy}$ corresponding to a catch of 26 000 t in 2014 and 23 500 t in 2015 has low risk (<5%) of exceeding $F_{lim}$, and is projected to maintain the stock well above $B_{msy}$.

**Recommendation for Capelin in Div. 3NO** (2013): For 2014 and 2015: No directed fishery.

**Recommendation for White hake in Div. 3NO** (2013): For 2014 and 2015: Based on the low recruitment, catches of white hake in Div. 3NO should not exceed their current levels of 100-300 t.

**Recommendation for Witch flounder in Div. 2J + 3KL** (2013): For 2014, 2015 and 2016: No directed fishery to allow for stock rebuilding. By-catches of witch flounder in other fisheries should be kept at the lowest possible level.

**Recommendation for Northern shortfin squid in SA 3+4** (2013): For 2014, 2015 and 2016: During 2012, the northern stock component remained in a state of low productivity. Therefore, Scientific Council recommends a TAC of no more than 34 000 t/yr.

## c) Special Requests for Management Advice

### *i) Greenland Halibut TAC & Exceptional Circumstances*

*i) The Fisheries Commission adopted in 2010 an MSE approach for Greenland halibut stock in Subarea 2 + Division 3KLMNO (FC Doc. 10/12). This approach considers a survey based harvest control rule (HCR) to set a TAC for this stock on an annual basis. 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 Document 10/12.*
Scientific Council responded:

| |
|---|
| The TAC for 2015 derived from the HCR is 15 578 t. |

As per the HCR adopted by the Fisheries Commission, survey slopes were computed using the most recent five years of survey data (2009-2013) and are illustrated in Fig. 1. The data series included in the HCR computation are the Canadian Fall Divs. 2J3K index, the Canadian Spring Div. 3LNO index and the EU Flemish Cap index covering depths from 0-1400m. Averaging the individual survey slopes yields *slope*= 0.0089. Therefore, the computed TAC is: 15 441*[1+1*(0.0089)] = 15 578 t. This change from the 2014 TAC is within the ± 5% constraint on TAC change that is part of the HCR.

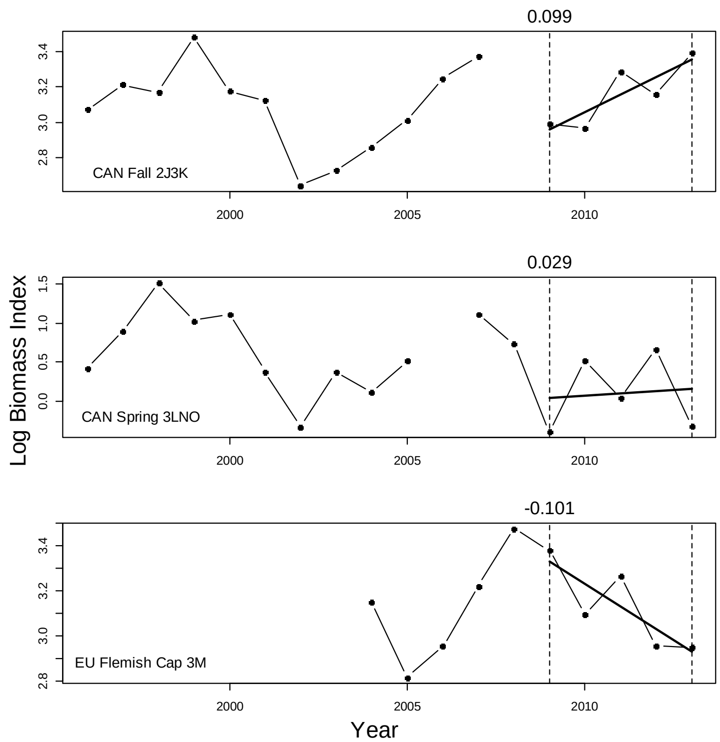



Fig. 1. Input for Greenland Halibut in Subarea 2 + Divisions 3KLMNO Harvest Control Rule. Slopes are estimated from linear regression of log-scale biomass indices (mean weight per tow) over 2009-2013. Survey data come from Canadian autumn surveys in Div. 2J3K, Canadian spring surveys in Div. 3LNO and EU Flemish Cap survey (to 1400m depth) in Div 3M.

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

According to the indicator based on surveys, exceptional circumstances are presently occurring, with one survey observation below the 5$^{th}$ percentile of the simulated distributions. Due to the unavailability of STACFIS catch estimates in 2011, 2012, and 2013, Scientific Council is unable to determine whether recent catches also constitute an exceptional circumstance nor does it allow evaluation for some of the secondary indicators.

Although the application of the HCR results in an increase in TAC, the fact that one of the 2013 surveys is below the simulated distributions constitutes an exceptional circumstance and is a conservation concern.

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

STACFIS catch estimates for 2011, 2012 and 2013 are not available. Therefore, Scientific Council cannot compare observed catches to the simulated distributions, and is unable to determine if exceptional circumstances are occurring in respect to this indicator. Scientific Council notes the management strategy for Greenland halibut assumed that the simulated catches would exactly equal the TACs generated from the HCR. The 90% confidence intervals for the simulated 2013 catches range from 15004 to 18234 t in the XSA based OMs and in SCAA based OMs, from 15507 to 15507 t. (The latter is constant as all SCAA simulations indicated a TAC that was 5% lower than the previous year, the maximum change permitted in the HCR.) The STATLANT 21 catches for 2013 were 14855 t, against a TAC of 15441 t.

For the three surveys that comprise the input data to the HCR, the 2013 observed values were compared with composite distributions of simulated surveys for both SCAA-based and XSA-based operating models. Out of the six comparisons possible (three surveys; two sets of operating models), there was one case (Canadian Spring 3LNO for the XSA operating models), for which the observed survey index was below the 5th percentile. The lower 5$^{th}$ percentile from the projections was 1.07 kg/haul and the observed value was 0.73 kg/haul (Fig. 2).

When exceptional circumstances are occurring there are five secondary indicators which should be considered. These are:

1. Data Gaps. There have been no data gaps in the survey series used in the HCR.

2. Biological Parameters: No new information is available.

3. Recruitment: Unable to update in relation to the 90% confidence intervals of the MSE as catches from 2011 – 2013 could not be estimated.

4. Fishing Mortality: Unable to update in relation to the 90% confidence intervals of the MSE as catches from 2011 – 2013 could not be estimated.

5. Exploitable Biomass: Unable to update in relation to the 90% confidence intervals of the MSE as catches from 2011 – 2013 could not be estimated.

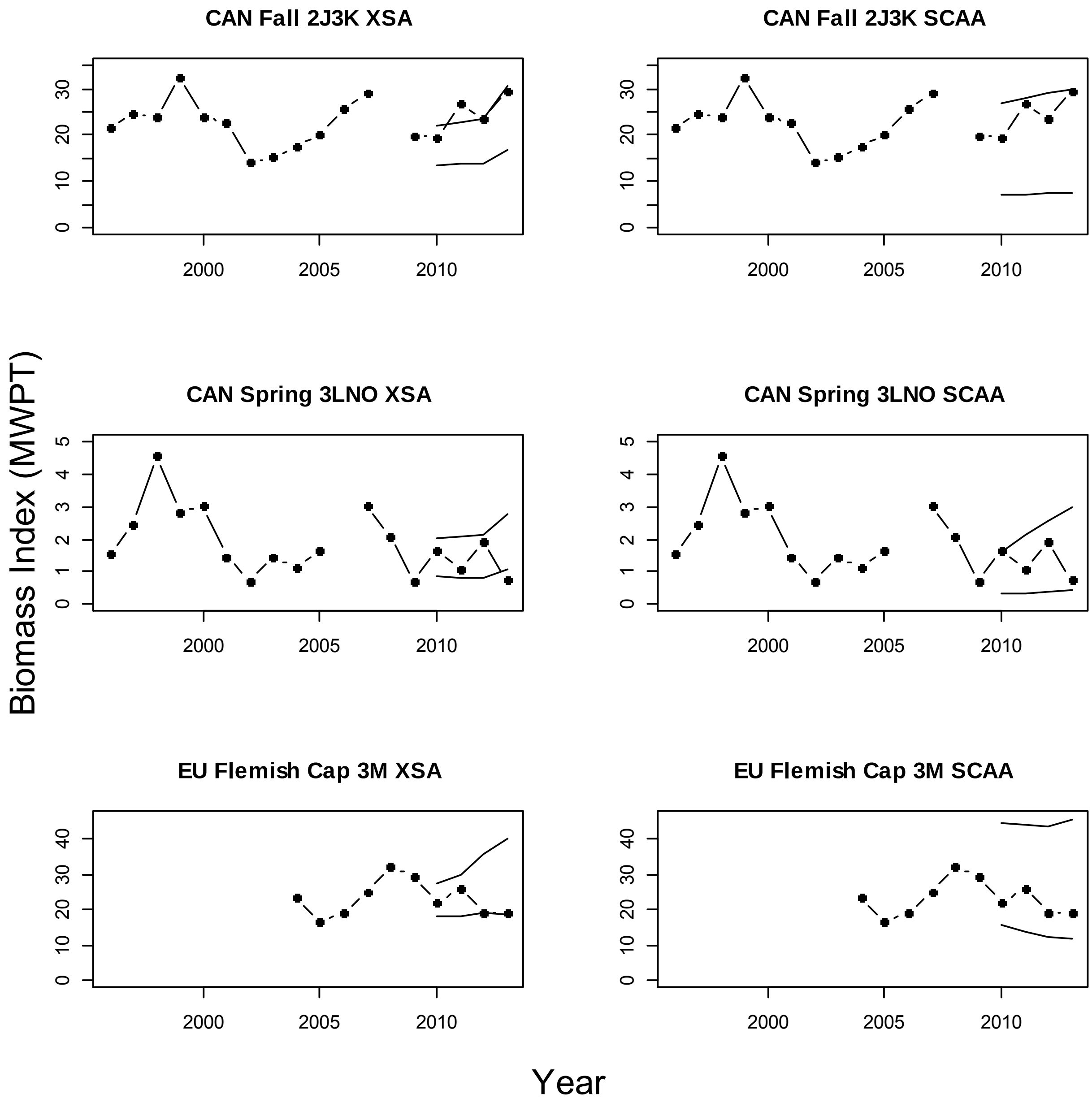



Fig. 2. Observed surveys (lines with dots) and upper and lower 90% confidence intervals of surveys simulated (solid lines) in the MSE for Greenland Halibut in Subarea 2 + Divisions 3KLMNO. The panels on the left give the simulated surveys from the XSA operating models

***ii) Reference points for cod in Div. 3M (Item 5)***

*The Fisheries Commission requests the Scientific Council to continue the work on reference points and provide $B_{msy}$ and $F_{msy}$ for cod in Div. 3M.*

The Scientific Council responded:

Scientific Council decided that $F_{30\%}$ (the fishing mortality which reduces Spawner Per Recruit (SPR) to 30% of its value at $F$=0) is the best $F_{msy}$ proxy at this moment.

In 2013, Scientific Council discussed the Div. 3M cod reference points based on the stock recruitment (S/R) data for 3M cod from the most recent assessment. Three different S/R models were fit to these data. Results show that none of these fitted appropriately. Scientific Council (NAFO, 2013) noted that the level of $B_{msy}$ estimated from Yield Per Recruit (YPR) and Spawning Per Recruit (SPR) depends on assumptions about the level of recruitment. So, more research about the possibility of changes in productivity and the level of recruitment that should be used to estimate the MSY is needed.

In 2014, Scientific Council analyzed the YPR and SPR inputs (mean weights, partial recruitment and maturity ogive) to study the possibility of changes in productivity in the past and its impact in the estimated values of reference points. The Fmsy proxy was estimated using data from 1972 to 2013 because trends in biological parameters (weights, maturity, partial recruitment) have been observed in the most recent years (2009-2013).

In Div. 3M cod there is clear evidence of recruitment dependence on biomass at low SSB levels. Low recruitment have been observed at SSB less than 14 000 t. The recruitment dependence on biomass is less clear at medium and high SSB levels although a certain decrease of the recruitment at high SSB levels. Scientific Council decided not to use $F_{max}$ in the Div. 3M cod case as the best $F_{msy}$ proxy due to the recruitment decline at low spawning stock sizes and probably Fmax overestimate $F_{msy}$.

The NAFO Study Group on Limit Reference considered that when a SR relationship or a production relationship cannot be determined from the available data, consideration should be given to SPR analysis as a means of determining $F_{msy}$. The determination of the appropriate %SPR for use as $F_{msy}$ depends on the biology of the population. %SPR of 35% should be used as a default $F_{lim}$ for such stocks in the absence of meta-analysis considerations or other considerations to suggest it should be higher or lower. Examination of the data for Div. 3M cod determined that a 30% SPR was the most appropriate proxy for $F_{msy}$.

***iii) Reference points for witch flounder in Div. 3NO (Item 6)***

*The Fisheries Commission requests the Scientific Council to provide reference points for Div. 3NO witch flounder including $B_{lim}$, $B_{msy}$ and $F_{msy}$ through modelling or proxies.*

The Scientific Council responded:

The average of the two highest Canadian spring research vessel survey points from 1984-2013 is considered to be a proxy for $B_{msy}$. 30% of this average is considered to be a proxy for $B_{lim}$. Following the same logic, a proxy for $F_{msy}$ (=$F_{lim}$) can be derived as 0.26 (based on catch/biomass ratio).

A variety of approaches were examined to determine limit reference points or proxies. A variety of formulations of a surplus production model in a Bayesian framework were examined but found not to be acceptable for determination of reference points at this time. Stock recruit data from the survey were considered but the early part of the time series which is comprised of surveys conducted with a gear that had a low catchability for small fish which meant that there were no recruitment indices during the time of higher stock size.

Another candidate for a proxy for a limit reference point is the lowest biomass from which there has previously been a rapid and sustained recovery ($B_{recover}$). However, this is a minimum standard for a reference point and not considered to be appropriate.

It was concluded that the best approach was to base the reference points on the longest survey series, the Canadian spring survey with the 1984-1990 estimates adjusted for depth coverage. The Canadian spring series is highly variable with large uncertainty in some years. However, it is the only index that extends from a period of higher stock size to the present. The Study Group on Limit Reference Points (SCS Doc. 04/12) determined that for data-poor stocks, "*the point at which a valid index of stock size has declined by 85% from the maximum observed index level provides a proxy for Blim, if that index of stock size commences prior to the start of the fishery. If the highest* *index of stock size is equal to* $B_{msy}$*, then it would be consistent for Blim to be 30% of that level. If the highest observed survey index is considered to be below* $B_{msy}$*, then this should be taken into account in a similar way".*

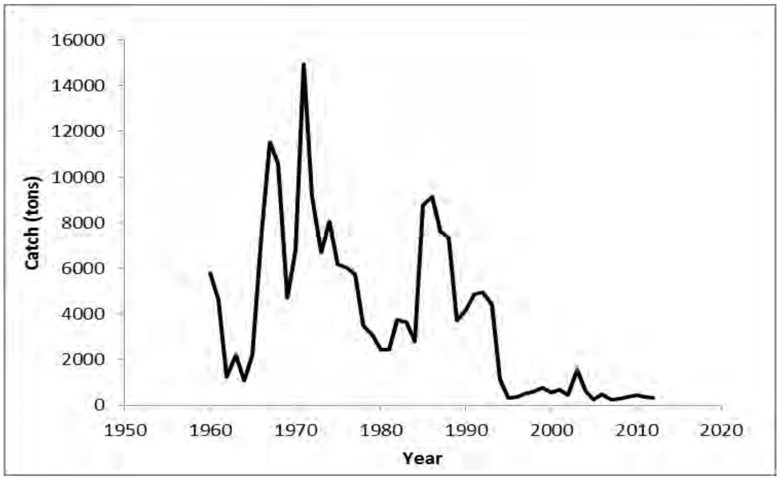



Fig. 3. Catch of Div. 3NO witch flounder.

The Canadian spring series begins in 1984. This is well after the beginning of the fishery on this stock (Fig. 3). The two highest Canadian spring research vessel survey points from 1984-2013 are considered to be a proxy for $B_{msy}$. 30% of this average is considered to be a proxy for $B_{lim}$ (9 200 ; Fig. 4). Following the same logic, a proxy for $F_{msy}$ ($=F_{lim}$) can be derived as 0.26 (based on catch/biomass ratio) (Fig. 5). Given uncertainties about the true status of the stock relative to $B_{msy}$ in the 1980s, the choice of the two highest points to provide a $B_{msy}$ proxy was considered as the most precautionary approach (Fig. 6).

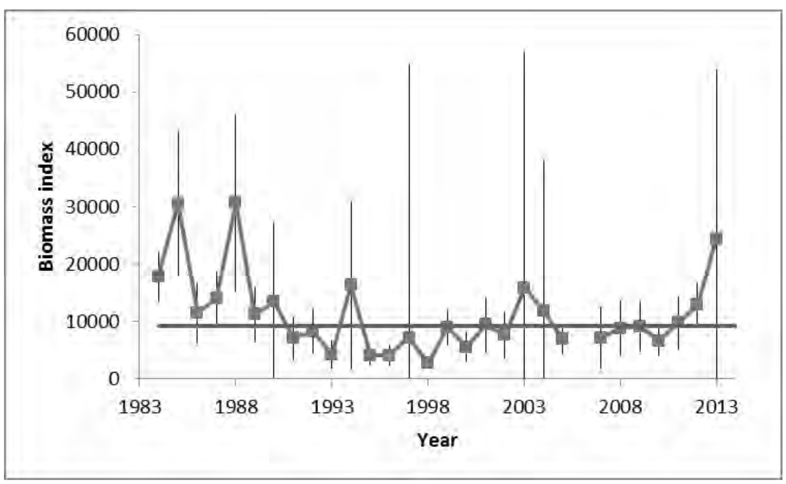



Fig. 4. Witch flounder in Div. 3NO: biomass index from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. The horizontal line is $B_{lim}$.

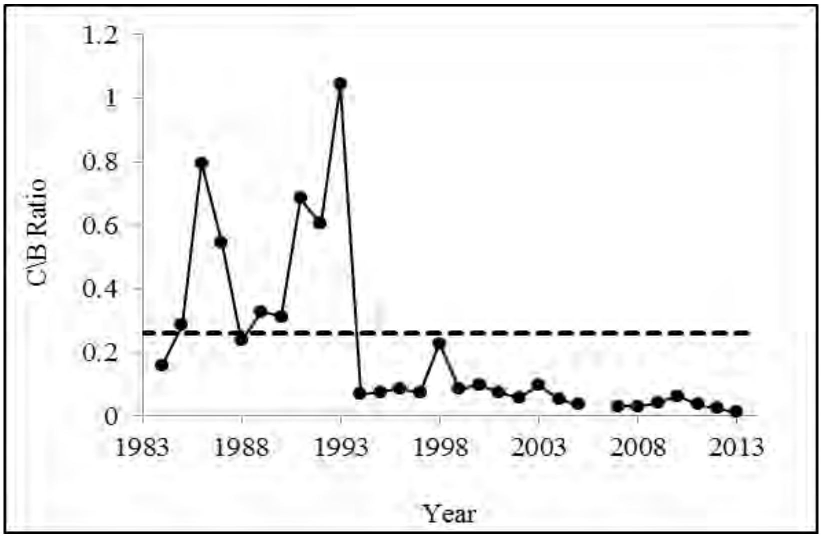



Fig. 5. Catch to biomass ratio for Div. 3NO witch flounder. The horizontal line is $F_{lim}$.

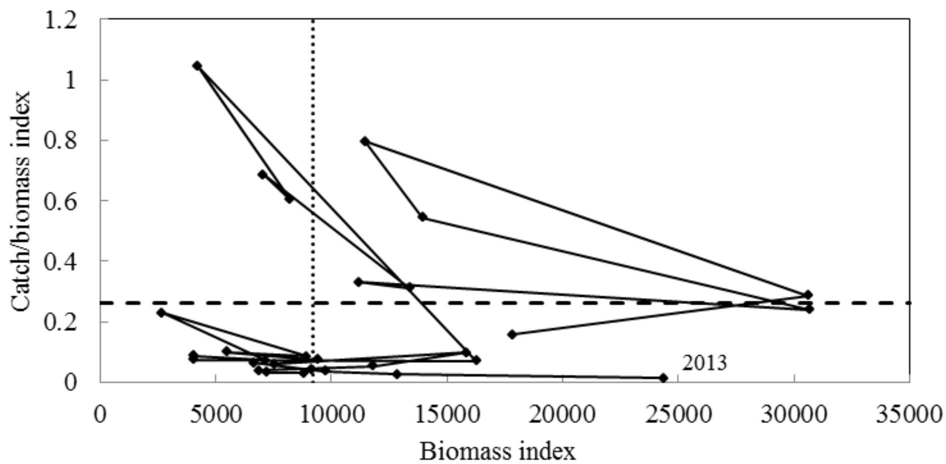



Fig. 6. Catch to biomass ratio and biomass index showing $B_{lim}$ (vertical line) and $F_{lim}$ (horizontal line)

***iv) Full assessment of cod in Div. 3M and advice for 2015 (Item 7)***

*The Fisheries Commission requests the Scientific Council to conduct a full assessment of Div. 3M cod and provide advice for 2015 on a range of management options and associated risks regarding reference points, according to Annexes A or B.*

Scientific Council responded:

**Cod in Division 3M** Advice June 2014 for 2015

**Recommendation for 2015**

In the short term the stock can sustain values of $F$ up to $F_{max}$, however any fishing mortality over $F_{max}$ will result in an overall loss in yield in the long term. Scientific Council considers that yields at $F_{statusquo}$ are not a viable option. Projections are heavily influenced by the 2010 and 2011 year classes, which is estimated to be extremely large, but with high uncertainty. Given the uncertainty in the projections, Scientific Council makes recommendations for 2015 only. The stock should be reassessed in 2015.

### Management objectives

A management strategy evaluation for this stock is being developed by Fisheries Commission and Scientific Council but is not yet being implemented. At this moment general convention objectives (NAFO/GC Doc 08/3) are applied.

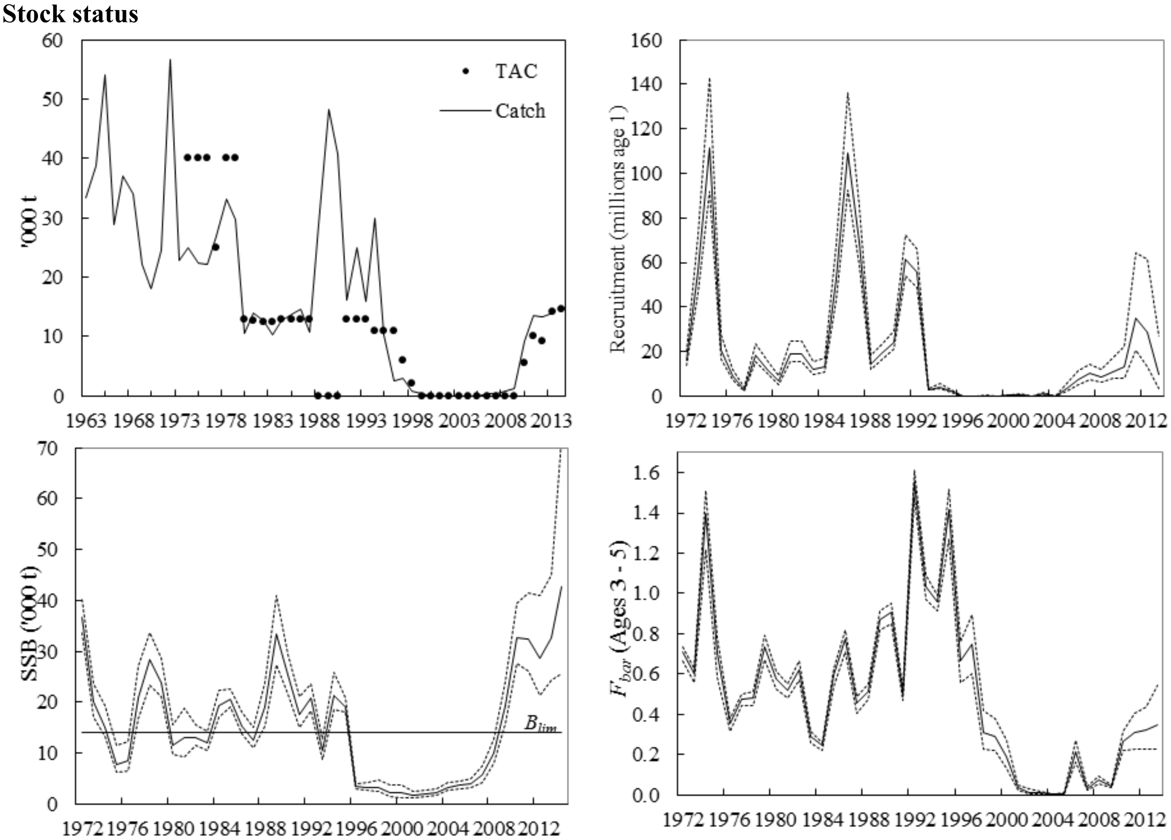
| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | | Stock increasing |
| Eliminate overfishing | | Current $F$ not sustainable in the long term |
| Apply Precautionary Approach | | $F_{lim}$ and $B_{lim}$ defined. HCR in development |
| Minimise harmful impacts on living marine resources and ecosystems | | No specific measures, general VME closures in effect |
| Preserve marine biodiversity | | Cannot be evaluated |

OK
Intermediate
Not accomplished
Unknown

### Management unit

The cod stock in Flemish Cap (NAFO Div. 3M) is considered to be a separate population.

### Stock status



**Stock Status (cont.)**

Current SSB is estimated to be well above $B_{lim}$. Recent recruitments are relatively high, but these estimates are imprecise. Fishing mortality in 2013 is high, at the level of more than twice $F_{max}$.

**Reference points**

| | |
|---|---|
| $B_{lim}$: | 14 000 t of spawning biomass (Scientific Council 2008). |
| $F_{lim} = F_{msy}$ ($F_{30\%}$): | 0.13 (developed in Scientific Council 2014 – not used in assessment at this time) |
| $F_{max}$: | 0.145 |

**Projections**

| | B | | | SSB | | | Yield | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5% | 50% | 95% | 5% | 50% | 95% | 5% | 50% | 95% |
| $F_{bar}$=$F_{0.1}$ (median = 0.090) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51148 | 85726 | 141169 | 33526 | 58334 | 96126 | 3717 | 7091 | 13216 |
| 2016 | 80488 | 140565 | 242288 | 50201 | 84280 | 140612 | | | |
| $F_{bar} = F_{max}$ (median = 0.145) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51007 | 85528 | 141921 | 33538 | 58341 | 96142 | 5804 | 10838 | 19894 |
| 2016 | 75911 | 134970 | 233068 | 47116 | 79646 | 133162 | | | |
| $F_{bar} = 2/3F_{max}$ (median = 0.097) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51600 | 85659 | 140511 | 33564 | 58355 | 96133 | 3984 | 7463 | 13901 |
| 2016 | 79919 | 139414 | 241557 | 49720 | 83828 | 140158 | | | |
| $F_{bar} = 3/4F_{max}$ (median = 0.109) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51451 | 85707 | 141013 | 33554 | 58302 | 96130 | 4449 | 8327 | 15461 |
| 2016 | 79064 | 138195 | 238799 | 49331 | 82737 | 138519 | | | |
| $F_{bar} = 0.85F_{max}$ (median = 0.123) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 50976 | 85605 | 140451 | 33567 | 58341 | 96114 | 4999 | 9351 | 17275 |
| 2016 | 77772 | 136555 | 239130 | 48233 | 81526 | 136327 | | | |
| $F_{bar} = 0.75F_{2013}$ (median = 0.259) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 50963 | 85988 | 141194 | 33526 | 58346 | 96068 | 12494 | 17926 | 27715 |
| 2016 | 68617 | 125904 | 226920 | 39178 | 70884 | 121773 | | | |
| $F_{bar} = F_{2013}$ (median = 0.346) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51451 | 85545 | 141194 | 33526 | 58346 | 96068 | 15768 | 22605 | 34554 |
| 2016 | 64236 | 119001 | 216119 | 35038 | 65093 | 113266 | | | |
| $F_{bar} = 1.25F_{2013}$ (median = 0.432) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51073 | 85533 | 139749 | 33535 | 58327 | 96233 | 18611 | 26799 | 40670 |
| 2016 | 59161 | 113669 | 207151 | 31681 | 60010 | 106017 | | | |

| | $p(B<B_{lim})$ | | | $p(F>F_{0.1})$ | | | $p(F>F_{max})$ | | | $p(B_{2016} > B_{2013})$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | |
| $F_{0.1}$ | <5% | <5% | <5% | | | | | | | >95% |
| $F_{max}$ | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $2/3F_{max}$ | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $3/4\ F_{max}$ | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $0.85F_{max}$ | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $0.75F_{2013}$ | <5% | <5% | <5% | >95% | >95% | | >95% | >95% | | >95% |
| $F_{2013}$ | <5% | <5% | <5% | >95% | >95% | | >95% | >95% | | >95% |
| $1.25F_{2013}$ | <5% | <5% | <5% | >95% | >95% | | >95% | >95% | | >95% |

**Assessment**
A quantitative model introduced in 2008 was used (Scientific Council 2008). Model settings were unchanged. Due to problems of estimating exact catches for 2011 and 2012, catches were estimated within the model. For 2013 catches, Scientific Council agreed Daily Catch Report (DCR) data were the best available estimate. The unavailability of independently verifiable catch estimates over 2011 – 2012 introduces an additional element of uncertainty in the assessment.

The next full assessment of this stock is planned for 2015.

*Human impact*
Mainly fishery related mortality. Other sources (e.g. pollution, shipping, oil-industry) are considered minor.

*Biological and environmental interactions*
Redfish, shrimp and smaller cod are important prey items for cod. Recent studies indicate strong trophic interactions between these species in the Flemish Cap.

**Fishery**
Cod is caught in a directed trawl fishery and as bycatch in the directed redfish fishery by trawlers. The fishery is regulated by quota. Recent catch estimates and TACs are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | 5.5 | 10 | 9.3 | 14.1 | 14.5 |
| STATLANT 21 | 0.0 | 0.1 | 0.1 | 0.4 | 1.2 | 5.3 | 9.8 | 9.0 | 11.2 | |
| STACFIS | 0.0 | 0.3 | 0.3 | 0.9 | 1.2 | 9.2 | 13.6[1] | 13.4[1] | 14.0[2] | |

[1] Estimated via the assessment model
[2] Daily Catch Reports

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

**Special comments**
In 2012 and 2013 the lack of length distributions and age-length keys from some contracting parties has further increased uncertainty in the current assessment.

Rapid changes in the biological parameters of this stock in recent years, and the sudden decrease in 2013 EU-survey indices, has led to the conclusion that last year's projections were overly optimistic. Similar revisions were noted in the 2012 assessment. If inter-annual variability continues, the accuracy of projections is reduced.

**Sources of information**
SCR Doc. 14/35, 14/17; SCS Doc. 14/06, 14/10, 14/13, 14/16, NAFO/GC Doc 08/3

***v) Development of MSE workplan for cod in Div. 3M (Item 8)***

*The Fisheries Commission requests the Scientific Council to develop a work plan to perform a Management Strategy Evaluation for Div. 3M cod, to explore operating models that could be used and report back through the Working Group on Risk-Based Management Strategies.*

NAFO Scientific Council reviewed the Div. 3M cod MSE proposed by the NAFO Fisheries Commission and Scientific Council Joint Working Group on Risk-Based Management Strategies (FC/SC RBMS). Scientific Council suggests some changes in the proposed MSE to reduce the high number of scenarios, and agreed a plan of work.

The Scientific Council discussed the way to carry out the simulations in the Div. 3M cod MSE. Scientific Council decided that the most appropriate data to implement the Div. 3M cod MSE should be the data used in the 2014 approved assessment. Scientific Council defined six different Operating Models (OM) based on different assumptions in the Stock/Recruitment relationship and different assumptions about Natural mortality (M) as the most appropriated for this case.

Scientific Council proposed some changes in the MSE proposed by the FC/SC RBMS to reduce this high number of scenarios and also proposed a Div. 3M cod MSE workplan.

Scientific Council decided that the most appropriated data to implement the Div. 3M cod MSE should be the data used in the 2014 approved assessment. Scientific Council defined six different Operating Models (OM) based in different assumptions in the Stock/Recruitment relationship and different assumptions about Natural mortality (M) as the most appropriated for this case. These OM are the following:

1. *M* constant, estimated by the model for all ages and for all years with the followings S/R functions:

    i. Recruitment independent of SSB.
    ii. Segmented Regression with Beta=Approved $B_{lim}$.
    iii. Segmented Regression fit with the assessment results.

2. *M* different, variable by time periods and age ranges with the followings S/R functions:

    i. Recruitment independent of SSB.
    ii. Segmented Regression with Beta=Approved $B_{lim}$.
    iii. Segmented Regression fit with the assessment results.

The model free HCR is a simple TAC adjustment strategy that uses the change in perceived status of the stock from research surveys to adjust the TAC accordingly. In the Div. 3M cod case we need to decide the survey indices, the age and the period to estimate the slope of the survey indices as well as the value for $\lambda$. The EU Flemish Cap Survey is the only research survey available to implement this HCR in the Div. 3M cod case. Scientific Council proposes to use the EU Flemish Cap Survey 3+ biomass index to implement the Model free HCR and to estimate the slope using the most recent 4 years. Scientific Council also recommended that the final values of the $\lambda$ parameter will be chosen after deterministic projections are conducted to understand how HCRs applying different $\lambda$ values perform.

Scientific Council decided that $F_{30\%}$ (% Spawner Per Recruit (SPR) relative to SPR at $F$=0) is the best $F_{msy}$ proxy at this moment to apply to the model HCR proposed.

Scientific Council recommends that the simulations period could be 20 years and that some of the Performance Objectives proposed by the FC/SC RBMS could be measure in a medium (5 years) and long term period (20 years).

In the Div. 3M cod MSE there are 6 OMs that cover part of the M and S/R uncertainty but due to the different requirements in the proposed HCRs 90 scenarios should be analyzed. This number of scenarios makes it very difficult to present the results in a clear way and it will probably be difficult to choice the best HCR. Scientific Council proposes, in order of priority, the following changes to reduce the high number of scenarios:

To remove the TAC 10% and 15% constraints of the HCR in a first stage and measure its importance creating a new performance statistics (PS) and performance targets (PT). This new PS will measure in the medium and long term the number of times that TAC(y) > TAC(y-1) + %TAC(y-1) and TAC(y) < TAC(y-1) - %TAC(y-1). The percentage levels that should be measured will be 10%, 15%. This PS would allow us to know the importance to impose a TAC constraint less than 20%. After analyze the results of this new PS we can decide the better constraint level to be tested. If this proposal is accepted the number scenarios to analyze will be reduced to 30.

The working group proposal for the model based HCR reads, "$F_{target}$ is defined as four different levels of $F_{msy}$, corresponding to probabilities of 20%, 30%, 40% and 50% of exceeding $F_{msy}$. If $F_{msy}$ is not available, an appropriate proxy should be used". Scientific Council proposed three different probability levels to be tested: 20%, 35% and 50%. With this proposal we reduce 6 scenarios and the final number of scenarios to be tested will be 24.

Taking into account the meetings schedule of the Scientific Council, the Fisheries Commission and the European Union project "Provision of advice on the development of a multiannual management plan and the evaluation of a management strategy for cod in NAFO Division 3M (SAFEwaters-2) Specific Contract No 2 (SI2.681887)" calendar, the Scientific Council proposes the following Div. 3M cod MSE workplan:

1. NAFO SC reviewed, during its 2014 June meeting, the Div. 3M cod MSE proposed by the NAFO Fisheries Commission and Scientific Council Joint Working Group on Risk-Based Management Strategies (FCSC RBMS). SC decided what will be the most appropriated data, Reference Points, Operating Models (OP) and Performance Statistics (PS) to carry out the proposed 3M cod MSE.

2. After the review and adoption of the MSE Inputs the SAFEwaters-2 project will carry out the quantitative simulations to evaluate the sustainability of the social and economic management objectives based on the MSE inputs agreed taking into account ecosystem interactions and the different fisheries. The results of these simulations will be available in March 2015.

3. FC/SC WGRBMS would be requested to review and comment on the results in its 2015 meeting before the 2015 SC June meeting and it can make a final proposal for the Div. 3M cod MSE.

4. NAFO SC will review during its 2015 June meeting the Div. 3M cod MSE final proposal of the FC/SC.

5. The final Div. 3M cod MSE will be presented to NAFO Fisheries Commission at its 2015 September meeting, to provide the TAC for 2016 based on the MSE.

***vi) Selectivity in Div. 3M cod and redfish fisheries (Item 9)***

*The Fisheries Commission requests the Scientific Council to analyze and provide advice on management measures that could improve selectivity in the Div. 3M cod and Div. 3M redfish fishery in the Flemish Cap in order to reduce possible by catches and discards. The objective is to reduce the mixed fisheries between cod and redfish, the by-catch of non-targeted stocks and to analyze if the selectivity pattern could be improved to reduce the catch of undersized fish.*

Scientific Council responded:

| |
|---|
| There was no new available information at this meeting on cod and redfish selectivity. |

At its September 2010 meeting Scientific Council analyzed the reduction in the mesh in the mid-water trawl fishery for redfish in Div. 3M. At that time Scientific Council concluded that for Div. 3M, the fish bycatch is low when the pelagic trawls are used well above the sea bed. However, it was also noted that some of the reported fish bycatch species were typically demersal species. This indicates that the newer pelagic trawls that are capable of fishing very near bottom could have bycatch concerns.

At its 2013 June meeting, Scientific Council considered the work done in the ICES Working Group on Fishing Technology and Fish Behaviour (WGFTFB) during the recent years (2010-2012) and one published paper related to this matter (Herrmann *et al.,* 2012. "Understanding the Size Selectivity of Redfish (*Sebastes* spp.) in North Atlantic Trawl Codends." Journal of Northwest Atlantic Fishery Science, 44: 1–13). The main conclusions were that the consequences resulting from a decrease in mesh size in the mid-water trawl fishery for redfish in Div. 3LN to 90mm will be a decrease in $L_{50}$ (length at which 50% of fish entering the cod-end are retained) from 34cm to 25cm, but the selection range ($L_{75}$-$L_{25}$) will decrease from 6.6 to 4.4cm.

The cod fishery in Div. 3M was opened in 2010 after 10 years closed. Since then there have not been available studies on the selectivity of this fishery.

***vii) Availability of data and progress towards quantitative assessments (Item 10)***

*The Scientific Council provides advice for a number of stocks based only on qualitative assessments of survey trends and catches (e.g. Div. 3NO white hake, Div. 3O redfish). For some of these stocks the advice is to lower the TAC to recent level of catches. On the other hand, there is an important effort in biological sampling, collection of fishing activity data and fishery independent surveys. There is also an important progress in providing more data to the Scientific Council such as VMS. In spite of these efforts, no progress has been reached regarding quantitative assessments of many stocks. The Fisheries Commission requests the Scientific Council to provide an overview for all stocks on what biological and fishery information is currently available by Contracting Party and what is necessary to improve in terms of data collection in order to develop quantitative assessments and biological reference points for stocks managed by NAFO.*

Scientific Council deferred this request to its September meeting.

***viii) Development of MSE for redfish in Div. 3LN (Item 11)***

*The Fisheries Commission requests the Scientific Council to explore models that could be used to conduct a Management Strategy Evaluation for Div. 3LN redfish and report back through the Working Group on Risk-Based Management Strategies during their next meeting.*

Further to this the FC/SC WG on Risk Based Management Strategies (FC-SC Doc. 14/02) made the following recommendation:

*The WG* ***recommends*** *SC discuss selection of operating models and evaluate the Div. 3LN Redfish management strategy relative to the performance statistics prior to the 2014 Annual Meeting (Annex 7).*

Scientific Council responded

Models to conduct a Management Strategy Evaluation for Div. 3LN redfish were developed. The management strategy proposed by the FC-SC WG on Risk Based Management Strategies was tested and found to meet the specified management objectives and performance statistics.

Scientific Council considered a range of operating models (OM) all based on versions of the Schaeffer surplus production model. The following set of OMs was chosen for the MSE:

i. old stock assessment model updated to 2014 (ASPIC 2012)

ii new stock assessment model (ASPIC 2014)

iii. "ASPIC2012-like" surplus production model in a Bayesian framework (same constraints on parameters)

iv. "ASPIC-like" new stock assessment in a Bayesian framework (ASPIC 2014 fixed MSY)

v. Surplus production model in a Bayesian framework with all data sets, minimum constraints

vi. A spatially disaggregated surplus production model in a Bayesian framework (treating carrying capacity in Div. 3L and 3N separately)

The MSE considered the harvest control rule (HCR) proposed by the WGRBM as well as three other HCRs.
HCR1 stepwise: (from WGRBM)

Increase the TAC in constant increments starting in 2015 – i.e. $TAC_{y+1} = TAC_y + 1\ 900t$ to a maximum of 20 000t. This would provide the following annual TACs:

2015: 8 900
2016: 10 800
2017: 12 700
2018: 14 600
2019: 16 500
2020: 18 400
2021: 20 000

HCR2 stepwise slow: this HCR is designed to reach 18 100 t of annual catch by 2019-2020 through a stepwise biannual catch increase, with the same amount of increase every two years between 2015 and 2020. 18 100 t is the equilibrium yield in 2014 assessment under the assumption of an MSY of 21 000 t.

2015: 10 400
2016: 10 400
2017: 14 200
2018: 14 200
2019: 18 100
2020: 18 100

HCR3: Constant catch (20 000 t)

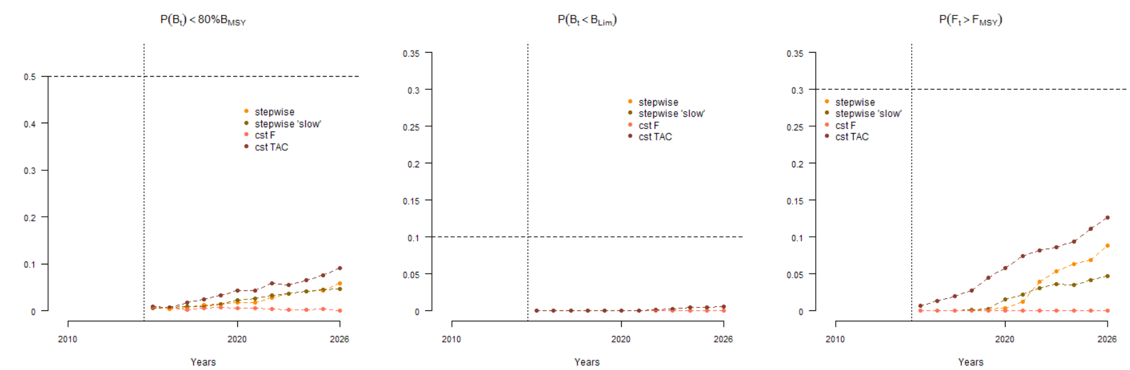
HCR4: Constant $F$ (2/3 of $F_{MSY}$)

The performance statistics used to evaluate the performance of the HCRs were as in FC-SC Doc. 14/02:

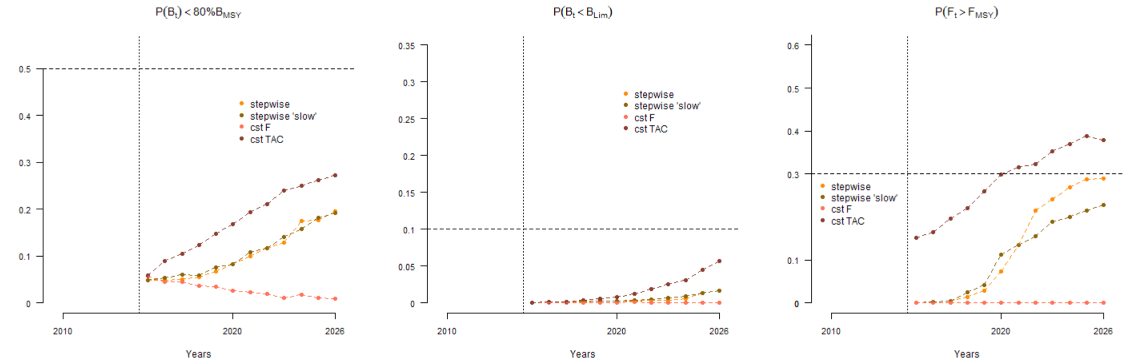
i. Low (30%) probability of exceeding $F_{msy}$ in any year
ii. Very low (10%) probability of declining below $B_{lim}$ in the next 7 years
iii. Less than 50% probability of declining below 80% $B_{msy}$ in the next 7 years

Projections of population size were conducted for each OM using each HCR and the probability of transgressing the performance statistics calculated. In the figures below the probabilities of transgressing each performance statistic are given for each operating model and HCR. In the plots 'stepwise' is the HCR proposed by the FC/SC WGRBMS, 'stepwise slow' is HCR2 which has an increase in TAC every two years to a maximum of 18 100 t, 'cst TAC' is a constant catch of 20 000 t, and 'cst F' is a constant $F$ of 2/3 $F_{msy}$.

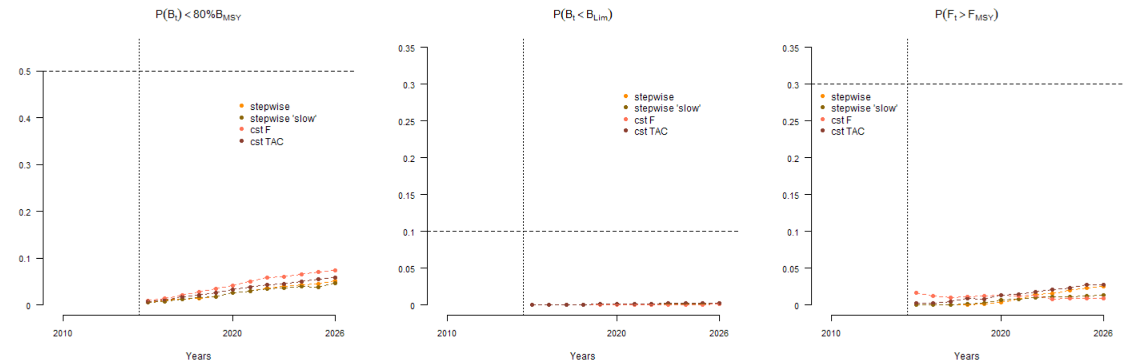
*OM1 ASPIC 2012*



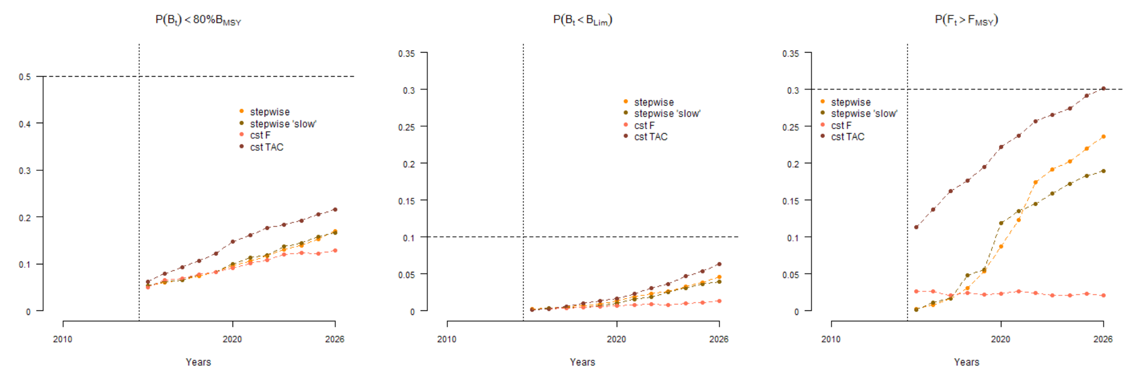
*OM2 ASPIC 2014*



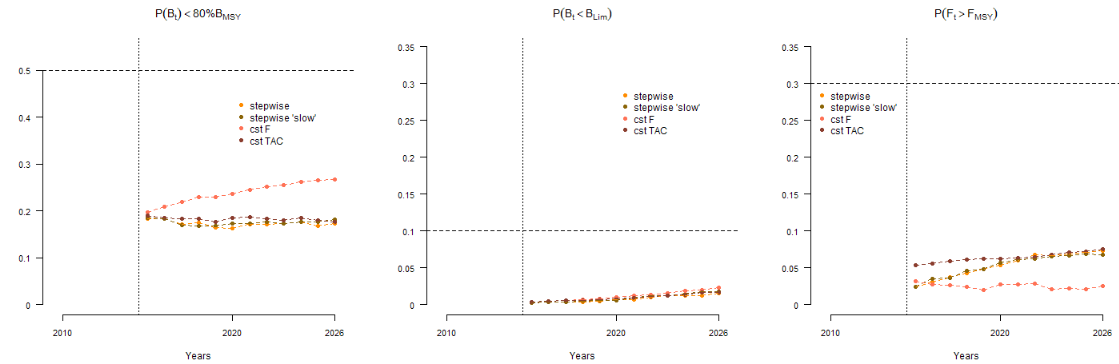

*OM3 Bayesian ASPIC 2012 like*



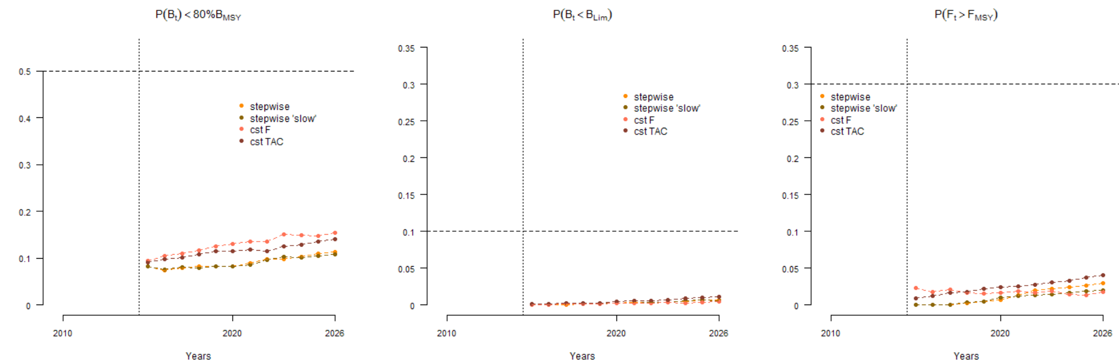

*OM4 Bayesian ASPIC 2014 like*



*OM5 Bayesian surplus production model minimum constraints*




*OM6*




Of the HCRs tested, only the constant catch of 20 000 t rule failed to meet the performance statistics on all OM. This HCR had greater than 30% probability of exceeding $F_{msy}$ by the end of the projection period for OM 2 and OM 4, the two operating models based on an MSY of 21 000 t. The HCR proposed by the FC-SC WGRBMS meets all performance statistics on all OM.

Scientific Council notes the uncertainty in performing long term projections. If a long term management strategy is implemented for this stock, Scientific Council will continue to monitor its performance through trends in the survey indices and every two years, by conducting a full assessment. If the assessment results indicate deterioration in stock status such that the probability of transgressing the performance statistics exceeds the probabilities outlined in the MSE, or if catches exceed the TACs defined in the harvest control rule, then exceptional circumstance will be considered to be occurring. Scientific Council will provide advice on other exceptional circumstances at a later date.

***ix) Risk assessment for SAI on VME elements and species (Item 12)***

*The Fisheries Commission requests the Scientific Council to continue to develop work on Significant Adverse Impacts in support of the reassessment of NAFO bottom fishing activities required in 2016, specifically an assessment of the risk associated with bottom fishing activities on known and predicted VME species and elements in the NRA.*

The Scientific Council responded:

> Scientific Council notes that work on significant adverse impacts on VME is on-going and that final results are not due until 2016, and indicates that good progress is been made. These analyses involved the production of fishery pressure layers based on VMS data, and VME biomass layers from RV surveys. Preliminary results indicated the important fractions of the recent effort are exerted in relatively small regions within the fishing footprint, and at least for some areas, this fishing effort seems to be concentrated in the near neighborhood of VMEs, suggesting a potential functional connection between some VMEs and commercially exploited fish species. This and other issues will continue to be explored as part of the process of developing the assessment of bottom fishing activities due in 2016. Specifically, the adopted approach has to be refined to take account of known and predicted VME habitat evaluated as part of the review of fishery closures.

As part of a past FC Request, SC developed a work-plan to achieve the reassessment of all NAFO fisheries by September 2016 and every 5 years thereafter, identifying the necessary steps to be taken, as well as the information and resources to do so. This work-plan has been updated, and specific leads were identified to progress the required fisheries assessment tasks. The plan also indicates how the assessment tasks relate to the FAO criteria for the assessment of SAI which are:

i. the intensity or severity of the impact at the specific site being affected;
ii. the spatial extent of the impact relative to the availability of the habitat type affected
iii. the sensitivity/vulnerability of the ecosystem to the impact;
iv. the ability of an ecosystem to recover from harm, and the rate of such recovery;
v. the extent to which ecosystem functions may be altered by the impact; and
vi. the timing and duration of the impact relative to the period in which a species needs the habitat during one or more of its life history stages

The proposed work-plan of fishery assessment tasks in relation to FAO criteria and the tasks to be undertaken is as follows:

| No. | Fisheries Assessment Task | FAO Criteria | Approach | Lead |
|---|---|---|---|---|
| 1 | Type(s) of fishing conducted or contemplated, including vessels and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing (harvesting plan) | i | Information and data is required to describe the fleet activities spatially and temporally. This will require integrating VMS data with information on the fishery e.g. fleet register and catch. NAFO has the catch data for the different gear types/fisheries.<br><br>It was agreed that WGESA will work with NAFO Secretariat to prepare a fisheries data table which can be integrated with the existing VMS data records.<br><br>Additional long time-series catch/landings data will be summarised at the highest possible spatial resolution.<br><br>The fisheries data table will be produced before WGESA 2014 and linked to the VMS data for the period 2008 – 2013. | WGESA with input from NAFO Secretariat for presentation and approval by Scientific Council and STACFIS in 2015. |

| | | | | |
|---|---|---|---|---|
| 2 | Existing baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes can be compared | i, ii, iii | The outcome of the "review of fisheries closures" should provide much of the seabed habitat data necessary to address this task.<br><br>Additional spatial data from the AZMP ecoregion analysis should be integrated with the detailed habitat maps within the NRA to provide broad-scale spatial context. For the NRA as a region. Also analyse the environmental data from the NRA used as part of the habitat suitability modelling so as to assess possible dominant fisheries habitat associations.<br><br>Time series analysis of the oceanography is required, e.g. long-term changes in production potential, SST, etc. This should include the work of STACFEN in relation to assessing the long-term physical oceanography.<br><br>The data sources (above) will be identified and collated and a summary meta-data table compiled for presentation at WGESA 2014. | WGESA with input from AZMP and STACFEN, for presentation and approval by Scientific Council and STACFEN in 2015. |
| 3 | Identification, description and mapping of VMEs known or likely to occur in the fishing area | iii | The outcome of the "review of fisheries closures" should provide much (if not all) of the necessary information. In addition further work to develop habitat suitability models for VME in the NRA will be useful. E.g. for VME indicator species or assemblages of VME indicator species.<br><br>At the WGESA meeting in 2014 a plan of what additional information should or could be included in the assessment should be made. | SC WGESA |
| 4 | Identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs | i, ii | The work undertaken to address FC Request 16 (2012) and FC Request 12 (2013) by Scientific Council contributes to this task.<br><br>We interpret this as the impact of the fishery on VME's.<br><br>We have started to integrate the fishing effort layers (2008 – 2012) with known and predicted VME (from the review) to show which areas (that correspond to a certain level of fishing effort) are at risk of SAI as they are not part of current closed areas. | SC WGESA |

| | | | | |
|---|---|---|---|---|
| 5 | Consideration of VME elements known to occur in the fishing area | iii | The outcome of the "review of fisheries closures" should provide much (if not all) of the necessary information.<br><br>An evaluation of the VME elements in relation to their potential to support VME indicator species should be investigated, possibly using model output – this will be considered and developed at WGESA 2014. | SC WGESA |
| 6 | Data and methods used to identify, describe and assess the impacts of the activity, the identification of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment | N/A | To be done in due course | SC WGESA |
| 7 | Risk assessment of likely impacts by the fishing operations to determine which impacts on VMEs are likely to be significant adverse impacts | ii, iii, iv, v | The work undertaken to address FC Request 16 (2012) and FC Request 12 (2013) by Scientific Council contributes to this task.<br><br>The development of a risk assessment framework to be planned at WGESA 2014.<br><br>We have started to integrate the fishing effort layers (2008 – 2012) with combined VME species biomass layers (2005 – 2013) to show which areas (that correspond to a certain level of fishing effort) are at greater risk of fishing impact.<br><br>Further work is required to model the biomass of VME species whose presence is predicted at levels below VME thresholds. The predicted biomass can then be compared to observed biomass values in areas of fishing activity. This difference can be used to assess the potential for SAI outside closed areas.<br><br>Furthermore, a method for assessing the resilience of the VME indicator taxa from a combination of fishing pressure and biomass for the same assemblage should be explored – this should be initiated at WGESA 2014.<br><br>Finally, function can be inferred by examining the proximity of fishing effort (percentiles) to known VME, e.g. more effort (by fleet sector) near to VME. In addition, an assessment of the long-time series of catches (over several decades) in relation to predicted VME extent could be examined.<br><br>Use of available commercial fishing data on by-catch could also be useful for validating model results. | SC WGESA |

| | | | | |
|---|---|---|---|---|
| 8 | The proposed mitigation and management measures to be used to prevent significant adverse impacts on VMEs, and the measures to be used to monitor effects of the fishing operations | N/A | To be done in due course<br><br>WGESA should provide some possible options at WGESA 2015 | Joint FC/SC Working Group on the Ecosystem Approach Framework to Fisheries Management |

***x) Summary of data available for identification of VMEs and prioritization of areas (Item 13a)***

*Considering that the current closures for VME indicators (i.e. species and elements in Annex I.E VI and VII) established under Chapter II of the NAFO Conservation and Enforcement Measures (NCEM) are due for revision in 2014, the Fisheries Commission requests the Scientific Council to:*

*a. Summarize and assess all the data available collected through the NEREIDA project, CP RV surveys, and any other suitable source of information, to identify VMEs in the NRA, in accordance to FAO Guidelines and NCEM.*

*b. Based on these analyses, evaluate and provide advice in the context of current closures specified in the NCEM for the protection of VMEs and prioritize areas for consideration by the Ecosystem Approach to Fisheries Working Group.*

Scientific Council responded:

**Summary of Data Sources**

Data available were obtained from research vessel trawl surveys, benthic imagery collected through the NEREIDA program, and from NEREIDA box cores samples, and rock and scallop dredges.

The data available to Scientific Council are listed below. This included research vessel trawl surveys (Table 1), benthic imagery collected through the NEREIDA program (Table 2 and Table 3) and from NEREIDA box cores samples (Table 4) and rock and scallop dredges (Table 5).

Table 1. Data sources from contracting party research vessel surveys; EU, European Union; DFO, Department of Fisheries and Oceans; NL, Newfoundland and Labrador; IEO, Instituto Español de Oceanografia; IIM, Instituto de Investigaciones Marinas; IPMA, Instituto Português do Mar e da Atmosfera.

| **Programme** | **Period** | **NAFO Division** | **Gear** | **Mesh size in codend liner (mm)** | **Trawl duration (min)** | **Average wingspread (m)** |
|---|---|---|---|---|---|---|
| Spanish 3NO Survey (IEO) | 2002 - 2013 | 3NO | Campelen 1800 | 20 | 30 | 24.2 – 31.9 |
| EU Flemish Cap Survey (IEO, IIM, IPMA) | 2003 - 2013 | 3M | Lofoten | 35 | 30 | 13.89 |
| Spanish 3L Survey (IEO) | 2003 - 2013 | 3L | Campelen 1800 | 20 | 30 | 24.2 – 31.9 |
| DFO NL Multi-species Surveys (DFO) | 1995 - 2012 | 3LNO | Campelen 1800 | 12.7 | 15 | 15 - 20 |

Table 2 Summary of the benthic imagery collected and analyzed from the CCGS Hudson NEREIDA 2009 cruise to the Flemish Cap area

| **Location** | **Transect ID** | **Inside closure?** | **Gear** | **Transect length (m)** | **Depth range (m)** | **# Photos** |
|---|---|---|---|---|---|---|
| Sackville Spur | 11 | Mostly | 4KCam | 6 211 | 1080 – 1545 | 167 |
| | 12 | Yes | 4KCam | 6 343 | 1313 – 1723 | 172 |
| | 18 | Yes | 4KCam | 5 238 | 1336 – 1478 | 92 |
| | 24 | Yes | 4KCam | 4 974 | 1290 – 1427 | 145 |
| | 26 | Yes | 4KCam | 3 212 | 1381 - 1409 | 38 |
| Flemish Pass area | 28 | No | Campod | 2 431 | 461 - 479 | 92 |
| | 29 | No | Campod | 3 197 | 444 - 471 | 132 |
| | 30 | No | 4KCam | 6 101 | 455 - 940 | 174 |
| | 38 | Yes | 4KCam | 2 978 | 1328 - 1411 | 75 |

Table 3. Summary of the benthic video collected and analyzed using the ROV ROPOS in 2010 during the CCGS *Hudson* NEREIDA cruise to the Flemish Cap (FC) area.

| Location | Transect ID | Inside closure? | Transect length (m) | Depth range (m) | Analysis details |
|---|---|---|---|---|---|
| Southern FC slope | 1335 | No | 8,292 | 873 – 1,853 | Explorer mode. Analyzed in detail; frame by frame. |
| | 1336 | No | 11,555 | 2,212 – 2,970 | Explorer mode. Transect not analyzed in detail ('live' recordings summarized). |
| Southeast FC slope | 1337 | No | 14,475 | 1,011 – 2,191 | Transect and explorer mode. Explorer mode analyzed frame by frame; every 10 m analyzed for transect modes. |
| | 1338 | Yes | 11,195 | 1,029 – 1,088 | Explorer and transect. Three lines were analyzed (1 trawled, 2 untrawled) every 10 m for the abundance of sponges and corals. Non-coral and sponge observations extracted from 'live' recordings. |
| Northeast FC slope | 1339 | Yes | 8,624 | 1,344 – 2,462 | Explorer mode. Data extracted from 10 m intervals. |

Table 4. Summary of the box cores samples collected and analyzed from the NEREIDA Programme on board the RV *Miguel Oliver*.

| Programme | Period | NAFO Division | Gear | Data extracted | Number of samples |
|---|---|---|---|---|---|
| NEREIDA | 2009-2010 | 3LMN | Box-corer | Epibenthos visible on box-corer surface photograph | 331 |

Table 5. Summary of the rock dredge and scallop gear sets collected and analyzed from the NEREIDA Programme on board the RV *Miguel Oliver*.

| Programme | Period | NAFO Division | Depth range (m) | Gear | N valid sets | Trawl duration (min) |
|---|---|---|---|---|---|---|
| NEREIDA | 2009 – 2010 | 3LMN | 502 - 1991 | Rock dredge | 88 | 15 |
| NEREIDA | 2009 | 3M | 870 - 1137 | Scallop gear | 7 | 15 |

**Review of Current Closures**

Using all available information Scientific Council determined VME areas in the NRA, and compared these areas with the current sponges, corals, and seamount protection zones. The coverage of the VMEs provided by the protection zones varied depending on location and VME taxa. VMEs inside and outside existing closures were identified. Based on the characteristics of the VMEs, the overall coverage provided by existing protection zones, and the threat level inferred from current fishing effort patterns, a set of priorities for management consideration by WGEAFFM is provided as requested.

**Definitions: Distributions, VMEs, VME Indicators and VME elements**

The FAO *International Guidelines for the Management of Deep-sea Fisheries in the High Seas* (FAO, 2009) provide general tools and considerations for the identification of Vulnerable Marine Ecosystems (VMEs).

In relation to VMEs, the FAO Guidelines indicate that vulnerability is related to the likelihood that a population, community, or habitat will experience substantial alteration from short-term or chronic disturbance, and the likelihood that it would recover and in what time frame.

Although no formal definitions for VMEs, VME indicators, or VME elements are provided, the FAO Guidelines indicate that VMEs should be identified based on the characteristics they possess, providing criteria that should be used, individually or in combination, for the identification process.

When identifying VMEs, the FAO Guidelines indicate that species groups, communities, habitats, and features often display characteristics consistent with possible VMEs, but they clearly state that merely detecting the presence of an element itself is not sufficient to identify a VME. This has two related and important implications:

a) the full spatial distribution of a species that meet the VME criteria does not constitute a VME

b) actual VMEs must possess a level of organization larger than the scale of a singular/individual presence.

Another important consideration is that areas where VMEs are likely to occur should also be identified. These VME elements are topographical, hydrophysical or geological features, including fragile geological structures, that potentially support species groups or communities that qualify as VMEs.

In this general context, NAFO has followed the FAO guidelines in defining and identifying:

- ***VME indicator species***. These are species that met one or more of the FAO Guidelines criteria for possible VMEs. Their simple presence is not an automatic indication of VMEs, but when found in significant aggregations with conspecifics, or other VME indicator species, can constitute a VME. NAFO has approved a list of taxa that qualify as VME indicator species (NCEM Annex I.E.VI).
- ***VME elements***. These are topographical, hydrophysical or geological features which are associated with VME indicator species in a global context and have the potential to support VMEs. NAFO has approved a list of features that qualify as physical VME indicator elements (NCEM Annex I.E.VII).
- ***Higher concentration observations of VME indicator species (a.k.a. "Significant concentrations")***. These are specific locations where there are individual records of VME indicator species at densities at or above a threshold value that, for that specific VME indicator species, is associated with the formation of highly aggregated groups of that species. These higher concentration locations have been the basis for the delineation of the polygons referred as "Areas of higher sponge and coral concentrations" in NCEM Article 16.5, which are closed to bottom fishing activities. Although NAFO has protected areas containing higher concentration observations of VME indicator species, it has not defined VMEs proper. Furthermore, all VME indicator species to date have been identified under the structure-forming criterion, in that they create structural habitats for other species and are thought to enhance biodiversity.
- ***Vulnerable Marine Ecosystem (VME).*** Under the structure-forming criterion, a VME is a regional habitat that contains VME indicator species at or above significant concentration levels. These habitats are structurally complex, characterized by higher diversities and/or different benthic communities, and provide a platform for ecosystem functions/processes closely linked to these characteristics.

NAFO Scientific Council has used the quantitative methods to determine VMEs. The spatial scale of these habitats is often larger than the footprint of a higher concentration observation. VMEs occur throughout the NRA and their spatial arrangement may be important to recruitment processes and to overall ecosystem function.

**Method used to determine VME Areas**

The primary tool used to quantitatively determine VMEs is kernel density analysis. This analysis identifies "hotspots" in the biomass distribution derived from research vessel trawl survey data, by looking at natural breaks in the spatial distribution associated with changes in local density. These natural breaks allow defining of significant area polygons.

*What does the method show?*

- Potential Areas of VMEs according to the definition.

*What are the limitations?*

- The method has limited spatial resolution, in particular, the delineation of borders for the VME areas are uncertain.

If to be used as a basis for making management decisions *e.g.* on the closing or opening of areas, these results are to be regarded as a first step.

It would be expected that depth contours, type of substrate, current and temperature fields, etc. will shape the fine scale boundary. The general locations given by the kernel method is our current best approach to determining the VME.

For some VME indicator species, new models of species distribution are in development and in some instances, these models could help inform the discussion on fine scale boundaries. Further refinement of these models is necessary.

*Application*

Although for most VME indicator species analytical methods were used, in some cases, the data available only allowed simple distribution maps to be produced.

The base analyses used for each VME indicator species were:

1. Sponge grounds: kernel analyses
2. Large gorgonian corals: kernel analyses
3. Small gorgonian corals: kernel analyses
4. Sea pens: kernel analyses
5. Erect Bryozoans: kernel analyses
6. Large sea squirts: kernel analyses
7. Cerianthid Anemones: distribution
8. Crinoids: distribution

Black Coral is not a VME indicator species in NAFO, but has been used as such in other regions.

**Review of Closed Areas in the NRA**

For each of the existing closed areas in the NRA an evaluation of the existing VMEs in the neighbouring region is provided. To assist in this process three maps are presented for each general area. In the first map all VMEs (VME polygons with associated catches within them for sponges, large and small gorgonian corals and sea pens), significant concentrations of other VME taxa (erect bryozoans, large sea squirts) and presence of biological VME indicator taxa (Crinoidea, tube dwelling anemones). This same map is reproduced with the available VMS data (2010 – mid 2013) overlain to show the current fishing patterns. The last map shows the location of the VME elements and NEREIDA multibeam data where available.

**Division 3O Coral Closure**

*Comment*: Only the portion of Div. 3O in the NRA has been considered in the analyses based on the request from Fisheries Commission. Kernel density analyses for sponges, large and small gorgonian corals and sea pens has been done within the Canadian EEZ; this information has been published.

*Summary* (Fig. 7): Sea pen and small gorgonian VME are found immediately adjacent to the existing closure.

*VME elements*: shelf indenting canyons and canyons with heads > 400 m in the closed area have potential to have VME; Only a partial picture of the canyons is available due to the extent of the NEREIDA multibeam bathymetric data coverage.

VMS data show high density of fishing activity close to the VME areas outside the closure.

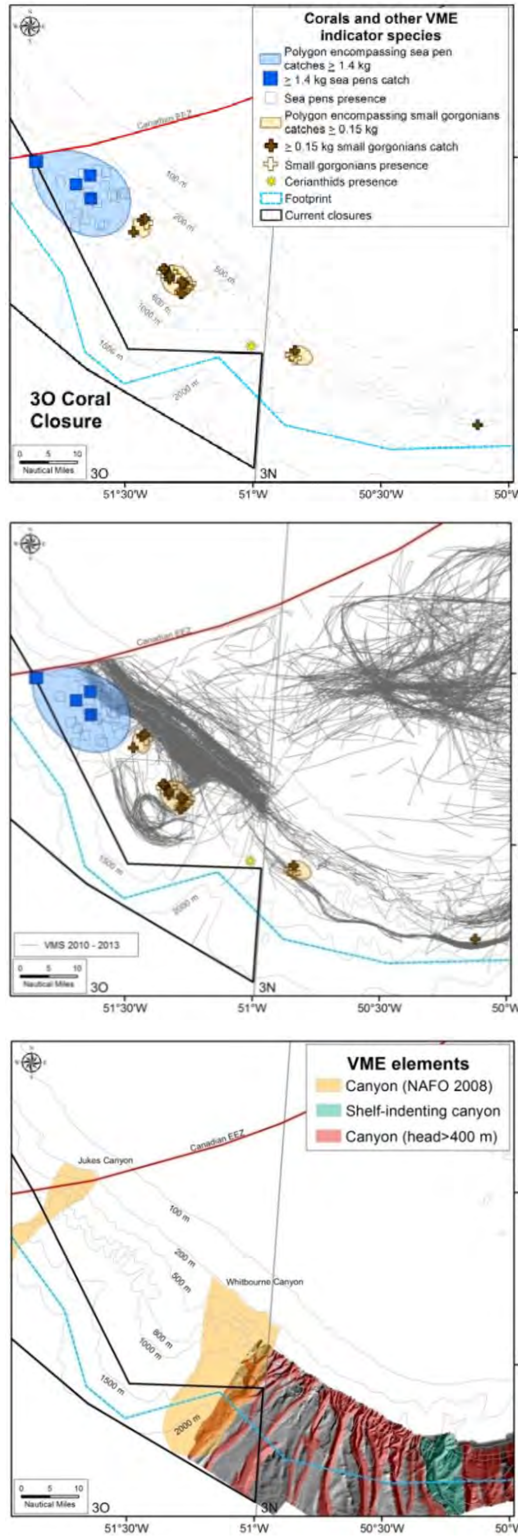



Fig. 7. Area of 3O Coral Closure. VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Area 1 Tail of the Bank**

*Summary* (Fig. 8): A portion of sponge VME is inside the closed area.

Relatively uncommon in the NRA, but locally spatially extensive, areas of significant concentrations of stalked tunicates (large sea squirts) and bryozoans are found in an area adjacent to significant fishing activity. The close proximity of the large gorgonian coral VME, small gorgonian VME and presence of crinoids with the significant concentrations of sea squirts and bryozoans is an assemblage of features not observed elsewhere in the NRA. This area also appears to have a different geomorphology in that there is a high concentration of canyons indenting the shelf than in other areas along the slope.

*VME Elements*: Physical VME elements in the area are the Southeast Shoal, canyons and shelf-indenting canyons.

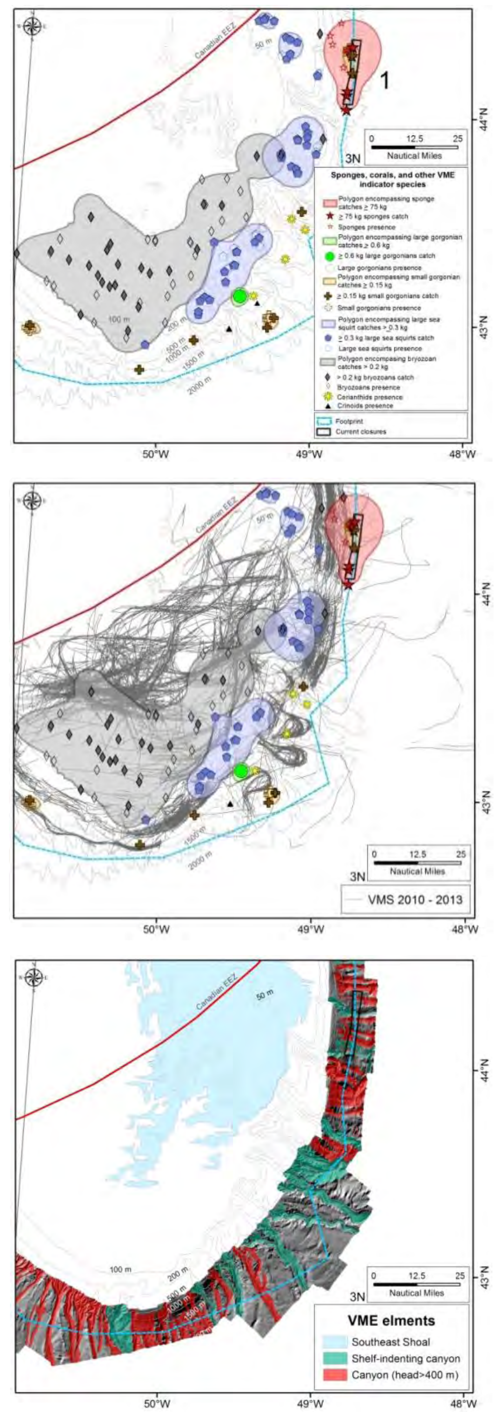



Fig. 8. Area 1. VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Area 2 Flemish Pass/Eastern Canyon Southern Portion**

*Summary* (Fig. 9): The closure is capturing most of high concentration locations within the broader sponges ground VME. Sponge catches and, high concentration locations of large gorgonians and sea pen catches occur outside the closed area.

*VME Elements*: Physical VME elements in the area are canyons, and shelf-indenting canyons.

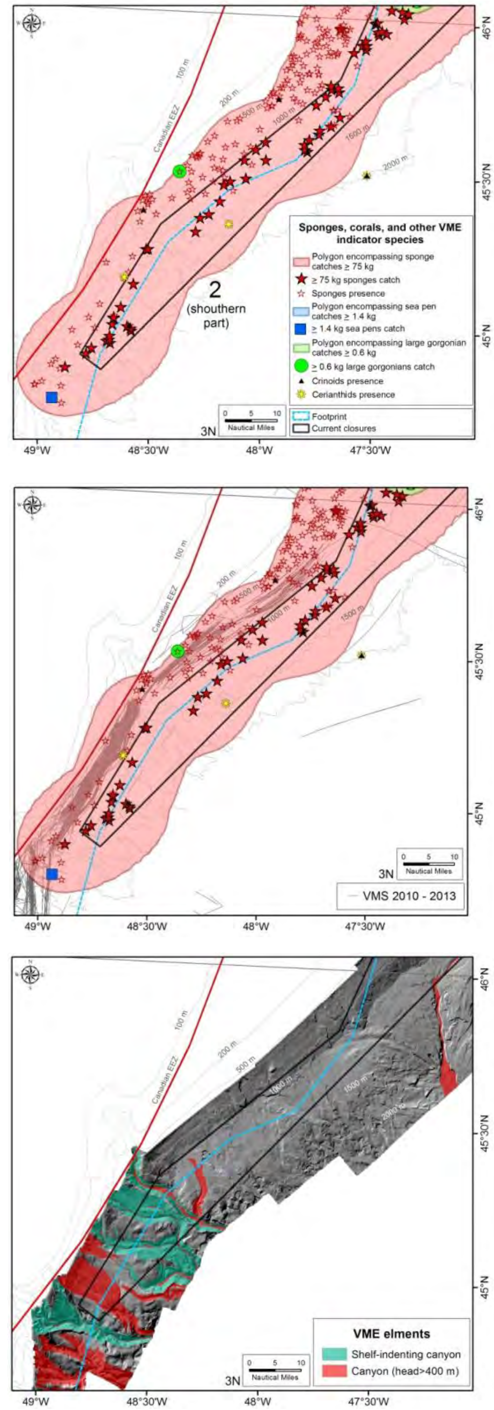



Fig. 9. Area 2 Southern Portion. VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Area 2 Upper Flemish Pass Portion and Area 3 Beothuk Knoll**

*Summary for Area 2 Upper Flemish Pass Portion* (Fig. 10): Large gorgonian coral areas are covered by the closure. VME of large gorgonians, sponges and seapens have been identified outside of the closure.

*VME Elements*: Physical VME elements include the Beothuk Knoll, steep flanks, and canyons with heads greater than 400 m.

*Summary Area 3 Beothuk Knoll* (Figure 4): High concentrations of sponges are covered by the closure.

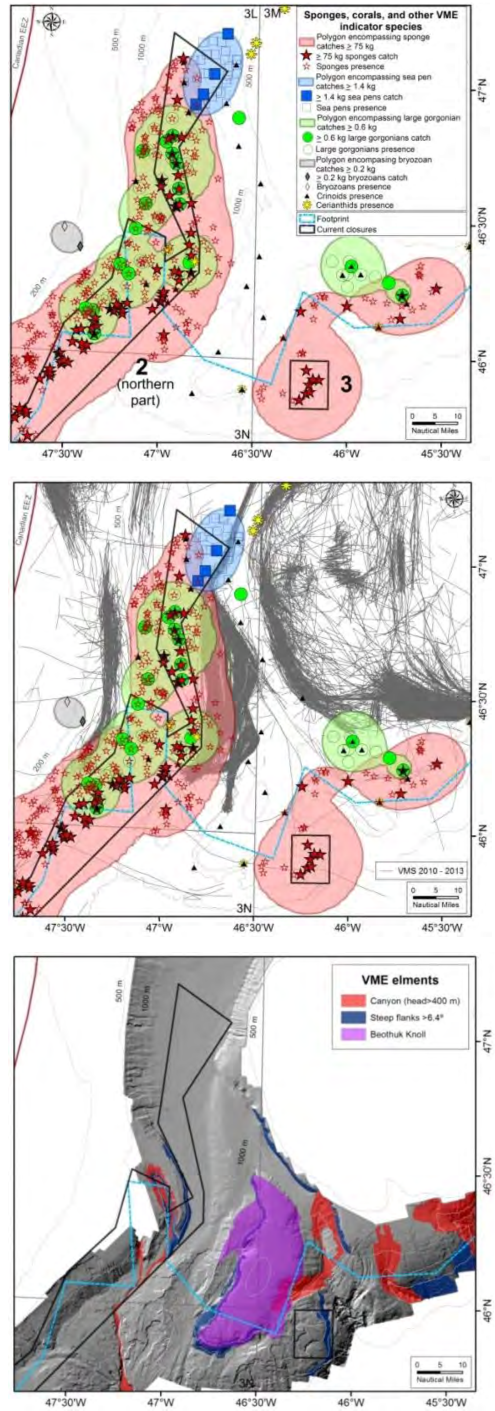



Fig. 10. Area 2 northern portion and Area 3 Beothuk Knoll. VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Area 4 Eastern Flemish Cap**

*Summary* (Fig. 11): High concentrations of large gorgonians and sponge grounds are covered by the closure. Large gorgonians and sponge ground also extend beyond the closed area.

*VME Elements*: Physical VMEs identified in this area are steep flanks, and canyons.

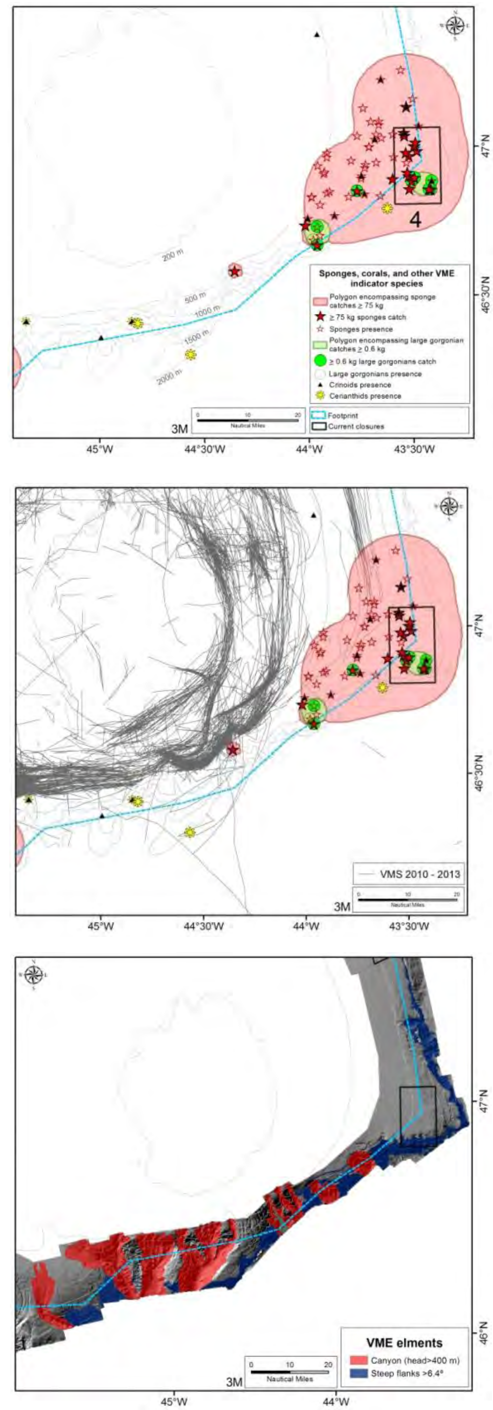



Fig. 11. Area 4 Eastern Flemish Cap. VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Area 5 Northeast Flemish Cap**

*Summary*: This closure covers sponge ground VMEs (Fig. 12). The extension of the closure into deeper water also covers a gradient of benthic communities with depth, transitioning from coral dominated communities at ~2450m depth, to corals intermixed with sponges around 2000m, to sponge dominated grounds at 1500m, and to a diverse community of corals, sponges and other benthic taxa at ~1300m depth. This gradient of communities was identified using a Remote Operated Vehicle; hence this data cannot be easily incorporated into the kernel analysis.

*VME Elements*: Steep flanks are the physical VME element in the closed area.

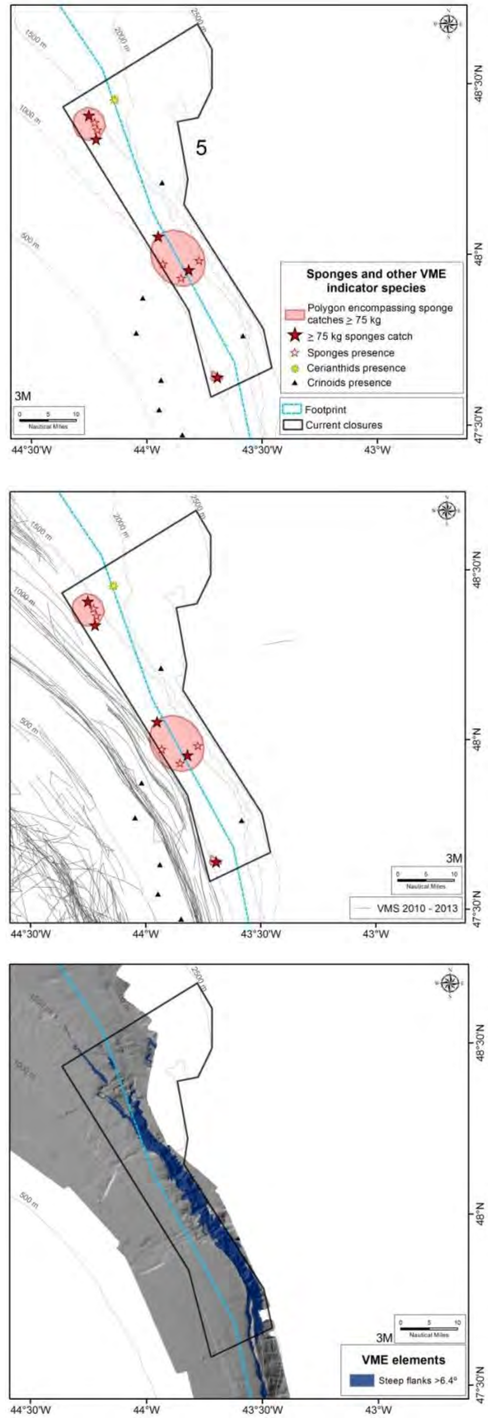



Fig. 12. Area 5 Northeast Flemish Cap. VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Area 6 Sackville Spur**

*Summary* (Fig. 13): This closure covers important sponge grounds. The sponge ground VME extends beyond the current closure. No significant concentrations have been found outside the closed area.

*VME Elements*: There are no physical VME elements in this area.

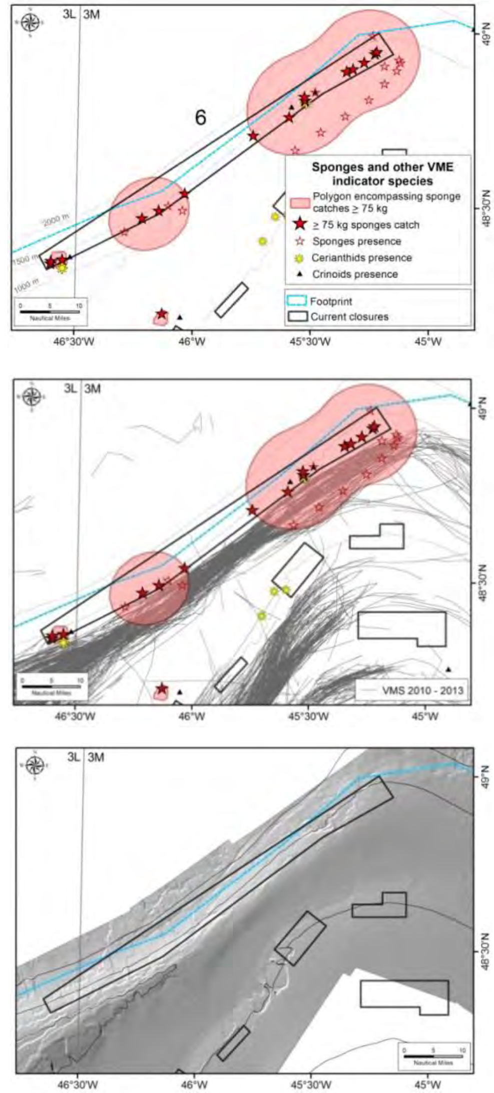



Fig. 13. Area 6 Sackville Spur**.** VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Areas 7, 8, 9, 10, 11, 12 Northern and Northwestern Flemish Cap Including Candidate Areas 13, 14**

*Summary* (Fig. 14): Areas 7 – 12 and Candidate Areas 13 and 14 cover seapen VME areas, however the seapen VME area extends beyond all of these areas. There is a system of seapen VMEs extending around the edge of the bank. The VME encompassing Areas 8 – 10 and 12 also contains sponges, crinoids and ceriantheds.

*VME Elements*: There are no physical VME elements in this area.

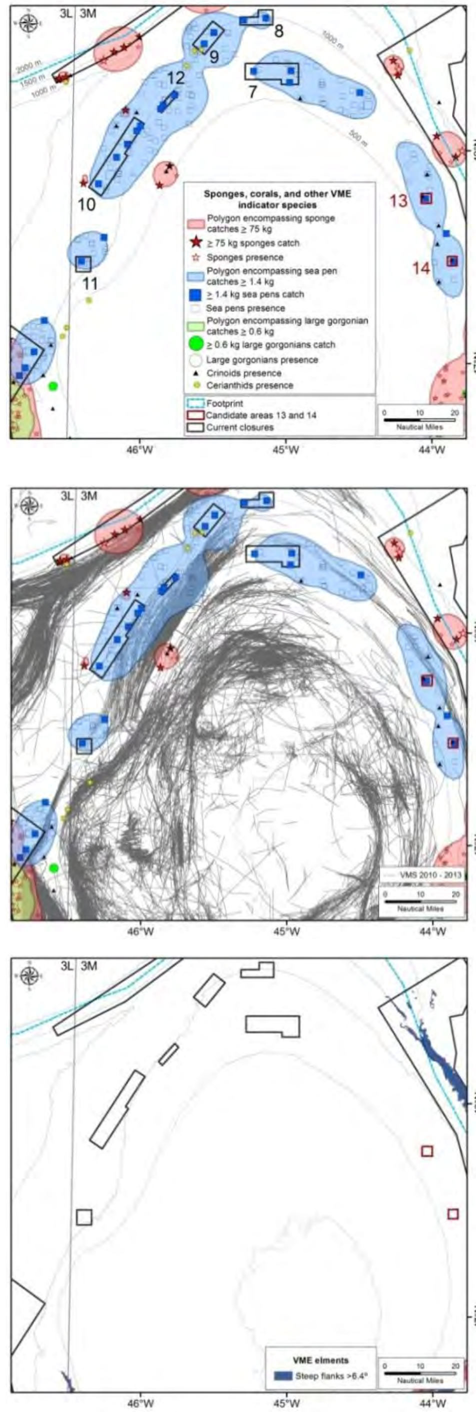



Fig. 14. Areas 7-12 and candidate 13 and 14 Northern and Northwestern Flemish Cap Including Candidate Areas 13, 14**.** VMEs and VME indicator species (top) from kernel analysis, VMS data (middle), and VME elements and NEREIDA multibeam (bottom).

**Review of Seamount Closed Areas in the NRA**

A review of information pertaining seamounts was done in 2010 when the seamount protection zones were revisited by Fisheries Commission. At that time it was concluded that the seamounts were properly classified as VME elements given the available knowledge on the ecology of seamounts in terms of structure and function, as well as the effects of human impacts on them, including midwater trawling and fishing with bottom gears. The information available since then continues to support the notion that seamounts should be considered VMEs. Scientific Council reiterates its advice from September 2013 (NAFO Scientific Council Reports, 2013, p311).

Scientific Council advises:

1) The polygons of the closures for both the New England and Corner Rise seamounts be revised to the north, east and west in the NAFO Convention Area to include all the peaks that are shallower than 2000 meters (as shown by green dots in Fig. 15).

2) For seamount fisheries in areas where fishing has not historically taken place, the Exploratory Fishing protocol be expanded to include all types of fishing, specifically the current mid-water trawl gears.

3) Precautionary regulations of the mid-water trawl fishery on splendid alfonsino be put in place. The regulations can include simple measures such as limiting spatially and temporally (i.e. outside the spawning season which is reported to be in July/August (Vinnchenko, 1997)) the activity with a close monitoring (i.e. include 100% scientific observer coverage in order to collect data for these less-known areas) including prior notifications, and effort or catch limitation. These regulations would only apply to areas where fishing has taken place historically as shown in Fig. 2, and only using a mid-water trawl (i.e. bottom trawl would remain under the Exploratory Protocol). Outside these areas, the expanded Exploratory fishing protocol would apply

Current seamount closures cover most of the shallow seamounts (less than 2000 m deep) in the NRA, but not all. Scientific Council has identified peaks in the Corner Rise and New England Seamount chains that are not currently included in NAFO seamount protection zone. It was also noted that the New England Seamount protection zone includes a portion of the Bermudan EEZ.

*Corner Rise Seamounts:* Not all sea mount peaks in this chain are closed. There are shallower peaks outside the protection zone that are potentially under threat. Corner Rise seamount protection zone could be revised to the north, east and west in the NAFO Convention Area to include all the peaks that are shallower than 2000 meters (Fig. 15).

*New England Seamounts:* Not all sea mount peaks in this chain are closed. The New England seamount protection zone should be revised by extending the existing protection zone area north, and northwesterly to coincide with the boundary of the EEZ of the United States of America and thereby encompass the shallower peaks in that area (Fig. 15). Also the boundary requires adjustment in the southwest corner to exclude the EEZ of Bermuda.

At the present time, seamount protection zones provide no additional protection to these areas than the ones afforded by the exploratory fishing protocol for all areas outside the NAFO fishing footprint.

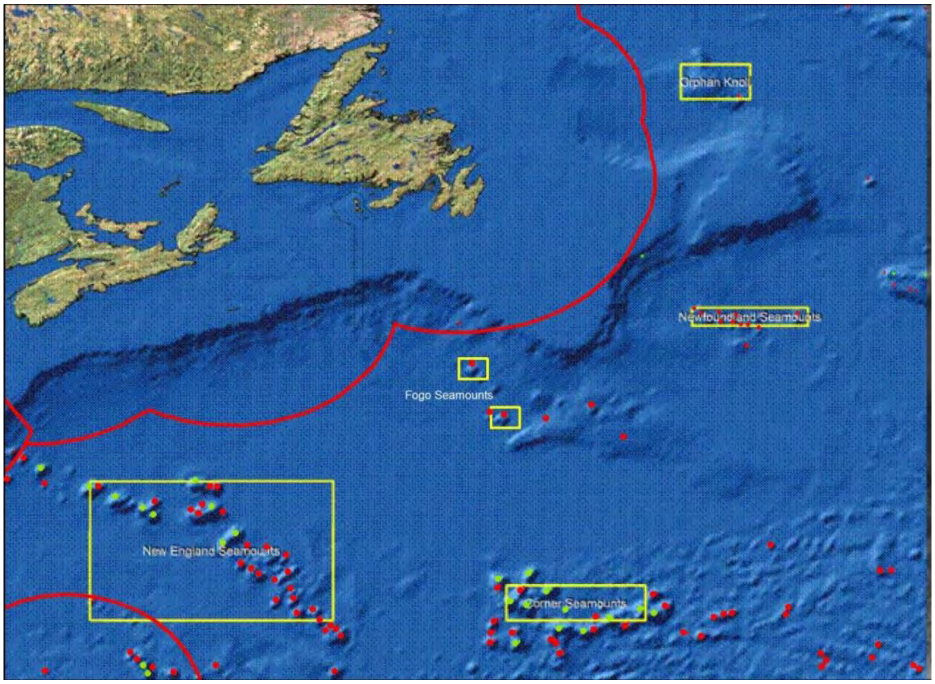



Fig. 15. Seamounts chains in the NRA and NAFO Seamount protection zones. Seamounts shallower than 2000m are indicated by green dots, and deeper seamount peaks by red dots. EEZs are indicated in red lines; note that the New England Seamount protection zone includes part of the Bermuda EEZ.

***xi) Extent of current closures and areas for prioritization by WGEAFFM (Item 13b)***

*b. Based on these analyses, evaluate and provide advice in the context of current closures specified in the NCEM for the protection of VMEs and prioritize areas for consideration by the Ecosystem Approach to Fisheries Working Group.*

The Scientific Council responded:

**Priorities for WGEAFFM**

Scientific Council considered what area will benefit most from management action when considering this part of the request. Scientific Council notes that this is not an evaluation of the relative importance of VME as there is not enough information to do it. All VMEs are treated equally important in terms of their functionality. Scientific Council also notes that the closed areas should be viewed as connected systems.

Higher priority is given to those areas based on:

- multiple VME presence;
- the approximate proportion of the VME that is protected;
- close proximity to an existing closed area as this may imply continuity of the habitats;
- proximity to high fishing activity which could endanger the VME (increased threat);
- areas with no current protection

**Priorities (not listed in any particular order)**

| Closure No. | Area | VME Inside Closure | Coverage of VME by closure | Reason for concern | Priority |
|---|---|---|---|---|---|
| Div. 3O | Coral Closure | Unknown | Moderate | Seapen, Gorgonians, Cerianthids | Moderate |
| 1 | Tail of Grand Bank | Sponge | Good | - | Low |
| 2 (southern) | Flemish Pass/Eastern Canyon | Sponge & large Gorgonians | Good | - | Low |
| 2 (northern) | Flemish Pass | Sponge, large Gorgonians & Seapen | Moderate | Seapen, large Gorgonians & Sponge | Moderate |
| 3 | Beothuk Knoll | Sponge | Poor | Sponge and large Gorgonians | High |
| 4 | Eastern Flemish Cap | Sponge & large Gorgonians | Poor | Sponge, large Gorgonians and Cerianthids | High |
| 5 | Northeast Flemish Cap | Sponge | Good | - | Low |
| 6 | Sackville Spur | Sponge | Good | - | Low |
| 7,8,9,10,11, 12 | Northwest and Northern Flemish Cap | Seapen System | Good | - | Low |
| New Area | Tail of Grand Bank (south) | - | Poor | Large and small Gorgonians, large sea-squirts, Bryozoans | High |
| Candidate Areas 13 & 14 | East Flemish Cap | - | Poor | Seapen | High |
| Corner Rise Seamounts | - | Seamount | Moderate | Seamount | Moderate |
| New England Seamounts | - | Seamount | Moderate | Seamount | Moderate |

***xii) Impacts of removing candidate VME closures from survey design (Item 14)***

*Recognizing the work done in NAFO to prevent significant adverse impacts to vulnerable marine ecosystems, and the need for effective stock assessments;*

*Further recognizing that modifications to survey designs occur on regular basis in fisheries surveys in many cases,*

*Fisheries Commission requests that Scientific Council investigate the impacts of removing the closed areas from the survey design for relevant stock surveys for consideration in the review of closed areas in 2014.*

Scientific Council responded:

There was no progress on this recommendation in 2013 or 2014, and, no analysis available at this meeting to evaluate the Fisheries Commission request to investigate the impacts of removing the closed areas from the survey design for relevant stock surveys, for consideration in the review of closed areas in 2014.

In 2012, Scientific Council recognized the issue of scientific surveys sampling in closed areas. This led to the following recommendation:

"Scientific Council **recommended** that *before designs 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*." (SC Report 2012)

Scientific Council requests WGESA to cooperate with the Secretariat to produce a footprint of trawl surveys and how these overlap with current closures, and to determine the percentage of each survey stratum within closed areas.

However, noted that there may be scope to lessen the impact on VME by considering some practical guidance which may already be built into survey protocols In any case, until such an impact analysis is available by survey, the Council suggests that consideration be given to the following:

(1) Survey tows in strata overlapping closed areas be conducted with the minimum acceptable time on bottom as dictated by the survey protocol.
(2) Consideration be given to conducting the minimum number of tows per stratum.
(3) Avoid creating new survey footprints, by reusing precisely those already used.
(4) Moving a randomly pre-selected sampling station as far as necessary if the position has been identified as a hotspot for a VME.

***xiii) Occurrence of sea pens around areas 13 and 14 (Item 15)***

*The Fisheries Commission Working Group on Vulnerable Marine Ecosystems (WGFMS-VME) considered the scientific advice available at the time of its last meeting held in April 2013. No consensus was reached between Contracting Parties regarding specific management measures that are best suited in protecting areas 13 and 14 as reflected in Figure 2 of the Working Group report (NAFO/FC Doc. 13/3) and defined by the coordinates indicated in page 10 of that report.*

*New information from the EU Flemish Cap survey was expected to be available on sea pens later in 2013, which would help to clarify what type of management measures would best suit areas 13 and 14.*

*The Fisheries Commission requests the Scientific Council to provide the Fisheries Commission with the preliminary results or analysis, regarding occurrence of sea pens in areas towed close to areas 13 and 14 and advise if these reveal significant concentrations of VME indicators.*

The Scientific Council responded:

The available data, including information from the 2013 EU-Spain and Portugal Flemish Cap survey, indicates that areas 13 and 14 are located within the easternmost seapen VME unit of the seapen VME system (Fig. 16). Within this unit, three high concentration locations have been identified, two corresponding to the candidate closures, and a third one located in between them, as well as several seapen observations of lower density. This seapen VME unit also encompasses locations of other VME indicator species (crinoids), as well as black corals.

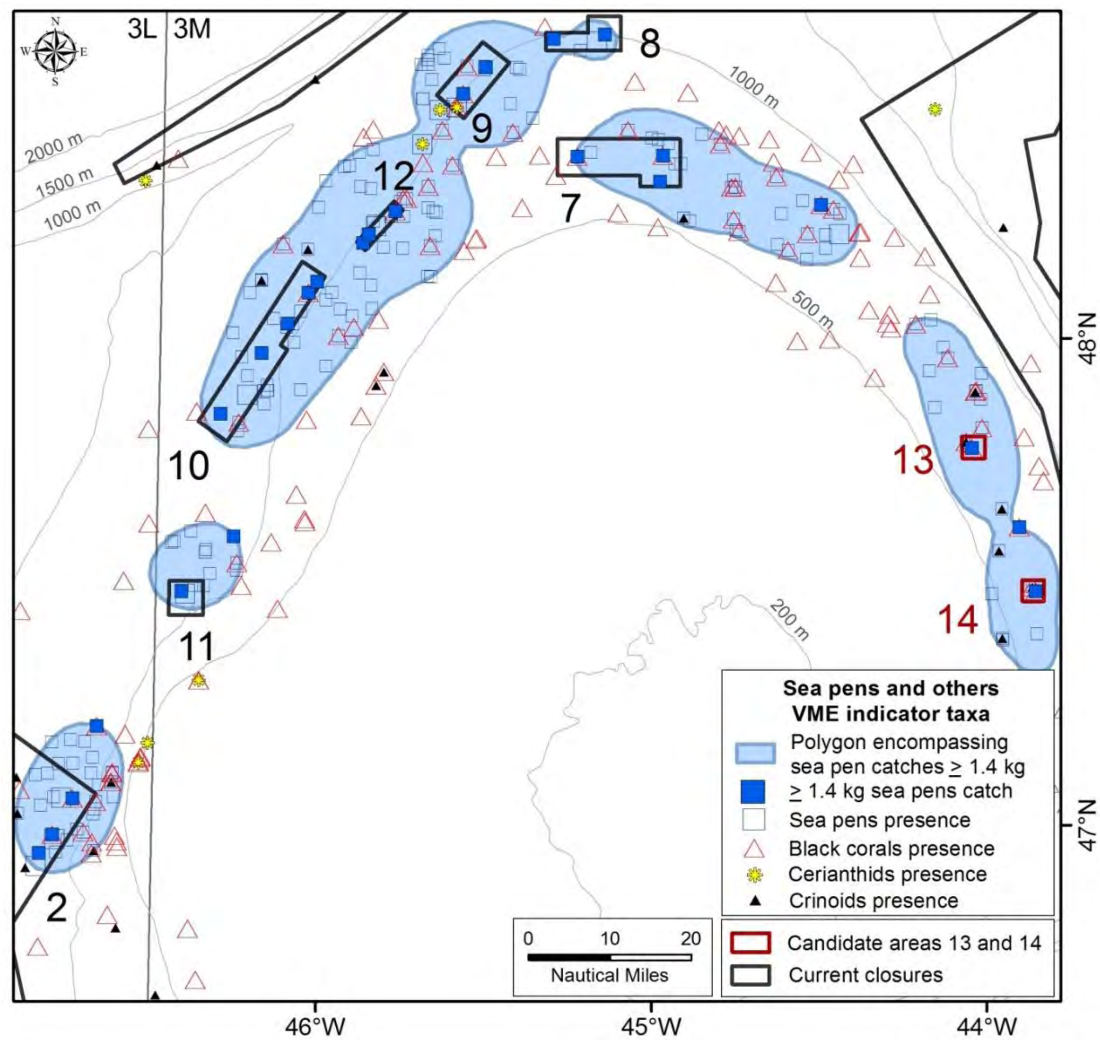



Fig. 16. Location of sea pen VME in relation to the candidate closure areas 13 and 14.

***xiv) Standardization of conversion factors (Item 16)***

*The Fisheries Commission requests the Scientific Council to evaluate and provide recommendations on the methodology for establishing standardized conversion factors outlined in STACTIC WP 13/3.*

The Scientific Council responded:

The methodology and workplan were reviewed by STACREC. Scientific Council endorsed the views of the committee that the methodology, in terms of field work and statistical analysis, was sound and that a plan like this was required to derive reliable product to round weight conversion factors corresponding to products produced at sea in the NRA. It was recognized that there are logistical issues in the implementation of such a project but the framework provides guidance in this regard. It would be up to STACTIC and the Fisheries Commission to initiate the project. It was noted that a similar program was under way within Canada's 200 mile limit to derive reliable conversion factors.

## 2. Coastal States

### a) Request by Denmark (Greenland) for Advice on Management in 2015-2017

(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: *provide advice on the scientific basis for the management of Roundnose grenadier in Subarea 0 + 1 for 2015-2017.*

Scientific Council responded:

## Roundnose Grenadier (*Coryphaenoides rupestris*) in Subareas 0 + 1

**Recommendation**: There should be no directed fishing for roundnose grenadier in Subareas 0 and 1 in 2015-2017. Catches should be restricted to bycatches in fisheries targeting other species.

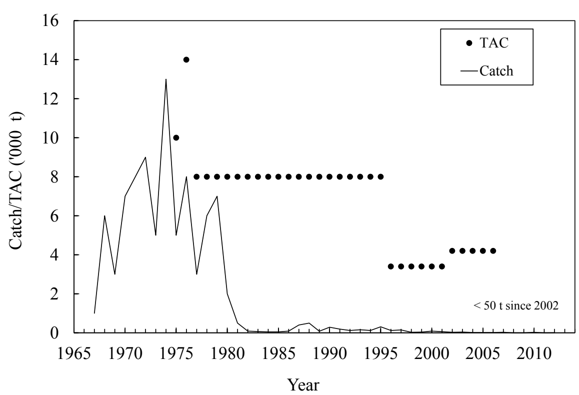
**Background:** The roundnose grenadier stock in Subarea 0 and 1 is believed to be part of a stock widely distributed in the Northwest Atlantic. The biomass in 1987 was estimated to be relatively high but decreased dramatically in the late 80's and early 90's possibly because of migration out of the area. There has been no directed fishery for roundnose grenadier in Subareas 0+1 since 1978.

**Fishery and Catches**: Roundnose grenadier is taken as by-catch in the Greenland halibut fishery. A total catch of 3 tons was estimated for 2013. Catches of roundnose grenadier have been reported from inshore areas and Div. 1A where roundnose grenadier is known not to occur. These catches must be roughhead grenadier and are therefore excluded from totals for roundnose grenadier, but it is also likely that catches from the offshore areas south of Div. 0A-1A reported as roundnose grenadier may include roughead grenadier.

| | Catch ('000) | | |
|---|---|---|---|
| Year | STACFIS | 21 | TAC[1] |
| 2011 | 0.00 | 0.00 | |
| 2012 | 0.01 | 0.01 | |
| 2013 | 0.00 | 0.00 | |
| 2014 | | | |

[1] No TAC set for 2007-2014

[2] ndf:No directed fishing, catches restricted to by-catch in other fisheries.



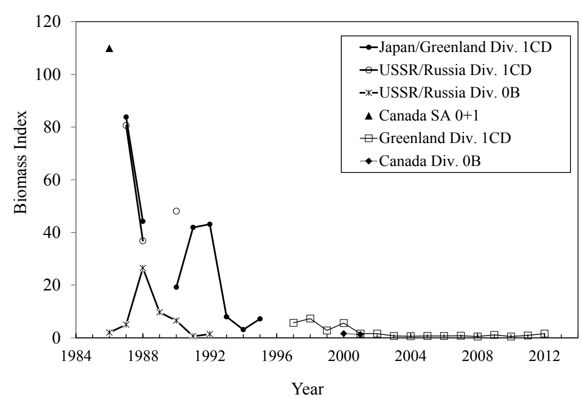

**Data**: There has not been any survey that covers the entire area or the entire period which makes means that the surveys not are comparable. In the period 1987-1995 Japan in cooperation with Greenland has conducted bottom trawl research surveys in Subarea 1 covering depths down to 1 500 m. The survey 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 m from then on. The surveys took place in October-November. Greenland has since 1997 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, 2011 and 2013 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.

The Greenland survey in 2013 only covered Div. 1D and the results are not considered as a reliable index of the total stock status.

The Canadian surveys in Div. 0B in 2000 in, 2001 also showed very low biomasses. The biomass was not calculated from the 2011 and 2013 surveys.

**Assessment**: No analytical assessment could be performed.

*Biomass*: Despite the fact that the biomass has increased gradually since 2010 the biomass in 2012 is still at the very low level seen since 1997, and there is no reason to consider that the status of the stock has changed.




*Recruitment:* Not known.

*Fishing Mortality*: Level not known

**State of the Stock**: The stock of roundnose grenadier is still at the very low level seen since 1997.

**Reference points:** Scientific Council is not in a position to determine biological reference points for roundnose grenadier in SA 0+1 at this time.

**Special Comments**: The next full assessment of this stock will take place in 2017.

**Sources of Information**: SCR Doc. 14/002 SCS Doc. 14/012.

***ii) Golden redfish, Demersal Deep-sea redfish, Atlantic wolfish, Spotted wolfish and American plaice in Subarea 1 (Item 2)***

Advice for golden red fish *(Sebastes marinus),* demersal deep-sea redfish *(Sebastes mentella)* American plaice *(Hippoglossoides platessoides),* Atlantic wolffish *(Anarhichas lupus)* and spotted wolffish *(A. minor)* in Subarea 1 was in 2011 given for 2012-2014. Denmark (on behalf of Greenland) requests the Scientific Council to: *provide advice for redfish (Sebastes marinus), American plaice (Hippoglossoides platessoides), Atlantic wolffish (Anarhichas lupus) and spotted wolffish (A. minor) on the scientific basis for the management of in Subarea 1A for 2015-2017.*

Scientific Council responded:

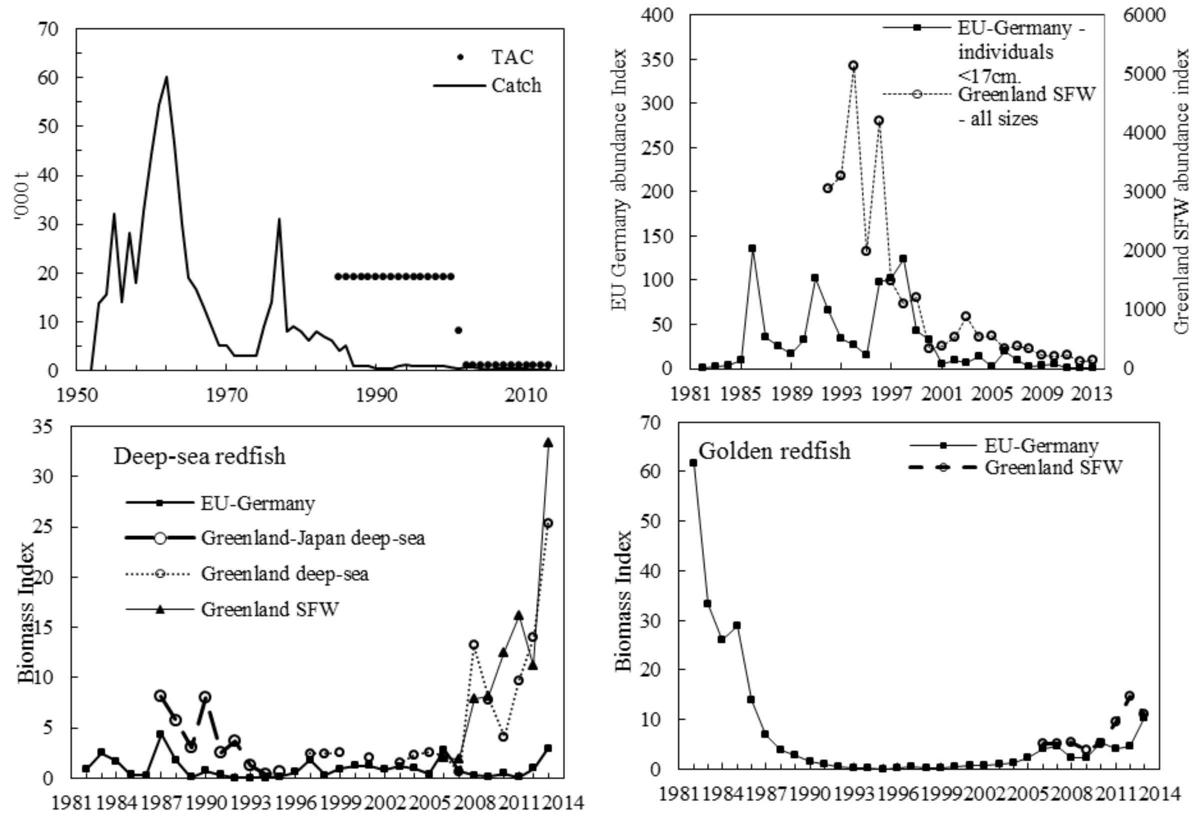
**Demersal Redfish (*Sebastes* spp.) in Subarea 1** Advice 2014 for 2015 - 2017

**Recommendation for 2015 and 2016**

*Golden redfish*
Survey indices indicate a steadily increasing stock due to either increased survival or immigration from nearby stocks. However the stock is far from historic levels and recruitment remains poor. The Scientific council therefore recommends that there should be no directed fishing in 2015 and 2016.

*Demersal deep-sea redfish*
Survey indices indicate a steadily increasing stock due to either increased survival or immigration from nearby stocks. However, recruitment remains poor and Scientific Council therefore recommends that there should be no directed fishery in 2015 and 2016.

**Background**: Two species of redfish are common in West Greenland, golden redfish (*Sebastes marinus*) and deep-sea redfish (*Sebastes mentella*). Relationships to other North Atlantic redfish stocks are unclear.




**Fishery and Catches**: The fishery targeting demersal redfish in Subarea 1 increased during the 1950 from a level of more than 10 000 t and peaked in 1962 at more than 60 000 t. Catches then decreased to around 3 000 t in the beginning of the 1970s but increased again to around 10 000 t by 1975. By 1986 reported catches had decreased to around 5 000 t and there after remained below 1 000 t per year with few exceptions.

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| STATLANT 21 | 0.2 | 0.4 | 0.3 | 0 | 0.02 | 0 | 0.2 | 0.12 | 0.16 | |
| STACFIS | 0.2 | 0.4 | 0.3 | 0.4 | 0.4 | 0.3 | 0.2 | 0.16 | 0.17 | |

**Data**: Mean length of golden redfish catches from commercial catches during 1962-90 were available.

Biomass and abundance indices were available from The EU-Germany survey (since 1982), the Greenland deep-water survey (since 1998) and the shallower Greenland Shrimp and Fish survey (SFW, since 1992)

**Assessment**: No analytical assessment could be performed.

***Golden redfish***

*Biomass:* Increasing. Both the EU-Germany survey and the Greenland Shrimp and Fish survey show slow but steady increasing trends during the past decade although remains far from historic levels.

*Fishing mortality:* Unknown, but likely to be at a lower level than a decade ago due to a low cod fishery off West Greenland and the use of sorting grids in the shrimp fishery.

*Recruitment:* Poor. The most recent abundance indices of juvenile redfish in both surveys are among the lowest recorded.

*State of the stock:* Survey indices indicate a steadily increasing stock due to either increased survival or immigration from nearby stocks. However the stock is far from historic levels and recruitment remains poor.

***Demersal deep-sea redfish***

*Biomass:* Increasing. All surveys show increasing trends in recent years.

*Fishing mortality:* Unknown, but likely to be at a lower level than a decade ago due to a low cod fishery off West Greenland and the use of sorting grids in the shrimp fishery.

*Recruitment:* Poor. The most recent abundance indices of juvenile redfish in the EU-Germany survey and the Greenland Shrimp and Fish survey are among the lowest recorded.

*State of the stock:* Survey indices indicate a steadily increasing stock due to either increased survival or immigration from nearby stocks. However, recruitment remains poor.

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

This stock will next be assessed in 2017

**Sources of Information**: SCR Doc. 14/003 SCS Doc. 14/012.

**American plaice in Subarea 1** Advice 2014 for 2015 – 2017

**Recommendation for 2015 - 2017**

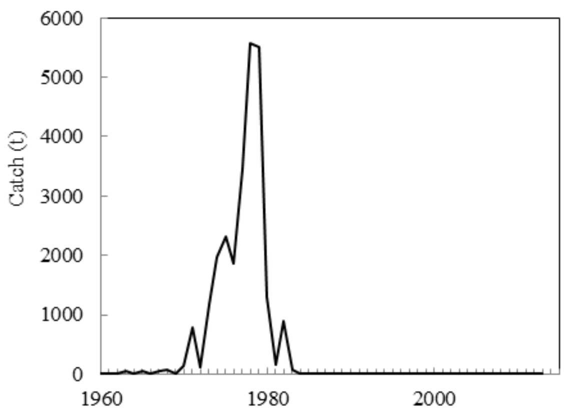
The stock is stable at a slightly higher level than the 1990's level, but far below the levels seen in the 1980s. The scientific council therefore recommends that there should be no directed fishing in 2015-2017.

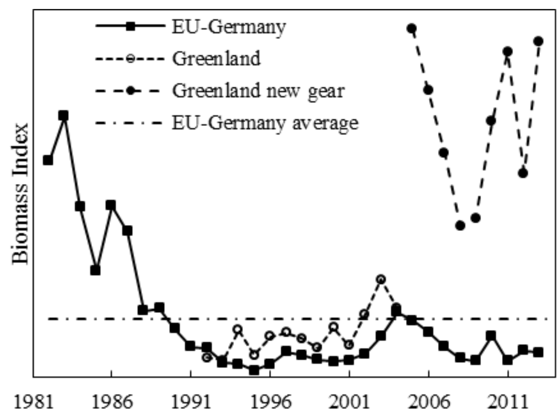
**Background**: American plaice in Subarea 1 have mainly been taken as a by-catch in fisheries targeting cod, redfish and shrimp.

**Fishery and Catches**: American plaice has been of very little commercial interest in Greenland at least for the past three decades. American plaice has mostly been taken as by-catch in other fisheries targeting cod, redfish, Greenland halibut and shrimp. Reported catches of American plaice increased in the same years as wolffish were directly target due to failing cod fisheries in the years after 1974. The highest reported catches occurred in 1977-1979, but in massive mis-reportings were documented and catches of American plaice in these years are likely overestimated.

Recent nominal catches (t) for American plaice are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|
| STATLANT 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| STACFIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




**Research survey data:** Biomass and abundance indices were available from the EU-Germany survey (since 1982) and the Greenland survey (since 1992).

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

*Biomass:* The biomass of the stock of American plaice in subarea 1 seems to be at a stable level, slightly higher than the 1990s, but far below the levels in the1980s.

*Fishing mortality:* Unknown.

*Recruitment:* Recruitment is lower than the initial values observed in initial years of the EU-Germany survey.

*State of the stock:* Stable at a slightly higher level than the 1990's level, but far below the levels in the 1980's.

**Sources of information:** SCR Doc. 80/VI/72 07/88 14/003 14/028 14/032; SCS Doc. 14/12

This stock will next be assessed in 2017**.**

**Wolffish in Subarea 1** Advice June 2014 for 2015 – 2017

**Recommendation for 2015 - 2017**

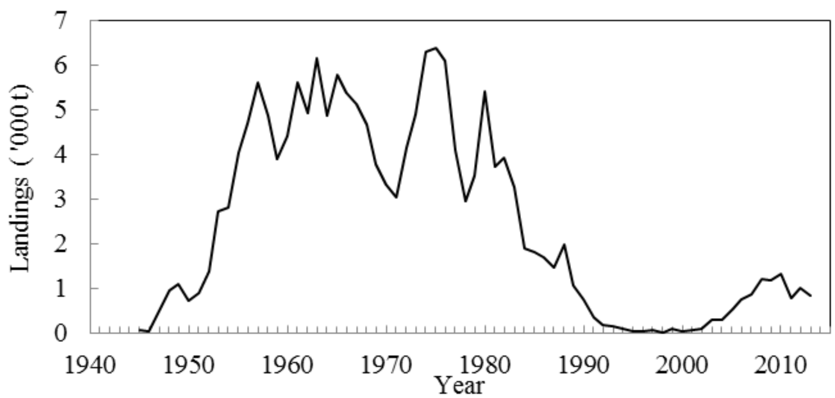
*Atlantic wolffish*

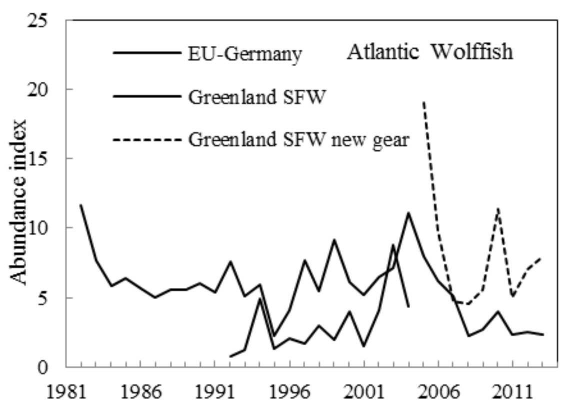
The Scientific Council recommends that there should be no directed fishery in 2015 –2017, and the bycatch in other fisheries be reduced to the lowest possible level.

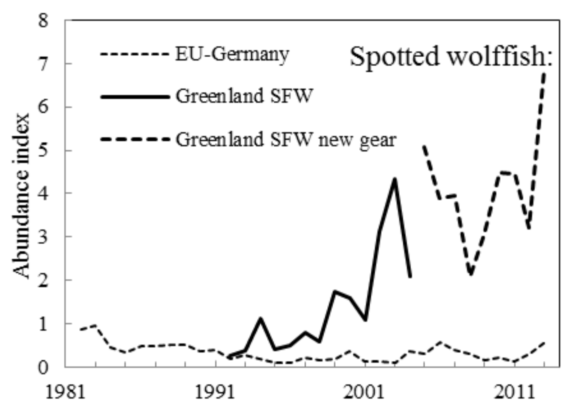
*Spotted wolffish*

The Scientific Council recommends that catches, including by-catches in other fisheries, should not increase beyond the 2009-13 average (1 025 t) in 2015 –2017.

**Background**: Spotted wolffish has a larger maximum length and higher growth rate than Atlantic wolffish. Although spotted wolffish and Atlantic wolffish are easily distinguishable from one another, the fishing industry and catch statistics have so far made no distinction between the two species. Atlantic wolffish has a more southern distribution and seems more connected to the shallow offshore banks. Spotted wolffish can be found in all divisions offshore and through survey and landing observations, still seems to be the dominant species in the fjords.




**Fishery and Catches**:

Recent nominal catches (t) for wolfish (combined) are as follows.

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | | | | | | | | | | |
| STATLANT 21 | 524 | 764 | 880 | 1195 | 50 | 9 | 752 | 1008 | 858 | |
| STACFIS | 515 | 764 | 880 | 1195 | 1175 | 1315 | 779 | 1008 | 858 | |

The fishery targeting Spotted wolffish started inshore in Div. 1C and gradually spread north. Annual landings reached a level of more than 5 000 t by 1957 and stayed at a level of 4 000 to 6 000 t until 1970. In 2013, 858 t of wolffish were reported, of which the majority was caught inshore in Div. 1A-C, indicating that most of the catches were spotted wolffish.

**Research survey data:** There are two surveys partly covering the stocks of Atlantic wolffish and spotted wolffish in Subarea 1. The EU-Germany survey (SCR Doc. 14/028) and Greenland Shrimp Fish survey in West Greenland (SCR Doc. 14/003). The EU Germany survey has a longer time series (since 1982, 0-400m, Div. 1Bs-F) and the Greenland shrimp and Fish survey in West Greenland covers a larger geographical area (since 1992, 600m, Div. 1A-F). Both surveys are appropriate in regards to main lower depth distribution of both Atlantic and spotted wolffish (100 to 400m), but do cover the inshore areas (except the Disko Bay) and are unlikely to fully cover the shallowest depths fully (0-100 m).

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

***Atlantic wolffish***

*Biomass:* The biomass is stable, but below average levels.

*Fishing mortality:* Unknown, but likely to be at a lower level than before the introduction of grid separators in the shrimp trawl fishery.

*Recruitment:* Unknown.

*State of the stock:* The stock of Atlantic wolffish is stable at low levels in the southern divisions but expanding its distribution to Northern divisions

***Spotted wolffish***

*Biomass:* Unknown. None of the surveys fully cover the distribution of Spotted wolffish. Indices are however increasing in both surveys.

*Fishing mortality:* Unknown, but likely to be at a lower level offshore than during the 1990s due to the low levels of cod fishery off West Greenland and the use of grid separators in the shrimp fishery. F is unknown in the inshore areas.

*Recruitment:* Unknown. But the increasing abundance indices observed particularly in the Greenland shrimp and fish survey suggests increasing recruitment since 1990s.

*State of the stock:* The increasing survey biomasses and abundance indices and the length distribution in surveys and landings suggest that the stock is in good and increasing condition. The state of the stock compared to historic levels is however unknown.

**Special comments:** Lack of separation of the species in the commercial statistics provides difficulties for making detailed biological assessment. The Scientific Council reiterated the **recommendation** that *the easily discernible species be separated in catch statistics*. These stocks will next be assessed in 2017

**Sources of Information**: SCR Doc. 14/003 SCS Doc. 14/012.

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

*Advice for Greenland halibut in Division 1A inshore was in 2012 given for 2013-2014. Denmark (on behalf of Greenland) requests the Scientific Council for advice for Greenland halibut in Division 1A inshore for 2015-2016.*

The Scientific Council responded:

**Greenland halibut (*Reinhardtius hippoglossoides*) in Div. 1A inshore.** Advice June 2014 for 2015–16

**Recommendation for 2015 and 2016:**

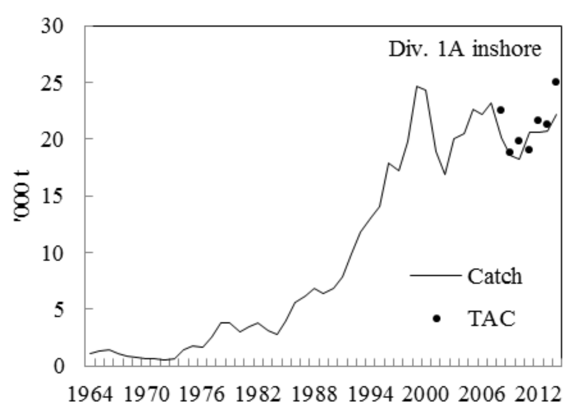
**Disko Bay:** The stock is stable at lower levels. The updated indices indicate that the stock is decreased and that the fishery is still dependant on new incoming year classes. However, the long-term stability in both surveys indicates a steady supply of pre-fishery recruits (35-50 cm) to the stock. Scientific council therefore recommends that catches in 2015 and 2016 should not exceed 8 000 t.

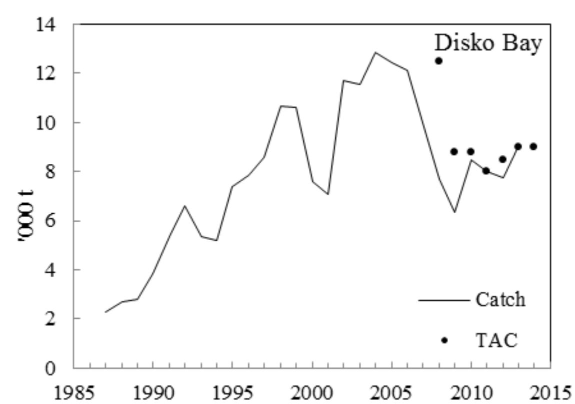
**Uummannaq:** The stock is in good condition. Stability in the indices suggests that changes in the stock have so far occurred at a slow rate. Catches have slowly increased during the past decade. Catches have been around 6 000 t annually over the past twenty years. Scientific council therefore recommends that any increases beyond this level should be slow and incremental.

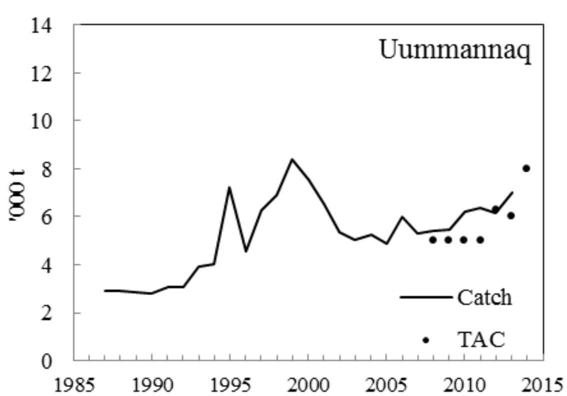
**Upernavik:** The stock is in good condition. The stability in the indices suggests that changes in the stock have so far occurred at a slow rate. However, catches have increased substantially since 2002. Scientific council therefore recommends that there should be no increase in catches beyond the 2009-11 average (6 300 t) in 2015 and 2016.

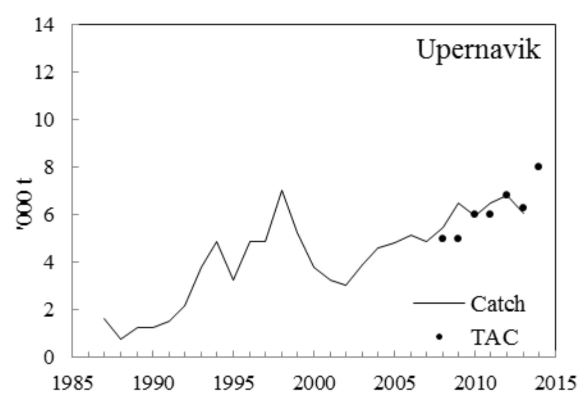
**Background:** The inshore stocks of Greenland halibut in Subarea 1 are believed to be dependent on recruitment from the offshore spawning stocks in the Davis Strait. Little migration out of the inshore areas to the offshore stock and between the separated inshore areas has been observed and a separate TAC is set for each of the districts: Disko Bay, Uummannaq and Upernavik.

**Fisheries and catches:**




*Total landings for Division 1A inshore*: For the three areas combined, landings were less than 1 000 t until 1955 but gradually increased to a level of 5 000 t by 1985. After the mid-1980s landings increased to 25 000 t in 1999 and have remained at a level of 20 000 to 25 000 t since then.

*Disko Bay:* Landings increased from about 2 000 t in the mid 1980s and peaked from 2004 to 2006 at more than 12 000 t. After 2006, landings were halved in just three years without any restrictions on effort, TAC or reduced prizes prices to explain the decrease. Landings have however gradually increased since then and in 2013, 9 073 t was landed from the area.

*Uummannaq*: landings increased from 3 000 t in the mid 1980's and peaked in 1999 at more than 8 000 t. Landings then decreased to a level of 5 – 6 000 t. In 2013, 7 007 t were landed from the district which is an increase compared to recent years

*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 gradually increased. In 2013, 6 039 t were landed from the district, which is less than the set TAC quota, but this can largely be explained by a change in effort distribution following the transition to the ITQ system.

Nominal catches and TACs for Div. 1A (Inshore) are as follows:

| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Disko Bay | TAC | | | | 12.5 | 8.8 | 8.8 | 8.0 | 8.0 | 9.0 | 9.0 |
| | STACFIS | 12.5 | 12.1 | 10.0 | 7.7 | 6.3 | 8.5 | 8.0 | 7.8 | 9.1 | |
| Uummannaq | TAC | | | | 5.0 | 5.0 | 5.0 | 5.0 | 6.0 | 6.0 | 8.0 |
| | STACFIS | 4.9 | 6.0 | 5.3 | 5.4 | 5.5 | 6.2 | 6.4 | 6.2 | 7.0 | |
| Upernavik | TAC | | | | 5.0 | 5.0 | 6.0 | 6.0 | 6.0 | 6.3 | 8.0 |
| | STACFIS | 4.8 | 5.1 | 4.9 | 5.5 | 6.5 | 5.9 | 6.5 | 6.8 | 6.0 | |
| Div. 1A Unknown | | 0.8 | | | | | | | | | |
| Total | TAC | | | | 22.5 | 18.8 | 19.8 | 19.0 | 21.6 | 21.3 | 25.0 |
| | STACFIS | 22.7 | 23.2 | 20.2 | 18.6 | 18.3 | 20.6 | 20.8 | 20.7 | 22.1 | |

**Data:**

*All areas:* Commercial length frequency data were available in 2013. Logbook data provided since 2008 was available, and used to calculate a standardized CPUE index based on longlines only.

*Disko Bay:* CPUE and NPUE indices were 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***

*Biomass***:** The continuing decrease in the mean length in the landings and the shift in the length distributions towards smaller size indicates that the biomass is currently below previous levels. Survey results indicate a relatively stable biomass of pre-fishery recruits.

*Fishing mortality*: Unknown. The contribution to *F* from the shrimp trawlers is likely reduced since the implementation of sorting grids in the inshore shrimp trawl fishery in 2011.

*Recruitment*: Good. Trawl survey results in the Disko Bay indicate high levels of recruits in 2011 and 2013.

***Uummannaq***

*Biomass*: The long term stability in the mean length in the landings and wide range of sizes in the landings suggests that changes, if any, until now has happened at a slow rate.

*Fishing mortality:* Unknown. But there are no other fisheries in the district inducing fishing mortality.

*Recruitment*: Good. Offshore survey results from nearby areas indicate high levels of recruitment in recent years.

***Upernavik***

*Biomass:* The long term stability in the mean length in the landings and wide range of sizes in the landings suggests that changes, if any, until now has happened at a slow rate.

*Fishing mortality:* Unknown. But there are no other fisheries in the district inducing fishing mortality.

*Recruitment*: Good. Trawl survey results from nearby offshore areas indicate high levels of recruitment.

**State of the stock:**

*Disko Bay*: The continuing decrease in the mean length in the landings and the shift in the length distributions towards smaller size indicates that the biomass is currently below previous levels. Survey results indicate a relatively stable biomass of pre fishery recruits. Trawl survey results in the Disko Bay indicate high levels of recruits in 2011 and 2013.

*Uummannaq*: The long term stability in the mean length in the landings and wide range of sizes in the landings suggests that changes, if any, until now has happened at a slow rate. Offshore survey results from nearby areas indicate high levels of recruitment in recent years.

*Upernavik*: The long term stability in the mean length in the landings and wide range of sizes in the landings suggests that changes, if any, until now has happened at a slow rate. Trawl survey results from nearby offshore areas indicate high levels of recruitment.

**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. 14/003, 038, 041; SCS Doc. 14/12.

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### b) Request by Canada and Denmark (Greenland) for Advice on Management in 2015

(Annexes 2 and 3)

#### *i) Greenland halibut in Div. 0B + Div. 1C-F*

*The Council is requested to provide advice on Total Allowable Catch levels for 2015, separately, for Greenland halibut in 1) Division 0A, the offshore area of Division 1A +Division 1B and 2) Divisions 0B+1C-F. The Scientific Council is also asked to advise on any other management measures it deems appropriate to ensure the sustainability of these resources.*

The Scientific Council responded:

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

**Recommendation**:

Div. 0A+1AB: TAC was increased in 2014. The CPUE and length frequencies in the commercial fishery have been stable. Scientific Council advises that there is a low risk of Greenland halibut in Div. 0A and Div. 1AB being below $B_{lim}$ if the TAC for 2015 remains unchanged and catches should not exceed 16 000 t.

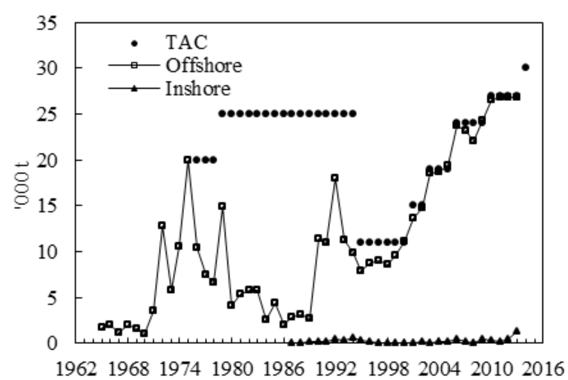
Div. 0B+1C-F: TAC was increased in 2010. The biomass and CPUE indices have been relatively stable. Scientific Council advises that there is a low risk of Greenland halibut in Div. 0B and Div. 1C-F being below $B_{lim}$ if the TAC for 2015 remains unchanged and catches should not exceed 14 000 t.

**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:** Catches have increased in response to increases in the TAC from approximately 10 000 t in the late 1990s to approximately 27 000 t during 2010 to 2012 then increased to 28 100 tons in 2013. The TAC is 30 000 t in 2014.

| | Catch ('000 t) | | TAC ('000 t) |
|---|---|---|---|
| Year | STACFIS | 21 | |
| 2011 | 27 | 27 | 27[1] |
| 2012 | 27 | 27 | 27[1] |
| 2013 | 28 | 28 | 27[1] |
| 2014 | | | 30[1] |

[1] Including 13 000 t allocated specially to Div. 0A and Div. 1AB during 2006-2013 and 16 000 in 2014.



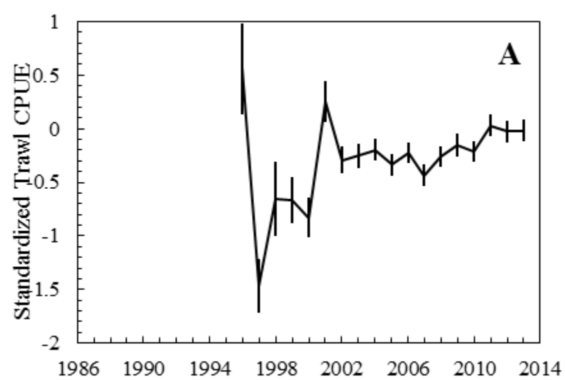

**Data:** Biomass indices from deep sea surveys in 2013 were only available from Div. 0B. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2013. Length distributions were available from both surveys and the fishery in SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD.

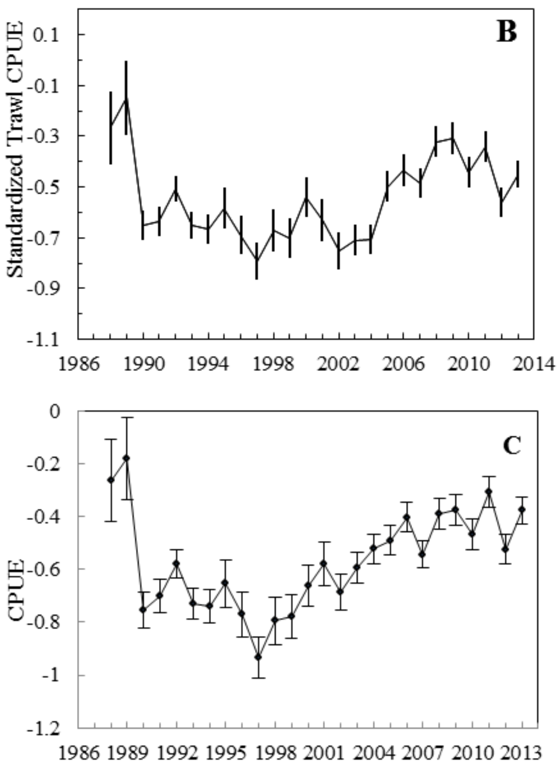
**Assessment:** No analytical assessment could be performed.

*Commercial CPUE indices.* The standardized trawl CPUE series (A) for Div. 0A+1AB combined has been stable since 2002 with a slightly increasing trend since 2007. Standardized CPUE for gillnets in Div. 0A increased gradually from 2006-2011 and has been stable since then.

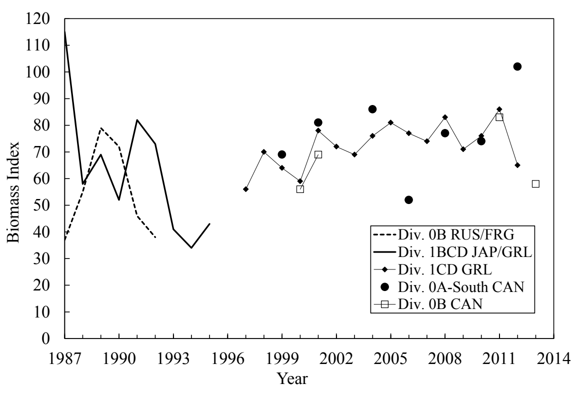
The standardized trawl CPUE series for Div. 0B+1CD combined (B) was relatively stable from 1990-2004, increased from 2004-2009 then decreased between 2009 and 2012. There was a slight increased between 2012 and 2013.The standardized CPUE for gillnets in Div. 0B has been gradually increasing since 2007 and in 2013 was at the highest level in the time series.

A standardized CPUE index for all trawlers fishing in SA 0+1 (C) increased between 2002 and 2006 and has been fluctuating at a high level since then. The 2013 estimate was the third largest seen since 1990.






*Biomass*: The Div. 1CD and Div. 0A-South indexes could not be updated in 2013. Division 0B was surveyed in 2013 for the fourth time. Previous surveys were conducted in 2000, 2001 and 2011, respectively. Biomass had decreased compared to previous two surveys and was back at the level seen in 2000.




*Recruitment*: A period of relative stability in the recruitment index (age one) during the 2000s was followed by an increase to the highest in the time series for the 2010 year class. There was a sharp decrease in the 2011 year class to the lowest estimate since 1996 but this was followed by an increase in the 2012 year class to the third largest in the time series.

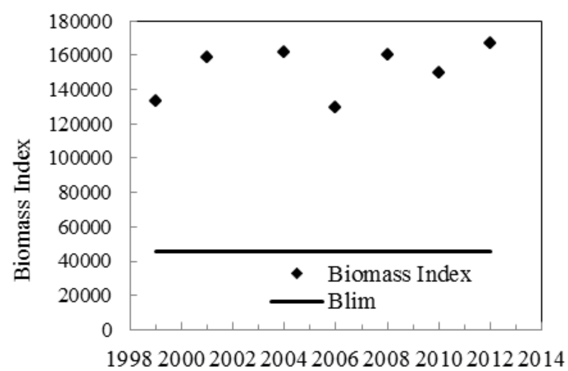
*Fishing Mortality:* Level not known.

*State of the Stock*: The biomass in 2012 was well above $B_{lim}$. Trawl CPUE has been stable in recent years and so has the CPUE in the Div. 0A and 0B gillnet fisheries. A standardized CPUE index for all trawlers fishing in SA 0+1 has been increasing between 2002 and 2006 and has been fluctuating at a high level since then. The 2013 estimate was the third largest seen since 1990.

Div. 0B+1C-F: The 1CD biomass index was not updated as the 2013 survey was incomplete. The biomass index in Div. 0B decreased between 2011 and 2013 and was back at the level seen in 2000. Length compositions in the catches and deep sea surveys have been stable in recent years. Standardized CPUE has decreased between 2009 and 2012 but increased slightly and it is above the level observed during 1990 to 2004. The Standardized CPUE for gillnets in Div. 0B has been increasing since 2007 and in 2013 was at the highest level in the time series.

Div. 0A+1AB: The biomass index and survey length frequencies were not updated as there was no survey in this area in 2013. Length frequencies were not available for the SA0 fishery in 2013. Combined Standardized CPUE indices for Div. 0A and 1AB have been stable in recent years.

**Precautionary Reference Points:** Age-based or production models were not available for estimation of precautionary reference points. In 2013 a preliminary proxy for $B_{lim}$ was set as 30% of the mean biomass index estimated for surveys conducted between 1997-2012 in Div. 1CD and 1999-2012 in Div. 0A-South. This same approach was applied to the combined survey index for the same period to establish a proxy for $B_{lim}$ for the entire stock (Fig. 1.7)



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

The next Scientific Council assessment of this stock will be in 2015.

**Sources of Information**: SCR Doc. 14/02, 03, 20, 21 27, 33; SCS Doc. 14/12, 13.

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***ii) Pandalus borealis in Subareas 0 and 1***

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

**c) Request by Canada for Advice on Management**

(Appendix 2)

***i) North Atlantic harp seal***

*Canada requests the Scientific Council to explore the impact of proposed harvest strategies that would maintain the North Atlantic harp seal population at a precautionary level of a PA framework, using the Canadian levels as a case study, and that would have a low risk of decreasing below the critical level.*

Scientific Council deferred answering this request until after the next WGHARP meeting.

**3. Scientific Advice from Council on its own Accord**

**a) Roughhead Grenadier in SA 2+3**

There was no change in the advice given in 2013.

## VIII. REVIEW OF FUTURE MEETINGS ARRANGEMENTS

**1. Scientific Council, (in conjunction with NIPAG), 10 – 17 Sep 2014**

Scientific Council noted that the Scientific Council shrimp advice meeting will be held at the Greenland Institute of Natural Resources in Nuuk, Greenland, 10 - 17 September in advance of the 2014 Annual Meeting. The Council noted the NAFO stocks will be addressed first so that the advice will be available to NAFO Contracting Parties on Monday, 15 September, a week in advance of the Annual Meeting.

**2. Scientific Council, 22 – 26 Sep 2014**

Scientific Council noted the Scientific Council meeting will be held in the Palacio de Congresos Mar de Vigo (Congress Centre) in Vigo, Spain, 22 - 24 September 2014.

**3. Scientific Council, 29 May – 11 June 2015**

Scientific Council agreed that its June meeting will be held on 29 May – 11 June 2015, at St Mary's University, Halifax.

**4. Scientific Council (in conjunction with NIPAG), 9 – 16 Sep 2015**

This meeting will be held 9 – 16 September 2015, St Johns, Newfoundland, Canada.

**5. Scientific Council, September 2015**

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

**6. Scientific Council, 3 - 16 June 2016**

Scientific Council agreed that its June meeting will be held on 3 - 16 June 2015, at St Mary's University, Halifax.

**7. NAFO/ICES Joint Groups**

**a) NIPAG, 10-17 Sep 2014**

Scientific Council noted the NIPAG meeting will be held at the Greenland Institute of Natural Resources in Nuuk, Greenland, 10 - 17 September 2014.

**b) NIPAG, 9 – 16 September 2015**

This meeting will be held 9 – 16 September 2015, St Johns, Newfoundland, Canada.

**8. WGESA (formerly SC WGEAFM), 18 - 27 November, 2014**

The Working Group on Ecosystem Science and Assessment will meet at the NAFO Secretariat, Dartmouth, Nova Scotia, Canada, 18 - 27 November, 2014.

**9. WGDEC, March 2015**

The next meeting of the ICES – NAFO Working Group on Deepwater Ecosystems is scheduled to take place at ICES Headquarters, Copenhagen, Denmark, during March 2015.

**10. WGRP**

The WG on Reproductive Potential has completed its third terms of reference and has reported to Scientific Council on all of its activities. The WG met 9 times since its inception in 1999 as well as completing much of its work intersessionally. WGRP produced a volume of the Journal of Northwest Atlantic Fishery Science, and two volumes of Scientific Council Studies, and numerous other primary publications. It also hosted a workshop on 'Implementation of Stock Reproductive Potential into Assessment and Management Advice for Harvested Marine Species'. Scientific Council congratulated the WG on its good work over the years. The WG will now be disbanded and so will not meet in future.

**11. WGHARP, 17 – 21 November 2014**

The next meeting of the ICES – NAFO Working Group on Harp and Hooded Seals is scheduled to take place in Quebec City, Canada, during 17 – 21 November 2014.

## IX. ARRANGEMENTS FOR SPECIAL SESSIONS

**1. Planned Sessions**

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

Scientific Council received an update on the conference being organized entitled "Effects of fishing on benthic fauna, habitat and ecosystem function", which NAFO is co-sponsoring. This symposium will review the physical and biological effects of fishing activities to sea bottom ecosystems, look at various technical conservation measures designed to mitigate these effects and ultimately try to quantify the overall ecosystem impact. The aim is to develop tools for use in informed ecosystem-based fisheries management. Scientific Council is supporting the attendance of one of the co-conveners Mariano Koen-Alonso (Canada) as well as two of the keynote speakers, Mike Kaiser (University of Bangor, Wales) and Barry O'Neill (Marine Scotland - Science).

**2. Proposals for Future Special Sessions**

There were no proposals for symposia.

# X. MEETING REPORTS

## 1. Report of the 6th Working Group on Ecosystem Science and Assessment (WGESA), Nov 2013

The Scientific Council Working Group on Ecosystem Science and Assessment (WGESA), formerly known as Working Group on Ecosystem Approaches to Fisheries Management (WGEAFM), met at the NAFO Headquarters, Dartmouth, Canada, on November 19-29, 2013. The detailed outcomes of this meeting are reported in SCS 13/24.

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

Following a request by the Scientific Council chair, WGESA organized its work for this meeting so to provide input towards addressing 3 ecosystem-related Fisheries Commission requests (FC Requests # 12, 13, and 15). These FC requests were integrated into the long-term ToRs.

The final form of the ToRs addressed at the 6th WGESA meeting were:

**Theme 1: Spatial considerations**

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

> **Part A**. New information
>
> **Part B**. Fisheries Commission Requests #13 and #15.**s** Review of VMEs in the NRA, and current closures to protect them.

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

> **ToR 2.1**. [*Roadmap*] Update on integrated ecoregion analysis for the entire Northwest Atlantic.

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

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

> **ToR 3.1**. [*Roadmap*]. Report progress on the development of Fisheries Production Potential Models for NAFO ecosystems.
>
> **ToR 3.2**. [*Roadmap*]. Report progress on trophic ecology/species interactions studies for the Grand Banks (NAFO Div 2J3KLNO).
>
> **ToR 3.3**. [*Roadmap*]. Report progress on trophic ecology/species interactions studies for the Flemish Cap (NAFO Div. 3M).
>
> **ToR 3.4**. [*Roadmap*]. Review of evidence for ecosystem function of VMEs in the NAFO area.
>
> **ToR 3.5**. [*Roadmap*]. Oceanographic conditions around Flemish Cap.

**Theme 3: Practical application of ecosystem knowledge to fisheries management**

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

> **ToR 4.1**. [FC Request # 12]. Report progress on the assessment of Significant Adverse Impacts on VMEs, with emphasis on analysis of the risk associated with bottom fishing activities on known and predicted VME species and elements in the NRA.
>
> **ToR 4.2**. [*Roadmap*]. Update workplan for the assessment of Significant Adverse Impacts on VMEs, towards the development of re-assessments of bottom fishing activities by 2016.

In addressing ToR 1, WGESA review all available information, including the most recent analysis emerging from the NEREIDA program, regarding VME indicator species in the NRA. Based on that review, WGESA developed operational definitions for VME indicator species, elements, higher concentrations and VME proper (i.e. habitat). These definitions were used to identify VMEs in the NRA and to compare these results with the existing NAFO closures. These comparisons were the basis for a set of priorities regarding VMEs for the consideration of Scientific

Council. These analyses constituted the supporting material for Scientific Council to address FC Requests 13 and 15.

In addressing ToR 2, WGESA review the progress made towards the integration of datasets across the Northwest Atlantic, for the development of an integrated ecoregion analysis at the scale of the Northwest Atlantic. This integrated analysis was initially planned for a dedicated working meeting in October of 2013, but unforeseen circumstances required moving this meeting to January 2014. Regardless this delay, preliminary results from this work were presented and discussed at the 2013 WGESA meeting. Although a final analysis will be tabled at WGESA in 2014, the preliminary results examined indicated that the general ecosystem delineations emerging from regional analyses are consistent with the areas emerging from the large scale integration.

In addressing ToR 3, WGESA made progress, among other topics, on the development of Ecosystem Production Potential (EPP) models, and the related estimates of Fisheries Production Potential (FPP), the exploration of the ecosystem boundary between the Grand Bank and the northern Newfoundland-Labrador Shelf, estimations of food consumption by the fish community in the Newfoundland-Labrador shelves, the estimation of cannibalism in 3M cod, as well as advancing the work towards summarizing the information regarding the functional role of VME indicator species, as well as ongoing ecosystem analysis focused on community trends in the Newfoundland-Labrador shelves. Highlights under this ToR included the initial estimates of FPP for the northern Newfoundland and Southern Labrador Shelf (NAFO Div. 2J3K), the Grand Bank (NAFO Div. 3LNO), the Flemish Cap (NAFO Div. 3M), the Scotian Shelf (NAFO Div. 4VsWX) and the Northeast US Continental Shelf (approx. NAFO Div. 5+6ABC), and comparisons of these estimates with past and current levels of catch for 2J3K, 3LNO and 3M. In the case of the Newfoundland-Labrador Shelves, the estimates of EPP were consistent with the estimates of food consumption for this area. The FPP estimates for the Flemish Cap indicated that catch levels in this ecosystem currently are at the estimated FPP level. In regard to cannibalism in 3M cod, the results indicated that during 2010-2012, a significant increase in cod cannibalism took place in the Flemish Cap.

In addressing ToR 4, and in the context of FC Request #12, WGESA advanced the work towards evaluating significant adverse impacts (SAI) on VMEs. These analyses involved the production of impact layers based on VMS data, and VME layers from RV surveys. Preliminary results indicated the important fractions of the effort are exerted in relatively small regions within the fishing footprint, and at least for some areas, fishing effort seems to be concentrated in the neighbourhood of VMEs, hinting to a potential functional connexion between some VMEs and commercial fishes. This and other issues will continue to be explored as part of the process of developing the assessment of bottom fishing activities due in 2016. WGESA also put together a workplan for Scientific Council consideration on how to deliver these assessments of bottom fishing activities.

Following the ongoing cross-attendance practice, the co-chair of the ICES Working Group on the Northwest Atlantic Regional Sea (WGNARS), Catherine Johnson, attended the 6th WGESA meeting, presenting a summary of the work done by ICES WGNARS in its 2013 meeting.

WGESA also discussed next step and future activities. It was proposed that the 7th WGESA meeting to take place in November 19-28, 2013, at the NAFO Secretariat in Dartmouth, Canada. WGEAFM proposed to continue addressing its long-term ToRs, focusing the work during the 6th meeting as follows:

**Theme 1: Spatial considerations**

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

- Update on VME data analyses and VME distribution analyses in relation to ecoregions and VME elements

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

- Final results on integrated Northwest Atlantic ecoregions analysis

**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.

- Analysis on benthic communities in Flemish Cap and NL

- Progress on multispecies and ecosystem production potential modelling

**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.

- Work towards the development of assessments of bottom fishing activities (e.g. distribution modelling, classification of fisheries, ecosystem background, template for risk analysis, and advance on assessment of significant adverse impacts on VMEs).

It was highlighted that given the current constraints in resources, limited participation (and expected decrease in attendance), workloads, and ongoing commitments (e.g. assessment of bottom fishing activities, advancement of the Roadmap), the existing WGESA capacity is fully committed. Depending on the workload involved, addressing FC Requests from NAFO September 2014 Annual meeting at the WGESA November 2014 meeting may hinder WGESA ability of delivering on existing commitments.

In addition to the report of the 6th WGESA meeting, the SC WGESA co-chairs informed SC that, after the meeting of the working group in November 2013, other WGESA-related activities took place, namely:

a) Integrated Northwest Atlantic ecoregion analysis and Ecosystem Production Potential modeling. A working meeting to finalize the large scale integrated ecoregion analysis, and to continue developing the EPP models took place at the Northeast Fisheries Science Centre (NEFSC), NOAA, Woods Hole, MA, on January 29 to February 1 2014. This meeting was attended, among others, by several WGESA members (Pierre Pepin, Michael Fogarty and Mariano Koen-Alonso), and the results obtained are will be tabled at the next WGESA meeting in November 2014.

b) ICES WGNARS. This ICES working group met Waquoit Bay National Estuarine Research Reserve in Falmouth, MA, USA, from 3–7 February 2014. In accordance to the ongoing cross-attendance practice, WGESA co-chair Mariano Koen-Alonso attended this meeting and presented a summary of the NAFO SC WGESA work to date. During this meeting, WGNARS made progress on i) operationalizing management objectives for a “worked example” IEA analysis for the Northwest Atlantic Regional Sea, and ii) identifying key biophysical drivers and anthropogenic interactions in the region. WGNARS has adopted stable Terms of Reference for until 2016, and has selected two specific regions to be compared within the Northwest Atlantic Regional Sea: the Georges Bank/Gulf of Maine and the Grand Banks, as part of a process to explore the development of IEAs. For these regions, bottom temperature, surface temperature, ice timing and cover, freshwater input, stratification and salinity were identified as key large-scale biophysical drivers, while fishing and energy development and/or exploitation were identified as the major large-scale anthropogenic interactions. The temporal scale for analysis will be the management-relevant time horizon of annual to decadal. The next WGNARS meeting will be held in Dartmouth, NS, Canada on 23–27 February 2015. The results of this meeting are reported in the ICES WGNARS Report 2014 (ICES CM 2014/SSGRSP:02).

**Scientific Council considerations**

Scientific Council took notice of the progress made by WGESA, and approved the plans for the next meeting in November 18-27, 2014 at the NAFO Headquarters. Scientific Council also requested WGESA to include among its ToRs for the next meeting the update of the NAFO VME indicator species guides to include the VME indicator species not currently included in the guides.

**2. Report from ICES-NAFO Working Group on Deepwater Ecosystems (WGDEC), Mar 2014**

On 24th February 2014, the joint ICES/NAFO WGDEC, chaired by Neil Golding (UK) and attended by fifteen members met at the ICES Headquarters, Copenhagen to consider the terms of reference (ToR) listed in Section 2. WGDEC was requested to update all records of deep-water vulnerable marine eco-systems (VMEs) in the North Atlantic. A significant number of new records were brought to the group this year totalling 7469, which now constitute 46% of records within the VME database. The new data were from a range of sources including fisheries surveys and seabed imagery surveys. For one area within the NEAFC Regulatory Area in the Southern Mid Atlantic Ridge, WGDEC made a recommendation for an extension to an area currently to be closed to bottom fisheries for the purposes of conservation of VMEs.

Within the NEAFC regulatory area the following areas were considered:

- **Josephine Seamount**: Additional historic VME indicator records were presented this year which supports the current ICES advice.
- **Southern Mid-Atlantic Ridge**: The group considered records of VME indicators on the Mid-Atlantic Ridge between the present NEAFC closure (Southern MAR) and the border with the Portuguese EEZ. A recommendation is made to extend the current NEAFC Southern MAR bottom fishing closure southwards.
- **Hatton Bank**: New information on longline bycatch of stony corals and gorgonians was available. No modification recommended to current closed area.
- **Rockall Bank**: New information from commercial fishery with observer, but no bycatch recorded.

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

- **East Rockall Bank**: Of particular interest to WGDEC was new information from a seabed imagery survey of the East Rockall slope, where *Lophelia pertusa* colonies were observed from one transect. No bottom fishing closure recommendations were made at this time.
- **Faroe-Shetland Channel**: New records of sponges (Geodia, *Axinellidae* and *Phakellia ventilabrum*) were presented from a seabed imagery in this area, indicative of the VME habitat Deep-sea sponge aggregations. No bottom fishing closure recommendations were made.
- **Bay of Biscay**: New records of VME indicators collected from 2009 to 2012 were considered by WGDEC. This submission accounted for over the half the new VME indicator records submitted this year. No bottom fishing closure recommendations were made.
- **Norway**: New records of VME indicators from seabed imagery surveys undertaken by the MAREANO project were submitted to WGDEC. No bottom fishing closure recommendations were made.
- **Faroe Islands**: New records of *Lophelia pertusa* from bottom trawling by-catch was made available; the weight was very low, and less than 1kg.
- **Greenland**: New records of sponges from *Geodia* genus were made available from bottom trawling bycatch; the weight was approximately 100kg, below the current threshold for sponges.

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

- **Flemish Cap and Grand Banks**: Records of VME indicator species caught as bycatch were reported to WGDEC. Weights were very low and no catches exceeded 1kg.

For the first time since 2006, WGDEC was able to analyse the spatial distribution of bottom fishing activity in the NEAFC Regulatory Area following submission of VMS-data from 2013 to ICES from NEAFC. After filtering for speed and bottom fishing gear types, WGDEC examined the general data distribution and also looked at some areas in greater detail, such as Hatton and Rockall Banks and the Mid-Atlantic Ridge.

WGDEC sought to develop a system that would formalise expert opinion and utilise as much relevant information from the ICES VME database. Historically, information on the presence of VME indicator species was plotted and expert opinion used to interpret the likelihood that the data indicate the presence of VMEs. A multi-criteria assessment (MCA) method was developed and trialled with information from within the current ICES VME database. The system currently developed goes some way to providing a simple means of assessing qualitatively different types of information on different types of VME indicator species. This weighting system will be further developed at WGDEC 2015.

WGDEC agreed an approach and format for collating records of multibeam bathy-metric surveys with the NAFO and NEAFC RAs. There was an acknowledgement that there are many multibeam catalogues already in existence, so these should be utilised alongside any new records that are brought to WGDEC by its members.

WGDEC reviewed state-of-the-art of high resolution 'terrain-based models' for predicting VME distribution. It was noted that the emergence of large-scale multibeam derived high-resolution bathymetry surveys has provided practitioners with the means to greatly increase species distribution model resolution. Predictive modelling approaches to mapping offer one option in the application of the precautionary approach to identify areas where VMEs are known *or likely to occur.* As well as modelling presence or presence/absence, density/abundance based modelling approaches are also being developed, which will allow the identification of areas of high densities of VME indicator species and by inference VMEs. WGDEC concluded that peer re-viewed predictive models of the distribution of VMEs or VME indicator species should be taken into consideration in management decisions regarding human use of the deep-sea ecosystem.

## 3. Report from Joint FC-SC Working Group on Risk Based Management Strategies (WG-RBMS), Feb 2014

(FC/SC Doc. 14/02)

One of the co-chairs of the Working Group updated the Council on the proceedings of this meeting. Work on a response to the recommendations of the group directed to Scientific Council was started. A full discussion of these issues was deferred to a later date.

## 4. Report from ad hoc Joint Working Group on Catch Reporting (WG-CR), Feb 2014

(FC/SC Doc. 14/01)

The Scientific Council Chair updated the Council on the proceedings of this meeting. The working group reviewed the Peer Review Expert Panel 2013 Recommendations. It was noted that several of these have already been actioned and further responses and details from Scientific Council from the June meeting are expected.

The Secretariat described the different catch databases housed at the Secretariat: Monthly Provisional Nominal Catches, at-sea inspection reports, port inspection reports, observer reports, vessel transmitted information (VTI), collectively referred to as STACTIC data, and STATLANT 21. Discussions centred on how these data can be used to cross validate the catch estimates. There was a lot of interest from the WG in tow-by-tow logbook data from NAFO and Scientific observers. It is hoped with the implementation of the new observer template in 2014, that data quality would improve considerably. All Contracting Parties were encouraged to analyse and provide their information as a data source.

The Secretariat made two presentations concerning approach in usage of the STACTIC data in complementing STATLANT 21: 1) methods to compare catch estimates --- STATLANT 21 vs STACTIC, and 2) analysis of Vessel Monitoring System (VMS) and VTI (daily catch reports) data. The latter presentation was a more detailed approach in making quantitative analysis using the VTI-CAT reports. The WG recognized the utility of the STACTIC data and the usefulness of the proposed approach. The WG proposed three stocks as a priority to investigate the utility of this approach: Div. 3M cod, SA2 + Divs. 3KLMNO Greenland halibut , and Div. 3LNO American plaice.

The WG agreed to operate for another year under the same goals and objectives as it did for this inaugural meeting. The WG went on to make a number of recommendations to the Fisheries Commission and Scientific Council

## 5. Meetings attended by the Secretariat

### a) Eurostat Fisheries Statistics Working Group

The NAFO Secretariat was invited to participate in the Eurostat Fisheries Statistics Working Group, held on October 16-17th at the Eurostat Headquarters, Luxembourg. Eurostat are keen to rationalize data provision and reduce multiple reporting by their member countries. Items of relevance on the agenda included the issue of STATLANT 21 data submission deadlines, the submission of monthly (21B) catch data and the collection of effort data.

*STATLANT 21A Deadlines*

Presently, NAFO's rules of procedure require Contracting Parties to submit STATLANT 21A data to the Secretariat by 1st May. Regulation (EC) No 217/2009 of the European Parliament and of the Council of 11 March 2009 on the submission of catch and activity statistics by Member States fishing in the north-west Atlantic requires EEA Member States to submit annual catch data to Eurostat for FAO Major Fishing Area 21 by 31st May. The question was raised from a number of participants as to why this was now an issue, and the Secretariat had the opportunity to explain the issues in NAFO regarding the lack of availability of alternative catch estimates and the timing of the Scientific Council meeting.

The following alternatives were proposed to reconcile the two contradictory deadlines:

- Alternative data sources and reliable scientific catch estimates may become available to NAFO in the future, making the use of STATLANT data for stock assessments redundant. In this case, NAFO's rules of procedure may be changed to a later deadline (31st of May).
- Eurostat may change the deadline in regulation (EC) 217/2009 to the 1st of May, provided that the EEA Member States agree.
- The 15th of May is agreed on as deadline by all parties.

No option was agreed upon, however as a transitional solution, Member States were asked to send their annual catch data for FAO Area 21 to Eurostat by the 1st of May (who would automatically forward it to NAFO).

*STATLANT 21B Catch Data*

Scientific Council rules of procedure 4.4 require Contracting Parties to submit disaggregated catch and effort data to the Secretariat by August 31st. As this data is considered more comprehensive it is used to update the annual 21A catch figures, and is made available in stand-alone spreadsheets via the NAFO website. Eurostat were under the impression that other than updating the 21A data, no use is made of this data. At their September 2013 meeting, Scientific Council contested the implication that no use is made of the information on gears, vessel size or main species. In conjunction with effort data (see below) Scientific Council have previously examined 21B-derived catch per unit efforts as a means of assessing abundance, and without catches being disaggregated using information on gear and capacity, misleading results can be obtained. It was agreed that EEA countries will continue to submit 21B catches via Eurostat.

*STATLANT 21B Effort Data*

Regulation (EC) No 217/2009 further requires the collection of fishing effort data. The regulation specifies that data on the "fishing activity, subdivided by calendar month of capture, fishing gear, vessel size and main species sought […] shall be submitted by 31 August of the year following the reference year". Due to a technical issue, data submitted to Eurostat have not been disseminated, and as far as Eurostat were concerned, this had not raised any concerns. Despite the technical oversight, the effort figures have been received by NAFO in recent years for those states that fill in the FAO STATLANT questionnaire in MS Excel format, as a courtesy copy of this from is forwarded by the FAO statistician.

As expressed above, Scientific Council is keen to see effort data being submitted using the STATLANT format, and again, the group agreed to its continued provision.

**b) EU Data Collection Framework Revision Stakeholders Workshop**

A framework for the collection and management of fisheries data in the EU has been in place since 2000, and was last reformed in 2008 resulting in the Data Collection Framework (DCF). Under this framework, Member States are obliged to collect, manage and make available a wide range of fisheries data needed for scientific advice, mainly for the purpose of fisheries management decisions, in the framework of multi-annual national programs.

The NAFO Secretariat was invited to attend the third Stakeholder Meeting on the Revision of the Data Collection Framework (DCF). Evaluations of the current system presented to the meeting identified its strengths - data collection has been harmonized; end-users consider that the DCF has produced data that enables the production of sound scientific advice, the quantity of available data has improved, regional cooperation has increased; there is overall good compliance; it is a cost efficient system.

There were also a number of problems identified with the current regulation:

- The insufficient alignment of the Data Collection process with the new needs of the reformed CFP such as: deficiencies in ecosystem information (including by-catch of non-target and protected species); the absence of methods for evaluating the biological, ecological, economic and other impacts of the landing obligation; and the lack of reliable socio-economic information about freshwater aquaculture.

- The insufficient responsiveness of data provision to end-users' needs, in particular the lack of a process to modify programs when the needs of end-users change.

- The insufficient reliability and quality of certain types of data transmitted by Member States.

- The lack of clarity on rules on access to data and contradictory interpretation of data protection requirements by Member States, which leads to a certain lack of transparency and a limited access to and availability of data for scientists and any other interested stakeholders.

- The wide divergence of data storage and data transmission across Member States and the incompatibility of IT systems among and within Member States, resulting in excessive complexity and costs of making data available to end-users (via a system of data calls).

The scope of the DCF is being aligned with new needs arising from the revision of the CFP Basic Regulation, and to improve alignment between the DCF and other EU instruments relating to data collection and provision. From a

NAFO perspective, the key elements relate to the EUs new landing obligation, particularly as regards the sampling of discards, and to the impact of fisheries on the ecosystem.

**c) FAO VME Database Workshop**

The SC and FC Coordinators attended the final FAO VME Database Meeting. NAFO has been involved in this project since its inception in 2011, and this meeting marked the final stages of the initiative. The NAFO/BIO case study model for the VME database was not adopted by the FAO, although some of the elements are still present, such as the map view and regional overviews of action by each RFMO.

The database presents a number of layers (closures, footprints, other areas) and allows searching on a number of criteria. Printable fact sheets on each measure can be created, and the database also features a time-slider, enabling users to see when were introduced.

The project coordinator, Tony Thompson, has entered much of the NAFO information. It will be possible to download a synoptic table of data; therefore this can be made available to Scientific Council for their approval in advance of the September meeting. The FAO aims to make the project live in October.

Going forward, it is estimated that around 2-3 days/year of Secretariat staff time will be required to keep the database up to date. This will probably be approached in a similar manner to FIRMS, with a memorandum of understanding being entered into b General Council. Scientific Council appointed a small number of reviewers to look over the data, with the intent of approving the content at the September meeting.

## 6. ICES/NAFO Symposium on "Gadoid Fisheries: The Ecology and Management of Rebuilding"

The ICES/NAFO symposium on ‘Gadoid Fisheries: The Ecology and Management of Rebuilding’ was held from 15-18 October, 2013 in St. Andrews, New Brunswick, Canada. There were 90 presentations, 52 of which were oral. The aims of the symposium were to address historical dynamics and current status of gadoid stocks in the North Atlantic; present new scientific findings on the biology and ecology of these species that can be used to improve fisheries management; link biological and environmental changes that can be used to forecast species distribution and productivity in relation to climate change; present and appraise the effectiveness of management strategies and actions in the absence, under and after rebuilding. These aims were addressed through 6 theme sessions. Presentations were well distributed across all sessions. Several themes emerged from the symposium, some emerging from more than one session. Changes in life history traits, either due to fishing effects or environmental variation, have an important impact on stock rebuilding and resilience and changes in productivity need to be taken into account in fisheries advice and management. Examples of successful rebuilding usually were stocks where there was strong policy, responsive management strategies, adoption of scientific advice and favorable stock productivity conditions. The proceedings of the symposium will be published in the ICES Journal of Marine Science.

## 7. World Conference on Stock Assessment Methods, Boston, USA, July 2013.

In 2010, ICES commenced a Strategic Initiative on Stock Assessment Methods (SISAM) to review the state of the art in stock assessment modeling and to reinvigorate the methodology used by ICES working groups in the provision of management advice. As similar issues are being experienced by many RFMOs and domestic assessment agencies worldwide, interest in this initiative quickly spread beyond the ICES community, drawing interest and expertise from around the globe. The culmination of this initiative was the *World Conference on Stock Assessment Methods* (WCSAM), held in Boston, MA, USA during July 2013. This three-day conference was preceded by a two-day workshop. In addition to funding the travel of keynote speaker Sidney Holt, NAFO funded the participation of two SC Designated Experts: D. González-Troncoso (EU) and B. Healey (Can) to both the workshop and conference.

The workshop was attended by a large number of participants (approximately 150) and therefore was not amenable to conducting any hands-on work. Presentations were given based upon either previously completed work or ongoing study, topics that were also more fully discussed during the subsequent conference. The main focus of the workshop was presenting results of a pre-conference simulation study. Several case studies were included in which data generation was loosely based upon existing stock datasets (such as Georges Bank Yellowtail Flounder), and several base models fit to these data sets. These ‘assessment’ results were used as starting point for generating simulated data for examining performance of various models/model types.

The simulation results had been completed and compiled immediately prior to the workshop and had not been reviewed by all contributors to the simulation study. Some results demonstrated at the workshop were questioned by simulation study participants, and these issues were unresolved. Comparisons were graphical only – there were no statistical comparisons, nor any ranking of performance of the various methods.

Focus was upon graphical presentation of: i) self-tests - how well can a given model predict itself, and ii) cross tests - how well can models reconstruct time-series that were generated within a different model. Comparisons of estimates of standard assessment quantities were such as fishing mortality and spawning stock biomass were provided. In many instances, large biases were present even for the self-tests, and exceedingly large biases were found in some cross tests. Overall, (and pending resolution of some of the questions noted previously) a state-space stock assessment model (SAM) developed by Anders Nielsen of the Danish Technical University in Copenhagen, Denmark (see www.stockassessment.org) outperformed XSA and an SCAA implementation. A series of stock assessment data sets were also subjected to a multiple-model test, i.e. many models were fit to each stock assessment dataset. Results were often in general agreement on a relative scale, but there were differences in estimating absolute stock size, often the key metric for provision of management advice. The workshop concluded that *a significant investment of resources in stock assessment methods is necessary to address issues regarding model selection and model uncertainty*.

The conference was held during 17-19th July with over 220 participants from 27 countries, providing a forum for presentations on the application and future of stock assessment methods. A total of 59 presentations were presented in four theme sessions during the conference and a poster session was held with a total of 53 posters shown.

The objective of the conference was to aid scientists to apply the best stock assessment methods when developing management advice for fisheries management. There was also the hope that the events would benefit the entire international fishery science community. The initiative was designed to contribute to the improved application of assessment methods. It was recognized that "best methods" are not static. Rather, the set of available methods will continue to evolve and improve in response to lessons learned in their current application (WCSAM Report).

Specific objectives of the conference included:

i. explore the merits of available assessment methods for providing fisheries management advice
ii. explore model performance across a range of factors through participatory workshops
iii. consider how to determine the most appropriate method for individual cases
iv. inform and educate about the range of available stock assessment methods
v. facilitate comparisons between methods through access to test data sets
vi. generate ideas for the features of next generation assessment models

An opening keynote address was delivered by Professor Sidney Holt, a pioneer of modern fisheries science. In a wide-ranging talk, Professor Holt discussed important milestones in the development of stock assessment methods, in which he questioned the value of production models, and also the concepts and utility of MSY, noting: "MSY as a target is rubbish". It was suggested that what really matters is the catch rate (the profitability) as well as the sustainability, so fisheries science should be concerned with economic parameters too. How far must we be from MSY to make a fishery profitable? The talk certainly promoted debate, and Sidney played an active and provocative role throughout the conference.

Four theme sessions were held in sequence:

*1. Key Challenges for Single Species Assessments*

Keynote Addresses by Rick Methot (NOAA, USA) and Mark Maunder (IATTC).

> The longest session (20 presentations, 21 posters) considered issues such as simplicity vs complexity, the advantages of using age data, doming and temporal trends in selectivity, analysing causes of retrospective patterns and the estimation and use of stock-recruitment relationships.

Of note, one of the central themes of the session keynote address was that progress in the field of Fisheries Science has been slow because people are busy doing stock assessment instead of working on solving the problems of stock assessment, and also that research money has gone to other fields. Discussion/suggestions on how this situation could be changed were offered, one example being the recent formation of the *Centre for the Advancement of Population Modelling*: http://www.capamresearch.org which is aiming to both improve quantitative methods and also to support educational opportunities to enable these improvements.

*2. Assessing Ecosystem Dynamics & Structure*

Keynote Speaker: Julia Blanchard (Univ. of Sheffield, UK)

The session consisted of eight presentation and nine posters and considered issues beyond single species stock assessment such as impacts of fishing on community structure, multispecies approaches and incorporating variable natural mortality.

*3. Spatial Complexity and Temporal Change*

Keynote Speaker: Richard Hillary (CSIRO, Australia)

The twelve presentations and 15 posters in the session dealt with issues related to stock structure, assessing populations across space and the impacts of changes in productivity, and how best to deal with them.

*4. Data Poor Approaches*

Keynote Speaker: Nokome Bentley (Trophia Ltd, New Zealand)

This large session (19 presentations and 8 posters) highlighted recent developments in data poor approaches. Scientists from many areas of the world are producing methods to assess data limited/poor stocks; is there a common theme/methodology developing?

Abstracts of all talks are available at: http://goo.gl/AaYcXR, and a special issue of the ICES Journal of Marine Science is to be published disseminating the research covered during the conference. Further, the full Conference Report is available at: http://goo.gl/8qiaPo.

NAFO Scientific Council Designated Experts Brian Healey (Canada) and Diana González-Troncoso (European Union) at WCSAM with Professor Sidney Holt, a pioneer of modern fisheries science, who has been involved in fisheries science of the northwest Atlantic since the Washington Conference of 1948 which lead to the establishment of ICNAF. Professor Holt delivered the conference keynote opening address.

## 8. *Ad Hoc* SC Working Group on Div. 3M Cod Catches

At the Joint FC-SC Working Group on Catch Reporting (3-5 February 2014) it was recommended that, *"due to the requirement for an assessment in 2014, Div. 3M cod will be used by Scientific Council as a pilot this spring to try to address lack of estimates for that stock assessment"*. An *ad hoc* subgroup of Scientific Council met via WebEx on

5 May 2014 to discuss progress to date and determine a plan of action on the issue of estimating catches for use in the Div. 3M cod assessment (Part C, this volume).

The meeting opened with a presentation on the data availability and quality at the Secretariat in recent years which relates to Div. 3M cod. It was noted that while observer data should be reported on a haul-by-haul basis, compliance with this requirement was poor. Reporting at this level of aggregation became mandatory at the start of 2014, and a preliminary investigation suggests observance of this regulation is promising and this may prove to be a useful source of information in the future. Provision of daily catch reports has been good since shortly after their introduction at the start of 2011. Coupled with VMS data to quantify the amount of effort associated with each report, this may be a good tool to examine catch rates by vessel.

Noting that the aim of this exercise was to provide an alternative source of catch data for recent years available in time for the assessment at the June Scientific Council meeting, participants made a number of suggestions for actions which could be pursued.

It was agreed that although the haul-by-haul observer data may be of value in the future, the level of detail available in the existing observer reports from 2011 – 2013 is not sufficient to be of use at present.

The information available for the VMS and daily catch reporting system was considered promising, although it was noted that the totals of the daily catch reports were approximately equivalent to the totals from STATLANT 21. The possibility of identifying vessels which are targeting cod and examining their average catch rates as a means to identify any anomalous values was proposed.

It was agreed that the Secretariat would prepare an anonymous data file of daily fishing effort, total catch and catch of cod within the 600m isobath of Div. 3M, disaggregated by vessel and flag state, along with some vessel capacity information (length overall and engine size) from the fleet register. This would be provided to Scientific Council for further exploration.

### 9. Scientific Council Working Group on Development of a Management Strategy for Div. 3LN Redfish

In June 2014 the Fisheries Commission requested the Scientific Council to explore models that could be used to conduct a Management Strategy Evaluation for Div. 3LN redfish and report back through the Working Group on Risk- Based Management Strategies during their next meeting. Furthermore, at the recent FC-SC Working Group on Risk Based Management Strategies (WG-RBMS) there were a number of recommendations directed to Scientific Council, including two relating to the ongoing development of a management strategy for Redfish in Div. 3LN:

Scientific Council met via WebEx on 13 May 2014 to discuss the ongoing development of a management strategy for redfish in Div. 3LN (Part D, this volume).

Details of four operating models were presented:

a. ASPIC (current stock assessment model)

b. ASPIC-like model in a Bayesian framework (ASPIC-BAYES)

c. ASPIC-like model in a Bayesian framework with all available data (ASPIC-BAYES-FULL)

d. Spatially disaggregated model (BAYES-SPATIAL)

The objectives and performance statistics, as defined by WG-RBMS, were also discussed. Some concerns were expressed that evaluating the performance of the management strategy over seven years was not suitable for a long-lived species such as redfish, and as a consequence it was suggested that performance of the management strategy over 30 years also be evaluated. Further discussion of this issue, as well as exceptional circumstances and the review process for the management strategy, was deferred to the June meeting of Scientific Council.

### 10. North-west Atlantic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas (EBSAs)

The North-west Atlantic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas (EBSAs), was held in Montreal, Canada, from 24 to 28 March 2014, hosted by the Government of Canada. This workshop was the eighth regional EBSA workshop convened by the Convention on Biological Diversity (CBD) Secretariat, whose primary objective is to facilitate the description of ecologically or biologically significant marine areas through the application of scientific criteria in annex I of decision IX/20 (http://www.cbd.int/decision/cop/?id=11663), as well as other relevant compatible and complementary nationally and intergovernmentally agreed scientific criteria, as well as the scientific guidance on the identification of marine areas beyond national jurisdiction, which meet the scientific criteria in annex I to decision IX/20 (paragraph 36 of decision X/29). These regional workshops provide a significant contribution to the application of the ecosystem approach and the precautionary approach to the conservation and sustainable use of marine biodiversity and will collate evidence on EBSAs and submit to UN via COP Process for formal adoption of candidate EBSAs.

The meeting was attended by experts from Canada, United States of America, Northwest Atlantic Fisheries Organization, Global Ocean Biodiversity Initiative Secretariat, World Wildlife Fund, and Memorial University of Newfoundland (Birdlife International). An expert from the UNEP Mediterranean Action Plan for the Barcelona Convention Regional Activity Centre for Specially Protected Areas (RAC/SPA) attended the workshop as an observer.

On behalf of the Government of Canada, as the host of the workshop, Mr. Patrice Simon, Assistant Director General, Ecosystem Science Directorate, Fisheries and Oceans Canada, presented opening remarks. And on behalf of the Secretariat of the CBD, Mr. Sarat Babu Gidda, Programme Officer for Conservation, welcomed participants and thanked them for participating in this workshop. He also emphasized the importance of collaboration with the Food and Agriculture Organization of the UN and its work on vulnerable marine ecosystems (VMEs), which complement the ongoing work on EBSAs in building an improved understanding of marine ecosystems and facilitating the application of appropriate policy responses.

After a brief explanation by the CBD Secretariat on procedures for electing the workshop Chair, Mr. Jake Rice (Canada), was elected as the workshop Chair, as offered by the hosting Government. Ms. Jihyun Lee (CBD Secretariat) provided an overview of the CBD EBSA process and highlighted the workshop objectives and expected outputs.

Mr. Jake Rice delivered a presentation on the scientific criteria for EBSAs (annex I to decision IX/20, http://www.cbd.int/doc/decisions/cop-09/cop-09-dec-20-en.pdf) and the scientific guidance on the application of EBSA criteria, building upon the results of the Ottawa Expert Workshop (http://www.cbd.int/doc/meetings/mar/ebsa-np-01/other/ebsa-np-01-ewbcsima-01-02-en.pdf). He made a useful comparison of the FAO (VME) and CBD (EBSA) criteria, noting that the FAO approach appealed to the fisheries management community, whereas the CBD approach appealed to the conservation biology community. He also shared experience from previous regional EBSA workshops in the North Pacific, North-east Atlantic regions, and Arctic.

Presentations in relation to the Canadian process for the identification of EBSAs in different regions and others on scientific information in support of applying EBSA criteria in the northwest Atlantic region were also provided. In addition, the Executive Secretary prepared a compilation of the submissions of scientific information to describe ecologically or biologically significant marine areas in the North-west Atlantic, submitted by Parties, other Governments and relevant organizations prior to the workshop and that were made available for the information of workshop participants on the meeting website. The information provided in these presentations was incorporated into the description of areas meeting the EBSA criteria. Each presentation describing areas meeting the EBSA criteria provided an overview of the areas considered, the assessment of the area against the EBSA criteria, scientific data/information available as well as other relevant information.

Following discussion of the information to be captured in the maps and EBSA descriptions, the workshop participants were then split into several break-out groups to address: (i) seamounts; (ii) the Southeast Shoal / Flemish Cap, Pass and Orphan Knoll; (iii) hydrothermal vents; (iv) the Labrador Sea deep convection area; (v) the transition zone front, (vi) seabird foraging areas to the east; and (vii) canyons and the shelf edge. The results of the break-out groups were reported at the plenary for consideration. At the plenary session, workshop participants reviewed the description of areas meeting EBSA criteria proposed by the break-out group sessions, including the draft descriptions, using templates provided by the CBD Secretariat, and considered them for inclusion in the final list of areas meeting EBSA criteria. The workshop participants agreed on descriptions of seven areas meeting EBSA criteria:

1. **Labrador Sea Deep Convection Area.** The area is located in the central gyre of the deep oceanic basin in the Labrador Sea, in an area transected by the World Ocean Circulation Experiment AR7W Line. The area

is not fixed by geographic coordinates; instead it is delineated dynamically according to physical oceanographic properties. Normally, deep winter convection occurs over a large region whose spatial extent can be mapped by geo-referenced contours of the mixed layer depth. A contoured mixed layer depth of 600 m delineates a nominal convection zone that straddles across areas that are within and outside national jurisdictions.

2. **Seabird Foraging Zone in the Southern Labrador Sea.** The area is located at the southern portion of the Labrador Sea, north-east of Newfoundland. The identified seabird habitats span the Canadian EEZ and adjacent pelagic waters, but the area described as meeting the EBSA criteria is restricted to the pelagic portion, where the overlap among species is greatest.
3. **Orphan Knoll.** EBSA boundaries were visually drawn around the Orphan Knoll to encompass the feature.
4. **Slopes of the Flemish Cap and Grand Bank.** The area is delimited by the 600 m and 2500 m bathymetric contours along the 3LMNO Divisions of the NRA and lies beyond the limit of the Canadian EEZ. However the entire Beothuk Knoll is included even though its shallower depth is less than 500 m, because it is considered a VME element by NAFO. The part of the Flemish Cap above 600m was considered but due to the absence of sponge grounds or any aggregation of any VME indicator taxa or VME elements, this part was not included of the proposed EBSA.
5. **Southeast Shoal and Adjacent Areas on the Tail of the Grand Bank.** The area is located at the southern portion of the Grand Bank, southeast of Newfoundland. The region proposed extends from the 200nm (Canadian EEZ) to the 100m contour.
6. **New England and Corner Rise Seamounts.** Boundaries were drawn around the named seamounts in each of the New England and Corner Rise Seamount chains. Two polygons were drawn given the large distance of about 300 km between them where there are no seamounts due to a pause in volcanism 83 million years ago. The New England Seamounts feature extends into the EEZ of the United States of America but the boundaries presented here only go to the US EEZ.
7. **Hydrothermal Vent Fields.** The area follows the Mid-Atlantic Ridge (MAR) from the Lost City vent fields at 30.125°N 42.1183°W to the Snake Pit vent fields at 23.3683°N 44.95°W. The entire feature is in area beyond national jurisdictions.
8. **Newfoundland Seamounts and Fogo Seamounts.** The collection of the Newfoundland Seamounts, the Fogo Seamounts, and Orphan Knoll was initially proposed as an area potentially meeting the EBSA criteria, but was concluded that there was limited bathymetric information of varying quality and limited geological sampling available for the Newfoundland Seamounts and Fogo Seamounts so it was inadequate to evaluate those seamounts with respect to the EBSA criteria. This does not imply that these seamount groups are not ecologically or biologically significant. For this reason, collection of at least basic ecological and oceanographic information on these seamounts is particularly of high priority.

## 11. ICES/NAFO Working Group on Harp and Hooded Seals

The ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP) met during August 2013 at the Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO, Murmansk, Russia. Scientists representing Canada, Greenland, Norway, and Russia participated. The WG received presentations related to stock identity, catch (mortality) estimates, abundance estimates, and biological parameters of White Sea/Barents Sea, Greenland Sea and Northwest Atlantic Ocean harp and hooded seal stocks, and provided updated catch options for northeast Atlantic harp and hooded seals in response to a request from Norway. The primary focus of the meeting was to respond to the Norwegian request. There were no new data on Northwest Atlantic hooded seals. Preliminary results of the 2012 pup production surveys of Northwest Atlantic harp seals were presented but final estimates were not available.

The Canadian National Marine Mammal Peer Review Committee reviewed the final results of the 2012 surveys and assessed the status of the Northwest Atlantic harp seal population. Pup production in the Gulf of St. Lawrence and at the ‘Front’ (southern Labrador and/or northeast Newfoundland) was estimated to be 790,000 (SE=69,700, CV=8.8 %) in 2012 (Fig. 17). This is approximately one half of the number of pups estimated in 2008, likely due to lower reproductive rates. The total population size was estimated using a model that incorporates a time series of independent pup production estimates up to 2012, as well as reproductive rates, ice-related mortality and harvest information to 2013. The model incorporates density dependence and, in addition to starting population and mortality, it estimates the carrying capacity (K). The model estimated 2012 pup production of 929,000

(SE=148,000), a total population of 7.4 million (SE=698,000) and a K=10.8 million (SE=564,000). The population appears to be relatively stable, showing little change in abundance since 2004.

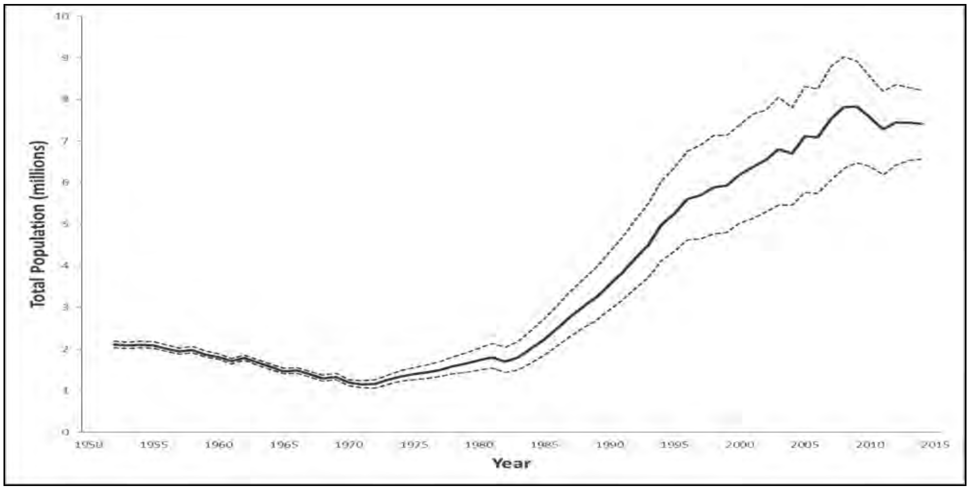


Fig. 17. Estimated total population of Northwest Atlantic harp seals, 1952-2014.

The declining, but highly variable, reproductive rates observed among NWA harp seals since the 1980s have continued. The general decline in fecundity can be explained by the observed population increase (i.e. density-dependent factors) while the inter-annual variability appears to be affected by late term abortions. The abortion rate is influenced by density independent factors and can be described either by a model that incorporated first year ice cover in late January or a model that incorporated ice cover and capelin biomass obtained from the previous fall as a proxy for prey availability. The abundance of capelin, a key prey of harp seals, has been shown to be correlated with the timing of ice retreat.

## XI. REVIEW OF SCIENTIFIC COUNCIL WORKING PROCEDURES/PROTOCOL

### 1. General Plan of Work for September 2014 Annual Meeting

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

### 2. Other Matters

#### a) Progress on performance assessment recommendations

Scientific Council noted that all recommendations directed towards it, both jointly and singly, have been considered and where appropriate actions have been taken or are underway.

#### b) Chair of STACFEN

Scientific Council were informed that Estelle Couture (Canada) would be stepping down as chair of STACFEN. A replacement will be nominated at the September meeting.

## XII. OTHER MATTERS

### 1. Designated Experts

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

### 2. Stock Assessment Spreadsheets

It is requested that the stock assessment spreadsheets be submitted to the Secretariat as soon after this June meeting as possible. The importance of this was reiterated by STACREC. The Secretariat will remind Designated Experts of this request by mid-July.

### 3. Meeting Highlights for the NAFO Website

The Secretariat informed the council that in recent years the highlights of the meeting have been delayed and in some cases not received. In order to improve the visibility of the work being done in Scientific Council, it was agreed that the Secretariat would prepare a press release, in conjunction with the chairs, to be published in conjunction with the release of the June report.

### 4. Scientific Merit Awards

No nominations for Scientific Merit Awards were received.

### 5. Budget Items

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

There was no other business.

## 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.

Specifically, Scientific Council discussed the recommendations of the joint Fisheries Commission – Scientific Council Working Group on Risk-Based Management Strategies to provide feedback in order that the group can continue to develop its work.

The responses are as follows:

*1. In order for the WG to start the process of revising the PA framework the WG* ***recommends*** *SC provide feedback on the following:*

- *Discuss the relevance and implications of:*
- *having* $F_{lim}$ *at* $F_{msy}$
- $F_{msy}$ *as a target*
  *These analyses should include situations where quantitative analysis of uncertainty are limited and situations where uncertainty has been well incorporated into evaluation of Harvest Control Rules.*
- *Consider the utility of buffers (particularly* $B_{buf}$*) in the framework and in management plans and provide advice on whether the use of buffers is considered appropriate for stocks which have* $B_{lim}$*.*
  *Note: the WG* ***recommends*** *that* $B_{isr}$ *is not considered part of the PA (but may be used as an interim milestone to aid decision making).*

Scientific Council responded:

SC initiated discussions on $F_{msy}$ as a limit reference point, and on buffers but due to workloads did not have time to produce a full response. SC will discuss this further in September. It may require an additional meeting to resolve this situation. A working paper will be circulated over the summer to reflect the discussions.

WG RBMS further noted :

*The working group noted that SC, in its 2013 June report, concluded that reference points can theoretically be constructed for all stocks, and that this work is given high priority. The WG recommends SC provide a status report and possible timelines for this work for consideration of Fisheries Commission in September 2014.*

Scientific Council responded:

Status of reference points and timelines for ongoing work is as follows:

| Stock | $B_{lim}$ | $F_{lim}$ | $B_{msy}$ | Comments |
|---|---|---|---|---|
| 1. GHL 0+1 | | | | |
| 2. GHL 1A | | | | |
| 3. RNG 0+1 | | | | |
| 4. Redfish SA1 | | | | |
| 5a. CAT SA1 | | | | |
| 5b. PLA SA1 | | | | |
| 6. COD 3M | | | | |
| 7. RED 3M | | | | Age base assessment |
| 8. PLA 3M | | | | Not a quantitative assessment |
| 9. COD 3NO | | | | |
| 10.RED 3LN | | | | MSY constrained at 21 000 t |
| 11. PLA 3LNO | | | | |
| 12. YEL 3LNO | | | | |
| 13. WIT 3NO | | | | Developed in 2014 based on survey |
| 14. CAP 3NO | | | | |
| 15. RED 3O | | | | |
| 16. SKA 3LNO | June 2015 | | | Proxy derived from survey indices |
| 17. HKW 3NO | June 2015 | | | Proxy derived from survey indices |
| 18. RHG SA2+3 | | | | Not a quantitative assessment, Short time series to derive RP |
| 19. WIT 2J+3KL | | June 2015 | | Proxy derived from survey indices |
| 20. GHL 2+3 | | | | YPR ref points available, no assessment at the moment |
| 21. SQI SA 3+4 | | | | $B_{msy}$ not appropriate given life history. Reference points based on productivity level. |
| 22. Shrimp 3M | | | | |
| 23. Shrimp 3LNO | | | | |
| 24. Shrimp 0+1 | | | | |
| 25. Shrimp EG | | | | |
| 26. Shrimp BS | | | | |
| 27. Shrimp NS | | | | |

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| | Available |
| 'date' | In progress/deadline |
| | No deadline set |
| | Not relevant |

WG RBMS further noted:

*In its assessments and advisory sheets, the working group* ***recommends*** *Scientific Council provide a table or list of reference points available for each stock that includes information on their derivation, and if reference points are missing, explain why.*

Scientific Council responded: this information should already be available for about half of the stock in the new advisory sheets introduced in 2013. This update continued this year and the full circle will be completed in 2015.

*4. The WG* ***recommends*** *SC discuss selection of operating models and evaluate the Div. 3LN Redfish management strategy relative to the performance statistics prior to the 2014 Annual Meeting (Annex 7).*

SC responded: see section VII.c.viii.

*5. The WG* ***recommends*** *SC comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN Redfish (Annex 7)*

SC responded: see section VII.c.viii.

*6. The WG* ***recommends*** *SC to discuss selection of operating models and evaluate the Div. 3M Cod management strategy prior to the 2015 Annual Meeting (Annex 8).*

SC responded: see section VII.c.v.

## XV. ADOPTION OF SCIENTIFIC COUNCIL REPORT

At its concluding session on 12 June 2014, 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 30 May-12 June 2014 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 St Mary's University for the excellent facilities. There being no other business the meeting was adjourned at 1430 hours on 12 June 2014.

**ANNEX 1. SCIENTIFIC COUNCIL PROGRESS ON PERFORMANCE ASSESSMENT RECOMMENDATIONS**

| PRP | Recommendation | SC/FC/GC (Priority) | GC Proposal (GC Doc. 12/03) | Prospective SC Action (GC Doc 12/08) | SC Progress to date |
|---|---|---|---|---|---|
| 4<br>Chapter 6,<br>6.3<br>#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.*<br><br>*Scientific Council made specific comments in support of ongoing cooperation in relation to seals and whales (ICES WGHARP) in the NAFO regulatory area, in light of their omission from the new convention in their June 2012 report (SCS 12-18).* | *Given the ongoing nature of this recommendation, and Scientific Council's continuing close collaboration with other international organizations, SC considers the objectives of this recommendation to have been met.* |
| 7<br>Chapter 4,<br>4.4.3<br>#5, p. 92 | Careful consideration should be given to developing and consolidating NAFO fishery resources data-access and utilization rules. These should take into consideration intellectual property rights related to scientific analyses as well as industrial confidentiality provisions to be attached to certain categories of data (e.g. detailed fishing location). | FC/SC/ SEC (ST) | The WG recommends that:<br>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;<br>FC encourages the SC to use VMS data for preparation of advice.<br>FC strengthens rules on secure and confidential treatment of data taking into consideration | *Scientific Council has used VMS data in the preparation of its responses to Fisheries Commission requests, and is keen to make further use of such data.* | *Scientific Council is using processed VMS data obtained from the Secretariat in the preparation of its advice and considers the objectives of this recommendation to have been met.* |

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| | | | intellectual property rights and commercial sensitivity of information taking into account experiences in other RFMOs. | | |
| 8<br>Chapter 4,<br>4.4.1 #6<br>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<br>(MT) | *See above* | *See above* | |
| 9<br>Chapter 4,<br>4.4.3<br>#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<br>(ST) | *See above* | *See above* | |
| 10<br>Chapter 4,<br>4.4.2 3 & 4<br>p. 90 | Encourages NAFO to continue to address the data requirements attached to implementation of UNGA<br>Resolution 61/105, with some urgency.<br>All efforts should be expended to encourage the timely | FC/SC/ CPs<br>(MT) | Taking into account the progress made in 2011 the WG recommends that:<br>FC, upon recommendation of the SC and the FC WGFMS VME, reviews data | *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* | *Scientific Council understands that data should now be being collected at a haul by haul basis, and will be in a better position to comment on this* |

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| | 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. | | 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);<br>In addition the WG urges CPs to comply with reporting requirements as laid down in Chapter II of NAFO CEM (ST). | *reassessment of VMEs in 2014 and fishery plans in 2016 (e.g. fishery independent survey data, VMS, haul-by-haul catches, observer reports, etc.). These views were endorsed by SC in June 2012. The key element is that data is available at the finest level possible (e.g. haul by haul), so that Scientific Council can determine the best way to analyse it.* | *recommendation during 2014 once it has had a chance to review this data.* |
| 11<br>Chapter 4,<br>4.2.2<br>#1, p. 74 | Suggests that NAFO consider enhancing its application of risk-based assessment approaches (e.g. the Greenland Halibut Management Strategy Evaluation and Kobe Matrix) when evaluating management strategies. | FC/SC (MT) | The WG recommends that the FC mandates the FC WGFMS-CPRS to consider the broader use of the PA framework, extension of management strategy evaluation and/or other risk-based management approaches (e.g. Kobe matrix) including conservation plans and rebuilding strategies, as appropriate. | *Rather than directing this work to the WGFMS-CPRS, Scientific Council supports the establishment of a joint FC/SC working group on the precautionary approach framework to address all issues regarding the implementation and extension of the current framework and implementation of management strategy evaluations. Further discussions will be held with Fisheries Commission on this matter.* | *Scientific Council is working with Fisheries Commission to draft terms of reference for a new joint working group on the application of risk based management, which will supersede the WGFMS-CPRS.*<br>*Progress on this issue is dependent on the appropriate expertise and capacity being available within Scientific Council.* |
| 12<br>Chapter 4,<br>4.6.6<br>#3, p. 110 | Encourages NAFO to broaden consideration of MSE-type approaches to managing other fisheries for which it is responsible. | FC/SC | *See above* | *See above* | |
| 13<br>Chapter 4, 4.2.3<br>#5, p.110<br>Chapter 4, 4.2.4 | 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, | FC/SC<br>(MT) | The WG recommends that:<br>SC prepares recommendations on how to implement the next steps of the | *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* | *Scientific Council is working with Fisheries Commission to draft terms of reference for a new joint working group on the application of risk based* |

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| #1, p.76 | 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. | | 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;<br><br>SC consider the usefulness and practicability of identifying the different types of ecosystems present in the NAFO area;<br><br>SC continues to take into account environmental factors impacting on NAFO fisheries;<br><br>FC and SC jointly develop the definition of bycatch, compile a consolidated list of the main relevant bycatch species (commercial, non-commercial, targeted, non-targeted, VMEs, …) and consider the issue of bycatches in the framework of conservation plans and rebuilding strategies, management plans and other management measures; (ST) | *proposal for developing fisheries assessments. As part of this process SC supports the creation of a SC/FC working group to address EAF issues.*<br><br>*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.*<br><br>*SC has already requested access to VMS and tow-by-tow information to further its VME studies and develop SAI assessments; this information request also includes by-catch and non-commercial species data. These data are expected to feed into the analyses and models required for the development of the Roadmap to EAF.*<br><br>*See also response to recommendation 10.* | *management, which will supersede the WGFMS-VME.*<br><br>*Scientific Council has prepared recommendations on the next step for implementation of the roadmap, review of coral and sponge closures by 2014, and development of fisheries assessments by 2016. This is an item which would benefit from close cooperation between SC and FC in the joint working group.* |

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| | | | 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.<br>*See also recommendations 14, 15 and 16* | | |
| 14<br>Chapter 4,<br>4.3<br>#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<br>(MT) | *See 13* | *See above* | |
| 15<br>Chapter 4,<br>4.3<br>#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<br>(MT) | *See 13* | *See above* | |

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| 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.*<br><br>*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.* | *Scientific Council reviewed its first exploratory fishing report at its June meeting. Scientific Council remains unclear as to the relevance of this recommendation, given the lack of specific proposal to SC. It is not apparent what form such a proposed "strategic framework" would take.* |

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| 18<br>Chapter 4,<br>4.6.4<br>#2, 3 & 4<br>p. 108 | Recognizes that a NAFO strategic imperative should be to articulate a specific plan aimed at developing ways to conserve biodiversity. NAFO, in general, and the Scientific Council in particular, are also encouraged to formally determine the potential effects that areas closed to fishing are likely to exert in terms of affecting fishing, protecting habitats and conserving biodiversity in the NAFO Convention Area. | FC/SC/ SEC/CP<br>(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.*<br>*Given the fact that the recommendation from the panel extends to the NAFO Convention Area, Scientific Council believes that Contracting Parties, especially coastal states, should be added to the list of responsible bodies.* | *Work to define ecoregions is still ongoing within Scientific Council. This will be fundamental to the roadmap to the ecosystem approach, the implementation of which is NAFO's main tool to conserve biodiversity.* |
| 19<br>Chapter 4,<br>4.6.4<br>#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<br>(MT) | *See above* | *See above* | |

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| 20<br>Chapter 4,<br>4.6.4<br>#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<br>(LT) | *See above* | *See above* | |
| 24<br>Chapter 4,<br>4.4.1<br>#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<br>(ST) | The WG recommends that GC submits the issue of catch discrepancy between STATLANT 21A catch estimates and those of STACFIS to an external peer review process. | *Scientific Council has cooperated with the group conducting the peer review into catch estimation methods of STACFIS, and will be pleased to support the group in the second part of their work, examining the discrepancy between the STACFIS and STATLANT figures.* | *Scientific Council continues to cooperate with the panel, although found it was not in a position to provide all the information requested of it.*<br>*Documentation produced by the June SC meeting will be passed to the panel to assist in their interim progress report. Given the problems in obtaining a full set of STATLANT figures in advance of the June SC meeting, Scientific Council urges all contracting parties to observe the 1st May deadline for provision of STATLANT 21A to the Secretariat.* |

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| 25<br>Chapter 4,<br>4.5<br>#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.<br>These include:<br>Tabular presentation of key management decisions to be taken rather than decisions being obscured in other documentation. This would serve as a 'targeted framework' and could extend the use of standardized management procedures by providing more risk-based, or risk-determined scientific advice.<br>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. | FC/SC<br>(ST) | The WG recommends that:<br>FC considers more regular inter-sessional meetings between managers and scientists for issues requiring discussion (e.g. via WebEx or teleconference),<br>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.<br>FC develops 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.*<br>*Recognizing the need for transparency, further steps, such as the public archiving of assessment data, could be considered.* | *No comment.* |

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| 26<br><br>Chapter 4,<br><br>4.5<br><br>#7, p. 98 | Suggests that NAFO as a whole may wish to reflect on the use, and allocation, of its scientific capacity from time-to time, although the burden of scientific input appears to be shared by all NAFO Contracting Parties in proportion to their respective fishery activities. | FC/SC/ CPs (MT) | The WG recommends the FC and SC analyse the availability of and the need for scientific capacity and identifies possibilities to extend scientific expertise by specific schemes (e.g. scholarship, meeting participation fund, etc.). | *Scientific Council supports this proposal, but recognizes that such changes required to expand the capacity of SC to address requests from FC will require financial support from Contracting Parties, through support of their own scientists' participation in NAFO activities, and through increased budgets of Scientific Council.* | *Scientific Council reiterates its position that such changes required to expand the capacity of SC to address requests from FC will require financial support from Contracting Parties, through support of their own scientists' participation in NAFO activities, and through increased budgets of Scientific Council.* |
| 34<br><br>Chapter 7,<br><br>7.5<br><br>#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<br><br>(ST) | The WG recommends that all NAFO bodies strive for clear and succinct reporting as recommended by the review panel and that the Secretariat provides proper guidance to rapporteurs and Chairs to that end. | *Scientific Council advice is given in summary sheets at the start of SC report, with technical details given in appendices and research documents. In 2012, SC began the process of revising the summary sheets to make the advice more prominent.* | *Scientific Council has taken steps to reduce the length of its reports and to make its advice more succinct and advice sheets more clear. Work is ongoing to this end.* |

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| 35<br>Chapter 4,<br>4.9<br>#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<br>(LT) | The WG recommends that NAFO reconsider previous work undertaken by the Working Group on the Allocation of Fishing Rights to Contracting Parties of NAFO and review the Resolution to Guide the Expectations of Future New Members with Regard to Fishing Opportunities in the NAFO Regulatory Area (NAFO GC Doc. 99/8), should new members join the organization or new fisheries come under NAFO management. | *Quota allocation is not an issue for Scientific Council.* | *N/A* |
| Chapter 4, 4.6.2 | Urges the Scientific Council to review the current absence of any formally defined decision rule(s) framework for the application of the PAF. The Panel notes that this gap may exacerbate perceived differences between the Scientific Council and Fisheries Commission. The Scientific Council should also develop a strategy to be used in applying the PAF to new and exploratory fisheries specifically. | SC | | *Scientific Council feels this recommendation should also be addressed to Fisheries Commission.*<br>*See response to "11 Chapter 4, 4.2.2 #1, p. 74" above.* | *A formal rule-based framework for implementation of the PA framework could be discussed by the joint SC-FC Working Group on Risk Based Management* |

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| Chapter 4, 4.5 | Tabular presentation of key management decisions to be taken rather than decisions being obscured in other documentation. The would serve as a 'targeted framework' and could extend the use of standardized management procedures by providing more risk- based, or risk- determined scientific advice. | SC | | *Scientific Council is taking steps to try to expand the risk based approach to advice but the ability to do so will be limited in some cases where data currently do not allow the use of quantitative assessment models.* | *Scientific Council feels that this recommendation is somewhat unclear due to its reference to management decisions.*<br>*Tables of management options have been requested by FC and work is underway to present advice in this format* |
| Chapter 4, 4.6.2 | Developing consolidated descriptions of the scientific approaches, models and underlying assumptions used by the Scientific Council. This could be in the form of a users' manual outlining, with attached lay explanations, the various assessment being undertaken. | SC | | *See response to "25, Chapter 4, 4.5 #1, p. 96" above.*<br>*As an outcome of the SISAM initiative which NAFO has been a partner in, Scientific Council is co-sponsoring the World Conference on Stock Assessment methods in July 2013 and will consider the results of this initiative.* | *Scientific Council will provide advice in a revised format in 2013. It is hoped that this will be more accessible to lay readers.* |
| Chapter 4, 4.5 | Suggests that the extent to which various reference points were being taken into account when stock recovery plans are being considered should be made much more explicit and should be documented alongside the PAF. | SC | | *Scientific Council feels that this recommendation is best directed to the FC WGFMS – CPRS. Scientific Council could take into account specific rebuilding plans and reference points when formulating advice on those where such plans are in place.* | *This matter will be addressed by the joint SC-FC Working Group on Risk-Based Management* |
| Chapter 5, 6.1 | Urges the Scientific Council to give careful consideration to improving its explanation of both the scientific processes it follows and the conclusions and results/advice it provides. | SC | | *Scientific Council has changed the way it provides advice to make the recommendation more prominent. Work is ongoing to investigate alternative ways of presenting its advice.* | *As discussed above, Scientific Council has taken steps to make its advice more accessible.* |

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

Chair: Estelle Couture Rapporteur: Gary Maillet

The Committee meet at the Sobeys School of Business (Unilever Lounge), Saint Mary's University, 903 Robbie St., Halifax, NS, Canada, on 2 and 12 June 2014, 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 (Germany, Portugal, and Spain), Russian Federation, USA and Japan.

**Highlights of Climate and Environmental Conditions in the NAFO Convention Area for 2013**

METEOROLOGICAL AND ICE CONDITIONS

- The North Atlantic Oscillation index (NAO), a key indicator of climate conditions over the North Atlantic was slightly negative in 2013 resulting in a decrease in arctic air outflow and a warming of winter air temperatures over the previous year.
- Annual air temperature over Newfoundland and Labrador remained above normal by 0.7°C (0.5 SD) at Cartwright and 0.7°C (0.8 SD) at St. John's.
- Air temperature anomalies on the Scotian Shelf and adjacent offshore areas were positive at all sites ranging from +0.1°C (Saint John) to +0.8°C (Sable Island).
- Sea ice was below normal in the Northern Labrador Sea and Shelf regions in January and February but above normal in Northern Labrador Sea in March.
- The annual sea ice extent on the NL Shelf remained below normal for the 18th consecutive year and decreased slightly over 2012 conditions.
- There were only 13 icebergs detected south of 48°N on the Northern Grand Bank in 2013, down from 499 in 2012 and substantially fewer than the 1981-2010 mean of 767.
- Ice coverage and volume on the Scotian Shelf were the 7th lowest in the 52 year long record while 2010, 2011 and 2012 had the second to fourth lowest.

TEMPERATURE AND SALINITY CONDITIONS

- Sea surface temperatures (SST) in the Labrador Sea were 1°-6°C above normal during the winter and about 0.5°C above normal during the summer.
- Winter time convection in 2013 reached to 1000 m, which is significantly shallower than the 1400 m seen in the previous year, although still deeper than in the years of reduced convective activity (e.g., 2007 and 2011).
- Annual water column averaged temperature at Station 27 off southeaster Newfoundland was 1.1 SD (0.4°C) above normal down from the record high of 2.7 (1°C) in 2011.
- Station 27 annual bottom temperatures (176 m) was 1.1 SD (0.4°C) above normal, nearly identical to the 2012 value and a significant decrease from the record high of 3.4 SD (1.3°C) in 2011.
- The area of the cold intermediate layer (CIL) water mass (<0°C) on the eastern NL Shelf along standard sections during the spring, summer and fall were below normal ranging from 0.7 to 1.5, 0.5 to 1.4 and 0.3 to 0.9 SD, respectively.
- Spring bottom temperatures in NAFO Div. 3P ranged from 0.4 to 1.1 SD above normal in 2013 and in Div. 3LNO they ranged from 0.8 to 1.3 SD above normal, a moderate decreased over 2012 conditions.
- Autumn bottom temperatures in 2J, 3K and 3LNO were above normal by 2, 2.7 and 1.8 SD in 2011, 1.1, 1.2 and 0.2 SD in 2012 and 0.8, 0.5 and 0.1 SD in 2013, respectively, a significant decrease in the past 2 years.

- A composite climate index derived from 26 meteorological, ices and ocean temperature and salinity time series for the NL region show a declining trend since the peak in 2010, however the index still indicates warmer than normal (18th warmest in 64 years) conditions throughout the region.
- A composite climate index derived from 18 selected temperature time series for the Scotian Shelf region averaged +0.9 standard deviations (SD) making 2013 the eight warmest year in the last 45 years.
- Bottom temperature anomalies in NAFO areas 4Vn, 4Vs, 4W, 4X were +0.2°C (+0.5 SD), +0.8°C (+1.1 SD), +0.6°C (+0.8 SD), and +1.0°C (+1.5 SD) respectively.
- The volume of the CIL on the Scotian Shelf, defined as waters with temperatures <4°C, was below normal by 0.4 SD, an increase from the smallest volume in the 44 years of surveys that occurred the previous year.
- Stratification on the Scotian Shelf strengthened slightly compared to 2012 and was the third strongest since 1950.

BIOLOGICAL AND CHEMICAL CONDITIONS

- Nitrate inventories in both the upper and lower water-column remained below normal along sections crossing the Labrador-Newfoundland Shelf (2J, 3K) and Grand Bank (3LNO, 3M).
- Nitrate inventories were near normal to above normal across the northwest Gulf of St. Lawrence and generally mixed along the Scotian Shelf (Subarea 4) sections and fixed stations in 2013.
- The chlorophyll *a* inventories inferred from the seasonal surveys were predominately below normal along several sections, particularly in the northern Subareas (2J to 3L) and Gulf of St. Lawrence (4ST) in 2013.
- Satellite remote ocean colour imagery, which provides large-scale synoptic information on the distribution of surface chlorophyll *a,* indicated lower biomass and weaker spring blooms over the NW Atlantic in 2013 consistent with seasonal surveys.
- The peak and initiation timing of the spring bloom was generally close to normal throughout the northern Subareas and into the Gulf of St. Lawrence, but shifted substantially to earlier and longer duration over the western Scotian Shelf (4X) in 2013.
- The zooplankton abundance anomalies for small grazing copepods were generally positive over much of the survey area with the highest abundance levels observed over the northern Subareas from 3K to 3LNO in 2013.
- The abundance anomalies for large grazing copepods were near to slightly above normal along the northern Subareas (2J, 3K) in contrast to a clear declining trend through the Gulf of St. Lawrence down to the eastern Scotian Shelf (Subarea 4) followed by mixed conditions further south in 2013.
- Reduction in total copepod taxa (dominant taxa) characterized the Gulf of St. Lawrence and most of the Scotian Shelf sections and fixed stations while positive anomalies in abundance were observed for the northeast Newfoundland Shelf and Grand Bank Subareas in 2013.
- The non-copepod taxa, consisting of carnivorous zooplankton, gelatinous invertebrates, and meroplankton, showed substantial positive anomalies extending from 3K with a declining trend southwards across the Gulf of St. Lawrence and Scotian Shelf sections in 2013.

## 1. Opening

The Chair opened the meeting by welcoming participants to this June 2014 Meeting of STACFEN.

The Committee adopted the agenda and discussed the work plan and noted the following documents would be reviewed: SCR Doc. 14/01, 14/04, 14/08, 14/10, 14/11, 14/13, 14/14, 14/15.

## 2. Appointment of Rapporteur

Gary Maillet (Canada) was appointed rapporteur.

## 3. Adoption of the Agenda

The provisional agenda was adopted with no further modifications.

## 4. Review of Recommendations in 2013

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

STATUS: An invited speaker was supported in 2014 along with one interdisciplinary presentation on physical oceanographic modelling that contributed to habitat suitability models for sea pens and sponges.

## 5. Invited Speaker

The Chair introduced this year's invited speaker Dr. Nancy Shackell.

The following is an abstract of Dr. Shackell's presentation entitled "***Which economically and ecologically important species are vulnerable to projected warming on the Scotian Shelf, Canada?***"

The Government of Canada has committed nine Federal departments to address and develop climate change adaptation programs. In 2011, Fisheries and Oceans Canada (DFO) initiated the "Aquatic Climate Change Adaptation Services Program" (ACCASP) to further develop the scientific understanding of climate change and to assess the risk to the delivery of DFO's mandate of safe-guarding the ocean and ocean infrastructure. A risk-based assessment of climate change impacts in the Atlantic Large Aquatic basin allowed identification of key gaps in knowledge (e.g. acidification effects on biological systems) and imminent risks (e.g. sea-level rise projections necessitate close attention to DFO coastal infrastructure and how it is maintained and/or rebuilt). A key part of ACCASP is the development of adaptation "tools" that will enable different sectors to fulfill their mandates under a changing climate. One example is a species-level vulnerability assessment that gauges which species are vulnerable to warming on the Scotian Shelf. Preliminary results suggest that various cold-water species are vulnerable but that the impact of warming must be considered relative to the much greater impact of over-exploitation. Overexploited populations are much less resilient to climate change. Safe-guarding the resilience of commercial populations is an effective way to fulfill DFO's mandate of sustainable and prosperous fisheries in a changing climate.

The invited lecture presented by Dr. Shackell was well received by Scientific Council and stimulated discussion on the benefits and different strategies to integrate environmental information into stock assessment. A number of questions addressed the confidence in using environmental information in the assessments of various stocks. There is some precedence in use of key environmental drivers such as thermal habitat indices in assessments of shrimp and snow crab along with stock projections based on these data. This approach has been more difficult to apply in a generalized way for a large number of stocks that are widely distributed across the NRA that experience broader thermal habitats. Further integration of environmental information into stock assessments is warranted based on climate change projections based on implied warming scenarios and other emerging issues such as biogeochemical conditions (e.g. ocean acidification).

## 6. Oceanography and Science Data (OSD) Report for 2013 (SCR Doc. 14/15)

Since 1975, MEDS, then ISDM, now Oceanography and Science Data (OSD), 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 OSD Report for 2013 was provided in **SCR Doc. 14/15** but no representative from OSD was available to present the report. OSD 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 OSD to carry out its responsibility of reporting to the Scientific Council, the Designated National Representatives are requested to provide OSD 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 required the submission to OSD of a completed oceanographic inventory form for data collected in 2013, and oceanographic data pertinent to the NAFO area, for all stations occupied in the year prior to 2013. 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 2013 are included. This report will also provide an update on other OSD activities during 2013.

Data that have been formatted and archived at OSD are available to all members on request. Requests can be made by telephone (613) 990-6065, by e-mail to isdm-gdsi@dfo-mpo.gc.ca, by completing an on-line order form on the OSD web site at http://http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/request-commande/form-eng.asp or by writing to Services, Oceanography and Scientific Data (OSD), Fisheries and Oceans Canada, 12th Floor, 200 Kent St., Ottawa, Ont. Canada K1A 0E6.

**Highlights of Oceanography and Science Data (OSD formerly ISDM and MEDS) Report for 2013:**

The following is the inventory of oceanographic data obtained by ISDM during 2013 (numbers in brackets refers to counts in 2012):

- Real-time temperature and/or salinity data collected and processed in 2013; total 317726 (342058) stations
- Delayed-mode temperature and/or salinity profiles collected and processed in 2012; total 797 (2834) stations
- Delayed-mode temperature and/or salinity profiles collected prior to 2013 and processed in 2013; total 10174 (7373) stations
- Near-surface underway temperature and/or salinity data collected in 2013; total 16798 (3133) stations
- Drifting Buoys in the NAFO Area in 2013; Total 335722 (457156) messages from 147 (208) buoys
- BIO Current meters recovered in 2013 and processed; total 8 instruments
- BIO Current meters recovered in 2013 but not yet processed; total 26 instruments
- Wave Buoys in the NAFO Area in 2013; 13 Environment Canada meteorological buoys, 6 Wave Instruments from the Oil and Gas industry
- Tide and water level data in the NAFO Area in 2013; total of 50 (26) tide gauges
- During 2013, Argo Canada acquired and deployed 19 Argo profilers in the NAFO region

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

A key indicator of ocean climate conditions, the North Atlantic Oscillation (NAO) index, returned to a weak negative phase in 2013 and as a result arctic air outflow to the Northwest Atlantic during the winter decreased over the previous year. This appears to have resulted in an increase in winter air temperatures over much of the North Atlantic causing a continuation of less sea-ice than normal on the NL Shelf.

**Subareas 0 and 1**. A review of meteorological, sea ice and hydrographic conditions in West Greenland in 2013 was presented in **SCR Doc. 14/01 and 14/04**.

The annual sea surface temperature (NOAA OI SST) anomalies for 2013 indicate positive anomalies of the SST in the Northwestern Atlantic and around Greenland. The time series of mid-June temperatures on top of Fylla Bank show temperatures 0.5°C above average conditions in 2013 and average salinities. The normalized near-surface salinity index and the presence of Polar Water were normal in 2013. The presence of Irminger Water in the West Greenland waters was high in 2013. Pure Irminger Water (waters of Atlantic origin) could be traced north to the Paamiut section and modified Irminger Water further north to the Sisimiut section. However, at the three southernmost sections, the pure Irminger Water does not occupy as large a volume as in recent years. It has to a large extent been replaced by modified Irminger Water. In contrast, mean (400–600 m) temperature and salinity were still very high over the Southwest Greenland shelf break north of Fylla Bank and into the Disko Bay region.

The hydrographic conditions monitored at two oceanographic NAFO/ICES sections, which span across the western shelf and continental slope of Greenland near Cape Desolation and Fyllas Bank. In 2013, the temperature and salinity of the Irminger Sea Water component of the West Greenland Current at Cape Desolation Station 3 was 5.84°C and 34.97, which was 0.12°C and 0.05 above the long-term mean (1983-2010), respectively. The properties of the North Atlantic Deep Water in the deep boundary current west of Greenland are monitored at 2000 m depth at

Cap Desolation Station 3. Between 2012 and 2013, the temperature and salinity decreased, but were 0.08°C and 0.01 above the long-term mean. The water properties between 0 and 50 m depth at Fyllas Bank Station 4 are used to monitor the variability of the fresh Polar Water component of the West Greenland current. In 2013, the temperature of this water mass was 0.37°C below the long-term mean and the salinity was 0.45 below its long-term mean, respectively.

**Subareas 1 and 2.** A review of air temperatures and sea surface temperature conditions over the Labrador Sea in 2013 was presented in **SCR Doc. 14/11**.

The NCEP reanalysis of surface air temperature indicated above normal conditions with an anomaly ranging between 3 - 7°C above normal in the Labrador Sea during the winter period; about 0.5°C above normal for the most of Labrador Sea during the spring; approximately 0-0.5°C above normal for the summer period; with an anomaly of -2 – 0.5°C during the fall period. The negative anomalies were mostly in the Baffin Bay/Davis Strait area north of the Labrador Sea, and the central and eastern portion of Labrador Sea region had mostly positive anomalies, though the magnitudes of the anomalies are relatively small. Sea surface temperature (SST) anomalies in the Labrador Sea followed the pattern observed in the air temperature: positive (1 to 6°C) in the winter and positive (about 0.5°C) in the summer. The Labrador Shelf ice concentration was below normal in January and March of 2013 (reference period: 1979-2000), while in February 2013, the ice concentration was higher than normal for the northwestern part of Labrador Shelf. Winter time convection in 2013 reached to 1000 m, which is significantly shallower than the 1400 m seen in the previous year, although still deeper than in the years of reduced convective activity (e.g., 2007 and 2011). The 1000-1500 m layer of the central Labrador Sea has been gradually warming since 2012. Under the warming trend, the winter ice extent has also decreased on the Labrador shelf. Increasing TIC and decreasing pH react as predicted by absorbing the excess anthropogenic atmospheric $CO_2$. When the ice extent on the shelves decreases, phytoplankton blooms occur earlier. In addition, blooms on the shelves, which occur following stratification caused by ice-melt, generally occur earlier than those in the central basin, where stratification is more the result of surface warming. Despite an increase in the magnitude of the spring blooms, when averaged over the year the chlorophyll-*a* biomass has tended to decline. The earlier and more intense production in the spring is certainly beneficial for the *Calanus* spp younger stages but the overall annual average decrease in chlorophyll could also be reflected in a decrease in total annual copepod abundance.

**Subareas 2 and 3**. A description of environmental information collected in the Newfoundland and Labrador (NL) Region during 2013 was presented in **SCR Doc. 14/10** and **SCS Doc. 14-06 and 14-14**.

Annually, air temperatures decreased over 2012 but remained above the long-term mean in southern Labrador by 0.5 SD (0.7°C at Cartwright) and Newfoundland by 0.8 SD (0.7°C at St. John's). The winter sea ice extent on the NL Shelf remained below normal (1.5 SD) for the 16$^{th}$ consecutive year, a decreased of 0.6 SD over 2012. As a result of these and other factors, local water temperatures remained above normal in most areas in 2013 but showed a decrease over 2011-2012 values. Average sea surface temperatures on the NL Shelf decreased from 1.6 SD above normal in 2012 to about 0.4 SD above normal in 2013 and near shore at Station 27 they were 1.1°C (1.6 SD) above normal, similar to 2012. Bottom temperatures at Station 27 were 1 SD (0.4°C) above normal, nearly identical to 2012 values. Spring bottom temperatures in NAFO Div. 3P ranged from 0.4 to 1.1 SD above normal in 2013 down from near +2 SD in 2011 and in 3LNO they ranged from 0.8 to 1.3 SD above normal, a moderate decrease over the previous two years. Fall bottom temperatures in 2J, 3K and 3LNO decreased from 2, 2.7 and 1.8 SD above normal in 2011 to 1.1, 1.2 and 0.2 SD above normal in 2012 and to 0.8, 0.5 and 0.1 above normal in 2013, respectively, a significant decrease in the past 2 years. The area of the cold intermediate layer (CIL) water mass with temperatures <0°C along standard sections on the NL Shelf during the spring, summer and fall were below normal ranging from 0.7 to 1.5, 0.5 to 1.4 and 0.3 to 0.9 SD, respectively, implying a continuation of less cold shelf water than normal. In general, most environmental indices show a continuation of a warmer than normal trend throughout the area. During the past 2 years however, temperatures have decreased from the record warm conditions of 2011. A composite climate index derived from 27 meteorological, ice and ocean temperature and salinity time series declined from 8$^{th}$ highest in 2012 to the 18$^{th}$ highest in the 64 year time series in 2013.

An investigation of the biological and chemical oceanographic conditions in subareas 2 to 5 in 2013 was presented in **SCR Doc. 14/14** and **SCS Doc. 14-14.**

Biological and chemical variables collected in 2013 from coastal high frequency monitoring stations, semi-annual oceanographic transects, and ships of opportunity ranging from the Labrador-Newfoundland and Grand Banks Shelf (Subareas 2 and 3), extending west into the Gulf of St. Lawrence (Subarea 4) and further 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 interannual variations in inventories of nitrate, chlorophyll *a* and indices of the spring bloom inferred from satellite ocean colour imagery, as well as the abundance of major functional taxa of zooplankton collected as part of the 2013 Atlantic Zone Monitoring Program (AZMP). In general, nitrate inventories in both the upper and lower water-column continue to remain below normal along the northern transects across the Labrador-Newfoundland Shelf and Grand Bank while levels are near normal to above average across the northwest Gulf of St. Lawrence and generally mixed along the Scotian Shelf transects and fixed stations in 2013. The chlorophyll *a* inventories inferred from the seasonal AZMP oceanographic surveys were predominately below normal over the various transects, particularly in the northern Subareas (2J to 3L) and Gulf of St. Lawrence (4ST) in 2013. Satellite remote ocean colour imagery, which provides large-scale synoptic information on the distribution of surface chlorophyll *a,* indicated lower biomass and weaker spring blooms over the NW Atlantic in 2013 consistent with the AZMP seasonal surveys. The peak and initiation timing of the spring bloom was generally close to normal throughout the northern Subareas into the Gulf of St. Lawrence but, shifted substantially to earlier and longer duration over the western Scotian Shelf (4X) in 2013. The abundance anomalies for the different functional zooplankton taxa showed some clear spatial gradients in 2013. The zooplankton abundance anomalies for small grazing copepods were generally positive over much of the survey area with the highest abundance levels observed over the northern Subareas from 3K to 3LNO. The abundance anomalies for large grazing copepods were near to slightly above normal along the northern Subareas in contrast to a clear declining trend through the Gulf of St. Lawrence down to the eastern Scotian Shelf followed by mixed conditions further south. Reduction in total copepod taxa characterized the Gulf of St. Lawrence and most of the Scotian Shelf transects and fixed stations while positive anomalies in abundance were observed for the northeast Newfoundland Shelf and Grand Bank Subareas. The non-copepod taxa, principally carnivorous zooplankton, gelatinous invertebrates, and meroplankton, showed substantial positive anomalies extending from 3K with a declining trend southwards across the Gulf of St. Lawrence and Scotian Shelf transects.

**Subarea 4**. A description of environmental information collected on the Scotian Shelf and in the eastern Gulf of Maine and adjacent offshore areas during 2013 was presented in **SCR Doc. 14/13**.

A review of the 2013 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 standard deviations (SD) making 2013 the eight warmest year in the last 45 years. The anomalies did not show a strong spatial variation. Bottom temperatures were above normal with anomalies for NAFO areas 4Vn, 4Vs, 4W, 4X of +0.2°C (+0.5 SD), +0.8°C (+1.1 SD), +0.6°C (+0.8 SD), and +1.0°C (+1.5 SD) respectively. Compared to 2012, bottom temperatures decreased in areas 4Vn, 4Vs, 4W and 4X by 0.3, 0.5, 1.2 and 1.1°C.

**Subarea 5 and 6.** Unfortunately a report on Subareas 5 and 6 is not available this year.

## 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 2014 Meeting along with relevant abstracts:

"***Physical oceanographic conditions on the Newfoundland Shelf / Flemish Cap from a model perspective (1990-2012)***". Authors: Z. Wang and B. Greenan.

The model results from 1990 to 2012 are presented for the Newfoundland Shelf and adjacent ocean in order to help better understand physical oceanographic conditions in the region. The model used in this report is a 1/12 degree North Atlantic model developed at Bedford Institute of Oceanography. The model is driven by CORE (Common Ocean-ice Reference Experiments) and NCEP (National Centers for Environmental Prediction) surface forcing for the 1990-2007 and 2008-2012 periods, respectively. The comparison between modeled mean states and observations demonstrates that the model does a good job of depicting oceanographic conditions in the region. Over the period of the study, there is a general warming trend for the sea surface temperature and bottom temperature for the Newfoundland Shelf and Flemish Cap regions. The model estimates a warming trend of 0.02° C/ year for both SST and bottom temperature for the Newfoundland Shelf region, and trends of 0.05° C/ year for SST and 0.005° C/ year for bottom temperature for the Flemish Cap region. We note that the model probably underestimates the trend for the Newfoundland Shelf. The mean transports through Flemish Pass and over Flemish Cap are 7.4 Sv and 0.3 Sv, respectively.

**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 is updated by the NAFO Secretariat on an annual basis with contributions from each contracting country. Information for 2013 will be made available from Subarea 1, West Greenland , Subareas 2-3, Grand Banks and Labrador Sea / Shelf , Subareas 4-5, Scotian Shelf and Gulf of Maine , and Subareas 5-6, Georges Bank and Gulf of Maine.

**10. The Formulation of Recommendations Based on Environmental Conditions**

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

**11. National Representatives**

Currently, the National Representatives for hydrographic data submissions are: E. Valdes (Cuba), S. Demargerie (Canada), E. Buch (Denmark), J.-C Mahé, (France), F. Nast (Germany), **Vacant** (Japan), H. Sagen (Norway), J. Janusz (Poland), **Vacant** (Portugal), M. J. Garcia (Spain), L. J. Rickards (United Kingdom), and K. J. Schnebele (USA; retired; temporary USA contact P, Fratantoni). B.F. Prischepa from Russia was replaced by K.V. Drevetniak.

The Secretariat will contact the countries where there are currently no National Representatives in order to fill these positions.

**12. Other Matters**

The Chair raised the issue of the integration of STACFEN and the Working Group on Ecosystem Science Assessment (WGESA). Although the Committee supported this integration on principle, it is too soon to put it into practice. The main issue lies with the fact that the two groups currently have two different roles. WGESA is a working group that focuses on the development of an ecosystem approach for fisheries management while STACFEN is operational and provides advice on the environment. Logistical issues were also raised.

Although it may too soon to integrate the two groups, the co-chairs of WGESA took this opportunity to indicate that the participation of oceanographers in WGESA would be extremely valuable and invited them to the future meetings of WGESA.

**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 were again given to the invited speaker Dr. Nancy Shackell (Bedford Institute of Oceanography, Dartmouth, NS, Canada), and contributions to the interdisciplinary session by Zeliang Wang.

The meeting was adjourned at 15:00 on 2 June 2014.

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

Chair: Margaret Treble Rapporteur: Alexis Pacey

The Committee met at the Sobey School of Business at St. Mary's University, 903 Robie St. Halifax, NS, Canada, on the 31 May and 12 June 2014, 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 (Spain, Portugal), Russian Federation, Japan and the United States of America. The Scientific Council Coordinator was in attendance as were other members of the Secretariat staff.

### 1. Opening

The Chair opened the meeting at 09:30 hours by welcoming the participants.

### 2. Appointment of Rapporteur

Alexis Pacey (NAFO Secretariat) was appointed rapporteur.

### 3. Adoption of Agenda

The Agenda as given in the Provisional Agenda distributed prior to the meeting was adopted with the addition of items 6a) Access to documents on the NAFO website, 6b) Gadoid Symposium, St. Andrews, NB, 6c) Future of the *Journal of the Northwest Atlantic Fishery Science*.

### 4. Review of Recommendations in 2013

STACPUB **recommended** that *the Scientific Council Reports be available on-line only. Print copies will be available on request in a spiral-bound format.*

STATUS: This has been done. 20 copies were made.

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

STATUS: An analysis of the JNAFS timeline was presented with a figure showing the timelines of each step of the publication progress. STACPUB indicated that it compares favourably to other journals, including high-profile journals and was considered acceptable.

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

STATUS: A new one page format was created and is available on the NAFO website.

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

STATUS: This has been implemented with a new cover for Vol. 45 2013.

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

STATUS: No Progress. The Secretariat approached a Scientific Council member with expertise in this area, however, they did not have any photos of VME species other than corals and sponges.

STACPUB was informed that there may be sampling opportunities on research surveys or other benthic research programs that could provide some of the photos required. Ideally these images would depict the species as the observers would see them (i.e. on the deck) and not necessarily *in situ*. High resolution images are also required in order to give the highest quality possible for the reference guides. It was suggested that the Working Group on Ecosystem Science and Assessment (WGESA) look into this matter at the upcoming meeting in autumn 2014. In addition, the Secretariat will look into contacting international species experts on this matter, *e.g.* the Smithsonian Institution and The Encyclopedia of Life.

## 5. Review of Publications

### a) Annual Summary

#### *i) Journal of Northwest Atlantic Fishery Science (JNAFS)*

Volume 45, Regular issue – 150 copies were printed in December 2013. 25 CDs were made. A total of four articles (69 pages) were published. The small number of pages is a concern given that this is the bare minimum required for printing purposes. (See also item 6c)

Volume 45, Regular issue – A total of five papers have been submitted for publication, one has been published (online), three are in the review process and one MS was rejected.

#### *ii) NAFO Scientific Council Studies*

Studies No. 45 (2013) *NAFO Research Vessel Stock-by-Stock Surveys Summary 2000–2010*

Studies No. 46 (2014) *Protocols of the EU bottom trawl survey of Flemish Cap.*

#### *iii) NAFO Scientific Council Reports*

The NAFO Scientific Council Reports 2013 (Redbook) was produced in January 2014. Twenty copies have been printed and coil-bound.

#### *iv) Progress report of meeting documentation CD*

STACPUB was informed that approximately 40 copies of the Meeting Documentation CD 2013 were produced. The CD contains:

- GC/FC Proceedings 12-13
- GC/FC Reports Sep 13
- SC Reports 2013
- NAFO Convention
- NCEM 2014
- Rules of Procedure
- Annual Report 2013

#### *v) ASFA*

Most science publications and documents have been submitted to ASFA as of April 30, 2014. This includes *The Journal of the Northwest Atlantic Fisheries*, SC Reports, SC Studies and SC Research Documents for 2013. Any documents not yet submitted will be uploaded to ASFA once they are published online.

#### *vi) SCR Documents*

In the last couple of years there has been a trend of assigning SCR Document numbers to non-existent or unfinished documents in order that they may be referred to in the meeting report. In some cases, despite reminders from the Secretariat, the documents have not been submitted in time for the publication of the Scientific Council Reports and some have been delayed by as long as a year. STACPUB discussed the need to revise the guidelines (NAFO, 2010) for the presentation of SCR Documents.

STACPUB ***recommends*** that in order for *authors to receive an SCR number they must submit a Title, Author and Abstract or Description of the document.*

## 6. Other Matters

### a) Access to documents on the NAFO website

Some STACPUB members have found it difficult to find certain documents and sections of the meeting report on the NAFO website. The frames system that the website is using limits the search functions and ability to provide links directly to sections of reports, documents and Journal articles. The Secretariat recognizes this limitation and is aware of the need to update to a newer system.

A package from Google was recently purchased to assist with searching NAFO and ICNAF documents and publications. The new search function was presented to SC and it will be fully operational later this year.

It was also suggested that links to certain web pages and documents could be made more visible on the homepage.

STACPUB was briefly introduced to an approach used by ICES to provide popular advice on their website and a suggestion was made that NAFO might consider doing something similar in the future.

STACPUB **recommends** that *an excerpt from the Scientific Council meeting report that contains the advice and answers to the Fisheries Commission and coastal States requests be prepared and placed in a prominent place on the public website for easy accessibility.*

STACPUB **recommends** that the *Secretariat work on providing direct links to key pages of the NAFO website and continue to provide easier access to documents and other information. STACPUB asked that these tasks be given a high priority by the Secretariat.*

**b) ICES/NAFO Gadoid Symposium, St. Andrews, NB, Canada – Oct 15-18 2013**

Participants at the Gadoid Symposium (St. Andrews NB, Canada, 15-18 Oct 2013) had discussed the possibility of publishing meeting abstract and summaries of theme sessions in the NAFO Studies Series. STACPUB agreed that this would be a good idea, if the conveners are still interested in pursuing this idea.

**c) Future of JNAFS**

Over the last 4-5 years the number of papers published in the JNAFS has been dropping, varying from 4 to 11 per volume. In 2013 it was close to the minimum number of pages required for binding. This low volume affects the quality and reputation of the Journal and it has been suggested that perhaps it is time to consider the budget savings that could be achieved if the Journal were canceled. The question posed for discussion was: Does the Journal still have value?

A number of people commented on the value of keeping the Journal. JNAFS is a specialized/niche journal that provides opportunities for scientists, both within and outside NAFO Scientific Council, to submit articles of relevance to the Northwest Atlantic context and the work of NAFO Scientific Council. These papers may not be accepted by high volume/high profile journals. The Journal has typically gone through cycles, with periods when the number of submissions have been low. Also, JNAFS publishes NAFO Scientific Council symposia papers and it has been several years since NAFO Scientific Council has hosted a symposium.

STACPUB discussed options that could be considered to reduce the cost of publishing JNAFS. For example a move to online publication would eliminate the need to print and mail out paper copies. The Secretariat noted that the cost of printing and mailing a Journal volume that contains 4-5 papers was relatively small.

The following were some suggestions to improve the on-line presence of the journal:

- Promote the Journal using social media, such as Twitter, Facebook or LinkedIn.
- Include a link on the home page of the NAFO website (www.nafo.int) that includes a picture of the cover.
- Eliminate the framesets and improve the structure of the Journal so that it can be more accessible with its links. (This is in progress).

It was decided that Vol. 46 would be printed as in the past and STACPUB would re-visit the issue next year.

**STACPUB *recommends* that the** *NAFO Secretariat investigate options to promote the Journal using social media.*

**STACPUB *recommends* that the** *NAFO Secretariat improve the visibility of the Journal by placing a prominent link directly on the NAFO websites homepage.*

**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 1330 hours on 12 June 2013.

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

Chair: Kathy Sosebee Rapporteur: Barbara Marshall

The Committee met at the Sobey School of Business, Saint Mary's University, Halifax, 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 (Germany, Portugal and Spain), France (in respect of St. Pierre et Miquelon), Japan, Russian Federation and United States of America. The Scientific Council Coordinator and other members of the Secretariat were in attendance.

**1. Opening**

The Chair opened the meeting at 1400 hours on 31 May 2014, welcomed all the participants and thanked the Secretariat for providing support for the meeting. The Committee also met on 04 June 2014 to review unfinished agenda items. The report was reviewed on 12 June.

**2. Appointment of Rapporteur**

Barbara Marshall was appointed as rapporteur.

**3. Review of Recommendations in 2013**

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

STATUS: The NAFO Secretariat continues to analyze Vessel Transmitted Information (VTI) and data from VMS.

**4. Fishery Statistics**

**a) Progress report on Secretariat activities in 2013/2014**

***i) STATLANT 21A and 21B***

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

TABLE 1. Dates of receipt of STATLANT 21A and 21B reports for 2011-2013 up to 1 June 2014.

| Country/Component | STATLANT 21A (deadline, 1 May) | | | STALANT 21B (deadline 31 August) | | |
|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2011 | 2012 | 2013 |
| CAN-CA | 24 Apr 12 | 21 May 13 | 30 Apr 14 | 21 May 12 | | |
| CAN-M | | | | | | |
| CAN-SF | 14 May 12 | 21 Apr 13 | | | | |
| CAN-G | 29 Apr 12 | 9 May 13 | | | | |
| CAN-N | 30 Mar 12 | 30 Apr 13 | 30 Apr 14 | 6 Sep 12 | | |
| CAN-Q | 19 Jun 12 | | | | | |
| CUB | 4 May 12 | 7 May 13 | | | | |
| E/BUL | | 21 May 13(NF) | | | 21 May 13(NF) | |
| E/EST | 17 May 12 | 2 May 13 (revised 6 Jun 13) | 22 May 14 | 2 Sep 12 | | |
| E/DNK | 18 May 12 | 17 May 13 | | 21 Aug 12 | | |
| E/FRA-M | 21 May 12 | 4 Jun 13 | 22 May 14 | | | |
| E/DEU | 26 Apr 12 | 28 May 13 | 28 Apr 14 | 7 Jul 12 | | |
| E/LVA | 17 May 12 | 22 Apr 13 | DNF | 24 Aug 12 | | |
| E/LTU | 2 May 12 | 27 May 13 | DNF | 31 Aug 12 | | |
| E/POL | 26 Apr 12 (no fishing) | | DNF | 26 Apr 12 (no fishing) | | |
| E/PRT | 8 May 12 (revised 29 May 12) | 23 Apr 13 | 22 May 14 | 14 Nov 12 | | |
| E/ESP | 30 May 12 | 28 May 13 (revised 29 May 13) | 22 May 14 | 3 Sep 12 | | |
| E/GBR | 26 Apr 12 | 8 May 13 | 23 May 14 | | | |
| FRO | 30 Apr 12 | 2 Jun 13 | | 27 Aug 12 | | |
| GRL | 19 Apr 12 | 30 Apr 13 | 5 May 14 | 6 Sep 12 | | |
| ISL | 31 May 12 | 23 May 13 (NF) | 23 May 14 | 20 Aug 12 | | |
| JPN | 25 Apr 12 (no fishing) | 26 Apr 13 (NF) | | 25 Apr 12 (no fishing) | 26 Apr 13 (NF) | |
| KOR | | | | | | |
| NOR | 27 Apr 12 | 30 Apr 13 | 22 May 14 | 2 Sep 12 | | |
| RUS | 29 Apr 12 | 21 May 13 | 12 May 14 | 6 Sep 12 | | |
| USA | 21 May 12 | 21 May 13 | 29 May 14 | | | |
| FRA-SP | 14 May 12 | 21 May 13 | | 24 Aug 12 | | |
| UKR | | | | | | |

## 5. Research Activities

### a) Biological Sampling

***i) Report on activities in 2013/2014***

STACREC reviewed the list of Biological Sampling Data for 2013 (SCS Doc. 14/08) 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 2014 Meeting.

***ii) Report by National Representatives on commercial sampling conducted***

**Canada-Newfoundland:** (SCS Doc. 14/08, 14/14 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, 3P4V), northern shrimp (Subarea 2 + Div. 3KLMNO), Iceland scallop (Div. 2HJ, Div. 3LNO, Subdiv. 3Ps, Div. 4R), sea scallop (Div. 3L, Subdiv. 3Ps), snow crab (Div. 2J+3KLNO, Subdiv. 3Ps, Div. 4R), squid (SA 3), thorny skate (Div. 3LNOPs), white hake (Div. 3NOPs), lobster (SA 2+3+4), capelin (SA 2 + Div. 3KL), and marine mammals (SA 2-4). A provisional sampling report was submitted to the Secretariat noting sampling of catches for length distribution and age for Cod, Redfish, Haddock, American plaice, Greenland halibut, Witch flounder, Yellowtail flounder. These data are provisional due to data formatting and quality control issues as a result of implementing a new service delivery system for the Observer Program on April 1, 2013. Once these data are finalized, the inventory will be updated.

**Denmark/Greenland:** Length frequencies were available from the Greenland trawl fishery in Div. 1A and 1D. CPUE data were available from the Greenland trawl fishery in Div. 1AB and 1CD. (SCS Doc. 14/12). Length distributions were available from the inshore long line and gill net fishery in inshore in Div. 1A. CPUE data were available from the inshore longline fishery in Div. 1A (SCR 14/038).

**EU-Estonia:** Estonia collected length frequencies for Greenland halibut in Div. 3L, Northern shrimp in Div. 3L and 3N, redfish in Div. 3L, 3M, 3N and 3O, cod in Div. 3L, 3M, 3N and 3O, capelin in Div. 3L, American plaice in Div. 3N, yellowtail flounder in Div. 3N and a few other species. Samples were done on both directed species and discards.

**EU-Portugal** (NAFO SCS Doc 14/10): Data on catch rates were obtained from trawl catches for redfish (Div. 3LMNO), Greenland halibut (Div. 3LMNO) and cod (Div. 3M). Data on length composition of the catch were obtained for Cod (Div. 3LMNO), redfish *S. mentella* (Div. 3LMNO), American plaice (Div. 3LMNO), Greenland halibut (Div. 3LMNO), thorny skate (Div. 3LMNO), roughhead grenadier (Div. 3LM), witch flounder (Div. 3NO), redfish *S. marinus* (Div. 3M), Yellowtail flounder (Div. 3N) and white hake (Div. 3O).

**EU-Spain ((SCS Doc. 14/06):** A total of 13 Spanish trawlers operated in Div. 3LMNO NAFO Regulatory Area (NRA) during 2013, amounting to 1,126 days (18 602 hours) of fishing effort. Total catches for all species combined in Div. 3LMNO were 14 000 t in 2013. In addition to NAFO observers (NAFO Observer Program), 9 IEO scientific observers were onboard Spanish vessels, comprising a total of 322 observed fishing days, around 28% coverage of the total Spanish effort. In 2013, 584 length samples were taken, with 64 051 individuals of different species examined to obtain the length distributions. Besides recording catches, discards and effort, these observers carried out biological sampling of the main species taken in the catch. For Greenland halibut, roughhead grenadier, American plaice and cod this includes recording weight at length, sex-ratio, maturity stages, performing stomach contents analyses and collecting material for reproductive studies. Otoliths of these four species were also taken for age determination.

One Spanish trawler operated in NAFO Regulatory Area, Div. 6G using a midwater trawl gear, during 2013, amounting to 17 days (87 hours) of fishing effort. The most important species in catches was the *Beryx splendens*.

***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 2013 (by National Representatives and Designated Experts)***

**Canada (SCR Doc. 14/020):** 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 2013 include a spring survey of Div. 3LNOP, and an autumn survey of Div. 2HJ3KLNO. The spring survey in Div. 3LNOP was conducted from March to late June, and the portion in

Div. 3LNO consisted of 291 tows (295 planned) covering all 84 planned strata to a maximum depth of 732m with the Campelen 1800 trawl, by the research vessel CCGS Alfred Needler. This survey continued a time series begun in 1971. The autumn survey was conducted from early October to December in Div. 2HJ3KLNO, and consisted of 624 tows (674 planned) covering 192 of 208 planned strata to a maximum depth of 1500m in 2HJ3KL and 732m in 3NO with the Campelen 1800 trawl. The reduction was required primarily due to mechanical issues as well as inclement weather, requiring the elimination of deepwater strata in Div. 3L as well as a 12% reduction in Div. 3K. Two research vessels were used: CCGS Teleost and CCGS Alfred Needler, and this survey continued a time series begun in 1977. The Additional surveys during 2013, directed at a number of species using a variety of designs and fishing gears, were described in detail in various documents. Results from Canadian oceanographic surveys in 2013 and earlier were discussed in detail in STACFEN.

**Denmark/Greenland (SCR Doc. 14/001):** The West Greenland standard oceanographic stations were surveyed in 2013 as in previous years (SCR Doc. 14/001).

A series of annual stratified-random bottom trawl surveys, mainly aimed at shrimps, initiated in 1988 was continued in 2013. The gear was changed in this survey in 2005. No correction for this gear change has been made and the 2005 - 2012 time series is hence not directly comparable with 1988-2004 time series. In July-August 211 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.14/003).

A Greenland deep sea trawl survey series for Greenland halibut was initiated in 1997. The survey is a continuing of the joint Japanese/Greenland survey carried out in the period 1987-95. In 1997-2012 the survey covered Div. 1C and 1D between the 3 nautical mile line and the 200 nautical mile line or the midline against Canada at depths between 400 and 1 500 m. In 2013 only Div. 1D was covered by 27 hauls and the survey is and the survey is not considered reliable for estimating indices for stock status 50 valid hauls were made. (SCR Doc. 14/002).

A longline survey for Greenland halibut in the inshore areas of Disko Bay, Uummannaq and Upernavik was initiated in 1993. In 2013 the longline survey was conducted in Uummannaq (35 sets) and Upernavik (16 set). In connection to the longline survey 7 and 19 gill net were set in Uummannaq and Upernavik, respectively. Each gillnet was composed of four panels with different mesh size (46, 55, 60 and 70 mm stretch meshes) as in Disko Bay.

Since 2001 a gillnet survey has been conducted annually in the Disko Bay area. In 2013 a total of 27 gillnet settings were made along 4 transect. No gill net survey in 2009.

**EU-Spain (SCR Doc. 14/005, 006, 007, 012, 016; SCS Doc. 14/06):** The Spanish bottom trawl survey in NAFO Regulatory Area Div. 3NO was conducted from 1st to 21st of June 2013 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 120 hydrographic stations were taken within a depth range of 45-1450 m according to a stratified random design. The results of this survey are presented as Scientific Council Research Documents. In addition, age distributions are presented for Greenland halibut and Atlantic cod.

In 2003 it was decided to extend the Spanish 3NO survey toward Div. 3L (Flemish Pass). In 2013, the bottom trawl survey in Flemish Pass (Div. 3L) was carry out on board R/V *Vizconde de Eza* using the usual survey gear (Campelen 1800) from July 30th to August 19th. 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 107 and 7 of them were nulls. Survey results are presented as Scientific Council Research documents. Survey results for Div. 3LNO of the northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 13/063.

The EU bottom trawl survey in Flemish Cap (Div. 3M) was carried out on board R/V *Vizconde de Eza* using the usual survey gear (Lofoten) from June 26th to July 23th 2012. The area surveyed was Flemish Cap Bank to depths up to 800 fathoms (1460 m) following the same procedure as in previous years. The number of hauls was 183 and two of them were nulls. Survey results are presented as Scientific Council Research Documents. Flemish Cap survey results for northern shrimp (*Pandalus borealis*) were presented in SCR Doc. 13/60.

**EU-Spanish and Portugal Survey (SCR Doc. 14/017):** A stratified random bottom trawl survey on Flemish Cap was carried out on July 2013, 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 181 haul were done, 120 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 length distribution and age composition for cod, American plaice, redfish, Greenland halibut, and roughhead grenadier. The results of the shrimp were presented the last September (SCR Doc. Doc. 13/60).

**Germany (SCS Doc. 14/15):** During the fourth quarter, stratified random surveys covered shelf areas and the continental slope off West Greenland (Divisions 1B-1F) outside the 3-mile limit to the 400 m isobath. In October-November 2013, 58 valid hauls were carried out covering about 95 % of the standard survey area as well as oceanographic measurements taken at 58 stations off West Greenland. Additionally, the temperature and salinity of the water along two standard NAFO sections off West Greenland (Cape Desolation [3 stations], Fyllas Bank [5]) were measured in order to monitor their interannual and longterm variability.

**USA (SCR Doc. 14/024 and SCS Doc. 14/11):** The US conducted a spring survey in 2013 covering NAFO Subareas 4, 5 and 6 aboard the FSV *Henry B. Bigelow*. All planned strata were covered with 382 out of 407 hauls completed successfully. The timing of the survey extended from March 4-May 9. Biomass indices for summer flounder and little skate declined since 2012.

The US conducted an autumn survey in 2013 covering NAFO Subareas 4, 5 and 6 aboard the FSV *Henry B. Bigelow*. All planned strata were covered with 367 out of 392 hauls completed successfully. The timing of the survey extended from September 5-November 20. Biomass indices were presented for many stocks and abundance for the two squid stocks.

***ii) Surveys planned for 2014 and early 2015***

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

**c) Tagging Activities**

STACREC noted that tagging activities had been reported in SCS Doc. 14/09. Participants were asked to check the document and send in any additional information before finalization in September.

**d) Other Research Activities**

**Analysis of Stock Reproductive Potential to promote sustainability of Greenland Halibut fishery (STREPHALIBUT)**

The results of the new techniques to incorporate different measures of Reproductive Potential (RP) into assessment, medium term projections and management strategy evaluation of Subarea 2+3KLMNO Greenland halibut stock were presented in the 2013 September Scientific Council meeting. This research was partially funded by the Canadian – Spanish cooperation founds under the scientific project "Analysis of Stock Reproductive Potential to promote sustainability of Greenland Halibut fishery" carried out by the following institutions: Fisheries and Oceans Canada, Institute of Marine Research (CSIC), Spanish Institute of Oceanography (IEO) and AZTI Foundation. It was tested the actual Greenland halibut approved Harvest Control Rule (HCR) using alternative stock recruitment functions (Segmented Regression, Ricker and Ricker) with different RP indices which vary in the level of biological complexity. The RP indices used in increasing order of biological information were: Biomass 10+, SSBcohort, FSBcohort, FSByear and TEP.

**NEREIDA Project**

New data on deep-water corals and sponges were presented based on Spanish/EU and Canadian bottom trawl groundfish surveys for the period 2011-2013 in order to make these data available to the NAFO WGESA and improve the mapping of sensitive species in the NAFO Regulatory area (Div. 3LMNO). "Significant" catches (according to the NAFO definition from groundfish surveys) of deep-water corals and sponges were provided and mapped together with the areas closed in 2010. Most of the significant catches of sponges (78.6%) are inside of the closed areas, meanwhile for corals the results are different according to the group considered. For large gorgonians the 87.5% are outside, for sea pens the 66.7% and for all small gorgonians the significant catches recorded are outside of the closed areas.

IEO and DFO worked in collaboration and carried out a new quantitative spatial analysis applied for corals and sponges for all the available data and different thresholds were selected for significant concentrations of coral and sponges as follows: 75 kg per tow for sponges, 0.6 kg per tow for large gorgonians, 0.15 kg per tow for small gorgonians; and 1.4 kg per tow for sea pens.

All NEREIDA box core samples were analyzed in order to determine the total biomass by major taxonomic group and an analysis of associated photographic records where they are being analyzed to produce a biomass layer. Sample taxon abundance and biomass data matrices are being constructed for the NRA. Multivariate analysis identified 18 statistically distinct groups of samples, each group represented by a varying number of samples. The distinct assemblage characterised by the most taxa also contained the most VME indicative taxa (sponges, sea pens and crinoids).

In addition and as part of the NEREIDA program, benthic imagery collected from the Flemish Cap area in 2009 and 2010 has been analyzed for the abundance of epibenthic megafauna.

**6. Review of SCR and SCS Documents**

SCS Doc. 14/11 US research Report. The report described catches and survey indices of 37 stocks of groundfish, invertebrates and elasmobranchs. Research on the environment, plankton, finfishes, marine mammals, and apex predators were described. Studies included age and growth, food habits, and tagging studies. The number of observer trips by fishery was discussed as well as cooperative research with the industry. A description of the method for estimating catches in the observer program used both in US waters and in the NRA was given.

SCR Doc. 14/009. Adriana Nogueira, Xabier Paz and Diana González-Troncoso. Persistence and Variation on the Groundfish Assemblages on Flemish Cap (NAFO Divisions 3M): 2004-2013.

Data from the EU (Spain-Portugal) bottom trawl surveys in the Division 3M of the NAFO Regulatory Area (2004-2013) were analyzed to examine patterns on this zone of groundfish assemblage structure and diversity in relation to depth. 1699 hauls between 129 and 1460 m in depth were carried out. We focused on the 29 most abundant species, which made up 87.5% of the catch in terms of biomass.

Assemblage structure was strongly correlated with depth. For the most part, changes in assemblages seem to be fairly continuous, although there were more abrupt changes at 600 m. Three main assemblages were identified. A shallow assemblage was found in the shelf, comprises the strata with depths lesser than 250 m. Assemblage II (Intermediate) includes the strata with depths between 251 and 600 m. Assemblage III (Deep) contains the depth strata greater than 601 m. Despite dramatic changes in biomass and abundance of the species in the area, the boundaries and composition of the assemblages seem to be similar to the period before the collapse. Extending depth range to 1460 m, no another boundaries were found. Although some changes were evident, the main ones were replacements of the dominant species in several assemblages and bathymetric range extension of distribution of some species. Acadian redfish and golden redfish appear to be the dominant species in the shallowest assemblage instead of Atlantic cod that were dominant in the period before the collapse in the area; redfish is the dominant species in the second shallow and intermediate assemblages.

Diversity appears inversely related to biomass in the different assemblages. Despite the collapse in some species and the permanent fishing activity target to the North Shrimp (*Pandalus borealis*), redfish (*Sebastes* spp) and Greenland halibut, the overall pattern of demersal fish assemblages remains similar over time. This pattern is similar in other Atlantic areas; it indicates that changes in the fish populations in Northwest Atlantic have been produced on a large scale and are not limited to specific areas.

SCR Doc. 14/024. Robert Johnston and Katherine Sosebee. History of the United States Bottom Trawl Surveys, NAFO Subareas 4-6.

A history of the United States bottom trawl survey program was presented. The autumn survey began in 1963 and has continued using several vessels into the present. Three different net types were used over the time series. Coverage first increased south and inshore through time and then with the introduction of the larger vessel, inshore coverage was reduced. Coverage now extends from the western part of 4X extending south to Cape Hatteras, NC or Subarea 7 (outside of NAFO convention area). The spring survey began later (1968) and has had similar changes to the fall with the addition of another net type to catch more pelagic fish from 1973-1981. The winter survey used a net designed to capture more flatfish and was conducted from 1992-2007. The coverage of the winter survey extended from southern Georges Bank (Div. 5Z) to Subarea 6 (Cape Hatteras, NC). The final survey presented was the shrimp survey which is conducted in the summer in the western Gulf of Maine with a shrimp net.

## 7. Other Matters

### a) Stock Assessment Spreadsheets

Designated Experts were reminded to include their spreadsheets under the DATA tab on the SharePoint. It was agreed to at least start with the stocks that were fully assessed.

### b) Conversion Factors

The Scientific Council was requested to: *evaluate and provide recommendations on the methodology for establishing standardized conversion factors outlined in STACTIC WP 13/3.* It was agreed that this would be reviewed in STACREC.

The author of the Sampling Framework and Methodology to Facilitate the Development of Standardized Conversion Factors in the NAFO Regulatory Area, Dave Kulka was requested by the Scientific Council to present the proposal outlined in STACTIC WP 13/3.

Upon review, STACREC agreed that the methodology in terms of field work and statistical analysis was sound and that a plan like this was required to derive reliable product to round weight conversion factors corresponding to products produced at sea in the NRA. It was recognized that there are logistical issues in the implementation of such a project but the framework provides guidance in this regard. It would be up to STACTIC and the Fisheries Commission to initiate the project. It was noted that a similar program was under way within Canada's 200 mile limit to derive reliable conversion factors.

### c) Survey Tracks

It was noted that the NAFO Secretariat had been contacted by Canadian Newfoundland and Labrador Offshore Petroleum Board (CNLOPB) and One Ocean to provide general information on research surveys taking place in the NRA. Canada routinely sends survey plans to various companies doing seismic work in the Canadian EEZ. Scientists involved in EU surveys agreed to obtain information about the upcoming surveys and forward it to the Secretariat to circulate as necessary.

### d) OBIS

Mary Kennedy gave a brief overview of OBIS and requested those with historic datasets to consider submitting them. She is available to get people started on setting up their data appropriately.

## 8. Adjournment

The Chair thanked the participants for their presentations to the Committee. Special thanks were extended to the rapporteur and the Scientific Council Coordinator and all other staff of the NAFO Secretariat for their invaluable assistance in preparation and distribution of documents. There being no other business the Chair adjourned the meeting at 1300 hours on 12 June 2014.

## ANNEX 1. HISTORICAL CATCH DATA BY SPECIES AND DIVISION

Table 1a. STACFIS catch ('000 t) estimates by NAFO Division and species from 2000 to 2013 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 | | | | 0.10 | 2.94[1] | |
| | 2012 | | | | 0.12 | 2.02[1] | |
| | 2013 | | | | 0.25 | 3.06[1] | |
| Capelin | 2000 | | | | | 0 | 0 |
| | 2001 | | | | | 0 | 0 |
| | 2002 | | | | | 0 | 0 |
| | 2003 | | | | | 0 | 0 |
| | 2004 | | | | | 0 | 0 |
| | 2005 | | | | | 0 | 0 |
| | 2006 | | | | | 0 | 0 |
| | 2007 | | | | | 0 | 0 |
| | 2008 | | | | | 0 | 0 |
| | 2009 | | | | | 0 | 0 |
| | 2010 | | | | | 0 | 0 |
| | 2011 | | | | | 0 | 0 |
| | 2012 | | | | | 0 | 0 |
| | 2013 | | | | | 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 | | | | 13.64[2] | 0.58 | 0.29 |
| | 2012 | | | | 13.43[2] | 0.53 | 0.21 |
| | 2013 | | | | 13.99[3] | 1.10[4] | |

[1] American plaice values for 2011-2013 for Div. 3N are for 3LNO and derived using:
Catch2011 = (Effort2011/Effort2010)*Catch2010
Catch2012 = (Effort2012/Effort2011)*Catch2011
Catch2013 = (Effort2013/Effort2012)*Catch2012
[2] Cod in 3M: Values for 2011 and 2012 are estimated in the assessment model in 2013.
[3] Cod in 3M: Value for 2013 from Daily Catch Reports
[4] Cod in 3N: Value for 3NO

| Species | Year | SA 1 | 2J | 3K | 3L | 3M[5] | 3N | 3O |
|---|---|---|---|---|---|---|---|---|
| Redfish | 2000 | 0.70 | | | 0.66 | 3.66 | 0.82 | 10.00 |
| | 2001 | 0.30 | | | 0.65 | 3.22 | 0.25 | 20.30 |
| | 2002 | 0.50 | | | 0.65 | 2.93 | 0.33 | 17.20 |
| | 2003 | 0.50 | | | 0.58 | 1.88 | 0.75 | 17.20 |
| | 2004 | 0.40 | | | 0.40 | 2.92 | 0.24 | 3.80 |
| | 2005 | 0.20 | | | 0.58 | 6.55 | 0.08 | 10.70 |
| | 2006 | 0.30 | | | 0.05 | 7.16 | 0.44 | 12.60 |
| | 2007 | 0.24 | | | 0.12 | 6.66 | 1.55 | 5.18 |
| | 2008 | 0.39 | | | 0.22 | 8.47 | 0.38 | 4.00 |
| | 2009 | 0.37 | | | 0.06 | 11.32 | 0.99 | 6.40 |
| | 2010 | 0.25 | | | 0.26 | 8.50 | 3.69 | 5.20 |
| | 2011 | 0.18 | | | 2.42 | 11.12 | 1.25 | 6.50 |
| | 2012 | 0.16 | | | 2.78 | 7.63 | 1.54 | 6.40 |
| | 2013 | 0.17 | | | | 7.70 | 6.00[6] | 7.50 |
| Thorny Skate | 2000 | | | | | | | |
| | 2001 | | | | | | | |
| | 2002 | | | | 1.20 | | 8.32 | 2.00 |
| | 2003 | | | | 1.32 | | 10.26 | 1.97 |
| | 2004 | | | | 0.77 | | 7.74 | 0.82 |
| | 2005 | | | | 0.41 | | 2.99 | 0.81 |
| | 2006 | | | | 0.15 | | 5.00 | 0.59 |
| | 2007 | | | | 0.15 | | 2.97 | 0.47 |
| | 2008 | | | | 0.13 | | 6.89 | 0.39 |
| | 2009 | | | | 0.08 | | 3.76 | 0.63 |
| | 2010 | | | | 0.10 | | 2.72 | 0.33 |
| | 2011 | | | | 0.10 | | 5.06 | 0.23 |
| | 2012 | | | | 0.12 | | 3.84 | 0.27 |
| | 2013 | | | | 4.40[7] | | | |
| White Hake | 2000 | | | | | | | |
| | 2001 | | | | | | | |
| | 2002 | | | | | | 1.45 | 5.23 |
| | 2003 | | | | | | 0.56 | 3.36 |
| | 2004 | | | | | | 0.07 | 1.15 |
| | 2005 | | | | | | 0.00 | 0.86 |
| | 2006 | | | | | | 0.00 | 0.96 |
| | 2007 | | | | | | 0.01 | 0.58 |
| | 2008 | | | | | | 0.03 | 0.85 |
| | 2009 | | | | | | 0.00 | 0.42 |
| | 2010 | | | | | | 0.02 | 0.21 |
| | 2011 | | | | | | 0.00 | 0.15 |
| | 2012 | | | | | | 0.01 | 0.13 |
| | 2013 | | | | | | | 0.20[8] |

[5] Redfish in 3M: Values are estimated total redfish catch
[6] Redfish in Div. 3N for Div. 3LN and provisional year-to-date catches
[7] Thorny skate in Div. 3L for Div. 3LNO
[8] White hake in Div. 3O for Div. 3NO

| Species | Year | 2J | 3K | 3L | 3M | 3N | 3O |
|---|---|---|---|---|---|---|---|
| Witch | 2000 | 0.00 | 0.02 | 0.33 | 0.31 | 0.38 | 0.09 |
| | 2001 | 0.01 | 0.05 | 0.41 | | 0.43 | 0.18 |
| | 2002 | 0.00 | 0.08 | 0.36 | 0.30 | 0.25 | 0.20 |
| | 2003 | 0.00 | 0.05 | 0.39 | | 0.06 | 0.08 |
| | 2004 | 0.00 | 0.01 | 0.33 | 0.47 | 0.19 | 0.44 |
| | 2005 | 0.01 | 0.03 | 0.12 | 0.11 | 0.11 | 0.15 |
| | 2006 | 0.00 | 0.05 | 0.03 | 0.03 | 0.16 | 0.32 |
| | 2007 | 0.02 | 0.00 | 0.03 | | 0.08 | 0.15 |
| | 2008 | 0.00 | 0.01 | 0.08 | 0.05 | 0.12 | 0.15 |
| | 2009 | 0.00 | 0.03 | 0.02 | | 0.10 | 0.28 |
| | 2010 | 0.05 | 0.08 | 0.06 | | 0.24 | 0.18 |
| | 2011 | 0.04 | 0.05 | 0.14 | | 0.21 | 0.15 |
| | 2012 | 0.07 | 0.02 | 0.11 | | 0.20 | 0.11 |
| | 2013 | 0.20[9] | | | | 0.30[10] | |
| Yellowtail | 2000 | | | 1.43 | | 9.15 | 0.33 |
| | 2001 | | | 0.20 | | 10.52 | 3.42 |
| | 2002 | | | 0.03 | | 8.44 | 2.12 |
| | 2003 | | | 0.03 | | 8.41 | 4.49 |
| | 2004 | | | 2.33 | | 8.40 | 2.63 |
| | 2005 | | | 0.28 | | 10.98 | 2.37 |
| | 2006 | | | 0.00 | | 0.79 | 0.02 |
| | 2007 | | | 0.01 | | 2.90 | 1.71 |
| | 2008 | | | 0.99 | | 8.22 | 2.27 |
| | 2009 | | | 0.23 | | 3.92 | 2.03 |
| | 2010 | | | 0.12 | | 6.88 | 2.37 |
| | 2011 | | | 0.17 | | 4.07 | 0.99 |
| | 2012 | | | 0.20 | | 2.46 | 0.47 |
| | 2013 | | | 9.80[11] | | | |

[9] Witch flounder in Div. 2J for Div. 2J3KL
[10] Witch flounder in Div. 3N for Div. 3NO
[11] Yellowtail flounder in Div. 3L for Div. 3LNO

Table 1b STACFIS catch ('000 t) estimates for Greenland Halibut by NAFO Division from 2000 to 2013 where available.

| Species | Year | 0A | 0B | 1AB Offshore | 1CD | 2G | 2H | 2J | 3K | 3L | 3M | 3N | 3O | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Greenland Halibut | 2000 | 0.00 | 5.44 | 0.10 | 5.63 | | | | 5.85 | 18.98 | 4.18 | 3.09 | 0.95 | |
| | 2001 | 3.07 | 5.03 | 0.58 | 5.08 | 0.06 | 0.25 | 1.03 | 4.00 | 21.08 | 6.08 | 4.07 | 0.70 | |
| | 2002 | 3.56 | 3.91 | 2.05 | 5.36 | | 0.38 | 1.04 | 2.90 | 21.45 | 5.20 | 2.65 | 0.31 | |
| | 2003 | 4.14 | 5.06 | 4.01 | 5.49 | 0.26 | 1.89 | 0.74 | 2.86 | 16.30 | 4.56 | 4.84 | 0.41 | |
| | 2004 | 3.75 | 5.77 | 3.91 | 5.50 | 0.15 | 1.05 | 0.89 | 1.84 | 12.75 | 4.84 | 3.36 | 0.45 | |
| | 2005 | 4.21 | 5.79 | 4.04 | 5.68 | 0.04 | 0.38 | 1.72 | 3.01 | 11.55 | 4.53 | 1.48 | 0.39 | |
| | 2006 | 6.63 | 5.59 | 6.22 | 5.72 | 0.10 | 0.40 | 0.45 | 3.88 | 12.80 | 2.98 | 0.51 | 0.10 | |
| | 2007 | 6.17 | 5.32 | 6.30 | 5.60 | 0.00 | 0.12 | 2.39 | 1.46 | 13.02 | 3.53 | 1.49 | 0.17 | |
| | 2008 | 5.26 | 5.18 | 6.24 | 5.80 | 0.01 | 0.16 | 2.43 | 1.71 | 11.04 | 4.55 | 0.98 | 0.07 | |
| | 2009 | 6.63 | 5.62 | 6.74 | 5.67 | 0.05 | 0.10 | 1.56 | 3.02 | 12.41 | 4.22 | 0.83 | 0.27 | |
| | 2010 | 6.39 | 6.84 | 6.46 | 7.25 | 0.03 | 0.03 | 2.89 | 2.27 | 15.95 | 3.37 | 1.56 | 0.07 | |
| | 2011 | 6.26 | 6.87 | 6.47 | 7.22 | | | | | | | | | |
| | 2012 | 6.37 | 6.97 | 6.50 | 7.47 | | | | | | | | | |
| | 2013 | 6.31 | 7.04 | 6.50 | 8.21 | | | | | | | | | |

Table 1c STACFIS catch (t) estimates for Roughhead grenadier by NAFO Division from 2000 to 2013 where available.

| Species | Year | 0A | 0B | 1AB Offshore | 1CD | 2G | 2H | 2J | 3K | 3L | 3M | 3N | 3O | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roughhead Grenadier | 2000 | | | | | | | | 139 | 1382 | 2109 | 888 | 38 | 211 |
| | 2001 | | | | | | | | 97 | 1465 | 753 | 754 | 48 | |
| | 2002 | | | | | | | | 147 | 1905 | 869 | 700 | 36 | |
| | 2003 | | | | | 1 | 4 | 16 | 91 | 1342 | 886 | 1201 | 443 | |
| | 2004 | | | | | 4 | 8 | 19 | 58 | 1310 | 844 | 897 | 42 | |
| | 2005 | | | | | | 1 | 15 | 93 | 642 | 457 | 235 | 13 | |
| | 2006 | | | | | | | 21 | 54 | 696 | 488 | 111 | 6 | 44 |
| | 2007 | | | | | | | 10 | 22 | 294 | 191 | 146 | 1 | |
| | 2008 | | | | | 0 | 0 | 1 | 3 | 347 | 355 | 132 | 9 | |
| | 2009 | | | | | | | | 6 | 379 | 136 | 102 | 6 | |
| | 2010 | | | | | | | 7 | 24 | 649 | 153 | 94 | 14 | |
| | 2011 | | | | | | | 1 | 61 | 426 | 294 | 224 | 1 | |
| | 2012 | | | | | | | 3 | 13 | 652 | 511 | 119 | 5 | |
| | 2013 | | | | | | | 1 | 1 | 202 | 146 | 48 | 0 | |

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

Chair: Brian Healey Rapporteurs: Various

## I. OPENING

The Committee met at the Sobey School of Business, Saint Mary's University, Halifax, NS, Canada, from 30 May to 12 June 2014, 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 (Germany, Portugal, Spain and the United Kingdom), France (in respect of St-Pierre et Miquelon), Japan, the Russian Federation, and the United States of America. Various members of the Committee, notably the designated stock experts, were significant in the preparation of the report considered by the Committee.

The Chair, Brian Healey (Canada), opened the meeting by welcoming participants. The agenda was reviewed and a plan of work developed for the meeting. In accordance with the Scientific Council plan of work, designated reviewers were assigned for each stock for which an interim monitoring update was scheduled (see SC Report). The provisional agenda was adopted with minor changes.

## II. GENERAL REVIEW

### 1. Review of Recommendations in 2013

STACFIS agreed that relevant stock-by-stock recommendations from previous years would be reviewed during the presentation of a stock assessment or noted within 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 2013. STACFIS noted that an ad hoc working group had deliberated on catch estimates before the meeting and the conclusions and workplan were presented to SC and discussed during the Div. 3LN Redfish Webex (SCS Doc. 14/05). 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 in many years led STACFIS to the conclusion that catch estimates from STATLANT have been unreliable for a number of stocks. Lack of catch estimates is hindering provision of advice for many stocks, and for other cases, the accuracy of assessment results and management advice rely on the assumption that the STATLANT data equals the annual landings, an assumption which can no longer be independently verified. It was noted that STATLANT 21A data was not available for all Contracting Parties by the start of the meeting, therefore only data available as of 30 May was considered.

Key sources of other data have not been available to evaluate STATLANT data since 2011. Priority has been given to three stocks where discrepancies between STATLANT and STACFIS, most recently over 2005-2010, were quite large and where the absence of a reliable STACFIS estimate would pose serious problems to the current assessment method: Div. 3M Cod, Greenland halibut in SA2+Div. 3KLMNO and American plaice in Div. 3LNO. For some stocks STACFIS is currently assuming that the STATLANT data represent nominal landings.

During the June 2014 Scientific Council meeting the only sources of recent catch information available for all but one stock were STATLANT 21A data and Daily Catch Records (DCR) for fleets that operated in the NRA. The exception was the availability of scientific observer CPUE data for one fleet fishing Div. 3M cod. As recommended by the FC-SC Working Group on Catch Reporting anonymized data was examined to audit a component of the DCR data and this led STACFIS to accept the catch compilation of DCR data for use in the Div. 3M cod assessment (see this report # 6. Cod in Div 3M). For Div. 3LNO American plaice, components of catch over 2011-2013 were estimated from either: i) STATLANT data for some components of catch or ii) adjusting the 2010 STACFIS catch estimate to the effort during 2011-2013 (see this report #11 American plaice in Div. 3LNO). The latter process assumes constant CPUE over 2010-2013. Constant CPUE is unlikely to hold over extended periods due to change in stock status or distribution, and also considering that these removals are by-caught in other fisheries.

STACFIS noted that both the ad-hoc WG on catch reporting (SCS Doc. 14/04) and STACTIC (FC Doc. 14/03) have had encouraging discussions about the provision of haul by haul logbook data to the Secretariat. STACFIS considers that the provision of haul by haul data is of critical importance to the auditing process for the reliability of STATLANT data and **recommended** that *such data be submitted to Secretariat in real time if possible for use by the Scientific Council for assessment purposes*. More generally, this data should be available for all fisheries affecting NAFO managed stocks. Further, STACFIS **recommended** that *the Secretariat use the information from VMS data to construct measures of effort (e.g. as in SCR Doc. 13/01) and compare this information to effort reported via DCR, as a means to validate these effort records*. Given that DCR information is only available for fisheries operating in the NRA, priority should be towards Div. 3M cod, Div. 3LNO American plaice and SA 2+ Div. 3KLNMO Greenland halibut, followed by any stock having an assessment in 2015.

Unavailability of accurate catch data also has implications on the potential to provide quantitative assessments for stocks that are currently assessed qualitatively. Several classes of population dynamics models will have poor diagnostics if the removals data are biased and are inconsistent with changes in survey trends. Consequently, estimation of population size and any resulting management options using biased catch data will be inaccurate.

# III. STOCK ASSESSMENTS

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

(SCR Doc. 14/01, 14/04, SCS 14/12)

Recent Conditions in Ocean Climate and Lower Trophic Levels

●The composite climate index in Subarea 0-1 shifted back to positive levels in 2013 after several years of mainly high positive anomalies reaching a record-high in 2010.

●The composite spring bloom index remains slightly below normal in 2013 consistent with conditions observed in 2012.

●Calanoid copepods and early life stages remain abundant in SA 1 in 2013 based on limited summer records ranging from 1999-2003 and 2009-2013.

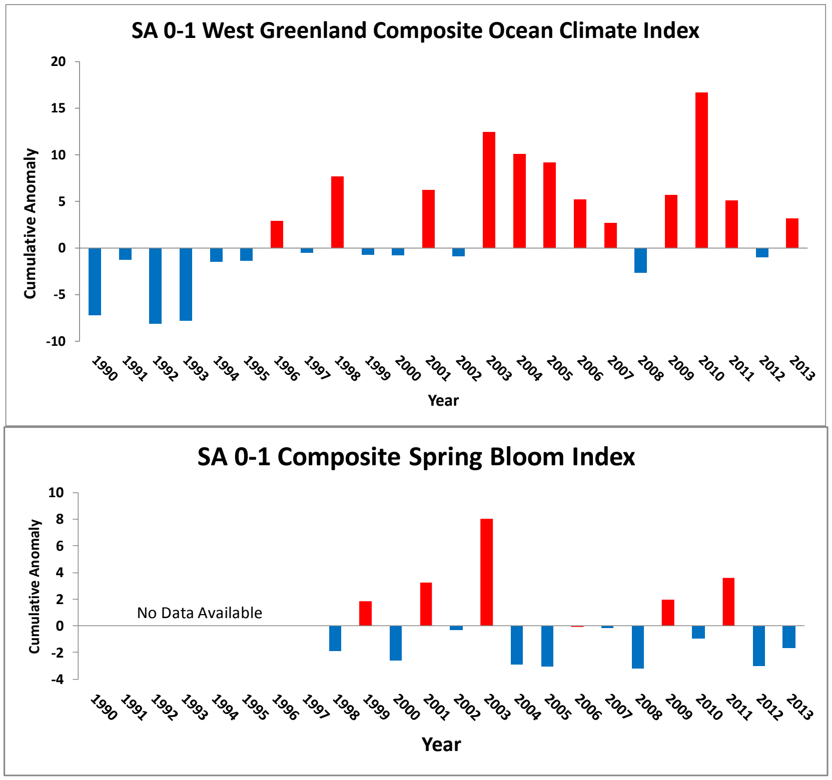



Fig. 1. Composite climate index for NAFO Subarea 1 (West Greenland) derived by summing the standardized anomalies of meteorological and ocean conditions during 1990-2013 (top panel), composite spring bloom (summed anomalies for background chlorophyll *a* levels, magnitude and amplitude indices) index during 1998-2013 (bottom panel). Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

**Environmental Overview**

Hydrographic conditions in this region depend on a balance of atmospheric forcing, advection and ice melt. Winter heat loss to the atmosphere in the central Labrador Sea is offset by warm water carried northward by the offshore branch of the West Greenland Current. The excess salt accompanying the warm inflows is balanced by exchanges with cold, fresh polar waters carried south by the east Baffin Island Current. The water mass circulation off Greenland comprises three main currents: Irminger Current (IC), West Greenland and East Greenland Currents (WGC and EGC). The EGC transports ice and cold low-salinity Surface Polar Water (SPW) to the south along the eastern coast of Greenland. The East Greenland Coastal Current (EGCC), predominantly a bifurcated branch of the EGC on the inner shelf, transports cold fresh Polar Water southwards near the shelf break. The IC is a branch of the North Atlantic current and transports warm and salty Atlantic Waters northwards along the Reykjanes Ridge. The current bifurcates south of the Denmark Strait and a small branch continues northward through the strait to form the Icelandic Irminger Current. The bulk of the IC recirculates to the south making a cyclonic loop in the Irminger Sea. The IC transports then southwards salty and warm Irminger Sea Water (ISW) along the eastern continental slope of Greenland, parallel to the EGC. The core properties of the water masses of the WGC are formed in the western Irminger Basin where the EGC meets the IC. After the currents converge, they turn around the southern tip of Greenland, forming a single jet (the WGC) and propagate northward along the western coast of Greenland. During this propagation considerable mixing takes place and ISW gradually deepens. The WGC consists thus of two components: a cold and fresh inshore component, which is a mixture of the SPW and melt water, and saltier and warmer ISW offshore component. The WGC transports water into the Labrador Sea and, hence, is important for Labrador Sea Water formation, which is an essential element of the Atlantic Meridional Overturning Circulation (AMOC).

### Ocean Climate and Ecosystem Indicators

The composite climate index in Subarea 0-1 shifted back to positive levels in 2013 from the slightly negative value the previous year. During the past several years the climate index showed positive anomalies reaching a record-high in 2010. (Fig. 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 a brief cooling events in 2008 and 2012. The composite spring bloom index remains slightly below normal in 2013 consistent with conditions observed in 2012. In winter 2012/13, 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 this winter with air temperature above normal. The time series of mid-June temperatures at Fylla Bank show temperatures 0.5°C above average conditions in 2013 and average salinities. The normalized near-surface salinity index and the presence of Polar Water were normal in 2013.

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

(SCR Doc. 14/02, 03, 20, 21, 27, 33; SCS Doc. 14/12, 13)

#### 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 Div. 1C-F).

A TAC was first established for SA 0+1, including Div. 1A inshore, in 1976 and set at 20 000 t. It increased to 25 000 t in 1979 and remained at this level until 1994. In 1994 Scientific Council decided to make separate assessments and advice for the inshore area in Div. 1A and for SA 0 + Div. 1A offshore + Div.1B-1F. As a result the TAC for SA 0 + Div. 1A offshore + Div.1B-1F decreased to 11 000 t and remained at this level until 2001. Between 2001 and 2014 the TAC increased to 30 000 t following a series of new surveys in previously unassessed areas of Div. 0A and 1AB and improving stock status in Div. 0B and 1CD. Since 2001 the TAC has been divided between Div. 0A+1AB and Div. 0B+1C-F with current levels of 16 000 t for Div. 0A+1AB and 14 000 t for Div. 0B+1CD (Fig. 1.1).

Catches in 0 + Div. 1A offshore + Div.1B-1F increased from low levels during the late 1960s to 20 000 t in 1975 before declining and remaining relatively stable at approximately 4 500 t during the 1980s. Catches increased again between 1989 and 1992, reaching a peak of almost 20 000 t before declining to 11 800 t in 1994. Catches were relatively stable at approximately 8 500 t from 1995 to 2000 with almost all the catch coming from Div. 0B and Div. 1CD. Since then catches have increased to current levels of 28 000 t with the TAC achieved in most years (Fig. 1.1).

**The fishery in Subarea 0**. Catches increased from 400 t in 1987 to 12 800 t in 1992 but decreased to 4 700 t in 1992 and stayed at that level until 2000. Prior to 2001 almost all the fishery has been taking place in Div. 0B and fishing occurred in only a few years between 1993 and 2000 with catches of less than 700 t in Div. 0A. In 2001 catches increased to 8 100 t due to increased effort in Div. 0A. Since then catches have increased gradually to 13 400 t in 2013 following increase in TAC mainly in Div. 0A but also in Div. 0B. In recent years all catches have been taken by vessels from Canada and approximately 1/3 has been taken by gill net and 2/3 by single and twin trawlers.

**The fishery in Div. 1A offshore + Div. 1B-1F**. In SA1 catches fluctuated between 1 800 and 5 700 t between 1987 and 2001 and almost all of the catches have been taken in Div. 1CD. A fishery was started in Div. 1AB in 2000 and catches increased gradually to 9 500 t in 2003. Catches remained at that level until 2005. Since then catches have increased gradually to 14 800 t in 2013 following increase in TAC mainly in Div. 1AB but also in Div. 1CD. In recent years the offshore fishery has been prosecuted by twin and single trawlers from Greenland, Norway, Russian Federation, Faroe Islands and EU (mainly Germany). Inshore catches in Div. 1B-1F has been around 200-300 t annually but increased from 440 t in 2012 to 1289 t in 2013 mainly due to increased effort in Div. 1D.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 19 | 24 | 24 | 24 | 24 | 27 | 27 | 27 | 27 | 30 |
| SA 0 | 10 | 12 | 11 | 11 | 12 | 13 | 13 | 13 | 13 | |
| SA 1 exl. Div. 1A inshore | 10 | 12 | 12 | 12 | 12 | 14 | 14 | 14 | 15 | |
| Total STATLANT 21 [1] | 20[2] | 24[2] | 22[2] | 22 | 25 | 27 | 27 | 27 | 28 | |
| Total STACFIS | 20 | 24 | 23 | 23 | 25 | 27 | 27 | 27 | 28 | |

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

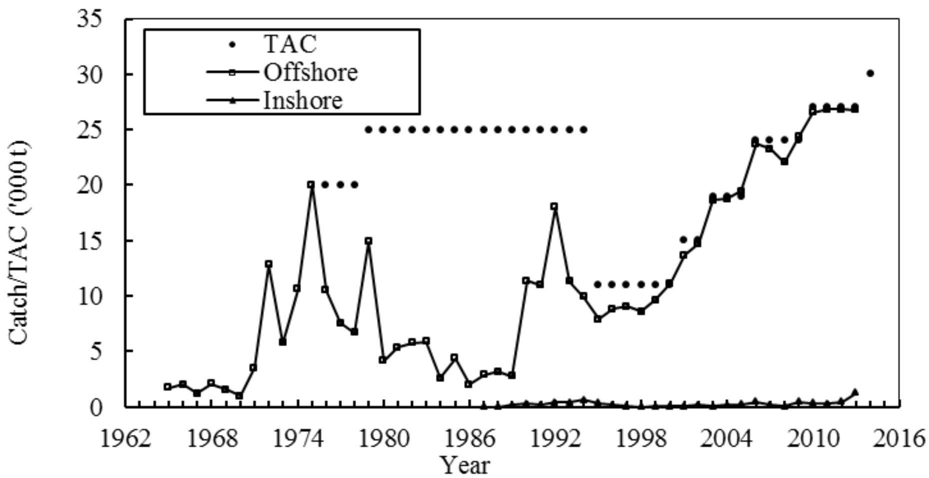



Fig. 1.1. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): catches and TACs.

**b) Input Data**

***i) Commercial fishery data***

Length frequencies were not available from Canadian fisheries in 2013.

Length frequencies were available from trawl fisheries by Greenland and Russian Federation in Div. 1A and from Russian Federation, Norway and Greenland in Div. 1D. Length frequencies were also available from the inshore longline fishery in Div. 1D. In 2013 catch from Greenland and Russian Federation in Div. 1A had modes at 51-53 cm and 48 cm. In recent years the trawl catches have been dominated by fish of 44-52 cm. In Div. 1D the catches by Russian Federation, Norway and Greenland showed modes around 48-55 cm. The mode in catches has been within this range for several years. The inshore catches were composed of fish between 35 and 83 cm with a mode around 53 cm.

The standardized trawl CPUE series for Div. 0A+1AB combined has been stable since 2002 with a slightly increasing trend since 2007 (Fig. 1.2). Catch rates before 2001 are from only one or two vessels fishing a small exploratory allocation and may not be directly comparable to subsequent years.

The standardized trawl CPUE series for Div. 0B+1CD combined was relatively stable from 1990-2004, increased from 2004-2009 then decreased between 2009 and 2012. There was a slight increase between 2012 and 2013 and it is above the level observed during 1990 to 2004 (Fig. 1.2). Catch rates in 1988 and 1989 are from one 4000 GT vessel fishing alone in the area and may not be directly comparable to subsequent years.

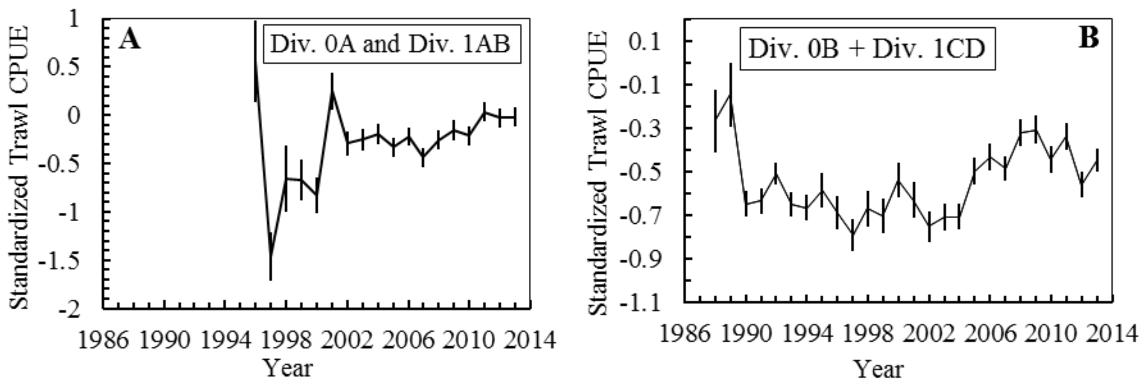



Fig. 1.2. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): Combined standardized trawler CPUE ± S.E from Div. 0A and Div. 1AB (panel A) and Div. 0B and Div. 1CD. (panel B)

A standardized CPUE index for all trawlers fishing in SA 0+1 increased between 2002 and 2006 and has been fluctuating at a high level since then. The 2013 estimate was the third largest seen since 1990. (Fig. 1.3). Standardized CPUE for gillnets in Div. 0A increased gradually from 2006-2011 and has been stable since then (Fig. 1.4).

Standardized CPUE for gill nets in Div. 0B has been gradually increasing since 2007 and was at the highest level in the time series in 2013 (Fig. 1.4).

Unstandardized gillnet CPUE is significantly higher in Div. 0A compared to Div. 0B and the unstandardized trawl CPUE in 2013 were also higher in Div. 0A and 1AB compared to Div. 0B-1CD,

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

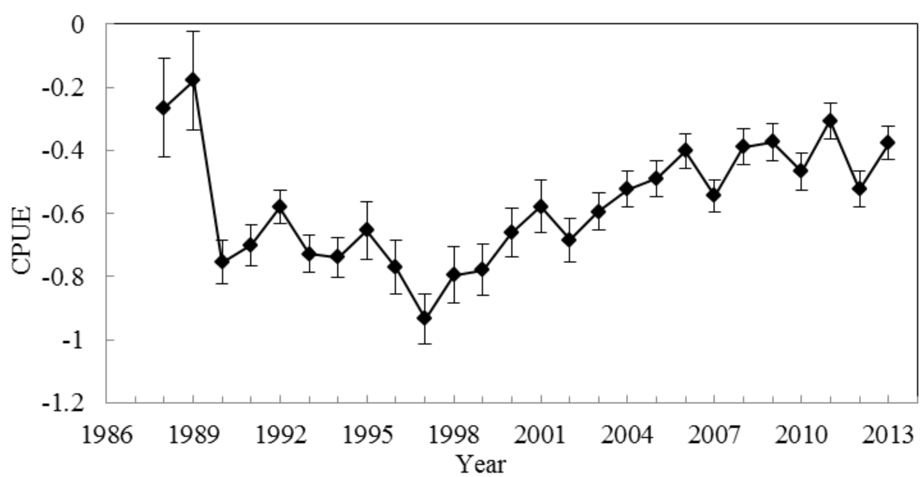



Fig. 1.3. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore). Combined standardized trawler CPUE from all divisions with ± S.E.

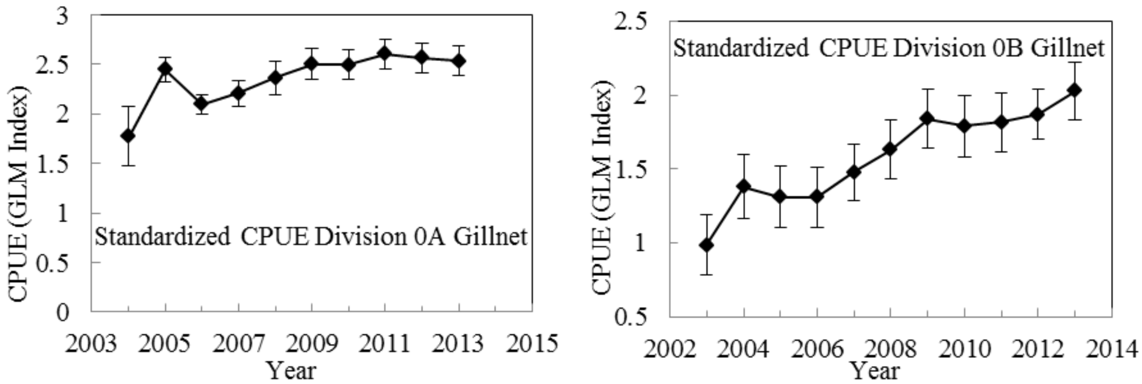



Fig. 1.4. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): Standardized gillnet CPUE from Div. 0A (left) and Div. 0B (right).

***ii) Research survey data***

**Japan-Greenland and Greenland deep sea surveys in Div. 1BCD**. From 1987-95 bottom trawl surveys were conducted in Div. 1BCD jointly by Japan and Greenland (the survey area was re-stratified and the biomass estimates were recalculated in 1997). The Japan-Greenland survey in 1987 only covered depths down to 1000 m and the biomass at depths 1000-1500 m is estimated by a GLM. In 1997 Greenland initiated a new survey series covering Div. 1CD. This index of trawlable biomass has been variable with a gradually increasing trend since 1997. 2011 was the highest in the time series but then in 2012 biomass decreased to the lowest level seen since 2000 (Fig. 1.5). Abundance increased between 1997 and 2001 and was relatively stable during 2002-2011 but decreased to the lowest level in the time series in 2012. The survey in 2013 was incomplete and the results are not considered as a reliable index of the total stock status.

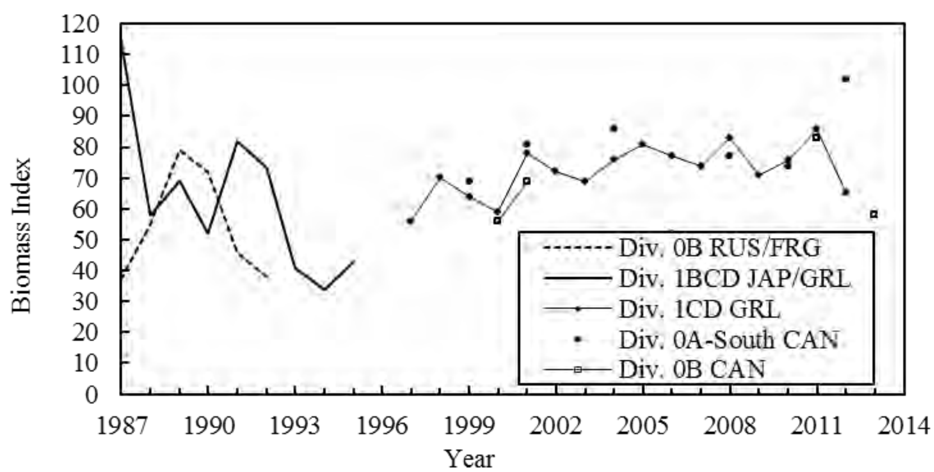



Fig. 1.5. Greenland halibut in Subareas 0+1 (excluding Div. 1A inshore): biomass indices from bottom trawl surveys. There was incomplete coverage of the 2006 survey in Div. 0A.

**Canada deep sea survey in Div. 0A-South.** The index of trawlable biomass for Div. 0A-South has been variable with a generally increasing trend from 1999 to 2012. The 2012 estimate is the highest of the time series. However, it is influenced by one very large set in a depth stratum that comprises 30% of the area covered. With this set removed the biomass estimate drops 15%. In 2006 the survey suffered from poor coverage with two of the four strata at depths 1001-1500 m missed that had accounted for approximately 14% of biomass in previous surveys (Fig. 1.5). Abundance increased slightly in 2012 but has been relatively stable since 1999. The overall length distribution showed a small mode at 21 cm, similar to that observed in 2006, with a larger mode at 42 cm, slightly higher than seen in previous surveys. The abundance of fish 40-60 cm has been increasing since 2006.

**Canada deep sea surveys in Div. 0B**. Division 0B was surveyed in 2013 for the fourth time by R/V *Pâmiut*. Previous surveys were conducted in 2000, 2001 and 2011. Prior to this there had been a survey conducted in 1986 using the R/V *Gadus Atlantica*. Biomass had decreased compared to previous two surveys and was back at the level seen in 2000 (Fig. 1.5) while the abundance was lower than in 2000. Biomass and abundance were reduced in all strata compared to 2011. Lengths ranged from 6 cm to 92 cm with 30% <45 cm. The length distribution had a single mode at 48 cm.

**Greenland shrimp and fish survey in Div. 1A-1F**. Since 1988 annual surveys with a shrimp trawl have been conducted off West Greenland during July-September. The survey covers the area between 59°N and 72°30'N (Div. 1A-1F), from the 3-mile limit to the 600-m depth contour line. The survey only covers a small fraction of the Greenland halibut distribution and catches mainly age one and age two Greenland halibut, therefore the biomass estimate is not used as a stock index but the survey is used to estimate a recruitment index for age one. The trawl was changed in 2005 but the 2005–2013 time series estimates are adjusted to the old 1989-2004 time series and the series are comparable.

The year class index of one-year-old fish in the total survey area, including Disko Bay, was variable for year classes 1989 to 1996 then increased to a peak in 2000 followed by a sharp decline in the 2001 year class. A period of relative stability during the 2000s was followed by an increase to the highest in the time series for the 2010 year class. There was a sharp decrease in the 2011 year class to the lowest estimate since 1996 but this was followed by an increase in the 2012 year class to the third largest in the time series (Fig. 1.6).

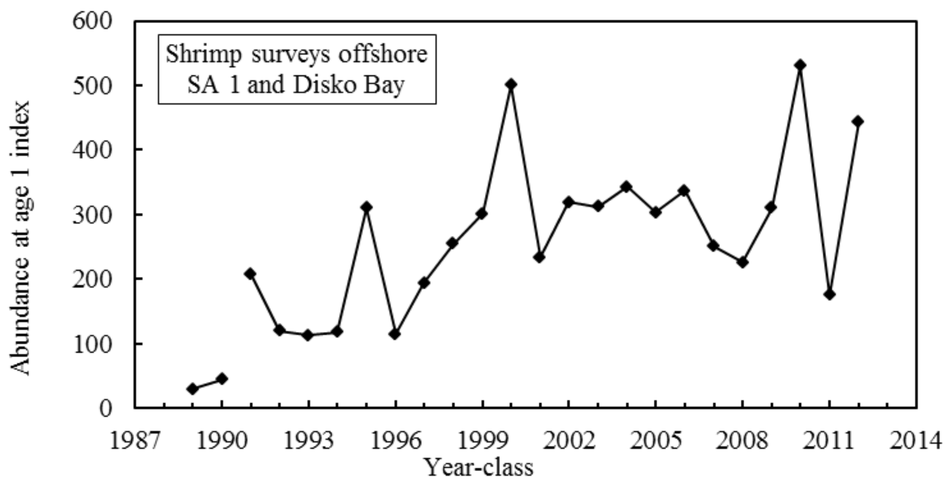



Fig. 1.6. Greenland halibut in Subareas 0+1: recruitment index at age 1 in Subarea 1 derived from the Greenland shrimp trawl surveys. Note that the survey coverage was not complete in 1990 and 1991 (the 1989 and 1990 year-classes are poorly estimated as age 1).

### c) Estimation of Parameters

In 2014 a simple Schaefer model was tested on the Greenland halibut stock offshore in NAFO SA 0 and 1. The minimum data required for this model is a catch time series and a measure of the resilience of the species. Other input parameters that required a starting guess were the carrying capacity, the biomass as a fraction of the carrying capacity at both the beginning and end of the time series, and the growth rate. MSY was estimated to be between 19 000 and 23 000 t. Sensitivity tests showed that the estimation of MSY was heavily dependent on the guess of especially the biomass at the end of the time series and the growth rate. The model cannot become any more reliable unless we can improve the input parameter "guesses" through a better understanding of the stock dynamics and biology. Until then the outcome of the model is considered only indicative of stock status and not useful for estimating reference points.

**d) Assessment Results**

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

*Fishery and Catches*: Catches have increased in response to increases in the TAC from approximately 10 000 t in the late 1990s to approximately 27 000 t during 2010 to 2012 then increased to 28 100 t in 2013. The TAC is 30 000 t in 2014.

*Data*: Biomass indices from deep sea surveys in 2013 were only available from Div. 0B. Further, biomass and recruitment data were available from shrimp surveys in Div. 1A-1F from 1989-2013. Length distributions were available from both surveys and the fishery in SA1. Unstandardized and standardized catch rates were available from Div. 0A, 0B, 1AB and 1CD.

*Assessment:* No analytical assessment could be performed.

*Commercial CPUE indices.* The standardized trawl CPUE series for Div. 0A+1AB combined has been stable since 2002 with a slightly increasing trend since 2007. Standardized CPUE for gillnets in Div. 0A increased gradually from 2006-2011 and has been stable since then.

The standardized trawl CPUE series for Div. 0B+1CD combined was relatively stable from 1990-2004, increased from 2004-2009 then decreased between 2009 and 2012. There was a slight increased between 2012 and 2013.The standardized CPUE for gillnets in Div. 0B has been gradually increasing since 2007 and in 2013 was at the highest level in the time series.

A standardized CPUE index for all trawlers fishing in SA 0+1 increased between 2002 and 2006 and has been fluctuating at a high level since then. The 2013 estimate was the third largest seen since 1990.

*Biomass*: The Div. 1CD and Div. 0A-South indexes could not be updated in 2013. Division 0B was surveyed in 2013 for the fourth time. Previous surveys were conducted in 2000, 2001 and 2011, respectively. Biomass had decreased compared to previous two surveys and was back at the level seen in 2000.

*Recruitment*: A period of relative stability in the recruitment index (age one) during the 2000s was followed by an increase to the highest in the time series for the 2010 year class. There was a sharp decrease in the 2011 year class to the lowest estimate since 1996 but this was followed by an increase in the 2012 year class to the third largest in the time series.

*Fishing Mortality:* Level not known.

*State of the Stock*: The biomass was in 2012 well above $B_{lim}$. Trawl CPUE has been stable in recent years and so has the CPUE in the Div. 0A and 0B gillnet fisheries. A standardized CPUE index for all trawlers fishing in SA 0+1 has been increasing between 2002 and 2006 and has been fluctuating at a high level since then. The 2013 estimate was the third largest seen since 1990.

Div. 0B+1C-F: The 1CD biomass index was not updated as the 2013 survey was incomplete. The biomass index in Div. 0B decreased between 2011 and 2013 and was back at the level seen in 2000. Length compositions in the catches and deep sea surveys have been stable in recent years. Standardized CPUE has decreased between 2009 and 2012 but increased slightly and it is above the level observed during 1990 to 2004. The Standardized CPUE for gillnets in Div. 0B has been increasing since 2007 and in 2013 was at the highest level in the time series.

Div. 0A+1AB: The biomass index and survey length frequencies were not updated as there was no survey in this area in 2013. Length frequencies were not available for the SA0 fishery in 2013. Combined Standardized CPUE indices for Div. 0A and 1AB have been stable in recent years.

**e) Precautionary Reference Points**

Age-based or production models were not available for estimation of precautionary reference points. In 2013 a preliminary proxy for $B_{lim}$ was set as 30% of the mean biomass index estimated for surveys conducted between 1997-2012 in Div. 1CD and 1999-2012 in Div. 0A-South. This same approach was applied to the combined survey index for the same period to establish a proxy for $B_{lim}$ for the entire stock (Fig. 1.7)

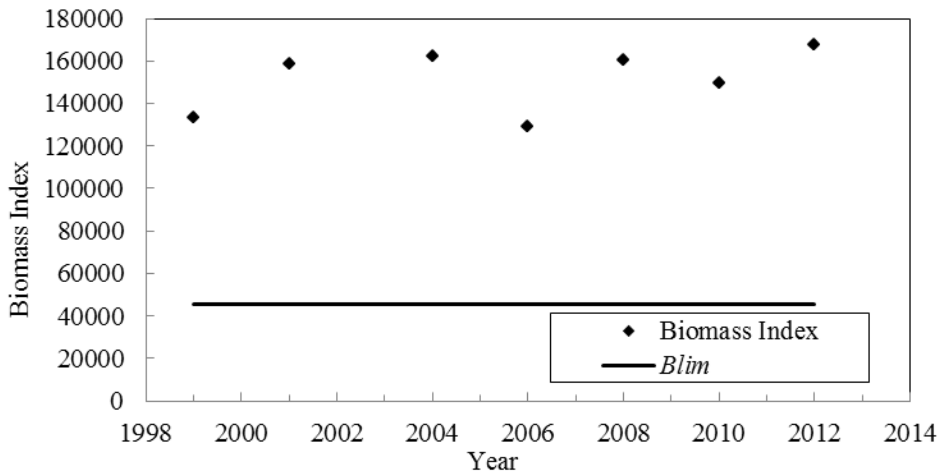



Fig. 1.7. Greenland halibut in Subareas 0+1: Biomass trends in Div. 0A-South and Div. 1CD and the proxy for $B_{lim}$.

The next assessment will be in 2015.

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

(SCR Doc. 14/003 14/038 14/041 SCS Doc. 14/12)

**a) Introduction**

The inshore fishery for Greenland halibut developed in the beginning of the twentieth century, with the introduction of the longline to Greenland in 1910. The majority of the inshore fishery is concentrated in the Disko Bay and the districts surrounding Uummannaq and Upernavik. The fishing grounds are concentrated near cities and settlements in the districts, but also tends to concentrate in areas where iceberg producing glaciers are located and better fishing is obtained. Access to the ice fjords is limited in some seasons, and varies from year to year. The stocks are believed to recruit from the spawning stock in the Davis Strait, and no significant spawning has so far been documented inshore. Therefore, the stocks are believed to be dependent on recruitment from the offshore spawning areas. There is little migration between the subareas and a separate TAC is set for each area. Quota regulations were introduced as a shared quota for each area in 2008, but in 2012 the TAC was split in two components with ITQ's for vessels and shared quota for small open boats. In general Greenland halibut is a dominating species in the area and the preferred target in the inshore fisheries in North-West Greenland. However, the Disko Bay is of major importance to the shrimp fishing industry and earlier studies of the by-catch of Greenland halibut in the commercial shrimp fishery (Jørgensen and Carlsson, 1998) suggest that the by-catch was considerable and could have a negative effect on recruitment to the inshore stock component. In order to minimize by-catch of fish in the shrimp fishery, offshore shrimp trawlers have been equipped with grid separators since 2002 and inshore shrimp trawlers (Disko Bay) since 2011. The implementation of sorting grids in the shrimp fishery has led to a protection of juvenile Greenland halibut larger than 25 cm (SCR 07/88).

**b) Fisheries and Catches**

**Total landings in Subarea 1A-inshore** for the three areas combined were less than 1000 t until 1955 but gradually increased to a level of 5 000 t by 1985 (Fig. 2.1). After the mid 1980s landings increased to 25 000 t in 1999 and have remained at a level of 20 000 to 25 000 t since then.

***Disko Bay***: Landings increased from about 2 000 t in the mid 1980s and peaked from 2004 to 2006 at more than 12 000 t. After 2006, landings were halved in just three years without any restrictions on effort, TAC or reduced prices to explain the decrease. Landings have however gradually increased since then and in 2013 9 073 t was landed from the area (Table 2.1 and Fig. 2.2, left).

***Uummannaq***: Landings increased from 3 000 t in the mid 1980s and peaked in 1999 at more than 8 000 t. Landings then decreased to a level of 5 000 to 6 000 t. In 2013, 7 007 t were landed from the district which is an increase compared to recent years (Table 2.1 and Fig. 2.2, centre).

***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 gradually increased. In 2013, 6 039 t were landed from the district, which is less than the set TAC quota, but this can largely be explained by the transition to the ITQ system (Table 2.1 and Fig. 2.2, right).

Table 2.1. Recent landings and advice ('000 tons) are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Disko Bay – TAC | | | | 12.5 | 8.8 | 8.8 | 8.0 | 8.0 | 9.0 | 9.0 |
| Disko Bay - Catch | 12.5 | 12.1 | 10.0 | 7.7 | 6.3 | 8.5 | 8.0 | 7.8 | 9.1 | |
| Uummannaq - TAC | | | | 5.0 | 5.0 | 5.0 | 5.0 | 6.0 | 6.0 | 8.0 |
| Uummannaq - Catch | 4.9 | 6.0 | 5.3 | 5.4 | 5.5 | 6.2 | 6.4 | 6.2 | 7.0 | |
| Upernavik - TAC | | | | 5.0 | 5.0 | 6.0 | 6.0 | 6.0 | 6.3 | 8.0 |
| Upernavik - Catch | 4.8 | 5.1 | 4.9 | 5.5 | 6.5 | 5.9 | 6.5 | 6.8 | 6.0 | |
| Division 1A Unknown | 0.8 | | | | | | | | | |
| TAC Total | - | - | - | 22.5 | 18.8 | 19.8 | 19.0 | 21.6 | 21.3 | 25.0 |
| STACFIS Total | 22.7 | 23.2 | 20.2 | 18.6 | 18.3 | 20.6 | 20.8 | 20.7 | 22.1 | |

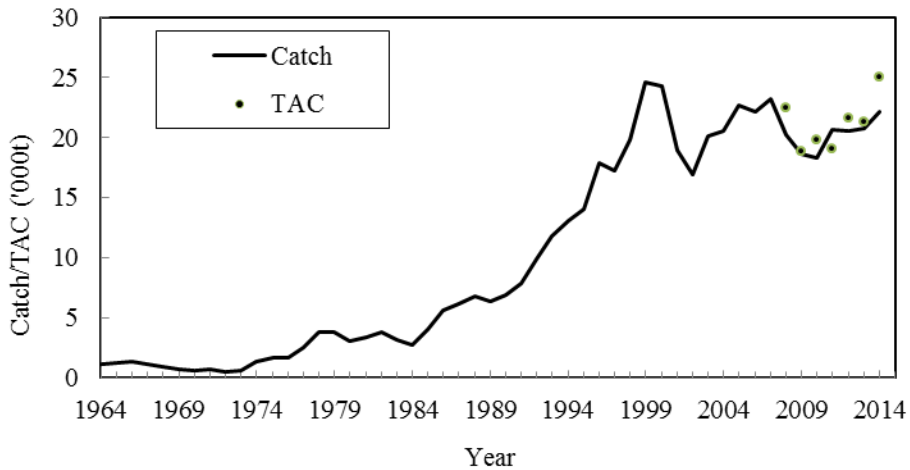



Fig 2.1. Greenland halibut in Division 1A inshore: Total landings of Greenland halibut from Division 1A-inshore.

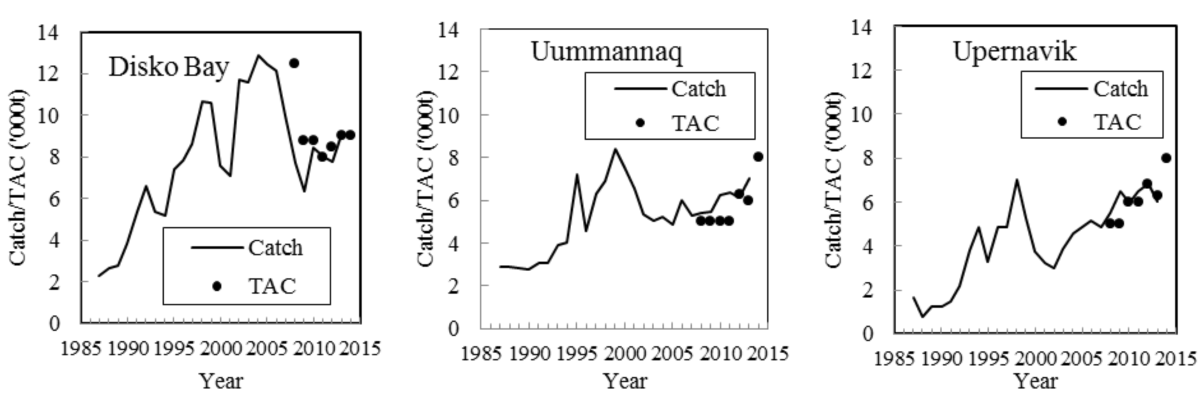



Fig 2.2. Greenland halibut in Division 1A inshore: Greenland halibut catches and TAC in Disko Bay, Uummannaq and Upernavik.

## c) Data

### *i) Commercial fishery data*

Length frequencies from factory landings collected during surveys, factory visits were available from all areas gears and seasons in 2013.

In **Disko Bay** the mean length in landings from the longline fishery, decreased gradually after 2001 in both the summer and the winter fishery and the 2012 and 2013 summer fishery estimates are the lowest observed (Fig. 2.3 left). Access to the deep Kangia ice fjord where large Greenland halibut are caught south of Ilulissat is limited during the summer, causing the difference in summer and winter fishery mean length. The trends in the seasons are however decreasing at the same rate over time and the persistent decrease suggests that the decrease was not due to new large incoming year classes. The decreasing mean length can also be observed in the plotted length distributions from longline landings as a general decrease of all sizes particularly after 2002 (Fig. 2.4). In **Uummannaq** the mean length in longline landings gradually decreased at a very slow rate during the past two decades. The trend has however reversed in the most recent five years and therefore may just as well be caused by recent years of good recruitment as a decrease in the stock. (Fig. 2.3 center). The increasing mean length in the longline landings can also be observed as an increasing range of sizes (Fig. 2.4). In **Upernavik** the mean length in longline landings decreased at a high rate until 1999, but has been very stable since then. The small decrease observed 2009 to 2010 could indicate good recruitment since the mean length in the summer fishery has an increasing trend in 2012 and 2013. The small fish observed in the 2014 winter fishery was due to poor ice conditions during the sampling program, and the fishery was conducted within walking distance from the settlements. (Fig. 2.3 right). The size range in the longline landings were very wide in the beginning of the 1990s, but gradually turned to a more narrow distribution by 2010 (Fig. 2.4). Since then the range has increased and both smaller and larger fish are observed in the longline landings in 2013.

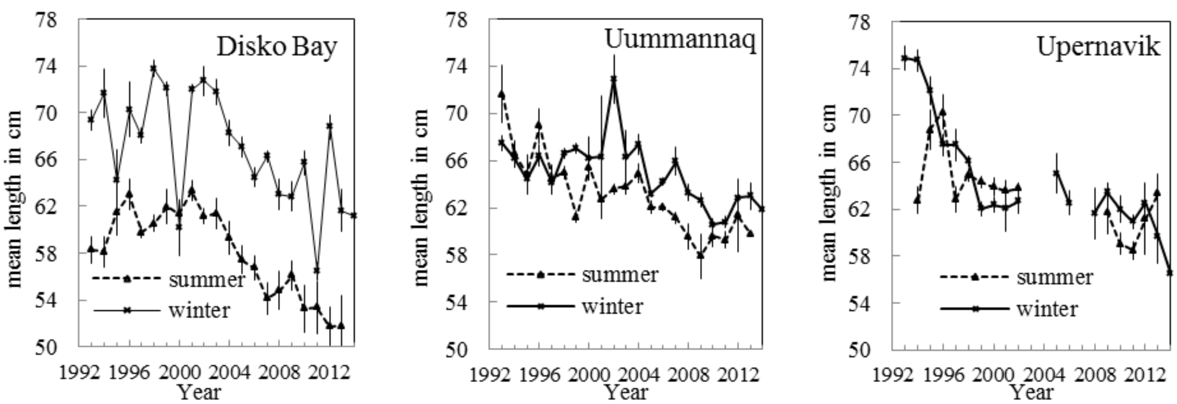



Fig. 2.3. Greenland halibut in Division 1A inshore: Longline mean length in landings from Ilulissat, Uummannaq and Upernavik.

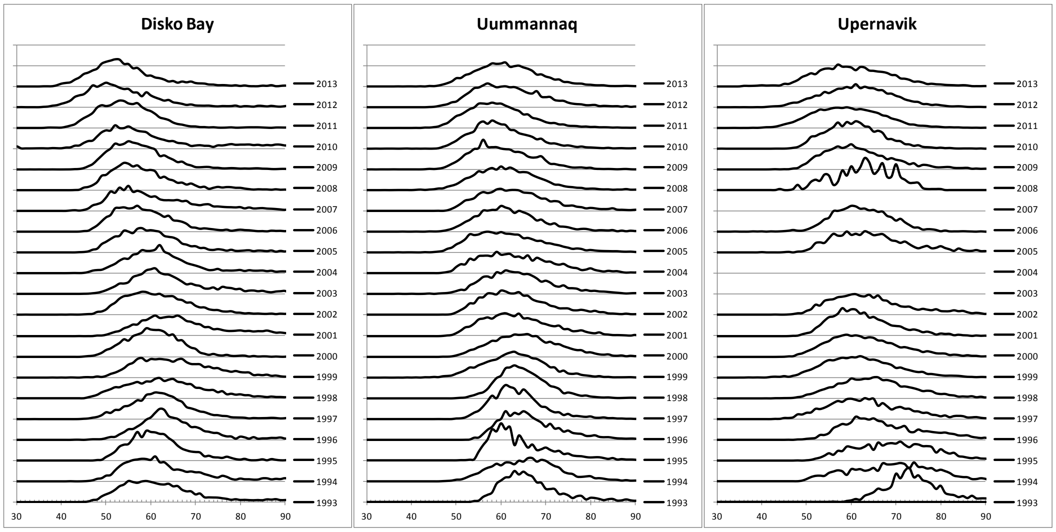



Fig. 2.4 Greenland halibut in Division 1A inshore: Length frequencies in longline landings (% of number measured) all fishing grounds and seasons combined.

**CPUE index.** A standardized CPUE series based on logbooks provided by vessels larger than 30 ft was constructed (Fig. 2.5). However, just as previous years the 2013 analysis only explained 22 to 32 % of the variability in the data. Also the CPUE series does not account for effect of fishing ground within the area and shifts in the fishing pattern could also lead to changes in trends. In the **Disko Bay** the index reveals little year to year variation and slow but gradual decrease in yield per effort after 2009 (Fig. 2.5). In **Uummannaq** the logbook CPUE index was based on far fewer observations, but indicates an increase in CPUE from 2009 to 2012 and a slight decrease in 2013 (Fig. 2.5). In **Upernavik** the logbook CPUE index shows greater inter annual variation and a higher mean CPUE than observed in Uummannaq and Disko Bay (Fig. 2.5). The apparent fluctuation is likely related to the year to year variation in access to the very good fishing grounds due to ice conditions in the narrow but deep ice fjords.

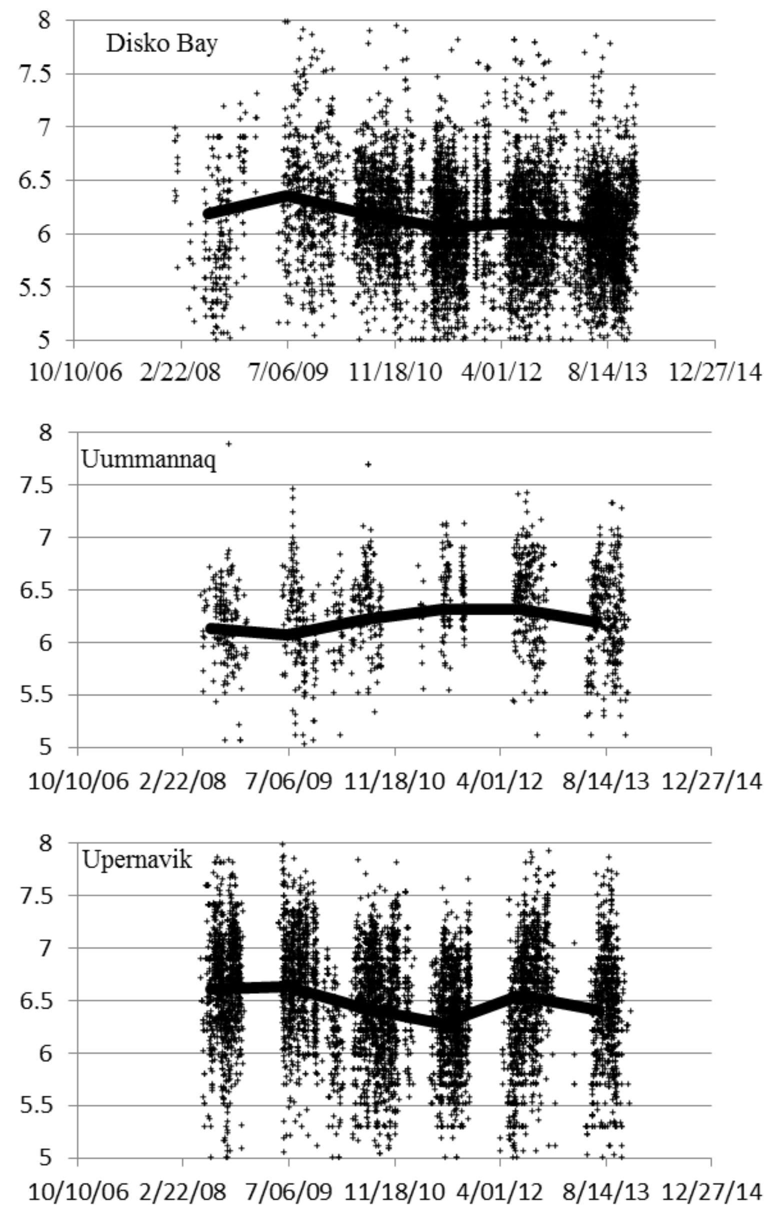



Fig 2.5. Greenland halibut in Division 1A inshore: Standardized longline logbook catch rates. (Points are LogCPUE, line is GLM: *logcpue = overall mean+yr+month+vessel*)

***ii) Research survey data***

Two surveys take place in the **Disko Bay**, the Greenland shrimp and fish survey and the Disko Bay gillnet survey. **Uummannaq** and **Upernavik** longline surveys were conducted in 2013, but the trends are difficult to interpret and no general conclusions can be drawn from the trends of these surveys in recent years. (SCR Doc. 14/038).

The trawl survey in **Disko Bay** indicated increasing abundance during the 1990s and until the gear change in 2004 (Fig. 2.6). In 2005, a new gear was introduced making the two time series less comparable. After the gear change in 2005 the abundance decreased to low levels in 2008 and 2009, but since then the abundance index has returned to the previous high levels, mainly driven by large 2010 and 2012 year classes (SCR Doc. 14/038). The biomass indices in the trawl survey indicate a steadily increasing trend during the 1990s, but strongly increasing biomass after 2002 and until the gear change (Fig. 2.6). The new gear introduced in 2005, indicated an initial decrease, but since 2006 the biomass index has been stable. The 2013 biomass estimate indicates a decrease, but this is not seen in the slightly more correct estimate based on the original survey strata and not NAFO Division (See SCR Doc. 14/03).

The **Disko Bay** gillnet survey was initiated in 2001 where it replaced a poorly performing longline survey. The gillnet survey in the Disko bay targets pre fishery recruits of Greenland halibut at lengths of 30-50 cm. Since the survey uses gillnets with narrow selection curves there is not a major difference between the trends of the CPUE and NPUE indices (Fig. 2.7). When comparing the gillnet NPUE (all sizes) to the trawl survey (SFW) indices of Greenland halibut larger than 35 cm, an unusually high correlation between the surveys is observed (Fig. 2.7) leading to increased credibility in the performance and indices of both surveys. The gillnet survey CPUE and NPUE indicated low levels of pre fishery recruits in 2006 and 2007, but returned to average levels in 2008. The survey CPUE and NPUE reached a record high in 2011, but has decreased in 2013. The 2012 survey was troubled with a defective gillnet section (60mm) and can be disregarded. However, both surveys show large year to year variation with long-term stability, indicating a steady supply of pre-fishery recruits (35-50 cm) to the stock.

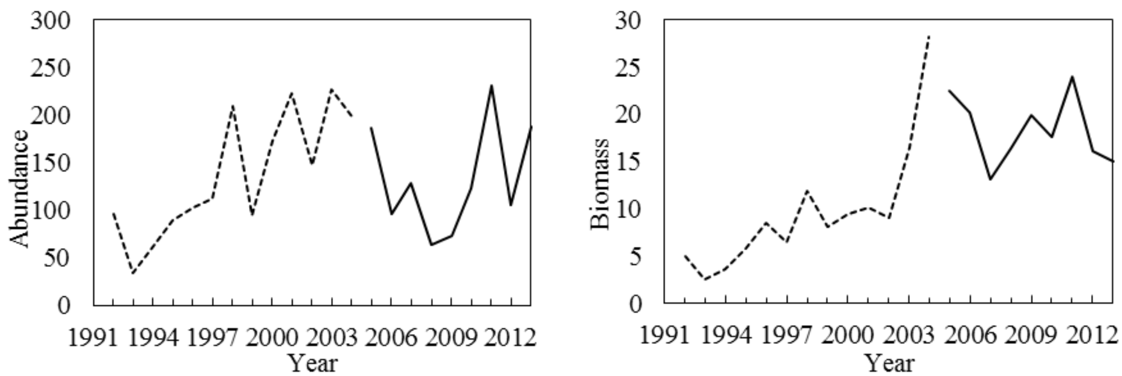



Fig 2.6. Greenland halibut in Division 1A inshore: Disko Bay abundance and biomass indices in the Greenland Shrimp Fish trawl survey.

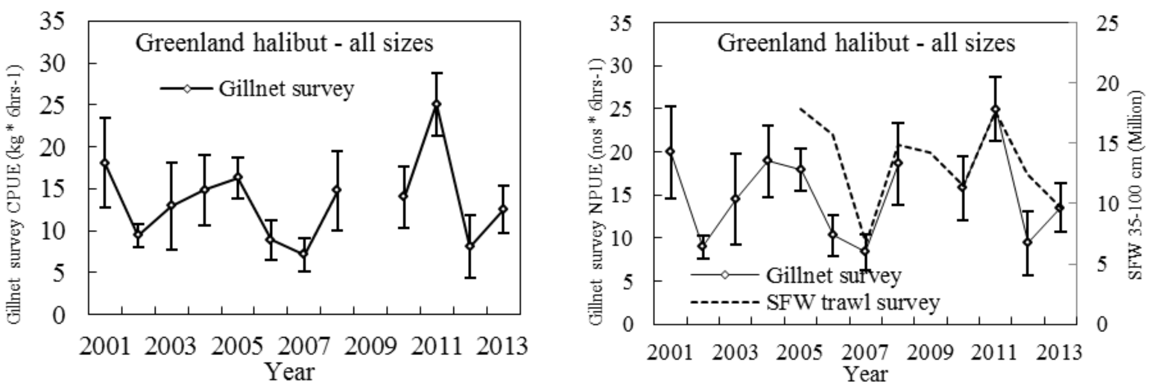



Fig 2.7. Greenland halibut in Division 1A inshore: Disko Bay gillnet survey CPUE and NPUE + % CI indicated.

**d) Assessment results:**

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

**Disko Bay**

*Biomass***:** The continuing decrease in the mean length in the landings and the shift in the length distributions towards smaller size indicates that the biomass is currently below previous levels. Survey results indicate a relatively stable biomass of pre-fishery recruits.

*Fishing mortality*: Unknown. The contribution to *F* from the shrimp trawlers is likely reduced since the implementation of sorting grids in the inshore shrimp trawl fishery in 2011.

*Recruitment*: Good. Trawl survey results in the Disko Bay indicate high levels of recruits in 2011 and 2013.

*State of the stock*: Stable at lower levels. The updated indices indicate that the stock is decreased and that the fishery is still dependant on new incoming year classes. However, the long-term stability in both surveys indicates a steady supply of pre-fishery recruits (35-50 cm) to the stock.

**Uummannaq**

*Biomass*: The long term stability in the mean length in the landings and wide range of sizes in the landings suggests that changes, if any, until now has happened at a slow rate.

*Fishing mortality*: Unknown. But there are no other fisheries in the district inducing fishing mortality.

*Recruitment*: Good. Offshore survey results from nearby areas indicate high levels of recruitment in recent years.

*State of the stock*: Good. The stability in the indices suggests that changes in the stock have so far occurred at a slow rate.

**Upernavik**

*Biomass*: The long term stability in the mean length in the landings and wide range of sizes in the landings suggests that changes, if any, until now has happened at a slow rate.

*Fishing mortality*: Unknown. Offshore survey results from nearby areas indicate high levels of recruitment in recent years.

*Recruitment*: Good. Trawl survey results from nearby offshore areas indicate high levels of recruitment.

*State of the stock*: Good. The stability in the indices suggests that changes in the stock have so far occurred at a slow rate.

These stocks will next be assessed in 2016

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

(SCR Doc. 14/002)

**a) Introduction**

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

Roundnose grenadier is taken as by-catch in the Greenland halibut fishery. A total catch of 3 t was estimated for 2013. Catches of roundnose grenadier have been reported from inshore areas and Div. 1A where roundnose grenadier is known not to occur. These catches must be roughhead grenadier and are therefore excluded from totals for roundnose grenadier, but it is also likely that catches from the offshore areas south of Div. 0A-1A reported as roundnose grenadier may include roughead grenadier.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Agreed TAC | 4.2 | 4.2 | | | | | | | | |
| Recommended TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 | 0.01 | 0.00 | |
| STACFIS | 0.01 | 0.02 | 0.03 | 0.00 | 0.00 | 0.03 | 0.00 | 0.01 | 0.00 | |
| ndf : No directed fishing. No TAC set for 2007 – 2014. | | | | | | | | | | |

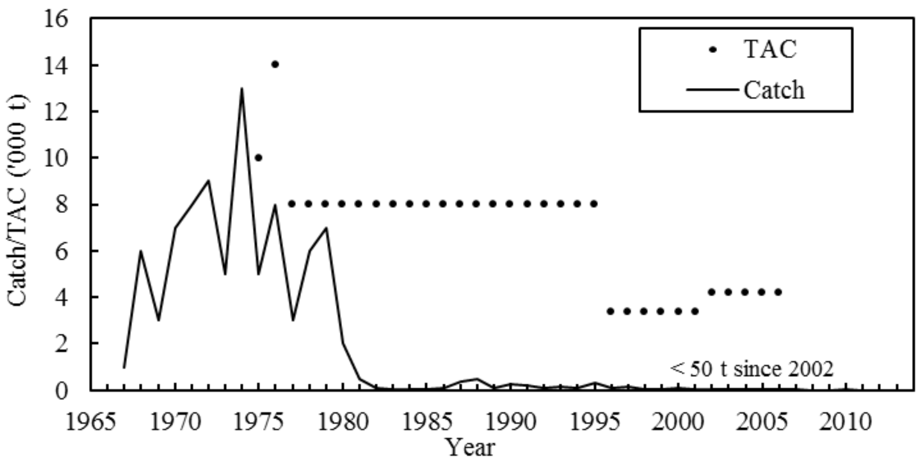



Fig. 3.1. Roundnose grenadier in Subareas 0+1: nominal catches and TACs. No TAC set for 2007-2014.

**b) Data Overview**

***i) Research survey data***

There has not been any survey that covers the entire area or the entire period. The various survey series available are not comparable. 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 m from then on. The surveys took place in October-November. Greenland has since 1997 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, 2011 and 2013 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.

The Greenland survey in 2013 only covered Div. 1D and the results are not considered as a reliable index of the total stock status.

The Canadian surveys in Div. 0B in 2000 and 2001 also showed very low biomasses. The biomass was not calculated from the 2011 and 2013 surveys but few roundnose grenadiers were recorded.

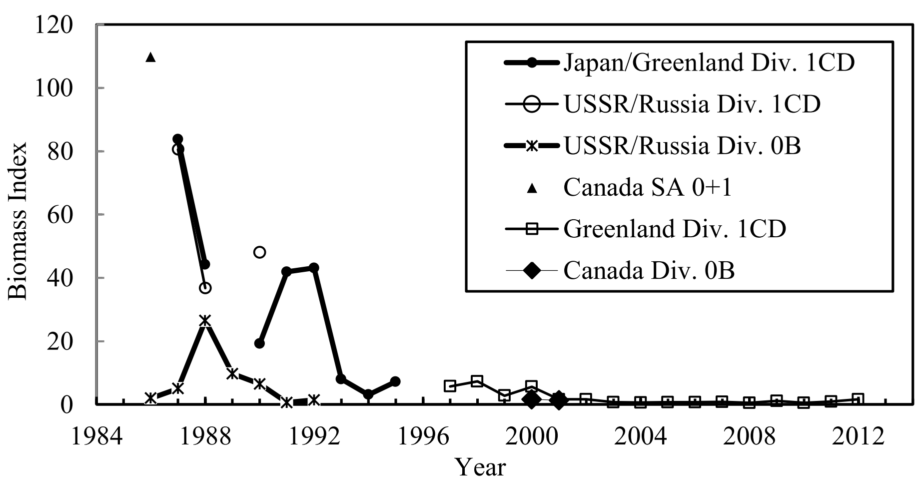



Fig. 3.2. Roundnose grenadier in Subareas 0+1: biomass estimates from Russian, Japan/Greenland, Canadian and Greenland surveys in Div. 0B and Div. 1CD.

**c) Assessment Results**

No analytical assessment could be performed.

*Biomass***:** Despite the fact that the biomass has increased gradually since 2010 the biomass in 2012 is still at the very low level seen since 1997, and there is no reason to consider that the status of the stock has changed.

*Recruitment:* not known.

*Fishing mortality:* not known.

*State of the Stock*: The stock of roundnose grenadier is still at the very low level seen since 1997.

**d) Reference Points**

STACFIS is not in a position to determine biological reference points for roundnose grenadier in SA 0+1 at this time. Previously STACFIS has considered a survey estimate of 111 000 t from 1986 as $B_{virgin.}$ However, given that roundnose grenadier is a long living species and that fishery stopped around 1979, it is uncertain whether the stock could be considered as virgin in 1986. Although the biomass estimates from the 1980s and early 1990s are not directly comparable with recent estimates these are far below what was seen previously. The survey time series from the 1980s and the early 1990s are, however, too short to be used for estimation of reference points.

The next full assessment of this stock will take place in 2017.

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

(SCR Doc. 07/88 14/002 14/003 14/025 14/028; SCS Doc. 14/12)

**a) Introduction**

Two species of redfish are common in West Greenland, golden redfish (*Sebastes marinus*) and deep-sea redfish (*Sebastes mentella*). Relationships to other North Atlantic redfish stocks are unclear. Both redfish species are included in the catch statistics, since no species-specific data are available. Greenland operates the quota uptake by categorising the catches in three types of redfish: 1) fish caught by bottom trawl and longlines on the bottom are considered *Sebastes marinus*. 2) fish caught pelagic are considered *Sebastes mentella* and 3) fish caught as by-catch in the shrimp fishery are named *Sebastes* sp. From surveys operating both offshore and inshore in West Greenland it is known that the demersal redfish found on the shelf and in the fjords are a mixture of *S. marinus* and *S. mentella*.

**b) Fisheries and Catches**

The fishery targeting demersal redfish in subarea 1 increased during the 1950 from a level of more than 10 000 t and peaked in 1962 at more than 60 000 t. Catches then decreased to around 3 000 t in the beginning of the 1970s but increased again to around 10 000 t by 1975. By 1986 reported catches had decreased to around 5 000 t and there after remained below 1 000 t per year with few exceptions. The differentiation between stocks in official statistics is however not straight forward. Even the correctness of the total landings of redfish from the area are highly uncertain. From 1977 to 1979 mis-reportings occurred where catches of cod were reported as other fish species, including redfish (SCR Doc. 80/VI/72), and the landings of redfish are likely overestimated in these years. Also, the by-catch of redfish in the shrimp fishery in 1988 was estimated to be 15 584 t (SCR Doc. 88/12) and 4 234 t in 1994 (SCR Doc. 96/36), implying that catches in these and surrounding years were far higher than indicated by the official statistics. To minimize by-catch in the shrimp fishery, offshore shrimp trawlers have been equipped with grid separators since 2002 and inshore shrimp trawlers (Disko Bay) since 2011. The implementation of sorting grids in the shrimp fishery has led to a protection of redfish larger than 14 cm and in 2007 the by-catch of redfish in the shrimp fishery was estimated to be 0.5% (around 700 t of redfish) of the shrimp catch (SCR Doc. 07/88).

A pelagic fishery for pelagic/beaked redfish (*Sebastes mentella*) occurred for the first time off West Greenland in 1999 and was conducted close to the edge of the Greenland EEZ and far off the Greenlandic shelf in Div. 1F. The pelagic redfish in West Greenland is believed to be part of the Irminger stock complex and is assessed by ICES.

In 2013 only 170 t of redfish were reported, of which the majority was caught inshore and landed to factories (156 t) and a minor part was reported as by-catch in the shrimp fishery (11 t) and offshore fishery mostly targeting Greenland halibut (3 t).

Recent catches ('000 t) are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| STATLANT 21 | 0.2 | 0.4 | 0.3 | 0 | 0.02 | 0 | 0.2 | 0.12 | 0.16 | |
| STACFIS | 0.2 | 0.4 | 0.3 | 0.4 | 0.4 | 0.3 | 0.2 | 0.16 | 0.17 | |

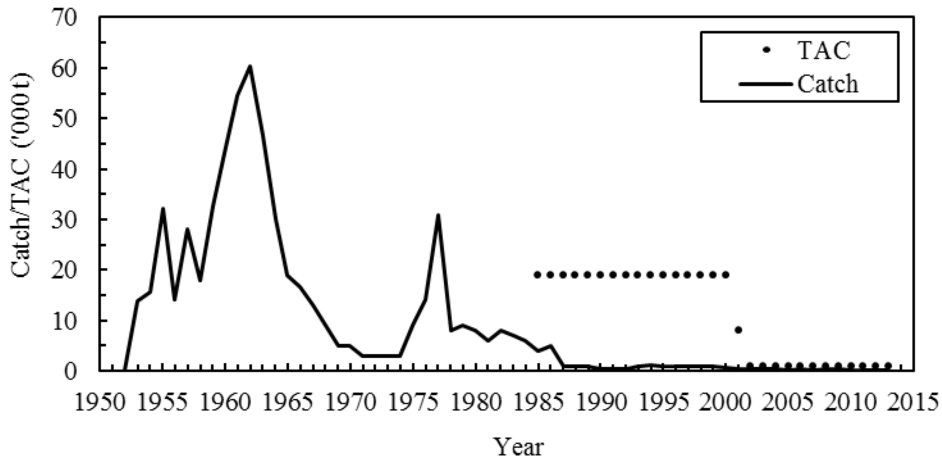



Fig. 4.1. Demersal redfish in Subarea 1: catches and TAC.

**c) Data overview**

***i) Commercial fishery data***

Mean length of golden redfish catches from sampling of EU-Germany commercial catches during 1962-90 revealed significant size reductions from 45 to 35 cm, with the most significant reductions occurring during the 1970s. There are no data available to estimate the size composition of catches of deep-sea redfish. Since the landings currently are at a very low level it is difficult to obtain data from the fishery.

***ii) Research survey data***

There are three recent surveys covering the demersal redfish stocks in Subarea 1. The EU-Germany survey (since 1982), the Greenland deep-water survey (since 1998) and the shallower Greenland Shrimp and Fish survey (SFW, since 1992). The latter has a more appropriate depth and geographical coverage (0-600m, Div. 1A-F) in regards to redfish distribution, than both the EU-Germany survey (0-400m, Div. 1Bs-F) and the Greenland deep-water survey (400-1 500m, Div. 1CD). The gear was changed in the Greenland Shrimp and Fish survey in 2005, but indices for redfish prior to 2005 have been converted to the new gear.

**Golden redfish (*Sebastes marinus*).** The indices of the EU-Germany survey (Div. 1Bs-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 2013 indices are the highest observed since 1986 (Fig. 4.2). The biomass of golden redfish in the EU-Germany survey is however still far below the 1982 indices which must have been obtained from a stock below historic levels, since the size reduction in the landings occurred already during the 1970s. The biomass index for golden redfish in the Greenland shrimp and fish survey increased in 2011 and 2012, but decreased slightly in 2013. For this survey no separation of species were made prior to 2006. However, since redfish are highly aggregating, some caution should be given when interpreting single year estimates that may be affected with some stochastic variation. The general impression of the surveys is a slowly but steadily increasing biomass of golden redfish.

**Demersal deep-sea redfish (*Sebastes mentella*).** The indices of the EU-Germany survey have fluctuated without a trend throughout the time series, but with very low values after 2007 (Fig. 4.3). The fluctuating trend is likely caused by poor survey overlap with the depth distribution of adult deep-sea redfish. Still, a slight increase was observed in this survey in 2012 and the 2013 index is among the highest observed for this survey. The joint Greenland-Japan deep-sea (Div. 1BCD) survey biomass index decreased from 1987 to 1995 (Fig. 4.3), were at a low level from 1997 to 2007, but have steadily increased since then. The 2013 estimate is the highest on record even though less than half the normal hauls were conducted. The biomass estimate was however driven by 2 larger hauls. The length distribution in this survey ranged from 21 to 45 cm with modes at 28 and 41 cm.

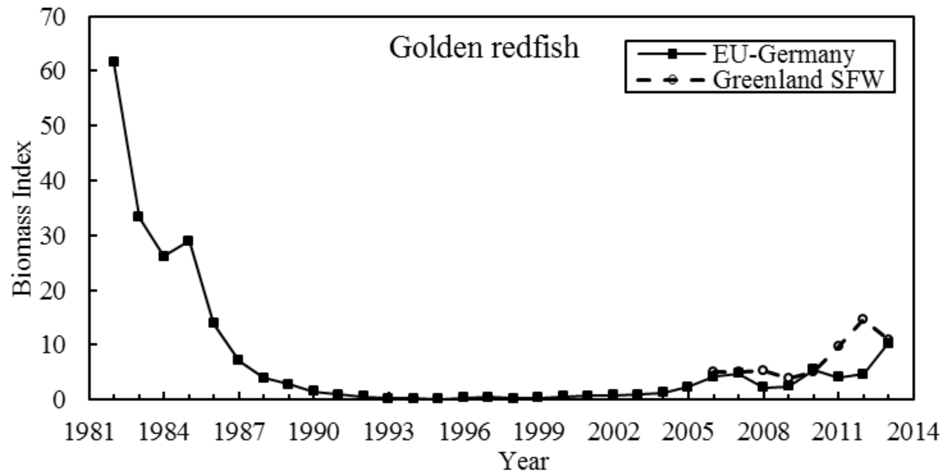



Fig. 4.2. Golden redfish (≥17 cm) survey biomass indices derived from the EU-Germany survey and the Greenland Shrimp and Fish survey since 2006.

In the Greenland Shrimp and Fish survey, no separation of redfish species was made prior to 2006. The biomass index for deep-sea redfish in this survey has steadily increased since 2008 and the 2013 indices are the highest observed since 2006 (Fig. 4.3). Length frequencies by Division in the 2013 survey revealed modes at 8 cm (Div. 1B), 17 cm (Div. 1A, B) 28 cm (Div. 1C) and 32 cm (Div. 1E). The combined impression of these surveys is a steadily increasing biomass of deep-sea redfish (Fig. 4.3).

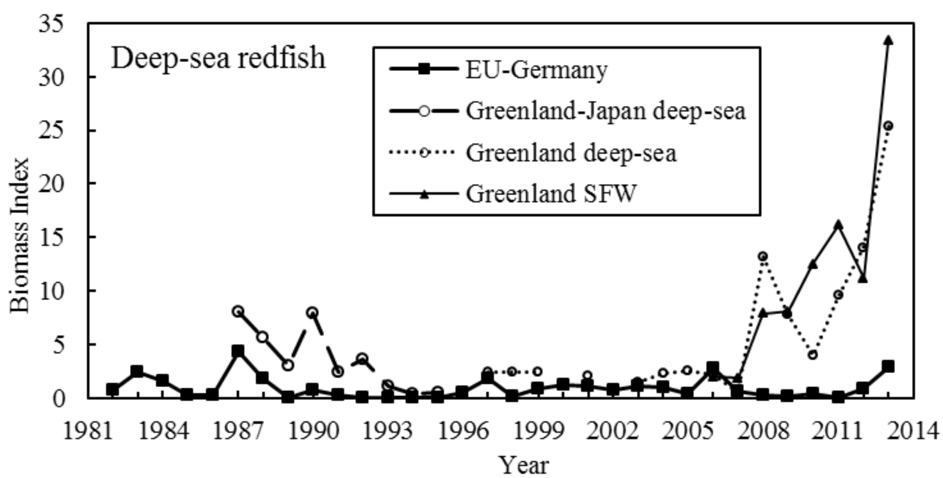



Fig. 4.3. Demersal deep-sea redfish (≥17 cm) survey biomass indices derived from the EU-Germany survey (1C-F), from the joint Greenland-Japan deep-sea survey (1987-1995), the Greenland deep-water survey (Div. 1CD) and the Greenland Shrimp and Fish survey (results since 2006).

**Juvenile redfish (both species combined).** Abundance indices of juvenile redfish (both species combined) in the EU-Germany survey has been at a very low level since 2001 (Fig. 4.4). The Greenland shrimp and fish survey is likely dominated by redfish < 20 cm and is therefore a good index of recruitment. Abundance indices of both redfish species combined in the Greenland Shrimp and Fish survey (Div. 1A-F) decreased during the 1990s and has remained at a low level since then. In 2012 the combined redfish abundance from the Greenland Shrimp and Fish survey was the lowest on record and the 2013 total abundance is the second lowest observed since 1992 (Fig. 4.4). Therefore, recruitment of juvenile redfish remains poor in the area and the increasing biomasses observed are likely a consequence of either increased survival of redfish and/or migration of redfish into subarea 1 from nearby areas. (Fig. 4.4).

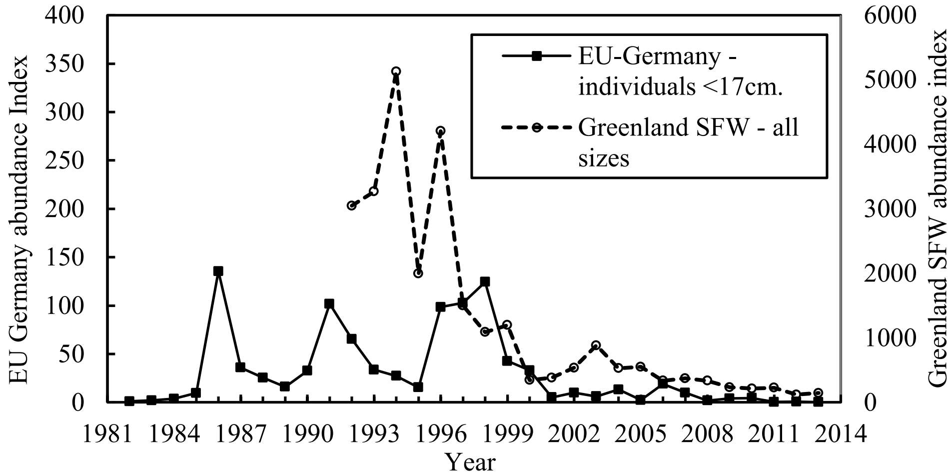



Fig. 4.4. Juvenile deep-sea redfish and golden redfish combined survey abundance indices for EU-Germany survey (1C-F, individuals <17cm) and the Greenland Shrimp and Fish survey (Div. 1A-F, All sizes and both species combined).

**d) Assessment results**

**Golden redfish**

*Biomass***:** Increasing. Both the EU-Germany survey and the Greenland Shrimp and Fish survey show slow but steady increasing trends during the past decade although remains far from historic levels.

*Fishing mortality***:** Unknown, but likely to be at a lower level than a decade ago due to a low cod fishery off West Greenland and the use of sorting grids in the shrimp fishery.

*Recruitment***:** Poor. The most recent abundance indices of juvenile redfish in both surveys are among the lowest recorded.

*State of the stock*: Survey indices indicate a steadily increasing stock due to either increased survival or immigration from nearby stocks. However the stock is far from historic levels and recruitment remains poor.

**Demersal deep-sea redfish**

*Biomass***:** Increasing. All surveys show increasing trends in recent years.

*Fishing mortality***:** Unknown, but likely to be at a lower level than a decade ago due to a low cod fishery off West Greenland and the use of sorting grids in the shrimp fishery.

*Recruitment***:** Poor. The most recent abundance indices of juvenile redfish in the EU-Germany survey and the Greenland Shrimp and Fish survey are among the lowest recorded.

*State of the stock*: Survey indices indicate a steadily increasing stock due to either increased survival or immigration from nearby stocks. However, recruitment remains poor.

**e) Research Recommendations**

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

STATUS: No progress in 2014

This stock will next be assessed in 2017.

## 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 requests of 2012 and 2013 no longer use 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

(SCR Doc. 80/VI/72 77; 96/036; 07/88; 14/002; 14/003; 14/028; 14/037; SCS Doc. 14/12)

#### a) Introduction

Three species of wolffish occur in Greenland waters, Atlantic wolffish (*Anarhichas lupus*), spotted wolffish (*Anarhichas minor*) and Northern wolffish (*Anarhichas denticulatus*). Only the two first are of commercial interest. Spotted wolffish has a larger maximum length and higher growth rate than Atlantic wolffish. Although spotted wolffish and Atlantic wolffish are easily distinguishable from one another (spotted wolffish has spots, and Atlantic wolffish has stripes), the fishing industry and catch statistics have so far made no distinction between the two species. Research performed by Greenland and Federal Republic of Germany, revealed an almost complete absence of Atlantic wolffish in landings and research fishery from Division 1A and 1B in 1957 and 1960, but a dominance of Atlantic wolffish in division 1C in 1976 (99% by weight, depth 70-90 meters) and 1D in 1980 (58% by weight, depth 300-500 meters) (SCR Doc. 80/VI/77). Therefore, the breakdown of the catches by Division gives some indication of species composition as Atlantic wolffish has a more southern distribution and seems more connected to the shallow offshore banks. Atlantic wolffish seems to disappear from the offshore fishing grounds during the summer months (June-September, SCR Doc. 80/VI/77), but gradually return during the winter months. Spotted wolffish can be found in all divisions offshore and through survey and landing observations, still seems to be the dominant species in the fjords.

#### b) Fishery and Catches

The commercial fishery for wolffish in West Greenland increased during the 1950 and was originally based on the production of wolffish skins (Fig. 5a-1). In 1951, a production of frozen fillets started inshore in Div. 1C and the fishery gradually spread to the northern inshore areas in Div. 1A-B. Annual landings reached a level of more than 5 000 t by 1957 and stayed at a level of 4 000 to 6 000 t until 1970. With the failing cod fishery off West Greenland, trawlers started targeting Atlantic wolffish on the banks off West Greenland and from 1974-1976 reported landings from trawlers were around 3 000 t per year (SCR Doc. 80/VI/77). The highest reported catches occurred in 1977-1979, but in these years non-Greenlandic vessels were excluded from the valuable cod fishery on the banks off West Greenland and mis-reportings were documented, where cod were reported as wolffish or other species (SCR Doc. 80/VI/72). After 1980, the cod fishery gradually decreased in West Greenland and catches of wolffish also decreased during in this period. The gradual switch from cod to shrimp fishery may however have meant that an unknown amount of wolffish could have been taken and discarded in the shrimp fishery. Studies of by-catch in the shrimp fishery in 1994 indicated low levels of wolffish by-catch, but survey indices for both species were also low in these years (SCR Doc. 96/036). To minimize by-catch in the shrimp fishery, offshore shrimp trawlers have been equipped with grid separators since 2002 and inshore shrimp trawlers since 2011. After the implementation of the sorting grids, studies of by-catch in the shrimp fishery indicated very low levels of wolffish in the shrimp fishery when using the grid separators (SCR Doc. 07/88). In 2013, 858 t of wolffish were reported, of which the majority was caught inshore in Div. 1A-C, indicating that most of the catches were spotted wolffish.

Recent nominal catches (t) for wolfish are:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Atlantic wolffish recommended TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| Spotted wolffish recommended TAC | ndf | ndf | ndf | ndf | na | na | na | na | na | na |
| STATLANT 21 | 524 | 764 | 880 | 1195 | 50 | 9 | 752 | 1008 | 858 | |
| STACFIS | 515 | 764 | 880 | 1195 | 1175 | 1315 | 779 | 1008 | 858 | |
| ndf – No directed fishery<br>na – No advice | | | | | | | | | | |

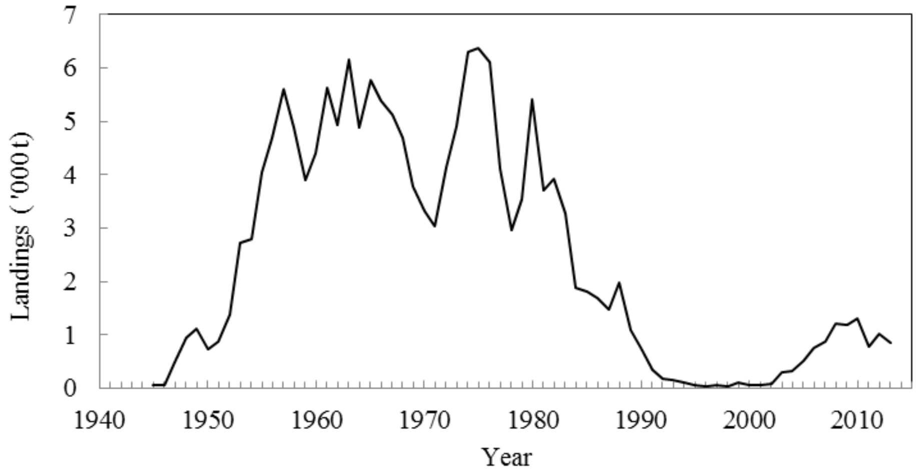



Fig 5a.1. Wolffish in Subarea 1: Catches of Atlantic wolffish and spotted wolffish combined from 1945 to 2013.

## c) Data Overview

### *i) Commercial fishery data*

Due to a lack of adequate commercial data no analytical assessment could be formulated. The missing separation of the species in the commercial statistics provides difficulties for making detailed biological assessment. Only few observations of wolffish landings are available and involves low numbers of observations.

### *ii) Research survey data*

There are two surveys partly covering the stocks of Atlantic wolffish and spotted wolffish in Subarea 1. The EU-Germany survey (SCR Doc. 14/028) and Greenland Shrimp Fish survey in West Greenland (SCR Doc. 14/003). The EU Germany survey has a longer time series (since 1982, 0-400 m, Div. 1Bs-F) and the Greenland shrimp and Fish survey in West Greenland covers a larger geographical area (since 1992, 0-600m, Div. 1A-F). Both surveys are appropriate in regards to main lower depth distribution of both Atlantic and spotted wolffish (100 to 400 m), but do cover the inshore areas (except the Disko Bay) and are unlikely to fully cover the shallowest depths fully (0-100 m).

## d) Assessment

**Atlantic wolffish:** Biomass indices decreased significantly in the 1980s in the EU-Germany survey (Fig. 5a.2). From 2002 to 2005 biomass indices increased in both surveys to above average levels. However after 2005 the biomass returned to the low levels observed during the 1990s. The length range has increased slightly in the EU-Germany survey in the most recent years. Abundance indices in the EU-Germany survey decreased after 1982, but were at a stable and perhaps slightly increasing level until 2005. After 2005 abundance indices in this survey decreased to below average levels, but remained stable after 2008 (Fig. 5a.3).

The Greenland shrimp and fish survey biomass indices were at low levels during the 1990s, but slightly increased from 2002 and until the gear change in 2004. After 2005, the surveys are highly correlated but the biomass index increases slightly more in the Greenland shrimp and fish survey than in the EU-Germany survey. (Fig. 5a.1). Abundance indices in the Greenland shrimp and fish survey also increased from 2002 to 2004. After 2005, the abundance indices are also highly correlated but the abundance index is higher and increase more in the Greenland shrimp and fish survey. The differing trends observed in the EU-Germany survey and the Greenland shrimp and fish survey can largely be explained with the difference in survey area. The increasing trends observed in Greenland shrimp and fish survey biomass indices are observed in Div. 1A-B, and therefore outside the EU-Germany survey area (SCR Doc. 14/003, 14/037). Therefore, the stagnant abundance indices observed in the EU-Germany survey are likely caused by an expansion in distribution of Atlantic wolffish further north than during the 1990s. Length distributions from the Greenland Shrimp and fish survey consists of all sizes from 5-65 cm with a mode at 10 cm and decreasing numbers with size.

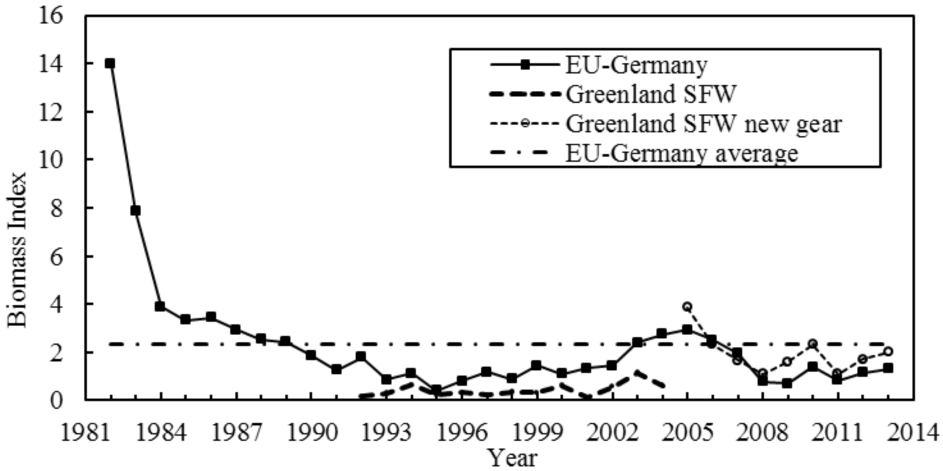



Fig. 5a.2. Wolffish in Subarea 1: Atlantic wolffish survey biomass indices in SA1.

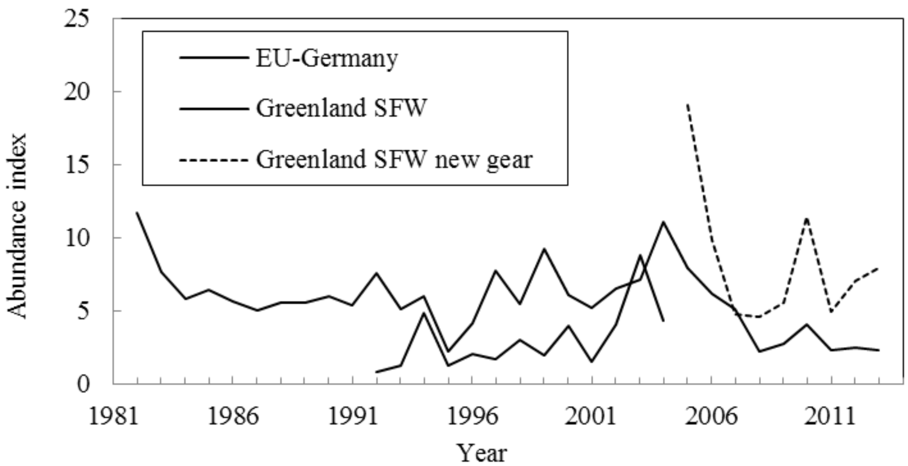



Fig. 5a.3. Wolffish in Subarea 1: Atlantic wolffish survey abundance indices in SA1.

**Spotted wolffish**: Biomass indices decreased significant in the 1980s in the EU-Germany survey and were at low levels during the 1990s (Fig 5a.4). After 2003 survey biomass indices in this survey increased to the long term average and the 2013 indices are the highest observed since 1983. Abundance indices in the EU-Germany survey decreased from 1982 to 1995, but has increased since 2012 (Fig 5a.5).

Biomass indices in the Greenland shrimp and fish survey were at low levels during the 1990s, but increased in 2003 and 2004. After the gear change in 2005, survey biomass indices have increased substantially and the 2013 estimate is the highest observed (Fig 5a.4). Abundance indices of spotted wolffish in the Greenland shrimp and fish survey was initially at the same level the EU-Germany survey in 1992 but increased during the 1990s and until the gear change in 2004. After 2005, the abundance indices continued the increase and the 2013 indices are the highest observed. Length measurements from the inshore landings and surveys using longlines indicates that the fishery is currently mostly catching spotted wolffish at lengths between 40 cm and 100 cm with the majority of the catches in the higher end of the interval. Length distributions in the Greenland Shrimp and fish survey consists of all sizes from 5-120 cm.

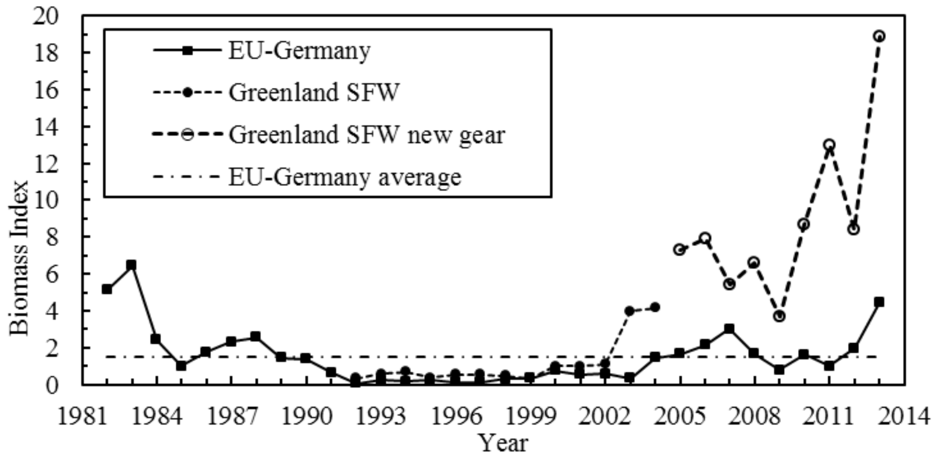



Fig. 5a.4. Wolffish in Subarea 1: Spotted wolffish survey biomass indices in SA1.

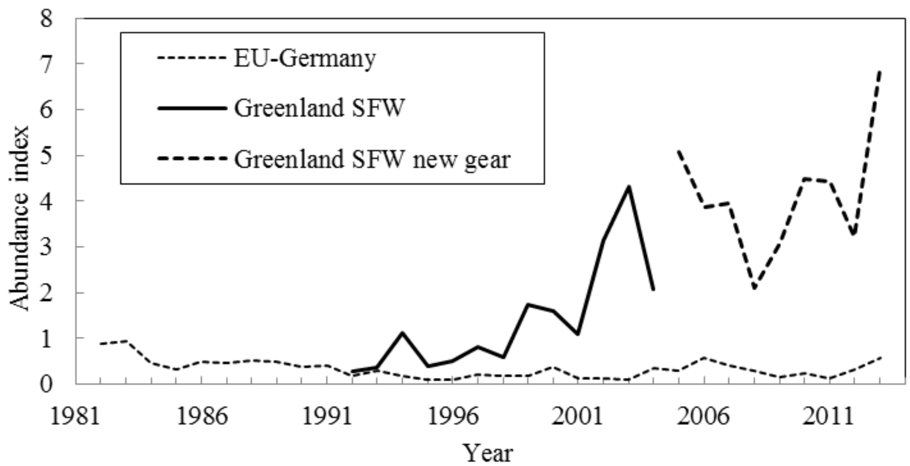



Fig. 5a.5. Wolffish in Subarea 1: Spotted wolffish survey abundance indices in SA1.

**e) Assessment results**

**Atlantic wolffish**

*Biomass*: The biomass is stable, but below average levels.

*Fishing mortality*: Unknown, but likely to be at a lower level than before the introduction of grid separators in the shrimp trawl fishery.

*Recruitment*: Unknown.

*State of the stock*: The stock of Atlantic wolffish is stable at low levels in the southern Divisions but expanding its distribution the northern Divisions.

**Spotted wolffish**

*Biomass*: Unknown. None of the surveys fully cover the distribution of spotted wolffish. Indices are however increasing in both surveys.

*Fishing mortality*: Unknown, but likely to be at a lower level offshore than during the 1990s due to the low levels of cod fishery off West Greenland and the use of grid separators in the shrimp fishery. *F* is unknown in the inshore areas.

*Recruitment*: Unknown. But the increasing abundance indices observed particularly in the Greenland shrimp and fish survey suggests increasing recruitment since 1990s.

*State of the stock*: The increasing survey biomasses and abundance indices and the length distribution in surveys and landings suggest that the stock is in good and increasing condition. The state of the stock compared to historic levels is however unknown.

**f) 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: Grid separators are currently used by all fleets. This recommendation is no longer needed.

Noting the change in the request for other finfish STACFIS **recommended** that *the distribution of wolffish in relation to the main shrimp-fishing grounds in SA1 be investigated, in order to further discover means of reducing the amount of discarded by-catch.*

STATUS: Grid separators are currently used by all fleets. This recommendation is no longer needed.

These stocks will next be assessed in 2017.

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

(SCR Doc. 80/VI/72, 07/88, 14/003, 028, 032; SCS Doc. 14/12)

**a) Introduction**

American plaice in Subarea 1 have mainly been taken as a by-catch in fisheries targeting cod, redfish and shrimp. To reduce the number of juvenile fish discarded in the trawl fishery targeting shrimp, sorting grids have been mandatory since October 2000 (fully implemented offshore in 2002).

***i) Fishery and Catches***

American plaice has been of very little commercial interest in Greenland at least for the past three decades. American plaice has mostly been taken as by-catch in other fisheries targeting cod, redfish, Greenland halibut and shrimp. Occasionally, when the cod fishery was poor, vessels would turn to other species such as wolffish, redfish and American plaice on the banks off West Greenland. Reported catches of American plaice increased in the same years as wolffish were directly targeted due to failing cod fisheries in the years after 1974. The highest reported catches occurred in 1977-1979, but in these years non-Greenlandic vessels were excluded from the valuable cod fishery on the banks off West Greenland and massive mis-reportings were documented. The catches of American plaice in these years are likely overestimated.

Recent reported catches (t):

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| STATLANT 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| STACFIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

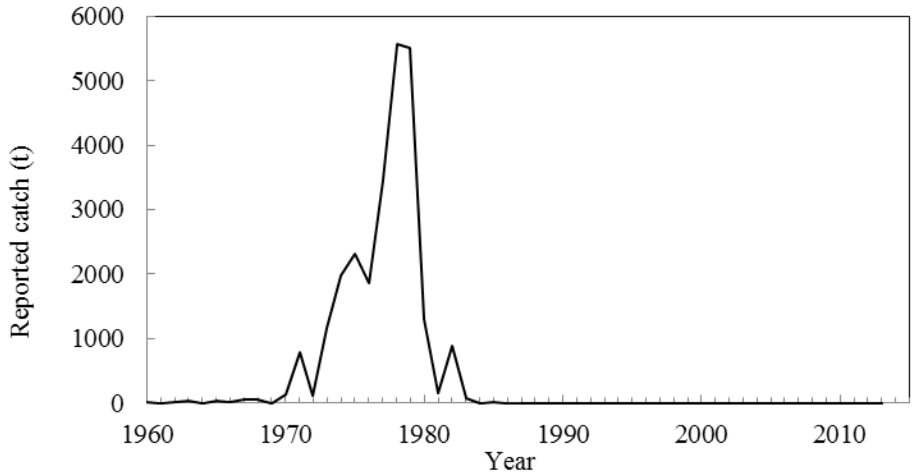



Fig 5b.1. Reported catches of American plaice from SA1 from 1960 to 2013.

**b) Data**

***i) Research survey data***

There are two surveys partly covering the American plaice stock in Subarea 1. The EU-Germany survey has a smaller depth coverage (0-400m, Div. 1Bs-F), than the Greenland Shrimp Fish survey in West Greenland (0-600m, Div. 1A-F). Biomass indices decreased during the 1980s in the EU-Germany survey, particularly from 1988 to 1990, but increased from 2002 to 2005. Since then the biomass indices have decreased. The biomass indices in the Greenland shrimp and fish survey steadily increased from 1992 to the gear change in 2004. After 2005 the indices have fluctuated without a clear trend. The difference in the indices between the two surveys is mainly due to the limited overlap of the surveys. The decreasing trend observed in the EU-Germany survey since 2005 is also observed in the overlapping divisions of the Greenland shrimp and fish survey (Div. 1Bs-F), but is cancelled by an increase in the northern Divisions 1A-Bn (Fig. 5b.2). Therefore the stock seems to be at a stable level although far below the biomass observed in the 1980s.

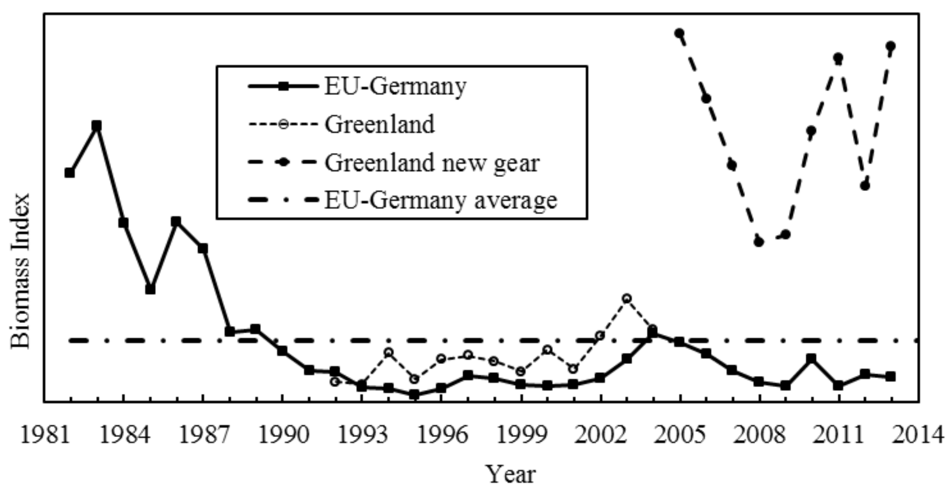



Fig. 5b.2. American plaice survey biomass indices in SA1.

**c) Assessment results**

*Biomass***:** The biomass of the stock of American plaice in Subarea 1 seems to be at a stable level, slightly higher than the 1990s, but far below the levels in the 1980s.

*Fishing mortality*: Unknown.

*Recruitment*: Recruitment is lower than the initial values observed in initial years of the EU-Germany survey.

*State of the stock*: Stable at a slightly higher level than the 1990s level, but far below the levels in the 1980s.

**d) Research Recommendation**

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

STATUS: No progress and STACFIS reiterates this recommendation

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 American plaice in the by-catch.*

STATUS: No progress and STACFIS reiterates this recommendation

These stocks will next be assessed in 2017.

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

(SCR Doc. 14/10, 14/14, SCS Doc. 14-14)

Recent Conditions in Ocean Climate and Lower Trophic Levels

●Ocean climate composite index on SA3 – Flemish Cap has shifted downward in recent years although remains slightly above normal in 2013.

●The composite spring bloom index has shifted to negative values in 2013 after relatively high positive anomalies (highest in 2010) in recent years.

●The composite zooplankton index has remained above normal since 2009 and reached its highest level in 2013.

●The composite trophic index increased to its highest level in 2013.

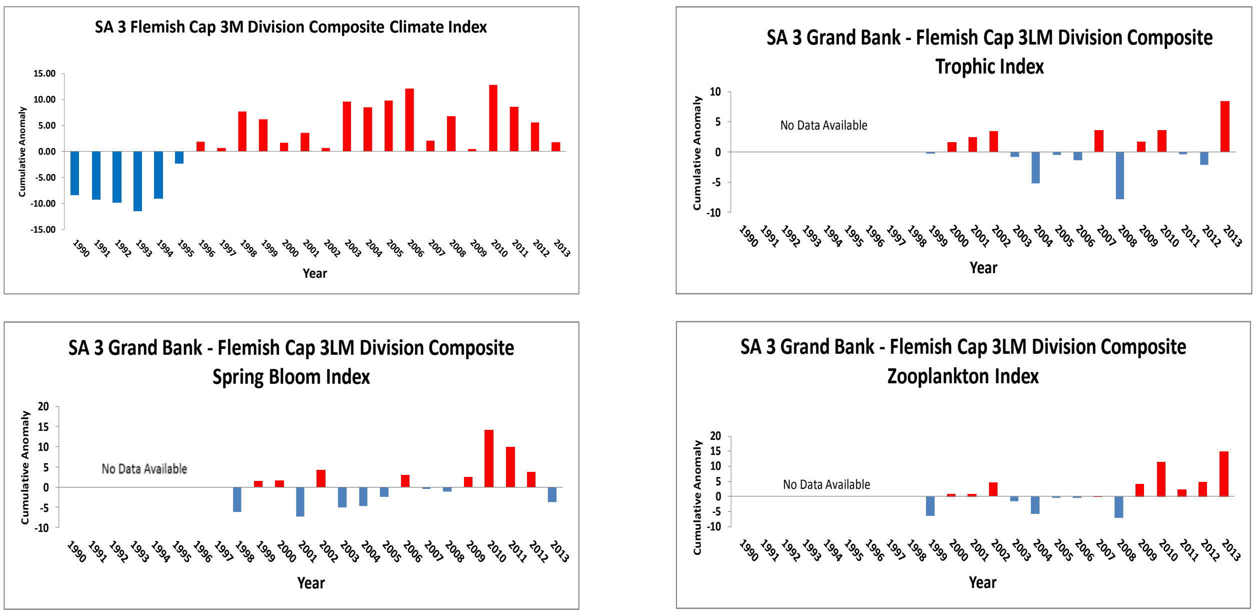



Fig. 2. Composite ocean climate index for NAFO Subarea 3 (Div. 3M) derived by summing the standardized anomalies during 1990-2013 (top left panel), composite spring bloom (summed background chlorophyll *a*, magnitude and amplitude indices) index (Div. 3LM) during 1998-2013 (lower left panel), composite zooplankton (cumulative anomalies of the four functional plankton taxa) index during 1999-2013 (top right panel), and composite trophic (summed anomalies of nutrient and standing stocks of phyto- and zooplankton indices) index (Div. 3LM) during 1999-2013 (bottom right panel). Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

### Environmental Overview

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

**Ocean Climate and Ecosystem Indicators**

The composite climate index in Subarea 3 (Div. 3M) has remained above normal since the mid-1990s although the index has been in decline since 2010 and now approaching near-normal conditions in 2013 (Fig. 2). The composite spring bloom index (Div. 3LM) peaked in 2010 and has declined sequentially shifting from a series of positive anomalies to below normal in 2013 (Fig. 2). The composite zooplankton index (mainly composed of copepod and invertebrate plankton) peaked in 2013 and has remained at above normal levels in recent years (Fig. 2). The composite tropic index which combines nutrient inventories and standing stocks of phytoplankton and zooplankton, increased to its highest level in 2013 (Fig. 2). Surface temperatures on the Flemish Cap were slightly above normal in 2013 with a standard deviation of 0.6. Bottom temperature anomalies across the Flemish Cap were similar to 2012 and ranged from 1-2 standard deviations above normal in 2013, and have remained high since 2008.

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

(SCR Doc. 14/35, 14/17; SCS Doc. 14/06, 14/10, 14/13, 14/16).

### 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 directed 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 to 889 and 1 161 t, respectively. The fishery had been reopened in 2010 with a TAC of 5 500 t and a catch of 9 192 t was estimated by STACFIS. TACs of 10 000 t for 2011, 9 280 t for 2012 and 14113 t for 2013 were established. Since 2011, alternative estimates of the annual total catch have not been available. The inconsistency between the information available to produce catch figures used in the previous years assessments and that available for 2011-2013 has made it impossible for STACFIS to provide the best assessments for some stocks. The assessment model of this stock was used to estimate the catches of 2011 and 2012, providing 13 640 t for 2011 and 13 670 t for 2012. In 2013, best available information for the catches of this stock is the Daily Catch Report data (see estimation of parameters), giving a total catch of 13 985 t. The TAC for 2014 is 14 521 t.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | 5.5 | 10 | 9.3 | 14.1 | 14.5 |
| STATLANT 21 | 0.0 | 0.1 | 0.1 | 0.4 | 1.2 | 5.3 | 9.8 | 9.0 | 11.2 | |
| STACFIS | 0.0 | 0.3 | 0.3 | 0.9 | 1.2 | 9.2 | 13.6[1] | 13.4[1] | 14.0[2] | |

ndf No directed fishery
[1] See estimation of parameters
[2] Daily Catch Report

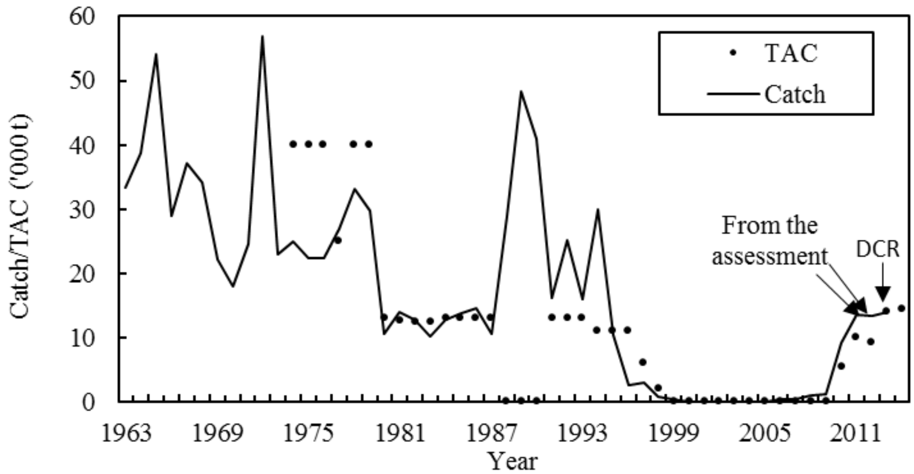



Fig. 6.1. Cod in Div. 3M: Catches and TACs. Catch line includes estimates of misreported catches from 1988 to 2010, estimates from the model for 2011 and 2012 and DCR for 2013. No direct fishery is plotted as 0 TAC.

## 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 2013. In 2010-2013, with the fishery open, there was a good sampling level. In 2013 there were length distributions for EU-Estonia, EU-Portugal, Russia, EU-Spain and EU-UK. The mode for Estonia was 47 cm. The Portuguese and Russian length distributions have a mode at 42 cm. Spain has the mode at 40 cm and UK at 63 cm, bigger than for the rest of the countries. In 2013 there were inconsistencies in the aging of commercial catches, so the 2013 EU-survey age-length key was used. In 2009, 2010 and 2013 age 4 was the most abundant in the catch, whereas it was age 3 in 2011 and 2012.

Length distributions from some countries with a high percentage of catch were not reported.

### *ii) Research survey data*

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

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

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

**EU survey.** The EU Flemish Cap survey indices showed a general decline in biomass going from a peak value in 1989 to the lowest observed level in 2003. Biomass index increased since then until 2012, especially from 2006. The growth of the strong year classes since 2005 has contributed to the increase in biomass. In 2013 a substantial decrease in biomass can be seen, reaching the level of 2010, although remaining at high level (Fig. 6.2).

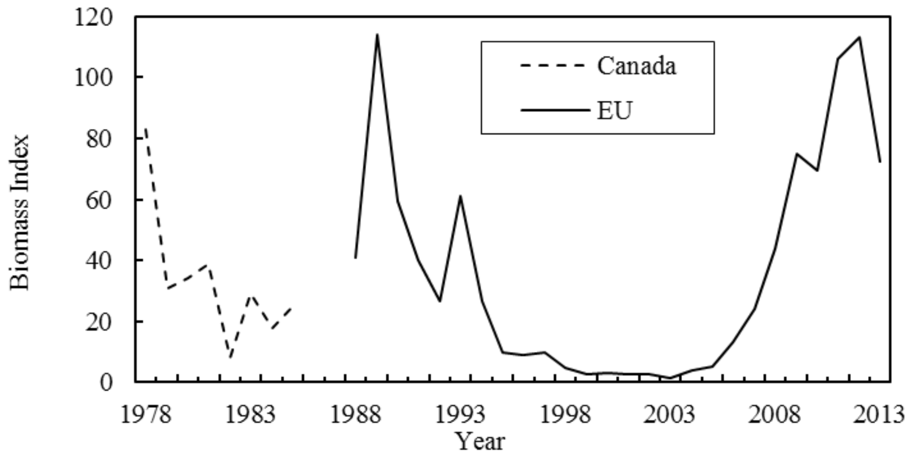



Fig. 6.2. Cod in Div. 3M: Survey biomass estimates from Canadian survey (1978-1985) and EU-Flemish Cap survey (1998-2013).

Abundance at age indices were available from the EU Flemish Cap survey. After several series of above average recruitments (age 1) during 1988-1992, the EU Flemish Cap survey indicates poor recruitments during 1996-2004, even obtaining observed zero values in 2002 and 2004. From 2005 to 2012 increased recruitments were observed. In particular, the age 1 index in 2011 is by far the largest in the EU series (Fig. 6.3; note that the level of both surveys is different in the two y-axis). In 2013 the recruitment in the survey dropped to the level at the beginning of the recovery of the stock.

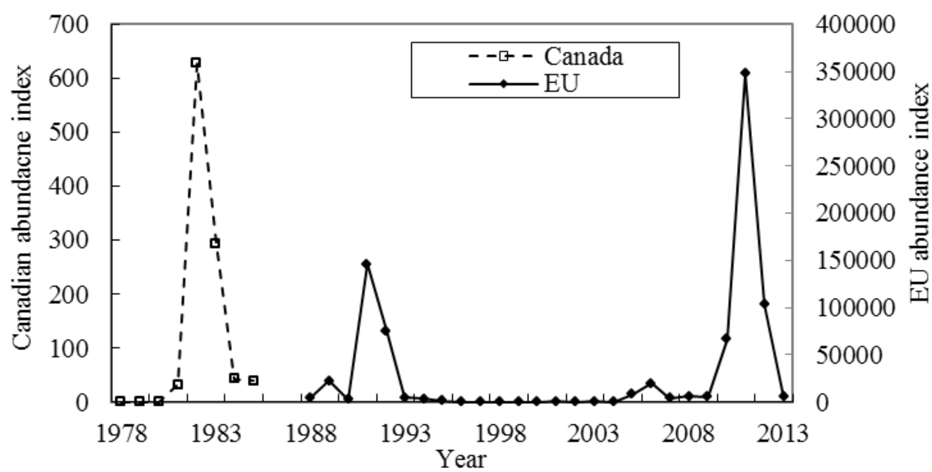



Fig. 6.3. Cod in Div. 3M: Number at age 1 in the Canadian survey (1978-1985) and EU survey (1988-2013).

Additional surveys have been conducted in Div. 3M but information was not available.

***iii) Biological data***

Mean weight at age in the stock, derived from the Canadian and the EU Flemish Cap survey data, shows a strong increasing trend since the beginning of the series, although in the last years the mean weight shows a general decrease, mainly since 2009. For example the mean weight of a five year old cod has decreased from 3.7 kg in 2009 to 2.0 kg in 2013. Similar patterns have been observed across all ages.

There are maturity information from the Canadian survey for years 1978-1985 and for the EU survey for 1990-1998, 2001-2006 and 2008-2013. There was a continuous decline of the $A_{50}$ (age at which 50% of fish are mature) through the years, going from above 5 years old in the late 1980s to just above 3 years old since about year 2000. Since 2005 to 2010 there was a slight increase in the $A_{50}$, mostly in 2011, reaching in that year a value of more than 4 years old. Since then the $A_{50}$ has decreased to 3.4 years old in 2013.

**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 1988-2013, except for 2002-2005, for which only total catch is available. As STACFIS was unable to estimate the catch in 2011 and 2012 appropriately, a lognormal prior over these catches was set in the model with a median of 12 800 t and a 95% confidence interval of (9 905 t, 16 630 t). The value of the median is based on the 2010 STACFIS estimate raised by the ratio of 2011 over 2010 effort. In 2012, as the TAC is almost the same as the 2011 one and from the VMS data there is no evidence that the effort has changed, the same prior was used.

Scientific Council noted that some flag states significant in the Div. 3M cod fishery did not submit their 2013 STATLANT 21A data before the start of the meeting, so STATLANT 21A could not be compared to other catch estimates for 2013. SC analyzed the CPUEs resulting from Daily Catch Reports (DCR) of Div. 3M cod for the period 2011-2013. These CPUEs were compared with the available scientific data. The results of this comparison show significant differences in 2011 and 2012 and a decrease of such differences in 2013. Based on these results, Scientific Council decided to use total catches from the DCR in 2013 (13 985 t), maintaining the model catch estimation for 2011 and 2012.

*Tuning*: numbers at age from the Canadian survey (1978-1985) and from EU Flemish Cap survey (1988-2013).

*Ages*: from 1 to 8+ in both cases.

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

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

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

*Additional priors*: for survivors at age at the end of the final assessment year, for survivors from the last true age in every year, for fishing mortalities at age and total catch weight for years without catch numbers at age, for numbers at age of the survey and for the natural mortality. Prior distributions were set as last year assessment.

The priors are defined as follows:

| Input data | Prior Model | Prior Parameters |
|---|---|---|
| Total Catch 2011-2012 | $LN\left(median, sd\right)$ | Median=9.46, sd=0.1313 |
| Survivors(2013,a), a=1-7<br>Survivors(y,7), y=1988-2012 | $LN\left(median = medrec \times e^{-medM - \sum_{age=1}^{a} medFsurv(age)}, cv = cvsurv\right)$ | medrec=15000<br>medFsurv(1,…,7)={0.0001, 0.1, 0.5, 0.7, 0.7, 0.7, 0.7}<br>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)<br>cvsurv=0.7 |
| Total Catch 2002-2005 | $LN\left(median = CW_{mod}(y),\ cv = cvCW\right)$ | $CW_{mod}$ is arised from the Baranov equation<br>cvCW=0.05 |
| Survey Indices: Canada and EU (I) | $I(y) \sim LN\left(median = \mu(y,a),\ cv = \sqrt{e^{\frac{1}{\psi(a)}} - 1}\right)$<br>$\mu(y,a) = q(a)\left(N(y,a)\dfrac{e^{-\alpha Z(y,a)} - e^{-\beta Z(y,a)}}{(\beta - \alpha)Z(y,a)}\right)^{\gamma(a)}$<br>$\gamma(a)\begin{cases} \sim N(\text{mean} = 1, \text{variance} = 0.25),\ if\ a = 1,2 \\ = 1,\ if\ a \geq 3 \end{cases}$<br>$\log(q(a)) \sim N(\text{mean} = 0, \text{variance} = 5)$<br>$\psi(a) \sim gamma(shape = 2, rate = 0.07)$ | I is the survey abundance index<br>q is the survey catchability at age<br>N is the commercial abundance index<br>α = 0.5, β = 0.58 for EU survey (survey made in July), and α = 0.08, β = 0.17 for Canadian survey (made in January-February)<br>Z is the total mortality |
| M | $M \sim LN(\text{median}, cv)$ | Median=0.218, cv=0.3 |

## d) Assessment Results

The 2011 and 2012 catch posterior medians, estimated by the model, are 13 650 t and 13 570 t, respectively, virtually equal to the values estimated in last year's assessment.

Note that estimates of SSB are available for 2014, whereas total biomass estimates are available to 2013 only. This difference arises because there are no age 1 recruitment estimates for 2014, which are an important component of the total, but not spawning biomass.

*Total Biomass and Abundance*: Estimated total biomass and abundance show an increasing trend since the mid-2000s. Both values are this year around the level of the early 1990s (Fig. 6.4).

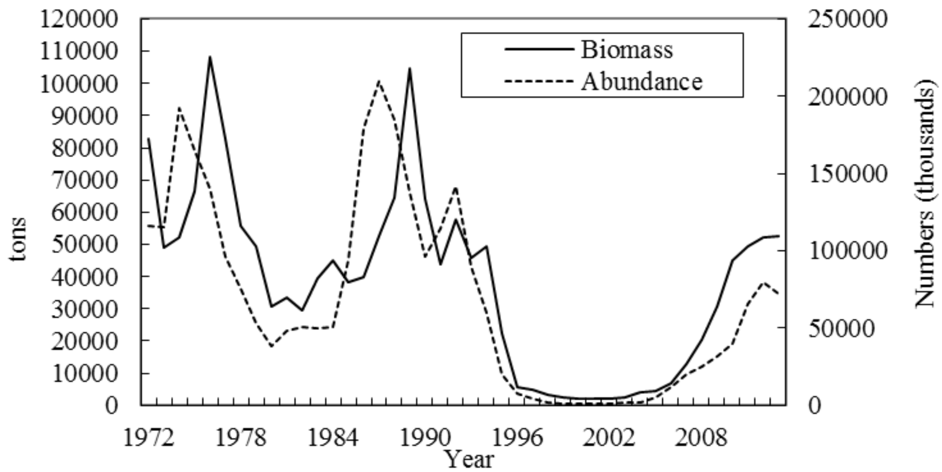



Fig. 6.4. Cod in Div. 3M: Biomass and abundance estimates for years 1988 to 2013.

*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). This increase is due to several abundant year classes and their early maturity.

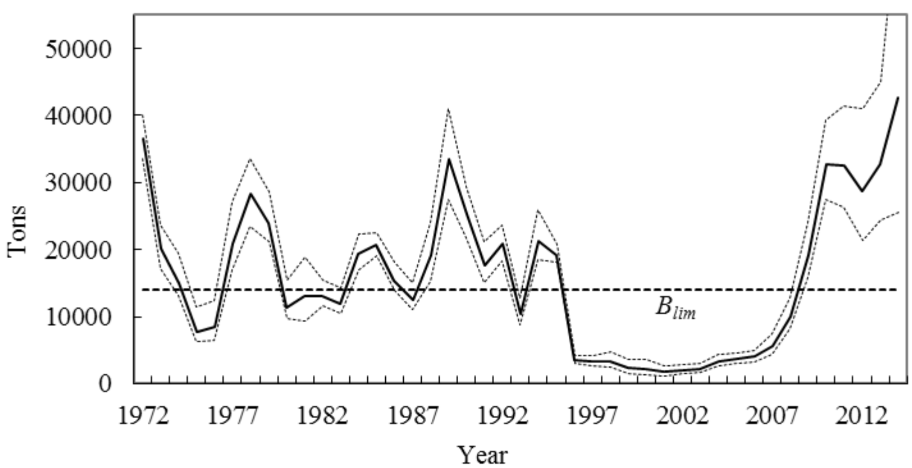



Fig. 6.5. Cod in Div. 3M: Median and 90% probability intervals SSB estimates for years 1988 to 2014. The horizontal dashed line is the $B_{lim}$ level of 14 000 t.

*Recruitment*: After a series of recruitment failures between 1996 and 2004, values of recruitment at age 1 in 2005-2013 were higher, especially the 2011 and 2012 values (Fig. 6.6). There is a high uncertainty associated with those last values.

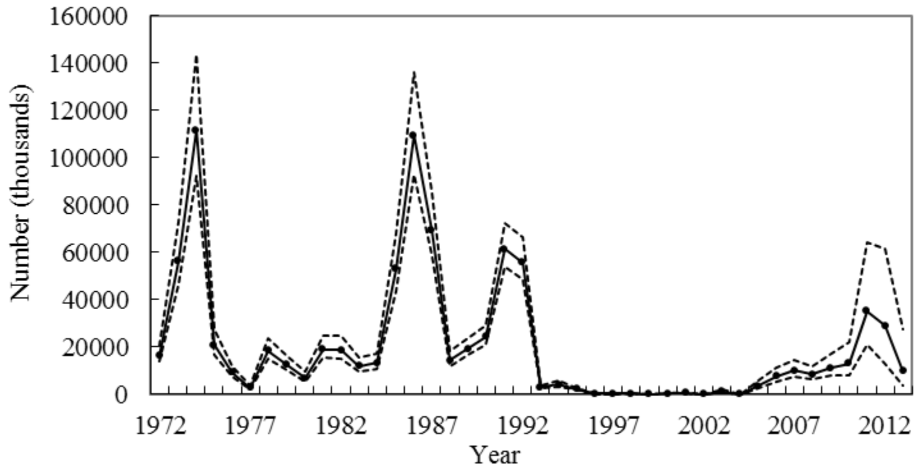



Fig. 6.6. Cod in Div. 3M: Recruitment (age 1) estimates and 90% probability intervals for years 1988 to 2013.

*Fishing mortality*: $F$ increased in 2010-2013 with the opening of the fishery (Fig. 6.7). $F_{bar}$ in 2013 (0.346) is more than twice $F_{max}$ (0.145).

Consistent with the changing age distribution in the catches of 2010-2013, the exploitation patterns in the four years are different between them. In 2010, fishing mortality was relatively constant across ages 3-8+, but during 2011 the estimated fishing mortality on ages 6-7 was almost double that on ages 3-5. In 2012 the largest values are ages 5-7. In 2013 it was at age 6. This sudden change contributes to significant revisions in estimated yield-per-recruit reference points (Section g).

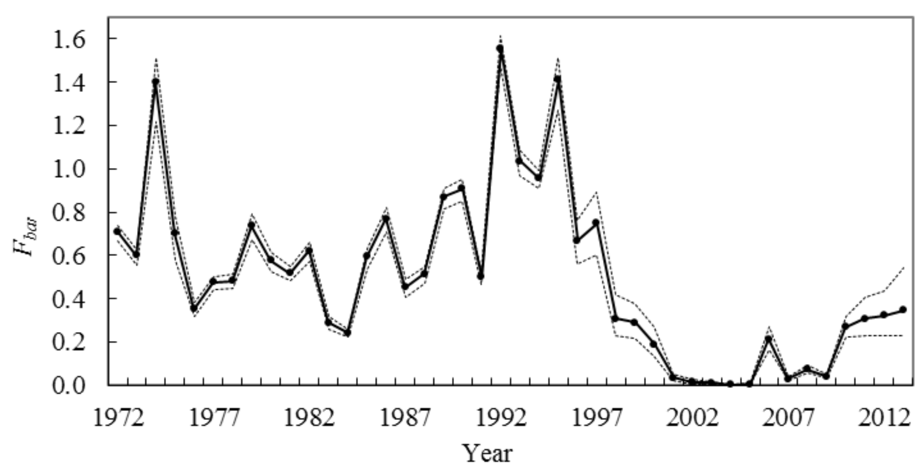



Fig. 6.7. Cod in Div. 3M: $F_{bar}$ (ages 3-5) estimates and 90% probability intervals for years 1988 to 2013.

*Natural mortality*: The posterior median of $M$ estimated by the model was 0.156.

**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 shows revisions in the recruitment, but no evident patterns can be seen (Fig. 6.8). SSB and $F$ show stability over the years (Fig. 6.9 and 6.10).

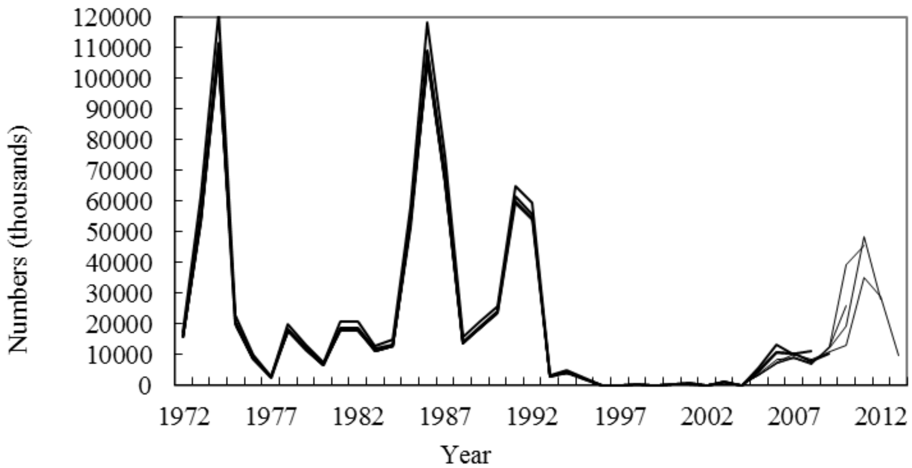



Fig. 6.8. Cod in Div. 3M: Retrospective results for recruitment.

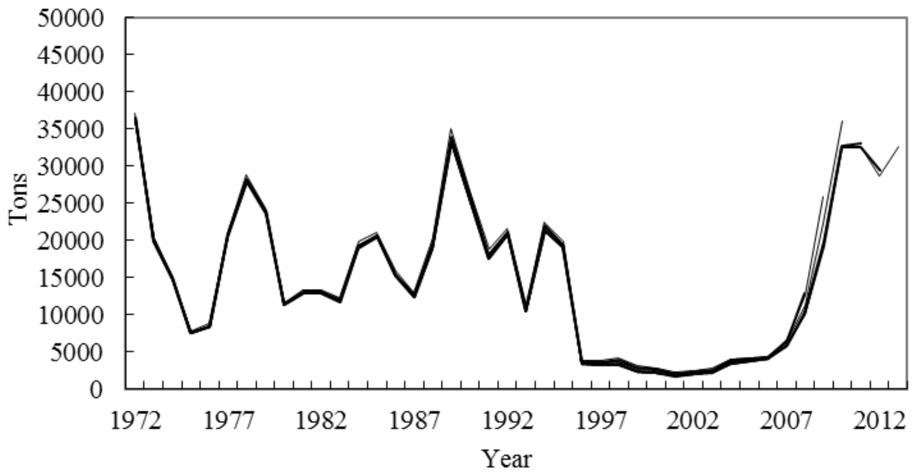



Fig. 6.9. Cod in Div. 3M: Retrospective results for SSB.

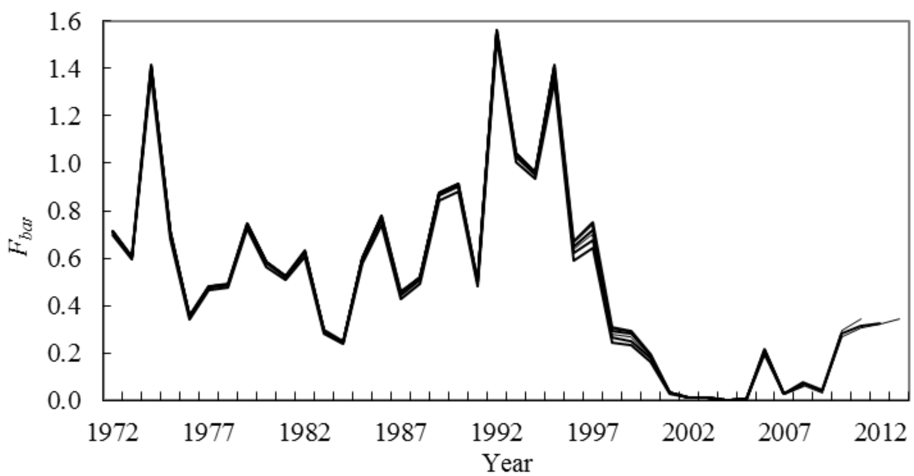



Fig. 6.10.Cod in Div. 3M: Retrospective results for $F_{bar}$.

**f) State of the stock**

*F* increased in 2010-2013 with the opening of the fishery. $F_{bar}$ in 2013 (0.346) is more than the twice $F_{max}$ (0.145).

Current SSB is estimated to be well above $B_{lim}$. Recruitment is relatively high, although 2011-2013 estimates are imprecise.

**g) Reference Points**

STACFIS has previously estimated $B_{lim}$ to be 14 000 t for this stock. SSB is well above $B_{lim}$ in 2013. Fig. 6.11 shows a stock-$F_{bar}$ plot.

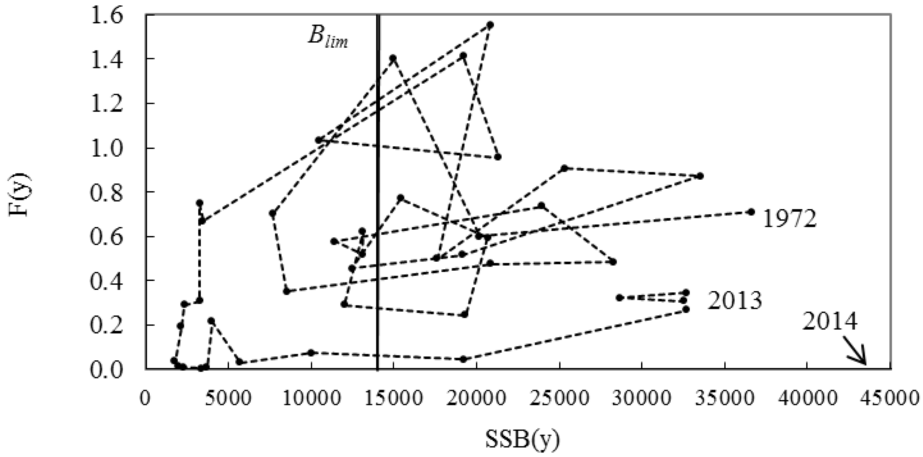



Fig. 6.11. Cod in Div. 3M: Stock-$F_{bar}$(3-5) (posterior medians) plot. $B_{lim}$ is plotted in the graph. The SSB in 2014 is indicated in the x-axis.

Figure 6.12 shows the Bayesian yield per recruit with respect to $F_{bar}$, in which we can see the estimated values for $F_{0.1}$, $F_{max}$ and $F_{2013}$. $F_{0.1}$ and $F_{max}$ are slightly lower as the estimated last year.

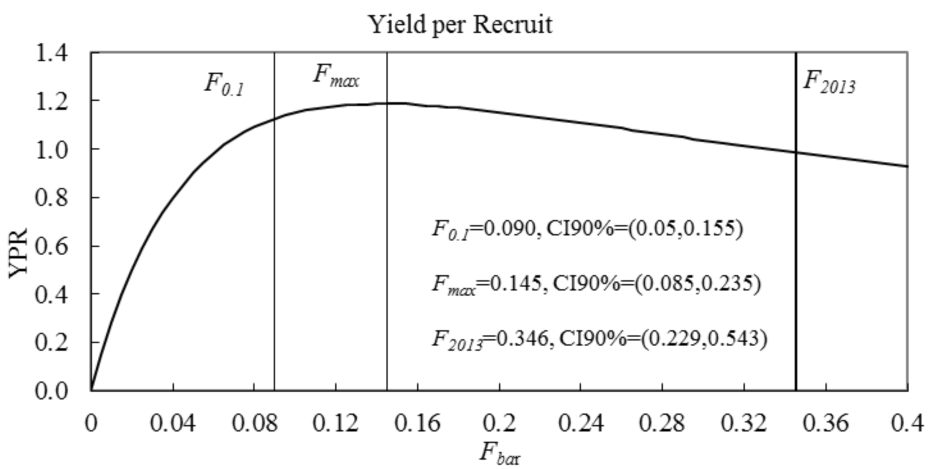



Fig. 6.12. Cod in Div. 3M: Bayesian Yield per recruit

**h) Stock projections**

Stochastic projections of the stock dynamics over a 2 year period (2014 to 2016) 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 2013*: estimated from the last assessment.

*Recruitments for 2014-2016*: Recruits per spawner were drawn randomly from the last nine years of the assessment (2005-2013), as these are the years in which recruitment has started to recover.

*Maturity ogive for 2014-2016*: 2013 maturity ogive.

*Natural mortality for 2014-2016*: 2013 natural mortality from the assessment results.

*Weight-at-age in stock and weight-at-age in catch for 2014-2016*: 2013 weights.

*PR at age for 2014-2016*: 2013 PRs.

$F_{bar}$*(ages 3-5)*: Eight scenarios were considered. All scenarios assumed that the Yield for 2014 is the established TAC (14 521 t):

*(Scenario 1)* $F_{bar}=F_{0.1}$ (median value = 0.090).

*(Scenario 2)* $F_{bar}=F_{max}$ (median value = 0.145).

*(Scenario 3)* $F_{bar}=2/3F_{max}$. (median value = 0.097).

*(Scenario 4)* $F_{bar}=3/4F_{max}$ (median value = 0.109).

*(Scenario 5)* $F_{bar}=0.85F_{max}$ (median value = 0.123).

*(Scenario 6)* $F_{bar}=0.75F_{2013}$ (median value = 0.259).

*(Scenario 7)* $F_{bar}=F_{2013}$ (median value = 0.346).

*(Scenario 8)* $F_{bar}=1.25F_{2013}$ (median value = 0.432).

Figures 6.14 to 6.16 summarize the projection results under the eight Scenarios in just one figure. These results indicate that under all scenarios total biomass and SSB during the next 2 years have high probability of reaching levels equal or higher than all of the 1972-2013 estimates (Fig. 6.14 and 6.15). The removals associated with the $F_{bar}$ based in $F_{2013}$ reach the level seen in 1979, before the collapse of the stock (Fig. 6.16).

Rapid changes in the biological parameters of this stock in recent years and the sudden decrease in the 2013 EU-survey index has led to substantial revision in estimate numbers for 2014 in the current assessment, compared to projected numbers for 2014 in the previous assessment.

The Scientific Council expresses it concerns with regards that next year the same pattern could happen and that this year projections would be unrealistic. The update from one year to the next of the numbers at age is very important in some cases. Figure 6.13 shows these differences for the abundance at age (2-8) estimating for the year 2014, comparing the abundances estimated by the model in last assessment and the abundances estimated in this assessment. It can be seen a large update in ages 2 and 4, with less individuals in the current assessment.

The 2014 yield projection was derived from an $F_{bar}$ of 0.14 in the 2013 assessment. Given the revision to estimated numbers and significant changes in biological parameters since the last assessment, the same level of catch in 2014 can now only be generated with an $F_{bar}$ of 0.28 in the current assessment.

Due to all of these changes, STACFIS considered that projection of management options can be provided for one year only.

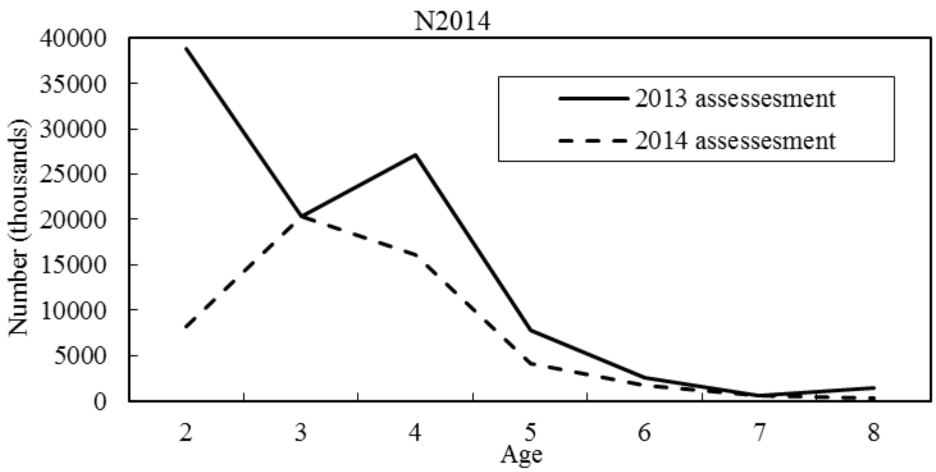



Fig. 6.13. Cod in Div. 3M: Numbers at ages 2 to 8 in 2014 from the assessment of 2013 and 2014.

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

Results of the projections are summarized in the following table:

| | B | | | SSB | | | Yield | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5% | 50% | 95% | 5% | 50% | 95% | 5% | 50% | 95% |
| $F_{bar}=F_{0.1}$ (median=0.090) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51148 | 85726 | 141169 | 33526 | 58334 | 96126 | 3717 | 7091 | 13216 |
| 2016 | 80488 | 140565 | 242288 | 50201 | 84280 | 140612 | | | |
| $F_{bar}=F_{max}$ (median=0.145) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51007 | 85528 | 141921 | 33538 | 58341 | 96142 | 5804 | 10838 | 19894 |
| 2016 | 75911 | 134970 | 233068 | 47116 | 79646 | 133162 | | | |
| $F_{bar}=2/3F_{max}$ (median=0.097) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51600 | 85659 | 140511 | 33564 | 58355 | 96133 | 3984 | 7463 | 13901 |
| 2016 | 79919 | 139414 | 241557 | 49720 | 83828 | 140158 | | | |
| $F_{bar}=3/4F_{max}$ (median=0.109) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51451 | 85707 | 141013 | 33554 | 58302 | 96130 | 4449 | 8327 | 15461 |
| 2016 | 79064 | 138195 | 238799 | 49331 | 82737 | 138519 | | | |
| $F_{bar}=0.85F_{max}$ (median=0.123) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 50976 | 85605 | 140451 | 33567 | 58341 | 96114 | 4999 | 9351 | 17275 |
| 2016 | 77772 | 136555 | 239130 | 48233 | 81562 | 136327 | | | |
| $F_{bar}=0.75F_{2013}$ (median=0.259) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 50963 | 85988 | 141194 | 33526 | 58346 | 96068 | 12494 | 17926 | 27715 |
| 2016 | 68617 | 125904 | 226920 | 39178 | 70884 | 121773 | | | |
| $F_{bar}=F_{2013}$ (median=0.346) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51451 | 85545 | 140120 | 33538 | 58375 | 96144 | 15768 | 22605 | 34554 |
| 2016 | 64236 | 119001 | 216119 | 35038 | 65093 | 113266 | | | |
| $F_{bar}=1.25F_{2013}$ (median=0.432) | | | | | | | | | |
| 2014 | 45089 | 66953 | 100551 | 29651 | 44869 | 67628 | | 14521 | |
| 2015 | 51073 | 85533 | 139749 | 33525 | 58327 | 96233 | 18611 | 26799 | 40670 |
| 2016 | 59161 | 113669 | 207151 | 31681 | 60010 | 106017 | | | |

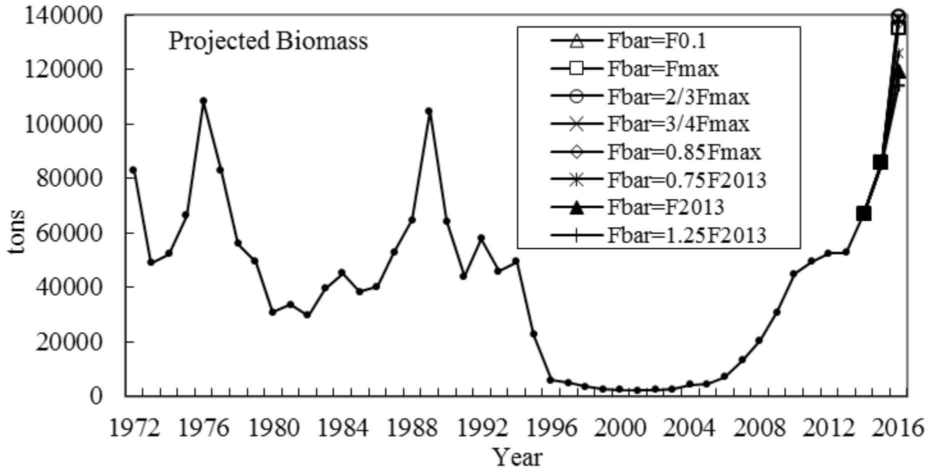



Fig. 6.14. Cod in Div. 3M: Projected Total Biomass under all the Scenarios.

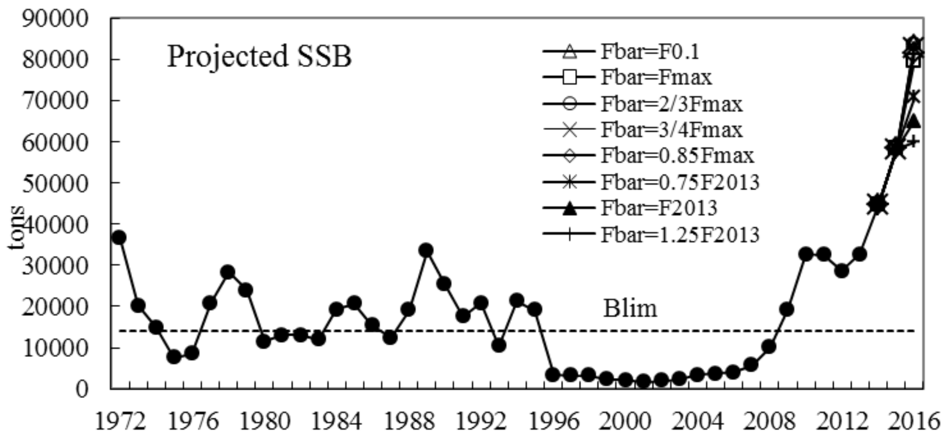



Fig. 6.15. Cod in Div. 3M: Projected SSB under all the Scenarios

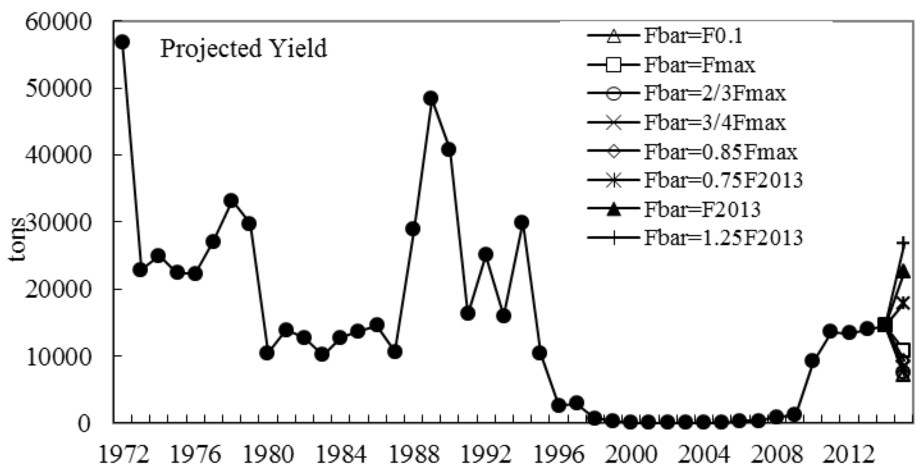



Fig. 6.16. Cod in Div. 3M: Projected removals under all the Scenarios

The risk of each scenarios is presented in the following table, with the limit reference points for each case:

| | Yield | | | $p(B<B_{lim})$ | | | $p(F>F_{0.1})$ | | | $p(F>F_{max})$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | $p(B_{2016} > B_{2014})$ |
| $F_{0.1}$ | 14521 | 7091 | | <5% | <5% | <5% | | | | | | | >95% |
| $F_{max}$ | 14521 | 10838 | | <5% | <5% | <5% | | | | | | | >95% |
| $2/3F_{max}$ | 14521 | 7463 | | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $3/4F_{max}$ | 14521 | 8327 | | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $0.85F_{max}$ | 14521 | 9351 | | <5% | <5% | <5% | >95% | >95% | | | | | >95% |
| $0.75F_{2013}$ | 14521 | 17926 | | <5% | <5% | <5% | >95% | >95% | | >95% | >95% | | >95% |
| $F_{2013}$ | 14521 | 22605 | | <5% | <5% | <5% | >95% | >95% | | >95% | >95% | | >95% |
| $1.25F_{2013}$ | 14521 | 26799 | | <5% | <5% | <5% | >95% | >95% | | >95% | >95% | | >95% |

### i) Research recommendations

STACFIS **recommended** that *an age reader comparison exercise be conducted*.

STATUS: No progress. This recommendation is reiterated.

STACFIS **recommends** that *the most recent catch at age figures will revised*.

The next full assessment for this stock will be in 2015.

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

Interim Monitoring Report (SCR Doc. 14/017; SCS Doc. 14/06, 14/010, 14/013)

### 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 by-catch of the Greenland halibut fishery. An increase of the fishing effort directed to Div. 3M redfish is observed 2005 onwards basically pursued by Portuguese bottom trawl and Russia bottom and pelagic trawl. Part of this fishing effort has been deployed on shallower depths above 300m and is associated with the increase of cod catches and reopening of the Flemish Cap cod fishery in 2010.

The increase of golden redfish catch resulted in a revision of catch estimates for recent years, in order to split redfish catch from the major fleets on Div. 3M into golden and beaked redfish catches. No STACFIS catch estimates were available since 2011. Over the previous five years (2006-2010) an average annual bias of 14% plus was recorded between overall STACFIS catch estimate and overall STATLANT nominal catch. In order to mitigate the lack of scientific catch information a 14% surplus was added to the STATLANT catch of each fleet since 2011. This inflated STALANT catches are included as the STACFIS catch estimates.

On 2012-2013 redfish catch was at an average level of 7 650 t while beaked redfish stayed at 5 800 t.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 5 | 5 | 5 | 5 | 8.5 | 10.0 | 10.0 | 6.5 | 6.5 | 6.5 |
| STATLANT 21 | 6.4 | 6.3 | 5.6 | 7.9 | 8.7 | 8.5 | 9.7 | 6.7 | 6.8 | |
| STACFIS Total catch[1] | 6.6 | 7.2 | 6.7 | 8.5 | 11.3 | 8.5 | 11.1 | 7.6 | 7.7 | |
| STACFIS beaked redfish catch[2] | 4.1 | 6.0 | 5.1 | 4.3 | 3.7 | 5.4 | 9.0 | 5.9 | 5.7[2] | |

[1] STACFIS catch estimates for the three redfish species.
[2] STACFIS beaked redfish catch estimate for 2013 based on beaked redfish average 2010-2012 proportion on observed catch.

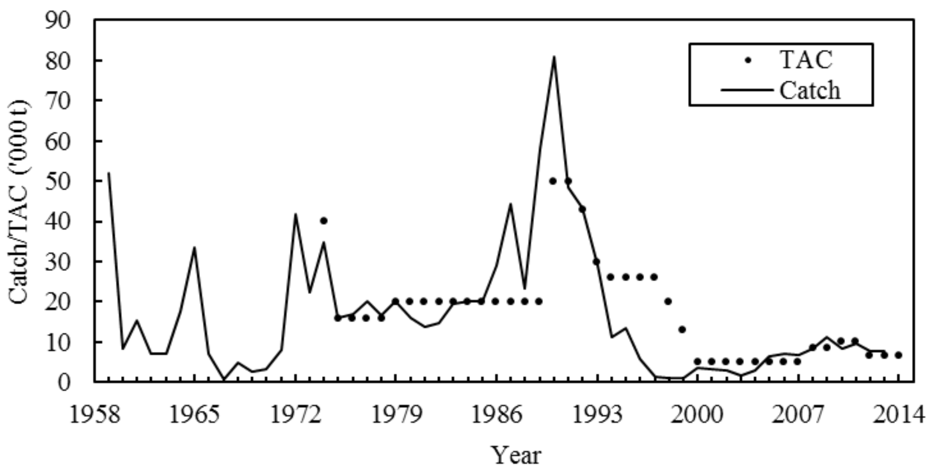



Fig. 7.1. Redfish in Div. 3M: catches and TACs.

## b) Data Overview

### *i) Research surveys*

Flemish Cap Survey: Despite a sequence of abundant year classes and a low exploitation regime over almost twenty years, survey results suggest that the beaked redfish stock increased sharply from 2004 to 2006 and then declined rapidly over the second half of the 2000s. Such unexpected shift on the stock dynamics can only be attributed to mortality other than fishing mortality. From the last surveys results the decline appeared to have been halted. But the stock has remained near its historical average level, due to a combination of poor recruitment and natural mortalities higher than level usually accepted for this stock.

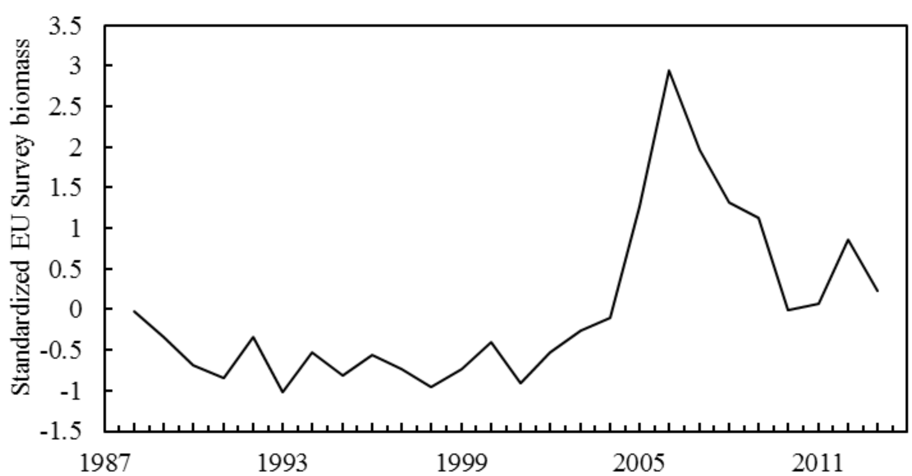



Fig. 7.2. Beaked redfish in Div. 3M: survey standardized total biomass index (1988-2013).

**c) Conclusions**

The perception of the stock status has not changed.

The next full assessment of the stock is planned for 2015.

**d) Research recommendations**

STACFIS **recommended** that, *in order to confirm the most likely redfish depletion by cod on Flemish Cap, and be able to have an assessment independent approach to the magnitude of such impact and to the size structure of the redfish most affected by cod predation, the existing feeding data from the past EU surveys be analyzed and made available.*

STATUS: Research work in progress.

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.*

STATUS: This recommendation has not yet been addressed.

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

(SCR Doc. 05/29; 11/41; 14/17, 36; SCS Doc. 11/4, 5; 12/5, 8; 13/5; 14/6, 10, 13)

**a) Introduction**

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

Nominal catches increased during the mid-1960s, reaching a peak of about 5 341 t in 1965, followed by a sharp decline to values less than 1 100 t until 1973. Since 1974, when catches of this stock became regulated, catches ranged from 600 t (1981) to 5 600 t (1987). After that catches declined to 275 t in 1993, caused partly by a reduction in directed effort by the Spanish fleet in 1992. STATLANT catch for 2010-2013 were 65 t, 63 t, 122 t and 246 t respectively.

From 1979 to 1993 a TAC of 2 000 t was in effect for this stock. A reduction to 1 000 t was agreed for 1994 and 1995 and a moratorium was agreed to thereafter (Fig. 8.1).

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 0.2 | |
| STACFIS | 0.05 | 0.05 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | |
| ndf No directed fishing. | | | | | | | | | | |

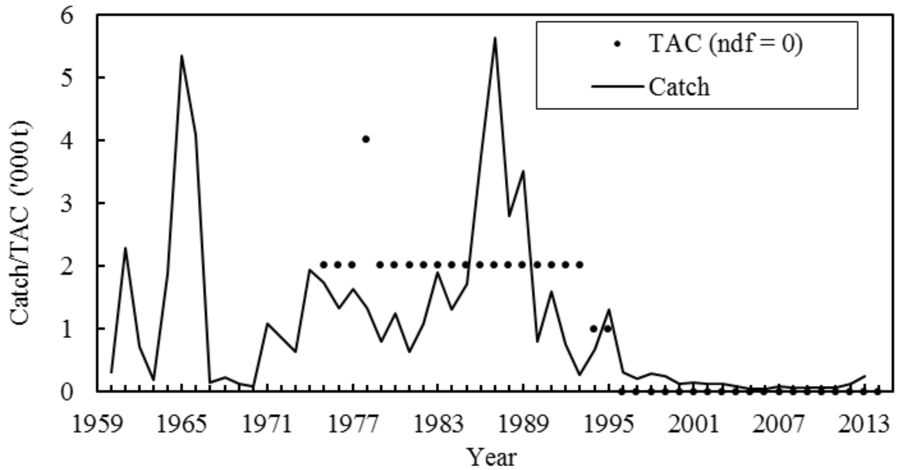



Fig. 8.1. American plaice in Div. 3M: STACFIS catches and TACs. No directed fishing is plotted as 0 TAC.

**b) Input Data**

***i) Commercial fishery data***

EU-Portugal provided length composition data for the 2010, 2011, 2012 and 2013 trawl catches. EU-Lithuania provided length composition data for the 2010 trawl catches. Russia provided length composition data for the 2011 and 2013 trawl catches. EU-Spain provided length composition data for the 2013 trawl catches. The length frequencies were used to estimate the length and age compositions for the 2010-2013 total catch. Ages 3 to 8 were the most abundant ones in the catches from 2010-2013.

***ii) Research survey data***

The series of research surveys conducted by the EU since 1988 was continued in July 2013. In June 2003 a new Spanish research vessel, the RV *Vizconde de Eza* replaced the RV *Cornide de Saavedra* that had carried out the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 survey indices, the original mean catch per tow, biomass and abundance at length distributions for American plaice have been converted to the new vessel units so that each former time series could be comparable with the correspondent new indices obtained since 2003 with the RV *Vizconde de Eza*. The methodology for convert the series was accepted by STACFIS in 2005 (SCR Doc. 05/29). The results of the calibration show that the new RV *Vizconde de Eza* is 33% more efficient than the former RV *Cornide de Saavedra* in catching American plaice.

The USSR/Russian survey series that began in 1972 was concluded in 1993. From 1972 to 1982 the survey series was post-stratified because surveys were conducted using fixed-station design. Since 1983 USSR/Russia adopted the stratified random survey method. A new Russian survey was carried out in 2001 and 2002. Canada conducted research vessel surveys from 1978 to 1985, and a single survey was conducted in 1996.

Although the USSR/Russian survey series shows higher variability, it showed a decreasing trend during the 1986-93 period. Abundance and biomass from the Russian survey in 2001 were the lowest of the series. Canadian survey biomass and abundance between 1978 and 1985 were around 6 700 t and 10 million fish. Both indices from the Canadian survey in 1996 were at the same level of the ones from the EU survey (Fig. 8.2 and 8.3). A continuous decreasing trend in abundance and biomass indices was observed from the beginning of the EU survey series. The 2007 abundance and biomass were the lowest of the series. After 2007, due to recruitment improvement (in particular the 2006 year class), the biomass and abundance indices increased, but in 2012 this increase was halted. In 2013 these indices decreased again and are at a low level.

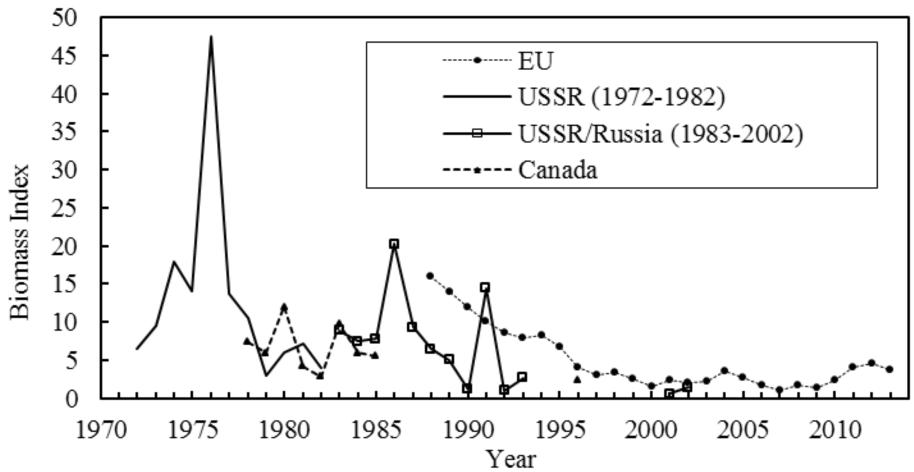



Fig. 8.2. American plaice in Div. 3M: trends in biomass index in the surveys. EU survey data prior to 2003 converted to RV *Vizconde de Eza* equivalents.

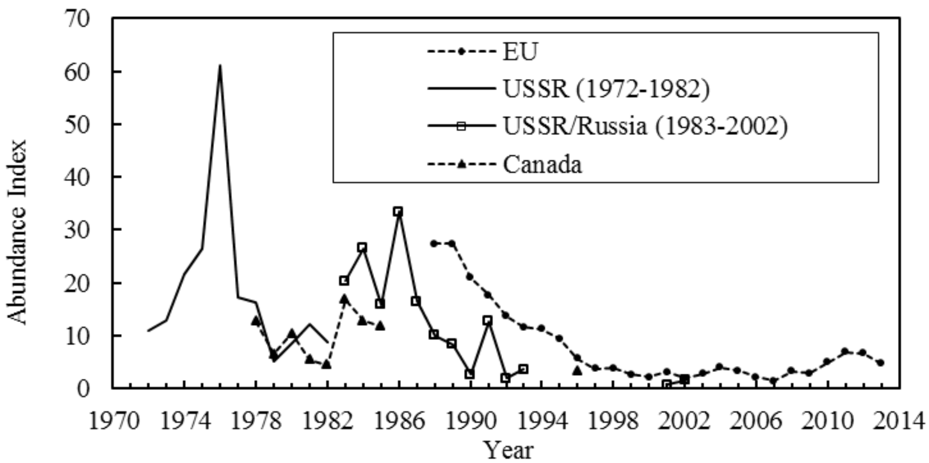



Fig. 8.3. American plaice in Div. 3M: trends in abundance index in the surveys. EU survey data prior to 2003 converted to RV *Vizconde de Eza* equivalents.

Age 7, corresponding to the 2006 year class, was dominant in the 2013 EU survey. Between this year class and the 1990 year class, the recruitment was very poor as shown by EU survey indices.

In the EU surveys an index of spawning stock biomass (50% of age 5 and 100% of age 6 plus) has been declining since 1988. A minimum was recorded in 2007. In 2011 and 2012 the indices increase with the income of the strong 2006 year class in the SSB but in 2013 it decrease as there were fewer older fish (ages 16+).

**c) Estimation of Parameters**

A fishing mortality index (*F*) is given by the catch and EU survey biomass ratio for ages fully recruited to the fishery.

A partial recruitment vector for American plaice in Div. 3M was revised assuming flat topped partial recruitment and adjusting a relative mean index-at-age to a general logistic curve. This index was derived by determining the ratio between the 1988-2013 age composition of the catch and American plaice EU survey abundance. Both data sets were standardized to numbers-per-thousand prior to analysis.

In addition to the XSA using the settings from the last assessment (adding the 2011, 2012 and 2013 values), further analyses were conducted investigating the impact of changing: the first age in the assessment (age 1 or 4); the first year of the tuning fleet (1998 or 1994). The XSA model showed problems to converge and unrealistic results.

A VPA-type Bayesian model, the same used for the Div. 3M cod, was applied. As in XSA some variety of combinations of the input data and in the values of *M* were tested. All model runs performed the following input sets:

*Catch data*: catch numbers and mean weight at age for 1988-2013.

*Catchability analysis*: dependent on stock size for the age 4.

*Priors*: for survivors at age at the end of the final assessment year, for survivors from the last true age at the end of every year, for numbers at age of the survey and for the natural mortality.

The VPA-type Bayesian model showed better diagnostics and results, but they are highly dependent of the chosen priors and its distribution.

None of the analyses (XSA or VPA-type Bayesian model) were accepted as a basis to estimate stock size. Nevertheless, the VPA-type Bayesian model with all data (ages 1-16+, tuning from 1988-2013) and with variability on *M* (0.2 with a c.v. of 0.05) was choose for illustrate the trends in the stock.

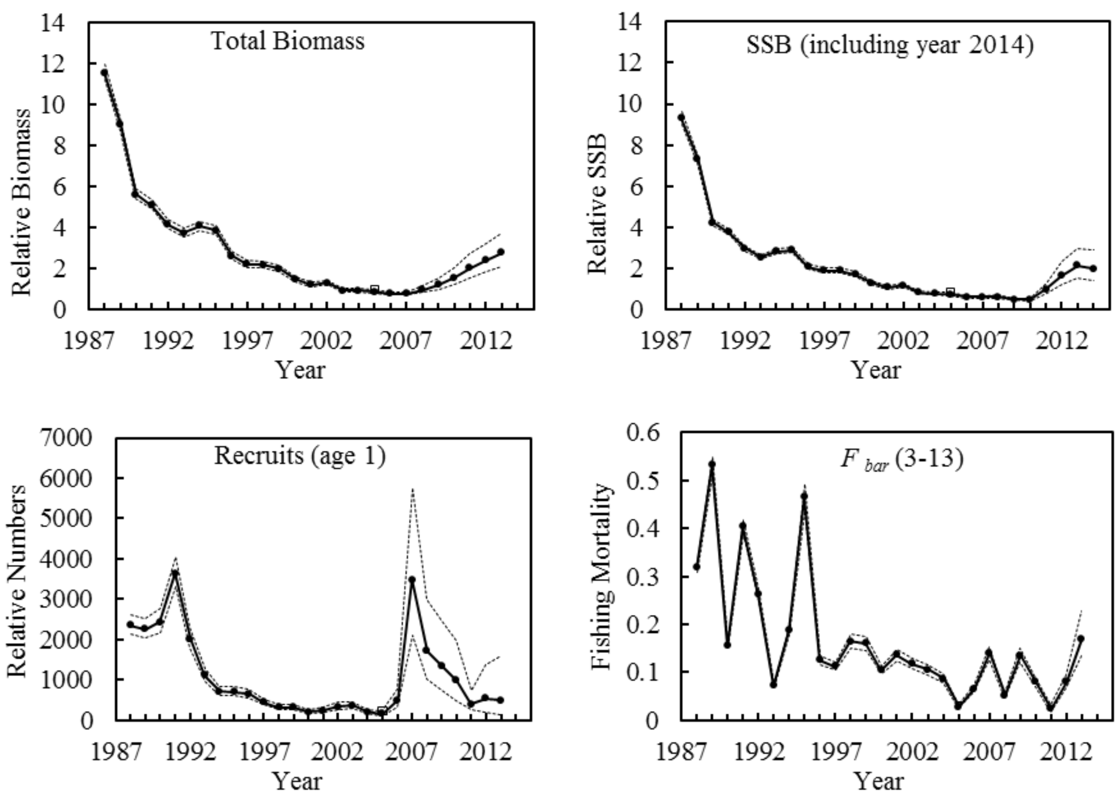



Fig. 8.4. American plaice in Div. 3M: stock trends in the exploratory assessment.

**d) VPA-type Bayesian model and Surveys results**

Both fishing mortality index (C/B) and VPA-type Bayesian model fishing mortality declined from the mid-1980s to the mid-2000s (Fig. 8.5) and since 2000 fluctuated at or below 0.1. *F* has increased in recent years.

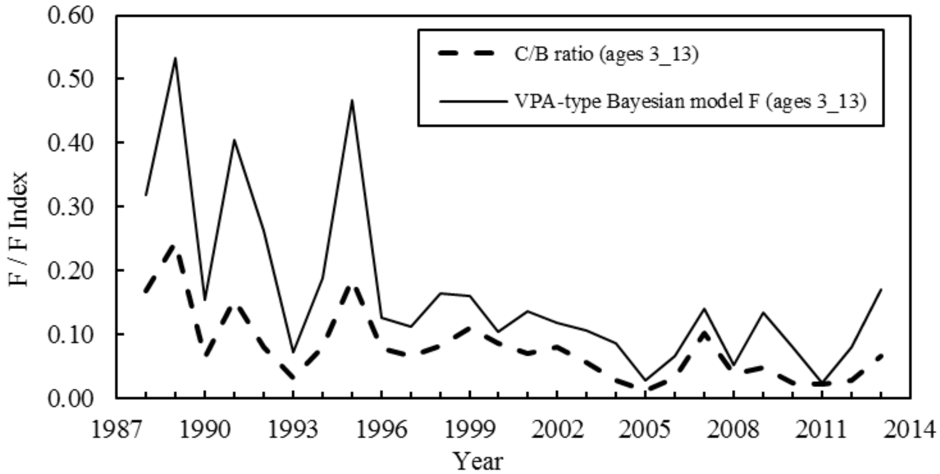



Fig. 8.5. American plaice in Div. 3M: fishing mortality (catch/biomass) index from EU survey (ages 3-13) and VPA-type Bayesian model estimated fishing mortality (ages 3-13).

The EU survey and VPA-type Bayesian model indicates only poor recruitment from 1991 to 2005 year class. SSB recorded a minimum in 2007, in recent years SSB indices increase with the income of the strong 2006 year class in the SSB but in 2013 this increase seems to halt mainly as there were fewer older fish (ages 16+). Stock biomass increased in recent years due to the improved recruitment since 2006 (mainly due to the 2006 year class). SSB and stock biomass are still at low level (Fig. 8.6).

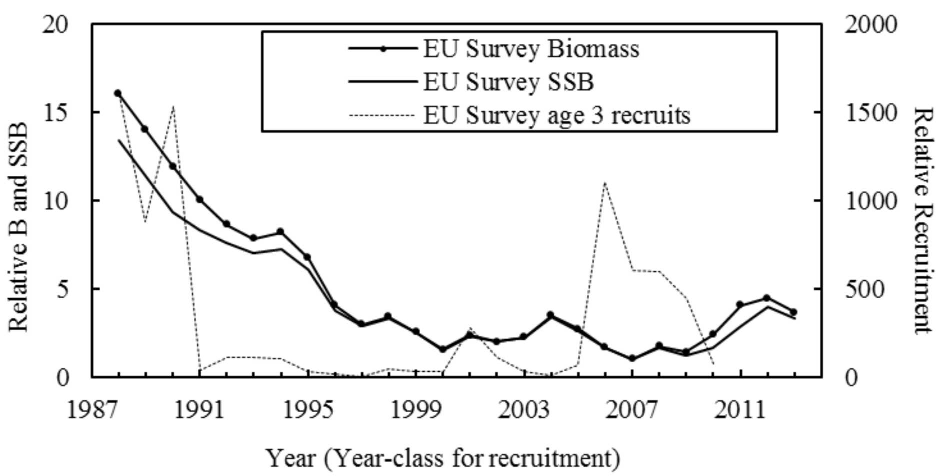



Fig. 8.6. American plaice in Div. 3M: biomass, spawning stock biomass (SSB) and corresponding recruitment (age 3) from the EU Survey.

**e) Assessment Results**

*Biomass:* Stock biomass and SSB recorded a minimum in 2007, due to consistent year-to-year recruitment failure from the 1991 to 2005 year classes. Stock biomass and SSB increased in recent years due to the improved recruitment since 2006 (mainly due to the 2006 year class), but are still at low level.

*Fishing Mortality:* Fishing mortality index (C/B) declined from the mid-1980s to the mid-2000s and since 2000 fluctuated at or below 0.1. *F* has increased slightly in recent years.

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

*State of the Stock:* Although the stock has increased slightly in recent years due to improved recruitment since 2006, it continues to be in a poor condition. Although the level of catches since 1996 is low, all the analysis indicates that this stock remains at a low level.

**f) Reference Points**

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

The fishing mortality proxy (Catch/Biomass index) remains low. Despite this, spawning stock biomass remains at a poor level (Fig. 8.7).

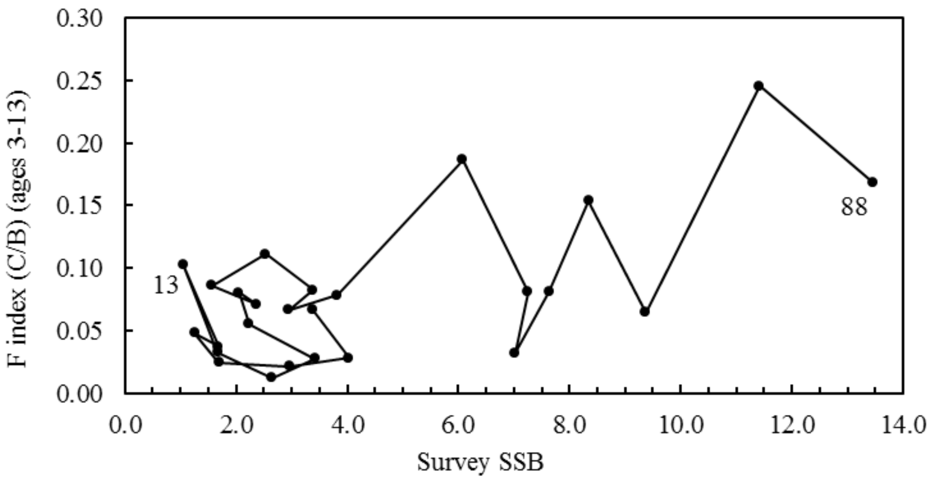



Fig. 8.7. American plaice in Div. 3M: stock trajectory within the NAFO PA framework.

The following set of parameters was used for the yield-per-recruit analysis: M = 0.2; exploitation pattern described above; maturity of 50% at age 5 and 100% at age 6 plus; and an average mean weights-at-age in the catch and in the stock for the period 1988-2013. This analysis gave a $F_{0.1}$ = 0.163 and a $F_{max}$ = 0.347.

**g) Research Recommendations**

STACFIS **recommends** that *several input frameworks be explored in both models (such as: q's; M (e.g. in relation to $F_{0.1}$); ages dependent of the stock size; the proxies and its distribution in the VPA-type Bayesian model).*

Due to the recent improved recruitment at low SSB, STACFIS **recommends** *to explore the Stock/Recruitment relationship and $B_{lim}$.*

This stock will be fully assessed in 2017.

## C. STOCKS ON THE GRAND BANK: SA 3 AND DIV. 3LNO

(SCR Doc. 14/10, 14/14, SCS Doc. 14/14)

Recent Conditions in Ocean Climate and Lower Trophic Levels

- Ocean climate composite index on SA3 - Grand Bank continues to remain well above normal in 2013 and recent years.
- The composite spring bloom index declined in 2012-2013 after several years of relatively high positive anomalies.
- The composite zooplankton index has remained above normal since 2009 and reached a peak in 2013.
- The composite trophic index has remained near normal in recent years and increased to its highest level in the time series in 2013.

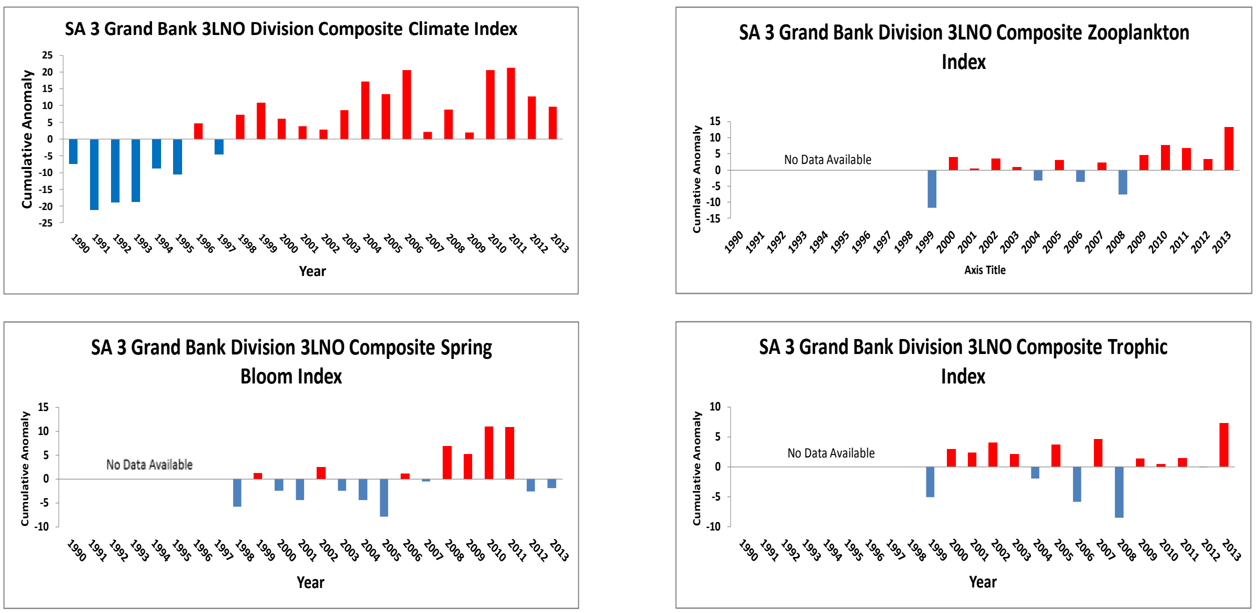



Fig. 3. Composite ocean climate index for NAFO Subarea 3 (SA3 Div. 3LNO) derived by summing the standardized anomalies (top left panel) during 1990-2013, composite spring bloom (summed background chlorophyll *a*, magnitude and amplitude indices) index (Div. 3LNO) during 1998-2013 (bottom left panel), composite zooplankton (cumulative anomalies of the four functional plankton taxa) index during 1999-2013 (top right panel), and composite trophic (summed anomalies of nutrient and standing stocks of phyto- and zooplankton indices) index (bottom right panel) during 1999-2013. Note the 2012 value for the composite trophic index is near zero and is not readily visible on the plot. Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

### Environmental Overview

The water mass characteristic of the Grand Bank are typical Cold-Intermediate-Layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0°C during spring and through to autumn. The winter-formed CIL water mass is a reliable index of ocean climate conditions in this area. Bottom temperatures increase to 1-4°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 Bank 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.

**Ocean Climate and Ecosystem Indicators**

The composite climate index in Subarea 3 (Div. 3LNO) continues to remain above normal in 2013 but has declined in a pattern similar to Div. 3M in recent years (Fig. 3). Standing stocks of phytoplankton based on the composite spring bloom index has remained below average in 2013 consistent with levels observed in 2012 (Fig. 3). Standing stocks of zooplankton based on the composite zooplankton index peaked in 2013 and has remained well above normal in the past several years (Fig. 3). The composite trophic index also peaked in 2013 after several years of near-normal levels (Fig. 3).

The annual surface temperatures at Station 27 in Div. 3L continue to remain above normal (~1°C) in 2013. Bottom temperatures at Station 27 remained stable at levels observed in 2012. Vertically averaged temperatures were relatively stable at +1.1 SD from 2012. Surface salinities at Station 27 were near the long temp mean in 2013 while bottom salinities decreased below normal. The vertical thickness of the layer of cold <0°C water (commonly referred as the cold-intermediate-layer or CIL on the shelf) increased to the mean of the time series in 2013. Spring bottom temperatures in NAFO Div. 3LNO during 2013 were above normal and slightly less warm than the conditions of 2012. During the autumn, bottom temperatures in Div. 3LNO decreased and were near the long term mean of the time-series.

## 9. Cod (*Gadus morhua*) in NAFO Div. 3NO

Interim Monitoring Report (SCR Doc. 14/05, SCS Doc. 14/06, 10, 11, 14)

### a) Introduction

This stock has been under moratorium to directed fishing since February 1994. By-catch occurs primarily in the yellowtail flounder, skate and redfish fisheries. By-catch during the moratorium increased from 170 t in 1995, peaked at about 4 800 t in 2003 and has been between 600 t and 1100 t since then. The catch in 2013 was 1052 t.

Recent nominal catches and TACs ('000 tons) are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21 | 0.6 | 0.3 | 0.7 | 0.7 | 0.6 | 0.8 | 0.8 | 0.7 | 1.1 | |
| STACFIS | 0.7 | 0.6 | 0.8 | 0.9 | 1.1 | 0.9 | 0.8 | 0.7 | 1.1 | |
| ndf: No directed fishery and by-catches of cod in fisheries targeting other species should be kept at the lowest possible level. | | | | | | | | | | |

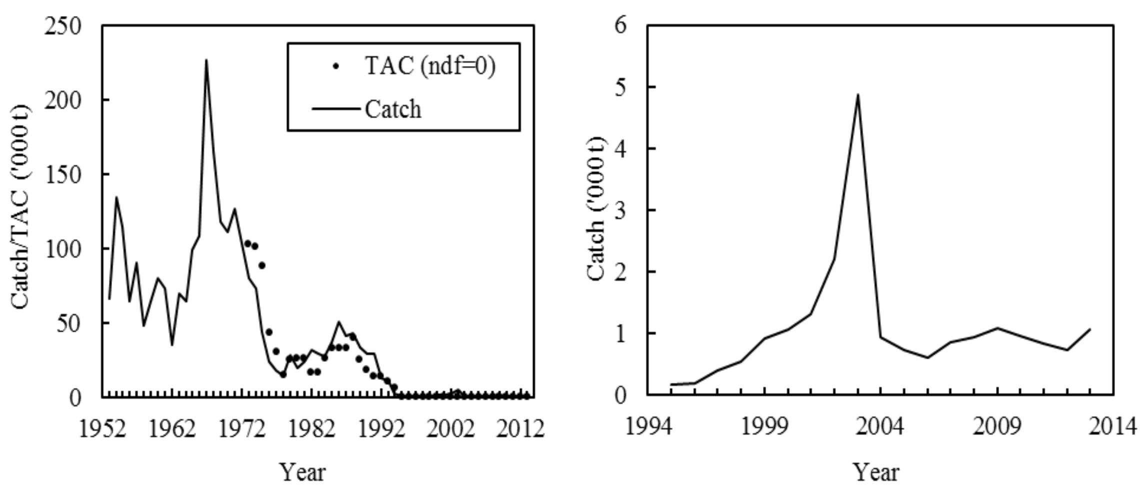



Fig. 9.1. Cod in Div. 3NO: total catches and TACs. Panel at right highlights catches during the moratorium on directed fishing.

**b) Data Overview**

**Canadian bottom trawl surveys**. The spring survey biomass index declined from 1984 to the lowest level in 1995 (Fig. 9.2). Except for a brief increase from 1998 to 2000, the spring index remained low to 2008. There was a substantial increase in 2009, the highest index since 1993, resulting from improved recruitment from the 2005-2007 year classes. The index declined for 2010 and 2011 before increasing again in 2012 and 2013. The trend in the autumn survey biomass index was similar to the spring series (Fig. 9.2).

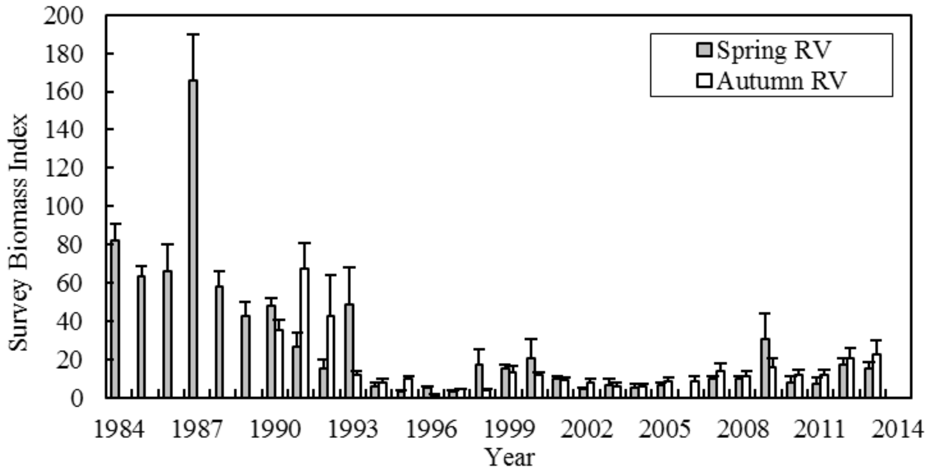



Fig. 9.2. Cod in Div. 3NO: survey biomass index (± 1 s.d.) from Canadian spring and autumn research surveys.

**EU-Spain bottom trawl survey**. The biomass index from the EU-Spain stratified-random survey in the NRA portion of Div. 3NO was relatively low and stable from 1997-2008 (Fig. 9.3). There was a considerable increase in the index from 2009 to the highest estimate in the series in 2011. However, the index has declined substantially in each of the last two years. Indices from this survey may not be suitable as indicators of overall stock trend since the survey covers only a small portion of the stock area and trends can be confounded by fish movement in and out of the area.

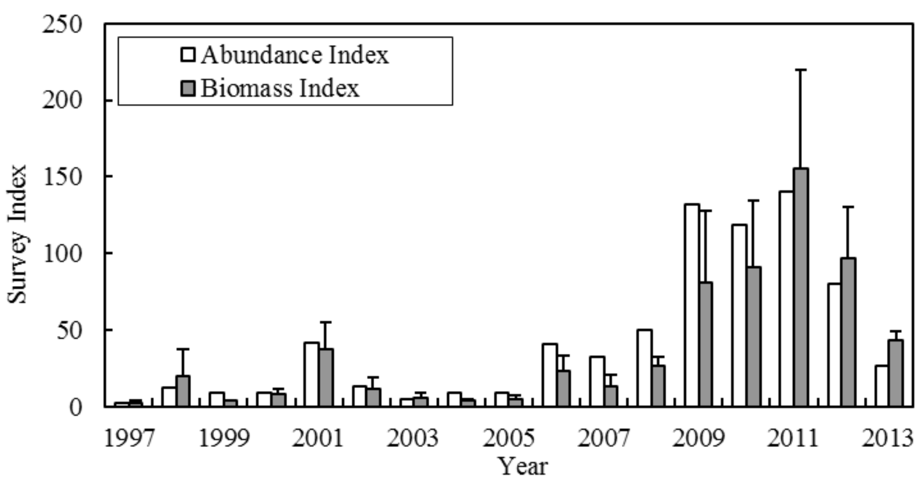



Fig. 9.3. Cod in Div. 3NO: survey biomass index (± 1 s.d.) from EU-Spain surveys conducted in the NRA portion of Div. 3NO.

**c) Conclusion**

The most recent analytical assessment (2013) concluded that SSB was well below $B_{lim}$ (60 000 t) in 2012. Canadian survey indices for 2013 suggest little change in the overall stock biomass since that time, and the EU-Spain survey indices have declined for the portion of the stock outside the Canadian EEZ. Overall, the 2013 indices are not considered to indicate a significant change in the status of the stock.

The next full assessment of this stock will occur in 2016.

## 10. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N

(SCR Doc. 14/006, 14/022; SCS Doc. 14/10, 14/13)

### 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 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 recommendations from the 2011 onwards. Catches increased with the reopening of the fishery in 2010 and have reached just over 6 000 t in 2013, the highest level recorded on 20 years (Table 1, Fig. 1). Catches from EU-Portugal, Russian and Canadian fleets justified most of the increase on the redfish catch observed on both Divisions 3L and 3N.

Recent catches and TACs are:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | 3.5 | 6.0 | 6.0 | 6.5 | 7.0 |
| STATLANT 21 | 0.4 | 0.2 | 0.2 | 0.4 | 0.3 | 3.1 | 5.4 | 4.3 | 6.0 | |
| STACFIS | 0.7 | 0.5 | 1.7 | 0.6 | 1.1 | 4.1 | 5.4 | 4.3 | 6.0 | |

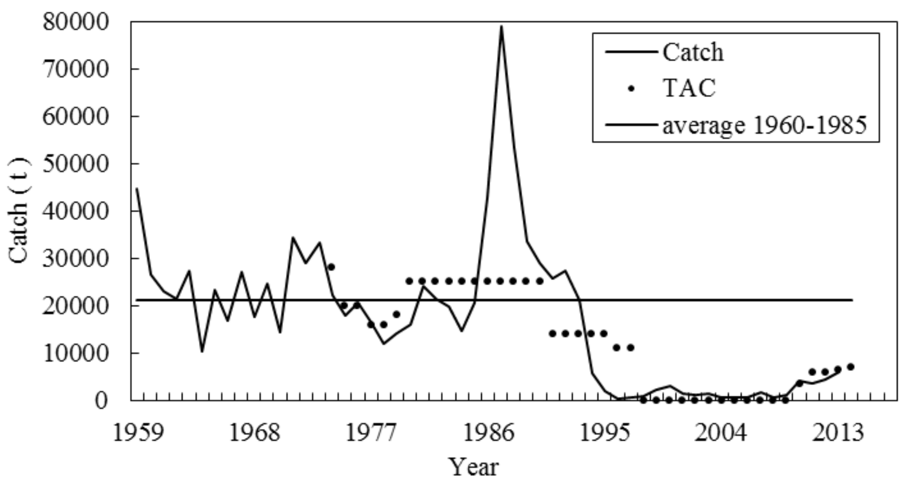



Fig. 10.1. Redfish in Div. 3LN: catches and TACs (No directed fishing is plotted as zero TAC).

### 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 by-catch 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 coupled with unusually high proportions of small redfish in the catch occurred afterwards on several years. Under a low exploitation regime such interlinked events should reflect the sequential recruitment of above average year classes into the exploitable stock between 2008 and 2013.

***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 Sub area 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. From 1995 till 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 (1995-2013) has been included in the assessment framework since 2010.

The Spanish survey in Div. 3L of NAFO Regulatory Area (Flemish Pass) was initiated by Spain in 2003. The Research vessel *Vizconde de Eza* has carried out the entire surveys series following the same procedures and using the same bottom trawl gear *Campelen 1800*. However only in 2006, for the first time, an adequate prospecting survey was conducted in Division 3L with over 100 valid hauls (Róman *et al.*, 2014).

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 well below average level until 1997 and started since then a discrete and discontinuous increase. A pronounced increase of the remaining biomass indices has been observed over the most recent years, 2007 onwards. Considering all available bottom trawl survey series occurring in Div. 3L and Div. 3N from 1978 till 2013, 100% of the biomass indices were above the average of their own series on 1978-1985, only 4% on 1986-2006, and 89% on 2007-2013.

Both 1991-2013 spring and autumn standardized female SSB series for Div. 3LN combined showed very similar patterns to correspondent survey biomass series.

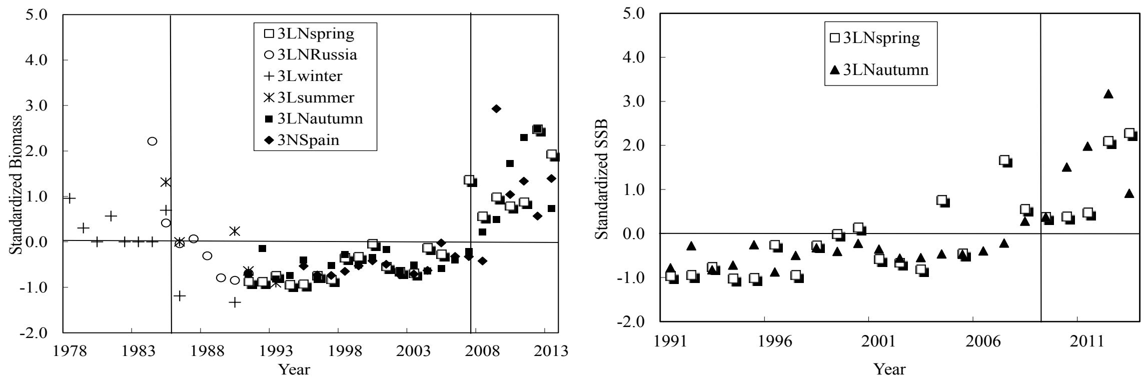



Fig. 10.2. Redfish in Div. 3LN: standardized survey biomass (1978-2013, left panel) and female spawning biomass (1991-2013, right panel). Each series standardized to zero mean and unit standard deviation. Vertical bars indicate periods when indices cross average levels.

During the first half of the 1990s on both survey series the mean lengths were negative or slightly above average. Mean lengths on most of the years between 1996 and 2007 (spring survey) or 2006 (autumn survey) were above the mean, reflecting a shift on the stock length structure to larger individuals Since 2008 mean lengths generally fall to below-well below average, just as observed on the commercial catch at length (Fig. 10.3). This most recent pattern on the length structure of both surveys and by catch seems to confirm the occurrence of recent pulses on recruitment after a low productivity regime that prevailed for more than 15 years.

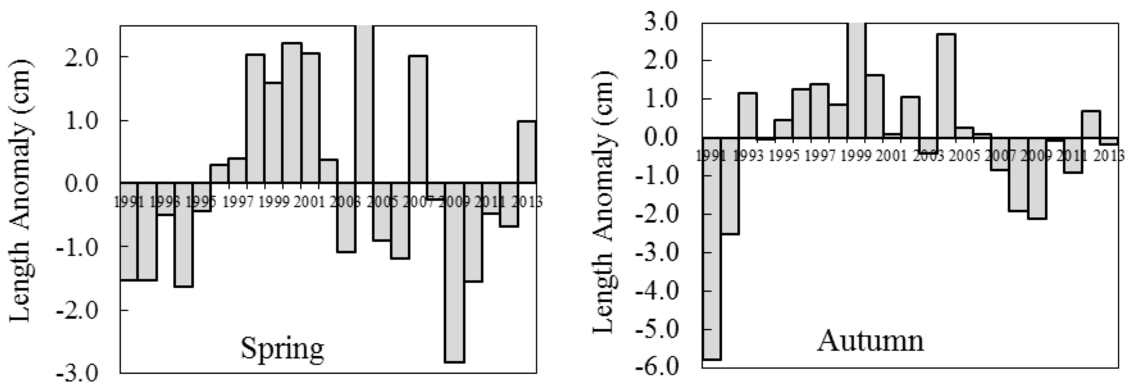



Fig. 10.3. Redfish in Div. 3LN: annual anomalies of the mean length on the spring and autumn survey, 1991-2013.

### *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 2005 onwards commercial catch and Canadian survey length data indicate that the proportion of redfish smaller than 20cm has increased significantly.

### c) Assessment Results

An ASPIC model framework (Prager, 1994), was used with 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. Catch in Div. 3LN for 2011-2012 taken from the NAFO STATLANT 21A and a provisional 2013 catch taken from the NAFO Provisional Catch Statistics letter, Feb 2014 (pers. comm.), were used in this assessment for the most recent years.

This assessment is not a follow up of the previous ones (Ávila de Melo *et al.*, 2012 and 2010). The logistic Schaefer production model (1954) incorporated in ASPIC operating model (Prager, 1994) cannot cope anymore with the most recent biomass increases observed in both spring and (mainly) autumn Canadian Div. 3LN surveys, as it provides unrealistic assessment results. Selective elimination of outliers, in order to get a picture in line to what is the perception of the stock history from commercial and survey data trends, is no longer a valid option, as reflected on the last STACFIS research recommendation on this matter (NAFO, 2012).

Being so, input has been reframed opening room to a new combination of Canadian autumn Div. 3L and 3N surveys. The inclusion of the Spanish spring survey on Div. 3N and the removal of the historical CPUE series have also been considered. ASPIC has also been run with MSY kept constant at an initial starting guess, instead of being estimated by the model. The average level of 21 000 t for the 1960-1985 period, when the stock experienced an apparent stability suggested either by the STATLANT CPUE series and the available surveys before declining in response to a sudden and important increase on catch, was assumed to be as a sound proxy to MSY.

The input data were:

| | |
|---|---|
| I1a (Statlant CPUE and catch), *or* | Statlant cpue for Div. 3LN,$_{1959\text{-}1994}$ & catch for Div. 3LN $_{1959\text{-}2013}$ |
| I1b (Catch) | Catch for Div. 3LN $_{1959\text{-}2013}$ |
| I2 (3LN spring survey) | Canadian spring survey biomass for Div. 3LN, $_{1991\text{-}2005,\ 2007\text{-}2013}$ |
| I3a (3N autumn survey) *or* | Canadian autumn survey biomass for Div. 3N, $_{1991,\ 1993\text{-}2010,\ 2012\text{-}2013}$ |
| I3b (3LN autumn survey) | Canadian autumn survey biomass for Div. 3LN, $_{1991\text{-}2013}$ |
| 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$_{,\ 1978\text{-}1979,\ 1981,1984\text{-}1985,\ 1990\text{-}1991and\ 1993}$ |
| I7a (3L autumn survey) *or* | Canadian autumn survey biomass for Div. 3L, $_{1985\text{-}1986,\ 1990\text{-}1994,\ 1996\text{-}2009,\ 2011\text{-}2013}$ |
| I7b (3L autumn survey) | Canadian autumn survey biomass for Div. 3L, $_{1985\text{-}1986,\ 1990}$ |
| I8 (3N spring spanish survey) | Spanish survey biomass for Div. 3N, $_{1995\text{-}2013}$ |

On this year exploratory analysis five candidate frameworks were classified into three categories corresponding to three different approaches to this assessment:

Category 1. A *status quo* category, with the update of the framework adopted in 2012 but keeping all the 2012-2013 new points. MSY was estimated by the model.

> ASPICfit 2014 **1**: update approved assessment framework (without 3N Spain, 3LN spring but 2007, 3L autumn but 2010 and 3N autumn but 2011) updated to 2012 and 2013 (all points included).

Category 2. An *MSY* model free estimate category, were *MSY* is estimated by the model along with the other key parameters. The two frameworks in this category have a joint 1991-2013 Canadian autumn 3LN survey series and a short 1985-1986 and 1990 Canadian autumn 3L survey series. All points included in all series.

> ASPICfit 2014 **2**: with 3LN autumn survey and 3N Spain survey full length survey series, all previous outliers included, option b for I3 and I7.

> ASPICfit 2014 **3**: strike out CPUE, full length catch and all survey series, all previous outliers included, option b for I1, I3 and I7.

Category 3. An *MSY* user fixed category, were an empirical approach to *MSY* is assumed as an input constant, based on 21000 t average catch level of the 1960-1985 interval. The two framework in this category have the same arrangement of the Canadian autumn surveys as on the previous category. All points included in all series.

> ASPICfit 2014 **4**: MSY fixed at 1960-1985 average catch, strike out CPUE, keep full length catch and all survey series, all previous outliers included, option b for I1, I3 and I7.

> ASPICfit 2014 **5**: MSY fixed at 1960-1985 average catch, keep full length CPUE and all survey series, all previous outliers included, option b for I3 and I7

An overview of the exploratory analysis under a traffic light rating scheme lead to the conclusion that both *MSY* fixed candidates (Category 3) shown a much better performance than either the *status quo* or the two *MSY* free estimate candidates.

All *MSY* free estimate runs gave depressed (first half) biomass trajectories well below $B_{msy}$, and $B_{msy}$ estimates at magnitudes well above all magnitudes estimated in the past. Both *MSY* and the equilibrium yield available in 2014 are also at much higher levels (Table 10.1) than the highest level observed of catch (41 600 t, 1986-1992), occurring at a time when all available indices for this stock declined. The model fit each estimated survey series to high inter annual variability on the correspondent survey, the final outcome being a stock increasing at an increasing speed from the second half of the 1990s onwards. The underlying logistic production model has no option but to assume that such a stock should still be in nowadays still increasing towards $B_{msy}$.

Table 10.1. Key parameters of five possible frameworks for ASPICfit 2014 assessment versus ASPICfit 2012 assessment

| | MSY | *B1/K* | $F_{msy}$ | $F_{2013}/F_{msy}$ | *Ye2014* | $B_{msy}$ | $B_{2014}/B_{msy}$ |
|---|---|---|---|---|---|---|---|
| ASPICfit 2014 1 | 117300 | 0.0579 | 0.0812 | 0.1257 | 79410 | 1444000 | 0.4319 |
| ASPICfit 2014 2 | 267300 | 0.0252 | 0.0925 | 0.0803 | 136900 | 2889000 | 0.3015 |
| ASPICfit 2014 3 | 112900 | 0.0619 | 0.0992 | 0.1105 | 59580 | 1138000 | 0.5152 |
| ASPICfit 2014 4 | *21000(1)* | 1.6230 | 0.1285 | 0.2104 | 17450 | 162300 | 1.4040 |
| ASPICfit 2014 5 | *21000(1)* | 0.6764 | 0.1097 | 0.2136 | 18120 | 191500 | 1.3710 |
| | MSY | *B1/K* | $F_{msy}$ | $F_{2011}/F_{msy}$ | *Ye2012* | $B_{msy}$ | $B_{2012}/B_{msy}$ |
| ASPICfit 2012 | 23700 | 0.4434 | 0.1053 | 0.1683 | 18360 | 225100 | 1.4750 |

*(1)* *fixed at the start user guess: average catch 1960-1985*

Comparing the results in Table 10.1 (see also Fig. 10.4), and also all 2014 analysis against the 2012 and 2010 assessments lead to the conclusion that ASPIC fit 2014-5 would be used to estimate stock status in the current assessment.

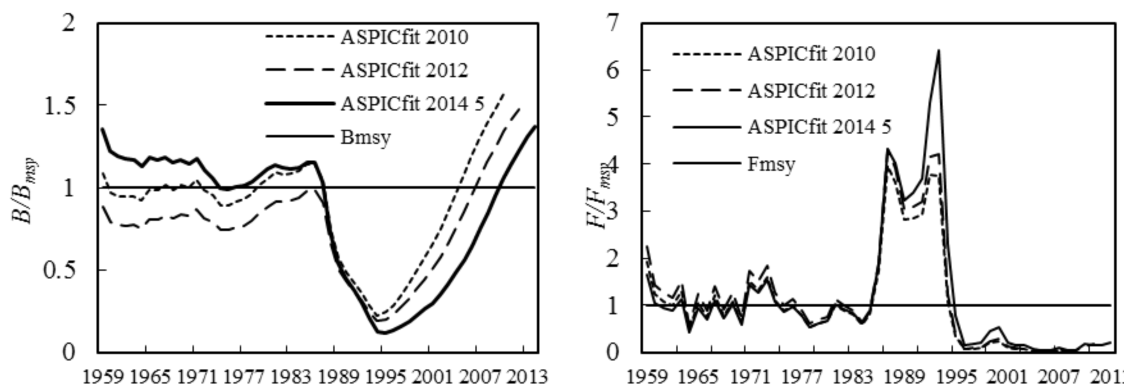



Fig. 10.4. $B/B_{msy}$ and $F/F_{msy}$ from 2010, 2012 and 2014 assessments.

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$_{fit}$ 2014 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. Very 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 2014-2012 ASPIC$_{fit}$ retrospective analysis (Fig. 10.5) was carried out. From one year to the next ASPIC assessments over estimate biomass and under estimate fishing mortality at small rates (1%-5%). These retrospective patterns are the model response to the general increase of the ongoing survey series, recorded over the most recent years.

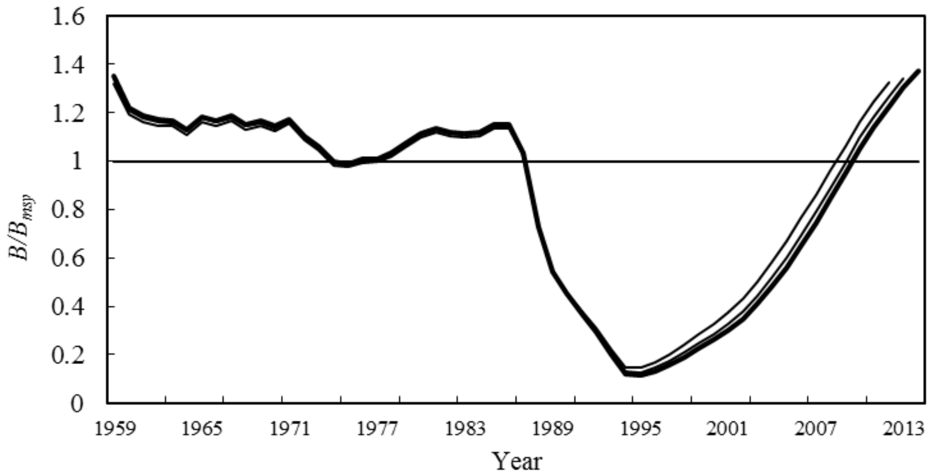



Fig. 10.5. Redfish in Div. 3LN: Retrospective $B/B_{msy}$ from $\text{ASPIC}_{\text{last year 2013-2011}}$

$\text{ASPIC}_{2014}$ diagnostics on deterministic (FIT) mode shown an unavoidable negative correlation between the estimated and the observed STATLANT CPUE series (due to the lack of observed values covering the last half of the time interval, when estimated series grows in line with the biomass increase estimated by the model), and a poor fit of the Spanish Div. 3N survey which had not been included in previous assessments. However, correlations between observed and estimated series increase from last assessment, which is a remarkable feature in favour of the chosen framework, taking into account that this assessment incorporates all the "outliers".

As in previous assessments, patterns in residuals are observed. Nevertheless these patterns have little impact on $\text{ASPIC}_{2014}$ bootstrap results (Table 10.2, Figure 10.6), as pointed out by:

- Small bias between the bias corrected and the point estimates (< 10%) for all key parameters,
- Similar key parameter results from either 2014, 2012 and 2010 $\text{ASPIC}_{\text{bot}}$ assessments.
- $B/B_{msy}$ 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,

Table 10.2. Compairision of ASPIC2014 with ASPIC2012 and ASPIC 2010 summaries of bootstrap analysis results.

| Param. name | ASPIC assessment | Point estimate | Estimated bias in pt estimate | median | point estimate bias corrected | Estimated relative bias | Bias-corrected approximate confidence limits of point estimates | | | | Inter-quartile range | Relative IQ range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 80% lower | 80% upper | 50% lower | 50% upper | | |
| B1/K | 2014 | **0.6764** | 0.1682 | 0.845 | 0.508 | **24.87%** | 0.5491 | 1.042 | 0.589 | 0.7887 | 0.1997 | 0.295 |
| | 2012 | 0.4434 | 0.064 | 0.507 | 0.380 | 14.37% | 0.241 | 0.643 | 0.315 | 0.519 | 0.204 | 0.460 |
| | 2010 | 0.5410 | 0.050 | 0.591 | 0.491 | 9.25% | 0.312 | 0.832 | 0.411 | 0.658 | 0.247 | 0.456 |
| K | 2014 | **383000** | 7837 | 390837 | 375163 | **1.53%** | 337100 | 478500 | 356700 | 433500 | 76800 | 0.200 |
| | 2012 | 450300 | 16210 | 466510 | 434090 | 3.60% | 351100 | 747600 | 398800 | 608400 | 209700 | 0.466 |
| | 2010 | 386700 | 27970 | 414670 | 358730 | 7.23% | 316300 | 606000 | 345000 | 471600 | 126600 | 0.327 |
| MSY | 2014 | **21000** | | 21000 | 21000 | | | | | | | |
| | 2012 | 23700 | 1099 | 24799 | 22601 | 4.64% | 21360 | 31580 | 22430 | 26430 | 4002 | 0.169 |
| | 2010 | 22580 | 1326 | 23906 | 21254 | 5.87% | 20400 | 24630 | 21310 | 23180 | 1871 | 0.083 |
| Ye Last year+1 | 2014 | **18120** | -869 | 17252 | 18989 | **-4.79%** | 12920 | 20930 | 15530 | 20430 | 4906 | 0.271 |
| | 2012 | 18360 | -718 | 17642 | 19078 | -3.91% | 10640 | 32820 | 14670 | 26200 | 11530 | 0.628 |
| | 2010 | 15350 | 352 | 15702 | 14998 | 2.29% | 7152 | 25890 | 10590 | 20850 | 10260 | 0.668 |
| $B_{msy}$ | 2014 | **191500** | 2931 | 194431 | 188569 | **1.53%** | 168500 | 239200 | 178400 | 216800 | 38400 | 0.200 |
| | 2012 | 225100 | 8103 | 233203 | 216997 | 3.60% | 175600 | 373800 | 199400 | 304200 | 104800 | 0.466 |
| | 2010 | 193300 | 13990 | 207290 | 179310 | 7.23% | 158100 | 303000 | 172500 | 235800 | 63310 | 0.327 |
| $F_{msy}$ | 2014 | **0.110** | 0.000122 | 0.110 | 0.110 | **0.11%** | 0.088 | 0.125 | 0.097 | 0.118 | 0.021 | 0.19 |
| | 2012 | 0.105 | 0.006 | 0.111 | 0.100 | 5.50% | 0.082 | 0.131 | 0.090 | 0.116 | 0.027 | 0.253 |
| | 2010 | 0.117 | 0.004 | 0.121 | 0.113 | 3.27% | 0.090 | 0.149 | 0.100 | 0.132 | 0.032 | 0.273 |

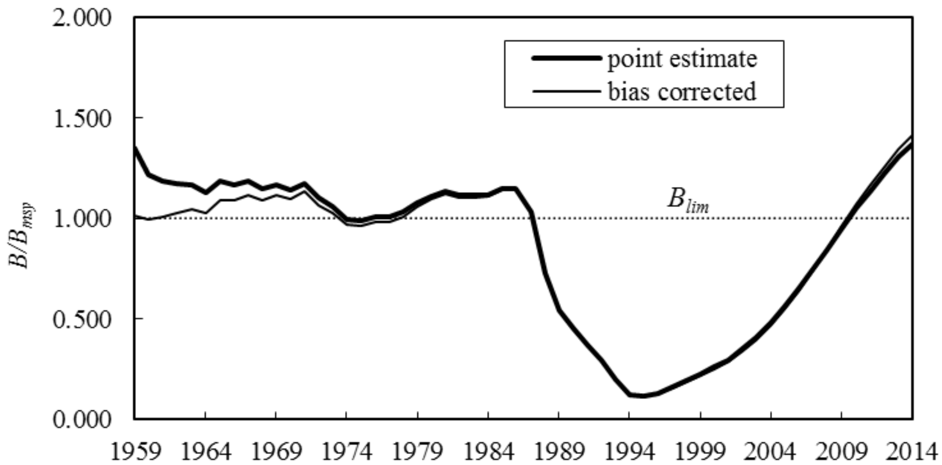



Fig. 10.6a. Redfish in Div. 3LN: $B/B_{msy}$ 1959-2014 point estimate and bias corrected trajectories.

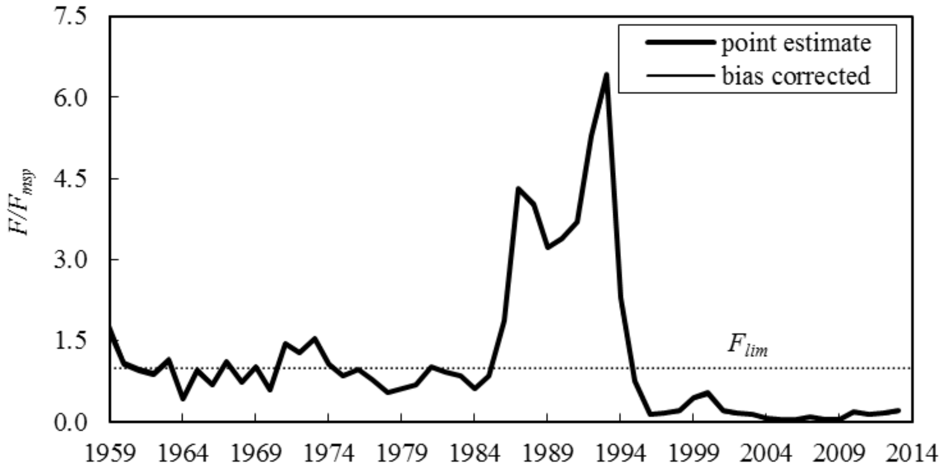



Fig. 10.6b. Redfish in Div. 3LN: $F/F_{msy}$ 1959-2013 point estimate and bias corrected trajectories.

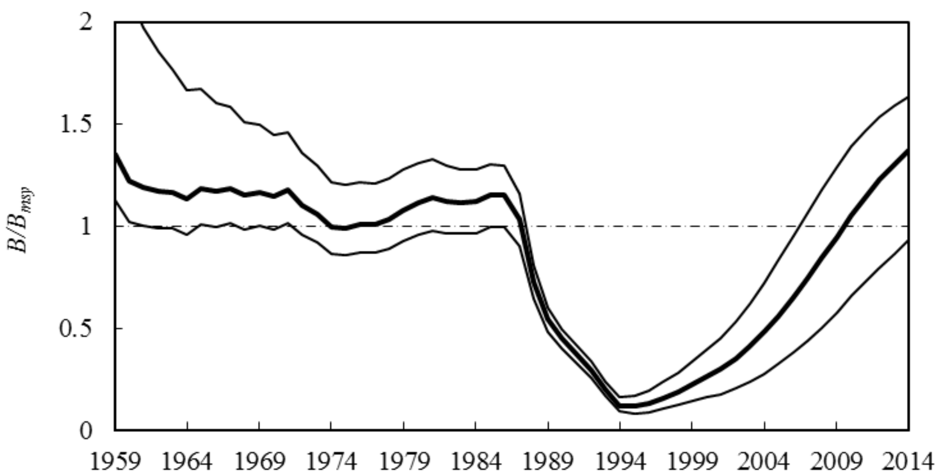



Fig. 10.6c. Redfish in Div. 3LN: $B/B_{msy}$ 1959-2014 trajectories (point estimates with approximate 80% CL's).

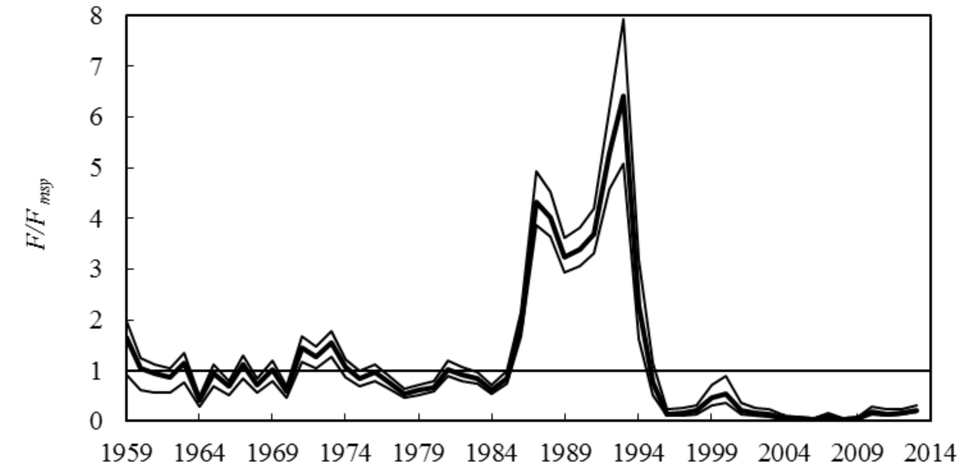



Fig. 10.6d. Redfish in Div. 3LN: $F/F_{msy}$ 1959-2013 trajectories (point estimate with approximate 80% CL's).

The model results suggest that the maximum observed sustainable yield (MSY) of 21000 t can be a long term sustainable yield if fishing mortality stands at a long term level of 0.11. The correspondent stock biomass is considered this stock $B_{msy}$ (191 500 t). The magnitude of $F_{msy}$ (0.11) is of the same order of magnitude than $F_{0.1}$ = 0.12 given by a previous yield per recruit analysis for redfish in Div. 3LN (Power and Parsons, 1999). Relative biomass was slightly above $B_{msy}$ for most of the former years up to 1985, under a fishing mortality in the vicinity of $F_{msy}$. Between 1986 and 1992 catches were higher than 21 000 t (26 000 t - 79 000 t), increasing fishing mortality to well above $F_{msy}$ from 1986 till 1993. Those eight years of heavy over-fishing determine the fall of biomass, from $B_{msy}$ in 1986 to 12% $B_{msy}$ in 1994-1995, when a minimum stock size is recorded. Since 1995 both were kept at low to very low levels. Over the moratorium years biomass was allowed to recover and at the beginning of 2014 biomass is predicted to be 1.4 x $B_{msy}$. The probability to be at or above $B_{msy}$ is high to very high. Current fishing mortality is predicted to be at 0.22 times $F_{msy}$, and the probability of being above $F_{msy}$ is very low.

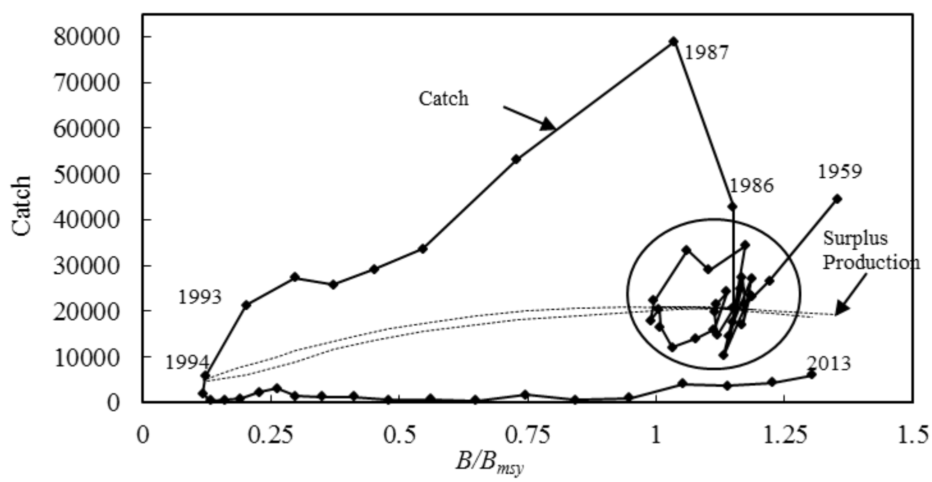



Fig. 10.7. Redfish in Div. 3LN: Catch versus Surplus Production from $ASPIC_{fit}$ 2014

Catch versus surplus production trajectories are presented on Fig. 10.7. From 1960 until 1985 catches from 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:* Slightly above $B_{msy}$ for most of the former years up to 1985. Declined from $B_{msy}$ in 1986 to 12% $B_{msy}$ in 1994-1995, when a minimum stock size is recorded., Over the moratorium years biomass was allowed to recover and at the beginning of 2014 biomass is predicted to be 1.4 x $B_{msy}$. The probability to be at or above $B_{msy}$ is high to very high..

*Fishing mortality:* Fishing mortality has been low to very low since 1995 but has slightly increased since the reopening of the fishery in 2010. Current fishing mortality is predicted to be at 0.22 x $F_{msy}$, and the probability of being above $F_{msy}$ is very low.

*Recruitment*: From commercial catch and Canadian survey length data there are signs of recent recruitment (2005-2013) of above average year classes to the exploitable stock.

*State of stock* : The stock is estimated to be at 1.4 x $B_{msy.}$ There is a low risk of the stock being below $B_{msy}$. Fishing mortality is below $F_{msy}$ (0.22 x $F_{msy}$), and the probability of being above $F_{msy}$ is very low. Recent recruitment (2005-2013) appears to be above average.

**d) Quality considerations**

The modeling framework previously used was not able to provide reliable results when allowed to run without constraints on MSY. Therefore MSY was fixed in the model and the results are conditioned on this assumption. Fixing MSY to the average catch of the 1960-1985 period generated much discussion in STACFIS as it is justified on a empirical basis. STACFIS **concluded** that the constrained model would likely produce the most realistic description of stock status at this point. It is however apparent that some uncertainties might not be well captured within this model. Management decisions based on this assessment should take into account this added uncertainty.

**e) Projections**

Three ASPIC short term stochastic projections were carried out assuming a 2014 catch of 6500 t (TAC in 2013), forwarded with increasing options of constant fishing mortality on 2015 and 2016, from $F_{statusquo}$ to 2/3 $F_{msy}$ , stopping at 1/3 $F_{msy}$ (Table 10.2a and 10.2b; Fig. 10.6).

For the three scenarios considered, estimated biomass remains above $B_{msy}$ with a low risk of being below $B_{msy}$.

Table 10.3. Short term projections for redfish in Div. 3LN. The 10th, 50th, and 90th percentiles of projected $B/B_{msy}$ , $F/F_{msy}$ and catch (t) are shown, for projected $F$ values of $F_{statusquo}$, 1/3 $F_{msy}$ and 2/3 $F_{msy}$. The assumed catch for 2014 was 6 500 t (TAC in 2013).

| $F_{status\ quo}$ | percentiles | | |
|---|---|---|---|
| Year | 10 | 50 | 90 |
| BIOMASS RELATIVE TO $B_{msy}$ | | | |
| 2014 | 0.931 | 1.371 | 1.632 |
| 2015 | 0.997 | 1.429 | 1.665 |
| 2016 | 1.062 | 1.481 | 1.695 |
| 2017 | 1.120 | 1.528 | 1.720 |
| FISHING MORTALITY RELATIVE TO $F_{msy}$ | | | |
| 2014 | 0.188 | 0.221 | 0.321 |
| 2015 | 0.177 | 0.214 | 0.318 |
| 2016 | 0.177 | 0.214 | 0.318 |
| YIELDS FOR 2014-2016 | | | |
| 2014 | 6500 | 6500 | 6500 |
| 2015 | 6254 | 6529 | 6361 |
| 2016 | 6353 | 6752 | 6501 |

| 1/3 $F_{msy}$ | percentiles | | | 2/3 $F_{msy}$ | percentiles | | |
|---|---|---|---|---|---|---|---|
| Year | 10 | 50 | 90 | Year | 10 | 50 | 90 |
| BIOMASS RELATIVE TO $B_{msy}$ | | | | BIOMASS RELATIVE TO $B_{msy}$ | | | |
| 2014 | 0.931 | 1.371 | 1.632 | 2014 | 0.931 | 1.371 | 1.632 |
| 2015 | 0.997 | 1.429 | 1.665 | 2015 | 0.997 | 1.429 | 1.665 |
| 2016 | 1.045 | 1.464 | 1.676 | 2016 | 0.996 | 1.415 | 1.625 |
| 2017 | 1.088 | 1.494 | 1.685 | 2017 | 0.997 | 1.403 | 1.594 |
| FISHING MORTALITY RELATIVE TO $F_{msy}$ | | | | FISHING MORTALITY RELATIVE TO $F_{msy}$ | | | |
| 2014 | 0.188 | 0.221 | 0.321 | 2014 | 0.188 | 0.221 | 0.321 |
| 2015 | 0.277 | 0.333 | 0.496 | 2015 | 0.553 | 0.667 | 0.991 |
| 2016 | 0.277 | 0.333 | 0.496 | 2016 | 0.553 | 0.667 | 0.991 |
| YIELDS FOR 2014-2016 | | | | YIELDS FOR 2014-2016 | | | |
| 2014 | 6500 | 6500 | 6500 | 2014 | 6500 | 6500 | 6500 |
| 2015 | 9708 | 10130 | 10650 | 2015 | 19100 | 19900 | 20790 |
| 2016 | 9762 | 10360 | 11100 | 2016 | 18700 | 19720 | 20770 |

On the 2014 ASPIC assessment MSY is not estimated by the underlying Schaeffer model (see section d). In turn it is a proxy given by the average level of catch that was sustained by the stock over 25 years. It is uncertain that the productivity regime which supported such level of exploitation from the 1960s to the first half of the 1980s still prevails.

The status of the stock allows an increase in its exploitation, the question is how far and how fast it should be. A higher TAC should be reached by a stepwise increase from the actual catch level in order to confirm with a high probability the stock will be able to accommodate increasing removals and still stand where it is: at or above a level of biomass that has sustained a long term catch of 21 000 t.

### f) Reference Points

The ASPIC point estimate results were put under the precautionary framework (Fig. 10.8). The trajectory presented shows a stock slightly above $B_{msy}$ under exploitation around $F_{msy}$ through 25 years in a row (1960-1985). The stock rapidly declined afterwards to well below $B_{msy}$ when fishing mortality rises to well above $F_{msy}$ (1987-1994). Biomass gradually approaches and finally surpasses $B_{msy}$ after fishing mortality dropped to well below $F_{msy}$ (1994-1996) being kept at a low to very low level ever since.

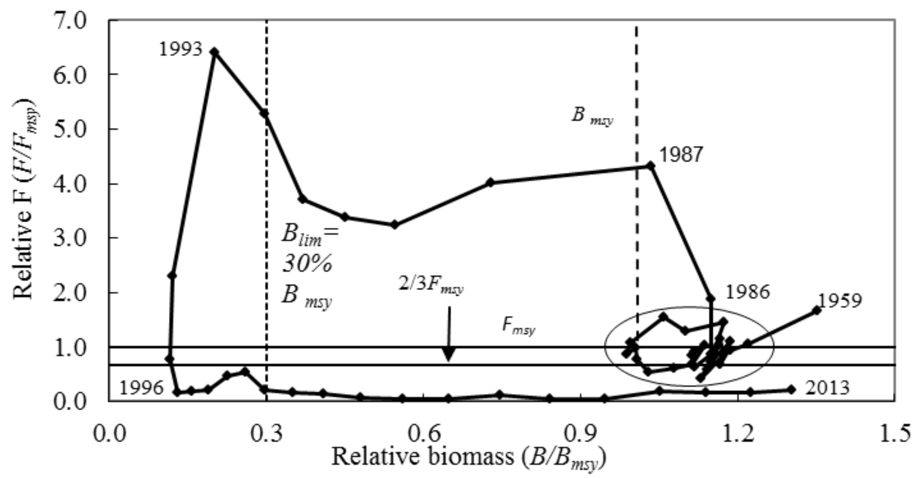



Fig. 10.8. Redfish in Div. 3LN: stock trajectory under a precautionary framework for $ASPIC_{fit}$ 2014.

## g) Research Recommendations

STACFIS **recommends** that *risks associated with the stock falling below $B_{lim}$ in the various projection scenarios be presented*.

The next full assessment of this stock will be in 2016.

## 11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO

(SCS Doc. 14/6, 10, 11, 13, 14; SCR Doc. 14/5, 12, 31, 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. Total catch based on ratios of fishing effort in 2013 to effort in 2010 was 3064 tons, mainly taken in the NAFO Regulatory Area (Fig. 11.1) (see section c for more detail). In 2011-13, American plaice were taken as by-catch in the Canadian yellowtail fishery, EU-Spain and EU-Portugal skate, redfish and Greenland halibut fisheries.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21 | 2.4 | 0.9 | 1.5 | 1.9 | 1.8 | 1.5 | 1.2 | 1.3 | 2.1 | |
| STACFIS | 4.1 | 2.8 | 3.6 | 2.5 | 3.0 | 2.9 | 2.9[1] | 3.0[1] | 3.1[1] | |

ndf No directed fishing.
[1] Catch was estimated using fishing effort ratio applied to 2010 STACFIS catch.

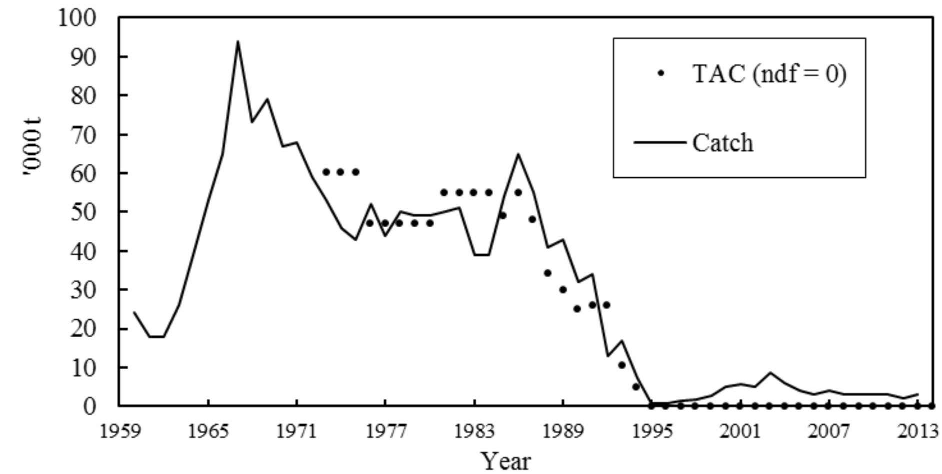



Fig. 11.1. American plaice in Div. 3LNO: estimated catches and TACs. No directed fishing is plotted as 0 TAC.

**b) Input Data**

Biomass and abundance data were available from: annual Canadian spring (1985-2013) and autumn (1990-2013) bottom trawl surveys; and EU-Spain surveys in the NAFO Regulatory Area of Div. 3NO (1995-2013). The Canadian spring survey in 2006 did not adequately cover many of the strata in Div. 3NO and therefore results were not used in the assessment. Likewise, in 2004, coverage of strata from Div. 3L in the Canadian autumn survey was incomplete, and results were therefore not used in the assessment. Age data from Canadian bycatch as well as length frequencies from EU-Portugal and EU-Spain bycatch were available for 2011-13.

***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 2011-13 bycatch in the Canadian fishery and length sampling of bycatch in the Canadian, EU-Spain, EU-Portugal and Russian fisheries. Total catch-at-age for all years was produced by applying Canadian survey age-length keys to length frequencies collected each year by countries with adequate sampling and adding it to the catch-at-age calculated for Canada. This total was adjusted to include catch for which there were no sampling data from Contracting Parties such as EU-Estonia, EU-Lithuania, France (SPM), Cuba and United States. In 2011, catch-at-age was comprised mainly of fish aged 6-8. In 2012 and 2013, the majority of the catch was dominated by ages 7-10. Sampling from the Canadian commercial fishery was incomplete for 2013 and as such, catch at age is considered interim.

***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. Generally there has been an increasing trend in both biomass and abundance indices since 1995. Biomass estimates increased from 1996 to 2008 but declined in 2009 to levels of the late 1990s (Fig. 11.2), however since then have continued to increase. Abundance has fluctuated since 1996 with a slight increase over the period until 2008, followed by a drop in 2009. In the past five years there has been a steady increase in biomass and abundance, in particular, the abundance of fish ages 0-5 has been increasing and is amongst the highest in the time series (Fig. 11.2). However, these ages are probably 'under converted' to varying degrees in the 1985 to 1995 data.

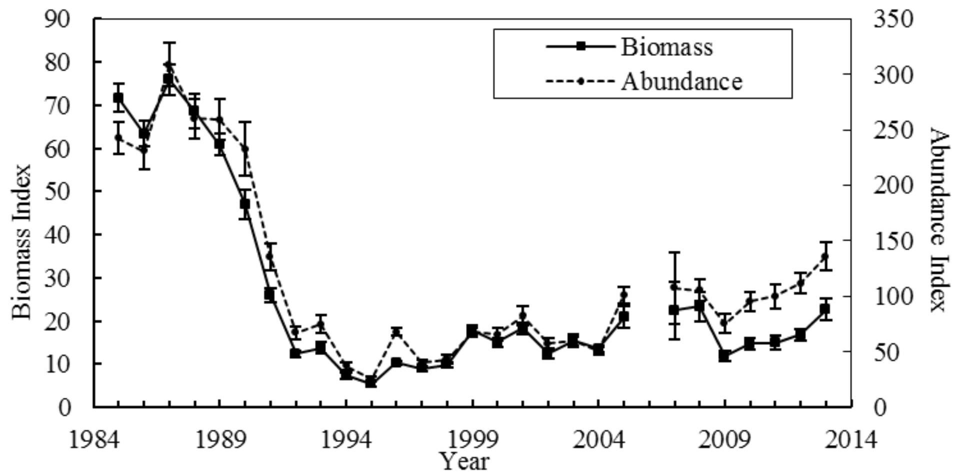



Fig. 11.2. American plaice in Div. 3LNO: biomass and abundance indices from Canadian spring surveys (Data prior to 1996 are Campelen equivalents and since then are Campelen).

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). There was an increase in biomass (80%) and abundance (60%) from 2012 to 2013. Over the past five years the average proportion of fish aged 0-5 has been 70% of the total.

The trends observed are similar to the Canadian spring surveys.

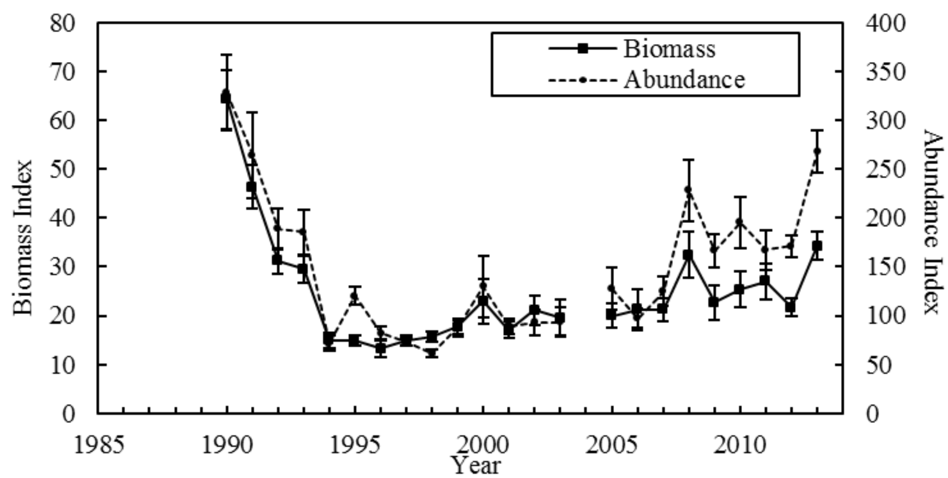



Fig. 11.3. American plaice in Div. 3LNO: biomass and abundance indices from autumn surveys (Data prior to 1995 are Campelen equivalents and since then are Campelen).

**Stock distribution for Canadian Surveys.** Historically the largest portion of this stock was located in Div. 3L but the highest declines in survey indices were experienced in this region. The stock in recent years was more heavily concentrated in Div. 3N in the NAFO Regulatory Area and the largest catches in the surveys are still found there. From 2011-2013 there has been some evidence that there has been an expansion in survey biomass into Div. 3L.

**EU-Spain Div. 3NO Survey**. From 1998-2013, surveys have been conducted annually in May-June by EU-Spain in the Regulatory Area in Div. 3NO. In 2001, the 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. Estimates of both indices from the EU-Spain survey followed a trend similar to the Canadian survey estimates with a drop in both biomass and abundance in 2009; since then have increased (Fig. 11.4).

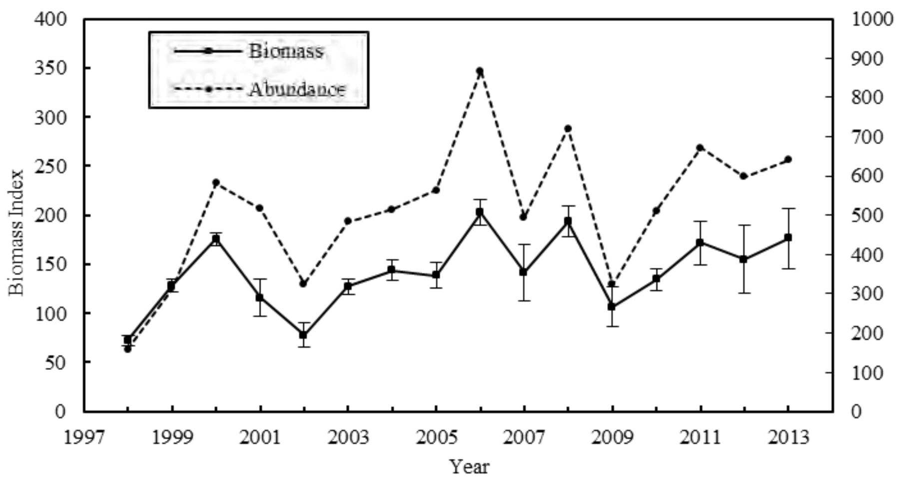



Fig. 11.4. American plaice in Div. 3LNO: biomass and abundance indices from the EU-Spain Div. 3NO survey (Data prior to 2001 are Campelen equivalents and since then are Campelen).

***iii) Biological studies***

**Maturity**. Age ($A_{50}$) and length ($L_{50}$) at 50% maturity estimates were produced by cohort from spring research vessel data. For males, $A_{50}$ were fairly stable for cohorts of the 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 to about 1990. For cohorts since then, females have had a fairly constant $A_{50}$ of 7.5 to 8 years compared to 11 years for cohorts at the beginning of the time series.

$L_{50}$ declined for both sexes but recovered somewhat in recent cohorts. The current $L_{50}$ for males of about 19 cm is 3 to 4 cm lower than the earliest cohorts estimated. The $L_{50}$ of most recent cohorts for females is in the range of 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 2013. Means were calculated accounting for the length stratified sampling design. Although there is variation in both length and weight-at-age there is little indication of any long-term trend for either males or females.

**c) Estimation of Parameters**

A comparison of STATLANT 21 data with STACFIS estimates in previous years for Div. 3L and 3O determined that STATLANT 21 adequately reflected catch for those Divisions and so STATLANT 21 data were used for catch estimates for Div. 3L and 3O for 2011-2013. In Div. 3N, there was a substantial difference between STATLANT 21 and STACFIS catches for the past number of years where agreed catches were available. To estimate catch for 2011-2013 for Div. 3N information on effort from NAFO observers and logbook data was used where possible with the assumption that CPUE has not changed substantially from 2010. To estimate catch the ratio of effort in year *y+1* to year *y* was multiplied by the estimated catch in year *y* to produce catch in year *y+1*. For example for 2011 this was $Catch_{2011} = (Effort_{2011}/Effort_{2010})*Catch_{2010}$. Effort for 2013 was considered provisional so this catch estimate could change if revised. This method is unlikely to be useful in future as CPUE is likely to change as the plaice population increases and as other fishing opportunities change.

An analytical assessment using the ADAPTive framework tuned to the Canadian spring, Canadian autumn and the EU-Spain Div. 3NO survey was used. The virtual population analysis (VPA)) was conducted based on the 2011 assessment formulation with catch-at-age and survey information from the following:

- Catch at age (1960-2013) (ages 5-15+);
- Canadian spring RV survey (1985-2013) (no 2006 value) (ages 5-14);
- Canadian autumn RV survey (1990-2013) (no 2004 value) (ages 5-14); and

- EU-Spanish Div. 3NO survey (1998-2013) (ages 5-14).

There was a plus group at age 15 in the catch-at-age and the ratio of *F* on the plus group to *F* on the last true age was set at 1.0 over all years. Natural mortality (*M*) was assumed to be 0.2 on all ages except from 1989-1996, where *M* was assumed to be 0.53 on all ages.

**d) Assessment Results**

The model provides a good fit to the data with a mean square of the residuals of 0.32, however there was some indication of auto-correlation in the residuals. Relative errors on the population estimates ranged from 0.12 to 0.34. The relative errors on the catchabilities (*q*) were all less than 0.2.

The VPA analyses showed that population abundance and biomass declined fairly steadily from the mid- 1970s to 1995. Biomass and abundance have been increasing over the last number of years (Fig 11.5). Average *F* on ages 9 to 14 showed an increasing trend from about 1965 to 1985. There was a large unexplained peak in *F* in 1993. *F* increased from 1995 to 2001 and has since declined (Fig. 11.6).

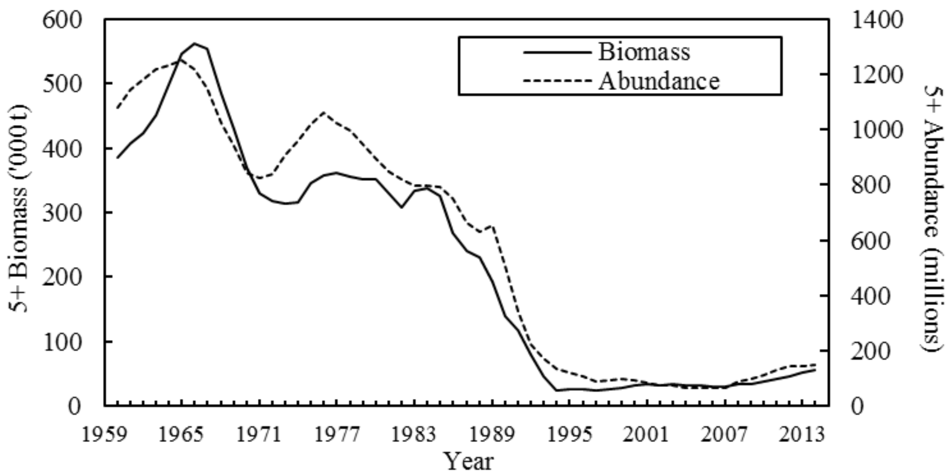



Fig. 11.5. American plaice in Div. 3LNO: population abundance and biomass from VPA

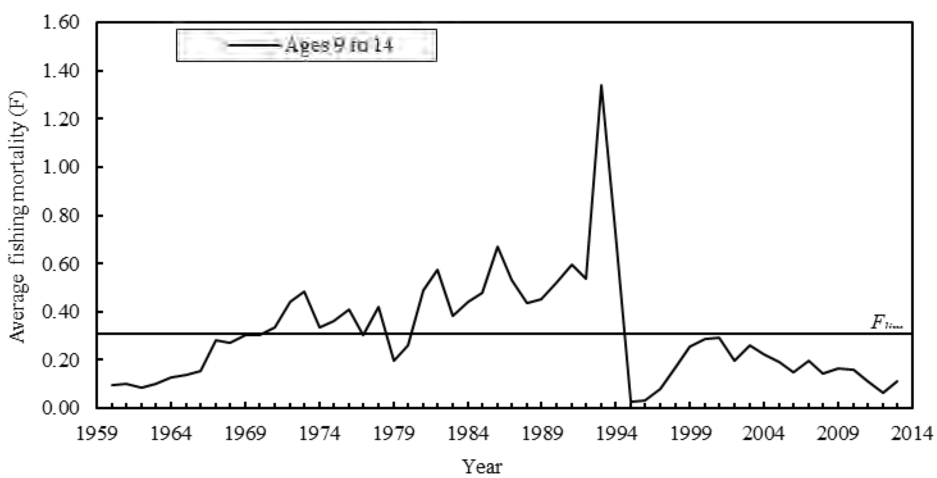



Fig. 11.6. American plaice in Div. 3LNO: average fishing mortality from VPA.

Spawning stock biomass has shown 2 peaks, one in the mid-1960s and another in the early to mid-1980s. It declined to a very low level (less than 10 000 t) in 1994 and 1995 (Fig. 11.7). Since then the SSB has been increasing, reaching about 38 000 t in the current year, which is about 75% of $B_{lim}$. Estimated recruitment at age 5 indicates there have been no year classes above the long term average since the mid-1980s (Fig. 11.8).

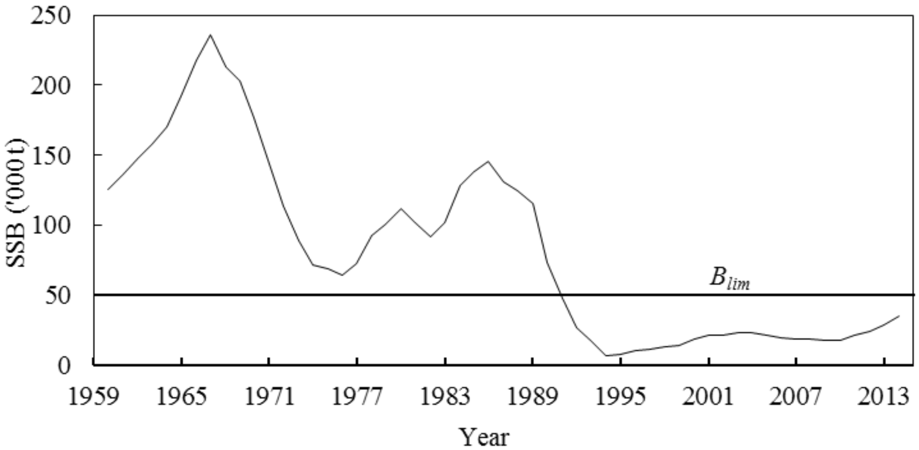



Fig. 11.7. American plaice in Div. 3LNO: spawning stock biomass from VPA.

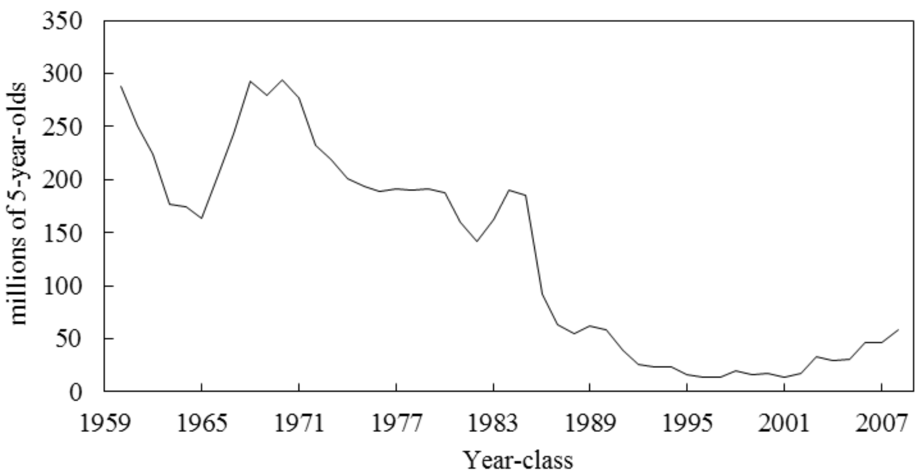



Fig. 11.8. American plaice in Div. 3LNO: recruits (at age 5) from VPA.

**e) State of the Stock**

The stock remains low compared to historic levels and, although SSB is increasing, it is still estimated to be below $B_{lim}$. Although estimated recruitment at age 5 has been higher from 2003-2008 than from 1995-2002, recruitment has been low since the late 1980s.

*Spawning stock biomass*: SSB declined to the lowest estimated level in 1994 and 1995. SSB has been increasing since then and is currently at 36 000 t. $B_{lim}$ for this stock is 50 000 t.

*Recruitment*: Although estimated recruitment at age 5 has been higher from 2004-2009 than from 1995-2003, recruitment has been low since the late 1980s.

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

**f) Retrospective patterns**

A five year retrospective analysis was conducted by sequentially removing one year of data from the input data set (Fig. 11.9). There is a retrospective pattern present in this assessment that was more obvious than typically observed in previous assessments. The SSB has been overestimated in each year since 2005.

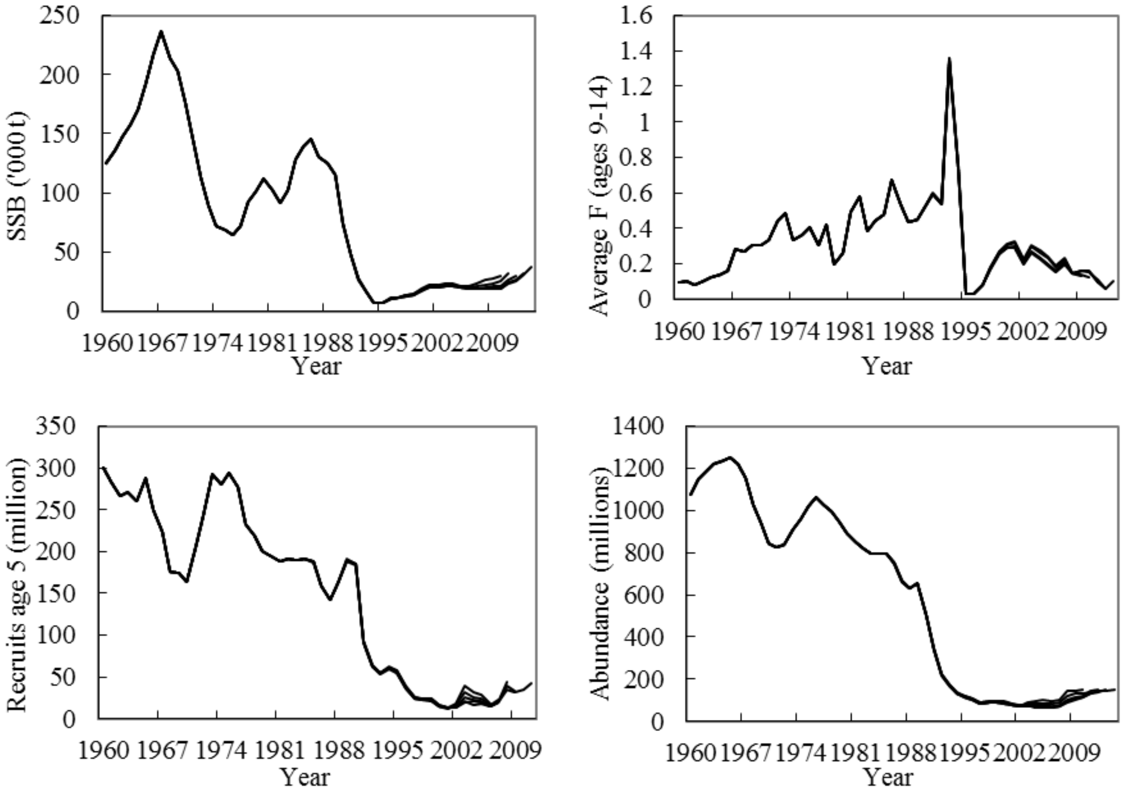



Fig 11.9 American plaice in Div. 3LNO: retrospective analysis of SSB, average *F* (ages 9-14), recruitment (age 5) and population numbers.

**g) Precautionary Reference Points**

An examination of the stock recruit scatter shows that good recruitment has rarely been observed in this stock at SSB below 50 000 t and this is currently the best estimate of $B_{lim}$. In 2011 STACFIS adopted $F_{lim}$ of 0.3 consistent with stock history and dynamics for this stock. The stock is currently below $B_{lim}$ and current fishing mortality is below $F_{lim}$ (Fig. 11.10).

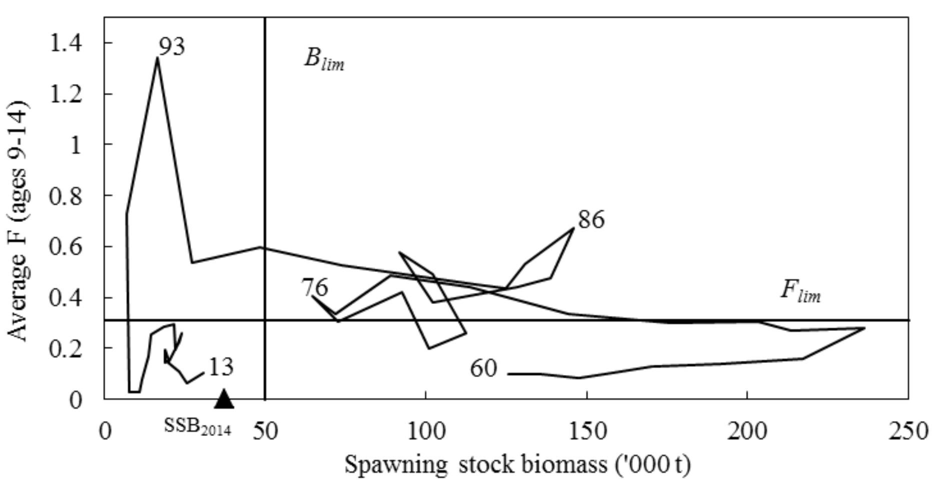



Fig. 11.10. American plaice in Div. 3LNO: stock trajectory within the NAFO PA framework. The 2014 SSB estimate is indicated by the triangle on the x-axis.

### h) Short Term Considerations

Simulations were carried out to examine the trajectory of the stock under 2 scenarios of fishing mortality: $F = 0$ and $F= F_{2013}$ (0.10).

For these simulations the results of the VPA and the covariance of these population estimates were used. The following assumptions were made:

| Age | Estimate of 2014 population numbers ('000) | CV on population estimate | Weight-at-age mid-year (avg. 2011-2013) | Weight-at-age beginning of year (avg. 2011-2013) | Maturity-at-age (avg. 2011-2013) | Rescaled PR relative to ages 9-14 (avg. 2011-2013) |
|---|---|---|---|---|---|---|
| 5 | | | 0.136 | 0.08 | 0.011 | 0.140 |
| 6 | 50489 | 0.333 | 0.201 | 0.237 | 0.042 | 0.245 |
| 7 | 31270 | 0.239 | 0.284 | 0.314 | 0.220 | 0.557 |
| 8 | 23866 | 0.201 | 0.397 | 0.415 | 0.569 | 0.747 |
| 9 | 11569 | 0.185 | 0.509 | 0.524 | 0.809 | 0.837 |
| 10 | 8315 | 0.175 | 0.632 | 0.643 | 0.942 | 1.029 |
| 11 | 7280 | 0.166 | 0.750 | 0.769 | 0.975 | 1.056 |
| 12 | 2787 | 0.165 | 0.905 | 0.946 | 0.990 | 1.340 |
| 13 | 1493 | 0.174 | 1.08 | 1.203 | 0.996 | 0.939 |
| 14 | 1479 | 0.162 | 1.311 | 1.414 | 0.999 | 0.799 |
| 15 | 2473 | 0.121 | 1.927 | 1.670 | 1.000 | 0.799 |

Simulations were limited to a 3-year period. Recruitment was resampled from three sections of the estimated stock recruit scatter, depending on SSB. The three sections were 50 000 t of SSB and below (only low recruitment), greater than 50 000 t to 155 000 t (low and high recruitment), and greater than 155 000 t (only high recruitment). The simulations contained a plus group at age 15.

Under no removals ($F = 0$), spawner biomass is projected to increase with $p($SSB$>B_{lim})$ in 2017 of >0.95 (Table 11.1, Fig 11.11). SSB was projected to have a probability of 0.30 of being greater than $B_{lim}$ by the start of 2017 when $F = F_{2013}$ (0.11). Current fishing mortality is delaying the recovery of this stock.

Under status quo fishing mortality ($F_{2013}$) projected removals increase slightly in each year

Table 11.1 American plaice in Div. 3LNO: Results of stochastic projections under various fishing mortality options. Labels p10, p50 and p90 refer to 10th, 50th and 90th percentiles of each quantity.

| | F = 0 | | |
|---|---|---|---|
| | SSB ('000 t) | | |
| | p10 | p50 | p90 |
| 2014 | 31 | 34 | 38 |
| 2015 | 39 | 44 | 48 |
| 2016 | 47 | 53 | 60 |
| 2017 | 54 | 62 | 71 |

| | $F_{2013} = 0.11$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | SSB ('000 t) | | | | Yield ('000 t) | | |
| | p10 | p50 | p90 | | p10 | p50 | p90 |
| 2014 | 31 | 34 | 38 | | 3.5 | 3.9 | 4.3 |
| 2015 | 36 | 40 | 44 | | 4.0 | 4.5 | 5.0 |
| 2016 | 40 | 45 | 51 | | 4.2 | 4.7 | 5.5 |
| 2017 | 41 | 47 | 55 | | | | |

Table 11.2 American plaice in Div. 3LNO: Risk assessment of the probability of being below $B_{lim}$ under various fishing scenarios. Yield is median projected value.

| Fishing Mortality | Yield | | | P(SSB>$B_{lim}$) | | | P($SSB_{2017}$>$SSB_{2014}$) |
|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2015 | 2016 | 2017 | |
| F = 0 | - | - | - | <0.05 | 0.76 | >0.95 | 1.00 |
| $F_{2013}$ = 0.10 | 3910 | 4456 | 4732 | <0.05 | 0.13 | 0.30 | 1.00 |

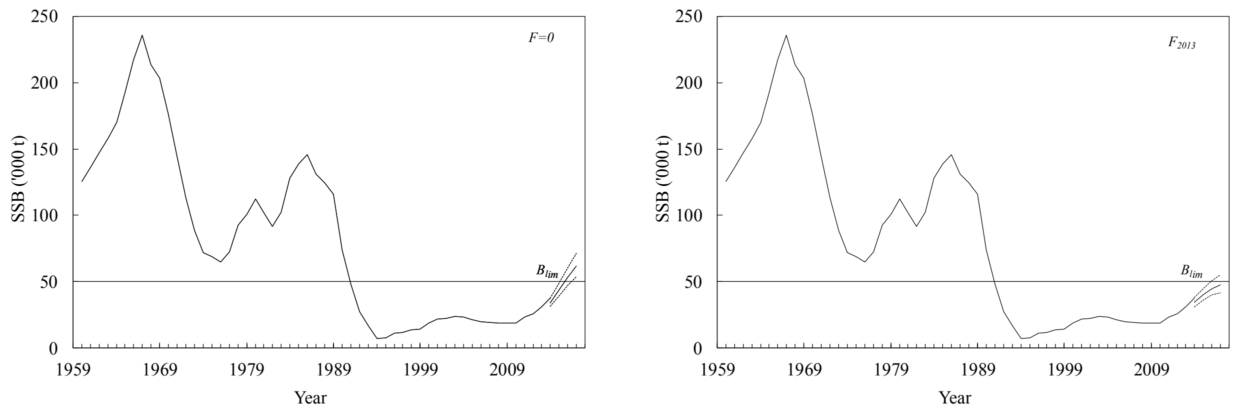



Fig. 11.11 American plaice in Div. 3LNO: Spawning stock biomass from projections along with 10th and 90th percentiles (dotted lines) for $F$=0 (left) and $F_{2013}$ (right).

The next full assessment of this stock is expected to be in 2016.

**i) Research Recommendations**

STACFIS **recommended** that *investigations be undertaken to compare ages obtained by current and former Canadian age readers.*

STATUS: Work is ongoing. This recommendation is reiterated.

STACFIS **recommends** that *investigations be undertaken to examine the retrospective pattern and take steps to improve the model.*

## 12. Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO

Interim Monitoring Report (SCS Doc. 14/06, 10, 13, 14)

**a) Introduction**

There was a moratorium on directed fishing from 1994 to 1997, and small catches were taken as by-catch in other fisheries. The fishery was re-opened in 1998 and catches increased from 4 400 t to 14 100 t in 2001 (Fig 12.1). Catches from 2001 to 2005 ranged from 11 000 t to 14 000 t. Since then, catches have been below the TAC and in some years, have been very low. The low catch in 2006 was due to corporate restructuring and a labour dispute in the Canadian fishing industry. Industry related factors continued to affect catches which remained well below the TAC in 2011 and 2012. However, in 2013, catch was higher at 9 800 t.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC[1] | 15.0 | 15.0 | 15.5 | 15.5 | 17 | 17 | 17 | 17 | 17 | 17 |
| STATLANT 21 | 13.9 | 0.6 | 4.4 | 11.3 | 5.5 | 9.1 | 5.2 | 3.1 | 9.8 | |
| STACFIS | 13.9 | 0.9 | 4.6 | 11.4 | 6.2 | 9.4 | 5.2 | 3.1 | 9.8 | |

[1] SC recommended any TAC up to 85% $F_{msy}$ in 2009-2015.

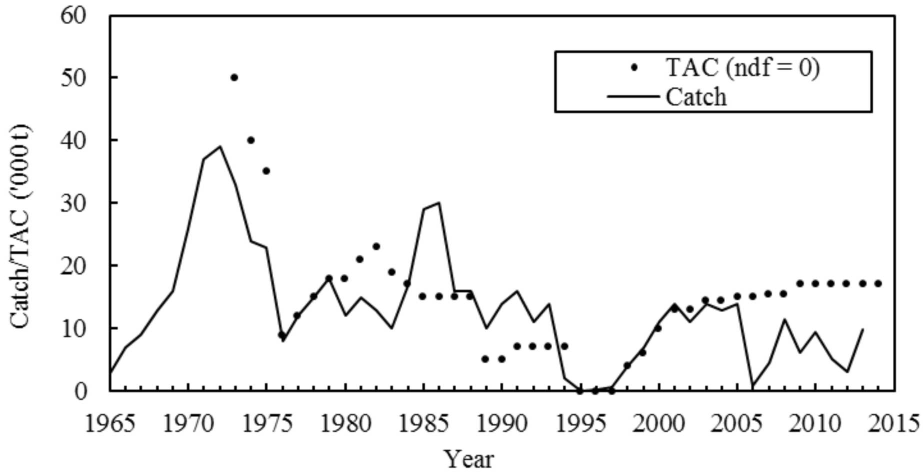



Fig. 12.1. Yellowtail flounder in Div. 3LNO: catches and TACs. No directed fishing is plotted as 0 TAC.

**b) Data Overview**

***i) Research survey data***

**Canadian stratified-random spring surveys.** Although variable, the spring survey index of trawlable biomass shows an increasing trend since 1995 and remains well above the level of the late 1980s and early 1990s.

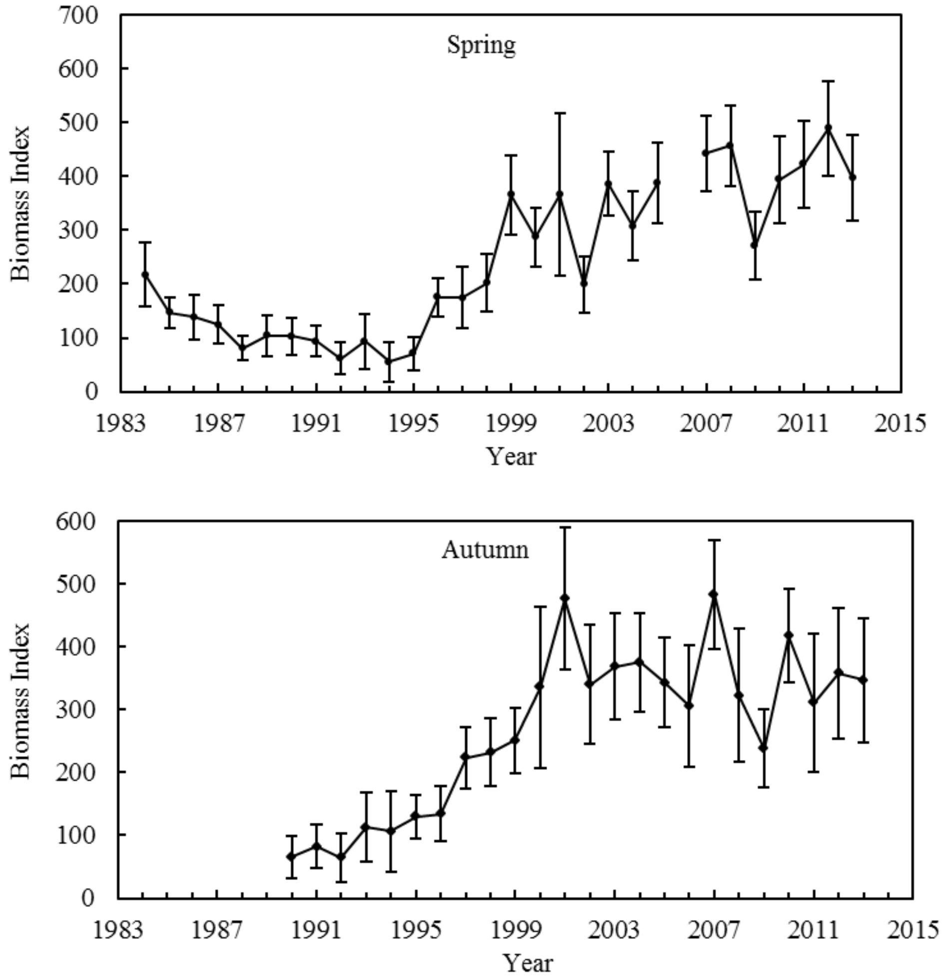



Fig.12.2. Yellowtail flounder in Div. 3LNO: indices of biomass with approximately 95% confidence intervals, from Canadian spring and autumn surveys. Values are Campelen units or, prior to autumn 1995, Campelen equivalent units.

**Canadian stratified-random autumn surveys**. The autumn survey index of trawlable biomass for Div. 3LNO increased steadily from the early-1990s to 2001, and although variable, it has remained relatively high since then (Fig. 12.2).

EU-Spain stratified-random spring surveys in the NAFO Regulatory Area of Div. 3NO. The biomass index of yellowtail flounder increased sharply up to 1999 and has thereafter remained relatively stable (Fig. 12.3), in general agreement with the Canadian series which covers the entire stock area.

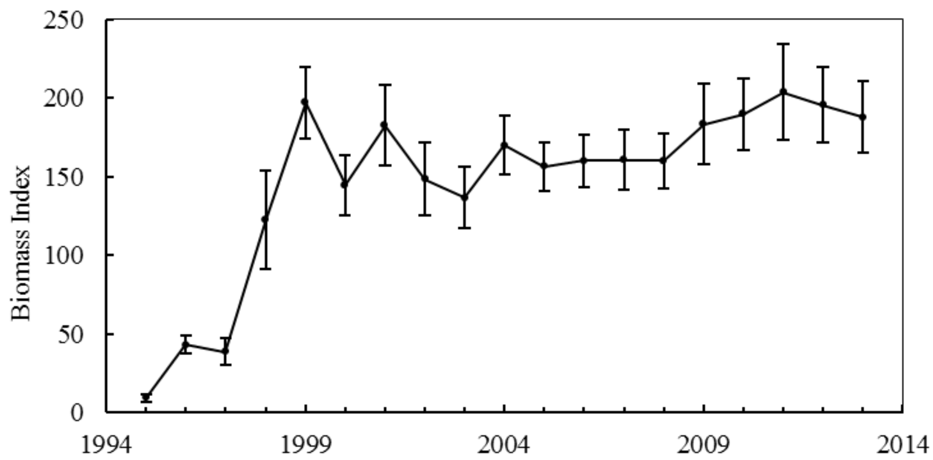



Fig.12.3. Yellowtail flounder in Div. 3LNO: index of biomass from the EU-Spain spring surveys in the Regulatory Area of Div. 3NO ±1SD. Values are Campelen units or, prior to 2001, Campelen equivalent units.

**Stock distribution**. 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 1999-2013 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 is 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. Although no clear trend in recruitment is evident, the number of small fish was above the 1996-2013 average in the Canadian surveys of 2010, and above average in several recent Canadian spring surveys. The spring survey by EU-Spain has shown lower than average numbers of small fish in the last seven surveys. Based on a comparison of small fish (<22 cm) in research surveys, recent recruitment appears to be about average.

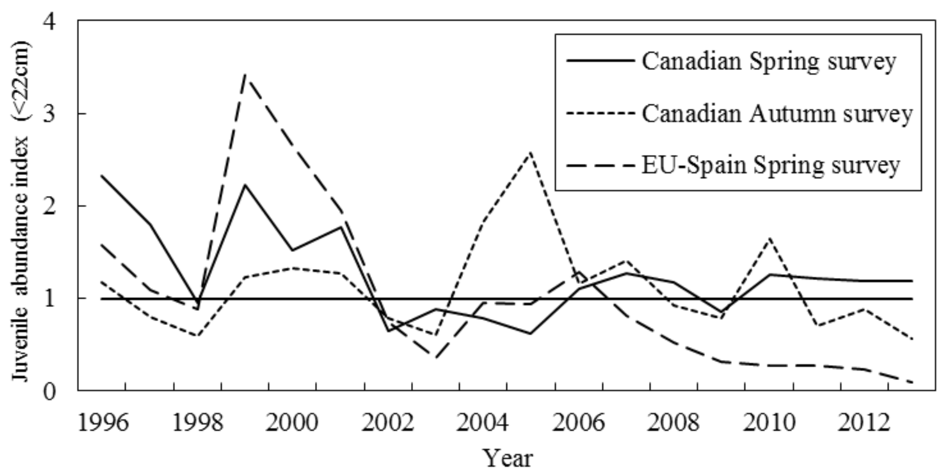



Fig.12.4. Yellowtail flounder in Div. 3LNO: Juvenile abundance indices from spring and autumn surveys by Canada and spring surveys by EU-Spain. Each series is scaled to its mean (horizontal line).

**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 2015.

### 13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO

(SCR Doc. 14/006, 010; 029; 13/11; SCS Doc. 14/13, 13/5, 7, 9, 13)

**a) Introduction**

Reported catches in the period 1972-84 ranged from a low of about 2 400 t in 1980 and 1981 to a high of about 9 200 t in 1972 (Fig. 13.1). Catches increased to around 9 000 t in the mid-1980s but then declined steadily to less than 1200 t in 1994, when a moratorium was imposed on the stock. Since then, catches have averaged about 500 t; in 2013 the catch was estimated to be 323 t, taken mainly in the NRA.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21A | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.4 | 0.4 | 0.3 | 0.3 | |
| STACFIS | 0.3 | 0.5 | 0.2 | 0.3 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | |

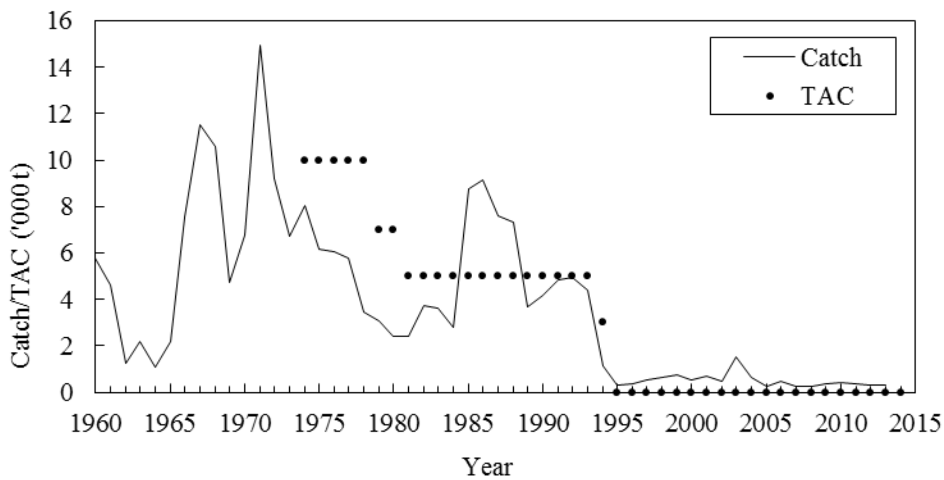



Fig. 13.1. Witch flounder in Div. 3NO: catches and TAC. No directed fishing is plotted as 0 TAC.

**b) Data Overview**

***i) Commercial fishery data***

**Catch and effort**. There were no recent catch per unit effort data available.

**Length frequencies.** Length sampling was available from by-catches in directed fisheries for other species by EU-Spain, EU-Portugal, and Russia in 2013. The Spanish data, from Div. 3N Greenland halibut and skate fisheries, showed most of the witch catch was between 35 and 49 cm in length, with a peak at 40 cm (SCR Doc. 14/006). LF samples were available from the 130 mm mesh in the Portuguese data for Div. 3N, lengths between 36cm and 42cm dominated the catch with a mode at 40 cm (mean length of 35.1 cm). In Div. 3N (280 mm mesh size) the Portuguese catch lengths ranged from 30 to 38 cm (mean length of 34.9 cm). In Div. 3O (130 mm mesh size) the Portuguese catch showed more small fish, as lengths between 28cm and 36cm dominated the catch, with a modal class at 32 cm (mean length of 34.6 cm) (SCS Doc. 14/010). For Russia, sampling of witch by-catch in Div. 3NO showed the lengths ranged from 26 to 50 cm, with a mean length 42.5 cm. Individuals from 32 to 44 cm in length made up the bulk of catches (SCS Doc. 14/13).

***ii) Research survey data***

**Canadian spring RV surveys**. The Div. 3NO estimates of biomass index, although variable, have shown a general decreasing trend from 1985 to 1998 followed by an increase from 1998 to 2003. From 2010 to 2013 the index increased to values near the series high from 1987, although the 2013 point estimate is imprecise (Fig. 13.2).

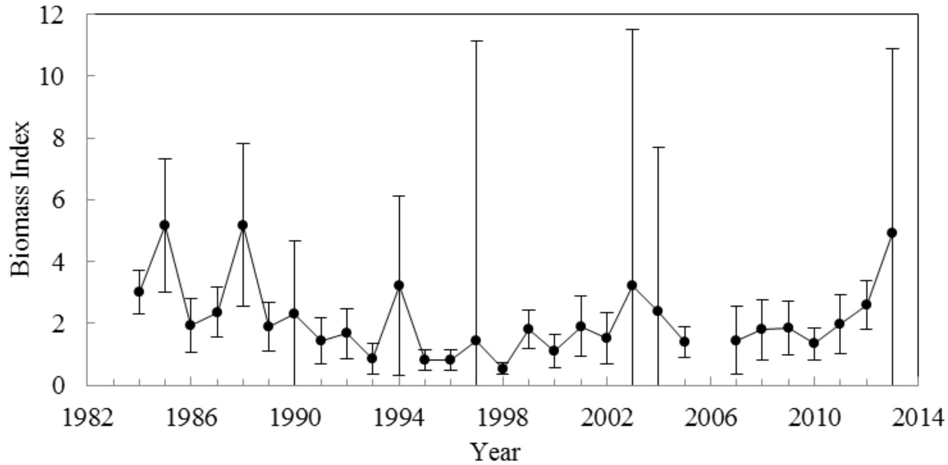



Fig. 13.2. Witch flounder in Div. 3NO: biomass indices from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1996, Campelen equivalent units. Due to substantial coverage deficiencies values from 2006 are not presented.

An index of Canadian spring survey spawning stock biomass from 1984 to 2012 indicated an increase from the lowest levels of the mid-1990s but remained well below the peak values from 1985 to 1990. The spawning stock biomass index was not updated in 2013.

**Canadian autumn RV surveys**. Trends in the autumn survey are complicated slightly by variable coverage of the deeper strata (>732m). There has not been complete coverage of the deeper strata since 2007 in Div. 3N or 2009 in Div. 3O, additionally, these depths will not be sampled in future Canadian surveys. Biomass indices in Div. 3NO (Fig. 13.3) have shown a general increasing trend since 1996. The indices increased substantially from 2007 to 2009 reaching the highest value in the series. Over 2008-2013 values have been approximately twice the time series average.

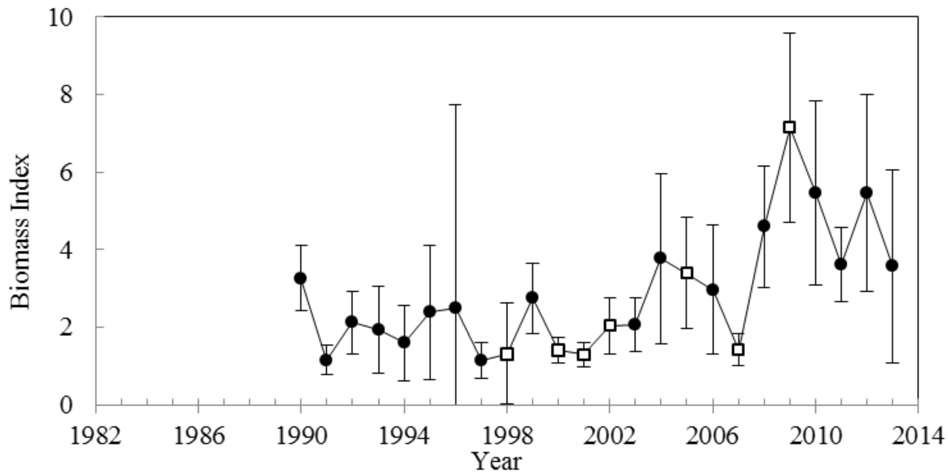
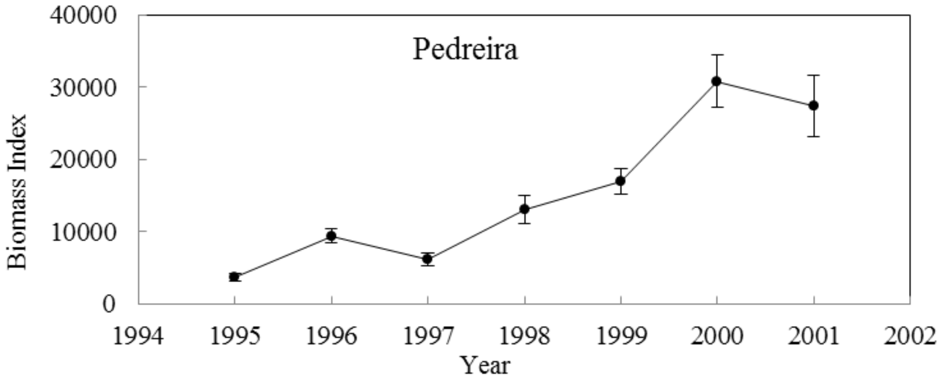



Fig. 13.3. Witch flounder in Div. 3NO: biomass indices from Canadian autumn surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. Open square symbols refer to years in which more than 50% of the deep water (> 730 m) strata were covered by the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

**EU-Spain RV survey biomass**. Surveys have been conducted annually from 1995 to 2013 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 series, the biomass increased from 1995-2000 but declined in 2001. In the Campelen gear series, the biomass index has been somewhat variable but generally decreased from 2001 to 2007. This was followed by an increase from 2007 to 2010 to levels near the previous series high of 2004. Since 2010, although variable, the biomass indices have generally decreased from 2010 to 2013.



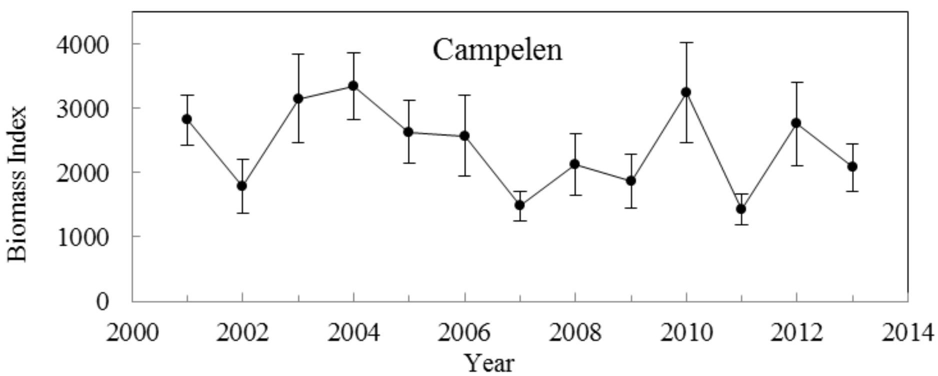




Fig. 13.4. Witch flounder in Div. 3NO: biomass indices from Spanish Div. 3NO surveys (± 1 standard deviation). Data from 1995-2001 is in Pedreira units; data from 2001-2013 are Campelen units. Both values are present for 2001.

**Abundance at length.** Abundance at length in the Canadian surveys appears to be fairly consistent since 1995 with few fish greater than 50 cm, and a mode generally around 40 cm. However, from 2004 to 2013 there has been an increase in the number of fish in the 30-50 cm range. There have been very few strong peaks (presumably year classes) that could be followed in successive years. There have been no strong peaks at lengths less than 21 cm, which would possibly indicate large year classes, since 2002. The highest levels of small fish were in the late 1990s, and values since 2002 have been variable but mostly below the mean of the series.

**Distribution**. Analysis of distribution data from the surveys show that this stock is mainly distributed in Div. 3O along the southwestern slope of the Grand Bank. In most years the distribution is concentrated toward this slope but in certain years, a higher percentage is distributed in shallower water. There are also seasonal differences, as witch flounder tend to be distributed more along the slope in spring, and further out on the shallower waters of the bank in autumn. Distributions of juvenile fish (less than 21 cm) appeared to be slightly more prevalent in shallower water during autumn surveys. It is possible however, that the juvenile distribution may be more related to the overall pattern of witch flounder being more widespread in shallower waters during the autumn. In years where all strata are surveyed to a depth of 1462 m in the autumn survey, generally less than 5% of the Div. 3NO biomass was found in the deeper strata (731-1462 m).

**Fishing Mortality.** The ratio of catch over biomass index, a proxy for $F$, suggests fishing mortality has been low since a moratorium on directed fishing was imposed in 1994. Prior to the moratorium in 1994, there were two peaks of high C/B ratios, in the mid-1980s and then in the early-1990s. Since 1994, $F$ has been below $F_{lim}$.

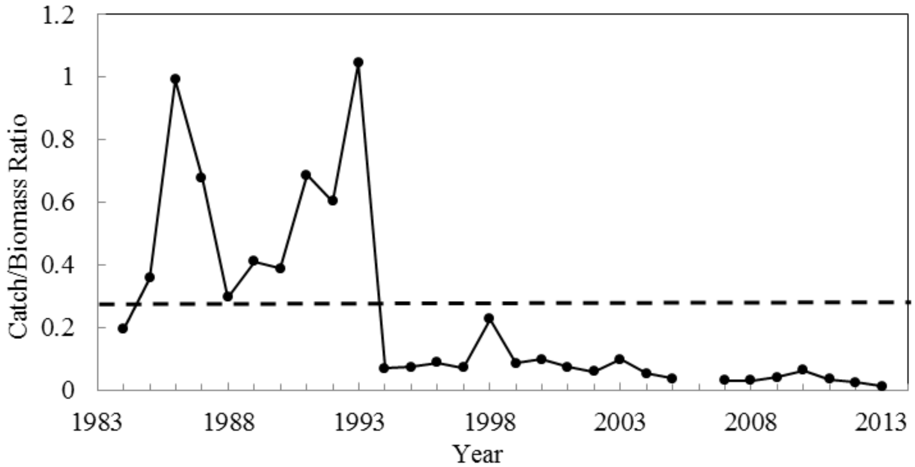



Fig. 13.5. Commercial bycatch of witch flounder divided by biomass estimates from the Canadian spring RV survey for NAFO Div. 3NO 1984-2012 Values are Campelen units or, prior to 1995, Campelen equivalent units. The horizontal line is $F_{lim}$ (see precautionary reference points section below)

**c) Estimation of parameters**

The application of a surplus production model in a Bayesian framework was explored for witch flounder in Div. 3NO. A variety of combinations of input data and prior distributions on the parameters was tested. Model results were found to be sensitive to the choice of the prior on survey catchabilities. Although the model shows promise, it was not considered to be acceptable for use in the assessment at this time.

**d) Assessment Results**

*Biomass*: The Canadian spring survey biomass indices increased substantially from 2011 to 2013 to levels near the time-series high. However, the 2013 point estimate was imprecise. A proxy for $B_{lim}$ was calculated to be 9 200. The biomass index has been above $B_{lim}$ since 2011.

The Canadian autumn survey biomass index was at the highest levels of the series from 2008 to 2013

The EU-Spanish spring survey biomass indices showed no clear trend from 2001 to 2013.

*Recruitment*: Recruitment (defined as fish less than 21cm) in both the spring and autumn Canadian surveys and the EU-Spanish spring surveys although somewhat variable has generally been low since 2002.

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

*State of the stock:* The stock has increased since 2010 and is likely to be above $B_{lim}$ since 2011, although the current status is measured with high uncertainty.

**e) Precautionary reference points**

A variety of approaches were examined to determine limit reference points or proxies. The best approach was determined to be to use the Canadian spring survey series, adjusted for depth coverage from 1984-1990 (by a factor of 1.25), to produce biomass limit reference point proxies. The series is highly variable with large uncertainty in some years. However, it is the only index that extends from a period of higher stock size to the present. The average of the two highest Canadian spring biomass index values between 1984-2013 is considered to be a proxy for $B_{msy}$. 30% of this average is considered to be a proxy for $B_{lim}$ (SCS Doc. 04/12). Following the same logic, a proxy for $F_{msy}$ ($=F_{lim}$) can be derived as 0.26 (based on catch/biomass ratio). Given uncertainties about the true status of the stock relative to $B_{msy}$ in the 1980s, the choice of the two highest points to provide a $B_{msy}$ proxy was considered as the most precautionary approach.

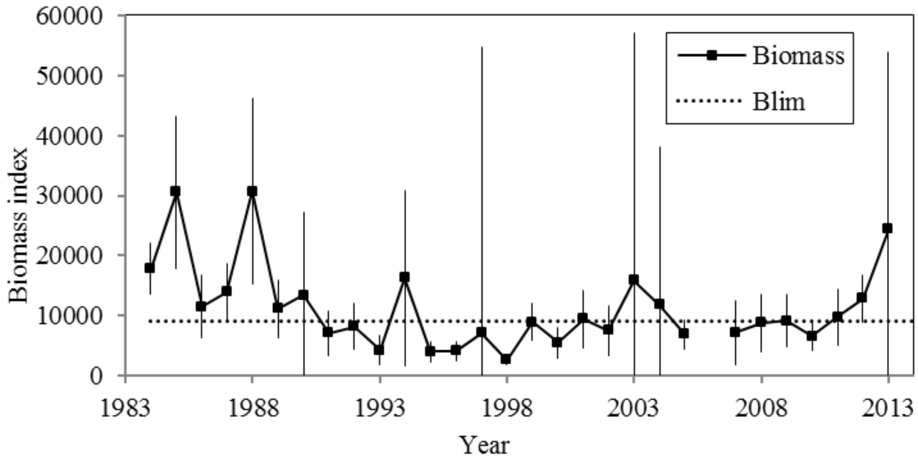



Fig. 13.6. Witch flounder in Div. 3NO: biomass index from Canadian spring surveys (95% confidence limits are given). Values are Campelen units or, prior to 1995, Campelen equivalent units. The dashed line is $B_{lim}$.

Since 1993, $F$ has been below $F_{lim}$ (Fig. 13.5). Biomass has increased since 2010 and is likely to be above $B_{lim}$, although the current status is measured with high uncertainty (Fig 13.7).

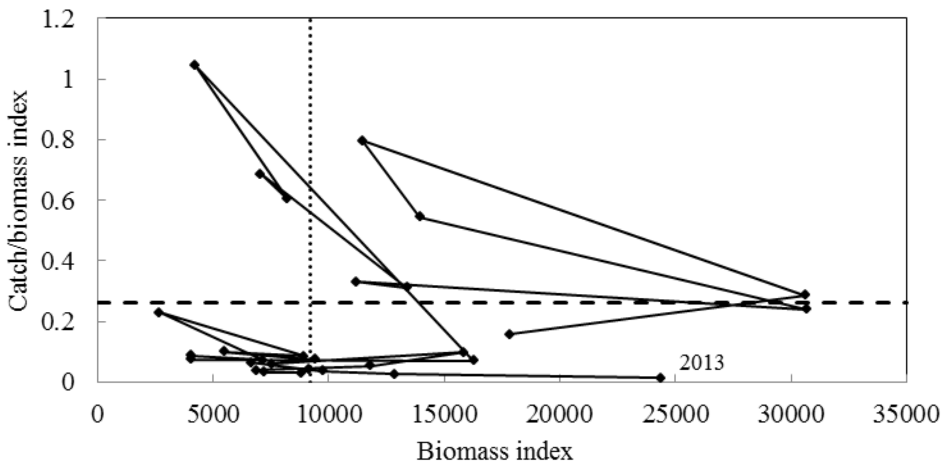



Fig. 13.7. Witch flounder in Div. 3NO: Catch to biomass ratio vs biomass index from Canadian spring surveys. The horizontal line is $F_{lim}$ and the vertical line is $B_{lim}$.

The next full assessment of this stock is scheduled for 2017. However, given recent dynamics in this stock Scientific Council plans to conduct a full assessment of its own accord in 2015.

**f) Research Recommendations**

STACFIS **recommends** *further investigation of survey indices of witch flounder in Div. 3NO in conjunction with those of Subdiv. 3Ps.*

Considering that Canadian autumn surveys are no longer planned for the deep waters of in Div. 3NO beyond 400 fathoms (732m), STACFIS **recommends** that *indices of abundance and biomass be developed that are comparative to the strata covered in the spring surveys.*

STACFIS **recommends** that *research into surplus production modelling in a Bayesian framework continue for Div. 3NO witch flounder*.

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

### 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 (Fig. 14.1). The stock has been under a moratorium to directed fishing since 1992. No catches have been reported for this stock since 1993.

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| 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

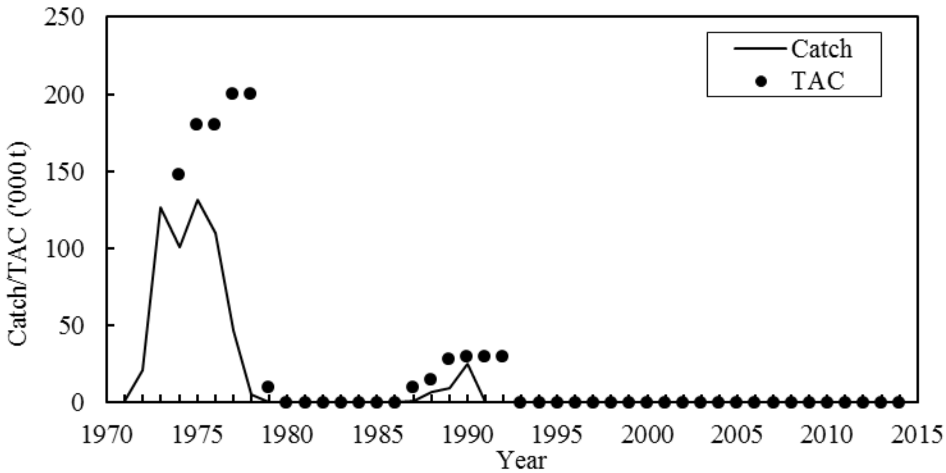



Fig. 14.1. Capelin in Div. 3NO: catches and TACs.

### 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 best indicator of stock dynamics currently available is capelin biomass from Canadian spring stratified-random bottom trawl surveys (Fig. 14.2). This index varied greatly over 1995-2013 without any clear trend. The time series maximum occurred in 2008 but the index declined rapidly over the next three years to one of the lowest values in the time series in 2011. In 2012 and 2013 the indices were again among the highest in the time series.

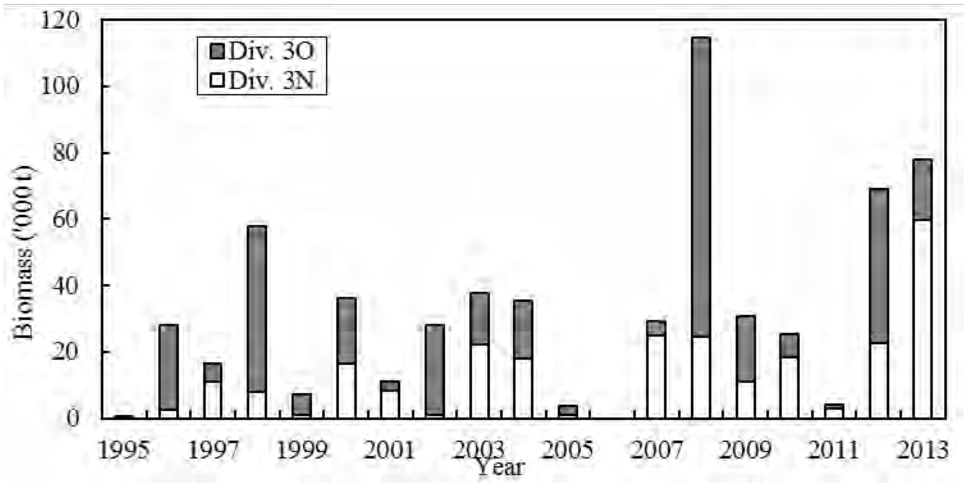



Fig. 14.2. Capelin in Div. 3NO: survey biomass index (bottom trawl) in 1995-2013.

**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 1990-2013. 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 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 1996-2013, the mean catch varied between 0.03 and 1.56 t/km$^2$. In 2013 this parameter was 0.57 t/km$^2$ (Fig. 14.3).

Bottom-trawling is not a satisfactory basis for a stock assessment of a pelagic species and survey results are indicative only.

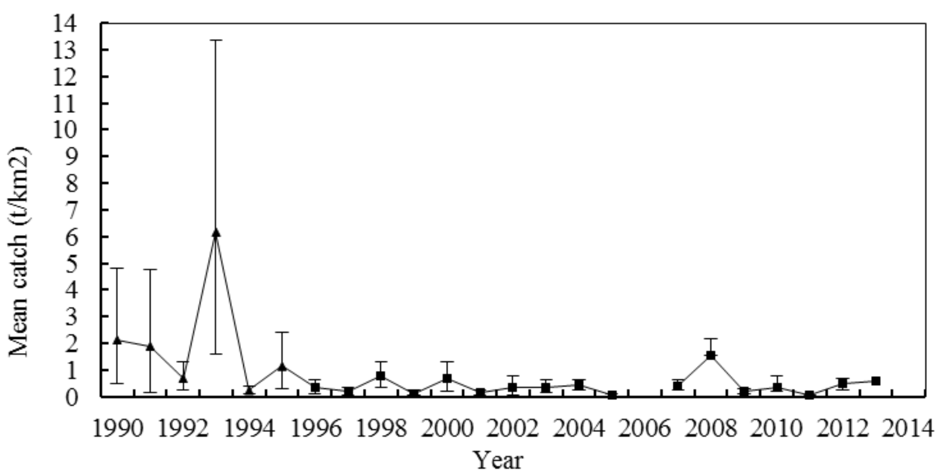



Fig. 14.3. Capelin in Div. 3NO: mean catch (t/km$^2$) in 1990-2013. Estimates prior to 1996 are from Engel and from 1996-2013 are from Campelen.

**d) Assessment Results**

An acoustic survey series that terminated in 1994 indicated a stock at a low level. Biomass indices from bottom trawl surveys since that time have not indicated any change in stock status, although the validity of such surveys for monitoring the dynamics of pelagic species is questionable.

### 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 2015.

## 15. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3O

### Interim Monitoring Report (SCR Doc. 14/006; SCS Doc. 14/06, 10, 13)

### 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 7 500 t with the 2013 catch estimated at 7 500 t.

Nominal catches and TACs ('000 t) for redfish in the recent period are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| STATLANT 21 | 11.9 | 11 | 7.5 | 5.1 | 6.3 | 6.5 | 6.5 | 6.4 | 7.5 | |
| STACFIS | 11.3 | 12.6 | 5.2 | 4.0 | 6.4 | 5.2 | 6.4 | 6.4 | 7.5 | |

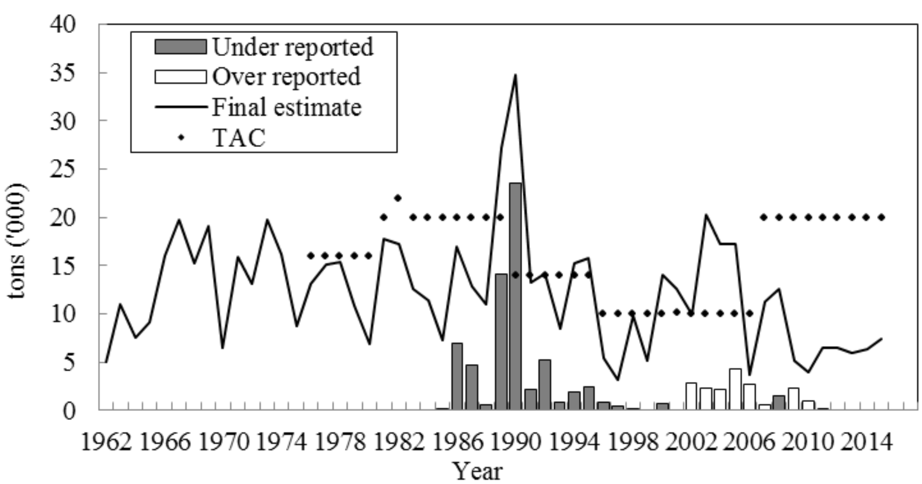



Fig. 15.1. Redfish in Div. 3O: catches and TACs. The TAC for 1997-2004 applied only within the Canadian EEZ.

## b) Data Overview

### *i) Surveys*

Canadian spring and autumn surveys were conducted in Div. 3O during 2013. 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 (Fig. 15.2). This may be influenced by one or two large sets on the survey. The spring biomass index increased steadily from 2008 to 2012, while the autumn biomass index increased from 2008 to 2010, then it remained stable to 2012. In 2013, both indices fell to levels comparable to those observed in 2008-2009. For the spring and autumn series, the 2013 biomass indices were 38% and 57%, respectively, of the average values over 2010-2012. The recent trend in abundance from the surveys is very similar to the trend in biomass. A relatively strong year-class born in the early 2000s constitutes the best sign of recruitment since the relatively strong 1998 year-class, but peak values in size frequency modes in 2013 were reduced to 23% (spring) and 40% (autumn) of 2012 values.

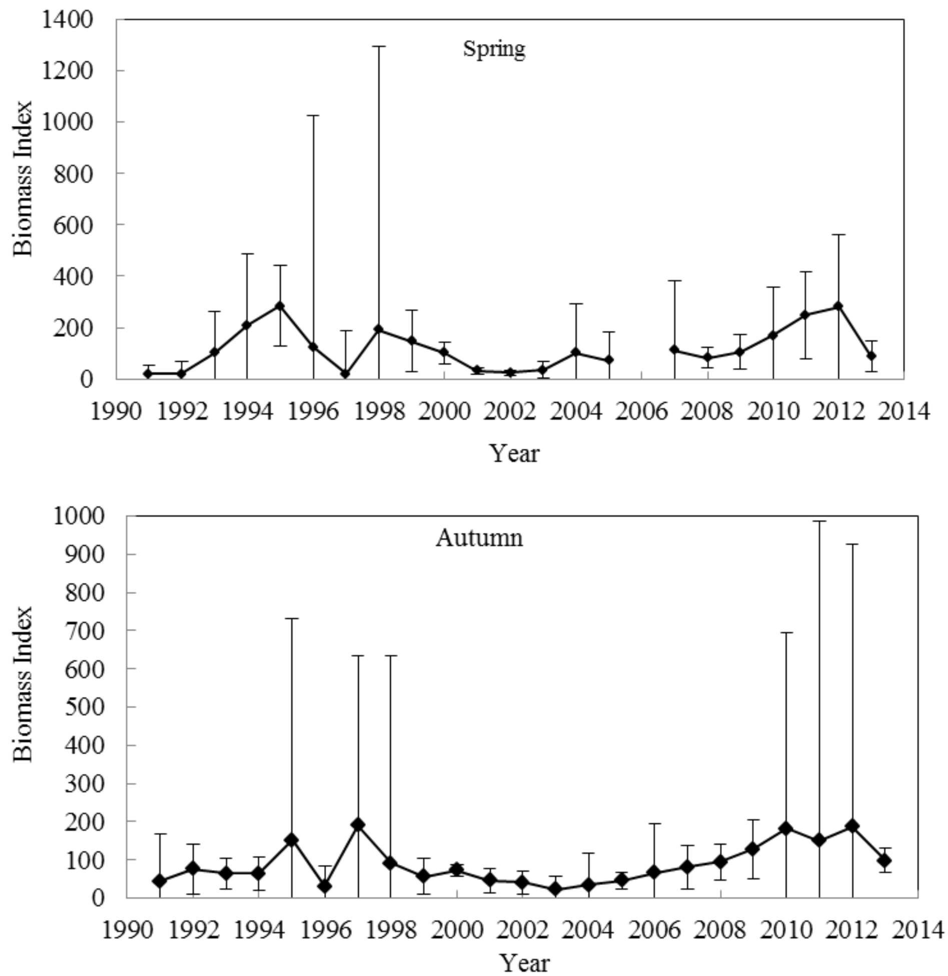



Fig. 15.2. Redfish in Div. 3O: Biomass index from Canadian RV surveys in Div. 3O (Campelen equivalent estimates prior to autumn 1995)

## c) Estimation of Stock Parameters

### *i) Catch/Biomass ratio*

A fishing mortality proxy derived from the ratio of catch to survey biomass was relatively high from 2001 to 2003, but values since 2007 are among the lowest in the time series (Fig. 15.3).

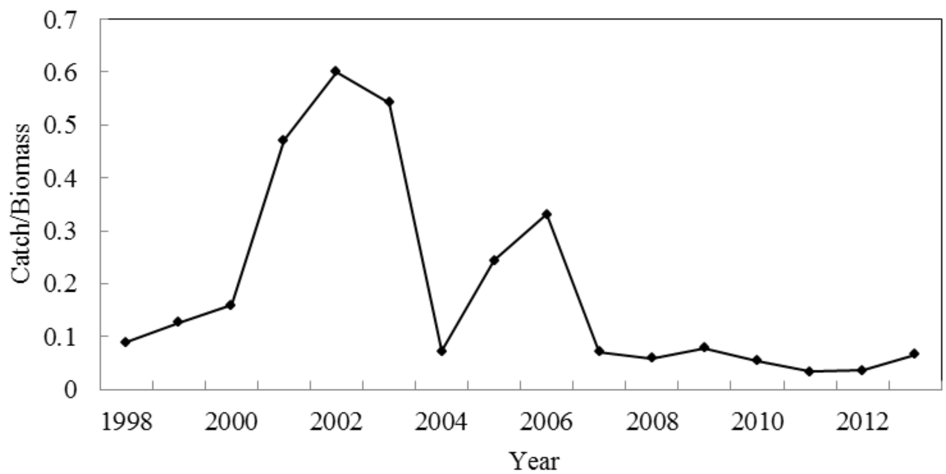



Fig. 15.3. Redfish in Div. 3O: Catch/survey biomass ratios for Div. 3O. Biomass was calculated as the average survey biomass between spring (*n*) and autumn (*n-1*) for year (*n*) in which catch was taken. The 2006 value of biomass comes from the autumn survey.

**d) Conclusion**

Catches were stable from 2009 to 2013. Survey indices increased or remained stable between years during the period 2009 to 2012, but both spring and autumn indices fell considerably in 2013 to below 2009 levels. Persistent and high variability in the indices makes it difficult to reconcile year to year changes. Current fishing mortality is low. Therefore, there is nothing to indicate a change in the status of the stock. The next full assessment of this stock is planned to be in 2016.

**e) Research Recommendations**

STACFIS **recommended** that *for Redfish in Div. 3O, a recruitment index be developed for this stock*.

STATUS: No progress on this recommendation; it will be addressed during the next full assessment.

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

(SCR Doc. 14/07, 12, 23; SCS Doc. 14/06, 10, 13, 14)

**a) Introduction**

Thorny skate on the Grand Banks was first assessed by Canada for the stock unit Div. 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. Based on the continuous distribution and lack of physical barriers between Div. 3LNO and Subdiv. 3Ps, thorny skate in Div. 3LNOPs is considered to constitute a single stock.

**Catch History.** Commercial catches of skates comprise a mix of skate species. However, thorny skate dominates, comprising about 95% of the skate species taken in the Canadian and EU-Spain catches. Thus, the skate fishery on the Grand Banks can be considered a fishery for thorny skate. In Subdivision 3Ps, Canada has established a TAC of 1 050 t. In 2005, NAFO Fisheries Commission established a TAC of 13 500 t for thorny skate in Div. 3LNO. For 2010 and 2011, the TAC for Div. 3LNO was reduced to 12 000 t. The TAC was further reduced to 8 500 t for 2012, and to 7 000 t for 2013-2014.

Catches for NAFO Div. 3LNO increased in the mid-1980s with the commencement of a directed fishery for thorny skate. The main participants in this new fishery were EU-Spain, EU-Portugal, Russia, and Canada. Catches by all countries in Div. 3LNOPs over 1985-1991 averaged 18 066 t; with a peak of 29 048 t in 1991 (STATLANT 21A). From 1992-1995, catches of thorny skate declined to an average of 7 554 t, however there are substantial uncertainties concerning reported skate catches prior to 1996. Average STACFIS catch in 3LNO for 2007-2012 was 5 292 t. STATLANT catch in 2013 was 4 353 t for Div. 3LNO and 285 t for Subdivision 3Ps.

Recent nominal catches and TACs (000 t) in NAFO Div. 3LNO and Subdiv. 3Ps are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Div. 3LNO: | | | | | | | | | | |
| TAC | 13.5 | 13.5 | 13.5 | 13.5 | 13.5 | 12 | 12 | 8.5 | 7 | 7 |
| STATLANT 21 | 3.5 | 5.5 | 6.2 | 7.1 | 5.7 | 5.4 | 5.5 | 4.3 | 4.4 | |
| STACFIS | 4.2 | 5.8 | 3.6 | 7.4 | 5.6 | 3.1 | 5.4 | 4.3 | 4.4 | |
| Subdiv. 3Ps: | | | | | | | | | | |
| TAC | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| STATLANT 21 | 1.0 | 1.0 | 1.8 | 1.4 | 0.6 | 0.3 | 0.5 | 0.4 | 0.3 | |
| Div. 3LNOPs: | | | | | | | | | | |
| STATLANT 21 | 4.5 | 6.5 | 8.0 | 8.5 | 6.3 | 5.7 | 6.1 | 4.6 | 4.6 | |
| STACFIS | 5.2 | 6.8 | 5.4 | 8.8 | 6.2 | 3.4 | 5.9 | 4.6 | 4.6 | |

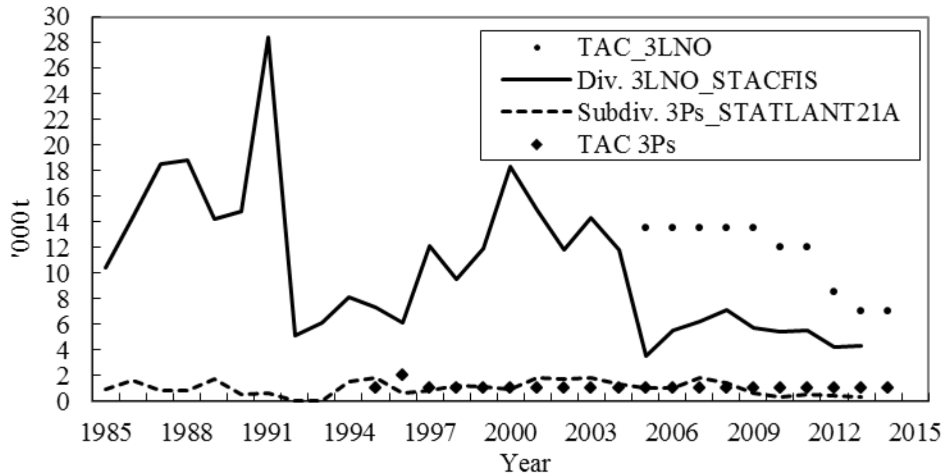



Fig. 16.1. Thorny skate catch in Div. 3LNO and Subdiv. 3Ps and TAC, 1985-20143.

**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, 1997-2013), EU-Portugal (2002-2004, 2006-2011, 2013), Russia (1998-2008, 2011- 2012), and Canada (1994-2008, 2010, 2012).

In skate-directed trawl fisheries (280 mm mesh), EU-Spain reported 23-93 cm skates in Div. 3N (mode at 42 cm). In 2013, EU-Portugal reported a similar range of skates, 26-85 cm in Div. 3N. In other trawl fisheries, Russian trawlers in Div. 3LN reported 24-78 cm skates (mode at 57 cm) in 2012.

Directing for monkfish with 305 mm mesh gillnets in Div. 3O, Canada caught an abbreviated range of larger thorny skates in 2012: 62-96 cm with a mode of 76 cm.

No standardized commercial catch per unit effort (CPUE) exists for thorny skate.

***ii) Research surveys***

**Canadian spring surveys**. Stratified-random research surveys have been conducted by Canada in Div. 3LNO and Subdiv. 3Ps in spring; using a Yankee 41.5 otter trawl in 1972-1982, an Engel 145 otter trawl in 1983-1995, and a Campelen 1800 shrimp trawl in 1996-2013. Subdiv. 3Ps was not surveyed in 2006, nor was the deeper portion (>103 m) of Div. 3NO in that year, due to mechanical difficulties on Canadian research vessels. The Canadian spring survey is considered the major indicator of the status of this stock, due to its spatial and temporal coverage.

Indices for Div. 3LNOPs in 1972-1982 (Yankee series) fluctuated without trend (Fig. 16.2a).

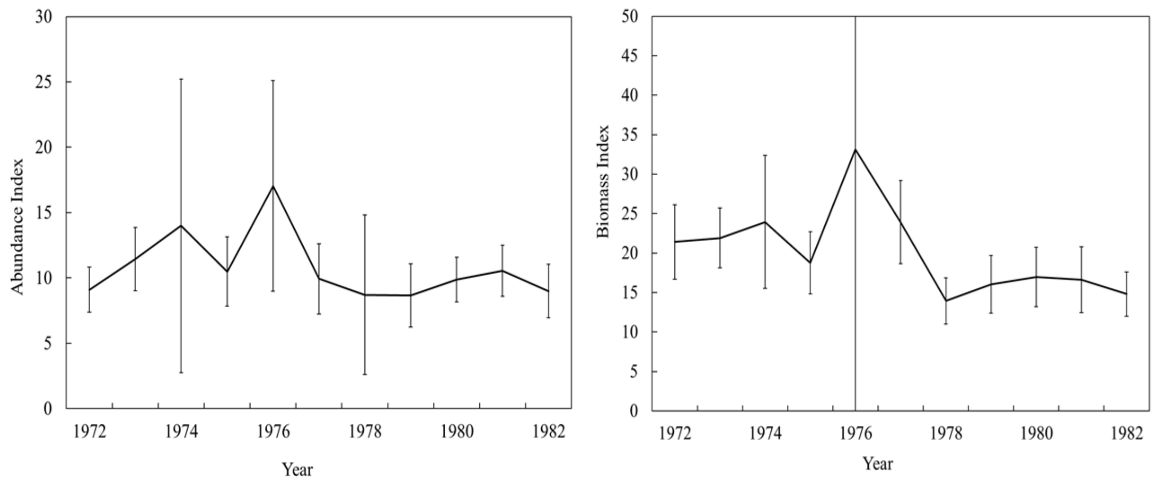
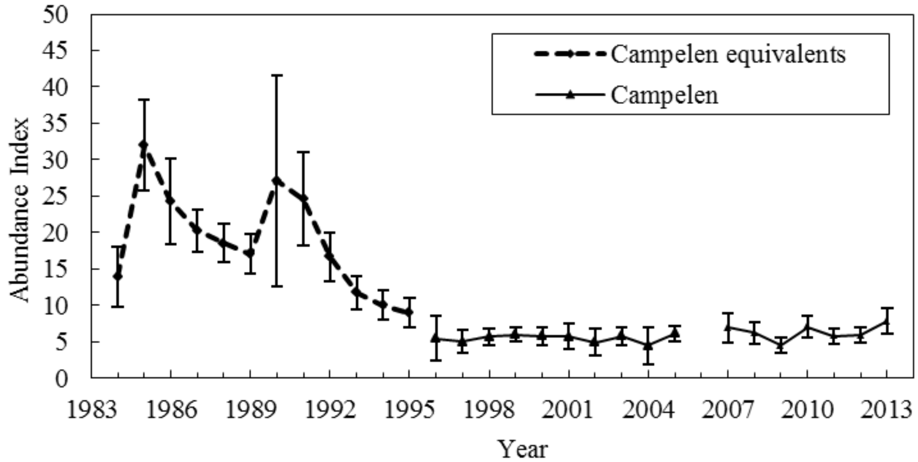



Fig. 16.2a. Thorny skate in Div. 3LNOPs: 1972-1982 abundance and biomass indices from Canadian spring surveys

Abundance and biomass indices are presented in Fig. 16.2b 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 increasing very slowly from low levels, while abundance indices remain relatively stable at very low levels.



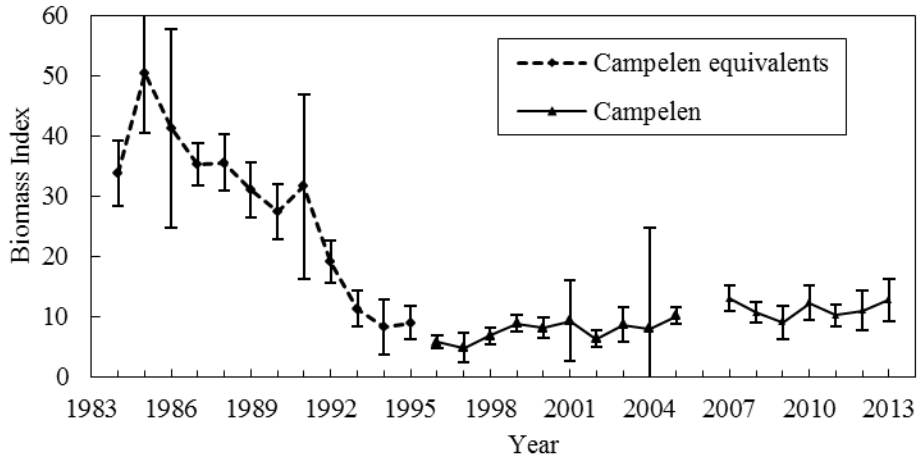




Fig. 16.2b. Thorny skate in Div. 3LNOPs, 1984-2013: abundance (top) and biomass (bottom) indices from Canadian spring surveys. The survey in 2006 was incomplete, due to mechanical difficulties on Canadian research vessels.

**Canadian autumn surveys.** Stratified-random autumn surveys have been conducted by Canada in Div. 3LNO in the autumn; using an Engel 145 otter trawl in 1990-1994, and a Campelen 1800 shrimp trawl in 1995-2013.

Autumn survey indices, similar to spring estimates, declined during the early 1990s. Catch rates have been stable at very low levels since 1995 (Fig. 16.3).

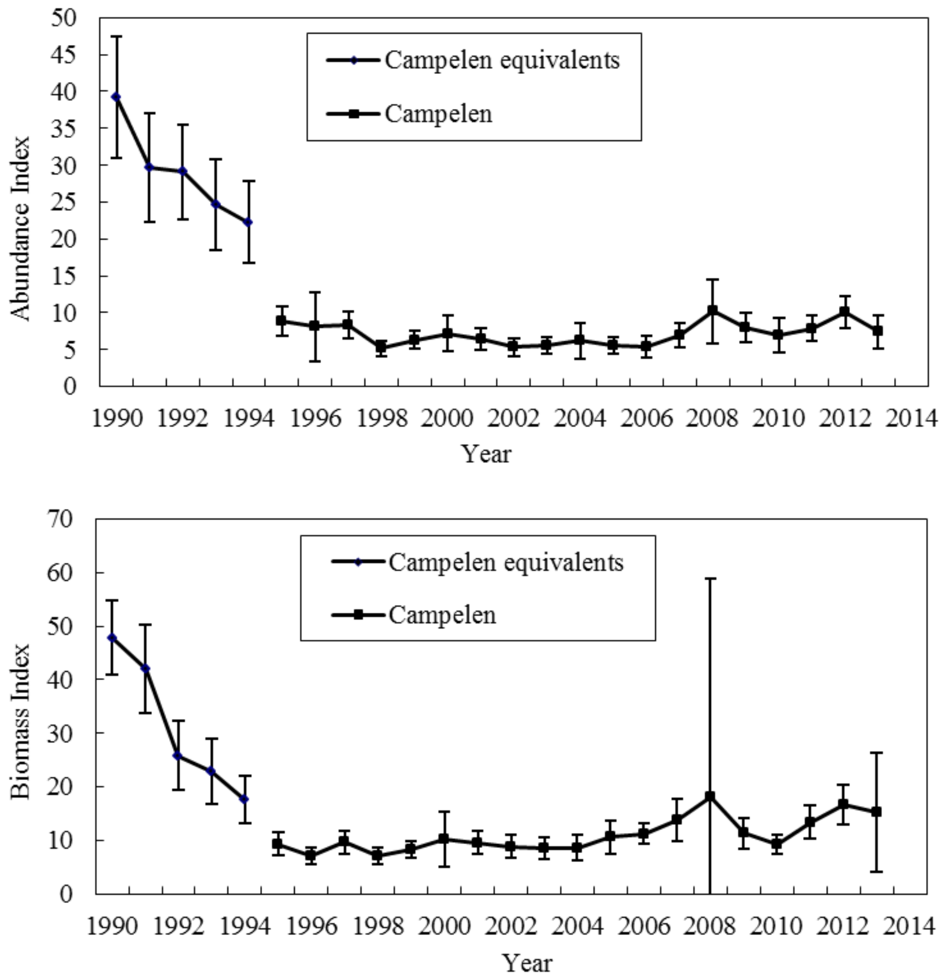



Fig. 16.3. Thorny skate in Div. 3LNO, 1990-2013, abundance (top) and biomass (bottom) indices from Canadian autumn surveys.

**EU-Spain 3NO survey**. The biomass trajectory from the EU-Spain May/June survey was very similar to that of Canadian spring surveys until 2006 (Fig. 16.4). In 2007, the two indices diverged: the EU-Spain index declined, while the Canadian Div. 3NO biomass index fluctuated within a narrow range. A comparison of common sampled strata between both time series found little difference between 1997-2005 and 2007-2010. Differences in biomass indices appear to result from reduced catches in the EU-Spain survey of deeper (~750 m) strata that were not sampled by Canadian surveys. The EU-Spain index has been variable in recent years at a lower level relative to 2004-2006.

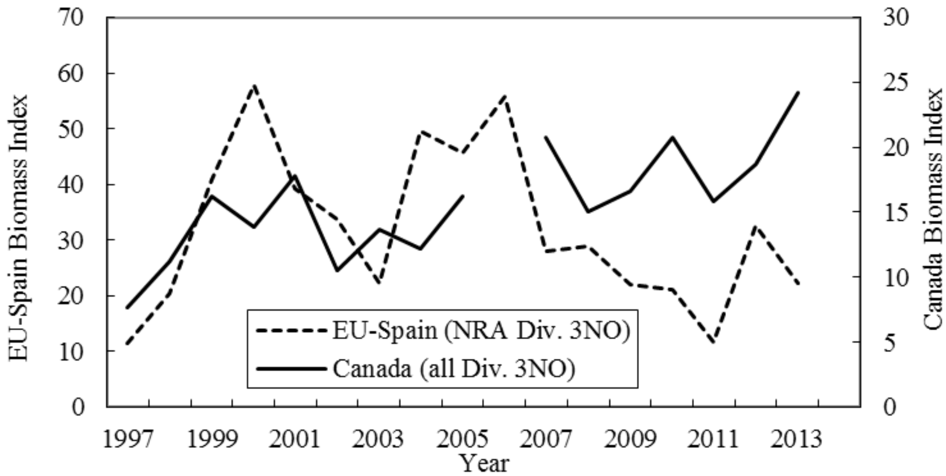



Fig. 16.4. Thorny Skate in Div. 3NO: estimates of biomass from EU-Spain spring surveys and Canadian spring surveys from 1997-2013.

**EU-Spain Div. 3L survey.** EU-Spain survey indices in the NRA of Div. 3L are available for 2003-2013 (excluding 2005). The stratified random survey is conducted in August by the R/V *Vizconde de Eza* using a Campelen bottom trawl. The survey only occurs in the NAFO Regulatory Area (Flemish Pass); thus not sampling the entire Division. The EU-Spain Div. 3L index has been generally stable since 2009, which is similar to the Canadian spring and autumn indices.

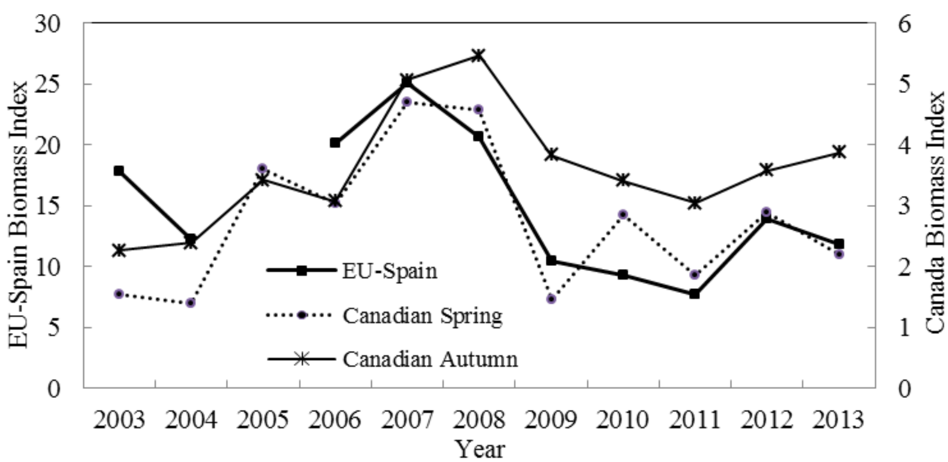



Fig. 16.5. Thorny skate in Div. 3L: Biomass indices from EU-Spain Div. 3L survey and the Canadian spring and autumn research surveys for Div. 3L from 2003-2013.

***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 1996-2013, the abundance of thorny skate recruits (5-20 cm TL) and immature skates have increased since 2010, and estimates of mature skates fluctuated along an increasing trend.

Recruitment index (skate < 21 cm) has been below average from 1997-2007. The index has been above average during 2010-2013. 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.

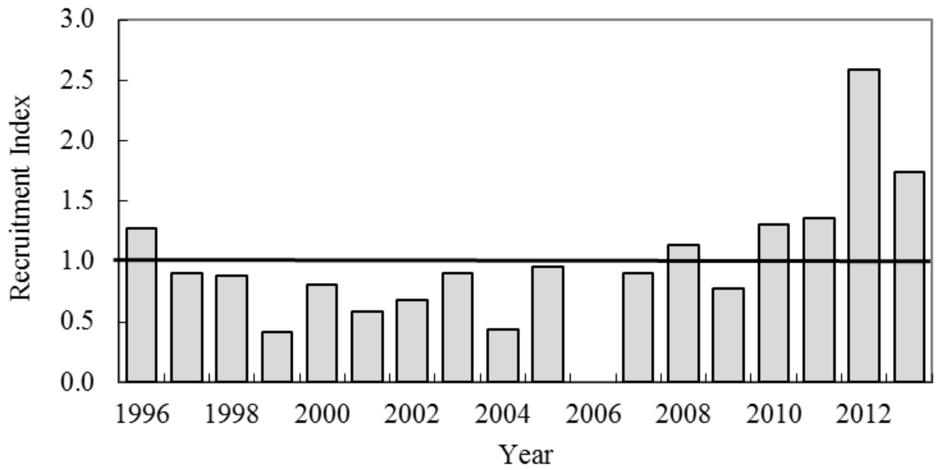



Fig. 16.6. Thorny skate in Div. 3LNOPs. Standardized recruitment index from Canadian spring surveys in Div. 3LNOPs, 1996-2013. Survey in 2006 was incomplete.

**c) Estimation of Parameters**

A fishing mortality index (catch/survey biomass for Div. 3LNO) has been declining since the mid-1990s and is currently low. Fishing mortality in Subdivision 3Ps has also been low in current years.

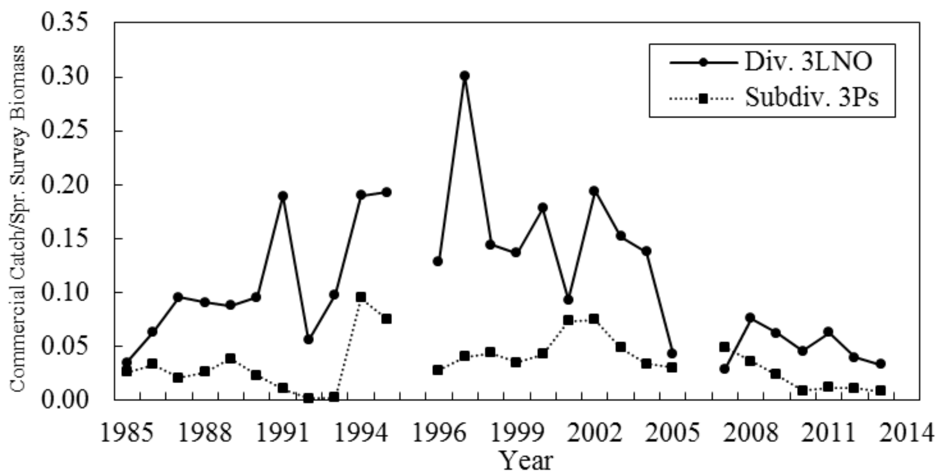



Fig. 16.7. Fishing Mortality Index (catch/spring survey biomass) for thorny skate in Div. 3LNO and Subdiv. 3Ps in 1985-2013. Commercial catch estimates are STACFIS-agreed numbers; biomass indices are from Canadian Campelen spring research surveys. Survey in 2006 was incomplete.

**d) Assessment Results**

*Assessment Results:* No analytical assessment was performed.

*Biomass:* Biomass has been increasing very slowly from low levels since the mid-1990s. The pattern from the Canadian autumn survey, for comparable periods, was similar.

*Fishing Mortality:* A fishing mortality index (Catch/survey biomass for Div. 3LNO) has been declining since the mid-1990s and is currently low.

*Recruitment:* Recruitment was below average from 1997 to 2007. Recruitment has been above average during 2010-2013.

*Reference Points*: None defined.

*State of the Stock:* The stock has been increasing very slowly from low levels since the mid-1990s. Recruitment in 2010-2013 has been above average.

**e) Research Recommendations**

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

STACFIS **recommends** that *survey indices be investigated to compare catch rates in relation to depth in the spring and autumn surveys, stock distribution and comparison between Div. 3LNO and Subdivision 3Ps.*

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

Interim Monitoring Report (SCR Doc. 14/007; SCS Doc. 14/06, 10, 13)

**a) Introduction**

The advice requested by Fisheries Commission is for NAFO Div. 3NO. Previous studies indicated that white hake constitute a single unit in Div. 3NOPs, and that fish younger than 1 year, 2+ juveniles, and mature adults distribute at different locations within Div. 3NO and Subdiv. 3Ps. This movement of fish of different stages between areas must be considered when assessing the status of white hake in Div. 3NO. Therefore, an assessment of Div. 3NO white hake is conducted with information on Subdiv. 3Ps included.

Canada commenced a directed fishery for white hake in 1988 in Div. 3NO and Subdiv. 3Ps. All Canadian landings prior to 1988 were as bycatch in various groundfish fisheries. EU-Spain and EU-Portugal commenced a directed fishery in 2002, and Russia in 2003, in the NAFO Regulatory Area (NRA) of Div. 3NO; resulting in the 2003-2004 peak. In 2003-2004, 14% of the total landings of white hake in Div. 3NO and Subdiv. 3Ps were taken by Canada, but increased to 93% by 2006; primarily due to the absence of a directed fishery for this species by other countries. A TAC for white hake was first implemented by Fisheries Commission in 2005 at 8 500 t, and then reduced to 6 000 t for 2010 and 2011. The 5 000 t TAC in Div. 3NO for 2012 was further reduced to 1 000 t for 2013 and 2014.

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 1987 at 8 061 t (Fig. 17.1). With the restriction of fishing by other countries to areas outside Canada's 200-mile limit in 1992, non-Canadian catches fell to zero. Average catch was low in 1995-2001 (422 t), then increased to 5 365 t in 2002 and 6 158 t in 2003; following recruitment of the large 1999 year-class. STACFIS-agreed catches decreased to an average of 752 t in 2005-2010. Catches declined to 163 t and 142 t in 2011 and 2012 respectively in Div. 3NO. Catches of white hake in NAFO Div. 3NO in 2013 were 203 t.

Commercial catches of white hake in Subdiv. 3Ps were less variable, averaging 1 114 t in 1985-93, then decreasing to an average of 619 t in 1994-2002 (Fig. 17.1). Subsequently, catches increased to an average of 1 374 t in 2003-2007, then decreased to a 368-t average in 2008-2012. Catches of white hake in NAFO Subdiv. 3Ps in 2013 were 170 t.

Recent reported landings and TACs ('000 t) in NAFO Div. 3NO and Subdiv. 3Ps are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| Div. 3NO: | | | | | | | | | | |
| TAC | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 6 | 6 | 5 | 1[1] | 1[1] |
| STATLANT 21 | 1 | 1.2 | 0.7 | 0.9 | 0.5 | 0.3 | 0.2 | 0.1 | 0.2 | |
| STACFIS | 0.9 | 1.1 | 0.6 | 0.9 | 0.4 | 0.2 | 0.2 | 0.1 | 0.2 | |
| Subdiv. 3Ps: | | | | | | | | | | |
| STATLANT 21 | 1.6 | 1.5 | 1.3 | 0.7 | 0.4 | 0.4 | 0.2 | 0.2 | 0.2 | |

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

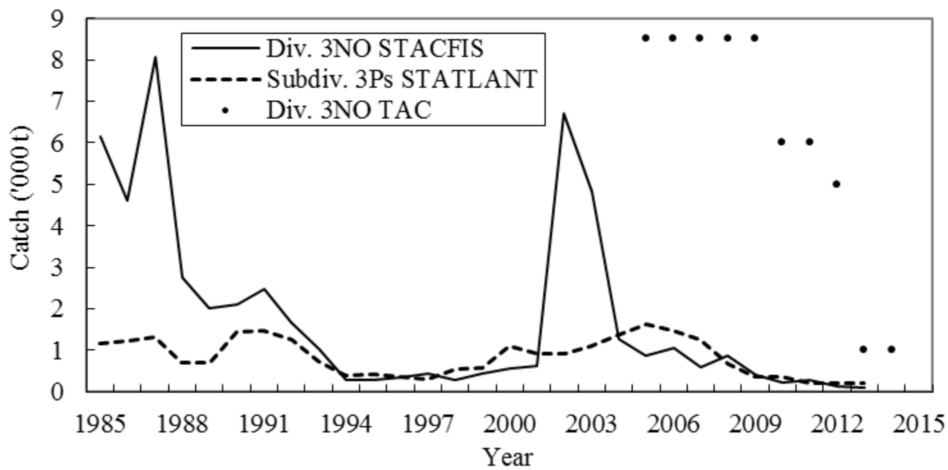



Fig. 17.1. White hake in Div.3NO and Subdivision 3Ps: Total catch of white hake in NAFO Division 3NO (STACFIS) and Subdiv. 3Ps (STATLANT-21A). The Total Allowable Catch (TAC) in Div. 3NO is indicated on the graph.

**b) Data Overview**

***i) Research survey data***

**Canadian stratified-random bottom trawl surveys**. Data from spring research surveys in NAFO Div. 3N, 3O, and winter-spring surveys in Subdiv. 3Ps were available from 1972 to 2013. In the 2006 Canadian spring survey, most of Subdiv. 3Ps was not surveyed, and only shallow strata in Div. 3NO (to a depth of 77 m in Div. 3N; to 103 m in Div. 3O) were surveyed; thus the survey estimate for 2006 was not included. Data from autumn surveys in Div. 3NO were available from 1990 to 2013. 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. In Subdiv. 3Ps, survey timing changed from winter to spring during 1993. Canadian autumn surveys in Div. 3NO were conducted with an Engel 145 trawl from 1990 to 1994, and a Campelen 1800 trawl from 1995-2012. There are no survey catch rate conversion factors between trawls for white hake; thus each gear type is presented as a separate time series.

Abundance and biomass indices of white hake from the Canadian spring research surveys in Div. 3NOPs are presented in Fig. 17.2a. In 2003-2010, the population remained at a level similar to that previously observed in the Campelen time series for 1996-1998. The dominant feature of the white hake abundance time series was the peak observed over 2000-2001. In recent years, the spring abundance of white hake increased in 2011 but declined in 2012. Biomass in 2011 and 2012 remained stable at levels similar to those observed since 2005. In 2013, both the biomass and abundance estimates were similar to those observed in the previous year.

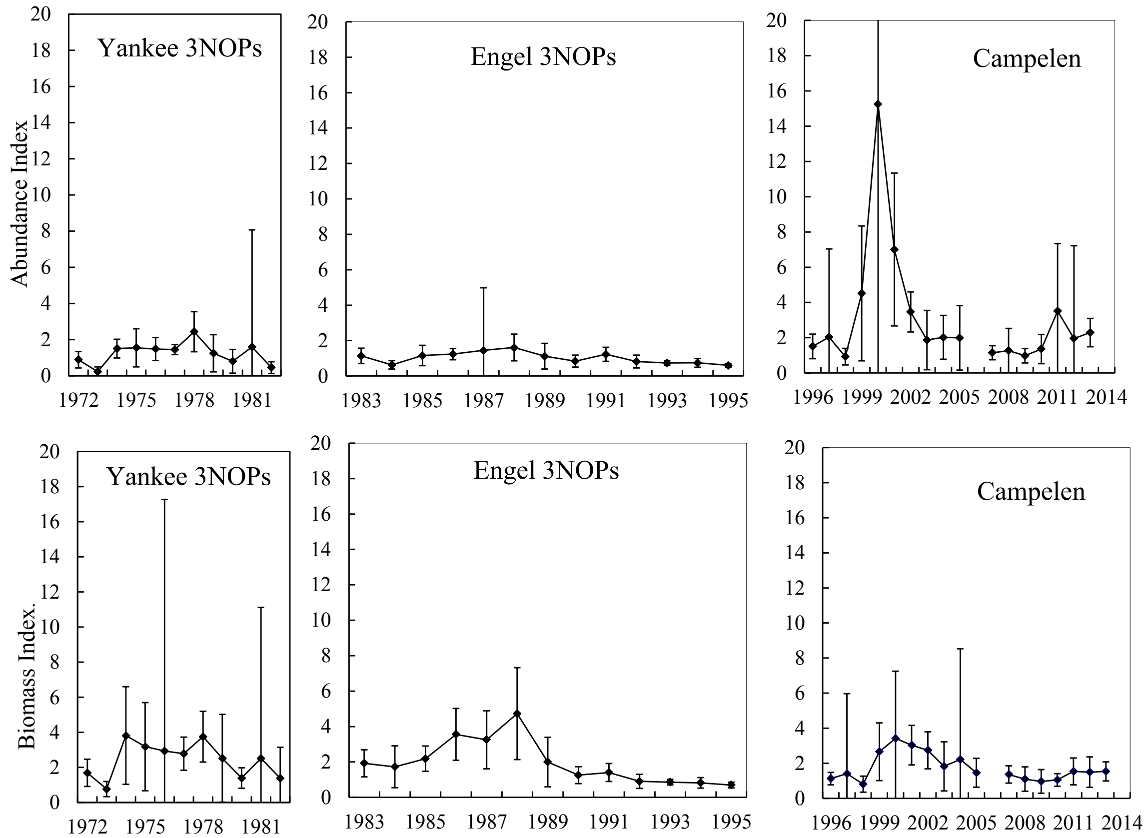



Fig. 17.2a. White hake in Div. 3NO and Subdiv. 3Ps: abundance and biomass indices from Canadian winter-spring research surveys, 1972-2013. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. Yankee, Engel, and Campelen time series are not standardized, and are presented on separate panels. Error bars are 95% confidence limits.

Canadian autumn surveys of Div. 3NO (Fig. 17.2b) have the peak in abundance reflected by the very large 1999 year-class. Autumn abundance indices then declined to levels similar to those observed during 1996-1998 until 2010. The biomass index has been increasing steadily since 2010.

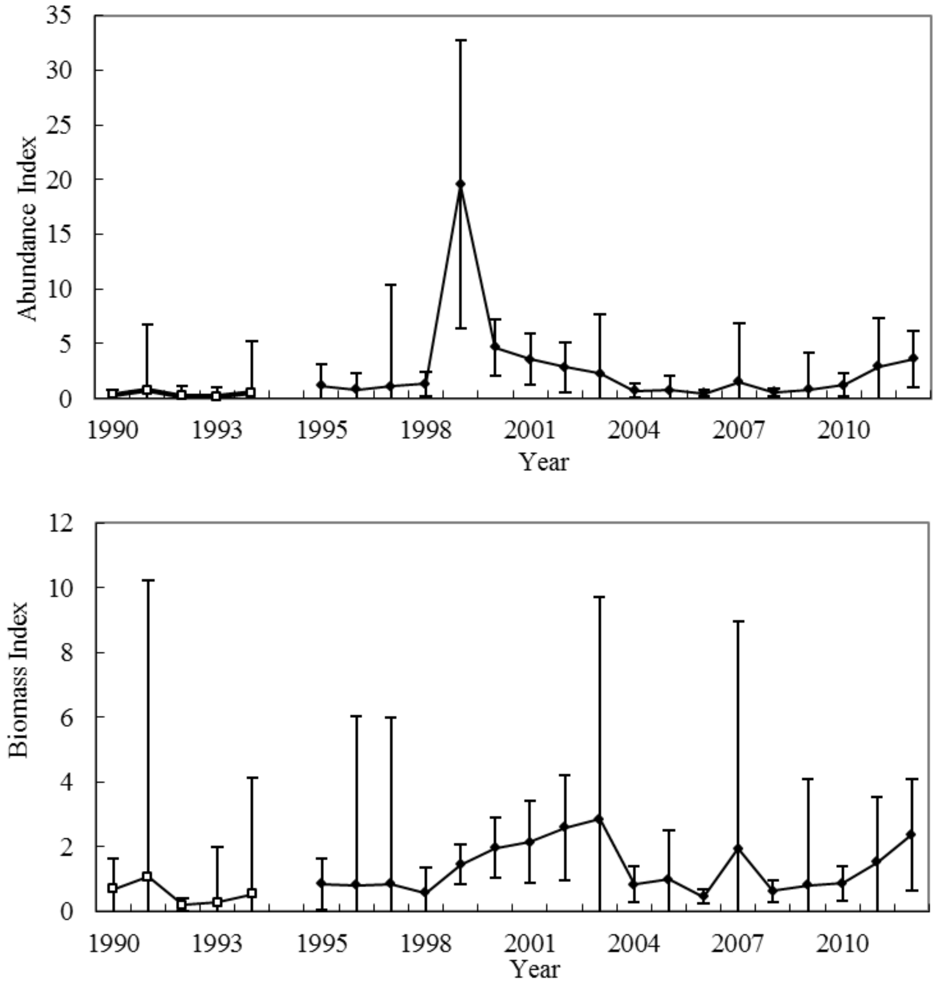



Fig. 17.2b White hake in Div. 3NO: abundance (top panel) and biomass indices (bottom panel) from Canadian autumn surveys, 1990-2013. Engel (□, 1990-1994) and Campelen (♦, 1995-2013) time series are not standardized. Error bars are 95% confidence limits.

**EU-Spanish stratified-random bottom trawl surveys in the NRA.** EU-Spain biomass indices in the NAFO Regulatory Area (NRA) of Div. 3NO were available for white hake from 2001 to 2013 (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. Generally, the EU-Spain biomass index has been increasing since 2008. The overall trend is similar to that of the Canadian spring biomass index (Fig. 17.3).

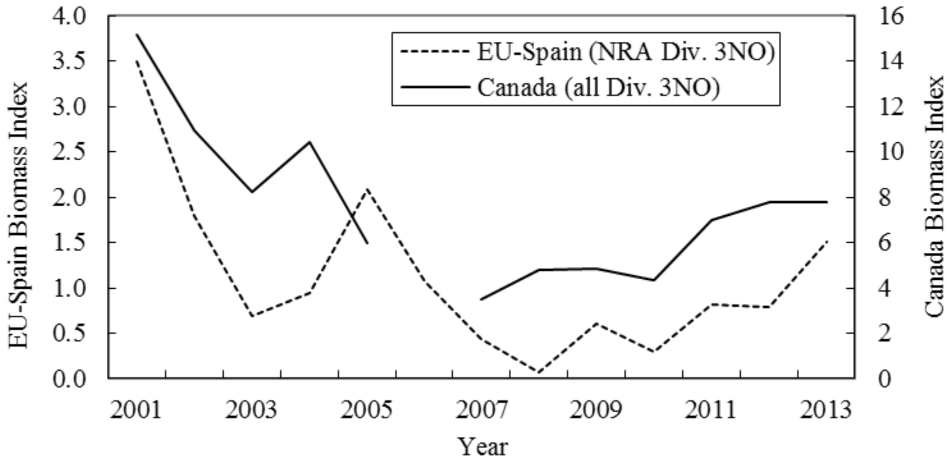



Fig. 17.3. White hake in the NRA of Div. 3NO: Biomass indices from EU-Spain Campelen spring surveys in 2001-2013 compared to Canadian spring survey indices in all of Div. 3NO. Estimates from 2006 Canadian survey are not shown, since survey coverage in that year was incomplete.

**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 recruitment index in 1999 and 2000 was large, but no large value was observed during 2001-2010. The index of recruitment for 2011 is comparable to that seen in 1999. The index declined in 2012, but slightly recovered in 2013 (Fig. 17.4).

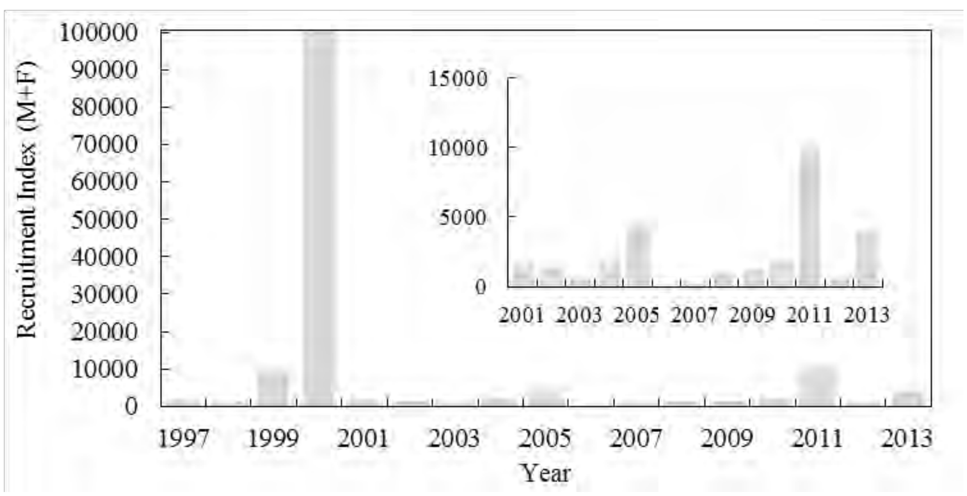



Fig. 17.4 White hake in Div. 3NO and Subdiv. 3Ps: recruitment index (Young of the year male and female=M+F) from Canadian Campelen spring surveys in Div. 3NO and Subdiv. 3Ps during 1997-2013. Estimates from 2006 are not shown, since survey coverage in that year was incomplete. Inset plot depicts 2001-2013 on a smaller scale.

### c) Conclusion

Based on current information there is no significant change in the status of this stock. Stock biomass remains at relatively low levels, and no large recruitments have been observed since 2000.

### d) Research Recommendations

STACFIS **recommended** that *age determination should be conducted on otolith samples collected during annual Canadian surveys (1972-2009+); thereby allowing age-based analyses of this population*.

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

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

STATUS: No progress on this recommendation. This recommendation is reiterated.

The next full assessment of this stock is planned for 2015.

## D. WIDELY DISTRIBUTED STOCKS: SA 2, SA 3 AND SA 4

(SCR Doc. 14/10, 11, 13, 14, SCS Doc. 14/14)

Recent Conditions in Ocean Climate and Lower Trophic Levels

●Ocean climate composite index across Labrador to the Scotian Shelf (SA2-4) remain well above normal in 2013 and recent years.

●The composite spring bloom index has remained at or above normal since 2006 but shifted to a negative phase in 2013.

●The composite zooplankton reached its highest level in 2013.

●The composite trophic index was positive in 2013 after several years of consistent negative anomalies and reaching the second lowest level in 2012.

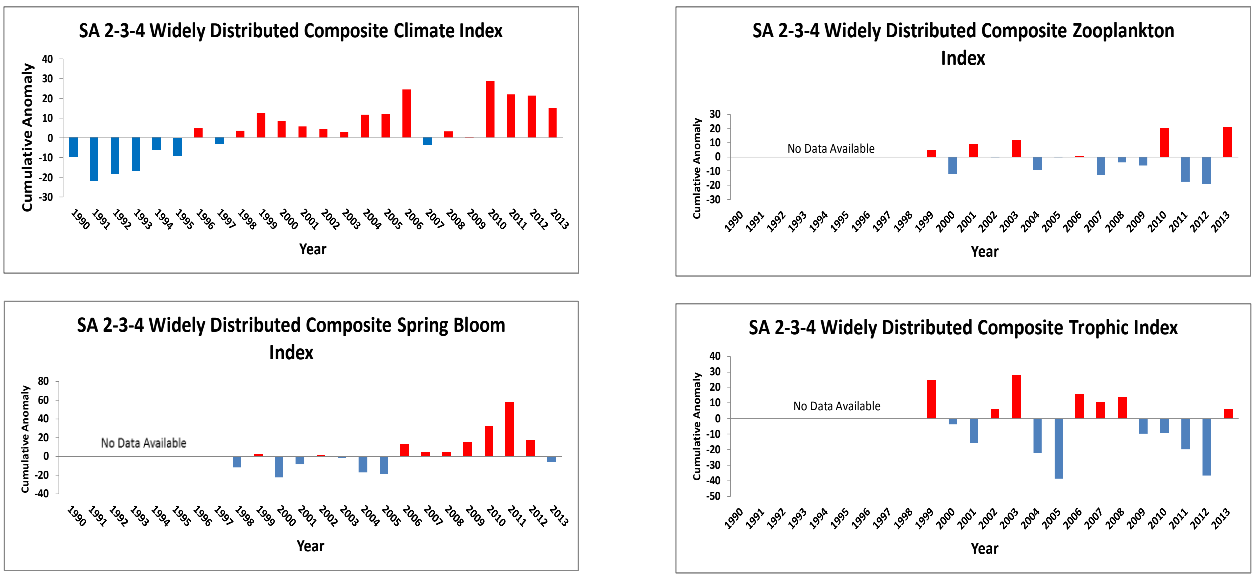



Fig. 4. Composite ocean climate index for NAFO Subarea 2-3-4 (widely distributed stocks) derived by summing the standardized anomalies (top left panel) during 1990-2013, composite spring bloom (summed background chlorophyll *a*, magnitude and amplitude indices) index during 1998-2013 (bottom left), composite zooplankton (cumulative anomalies of the four functional plankton taxa) index during 1999-2013 (top right panel), and composite trophic (summed anomalies of nutrient and standing stocks of phyto- and zooplankton indices) index (bottom right panel) during 1999-2013. Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

**Environmental Overview**

The water mass characteristics of Newfoundland and Labrador Shelf are typical of sub-polar waters with a sub-surface temperature range of -1-2ºC and salinities of 32-33.5. Labrador Slope Water flows southward along the shelf edge and into the Flemish Pass region, this water mass is generally warmer and saltier than the sub-polar shelf waters with a temperature range of 3°-4°C and salinities in the range of 34-34.75. On average bottom temperatures remain <0°C over most of the northern Grand Banks but increase to 1-4°C in southern regions and along the slopes of the banks below 200 m. North of the Grand Bank, in Div. 3K, bottom temperatures are generally warmer (1-3°C) except for the shallow inshore regions where they are mainly <0°C. In the deeper waters of the Flemish Pass and across the Flemish Cap bottom temperatures generally range from 3-4°C. Throughout most of the year the cold, relatively fresh water overlying the shelf is separated from the warmer higher-density water of the continental slope region by a strong temperature and density front. This winter-formed water mass is generally referred to as the Cold Intermediate Layer (CIL) and is considered a robust index of ocean climate conditions. In general, shelf water masses undergo seasonal modification in their properties due to the seasonal cycles of air-sea heat flux, wind-forced mixing and ice formation and melt, leading to intense vertical and horizontal gradients particularly along the frontal boundaries separating the shelf and slope water masses. Temperature and salinity conditions in the Scotian Shelf, Bay of Fundy and Gulf of Maine regions are determined by many processes: heat transfer between the ocean and atmosphere, inflow from the Gulf of St. Lawrence supplemented by flow from the Newfoundland Shelf, exchange with offshore slope waters, local mixing, freshwater runoff, direct precipitation and melting of sea-ice. The Nova Scotia Current is the dominant inflow, originating in the Gulf of St. Lawrence and entering the region through Cabot Strait. The Current, whose path is strongly affected by topography, has a general southwestward drift over the Scotian Shelf and continues into the Gulf of Maine where it contributes to the counter-clockwise mean circulation. The properties of shelf waters are modified by mixing with offshore waters from the continental slope. These offshore waters are generally of two types, Warm Slope Water, with temperatures in the range of 8-13°C and salinities from 34.7-35.6, and Labrador Slope Water, with temperatures from 3.5°C to 8°C and salinities from 34.3 to 35. Shelf water properties have large seasonal cycles, east-west and inshore-offshore gradients, and vary with depth.

**Ocean Climate and Ecosystem Indicators**

The composite climate index across the widely distributed stocks in Subareas 2 to 4 has remained above normal in 2013 and in recent years peaking in 2010 (Fig. 4). The composite spring bloom index peaked in 2011 but has subsequently declined to slightly below normal levels in 2013 (Fig. 4). The composite zooplankton index has returned to a record-high level in 2013 after record-high negative anomalies in 2011-2012 (Fig. 4). The composite trophic index has returned to above normal in 2013 after four consecutive years of below average conditions across Subareas 2 to 4 (Fig. 4).

Sea surface temperature (SST) in the Labrador Sea indicated above normal conditions showing an anomaly ranging from 1 to 6°C in the winter and about 0.5°C in the summer. The Labrador Shelf ice concentration was below normal in January and March of 2013 (reference period: 1979-2000), while in February 2013, the ice concentration was higher than normal for the northwestern part of Labrador Shelf. Winter time convection in 2013 reached to 1000 m, which is significantly shallower than the 1400 m seen in the previous year, although still deeper than in the years of reduced convective activity (e.g., 2007 and 2011). The 1000-1500 m layer of the central Labrador Sea has been gradually warming since 2012. Under the warming trend, the winter ice extent has also decreased on the Labrador shelf. The increasing decadal trend of the total inorganic carbon and decreasing trend of pH continue into 2013. For the year of 2013 as a whole, chlorophyll *a* estimated from remote sensing imagery showed the three regions together being close to normal, with the Labrador shelf just above normal, the central basin slightly below and the Greenland shelf almost even. In 2013 *Calanus finmarchicus* abundances were similar to those seen in other years when sampling was in spring.

Above normal conditions prevailed in NAFO Subarea 4 in 2013. The climate index, a composite of 18 selected, normalized time series, averaged +0.9 standard deviations making 2013 the eighth warmest year in the last 45 years. The anomalies did not show a strong spatial variation. Bottom temperatures were above normal with anomalies for NAFO Div. 4Vn, 4Vs, 4W, 4X of +0.2°C, +0.8°C, +0.6°C, and +1.0°C respectively. Compared to 2012, bottom temperatures decreased in Div. 4Vn, 4Vs, 4W and 4X by 0.3, 0.5, 1.2 and 1.1°C.

## 18. Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3

Interim Monitoring Report

### 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 the relationships between them. 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 (SCR Doc. 98/57) revised and approved roughhead grenadier catch statistics since 1987. 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. Since then, catches decreased to 600 t in 2009. Catches for the Subareas 2+3 roughhead grenadier in 2011-2012 were 1 016 and 1 303 t. In 2013 catches decreased to 398 t. (Fig. 18.1). Most of the catches were taken in Div. 3LMN by Spain, Estonia and Portugal fleets. In the catch series available, less than 2% of the yearly catch has been taken in Subarea 2.

Recent catches ('000 t) are as follows:

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| STATLANT 21 | 1.7 | 1.3 | 0.6 | 0.5 | 0.41 | 0.71 | 0.8 | 1.0 | 1.3 | 0.4 |
| STACFIS | 3.2 | 1.5 | 1.4 | 0.7 | 0.8 | 0.6 | 0.9 | 1.0 | 1.3 | 0.4 |

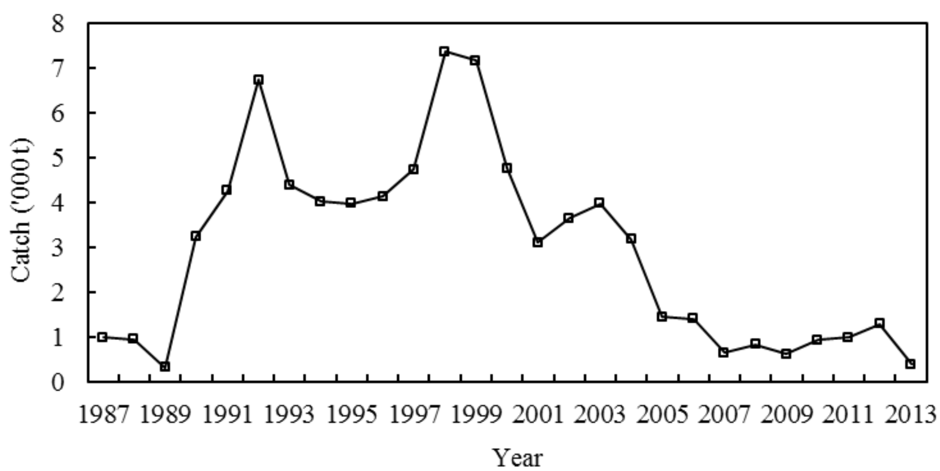



Fig. 18.1. Roughhead grenadier in Subareas 2+3: catches

### b) Data Overview

#### *i) Surveys*

There are no surveys indices available covering the total distribution, in depth and area, of this stock. According to other information this species is predominant at depths ranging from 800 to 1 500 m, therefore the best survey indicators of stock biomass should be the series extending 1 500 meters depth as they cover the depth distribution of roughhead grenadier fairly well. Figure 18.2 presents the biomass indices for the following series: Canadian autumn Div. 2J+3K Engel (1978-1994, Series 1) and Campelen (1995-2012, Series 2), EU Div. 3NO (1997-2012), EU Div. 3L (2006-2012) and EU Flemish Cap until 1400 m (2004-2012). An increase is shown since 1995 until 2004-2008 for all available indices and since then all the indices show a decreasing trend, except the Canadian autumn Div. 2J+3K index.

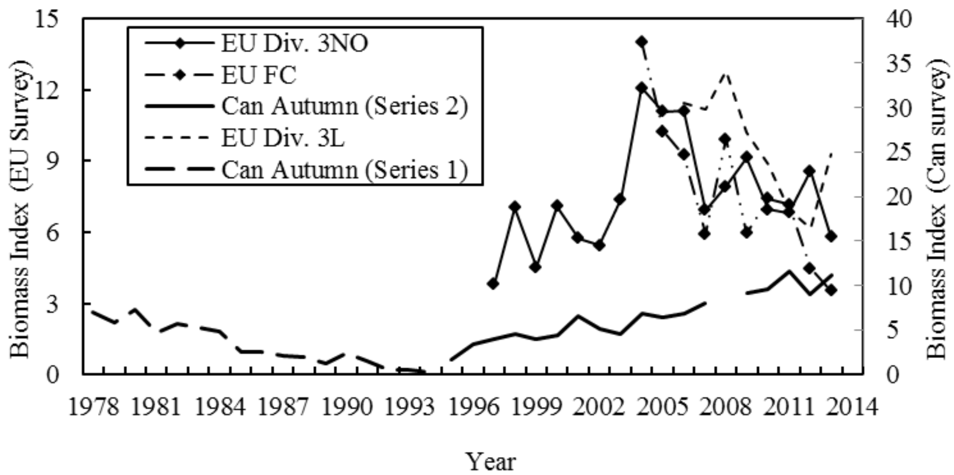



Fig. 18.2. Roughhead grenadier in Subareas 2+3: Most representatives survey biomass indices for roughhhead grenadier. The indices are relative to the mean of the period.

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. 18.2).The (C/B) ratio remains low since 2008 despite the decline of many of the surveys biomass indices because catches levels in the last years are very low.

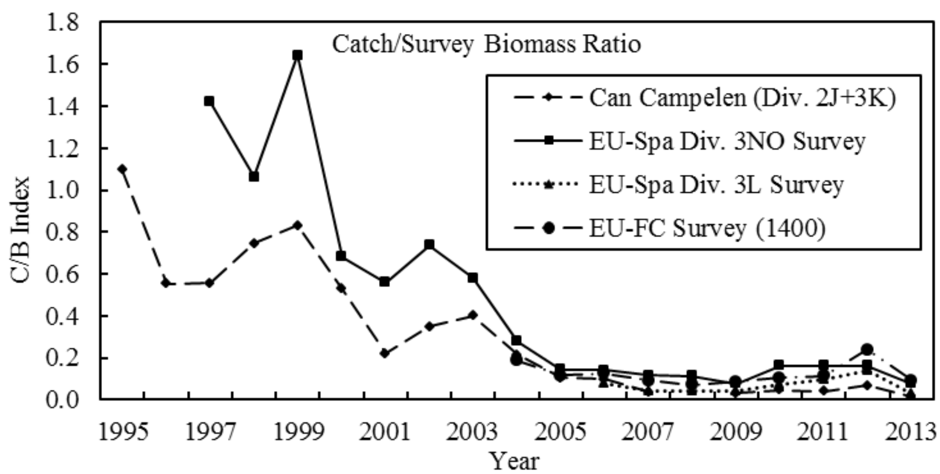



Fig. 18.3. Roughhead grenadier in Subareas 2+3: catch/biomass survey indices based upon Canadian Autumn (Campelen series), EU-Spanish Div. 3NO, EU-Spanish Div. 3L and EU-Flemish Cap until 1400 m.

### c) Conclusion

Based on overall indices for the current year, there is no significant change in the status of the stock: survey indices indicate a stable or declining stock in recent years. Fishing mortality indices have remained at low levels since 2005.

The next full assessment of this stock is planned to be in 2016.

## 19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL

Interim Monitoring Report (SCS Docs. 14/06, 14/13, 14/14)

### a) Introduction

A moratorium on directed fishing on this stock was implemented in 1995 following drastic declines in catch from the mid-1970s, and catches since then have been low levels of by-catch in other fisheries. From 1999 to 2004 catches were estimated to be very low, between 300 and 800 t and from 2005-2013, catches averaged less than 150 t.

Recent catches and TACs ('000 tons) are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf | ndf |
| STATLANT 21 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | |
| STACFIS | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | |
| ndf: no directed fishing. | | | | | | | | | | |

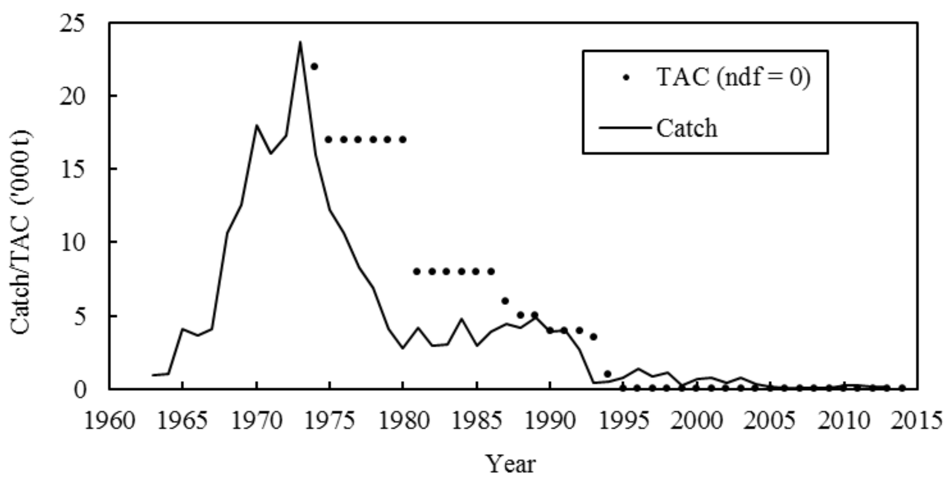



Fig. 19.1. Witch flounder in Div. 2J, 3K and 3L: catches and TAC.

### b) Data Overview

#### *i) Surveys*

Canadian autumn surveys were conducted in Div. 2J, 3K and 3L beginning in 1977, 1978 and 1984 respectively and continued to 2013 (Fig. 19.2). The survey biomass estimates showed a rapid decline from the mid-1980s to 1995, remained at very low levels and then showed a general increase trend from 2003 to 2013.

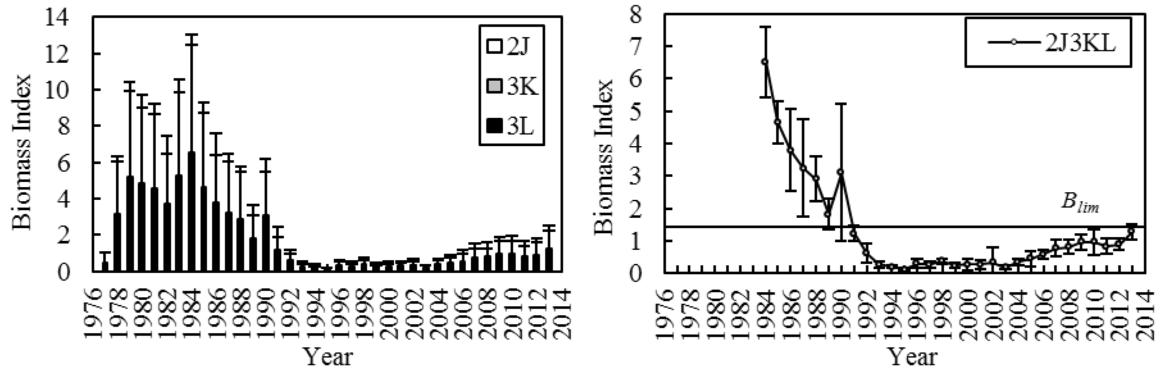



Fig. 19.2. Witch flounder in Div. 2J, 3K and 3L: Index of biomass from Canadian autumn surveys by Division (left panel) and overall with 95% confidence limits (right panel). Values are Campelen units or, prior to 1995, Campelen equivalent units.

### c) Conclusion

There was an increase in the survey biomass index from 2003 to 2013, nevertheless, the overall stock remains below $B_{lim}$. 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 2016.

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

(SCR Doc. 14/05, 12, 17, 39; SCS Doc. 14/06, 10, 14; FC Doc. 03/13, 10/12, 13/23)

### a) Introduction

**Fishery and Catches**: TACs prior to 1995 were set autonomously by Canada; subsequent TACs have been established by NAFO Fisheries Commission (FC). Catches increased sharply in 1990 due to a developing fishery in the NAFO Regulatory Area in Div. 3LMNO and continued at high levels during 1991-94. The catch was only 15 000 to 20 000 t per year in 1995 to 1998. The catch increased since 1998 and by 2001 was estimated to be 38 000 t, the highest since 1994. The estimated catch for 2002 was 34 000 t. The 2003 catch could not be precisely estimated, but was believed to be within the range of 32 000 t to 38 500 t. In 2003, a fifteen year rebuilding plan was implemented by Fisheries Commission for this stock (FC Doc. 03/13). Though much lower than values of the early 2000s, estimated catch over 2004-2010 has exceeded the TAC by considerable margins. TAC over-runs have ranged from 22%-64%, despite considerable reductions in effort. The STACFIS estimate of catch for 2010 was 26 170 t (64% over-run). In 2010, Fisheries Commission implemented a survey-based harvest control rule (FC Doc. 10/12) to generate annual TACs over at least 2011-2014. In 2013 Fisheries Commission extended this management approach to set the TACs for 2015 – 2017 (FC Doc. 13/23). STACFIS could not estimate total catches for 2011-2013.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | 19 | 18.5 | 16 | 16 | 16 | 16 | 17.2[1] | 16.3[1] | 15.5[1] | 15.4[1] |
| STATLANT 21 | 17.8 | 17.7 | 15.3 | 15.0 | 14.7 | 15.7 | 15.7 | 15.2 | 14.9 | |
| STACFIS | 23.3 | 23.5 | 22.7 | 21.2 | 23.2 | 26.2 | na | na | na | |
| na Not available<br>[1] TAC generated from HCR | | | | | | | | | | |

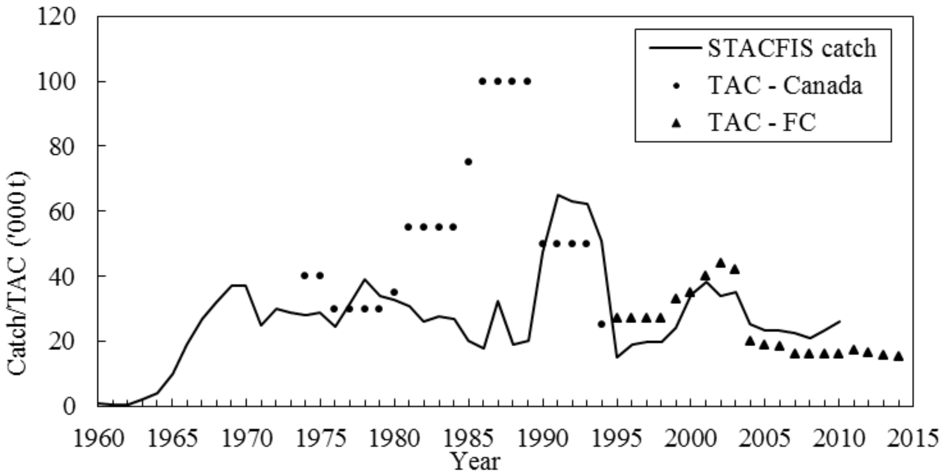



Fig. 20.1. Greenland halibut in Subarea 2 + Div. 3KLMNO: TACs and STACFIS catches.

**b) Input Data**

Standardized estimates of CPUE were available from fisheries conducted by EU- Spain and EU-Portugal. Abundance and biomass indices were available from research vessel surveys by Canada in SA 2+ Div. 3KLMNO (1978-2013), EU in Div. 3M (1988-2013) and EU-Spain in Div. 3NO (1995-2013). Commercial catch-at-age data were available from 1975-2010 but were not compiled for 2011, 2012 or 2013 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 2010-2012 estimates of standardized CPUE for Canadian otter-trawlers decreased substantially from the 2007-2009 levels. The Canadian CPUE series was not updated with 2013 data.

Catch-rates of Portuguese otter trawlers fishing in the NRA of Div. 3LMNO over 1988-2013 (SCS Doc. 14/10) declined sharply in 1991 from initial levels. Between 1991 and 1994 catch rates remained stable at a low level. Since then, catch rates gradually increased, reaching an upper level in 1999-2000. Catch rates declined in 2001 and remained stable at that lower level in 2002 and 2003. In 2004 the catch rates declined again, reaching the lowest value since 1994. However, after 2004 the Greenland halibut catch rates increased and, despite the high variability from 2006 to 2013, the catch rates reached, in this period, the highest values observed of the time series.

Analyses of data from the Spanish fishery show that in 2013 the CPUE has increased reaching maximum levels similar to the 2007-2008 level (SCS Doc. 14/06).

In general, for the Russian fishery, the catch rate per fishing vessel day in the area ranged from 0.6 t to 10.2 t and averaged 7.2 t per fishing vessel day and 0.44 t per hour of hauling (SCS Doc. 14/13).

A comparison of the available standardized CPUE estimates from the Canadian, Spanish and Portuguese fleets indicates consistency in the timing and relative magnitude of change over the 2004-2007 period, but less consistency thereafter (Fig. 20.2). However, CPUE for all three countries is higher from 2007-2012 than in the period of the 1990s to the mid-2000s.

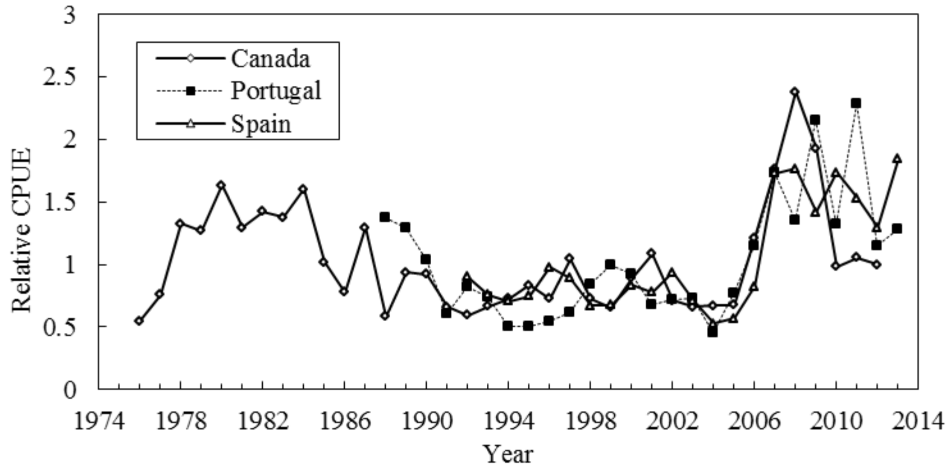



Fig. 20.2 Greenland halibut in Subarea 2 + Div. 3KLMNO: standardized CPUE from Canadian, Portuguese and Spanish trawlers. (Each standardized CPUE series is scaled to its 1992-2012 average.)

STACFIS previously recognized that trends in commercial catch per unit effort for Greenland halibut in Subarea 2 and Div. 3KLMNO should not be used as indices of the trends in the stock (*NAFO Sci. Coun. Rep.*, 2004, p.149). It is possible that by concentration of effort and/or concentration of Greenland halibut, commercial catch rates may remain stable or even increase as the stock declines.

**Catch-at-age and mean weights-at-age.** Length samples of the 2013 fishery were provided by EU-Spain, EU-Portugal, Russia and Canada. Aging information was available for Spanish fisheries. STACFIS could not estimate total catch for 2011-2013, therefore the catch-at-age was not calculated.

***ii) Research survey data***

STACFIS reiterated that most research vessel survey series providing information on the abundance of Greenland halibut are deficient in various ways and to varying degrees. Variation in divisional and depth coverage creates problems in comparing results of different years (SCR Doc. 12/19). A single survey series which covers the entire stock area is not available. A subset of standardized (depth and area) stratified random survey indices have been used to monitor trends in resource status, and are described below.

**Canadian stratified-random autumn surveys in Div. 2J and 3KLNO.** The Canadian autumn Div. 2J3K survey index provides the longest time-series of abundance and biomass indices (Fig. 20.3) for this resource (SCR Doc. 14/39). Biomass declined from relatively high estimates of the early 1980s to reach an all-time low in 1992. The index increased substantially due to the abundant 1993-1995 year-classes, but this increase was not sustained, with declines over 1999-2002. The index continually increased over the next five years. The increasing trend has not continued, though in 2012 the index is near the time-series average. Mean numbers per tow were stable through the 1980s, but increased substantially in the mid-1990s, again due to the presence of the 1993-1995 year-classes. After this, abundance declined to the late 1990s and had been relatively stable except for the decline in 2005. Following improved estimates of abundance in 2010 and 2011, the 2012 index is considerably lower as much fewer age 1 and 2 fish were observed. The 2013 biomass and abundance indices both increased compared to 2012, with more age 1 than in 2012. However, the number of age 1-4 in 2013 is still below the series average.

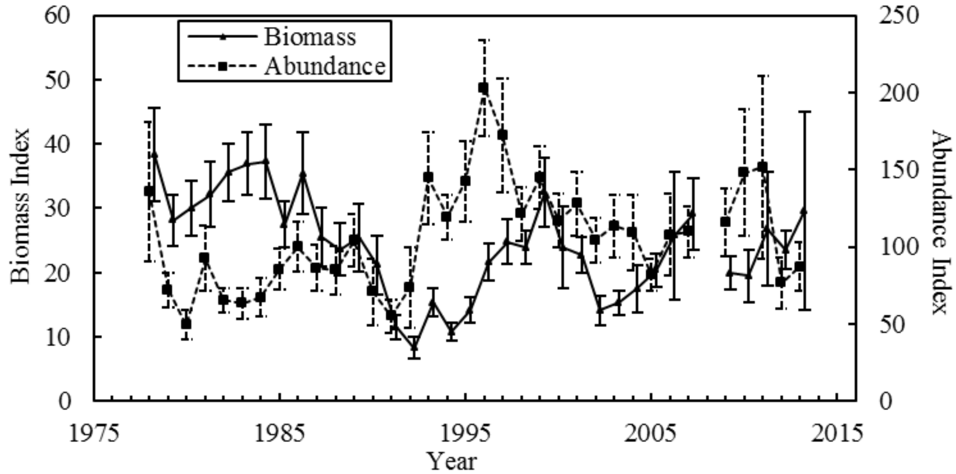



Fig. 20.3. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian autumn surveys in Div. 2J and 3K. The 2008 survey was not completed.

The Canadian autumn survey in Div. 3L has generally shown trends that are consistent with those from Div. 2J+3K. Autumn surveys within Div. 3NO have erratic deep-water coverage and as such are not useful for inferring stock status.

**Canadian stratified-random spring surveys in Div. 3LNO.** Abundance and biomass indices from the Canadian spring surveys in Div. 3LNO (Fig. 20.4) declined from relatively high values in the late 1990s and has been relatively low in most years thereafter. In 2013, both abundance and biomass were below the time-series average. The abundance of recruits (ages 1-4) in 2013 is much lower than that observed in 2011 and 2012.

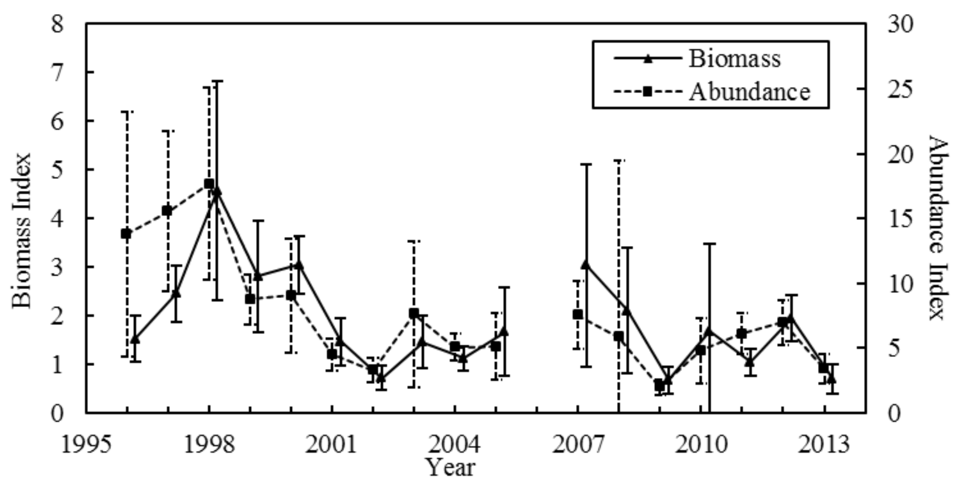



Fig. 20.4. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass and abundance indices (with 95% CI) from Canadian spring surveys in Div. 3LNO.

**EU stratified-random surveys in Div. 3M (Flemish Cap).** Surveys conducted by the EU in Div. 3M during summer (SCR Doc. 14/17) 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 2013, the index has decreased and is presently at its lowest observed value. The Flemish Cap survey was extended to cover depths down to 1460 m beginning in 2004. Biomass estimates over the full depth range doubled over 2005-2008 but declined thereafter. The 2012 and 2013 estimates are below the time-series average. Over 2009-2013, recruitment indices (ages 1-4) from this survey are below average.

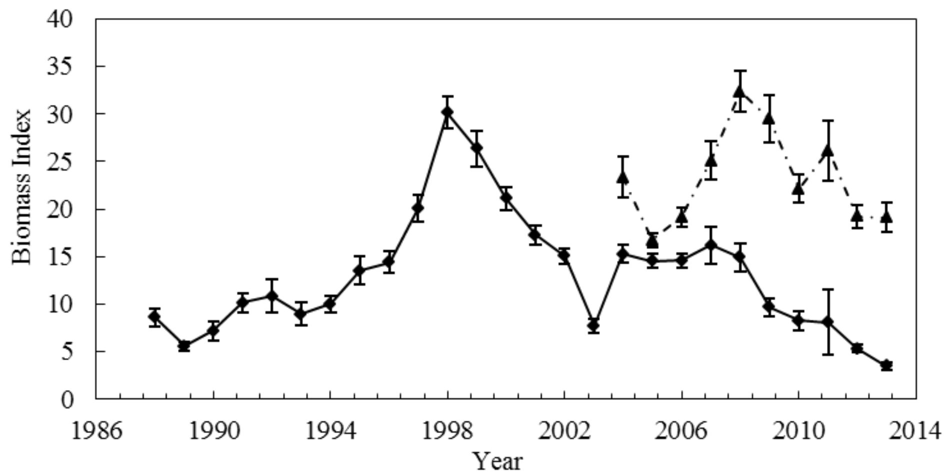



Fig. 20.5. Greenland halibut in Subarea 2 + Div. 3KLMNO: Biomass index (± 1 S.E.) from EU Flemish Cap surveys in Div. 3M. Solid line: biomass index for depths <730 m. Dashed line: biomass index for all depths <1460 m.

**EU-Spain stratified-random surveys in NAFO Regulatory Area of Div. 3NO.** The biomass index for this survey of the NRA (SCR Doc. 14/12) generally declined over 1999 to 2006 (Fig. 20.6) but increased four-fold over 2006-2009. The survey index declined to 2013 and from 2011-2013 is below average.

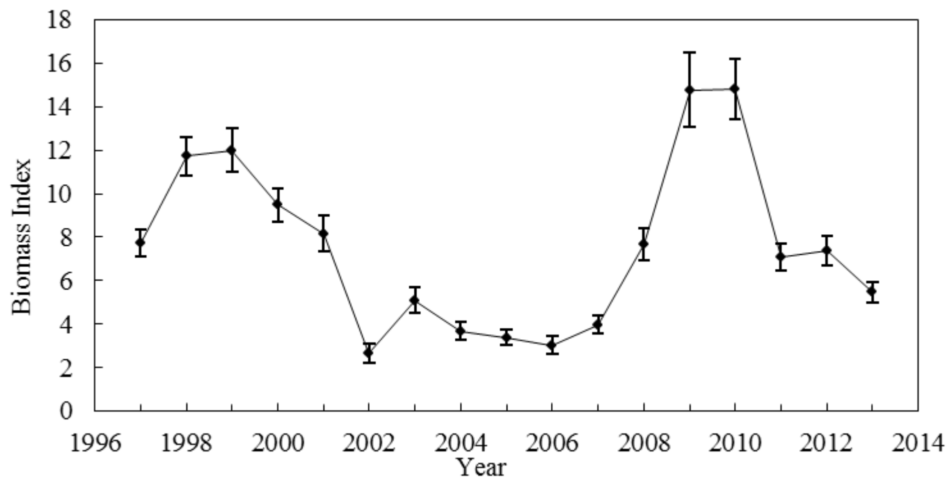



Fig. 20.6. Greenland halibut in Subarea 2 + Div. 3KLMNO: biomass index (±1 SE) from EU-Spain spring surveys in the NRA of Div. 3NO.

**Summary of research survey data trends.** These surveys provide coverage of the majority of the spatial distribution of the stock and the area from which the majority of catches are taken. Over 1995-2003, indices from the majority of the surveys generally provided a consistent signal in stock biomass (Fig. 20.7). Results since 2004 show greater divergence which complicates interpretation of overall status. Three of the 4 indices have declined since 2010, while the Canadian Div. 2J3K survey increased.

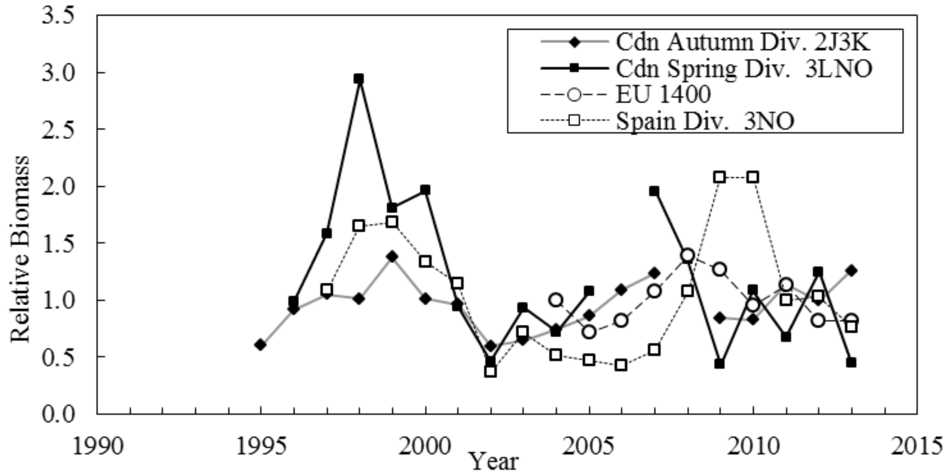



Fig. 20.7. Greenland halibut in Subarea 2 + Div. 3KLMNO: Relative biomass indices from Canadian autumn surveys in Div. 2J+3K, Canadian spring surveys in Div. 3LNO, EU survey of Flemish Cap, and EU-Spain surveys of the NRA of Div. 3NO. Each series is scaled to its 2004-2013 average.

### c) State of the Stock:

*Biomass*: Survey data from 2009-2013 are variable. The Canadian Div. 2J3K autumn survey has increased, the Canadian spring Div. 3LNO survey has varied with no trend, while the EU survey of Flemish Cap and the EU-Spain survey of the NRA of Div. 3NO have both declined.

*Recruitment*: Results of Canadian surveys and the EU Flemish Cap survey indicate that recruitment was well below average in 2013.

*Fishing Mortality*: Unknown, as estimates of total catch were unavailable.

### d) Reference Points

#### *i) Precautionary approach reference points*

Precautionary approach reference points have not been determined for this stock at this time.

#### *ii) Yield per recruit reference points*

Yield per recruit reference points were estimated in previous assessments. $F_{max}$ was computed to be 0.41 and $F_{0.1}$ was 0.22.

This stock will be next assessed during June 2015.

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

Interim Monitoring Report (SCR Doc. 98/59; 98/75; 02/56; 13/31)

### a) Introduction

The species has a lifespan of less than one year and is considered a single stock throughout Subareas 3 through 6. However, 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. The stock assessment is data-poor. Indices of relative biomass and mean body size, computed using data from the Canadian surveys conducted in Div. 4VWX during July, were used to assess whether the Subareas 3+4 stock component was at a low or high productivity level during the previous year. When compared with biomass indices derived from other bottom trawl surveys (i.e., Canadian spring and autumn surveys in Div. 3LNO and autumn surveys in Div. 4T, and EU-Spain/Portugal July surveys in Div. 3M), the Div. 4VWX July indices represented the best measure of relative biomass in Subareas 3+4 due to the length of the time series, area of habitat coverage, and survey timing in relation to the fisheries. Stock biomass projections are not currently possible. Relative fishing mortality indices, computed as the Subareas 3+4 nominal catch divided by the Div. 4VWX biomass ratio, are also used to assess stock status. Based on the trends in these indices, 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 the Subarea 3 inshore jig fishery. During 2004-2012, catches from Subareas 3+4 were low during most years (average = 1 325 t), compared to catches during 1976-1981 (average = 80 645 t), and ranged between about 50 t in 2012 to about 7 000 t in 2006 (Fig. 21.1). Catches declined from about 700 t in 2009 to the lowest level in the time series (since 1953) during 2013 (about 20 t) and were solely taken from Subarea 4.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC SA 3+4 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |
| STATLANT 21 SA 3+4 | 0.6 | 7.0[1] | 0.2[1] | 0.5 | 0.7 | 0.1[1] | 0.1[1] | <0.1[1] | <0.1[1] | |
| STATLANT 21 SA 5+6[2] | | | | | | | | | | |
| STACFIS SA 3+4 | 0.6 | 7.0 | 0.2 | 0.5 | 0.7 | 0.1 | 0.1 | <0.1 | <0.1 | |
| STACFIS SA 5+6 | 12.0 | 14.0 | 9.0 | 15.9 | 18.4 | 15.8 | 18.8 | 11.7 | 3.8 | |
| STACFIS Total SA 3-6 | 12.6 | 21.0 | 9.2 | 16.4 | 19.1 | 15.9 | 18.9 | 11.7 | 3.8 | |

[1] Includes amounts (ranging from less than 0.1 t to 22 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

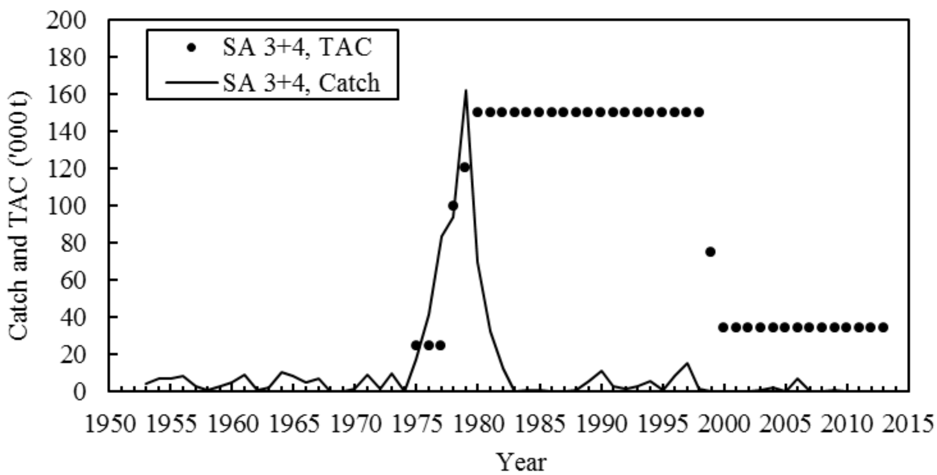



Fig. 21.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

**b) Data Overview**

Relative biomass indices were derived using data from the Canadian bottom trawl surveys conducted during July in Div. 4VWX. The indices show a high degree of interannual variability, which is typical for squid stocks, because recruitment is highly affected by environmental conditions. However, two general levels of productivity can be identified. A period of high productivity (1976-1981, mean = 13.2 kg per tow) preceded a period of low productivity (1982-2012, mean = 3.0 kg per tow). The third and fourth highest indices in the time series occurred during 2004 and 2006, respectively, but both years were followed by very low indices. Relative biomass indices generally declined after 2004, from a level near the mean of the high productivity period to below the mean of the low productivity period in 2010, then declined further to the lowest level in the time series during 2013 (Fig. 21.2).

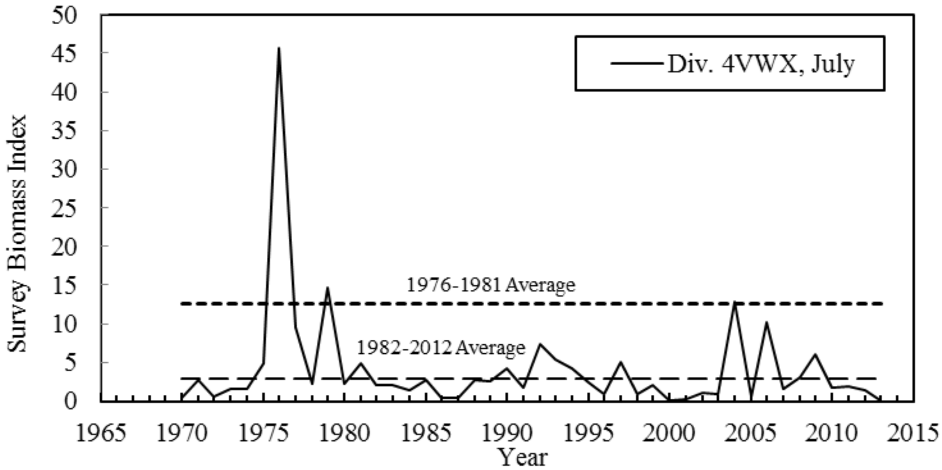



Fig. 21.2. Northern shortfin squid in Subareas 3+4: survey biomass indices.

Mean body weights of squid caught during the July Div. 4VWX surveys averaged 150 g during the 1976-1981 high productivity period. Since 1982, mean body weights have fluctuated widely around the mean for the 1982-2012 low productivity period (81 g, Fig. 21.3). After reaching a low productivity period peak of 137 g in 2006, mean body weights gradually declined to the fourth lowest level of the time series in 2013 (42 g).

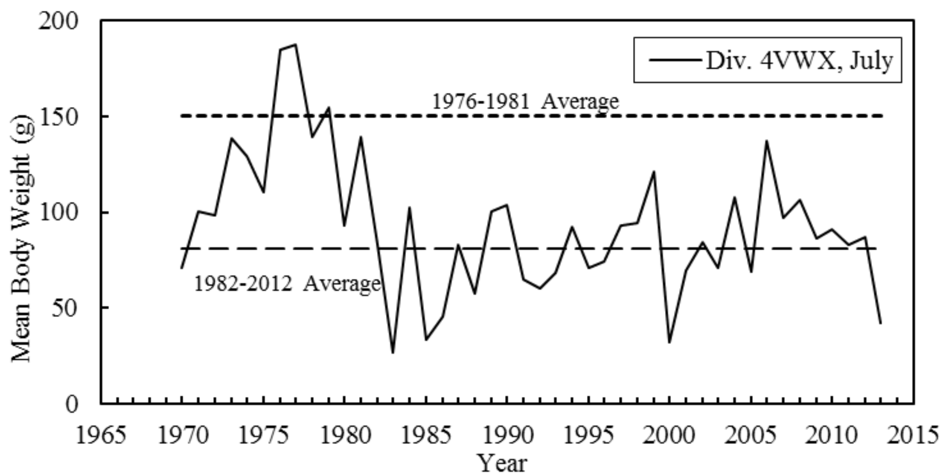



Fig. 21.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid.

Catch/biomass ratios (SA 3+4 catch/Div. 4VWX July survey biomass) during the 1976-1981 high productivity period averaged 1.67 and were well below the 1982-2012 mean (0.13) during most years since 2001. The ratio was 0.04 in 2013 (Fig. 21.4).

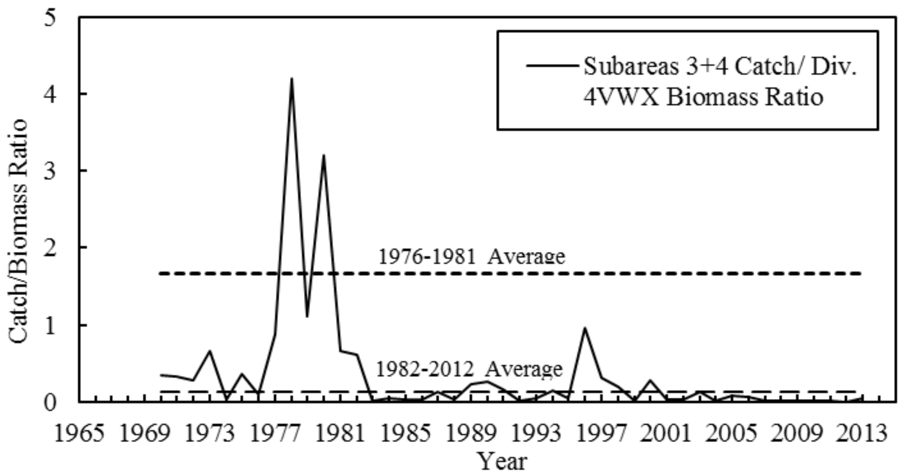



Fig. 21.4. Northern shortfin squid in Subareas 3+4: catch/biomass ratios.

**c) Conclusion**

In 2013, the biomass index from the July Div. 4VWX survey was the lowest on record and mean body weight was well below the 1982-2012 mean for the low productivity period. Catch/biomass ratios were well below the low productivity period mean during most years since 2001. Thus, in 2013, the stock remained in a state of low productivity.

The next full assessment of the stock is scheduled for 2016.

**d) Research Recommendations**

In 2013, STACFIS **recommended** *that gear/vessel conversion factors be computed to standardize the 1970-2003 relative abundance and biomass indices from the July Div. 4VWX surveys*.

STATUS: No progress has been made and 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 2014. 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[3]<br>3LN Redfish | 3LNO Northern shrimp[1]<br>SA0+1 Northern shrimp[1]<br>DS Northern shrimp[1] | 3M Cod | Greenland halibut in Uummannaq[2]<br>Greenland halibut in Upernavik[2]<br>Greenland halibut in Disko Bay[2]<br>SA1 American Plaice<br>SA1 Spotted Wolffish |
| Small | SA3+4 Northern shortfin squid<br>3NO Witch flounder | SA2+3KLMNO Greenland halibut | | 3NOPs White hake<br>3LNOPs Thorny skate |
| Depleted | 3M American plaice<br>3LNO American plaice<br>2J3KL Witch flounder<br>3NO Cod<br>3M Northern shrimp[1,3] | | | SA1 Redfish<br>SA0+1 Roundnose grenadier<br>SA1 Atlantic Wolffish |
| Unknown | SA2+3 Roughhead grenadier<br>3NO Capelin<br>3O Redfish | 0&1A Offsh. & 1B–1F Greenland halibut | | SA2+3 Roundnose grenadier |

[1] Shrimp will be re-assessed in September 2014
[2] Assessed as Greenland halibut in Div. 1A inshore
[3] Fishing mortality may not be the main driver of biomass for Div. 3M Shrimp and Redfish

**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 Chair also noted the contributions of Designated Reviewers in providing detailed reviews of interim monitoring reports. 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 1400 on 12 June, 2014.

## PART F. FISHERIES COMMISSION AND SCIENTIFIC COUNCIL WORKING GROUP ON THE ECOSYSTEM APPROACH FRAMEWORK TO FISHERIES MANAGEMENT, 9-11 JULY 2014

**Report of Fisheries Commission and Scientific Council Working Group on the Ecosystem Approach Framework to Fisheries Management (FC-SC Doc. 14/03)**

**9-11 July 2014**

## 1. Opening

The working group (WG) met at the Lord Nelson, Halifax, Canada, during 9-11 July 2014. The meeting was attended by representatives from Canada, EU, Iceland, Japan, Norway, the Russian Federation and the United States of America. The NAFO Executive Secretary, Fisheries Commission (FC) Coordinator and Scientific Council (SC) Coordinator were in attendance. An observer from World Wildlife Fund was present. The meeting was co-chaired by Robert Day (Canada) and Andrew Kenny (EU) representing FC and SC, respectively (See Part I, this volume).

The chairs opened the meeting at 0900 hrs on Wednesday, 9 July.

## 2. Appointment of Rapporteur

With the agreement of the WG, the FC Coordinator Ricardo Federizon and the SC Coordinator Neil Campbell were appointed as joint rapporteurs.

## 3. Adoption of Agenda

The previously circulated agenda was adopted with slight modification on the sequence of items: the old item 6.a.ii and 6.a.iii were reversed and item 8 was moved ahead of item 7. Russian Federation requested the opportunity to make a presentation on the splendid alfonsino fishery at the Corner Seamount. It was agreed it would be discussed under item 10. The adopted agenda is presented in Part I, this volume).

## 4. Review of Terms of Reference

The terms of reference of the WG as documented in FC Doc. 13/19 were reviewed. The WG considered membership, work format, reporting procedures, observers and future meetings. Proposed revisions to the Terms of Reference (ToR) are presented in Annex 3. It incorporates the comments from SC during its June 2014 meeting and the recommendation recognizes the need to consider the Risk Based Management Strategies WG ToR to ensure coherence.

## 5. Engagement with Canada-Newfoundland and Labrador Offshore Petroleum Board

The FC co-chair provided an update on the NAFO submission (submission agreed to at the 2013 Annual Meeting) to the development of the Eastern Newfoundland Strategic Environment Assessment (SEA) which is being conducted by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB). NAFO comments on the draft SEA were submitted in April 2014. The comments were drafted by the co-Chairs and endorsed by the General Council (GC).

The Secretariat informed participants that after the submission of the comments, additional fisheries information (previously published) were provided to C-NLOPB at their request.

The European Union noted that communication between their research vessel and C-NOLPB's seismic research company has occurred by exchanging details of planned surveys.

Japan noted the interaction between the seismic and fisheries surveys might have occurred in 2013, i.e. large noises by seismic surveys may have caused disruptions in the Greenland halibut surveys resulting in very low CPUE. Due to this low CPUE, SC in 2014 had declared "occurrence of exceptional circumstances" by following the Management Strategy Evaluation (MSE) protocol. Japan further noted that such potential detrimental influences should be monitored carefully.

The SEA is expected to be released in July and August. The WG will track the development of the SEA but will not itself engage directly in any future processes without direction from GC.

## 6. Consideration of Scientific Advice

### a) Review of Vulnerable Marine Ecosystems (VMEs) and fishery closures

At the 2013 Annual Meeting, FC requested SC for scientific advice on VMEs. SC formulated the advice during its 2014 June Meeting (SCS Doc. 14/17). The advice draws on the work of the SC WG on Ecosystem Science and Assessment which met in November 2013 (SCS Doc. 13/24).

The SC co-chair presented the advice on behalf of SC.

#### *i) Summary of data available for identification of VMEs (Request 13a)*

The SC co-Chair presented the method of *kernel density analysis* and noted that currently the best approach in identifying VMEs is the application of this method on the data (the detailed metadata can be found in pages 36-38 of SCS Doc 14/17). This analysis identifies “hotspots” in the biomass distribution derived from research vessel trawl survey data, by looking at natural breaks in the spatial distribution associated with changes in local density. These natural breaks allow defining of significant area polygons. The method identifies potential areas of VMEs according to the definition, however has limited spatial resolution, in particular, the delineation of borders for the VME areas are uncertain. If to be used as a basis for making management decisions, e.g. on the closing or opening of areas, these results are to be regarded as a first step. It would be expected that depth contours, type of substrate, current and temperature fields, etc. will shape the fine scale boundary.

Significant discussion ensued on clarifying how the kernel density approach was used to identify hotspots within which it was probable that VMEs would occur but did not actually delineate the boundaries of VMEs.

#### *ii) Occurrence of sea pens around Areas 13 and 14 (Request 15)*

SC advice: The available data, including information from the 2013 EU-Spain and Portugal Flemish Cap survey, indicates that areas 13 and 14 are located within the easternmost seapen VME unit of the seapen VME system. Within this unit, three high concentration locations have been identified, two corresponding to the candidate closures, and a third one located in between them, as well as several seapen observations of lower density. This seapen VME unit also encompasses locations of other VME indicator species (crinoids), as well as black corals.

Details of this advice can be found in pages 52- 53 of the SCS Doc. 14/17.

The WG noted that discussions on the candidate Areas 13 and 14 were initiated in the FC WG of Fishery Managers and Scientists on Vulnerable Marine Ecosystems (WGFMS-VME), the predecessor of this WG. The debate – whether the latest survey information and scientific advice warrant some VME protection management measures, e.g. closure, applied to candidate Areas 13 and 14 – remains unresolved. In this regard, the WG would recommend that FC and SC support the continuing analysis by this WG and that this does not preclude FC from considering possible closure if proposals are made at the Annual Meeting (see item 9).

#### *iii) Extent of current closures and areas for prioritization (Request 13b)*

The SC review of the current closures including seamounts is contained in pages 38 – 53 of SCS Doc 14/17. In the review new polygons were drawn indicating where the evidence of VMEs was located. It was emphasized that the polygons were not necessarily proposed closure boundaries but rather hot spots where VMEs could be located, as noted in 6.a.i.

Within the list comprising the current closures, a new area (Tail of the Grand Bank) and two candidate areas (Area 13 and 14), SC identified some high priority (Areas 3 and 4, candidate Areas 13 and 14, and the new area). The details of the existing closed area designation are described in Chapter II of the NAFO Conservation and Enforcement Measures (NCEM). Prioritization was based on multiple VME presence, approximate proportion of the VME that is protected, proximity to an existing area, proximity to high fishing activity, and areas with no current protection (page 50-51 of SCS Doc. 14/17).

The WG noted significant protection of the identified VMEs has been achieved. Yet, some further work can be considered. The WG considered the SC priority list and took note of the presence of VME indicator species adjacent to the existing 3O closure. It was acknowledged area 3O and new area “Tail of the Grand Bank” in the list would entail considerable further work. As short term priorities, Areas 3 (Beothuk Knoll) and 4 (Eastern Flemish Cap) were recommended (see item 9).

Regarding the management recommendations on revised and new areas (Recommendation 6) and encounter thresholds (Recommendation 8), Japan noted: *Japan has some reservations and different views on these two issues (additional closed areas and threshold values), although Japan does not wish to block these recommendations. Japan basically prefers to apply "move-on rules with encounter thresholds" to protect SAI to VME for the following three reasons: (a) In NAFO Convention Area, there have been a number of sporadic and patchy closed areas, which make operations difficult. From recent meeting of the WG Bycatch, Discards and Selectivity, it was also anticipated that more fine scale time-area closed areas will be established to mitigate bycatch and discards in the near future. This may create further difficulty to conduct operations as vessels might mistakenly make operations in closed area. (b) At present, CCAMLR, SEAFO, NEAFC and NPFC (near future) effectively apply "move-on rules with encounter thresholds", in addition to existing closed areas. Move-on rules are simple, i.e., vessels just keep away 2 nautical miles (NM) from the points where VME exceeding threshold values and then closed areas are instantaneously established and (c) Similar exercise has been also effectively in place in NAFO and Canada, i.e. 10 NM move-away-rule to avoid exploiting excess bycatch and discards.*

Regarding the seamount closures, it was noted the management regimes governing unfished bottom areas (as defined in Chapter II of the NCEM, outside of the fishing footprint) and fisheries in seamount areas are identical, i.e. both are subject to the exploratory bottom fishing protocol. As the fisheries associated with these areas might be different, consideration for different management regimes might be warranted.

In noting the SC advice on seamounts (see page 49-50 of SCS Doc. 14/17), some debate has ensued as to whether management measures concerning fisheries stocks associated with seamounts may be warranted. The WG indicated that FC be mindful of the following points when considering the management of seamount fisheries:

a. Some CPs proposed that all ongoing fisheries taking place on seamounts should require 100% observer coverage in light of the knowledge and information gaps of the use of midwater trawl on seamount. Some CPs noted that in practice this is currently the case,

b. Some CPs proposed that any proposed new or expanded midwater trawl fishing activity on the NAFO seamounts outlined in Article 16.1, be subject to the exploratory fisheries protocol outlined in Article 18,

c. Some CPs expressed a view that the splendid alfonsino fishery be subject to NAFO management.

***iv) Consideration of removing candidate VME closures from survey design (Request 14)***

SC reported limited progress on this issue. However, it has recognized the issue of scientific surveys potentially impacting VMEs. SC suggested some points for consideration in minimizing the risk of impacts (see page 52 of SCS Doc. 14/17).

The WG noted that the pros and cons must be balanced: whereas repeated surveys might impact VMEs, the benefits of having long time-series scientific data should not be ignored. The WG encouraged SC to continue to explore measures to mitigate the risk of significant adverse impacts on VMEs from research surveys.

**b) Significant Adverse Impact (SAI) on VME elements**

***i) Risk assessment for SAI on VME elements and species (Request 12)***

The WG noted the following SC response to the FC request: Scientific Council notes that work on significant adverse impacts on VME is on-going and that final results are not due until 2016, and indicates that good progress is been made. These analyses involved the production of fishery pressure layers based on VMS data, and VME biomass layers from RV surveys. Preliminary results indicated the important fractions of the recent effort are exerted in relatively small regions within the fishing footprint, and at least for some areas, this fishing effort seems to be concentrated in the near neighborhood of VMEs, suggesting a potential functional connection between some VMEs and commercially exploited fish species. This and other issues will continue to be explored as part of the process of developing the assessment of bottom fishing activities due in 2016. Specifically, the adopted approach has to be refined to take account of known and predicted VME habitat evaluated as part of the review of fishery closures (see page 33 of the SCS Doc. 14/17).

***ii) Workplan towards the assessment of NAFO bottom fisheries by 2016***

The WG noted the SC-developed workplan which can be found in page 32 of the SCS Doc 14/17. In the workplan, specific tasks, the relevant FAO criteria (the six factors to be addressed when determining the scale and SAI, as enumerated in paragraph 18 of the FAO *International Guidelines for the Management of Deep-Sea Fisheries in the*

*High Seas*), approach, and the lead body (e.g. SC and its standing committees and working groups) are identified. This WG was identified as the lead in task 8 – proposed mitigation and management measures to be used to prevent SAI on VMEs.

The workplan was noted as being ambitious. SC clarified that many of the tasks identified in the table are in the various stages of accomplishment and that it can be considered that four or five criteria have already been fulfilled. The focus of SC work has been the review of VMEs and it is now moving into the SAI phase. The WG requested that SC continue to provide annual updates on progress of this review including the methods it is employing.

**7. Review of the provisions of Chapter II: – Bottom Fisheries in the NAFO Regulatory Area --- of the NAFO Conservation and Enforcement Measures (NCEM) for the implementation of Article 24; and recommendations to the Fisheries Commission**

The precursor of this WG, the FC WGFMS-VME, conducted a review and update on Chapter II provisions of the NCEM in 2012. STACTIC is also undertaking an editorial review of the provisions. The UN General Assembly will conduct a review of the implementations of Resolution 61/105 in 2015. In view of these, it was agreed that it would not be necessary at this time to conduct an in-depth review of the provisions that would entail substantive changes. Instead, the WG could focus on the time-sensitive provisions and determine whether they need to be updated accordingly. It was noted that the NCEM are updated on an annual basis to reflect decisions taken by FC at the annual meeting to update management measures. It was also noted that references in Chapter II of the NCEM to the precursor WG should be replaced with this WG.

Regarding STACTIC's editorial review of the provisions, Japan commented that the STACTIC proposed revision of Article 22.1.b and Article 22.2.b – concerning the SC's advice on the need for action, using the FAO *International Guidelines for the Management of Deep-Sea Fisheries in the High Seas* as a basis – weakens the role of the FAO Guidelines. NAFO should follow the FAO Guidelines in defining and identifying VMEs as described in page 39 of the June 2014 SC Report. Japan suggested that this should be discussed in the forthcoming Annual Meeting at FC.

Recommendations 1-4 and 13-14 in item 9 relate to the considerations mentioned above.

**8. Input and guidance on the development and application of Ecosystems Approach to Fisheries (EAF) Roadmap**

**a) Overview of the EAF Roadmap: purpose and goals**

The FC Co-Chair highlighted sections in the amended NAFO convention, the FAO Technical Guidelines for Responsible Fisheries: Fisheries Management-2. The Ecosystem Approach and 2011 NAFO Performance Review Recommendations which relate to EAF as a prelude to the SC's presentation of the EAF Roadmap.

A representative from SC presented the EAF Road Map (Annex 4).

**b) Operational expectations**

This sub-item was discussed together with sub-item a).

**c) Consideration of workplan and prioritization**

The WG noted the comprehensive coverage of the EAF Roadmap and of the workplan (see slides 8-17 in Annex 4). As a way forward, the WG noted that priorities need to be established to allow allocation of scarce resources. The intention was not to revise the road map but to identify areas for priority work to occur. In Annex 5, the recommended priority areas and their associated tasks were grouped into four headings and timelines were identified:

- External impacts on ecosystem productivity (medium term)
- VMEs and impact s of bottom fishing (ongoing to short term for VMEs, short term for SAI)
- Multispecies interactions (medium term)
- Bycatch and discards (short term, ongoing).

## 9. Recommendations to forward to Fisheries Commission and Scientific Council

Recognizing the ground-breaking work, significant achievements and ongoing efforts made by NAFO on the identification of VMEs and development of the ecosystem approach to fisheries management, the WG **recommends**:

1. That the FC maintains the delineated seamounts areas identified in Chapter II, Article 16.1 of the NCEM (Delete or amend "*Until 31 December 2014).*
2. That the FC maintains the Div. 3O closure identified in Chapter II, Article 16.4 of the NCEM (Delete or amend "*Until 31 December 2014"*).
3. That the FC maintains the closures identified in Chapter II, Article 16.5 of the NCEM (Delete or amend "*Until 31 December 2014"*).
4. That the FC considers deleting Article 16.6 recognizing that the NCEM are regularly updated and the ongoing review envisioned by Article 23.
5. That the FC considers deleting or amending Article 24 (Review) considering the ongoing review and update of the NCEM in general.
6. Recognizing that the scientific advice also noted some gaps in the protection of VMEs, that the FC considers adjustments to Area 4 (Southeastern Flemish Cap – sponge and large gorgonians), and new area 15 (Beothuk Knoll - large gorgonians) (see Annex 6 for maps).
7. That the FC and SC support continuing analysis by the WG of areas on the Tail of the Grand Bank (Div. 3O closure and related areas) (See Annex 6 for maps).
8. That the FC and SC support continuing analysis by the WG of areas 13 and 14 (Eastern Flemish Cap), and FC consider possible closed areas, if proposals are made at the Annual Meeting (see Annex 6 for maps).
9. That the FC further considers whether to withdraw the encounter thresholds within the fishing footprint, taking into account the scientific advice, the review of VME closures and the review of UNGA 61/105 in 2015.
10. That priority attention by FC and SC and their constituent bodies be given to the areas identified in Annex 5 that include external factors (e.g. climate change and oil and gas development), bycatch and discards, multispecies interactions, and VMEs including concluding the assessment of bottom fisheries for 2016.
11. That FC and SC consider the revised Terms of Reference at their September 2014 joint session and have FC and SC adopt the revisions in their respective meetings (see Annex 3). Consideration could also be given to making terms of reference consistent across all joint FC-SC working groups.
12. Request that the SC provide annual updates to the FC-SC Working Group on Ecosystem Approach Framework to Fisheries Management pertaining to the 2016 review of significant adverse impacts of NAFO bottom fisheries on VMEs in the NRA.
13. That the FC amend the text of the NCEM to reflect the replacement of the FC WG-VME with the Joint FC-SC WG-EAFFM,
14. Article 23.1 of the NCEM be rephrased such that the "*Fisheries Commission will request Scientific Council…*".

## 10. Other Matters

### a) Corner Rise Seamount and the Alfonsino fisheries

The Russian Federation made a presentation on Corner Rise Seamount and the alfonsino fisheries (Annex 7). The summary of the discussion arising from the presentation is also captured in item 6.a.iii.

### b) Convention on Biological Diversity

At the request of WG participants, for information purposes, a Canadian representative presented the report of the Convention on Biological Diversity - Northwest Atlantic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas which was held in Montreal Canada in March 2014 (Annex 8).

### c) Dr Enrique de Cardenas (Quique) Retirement

It came to the attention of the WG that a colleague in the SC and in the NEREIDA project, Dr. Enrique de Cardenas, is about to retire. On behalf of the WG, Ricardo Alpoim, as well as the SC WG co-Chair and Ellen Kenchington, delivered the best wishes greetings with the recognition of his significant contributions to the SC and the NEREIDA project (Annex 9).

## 11. Adoption of Report

This meeting report was adopted by correspondence.

## 12. Adjournment

The meeting adjourned at 1500 hrs on 11 July. The chairs thanked the participants for their cooperation and input and the Secretariat for its support. The participants in turn expressed their thanks to the Chairs for their leadership.

# PART G: SCIENTIFIC COUNCIL MEETING, 10-17 SEPTEMBER 2014

## Contents

**SC-NIPAG Participants 2014**

Back Row: Brian Healey, Don Stansbury, Dennis Zakharov, Ole Eigaard, Mats Ulmestrand, Rimantas Dapšys
Middle Row: Helle Siegstad, AnnDorte Burmeister, Silver Sirp, Don Power, Carsten Hvingel, Nannette Hammeken-Arboe
Front Row: Miquel Casas, Neil Campbell, Dave Orr, Barbara Marshall, Guldborg Søvik, Michael Kingsley.

SC Chair – Don Stansbury, NIPAG Co-Chairs – Michael Kingsley and Brian Healey
SC Coordinator – Neil Campbell

**Report of Scientific Council Meeting**

**10-17 September 2014**

Chair: Don Stansbury Rapporteur: Neil Campbell

## I. PLENARY SESSIONS

The Scientific Council met at the Greenland Institute of Natural Resources, Nuuk, Greenalnd during 10-17 September 2014, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), European Union (Denmark, Estonia, Lithuania and Spain), Norway and Russia. The Scientific Council Coordinator 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 10 September 2014.

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 1000 hours on 17 September 2014. The Council then considered and adopted Sections III.1–4 of the "Report of the NAFO/ICES *Pandalus* Assessment Group" (NAFO SCS Doc. 14/18, ICES CM 2014/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 10-17 September 2014 meeting.

The meeting adjourned at 1600 hours on 17 September 2014.

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 2013

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 recommendations to Fisheries Commission, with respect to stock advice, appear in the summary sheets. The full NIPAG report is available in NAFO SCS Doc. 14/18 and ICES CM 2014/ACOM:14

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

### 1. Request from Fisheries Commission

The Fisheries Commission Request for Advice (Annex 1a) for shrimp in Div. 3M and Div. 3LNO regarding stock assessment (Item 1) is given below.

## a) Northern Shrimp in Division 3M

Advice September 2014 for 2015

**Recommendation**

No directed fishery.

**Management objectives**

No explicit management plan or management objectives defined by Fisheries Commission. General convention objectives (GC Doc. 08-03) are applied. Advice is based on qualitative evaluation of biomass indices in relation to historic levels, and provided in the context of the precautionary approach framework (FC Doc. 04/18).

| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | 🔴 | Stock below $B_{lim}$ |
| Eliminate overfishing | 🟢 | No directed fishery |
| Apply Precautionary Approach | 🟡 | $B_{lim}$ defined. No fishing mortality reference point defined |
| Minimise harmful impacts on living marine resources and ecosystems | 🟢 | VME closures in effect, no directed fishery, sorting grids mandatory |
| Preserve marine biodiversity | ⚪ | Cannot be evaluated |

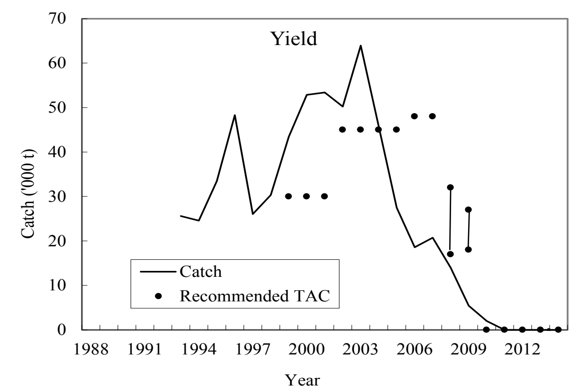
| | |
|---|---|
| 🟢 | OK |
| 🟡 | Intermediate |
| 🔴 | Not accomplished |
| ⚪ | Unknown |

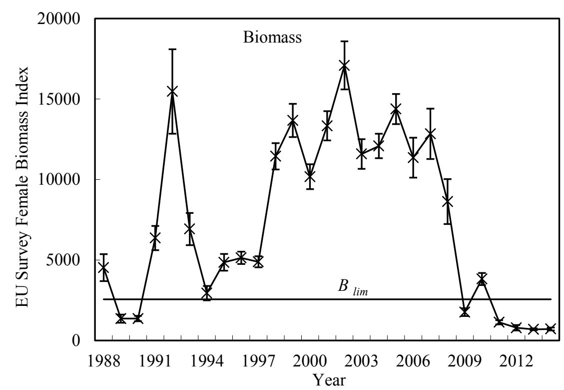
**Management unit**

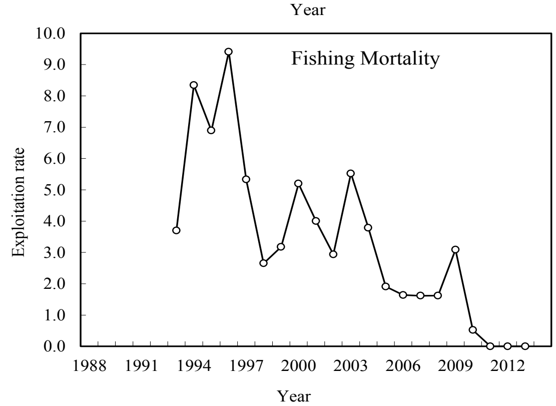
The Northern Shrimp stock on Flemish Cap is considered to be a separate population.

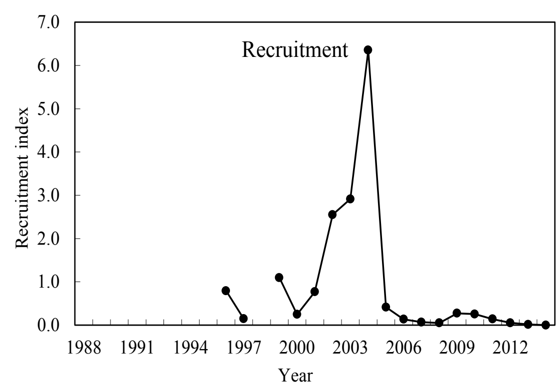
**Stock status**

Following several years of low recruitment, the spawning stock has declined, and has remained below $B_{lim}$ since 2011. Due to continued poor recruitment there are concerns that the stock will remain at low levels.



**Reference points**

Scientific Council considers that a female survey biomass index of 15% of its maximum observed level (2564) provides a proxy for $B_{lim}$ (SCS Doc. 04/12).

**Projections**

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

**Assessment**

No analytical assessment is available. Evaluation of stock status is based upon fishery and research survey data.

This stock is typically assessed annually. The next full assessment is currently scheduled for 2015. Scientific Council suggests this stock be moved to biennial assessments.

*Human impact*

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

*Biological and Environmental Interactions*

The drastic decline of shrimp biomass since 2007 correlates with the increase of the cod stock in Div. 3M. It is uncertain whether this represents a causal relationship and/or the result of an environmental factor.

Results of modelling suggest 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 1998 – 2007 period, would not be a stable feature in the Flemish Cap.

**Fishery**

This fishery is effort-regulated. 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 2014.

Recent catches were as follows:

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| NIPAG | 21 000 | 13 000 | 5 000 | 2 000 | 0 | 0 | 0 | 0[1] |
| STATLANT 21 | 17642 | 13431 | 5374 | 1976 | 0 | 0 | 0 | |
| Effort (Agreed Days) | 10555 | 10555 | 10555 | 5227 | 0 | 0 | 0 | |

[1] To September 2014

**Effects of the fishery on the ecosystem**

No fishery.

**Special comments**

None

**Source of Information**

SCR Doc. 14/049, 050

### b) Northern Shrimp in Divisions 3LNO

Advice September 2014 for 2015

#### Recommendation

No directed fishery as there is a very high probability that the stock is below $B_{lim}$.

#### Management objectives

No explicit management plan or objectives defined by Fisheries Commission. General convention objectives (GC Doc. 08/3) are applied. Advice is based on qualitative evaluation of biomass indices in relation to historic levels, and provided in the context of the precautionary approach framework (FC Doc. 04/18).

| *Convention objectives* | *Status* | *Comment/consideration* |
|---|---|---|
| Restore to or maintain at $B_{msy}$ | | Stock below $B_{lim}$ |
| Eliminate overfishing | | Current exploitation rate not sustainable |
| Apply Precautionary Approach | | Only $B_{lim}$ is defined |
| Minimise harmful impacts on living marine resources and ecosystems | | Nordmøre Grate mandatory; bycatch protocols; VME closures in effect |
| Preserve marine biodiversity | | Cannot be evaluated |

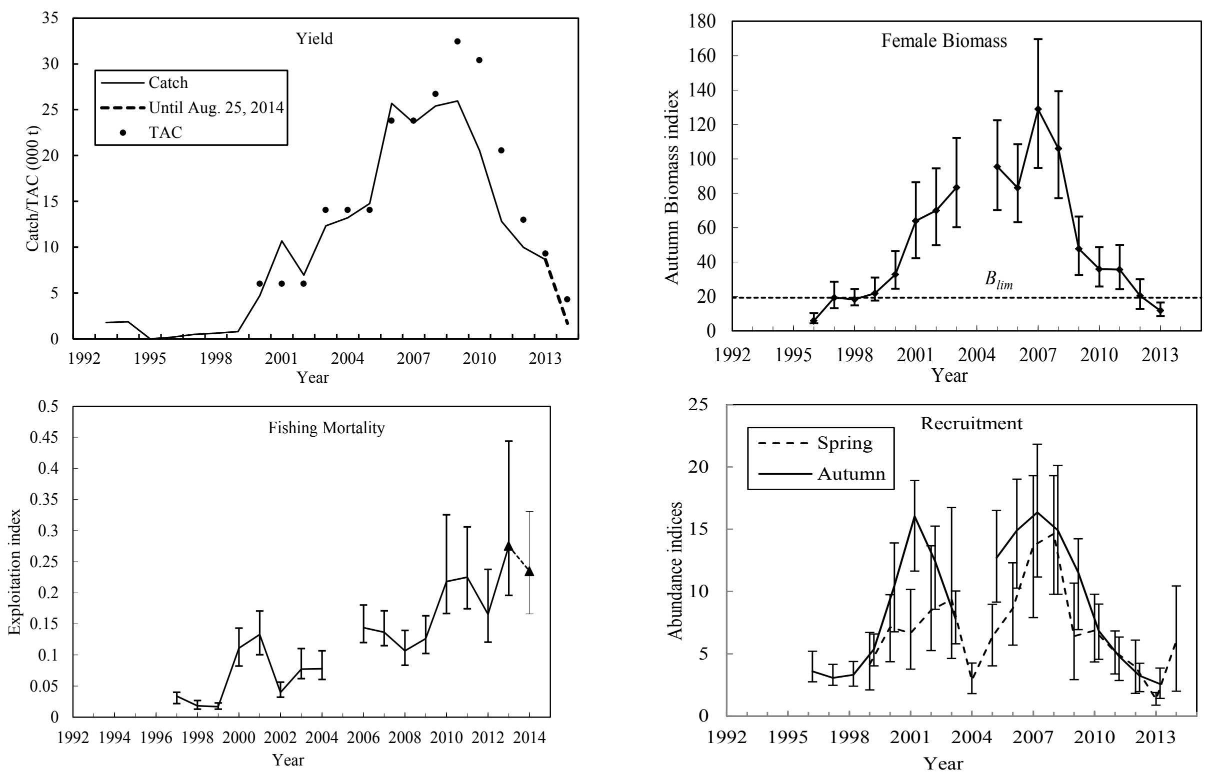
OK
Intermediate
Not accomplished
Unknown

#### Management Unit

The stock in Div. 3LNO is assessed and managed as a discrete population (see special comment).

#### Stock Status

The stock has declined since 2007 and in 2013 the risk of being below $B_{lim}$ is greater than 95%. Given expectations of poor recruitment and relatively high fishing mortality, the stock is not expected to increase in the near future.



**Reference points**

Scientific Council considers that a female survey biomass index of 15% of its maximum observed level (19 330) provides a proxy for $B_{lim}$ (SCS Doc. 04/12).

**Projections**

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

**Assessment**

Based upon a qualitative evaluation of trends in stock biomass, fishing mortality proxy and recruitment. Input data are research survey indices and fishery data.

Next full assessment is planned for 2015.

*Human impact*

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

*Biological and Environmental Interactions*

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. The size of the cod stocks in Div. 2J3KL and Div. 3NO have increased but remain at low levels and therefore the impact of cod predation is considered to be small. Some other groundfish which consume shrimps are known to have increased, but the impact on the shrimp stock has not been quantified.

Temperature in the stock area has been warming over the past decade. Effects of warmer temperatures on shrimp distribution, recruitment, growth and survival are unknown.

**Fishery**

Northern Shrimp is caught in a directed bottom trawl fishery and there is little or no bycatch in other trawl fisheries. The Northern Shrimp fishery is regulated by quota.

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| Enacted TAC[1] | 23784 | 26718 | 32438 | 30396 | 20557 | 12975 | 9297 | 4300 |
| STATLANT 21 | 21140 | 24855 | 25609 | 17575 | 12598 | 9994 | 8197 | |
| NIPAG[2] | 23570 | 25407 | 25900 | 20536 | 12900 | 10108 | 8647 | 1688[3] |

[1] Includes autonomous quotas
[2] NIPAG catch estimates have been updated using various data sources (see p. 13, SCR Doc. 14/048)
[3] Provisional catches up to August 25, 2014

**Effects of the fishery on the ecosystem**

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

**Special Comments**

Genetic analysis has been completed. Shrimp in Div. 3LNO are genetically distinct from those in Div. 3M and the Gulf of Maine, but not from those further north. Additional work is ongoing to investigate the contribution of stocks north of Div. 3L to the production of Div. 3LNO shrimp.

**Sources of information**

SCR Doc. 14/047, 048; http://www.dfo-mpo.gc.ca/Library/352955.pdf

## 2. Requests from Coastal States

### a) Northern Shrimp in Subarea 1 and Div. 0A

*Advice September 2014 for 2015*

**Recommendation**

Previous work has shown that a maintained mortality risk of 35% is low enough to keep stock levels safely at or above $B_{msy}$. A catch of 60 000 t in 2015 would entail an estimated mortality risk below 35% and is projected to allow stock growth. Scientific Council therefore advises that catches in 2015 should not exceed 60 000 t.

**Management Objectives**

Scientific Council is aware of the Greenland management plan for shrimp and of general management objectives specified in the Greenland Fisheries Act; however the contents of these have not been conveyed to the Council. Canada requested Scientific Council to provide advice on this stock within the context of the NAFO Precautionary Approach Framework (SCS Doc. 13/04).

Advice is based on risk analysis coming from a quantitative model, and on qualitative evaluation of biomass and stock-composition indices.

| *Objective* | *Status* | *Comment/consideration* |
|---|---|---|
| Apply Precautionary Approach | ● | Stock status is both estimated and forecast relative to precautionary reference points |

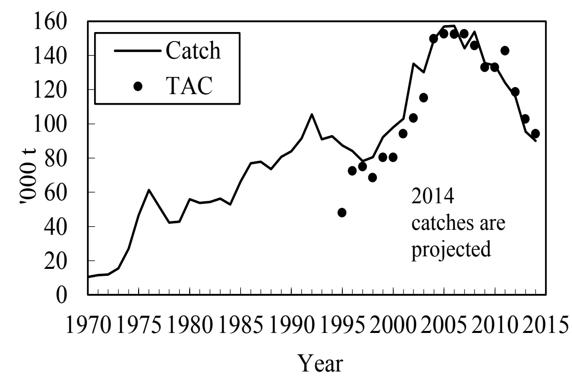
● OK

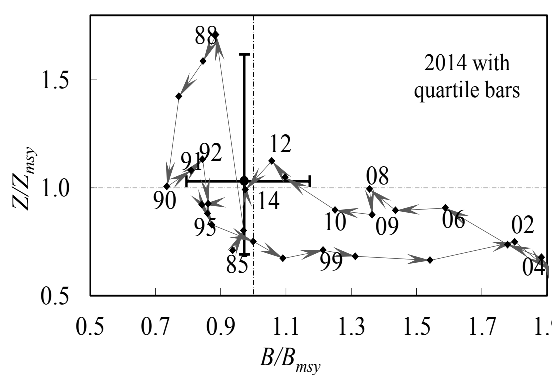
**Management unit**

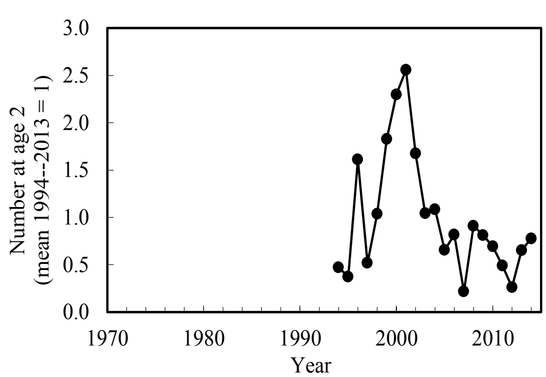
The stock, considered distinct from all others, is distributed throughout Subarea 1, extends into Div. 0A east of 60°30'W, and is assessed as a single stock.

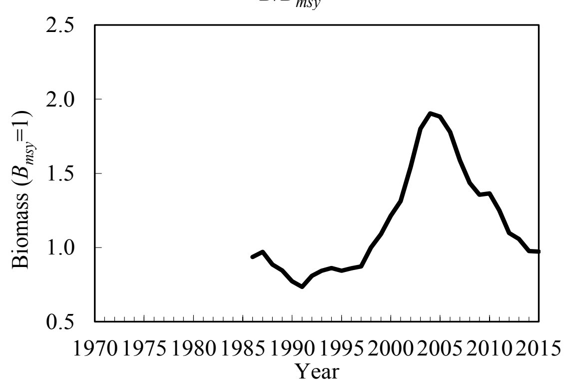
**Stock status**

Biomass is estimated to have been declining since 2004, and at the end of 2014 is projected to be near $B_{msy}$ with a risk of being below $B_{lim}$ of <2%. The risk that total mortality in 2014 will exceed $Z_{msy}$ is estimated at 53%.



**Reference points**

$B_{lim}$ is 30% of $B_{msy}$ and the limit reference point for mortality is $Z_{msy}$ (FC Doc. 04/18).

**Projections**

Projections for 2015 were made with catch levels ranging from 50 to 90 Kt/yr and a cod stock biomass at 50 Kt.

| 50 000 t cod | Catch option ('000 t) | | | | | | |
|---|---|---|---|---|---|---|---|
| Risk (%) of transgressing: | 50 | 55 | 60 | 65 | 70 | 80 | 90 |
| $B_{msy}$, end 2015 | 50 | 51 | 51 | 52 | 52 | 53 | 54 |
| 2016 | 47 | 47 | 48 | 49 | 49 | 52 | 53 |
| 2017 | 45 | 46 | 47 | 48 | 49 | 52 | 54 |
| $B_{lim}$, end 2015 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 2016 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| 2017 | 5 | 5 | 5 | 5 | 5 | 5 | 6 |
| $Z_{msy}$ during 2015 | 27 | 30 | 32 | 36 | 39 | 47 | 53 |
| 2016 | 28 | 30 | 33 | 37 | 40 | 47 | 54 |
| 2017 | 28 | 31 | 34 | 37 | 41 | 47 | 55 |

**Assessment**

The analytical assessment was run with the same methods as in 2011–13, with the exception that cod-stock biomass index series were combined within the model, and with updated data series.

The next assessment is scheduled for 2015.

*Human impact*

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

*Biological and Environmental Interactions*

Cod is an important predator on shrimps. This assessment incorporates this interaction.

**Fishery**

Shrimps are caught in a directed trawl fishery. Bycatch of fish in the shrimp fishery is around 1% by weight. The fishery is regulated by TAC.

Recent catches and TACs (t) have been as follows:

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| NIPAG | 144 190 | 152 749 | 135 458 | 133 990 | 123 985 | 115 975 | 95 380 | 90 000[1] |
| STATLANT 21 | 144 123 | 148 550 | 133 990 | 129 179 | 123 195 | 115 080 | 91 802 | - |
| Enacted TAC[2] | 152 417 | 145 717 | 132 987 | 132 987 | 142 597 | 118 596 | 102 767 | 94 140 |

[1] provisional—projected to year end;

[2] sum of TACs autonomously set by Canada and Greenland.

**Effects of the fishery on the ecosystem**

Measures to reduce effects of the fishery on the ecosystem include area closures and moving rules to protect sponges and cold-water corals and to reduce bycatch, and gear modifications to reduce damage to benthic communities, and, again, to reduce bycatch.

**Special comments**

The future trajectory of the stock is likely to depend on the evolution of the stock of cod, which has recently been increasing and is difficult to predict.

The stock comprises a low proportion of males, and recruitment to both the fishable and the spawning stocks in the short term are expected to remain low.

**Source of Information**

SCR Docs 04/75, 04/76, 08/6, 11/053, 11/058, 12/44, 13/54, 14/52, 58, 59, 61, 62, 67 SCS Doc. 04/12.

## b) Northern Shrimp in Denmark Strait and off East Greenland

*Advice September 2014 for 2015*

**Recommendation**

In 2013 Scientific Council advised that catches should not exceed the current catch level of 2 000 t, and there is no basis to change this advice.

**Management objectives**

Scientific Council is aware of general management objectives specified in the Greenland Fisheries Act; however the contents of these have not been conveyed to the Council.

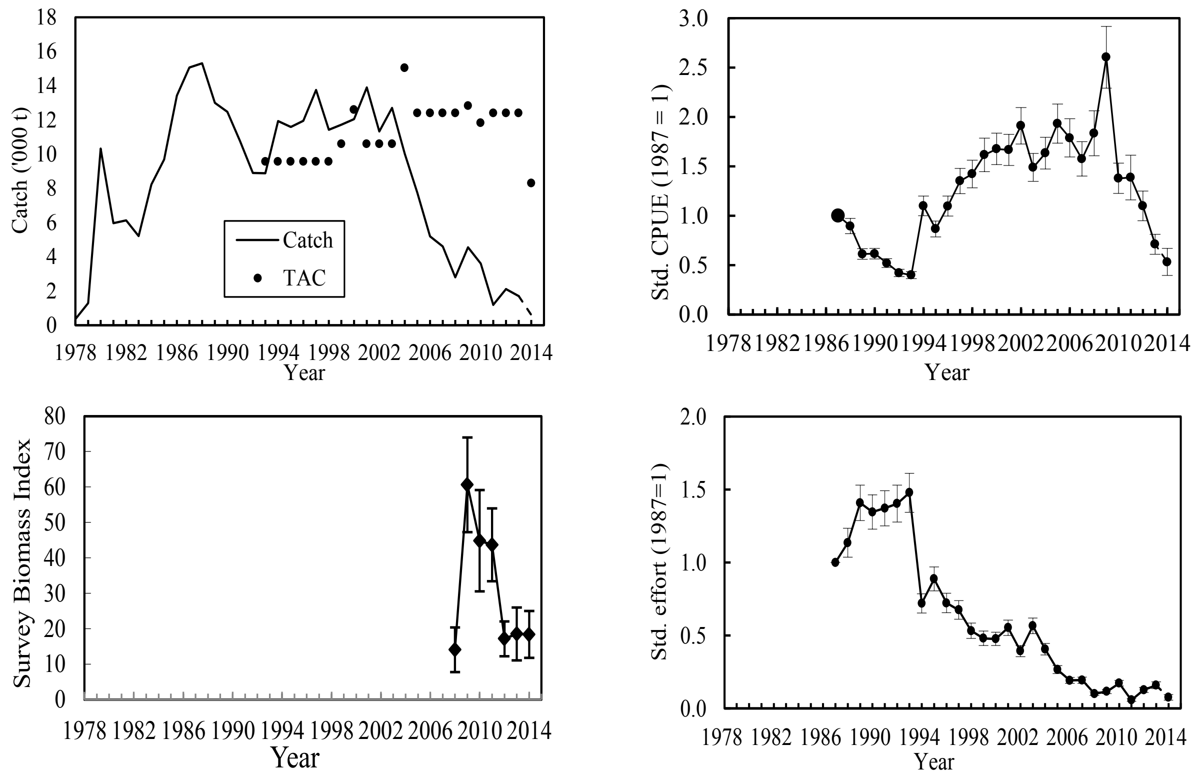
Advice is based on qualitative evaluation of biomass indices in relation to historic levels.

**Management unit**

The shrimp stock is distributed off East Greenland in ICES Div. XIVb and Va and is assessed as a single population

**Stock status**

The stock size remained at a very low level in 2014 despite several years of very low exploitation rates.



**Reference points**

No reference points have been established for this stock

**Projections**

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

**Assessment**

No analytical assessment is available. Evaluation of stock status is based upon interpretation of commercial fishery and research survey data.

*Human impact*

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

*Biological and Environmental Interactions*

Cod is an important predator on shrimp. The cod stock has been increasing in East Greenland waters in recent years.

**Fishery**

Shrimp is caught in a directed trawl fishery. The fishery is regulated by TAC and bycatch reduction measures include move on rules and Nordmøre grates.

Recent catches were as follows:

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014[1] |
|---|---|---|---|---|---|---|---|---|
| NIPAG | 4 600 | 2 794 | 4 555 | 3 735 | 1 235 | 2 109 | 1 706 | 609 |
| SC Recommended TAC | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 2 000 |
| Enacted TAC | 12 400 | 12 400 | 12 835 | 11 835 | 12 400 | 12 400 | 12 400 | 8 300 |

[1] To July 2014

**Effects of the fishery on the ecosystem**

Measures to reduce effects of the fishery on the ecosystem include move-on rules to protect sponges and cold-water corals, and gear modifications to reduce damage to benthic communities.

**Source of Information**

SCR Doc. 14/057, 14/060

**c) Harvest Control Rule (Item 7 of Annex II)**

7. In connection with the certification of the West Greenland Cold Water Prawn Trawl Fishery, Denmark (on behalf of Greenland) asks the NAFO Scientific Council to view the below suggested Harvest Control Rules to be applied in the context of the present risk-based management of the fishery:

1. *The management of the fishery must be based on long-term goals.*
2. *The total TAC should be set in such a way as to ensure that the estimated risk of the overall stock mortality exceeding Fmsy does not exceed 35%.*
3. *The above 35% risk level must be maintained regardless of the estimated size of the stock relative to Bmsy.*
4. *Efforts must be made to ensure that the TAC does not vary by more than a maximum of 12.5% from year to year, either up or down.*

*Scientific Council is asked to assess whether the above proposed HCR, in relation to the management of the West Greenland prawn fishery, are likely to maintain biomass in a safe zone above $B_{msy}$, and to recommend research studies that would improve its ability to make such an assessment.*

The Council responded:

Scientific Council is presently unable to determine whether the proposed HCR is sustainable over the long term.

In order to address this matter, SC **advises** that simulation studies can be undertaken that can determine whether this and/or other candidate management plans will meet management goals, but, before undertaking such studies, management goals need to be established and an acceptable risk of not attaining them defined. These goals could include metrics of stock sustainability, fishery performance and socio-economic factors *inter alia*.

For example, if a long-term goal is to maintain biomass above the $B_{msy}$ level, then the risk of the stock being below $B_{msy}$ after some predefined period must be agreed to and explicitly tested against the above rule or any rules that could become part of the stock management plan.

Initial work was presented to Scientific Council in 2013 (SCR Doc 13/055). Preliminary conclusions from these experiments were:

- Catch smoothing costs. Keeping the inter-annual change in catch small appears to reduce mean catches and reduces mean biomass—i.e. is less safe. Even worse is unsymmetrical catch smoothing, a policy under which catches can be increased when things look good but cannot be brought down when they don't. Such a policy tends to drive the stock into a hole from which it is eternally trying to climb out.
- Responsive HCRs aren't so much the good idea that they appear to be at first sight. It looks as though an unresponsive HCR which keeps to a fixed mortality risk regardless of the biomass risk is, under most circumstances, at least as good if not better.
- Conservative levels of mortality risk do give more safety and higher mean levels of biomass, but carry a cost in lower mean catches. They appear to bring the CV of catch down a little bit. A conservative level of mortality risk looks like something of a palliative to unsymmetrical catch smoothing, reducing its worst effects. The effect of changing mortality risk is greater if assessments are imprecise, less if assessments are precise. Might it therefore be useful to change the allowable mortality risk according to the perceived level of uncertainty associated with the assessment?

A maintained mortality risk of 35% appeared to be low enough to keep stock levels safely at or above $B_{msy}$.

Scientific Council advises that work continues and that experience gained elsewhere in NAFO could be considered in this context.

## V. OTHER MATTERS

### 1. Scheduling of Future Meetings

Scientific Council felt that the timing of the SC/NIPAG meeting worked well and planned to continue with this schedule.

**a) Scientific Council, 22 – 26 Sep 2014**

Scientific Council noted the Scientific Council meeting will be held in the Palacio de Congresos Mar de Vigo (Congress Centre) in Vigo, Spain, 22-24 September 2014.

**b) Scientific Council, 29 May – 11 June 2015**

Scientific Council agreed that its June meeting will be held on 29 May – 11 June 2015, at St Mary's University, Halifax.

**c) Scientific Council (in conjunction with NIPAG), 9 – 16 Sep 2015**

An invitation to host the meeting was given by Canada to be held in St. John's, NL, Canada. This invitation was accepted by the meeting. The agreed dates are 9 – 16 September, 2015.

**d) Scientific Council, September 2015**

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

**e) NAFO/ICES Joint Groups**

***i) NIPAG, 9 – 16 September 2015***

This meeting will be held 9 – 16 September 2015, St Johns, Newfoundland, Canada.

***ii) WGDEC, March 2015***

The next meeting of the ICES – NAFO Working Group on Deepwater Ecosystems is scheduled to take place at ICES Headquarters, Copenhagen, Denmark, during March 2015.

**f) NAFO SC Working Groups**

***i) WGESA (formerly SC WGEAFM), 19 - 27 November, 2014***

The Working Group on Ecosystem Science and Assessment will meet at the NAFO Secretariat, Dartmouth, Nova Scotia, Canada, 19 - 27 November, 2014.

## 2. Topics for Future Special Sessions

No special sessions were proposed.

## 3. Other Business

**a) SC/NIPAG Intersessional Workshop on Recruitment Signals**

Scientific Council will hold an intersessional meeting by correspondence to investigate the approporiate recruitment signal which can be used in prediction, taking into account environmental and trophic factors. This was proposed to be hosted by the NAFO Secretariat using Webex.

**b) Genetic population structure of northern shrimp, *Pandalus borealis*, in the Northwest Atlantic**

Scientific Council received a short presentation on a recently published study (Canadian Technical Report of Fisheries and Aquatic Sciences, 3046). This is a report on genetic variability patterns of northern shrimp sampled along the Northwestern Atlantic coast, from the Hudson Strait to the Gulf of Maine.

A total of 1 384 female shrimp from 14 sample locations were genotyped at 10 microsatellite loci for the purpose of identifying potential population structure of relevance for the management of Canadian shrimp fisheries. Highly significant genetic structuring was detected between parts of the sampled area, with genetically distinct shrimp in the Gulf of Maine and on the Flemish Cap. These locations were therefore concluded to harbour separate shrimp populations. The Newfoundland and Labrador shelf areas appeared much more genetically homogenous, which we attributed to population intermixing as a result of the Labrador Current.

Some genetic differences were detected among samples from these areas, but this putative structuring was comparable in magnitude to that observed among temporal replicates, and was therefore not considered robust evidence for population subdivisions.

## VI. ADOPTION OF SCIENTIFIC COUNCIL AND NIPAG REPORTS

The Council at its session on 17 September 2014 considered and adopted Sections III.1-4 of the "Report of the NAFO/ICES *Pandalus* Assessment Group" (SCS Doc. 14/18, ICES CM 2014/ACOM:14). The Council then considered and adopted its own report of the 10-17 September 2014 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. All participants were then wished a safe journey home and the meeting was adjourned at 1600 hours.

# PART H: NAFO/ICES PANDALUS ASSESSMENT GROUP (NIPAG) MEETING, 10–17 SEPTEMBER 2014

## Contents

**Report of NIPAG Meeting**

**10–17 September 2014**

Co-Chairs: Brian Healey and Michael Kingsley Rapporteurs: Various

## I. OPENING

The NAFO/ICES *Pandalus* Assessment Group (NIPAG) met at the Greenland Institute of Natural Resources (Pinngortitaleriffik), Nuuk, Greenland during 10-17 September 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, Lithuania, Spain and Sweden), Norway and Russian Federation. The NAFO Scientific Council Coordinator and Information Officer were also in attendance.

## II. GENERAL REVIEW

### 1. Review of Research Recommendations in 2013

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)

(SCR Doc. 14/049, 050)

**Environmental Overview**

Recent Conditions in Ocean Climate and Lower Trophic Levels

●Ocean climate composite index on SA3 – Flemish Cap has shifted downward in recent years although remains slightly above normal in 2013.

●The composite spring bloom index has shifted to negative values in 2013 after relatively high positive anomalies (highest in 2010) in recent years.

●The composite zooplankton index has remained above normal since 2009 and reached its highest level in 2013.

●The composite trophic index increased to its highest level in 2013.

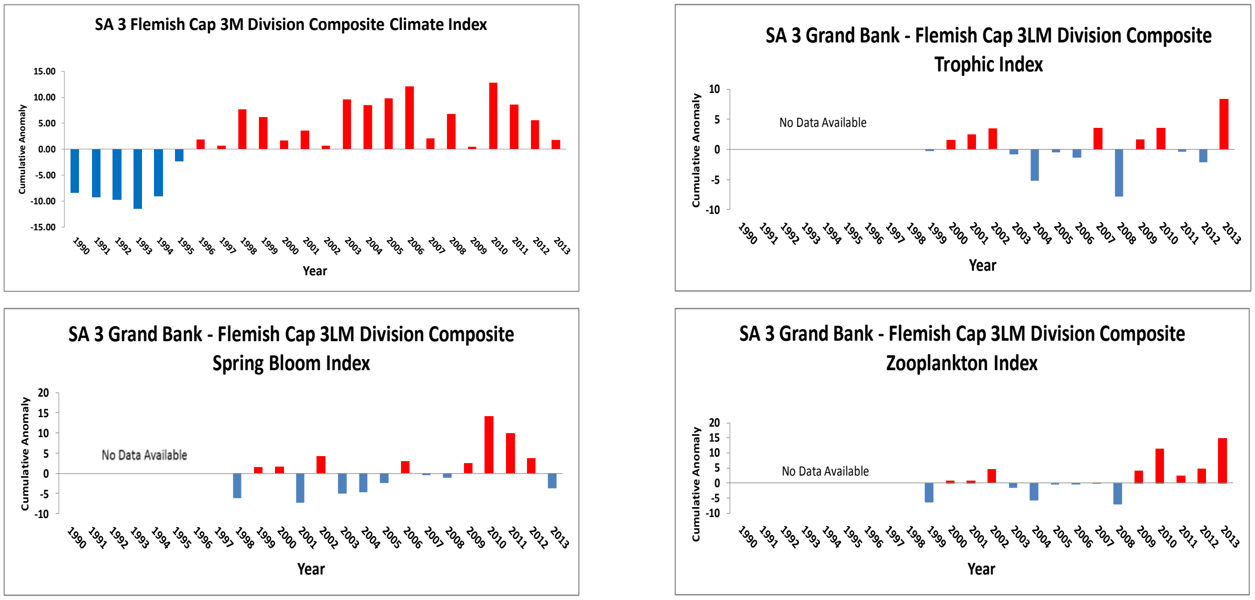



Fig. 1. Composite ocean climate index for NAFO Subarea 3 (Div. 3M) derived by summing the standardized anomalies during 1990-2013 (top left panel), composite spring bloom (summed background chlorophyll *a*, magnitude and amplitude indices) index (Div. 3LM) during 1998-2013 (lower left panel), composite zooplankton (cumulative anomalies of the four functional plankton taxa) index during 1999-2013 (top right panel), and composite trophic (summed anomalies of nutrient and standing stocks of phyto- and zooplankton indices) index (Div. 3LM) during 1999-2013 (bottom right panel). Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

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

**Ocean Climate and Ecosystem Indicators**

The composite climate index in Subarea 3 (Div. 3M) has remained above normal since the mid-1990s although the index has been in decline since 2010 and now approaching near-normal conditions in 2013 (Fig. 1). The composite spring bloom index (Div. 3LM) peaked in 2010 and has declined sequentially shifting from a series of positive anomalies to below normal in 2013 (Fig. 1). The composite zooplankton index (mainly composed of copepod and invertebrate plankton) peaked in 2013 and has remained at above normal levels in recent years (Fig. 1). The composite tropic index which combines nutrient inventories and standing stocks of phytoplankton and zooplankton, increased to its highest level in 2013 (Fig. 1). Surface temperatures on the Flemish Cap were slightly above normal in

2013 with a standard deviation of 0.6. Bottom temperature anomalies across the Flemish Cap were similar to 2012 and ranged from 1-2 standard deviations above normal in 2013, and have remained high since 2008.

## 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:** A moratorium was imposed in 2011. Catches are expected to be close to zero in 2014. Recent catches were as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| STACFIS | 27000 | 18000 | 21000 | 13000 | 5000 | 2000 | 0 | 0 | 0 | 0 |
| STATLANT 21 | 27651 | 15191 | 17642 | 13431 | 5374 | 1976 | 0 | 0 | 0 | 0[1] |
| SC Recommended Catches | 45000 | 48000 | 48000 | 17000–32000 | 18000–27000 | ndf | ndf | ndf | ndf | ndf |
| Effort[2] (Agreed Days) | 10555 | 10555 | 10555 | 10555 | 10555 | 5227 | 0 | 0 | 0 | 0 |

[1] To September 2014
[2] Effort regulated

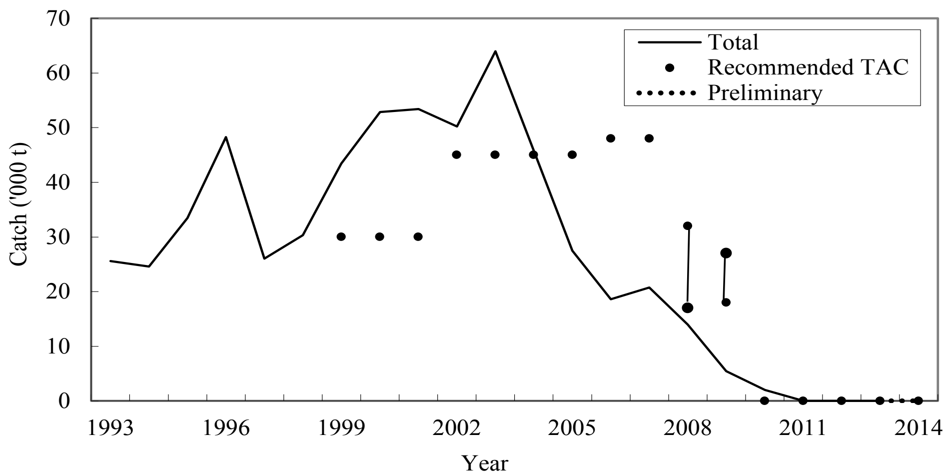



Fig. 1.1. Shrimp in Div. 3M: Catches (t) of shrimp on Flemish Cap and TACs recommended in the period 1993-2014. Due to a moratorium, the shrimp catch is expected to be zero in 2014.

## b) Input Data

### *i) Commercial fishery data*

Time series of size and sex composition data were available mainly from Iceland and Faroes between 1993 and 2005 and survey indices were available from EU research surveys (1988-2014). Because of the moratorium catch and effort data have not been available since 2010, and therefore the standardized CPUE series has not been extended.

### *ii) Research Survey Data*

Stratified-random trawl surveys have been conducted on Flemish Cap by the EU in July from 1988 to 2014. 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 using the methods accepted by STACFIS in 2004 (NAFO 2004 SC Rep., SCR Doc. 04/77). The female biomass index was stable at a high level from 1998 to 2007. After 2007 the survey biomass index declined and in 2014 although the shrimp biomass increased slightly (4%) over 2013, the estimated biomass (717 t.) remained among the lowest recorded in the historical series.

**c) Assessment**

No analytical assessment is available. Evaluation of stock status is based upon interpretation of commercial fishery up to 2010, and research survey data.

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

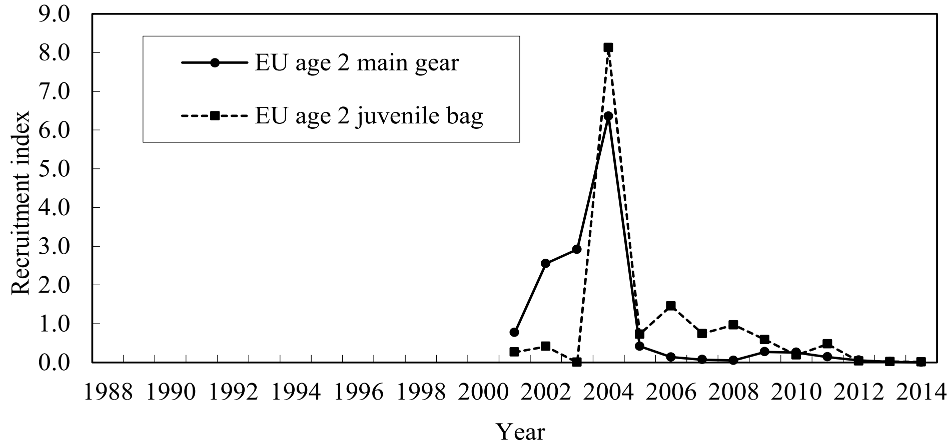



Fig. 1.2. Shrimp in Div. 3M: Abundance indices at age 2 from the EU survey. Each series was standardized to its mean.

*SSB:* The survey female biomass index was at a high level from 1998 to 2007, and has declined to second lowest level in 2014, well below $B_{lim}$.

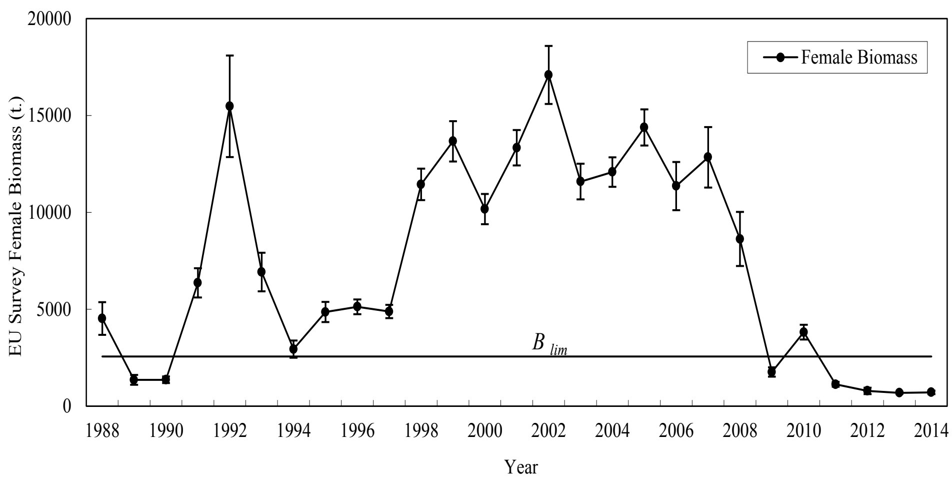



Fig. 1.3. Shrimp in Div. 3M: Female biomass index from EU trawl surveys, 1988-2014. Error bars are 1 std. err.

*Exploitation rate:* Because of low catches, followed by the moratorium, the exploitation rate index (nominal catch divided by the EU survey biomass index of the same year) has declined to near zero.

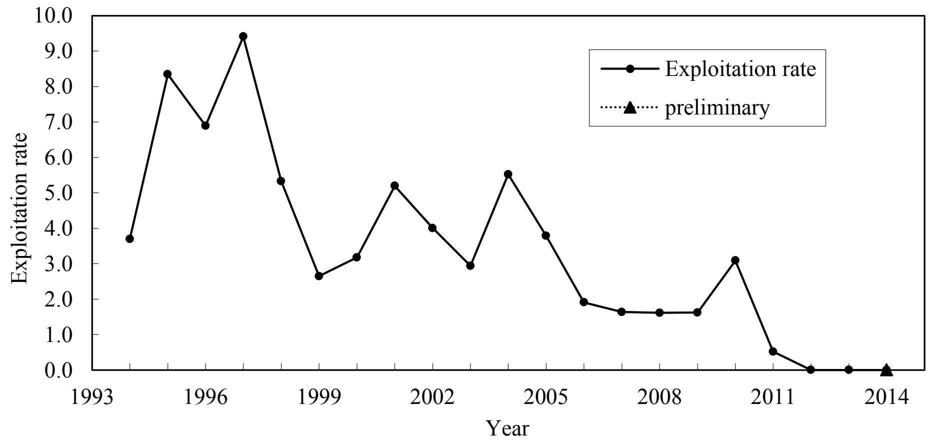



Fig. 1.4. Shrimp in Div. 3M exploitation rate index as derived by catch divided by the EU survey biomass index of the same year.

**d) State of the Stock**

Following several years of low recruitment, the spawning stock has declined, and has remained below $B_{lim}$ since 2011. Due to continued poor recruitment there are concerns that the stock will remain at low levels.

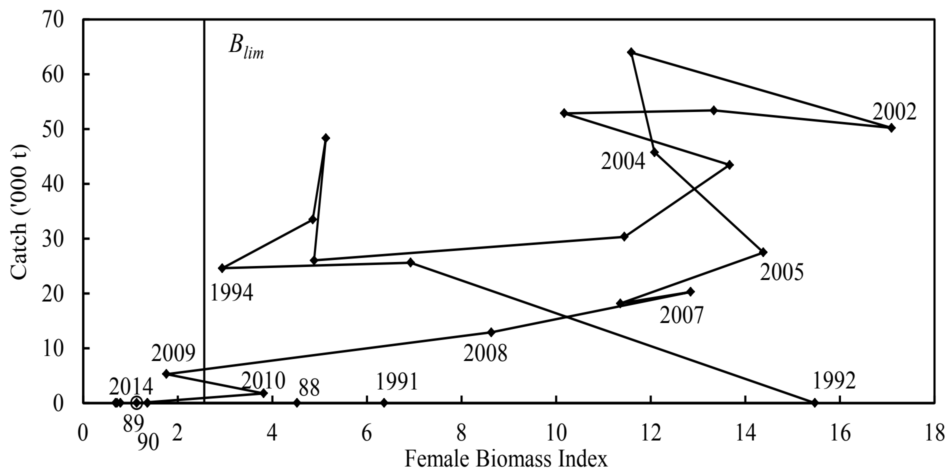



Fig. 1.5. Shrimp in Div. 3M: Catch plotted against female biomass index from EU survey. Line denoting $B_{lim}$ is drawn where biomass is 15% of the maximum point in 2002. Due to the moratorium on shrimp fishing the expected catch in 2014 is 0 t.

**e) Reference Points**

Scientific Council considers that a female survey biomass index of 15% of its maximum observed level provides a proxy for $B_{lim}$. This corresponds to an index value of 2 564. The index has been below $B_{lim}$ since 2010. A limit reference point for fishing mortality has not been defined.

**f) Ecosystem considerations**

The drastic decline of shrimp biomass since 2007 correlates with the increase of the cod stock in Div. 3M. It is uncertain whether this represents a causal relationship and/or covariance as the result of an environmental factor.

The environment, trophic interactions, and fisheries are important drivers of fish stock dynamics. Analyses of fish stomachs over 1990 to 2012 show an increasing proportion of shrimp in the diets of most fish species. Since the early 2000s, there has been an increase of redfish in the diet of large individuals of predatory species. These trends are observed throughout the Flemish Cap fish community.

Results of modelling suggest 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 1998 – 2007 period, would not be a stable feature in the Flemish Cap.

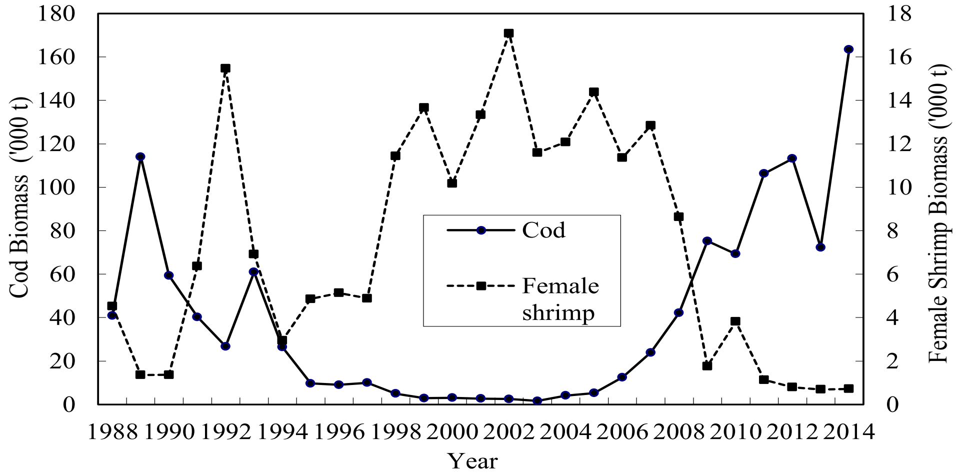



Fig. 1.6. Shrimp in Div. 3M: Cod and total shrimp biomass from EU trawl surveys, 1988-2014.

## g) Research Recommendations

For Northern Shrimp in Div. 3M NIPAG **recommends** that *further exploration of the relationship between shrimp, cod and the environment be continued in WGESA and NIPAG encourages the shrimp experts to be involved in this work.*

STATUS: No progress. This recommendation is reiterated.

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

(SCR Doc. 14/047, 048)

**Environmental Overview**

Recent Conditions in Ocean Climate and Lower Trophic Levels

●Ocean climate composite index on SA3 - Grand Bank continues to remain well above normal in 2013 and recent years.

●The composite spring bloom index declined in 2012-2013 after several years of relatively high positive anomalies.

●The composite zooplankton index has remained above normal since 2009 and reached a peak in 2013.

●The composite trophic index has remained near normal in recent years and increased to its highest level in the time series in 2013.

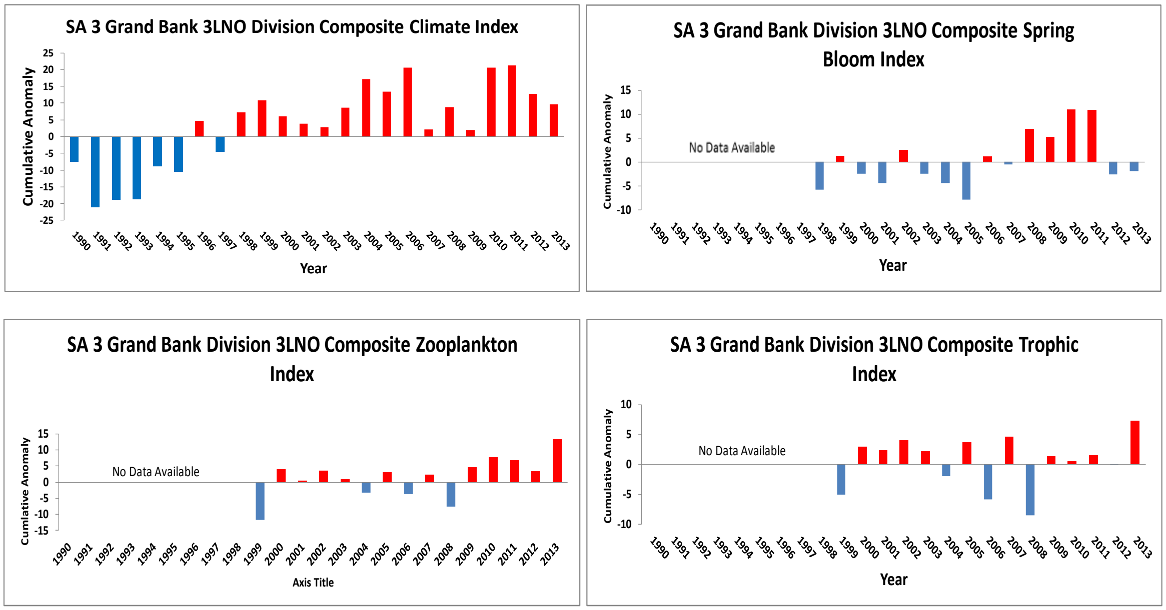



Fig. 2. Composite ocean climate index for NAFO Subarea 3 (SA3 Div. 3LNO) derived by summing the standardized anomalies (top left panel) during 1990-2013, composite spring bloom (summed background chlorophyll *a*, magnitude and amplitude indices) index (Div. 3LNO) during 1998-2013 (bottom left panel), composite zooplankton (cumulative anomalies of the four functional plankton taxa) index during 1999-2013 (top right panel), and composite trophic (summed anomalies of nutrient and standing stocks of phyto- and zooplankton indices) index (bottom right panel) during 1999-2013. Note the 2012 value for the composite trophic index is near zero and is not readily visible on the plot. Red bars are positive anomalies indicating above average levels while blue bars are negative anomalies indicating below average values.

The water mass characteristic of the Grand Bank are typical Cold-Intermediate-Layer (CIL) sub-polar waters which extend to the bottom in northern areas with average bottom temperatures generally <0°C during spring and through to autumn. The winter-formed CIL water mass is a reliable index of ocean climate conditions in this area. Bottom temperatures increase to 1-4°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 Bank 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.

**Ocean Climate and Ecosystem Indicators**

The composite climate index in Subarea 3 (Div. 3LNO) continues to remain above normal in 2013 but has declined in a pattern similar to Div. 3M in recent years (Fig. 2). Standing stocks of phytoplankton based on the composite spring bloom index has remained below average in 2013 consistent with levels observed in 2012 (Fig. 2). Standing stocks of zooplankton based on the composite zooplankton index peaked in 2013 and has remained well above normal in the past several years (Fig. 2). The composite trophic index also peaked in 2013 after several years of near-normal levels (Fig. 2).

The annual surface temperatures at Station 27 in Div. 3L continue to remain above normal (~1°C) in 2013. Bottom temperatures at Station 27 remained stable at levels observed in 2012. Vertically averaged temperatures were relatively stable at +1.1 SD from 2012. Surface salinities at Station 27 were near the long temp mean in 2013 while bottom salinities decreased below normal. The vertical thickness of the layer of cold <0°C water (commonly referred as the cold-intermediate-layer or CIL on the shelf) increased to the mean of the time series in 2013. Spring bottom temperatures in NAFO Div. 3LNO during 2013 were above normal and slightly less warm than the conditions of

2012. During the autumn, bottom temperatures in Div. 3LNO decreased and were near the long term mean of the time-series.

**a) Introduction**

This shrimp stock is distributed around the edge of the Grand Bank mainly in Div. 3L. The fishery began in 1993 and came under TAC control in 2000 with a 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 4 300 t in 2014 (Fig. 2.1).

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC[1] | 14056 | 23784 | 23784 | 26718 | 32438 | 30396 | 20557 | 12975 | 9297 | 4300 |
| STATLANT 21 | 13574 | 21284 | 21140 | 24855 | 25609 | 17575 | 12598 | 9994 | 8197 | |
| NIPAG[2] | 14775 | 25689 | 23570 | 25407 | 25900 | 20536 | 12900 | 10108 | 8647 | 1688[3] |

[1] Includes autonomous TAC as set by Denmark.
[2] NIPAG catch estimates have been updated using various data sources (see p. 13, SCR. 14/048).
[3] Provisional catches up to August 25, 2014

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 August 25, 2014, the small- and large-vessel fleets had taken 1 594 t and 87 t of shrimp respectively in Div. 3L.. The annual quota within the NAFO Regulatory Area (NRA) is 17% of the total TAC. 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), 334 t (2009), 334 t (2010), 214 (2011), 133 (2012), 96 (2013), or 48 t (2014) and set their own TACs of 1 344 t (2003–2005), 2 274 t (2006–2008), 3 106 t (2009), 1064 t (2010), 1 985 t (2011), 1 241 t (2012) and 889 t (2013). The TAC includes the autonomous quotas set by Denmark with respect to Faroes and Greenland.

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.

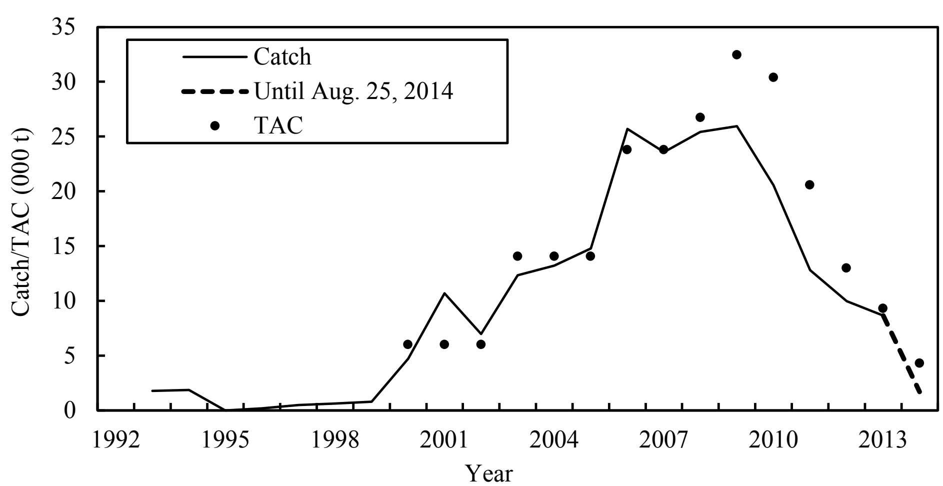



Fig. 2.1. Shrimp in Div. 3LNO: Catches (to August 25th 2014) and TAC. The TAC includes the autonomous quotas set by Denmark with respect to Faroes and Greenland.

**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 has been updated for these analyses. CPUE models were standardized to 2001. The 2010 - 14 indices 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). CPUE, while reflecting fishery performance, is not effectively indicating the status of the resource. The trends of these CPUE indices show conflicting patterns with the survey biomass indices and were therefore not used as indicators of stock biomass.

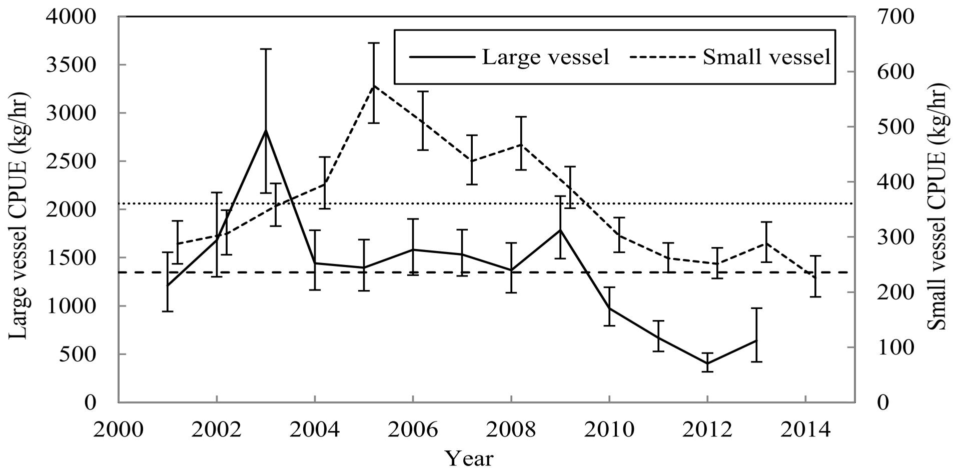



Fig. 2.2. Shrimp in Div. 3LNO: Standardized CPUE for the Canadian large-vessel (>500 t) and small-vessel (≤500 t; LOA<65') fleets fishing shrimp in Div. 3L within the Canadian EEZ.

Logbook data from Spain and Estonia, were available for the shrimp fishery within the NRA in 2014. The data was insufficient to produce a standardized CPUE model.

**Catch composition**. Length compositions were derived from Canadian (2003–2012) and Estonian (2010–2014) observer datasets. 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 (1999–2014) and autumn (1996–2013). 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 stratified-random survey in the NRA part of Div. 3L since 2003. Data is collected with a Campelen 1800 trawl. There was no Spanish survey in 2005.

**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 both the spring and autumn indices to 2007 after which they decreased by over 90% to 2013. However, there was a slight increase during spring 2014 (Fig. 2.3). Confidence intervals from the spring surveys are usually broader than from the autumn surveys.

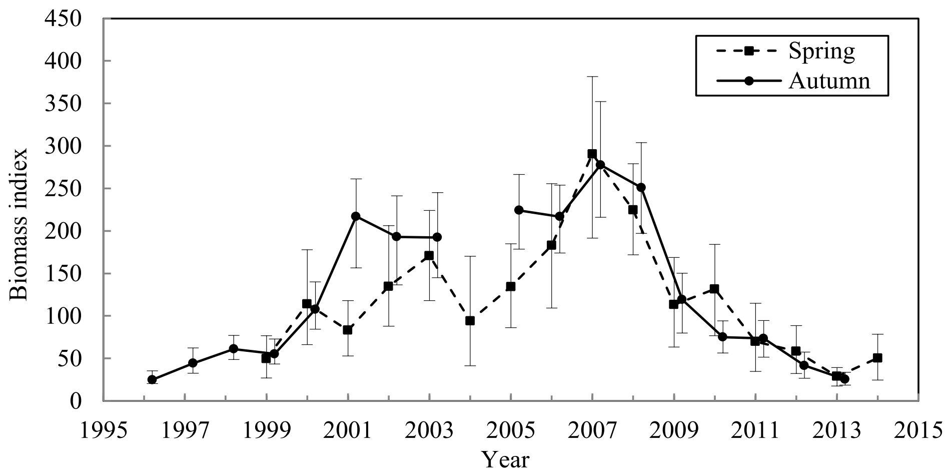



Fig. 2.3. Shrimp in Div. 3LNO: Total biomass index estimates from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

Spanish survey biomass indices for Div. 3LNO, within the NRA only, increased from 2003 to 2008 followed by a 93% decrease by 2012 remaining near that level in 2014 (Fig. 2.4).

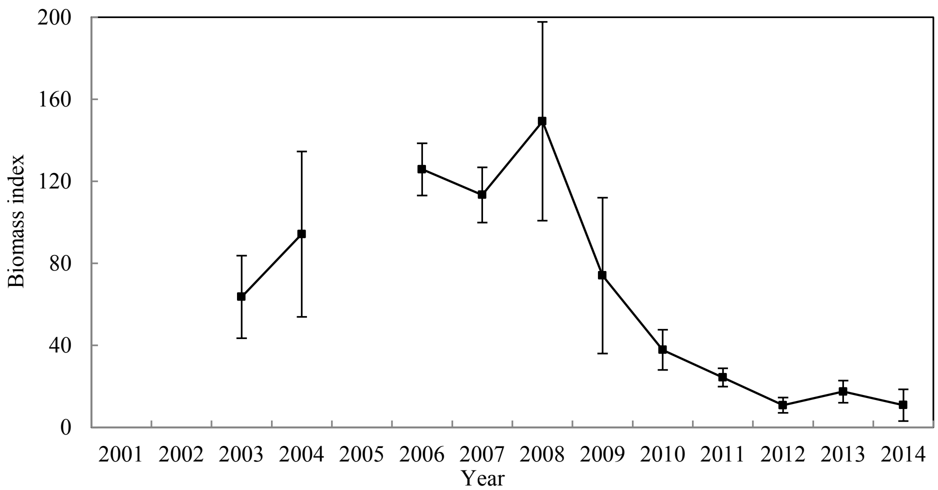



Fig. 2.4. Shrimp in Div. 3LNO: biomass index estimates from EU - Spanish multi-species surveys (± 1 s.e.) in the NRA of Div. 3LNO.

**Female Biomass (SSB) indices**. The autumn Div. 3LNO female SSB index showed an increasing trend to 2007 but decreased 91% by 2013. The spring SSB index decreased by 91% between 2007 and 2014 (Fig. 2.5).

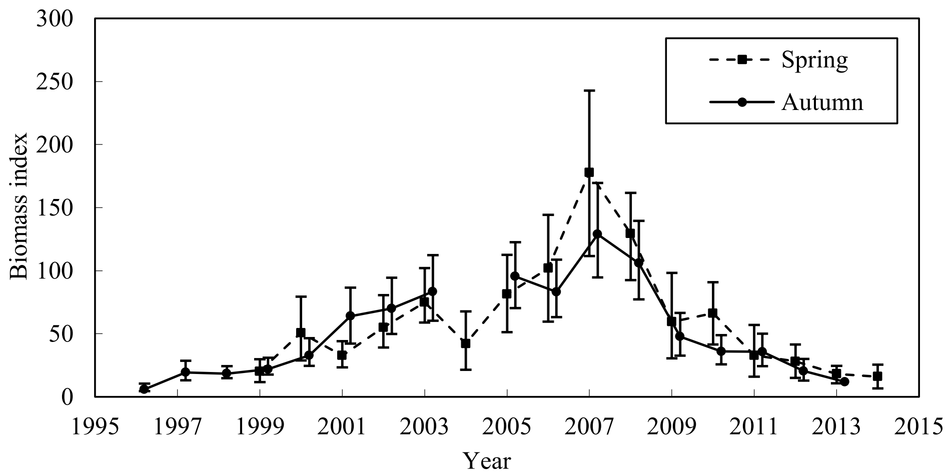



Fig. 2.5. Shrimp in Div. 3LNO: Female SSB indices from Canadian spring and autumn multi-species surveys (with 95% confidence intervals).

**Stock Composition.**

Both males and females showed a broad distribution of lengths in recent surveys indicating the presence of more than one year class (Fig. 2.6).

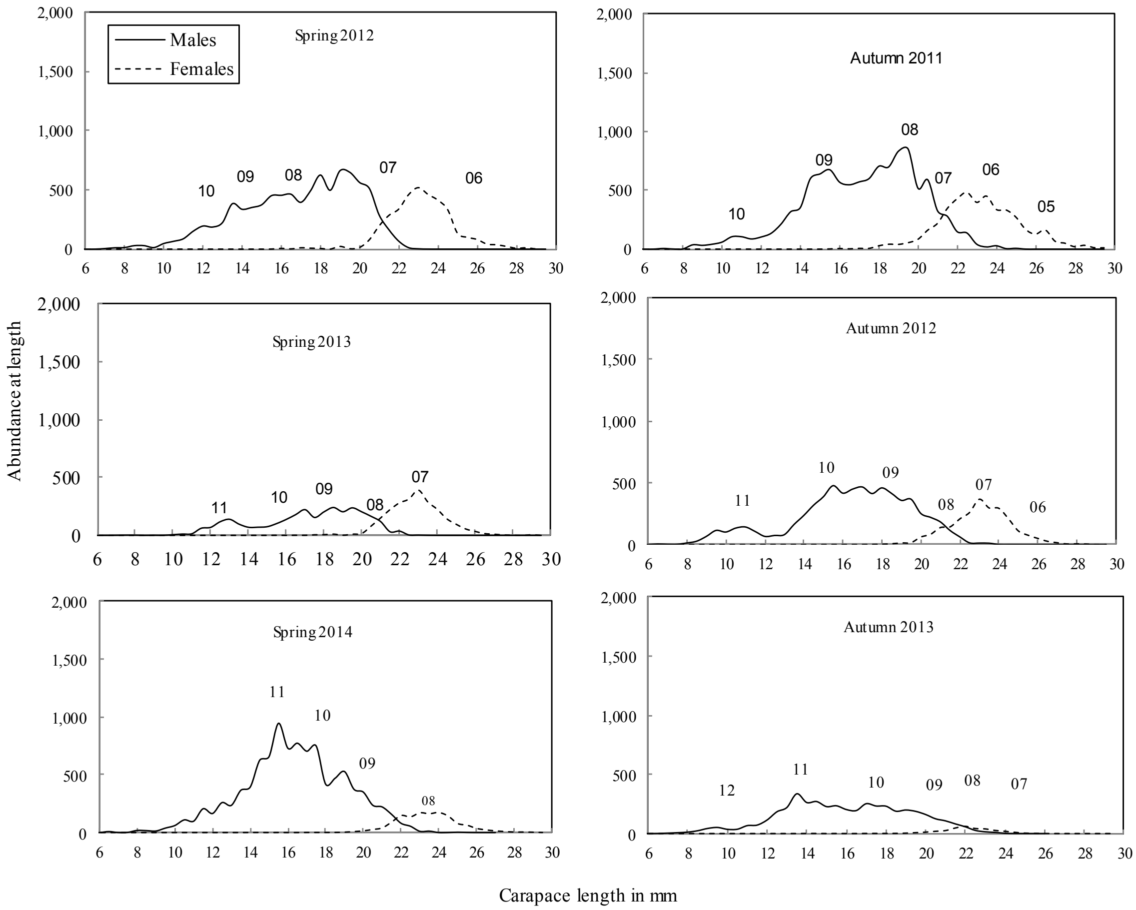



Fig. 2.6. Shrimp in Div. 3LNO: abundance at length estimated from Canadian multi-species survey data. Numbers within charts denote estimated modal length of each year-class.

**Recruitment indices**. The recruitment indices were based upon abundances of all shrimp with carapace lengths of 11.5 – 17 mm from Canadian survey data. These animals are thought to be one year away from the fishery. The 2006 – 2008 recruitment indices were among the highest in both spring and autumn time series. Both indices decreased through to autumn 2013. The index increased slightly in spring 2014, with a high degree of uncertainty (Fig. 2.7).

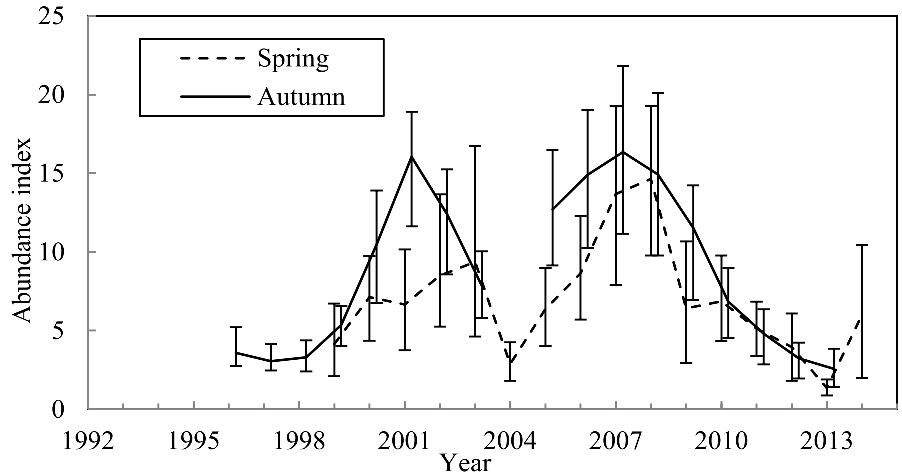



Fig. 2.7. Shrimp in Div. 3LNO: Recruitment indices derived from abundances of all shrimp with 11.5-17 mm carapace lengths from Canadian spring and autumn bottom trawl survey (1996-2014) data. Error bars represent 95% confidence intervals.

**Fishable biomass and exploitation index**. The autumn fishable biomass (shrimp >17mm CL) showed an increasing trend until 2007 then decreased by 92% through to 2013. Similarly, the spring fishable biomass index increased to 2007 but has since decreased by 91 % through to 2013 followed by a slight increase during 2014 (Fig. 2.8).

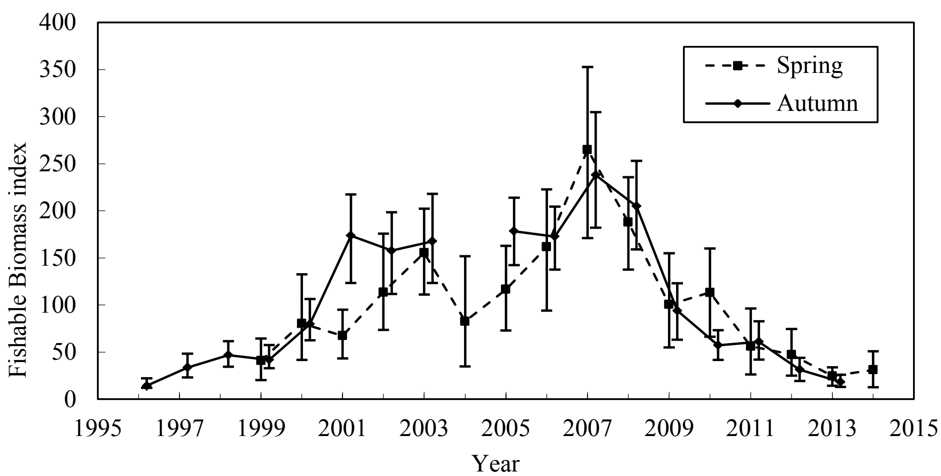



Fig. 2.8. Shrimp in Div. 3LNO: fishable (shrimp >17mm CL) biomass index. Bars indicate 95% confidence limits.

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 exploitation index has been generally increasing throughout the course of the fishery (Fig. 2.9). The exploitation rate for 2014 assumes the entire TAC is taken.

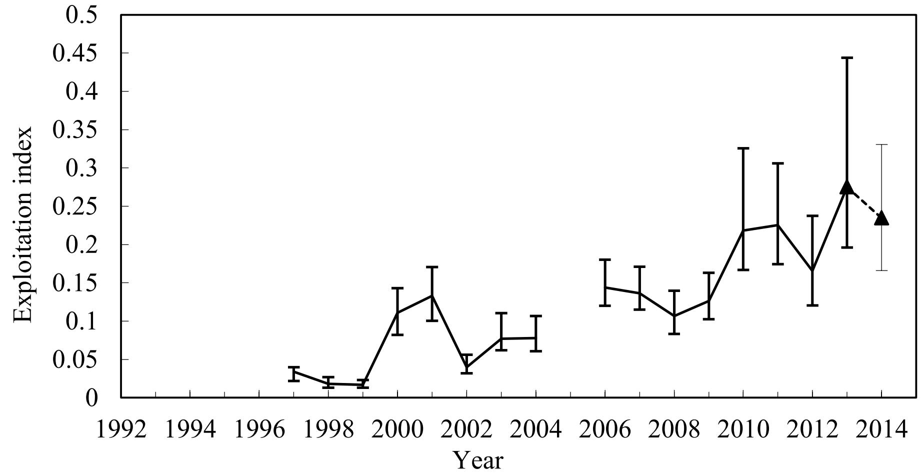



Fig. 2.9. Shrimp in Div. 3LNO: exploitation rates calculated as year's catch divided by the previous year's autumn fishable biomass index. Bars indicate 95% confidence limits.

**c) Assessment Results**

*Recruitment.* Recruitment indices have decreased since 2008 and are now among the lowest observed values.

*Biomass*. Spring and autumn biomass indices have decreased considerably since 2007.

*Exploitation.* The index of exploitation generally increased over the 1997 – 2014 period.

*State of the Stock.* The stock has declined since 2007, and in 2013 the risk of being below $B_{lim}$ is greater than 95%.

Given expectations of poor recruitment and relatively high fishing mortality, the stock is not predicted to increase in the near future.

**d) Precautionary Reference Points**

The point at which a valid index of stock size has declined to 15% of its highest observed value is considered to be $B_{lim}$ (SCS Doc. 04/12). The 2013 autumn female biomass index was 11 780 t, and in 2013 the risk of being below $B_{lim}$ is greater than 95% (Fig 2.10). A limit reference point for fishing mortality has not been defined.

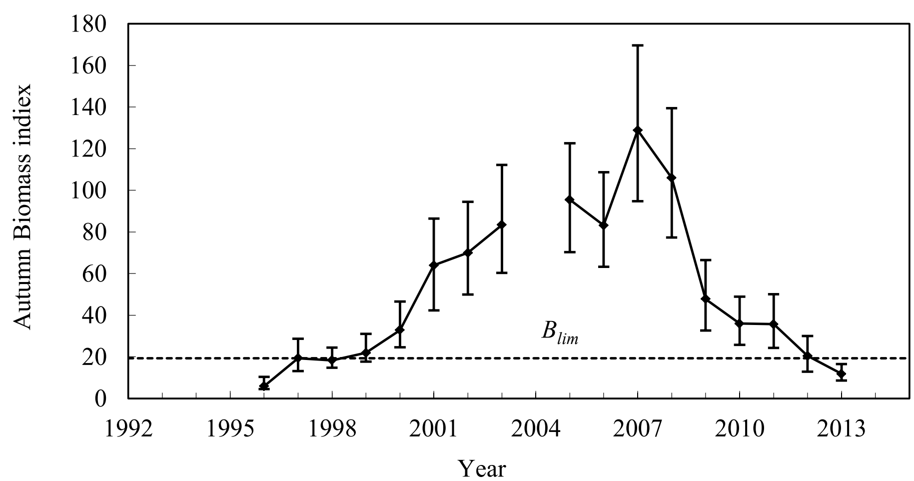



Fig. 2.10. Shrimp in Div. 3LNO: autumn female spawning stock biomass (SSB) and precautionary approach $B_{lim}$. $B_{lim}$ is defined as 15% of the maximum autumn female biomass over the time series. Bars indicate 95% confidence limits.

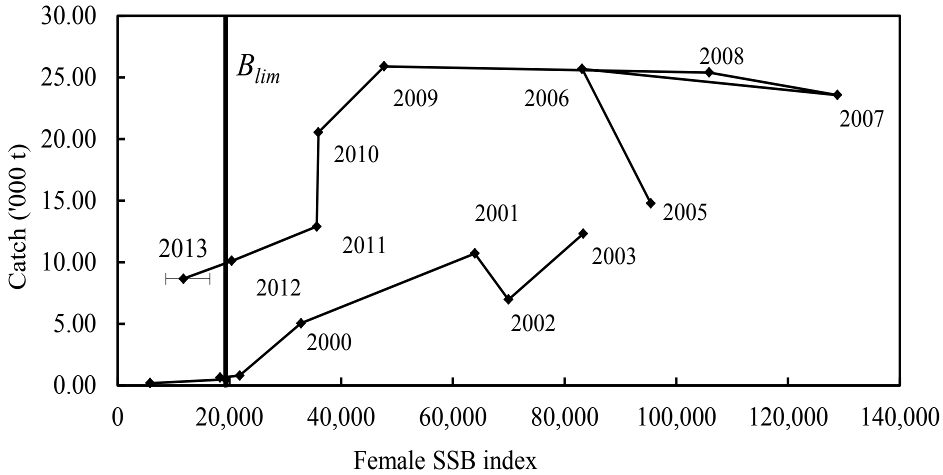



Fig. 2.11. Shrimp in Div. 3LNO: Catch against female SSB index from Canadian autumn survey. Line denoting $B_{lim}$ (approximately 19 300) is drawn where female biomass index is 15% of the maximum estimate over the time series.

**e) Other Studies**

***i) Female instantaneous mortality rate (Z).***

SCR Doc. 14/048

The female mortality rate (*Z*) was determined from the spring survey dataset and compared with the ratio of catch to biomass (*F*). *F* increased after 2008, but *Z* appears to have remained stable (Fig 2.12). It is unknown at this point what the relative contributions of *F* and *M* are to *Z*, but there is no indication of increased natural mortality.

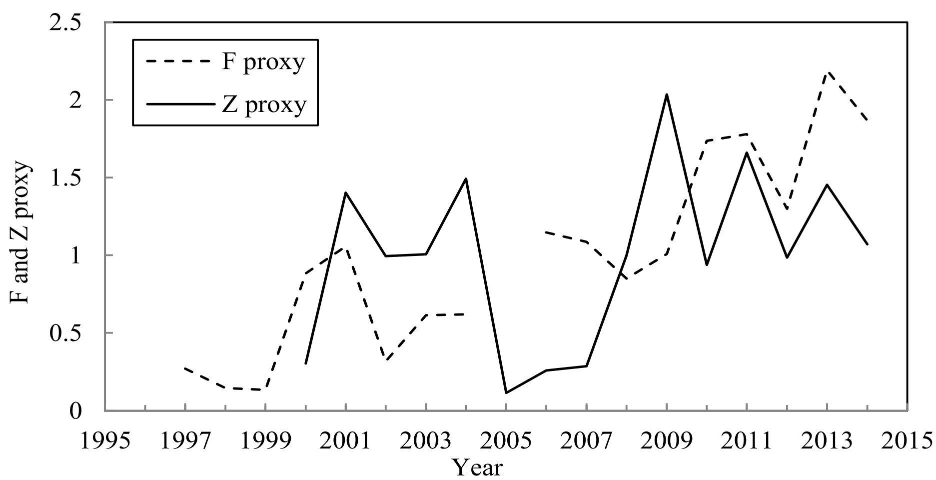



Fig. 2.12. Shrimp in Div. 3LNO: A comparison between exploitation rates (*F*) and the female instantaneous mortality rates (*Z*).

**3. Northern shrimp (Subareas 0 and 1)**

(SCR Docs 04/75, 76, 08/6, 11/53, 58, 12/44, 13/54, 14/52, 58, 59, 61, 62, 67; SCS Doc. 04/12)

**a) Introduction**

The shrimp stock off West Greenland is distributed mainly in NAFO Subarea 1 (Greenland EEZ), but a small part of the habitat, and of the stock, intrudes into the eastern edge of Div. 0A (Canadian EEZ). Canada has defined 'Shrimp

Fishing Area 1' (Canadian SFA1), to be the part of Div. 0A lying east of 60°30'W, i.e. east of the deepest water in this part of Davis Strait.

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

Three fleets, one from Canada and two from Greenland (offshore and coastal) have participated in the fishery since the late 1970s. The Canadian fleet and the Greenland offshore fleet have been restricted by areas and quotas since 1977. The Greenland coastal fleet has privileged access to inshore areas (primarily Disko Bay and Vaigat in the north, and Julianehåb Bay in the south). Coastal licences were originally given only to vessels under 80 tons, but in recent years 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 TAC advised for 2012 was 90 000t. For 2012, Greenland enacted a TAC of 101 675 t for Subarea 1; Canada enacted a TAC of 16 921 t for SFA 1. Further deterioration of the assessed status of the stock in 2012 induced yet lower advised TACs of 80 000 t for 2013 and 2014. In 2014 Greenland enacted a TAC of 82 807 t with quotas of 3400, 45 262 and 34 145 t, and Canada a TAC of 11 333 t.

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, in previous years, the coastal fleet catching bulk shrimps did not log catch weights of *P. montagui* separately from *borealis;* weights were estimated by catch sampling at the point of sale and the price adjusted accordingly, but the weight of *montagui* was not deducted from the quota (SCR Doc. 11/53). Logbook-recorded catches could therefore still legally exceed quotas. Since 2012 *P. montagui* has been included among the species protected by a 'moving rule' to limit bycatch and there are no licences issued for directed fishing on it (SCR Doc. 14/61). Instructions for reporting *montagui* in logbooks were changed in 2012, to improve the reporting of these catches.

The table of recent catches was updated (SCR Doc. 14/45). 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 95 380 t in 2013 and 90 000 t (projected) in 2014.

Recent catches, projected catches for 2014 and recommended and enacted TACs (t) for Northern Shrimp in Div. 0A east of 60°30'W and in Subarea 1 are as follows:

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAC | | | | | | | | | | |
| Advised | 130 000 | 130 000 | 130 000 | 110 000 | 110 000 | 110 000 | 120 000 | 90 000 | 80 000 | 80 000 |
| Enacted[3] | 152 452 | 152 380 | 152 417 | 145 717 | 132 987 | 132 987 | 142 597 | 118 596 | 102 767 | 94 140 |
| Catches (NIPAG) | | | | | | | | | | |
| SA 1 | 149 978 | 153 188 | 142 245 | 153 889 | 135 029 | 128 108 | 122 655 | 115 963 | 95 379 | *90 000*[1] |
| Div. 0A (SFA 1) | 6921 | 4127 | 1945 | 0 | 429 | 5882 | 1 330 | 12 | 2 | 0 |
| TOTAL SA 1–Div. 0A | 156 899 | 157 315 | 144 190 | 153 889 | 135 458 | 133 990 | 123 985 | 115 975 | 95 380 | *90 000*[1] |
| STATLANT 21 | | | | | | | | | | |
| SA 1 | 149 978 | 153 188 | 142 245 | 148 550 | 133 561 | 123 973 | 122 061 | 114 958 | 91 800[2] | |
| Div. 0A | 6410 | 3788 | 1878 | 0 | 429 | 5206 | 1134 | 12 | 2[2] | |

[1] Total catches for the year as predicted by industry observers.
[2] Provisional
[3] 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. 14/61).

In 2002–2005 the Canadian catch in SFA1 was stable at 6000 to 7000 t - about 4–5% of the total - but since 2007 fishing effort has been sporadic and catches variable, averaging about 1260 t in 2007–13 (SCR Doc. 14/46).

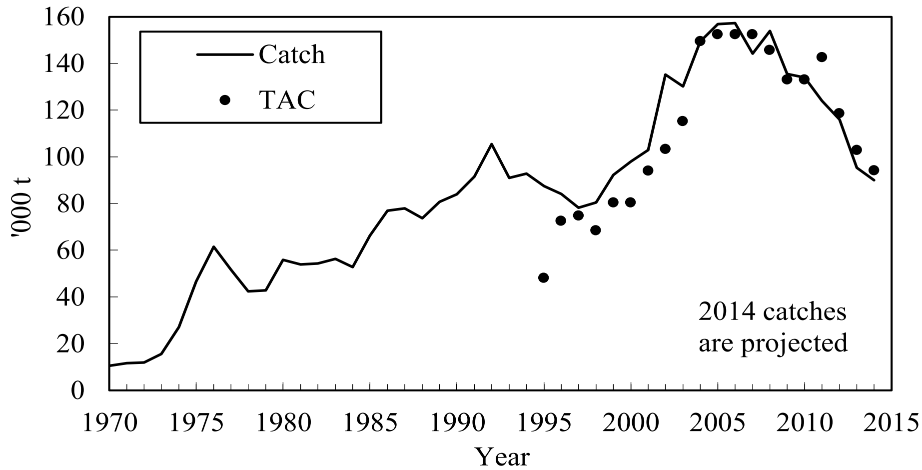



Fig. 3.1. Northern shrimp in Subarea 1 and Canadian SFA1: enacted TACs and total catches (2014 predicted for the year).

**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. 14/45). 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 between the two fleets 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, 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. In 2013 for the first time catch and effort data for statistical area 0, which extends north to 74°N, comprises 82 300 sq. km. and in 2005–12 yielded 16% of the offshore catch, was included in the CPUE analyses. A series for 1976–1990 was constructed for the KGH (Kongelige Grønlandske Handel) fleet of sister trawlers and a series for 1989–96, 1998–2007 and 2010–11 for the Canadian fleet fishing in SFA1 (Fig. 3.2). The standardised CPUE estimate for the Canadian fleet in 2011 was anomalously low; close examination of the data confirmed that there had been low catch rates and little fishing. This value has little influence on the unified series.

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 peak in 2008 at over twice its 1997 value (Fig. 3.2). Values for 2009 to 2014 have been lower but remain relatively high (SCR Doc. 14/61).

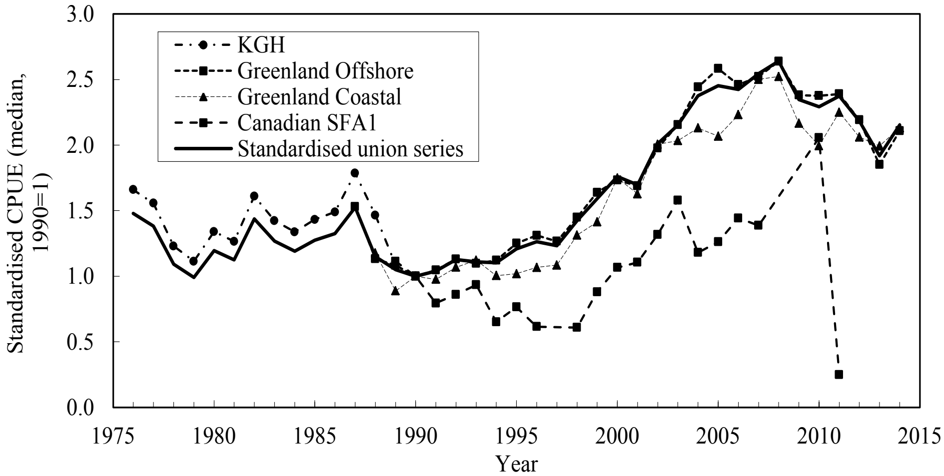



Fig. 3.2. Northern shrimp in Subarea 1 and Canadian SFA1: standardised CPUE index series 1976-2014.

The distribution of catch and effort among statistical areas was summarised using Simpson's diversity index to calculate an 'effective' number of statistical areas being fished as an index of how widely the fishery is distributed (Fig 3.3). The fishery area has contracted; NIPAG has for some years been concerned for effects of this contraction on the relationship between CPUE and stock biomass, and in particular that relative to earlier years biomass might be overestimated by recent CPUE values.

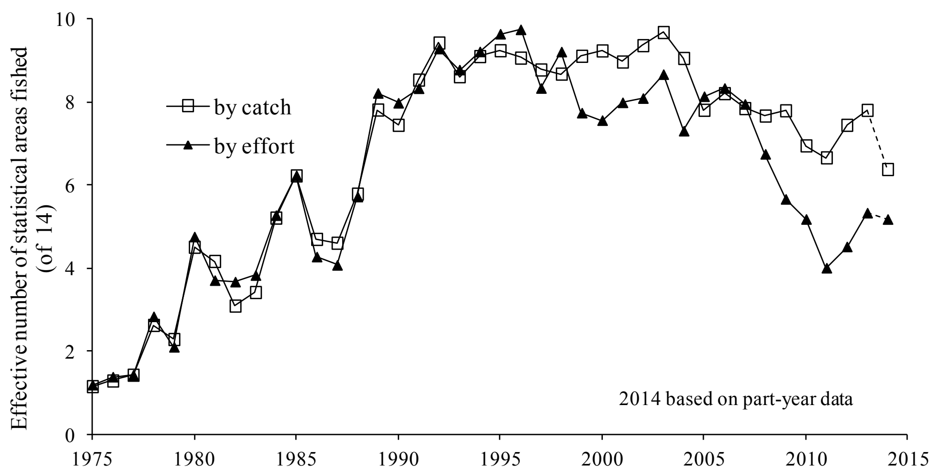



Fig. 3.3. Northern shrimp in Subarea 1 and Canadian SFA1: indices for the distribution of the Greenland fishery between statistical areas in 1975–2014.

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 statistical areas being fished in SA 1 reached a plateau in 1992–2003. The range of the fishery has since contracted northwards and the effective number of statistical areas being fished has decreased.

**Catch composition**. There is no biological sampling programme 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.

14/52). 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 1997–2014 (SCR Doc. 14/52). About 80% of the survey biomass estimate is in water 200–400 m deep. In the early 1990s, about ¾ of this 80% 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. 14/52). The proportion of survey biomass in Div. 1E–F has [illegible] biomass, like that of the fishery,

[illegible] 997 (c.v. 18%, downward trend [illegible] of the 1997 value. Subsequent [illegible] (Fig. 3.4); this decline has been [illegible] 20 years (SCR Doc. 14/52). For [illegible]

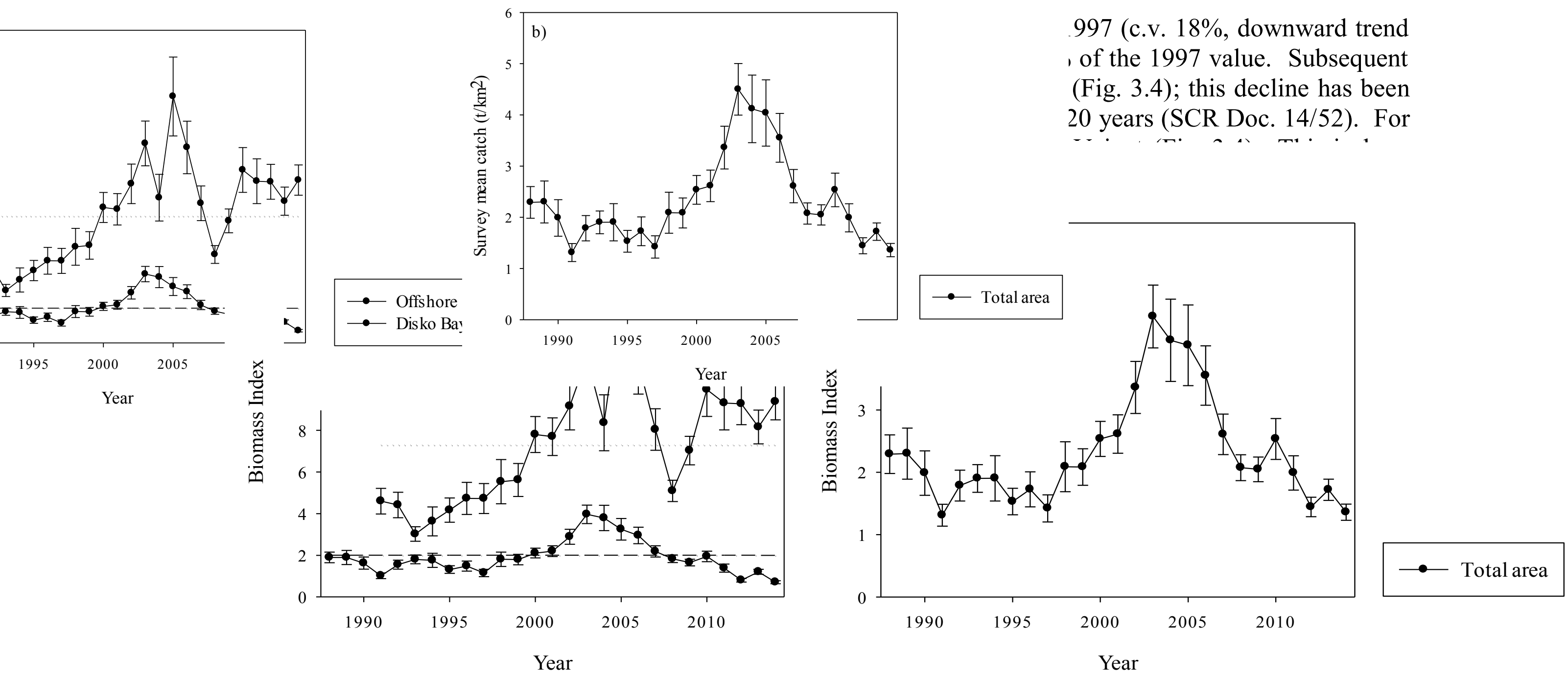



Fig. 3.4. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey mean catch rates inshore and offshore (panel a) and overall (panel b) 1988–2014 (error bars 1 s.e.).

*Length and sex composition* (SCR Doc. 14/52).

In 2012 overall the fishable biomass at 91.1% of total was a little below its 20-year median, but included an exceptionally high proportion of females. Pre-recruits (14–16.5 mm) have been few since 2008 in absolute numbers. In 2013 the fishable biomass was estimated to have increased by one-third, but this seemed entirely due to increases in number and biomass of females, which composed an exceptionally high proportion of the stock (SCR Doc. 14/52). This size distribution continues in 2014: females still compose a high proportion of both the fishable and total biomass, while both fishable males and unrecruited males at 14–16.5 mm remain low in absolute numbers and as a proportion of the stock.

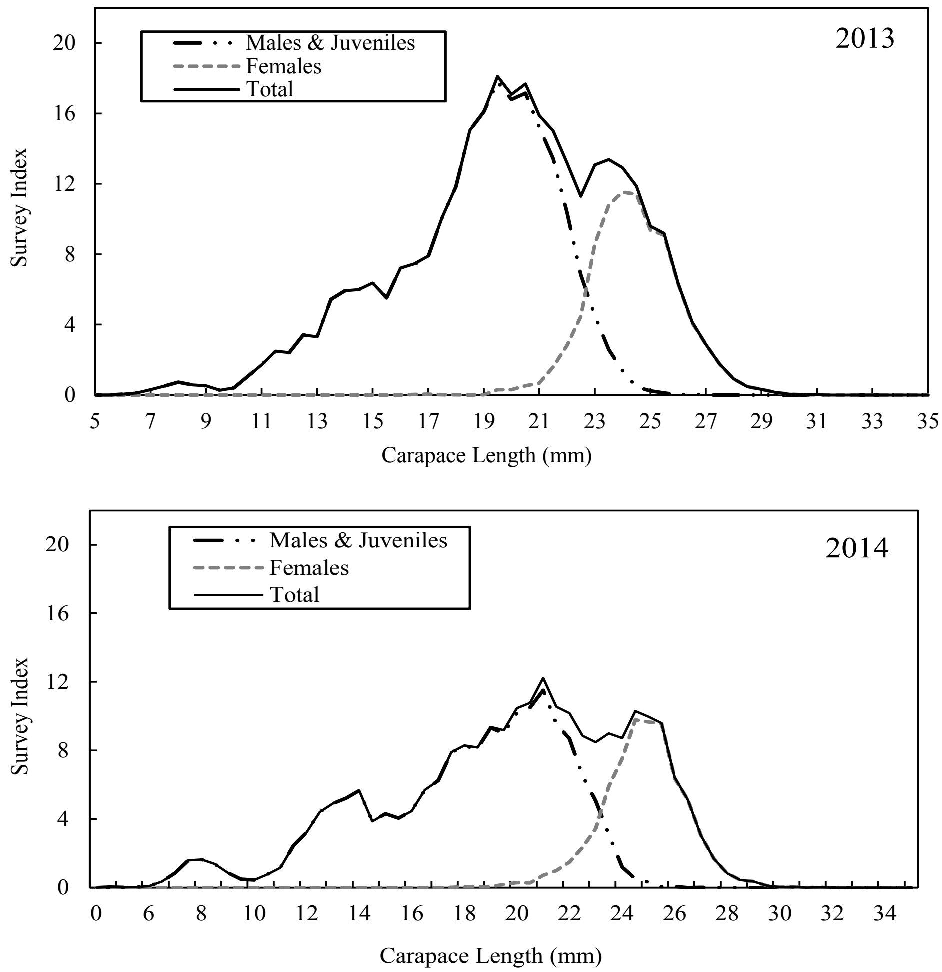



Fig. 3.5. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey mean catch rates at length in the West Greenland trawl survey in 2013–2014.

**Recruitment Index**. In 2014 numbers at age 2 were estimated by fitting Normally distributed components to the length distribution, but only as far as 19 mm CPL. In other words, two components, considered age-1 and age-2, were fully fitted, and a third component was fitted only on its left-hand limb (SCR Doc. 14/58). Components were required to have equal CVs of CPL. This method was used to revise numbers at age 2 back to 2005.

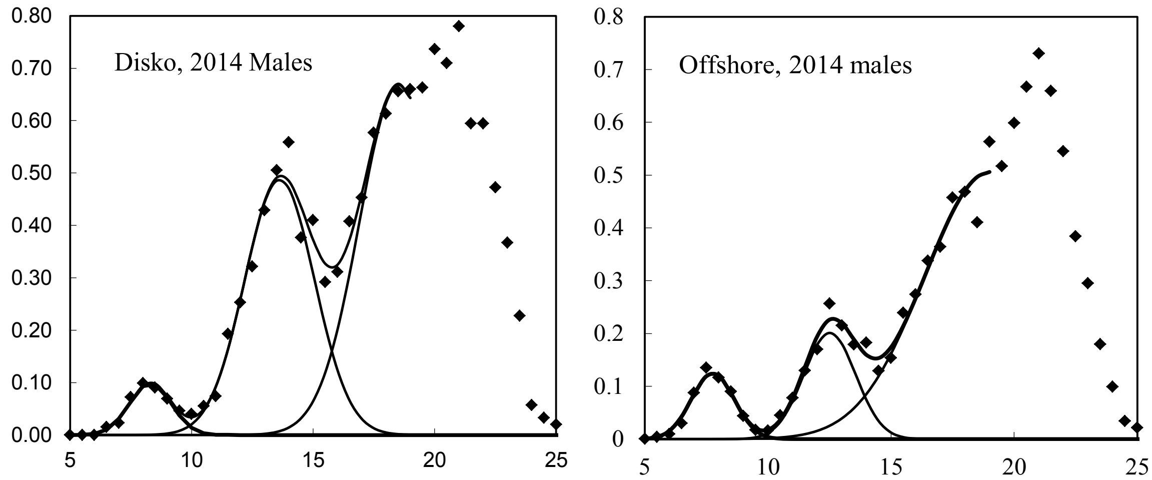



Figure 3.6: Examples of estimating numbers at age by fitting Normally distributed components, two full and one partial, with equal CVs, to the length distribution of males.

Numbers at age 2 have been low since 2010, but in 2013 and 2014 have been higher, although still below the 20-year median. The changes in 2013 and 2014 are mostly attributable to survey results in the inshore area.

Proportions, and numbers, of both unrecruited males and fishable males remain low, especially offshore, presaging poor recruitment to the fishable biomass and to the spawning stock next year.

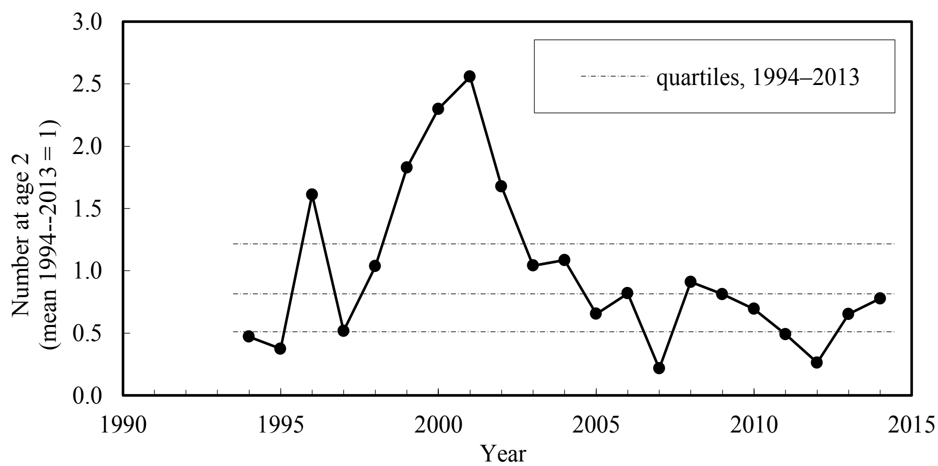



Fig. 3.7. Northern Shrimp in Subarea 1 and Canadian SFA 1: survey index of numbers at age 2, 1994-2014.

***iii) Predation index***

Series of estimates of cod biomass in West Greenland waters are available for different periods from VPA, from the German groundfish survey at West Greenland and from the Greenland trawl survey for shrimps. The results from the German survey for the current year are not available in time for the assessment. Heretofore the estimate from the German survey has been used as the main estimate, the Greenland trawl survey value, adjusted, being used only for the current year.

**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. 14/59).

The model includes a term for predation by Atlantic cod. In 2014 the full Greenland trawl survey was combined with the German survey within the assessment model, the two always having been well correlated, to produce an overall cod-stock biomass estimate series. The estimate for the current year depends only on the (scaled) Greenland survey value, the German survey being late in the year. The methods used in the German survey have recently been reviewed and revised; past estimates were little changed. The index of cod biomass is adjusted by a measure of the overlap between the stocks of cod and shrimps in order to arrive at an index of 'effective' cod biomass, which is used in the assessment model to estimate predation.

Total catches for 2014 were projected at 90 000 t. The assessment model had been modified in 2012 to include the uncertainty of projecting the current year's catches. 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 (SCR Doc. 11/58). Stability of the assessment was checked by looking at changes, due to the addition of subsequent years' data, in year-end stock status estimates. Though slight changes occurred, they were commensurate with fluctuations in biomass indices and did not trend either up or down.

The modelled biomass was low and stable until the late 1990s, when it started a rapid increase. Biomass doubled by about 2004; the survey index increased much more than the fishery CPUE. Since 2004 the modelled biomass has steadily declined to reach in 2014 a level similar to that of the late 1990s, close to $B_{msy}$. The survey index has declined to 31% of its peak, but the fishery CPUE, although slowly decreasing since 2008, is still relatively high.

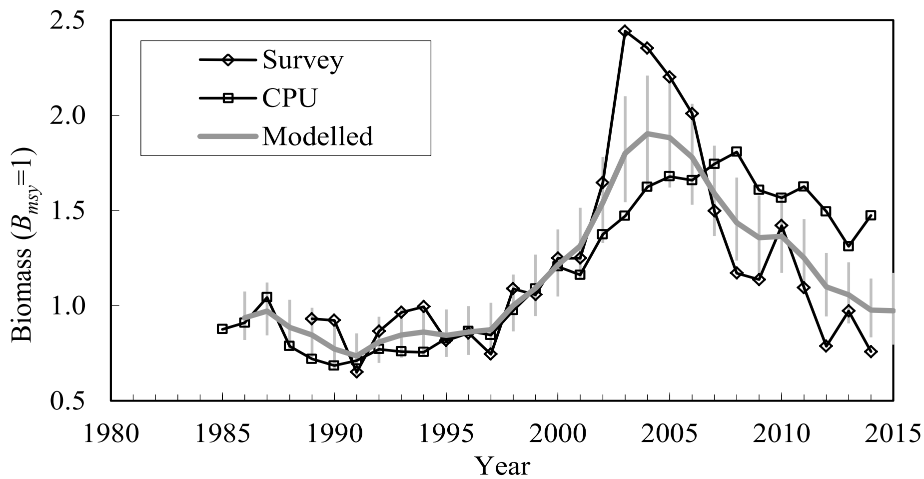



Fig. 3.8.a: Northern Shrimp in SA 1 and Canadian SFA1: trajectory of the median estimate of relative stock biomass at start of year 1986–2015, with median CPUE and survey indices; 30 years' data with constrained CVs.

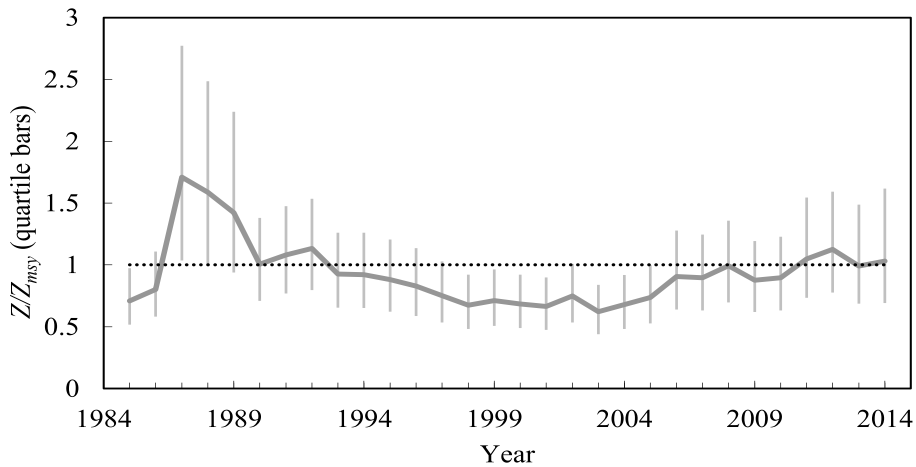



Fig 3.8.b: Northern Shrimp in SA 1 and Canadian SFA1: trajectory of the median modelled estimate of mortality relative to $Z_{msy}$ during the year, 1985–2014, with quartile bars.

Mortality has generally been below $Z_{msy}$ during the modelled period, although a short-lived episode of high cod biomass occasioned three years of high values in the late 1980s (Fig. 3.7). From 1998 to 2005 total mortality was noticeably low — in 1998–2001 because catches were still below 100 Kt while the stock had started to increase, in 2002–05 because the stock biomass increased, to high levels, much faster than catches. After 2005 increasing cod biomass, decreasing shrimp stock biomass, and persistent high catches have resulted in higher mortalities, exceeding $Z_{msy}$ in recent years.

Estimates of stock-dynamic and fit parameters from fitting a Schaefer stock-production model, to 30 years' data on the West Greenland stock of the Northern shrimp in 2014. Median values from the 2013 assessment are provided for comparison. In 2014, biomass is predicted to be close to $B_{msy}$, and mortality to slightly exceed $Z_{msy}$.

| | 2014 assessment | | | | | | 2013 assessment |
|---|---|---|---|---|---|---|---|
| | Mean | S.D. | 25% | Median | 75% | Est. Mode | Median |
| *Max.sustainable yield (kt)* | 140.5 | 76.5 | 102.9 | 131.3 | 165.0 | 112.9 | 138.0 |
| *B/Bmsy, end current year (proj.) (%)* | 98.9 | 30.6 | 79.5 | 97.3 | 117.2 | 94.0 | 109.0 |
| *Biom. risk, end current yr (%)* | 53.7 | 49.9 | – | – | – | – | – |
| *Z/Zmsy, current year (proj.)(%)* | – | – | 69.2 | 103.1 | 161.8 | – | 93.0 |
| *Carrying capacity (kt)* | 4216 | 3710 | 2042 | 3126 | 5057 | 946 | 3162 |
| *Max. sustainable yield ratio (%)* | 9.8 | 6.1 | 5.1 | 9.0 | 13.5 | 7.6 | 9.3 |
| *Survey catchability (%)* | 17.4 | 12.6 | 8.3 | 14.1 | 23.1 | 7.5 | 14.0 |
| *CV of process (%)* | 12.4 | 2.9 | 10.4 | 12.1 | 14.1 | 11.4 | 11.6 |
| *CV of survey fit (%)* | 15.8 | 2.1 | 14.4 | 15.9 | 17.3 | 16.1 | 15.0 |
| *CV of CPUE fit (%)* | 19.4 | 2.9 | 17.4 | 19.0 | 20.9 | 18.1 | 17.4 |
| *CV of predation fit (%)* | 131.0 | 87.5 | 59.5 | 115.4 | 185.3 | 84.2 | 112.4 |

***ii) Assessment Summary***

*Recruitment*. Pre-recruits at CL 14–16.5 mm are few and have been so since 2008 in absolute terms, so short-term recruitment is expected to be low. The number at age 2 in 2014 is near its 20-year median.

*Biomass*. A stock-dynamic model showed a maximum biomass in 2004 with a continuing decline since. At the end of 2014, the stock will be at $B_{msy}$, with a risk of being below $B_{lim}$ (30% of $B_{msy}$) of 2%.

*Mortality*. With 2014 catches projected at 90 000 t the risk that total mortality will exceed $Z_{msy}$ is estimated at about 53%. Atlantic cod is, in 2014, still concentrated in southerly areas where shrimps are now scarce, but its biomass is high and predation pressure is expected to be similar to the previous 3 years.

*State of the Stock*. Biomass is estimated to have been declining since 2004, and at the end of 2014 is projected to be near $B_{msy}$ with a risk of being below $B_{lim}$ (30% of $B_{msy}$) of 1.6%. The risk that total mortality in 2014 will exceed $Z_{msy}$ is estimated at 53%.

**d) Precautionary Approach**

$B_{lim}$ has been established as 30% $B_{msy}$, and $Z_{msy}$ (fishery and cod predation) has been set as the mortality reference point.

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 high proportions of $B_{msy}$ 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. At the end of 2014, the stock will be at $B_{msy}$, with a risk of being below $B_{lim}$ (30% of $B_{msy}$) of 2%. The risk that total mortality in 2014 will exceed $Z_{msy}$ is estimated at 53%.

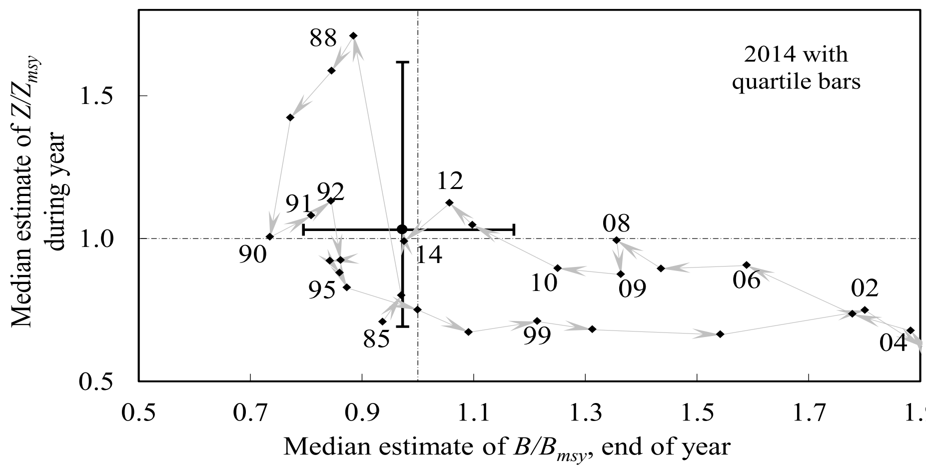



Fig. 3.9: Northern shrimp in Subarea 1 and Canadian SFA1: trajectory of relative biomass and relative mortality, 1985–2014.

**e) Projections**

Predicted probabilities of transgressing precautionary reference points in 2015 – 2017 under seven catch options and subject to predation by a cod stock with an effective biomass of 50 Kt (the value for 2014 being 44Kt.):

| 50 000 t cod | | Catch option ('000 t) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Risk (%) of transgressing: | | 50 | 55 | 60 | 65 | 70 | 80 | 90 |
| $B_{msy}$, end | 2015 | 50 | 51 | 51 | 52 | 52 | 53 | 54 |
| | 2016 | 47 | 47 | 48 | 49 | 49 | 52 | 53 |
| | 2017 | 45 | 46 | 47 | 48 | 49 | 52 | 54 |
| $B_{lim}$, end | 2015 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | 2016 | 3 | 4 | 4 | 4 | 4 | 4 | 4 |
| | 2017 | 5 | 5 | 5 | 5 | 5 | 5 | 6 |
| $Z_{msy}$ during | 2015 | 27 | 30 | 32 | 36 | 39 | 47 | 53 |
| | 2016 | 28 | 30 | 33 | 37 | 40 | 47 | 54 |
| | 2017 | 28 | 31 | 34 | 37 | 41 | 47 | 55 |

In the medium term, model results estimate that catches up to 80 000 t/yr could be associated with a slowly increasing stock (Fig. 3.10). For larger catches estimates of biomass risk ($B<B_{msy}$) increase with projections into the future.

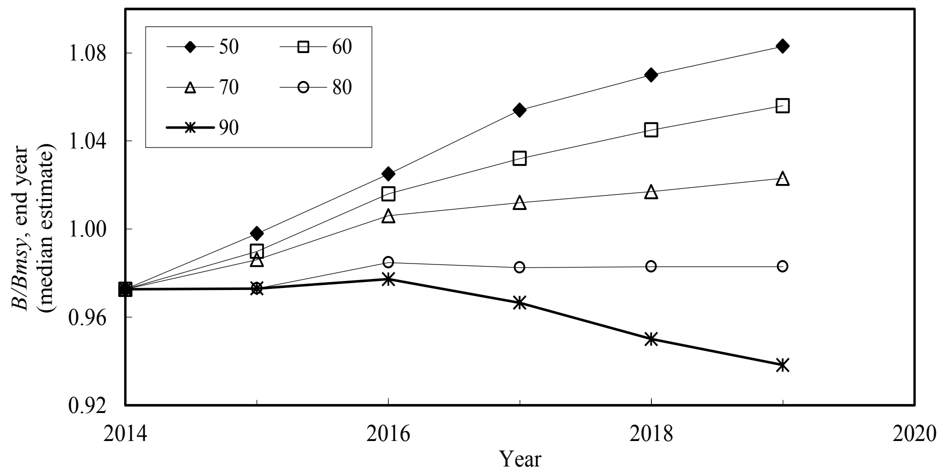



Fig. 3.10. Northern shrimp in Subarea 1 and Canadian SFA1: median estimates of biomass trajectory for 5 years with annual catches at 50–90 Kt and an 'effective' cod stock assumed at 50 Kt.

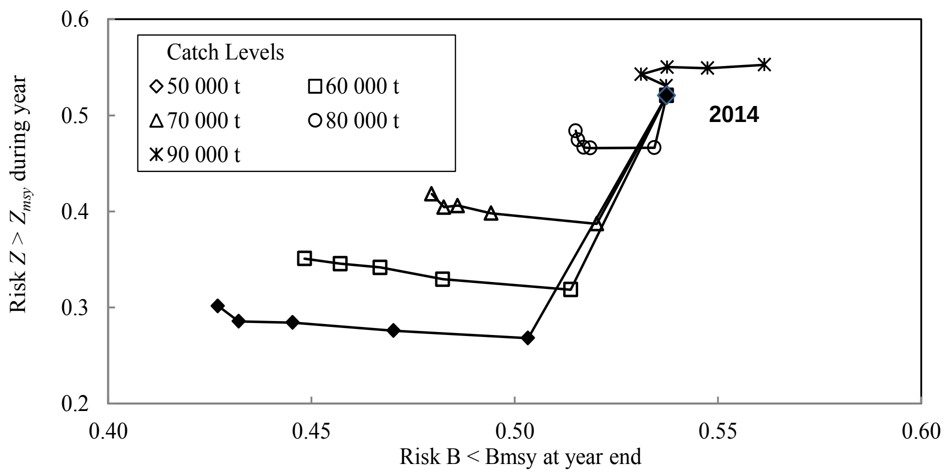



Fig. 3.11. Northern shrimp in Subarea 1 and Canadian SFA1: Risks of transgressing mortality and biomass precautionary limits with annual catches at 50–90 Kt projected for 2015–19 with an 'effective' cod stock assumed at 50 Kt.

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 an 'effective' cod stock close to the 2014 estimate (Fig. 3.11). The mortality risk depends immediately upon the assumed future catch and cod-stock levels, but changes little with time. For catches of 60 Kt to 70 Kt the mortality risk is 35–42% and nearly constant over the projection period. The immediate biomass risk is relatively insensitive to catch level but changes with time. At catch levels that permit rapid growth in biomass (70Kt or less), biomass risk decreases with time, but at catch levels that allow only slow growth, the compounding of uncertainties eventually causes estimated biomass risk to increase. This is aggravated by the high cod-stock biomass for which predictions are being made, the uncertainty associated with predation by cod being large in the present assessment.

**f) Review of Research Recommendations**

NIPAG **recommended** in 2010 that, for Northern 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: Completed

The assessment model was modified in 2014 so that cod biomass index series, including the W. Greenland trawl survey, were separately included among the data instead of being combined in advance and outside the model. The series of overlap indices used to scale down the estimated total cod biomass to an 'effective' biomass capable of preying on shrimps was also included among the input data in 2014 instead of being factored in outside the model. The 2013 assessment was re-run with this revision and its output found to agree closely with the original results; the principal difference was a larger uncertainty in the current-year predation and therefore also the total mortality.

NIPAG **further recommended** in 2012 that, for Northern shrimp off West Greenland (NAFO Subareas 0 and 1):

- *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;*

STATUS: In progress; this recommendation is reiterated.

- *the relationship between estimated numbers of small shrimps and later estimates of fishable biomass should be investigated anew.*

STATUS: In progress; this recommendation is reiterated.

**g) Research Recommendations**

NIPAG **recommends** that *the structure and coding in the assessment model of the relationship between cod biomass, shrimp biomass and estimated predation should be reviewed, including an analysis of the error variation*.

NIPAG **recommends** *that further refinements to the "partial MIXing" method of estimating numbers at age should be explored*.

Survey trends inshore and offshore are divergent and NIPAG **recommends** *exploration of the nature and implications of this divergence*.

## 4. Northern shrimp (in Denmark Strait and off East Greenland) – NAFO Stock

(SCR Doc. 03/74, 14/57, 14/60)

### 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.

A multinational fleet exploits the stock. During the recent ten years, vessels from Greenland, EU, 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 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, decreasing to about 10% from 2008 - 2012. No fishery has taken place in the Southern area in 2013 and 2014.

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, however there have been no catches by Iceland after 2005. In both EEZs, sorting grids with 22-mm bar spacing to reduce by-catch of fish are mandatory. Discarding of shrimp is prohibited in both areas.

As the fishery developed, catches increased rapidly to more than 15 000 t in 1987-88, but declined thereafter to about 9 000 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 and have been about 2000 t since 2011. In the first half of 2014 catches of 609 t haves been obtained.

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

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| Recommended TAC, total area | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 12 400 | 2 000 |
| Actual TAC, Greenland | 12 400 | 12 400 | 12 400 | 12 400 | 12 835 | 11 835 | 12 400 | 12 400 | 12 400 | 8 300 |
| North of 65°N, Greenland EEZ | 3 987 | 3 887 | 3 314 | 2 529 | 3 945 | 3 321 | 1 182 | 1 893 | 1 702 | 609 |
| North of 65°N, Iceland EEZ | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| North of 65°N, total | 4 016 | 3 887 | 3 314 | 2 529 | 3 945 | 3 321 | 1 182 | 1 893 | 1 702 | 609 |
| South of 65°N, Greenland EEZ | 3 737 | 1 302 | 1 286 | 266 | 610 | 279 | 53 | 215 | 3 | 0 |
| TOTAL NIPAG | 7 753 | 5 189 | 4 600 | 2 794 | 4 555 | 3 601 | 1 235 | 2 109 | 1 705 | 609 |

[1] Catches until July 2014

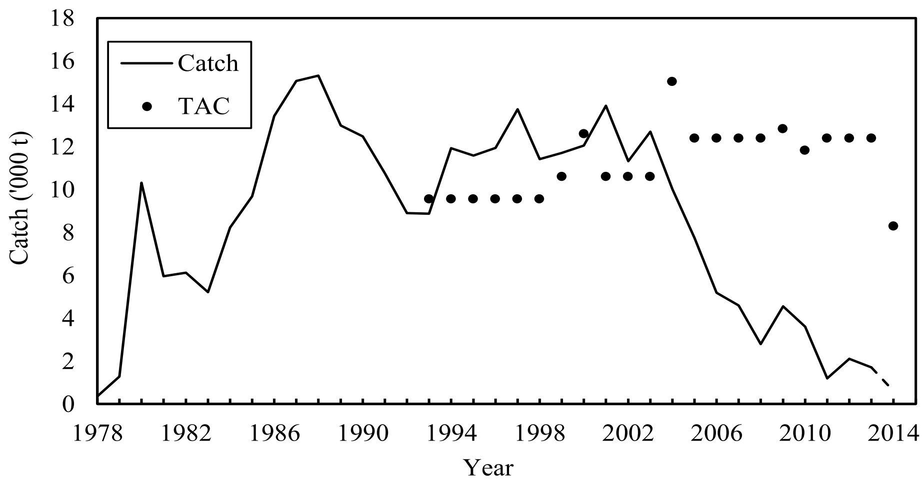



Fig. 4.1. Shrimp in Denmark Strait and off East Greenland. Catch and TAC (2014 catches until July).

### 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 both single and double trawl are included 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” up to 2004 (SCR Doc. 03/74).

The overall CPUE index remained at a high level from 2000-2008, nearly doubled in 2009, but has been declining since (Fig. 4.2).

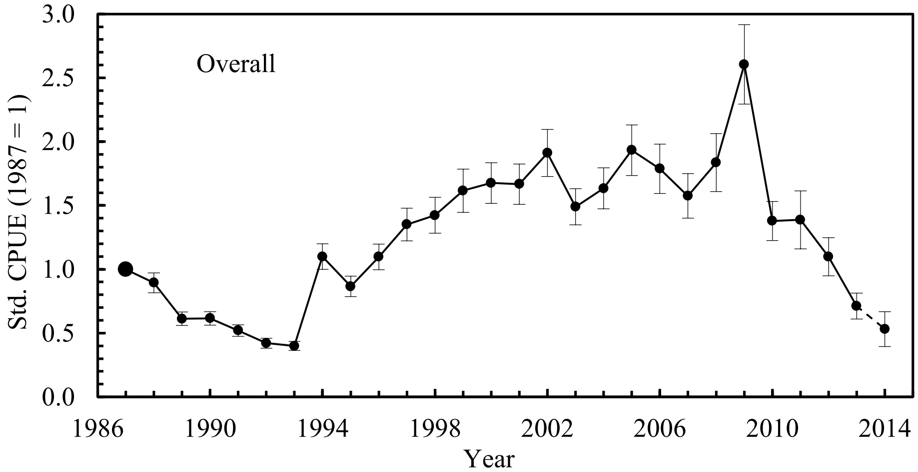



Fig. 4.2. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE-indices (1987 = 1) with ± 1 SE combined for the total area (2014 catches until July).

North of 65°N standardized catch rates declined continuously from 1987 to 1993. Since 1993 catch rates have increased until 2009 but have since decreased and in 2014 are close to the lowest level seen in the time series (Fig. 4.3).

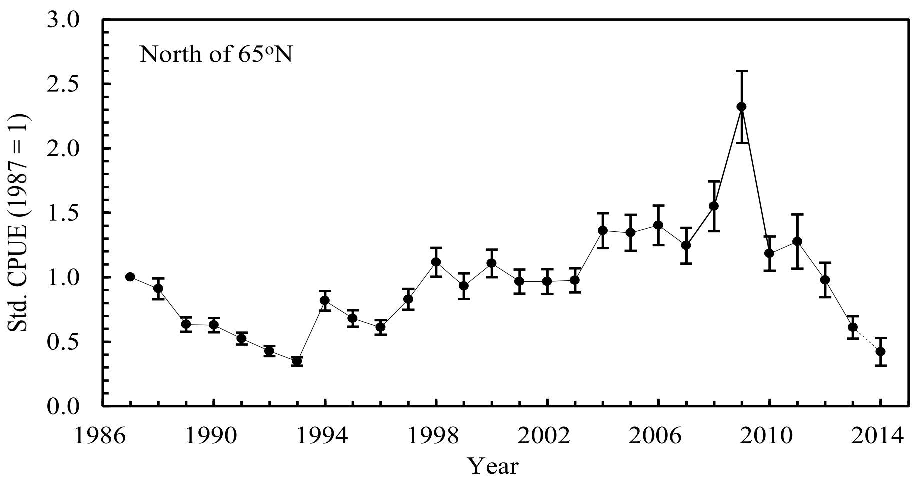



Fig. 4.3. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1987 = 1) with ±1 SE fishing north of 65°N (2014 catches until July).

In the southern area a standardized catch rate series increased until 1999, and has since then fluctuated without a trend (Fig. 4.4). No index for the southern area was calculated since 2010 due to a low number of hauls (less than 10 each year).

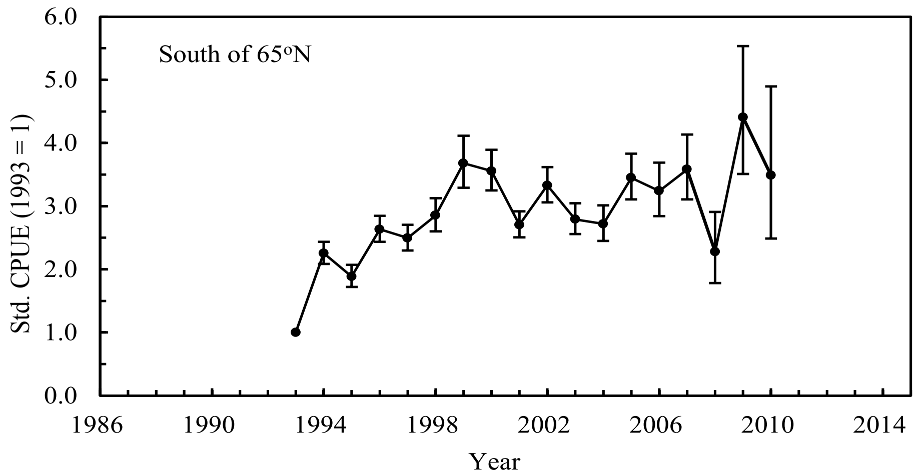



Fig. 4.4. Shrimp in Denmark Strait and off East Greenland: annual standardized CPUE (1993 = 1) with ±1 SE fishing south of 65°N (no data for the area since 2010).

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).

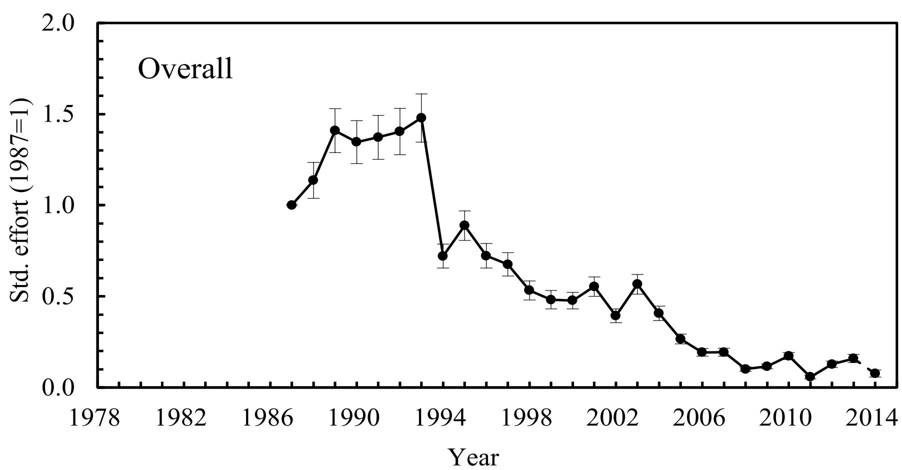



Fig. 4.5. Shrimp in Denmark Strait and off East Greenland: annual standardized effort indices, as a proxy for exploitation rate (± 1 SE; 1987 = 1), combined for the total area (2014 effort until July).

***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. 14/057). 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 comparable with the recent survey due to different areas covered, survey technique and trawling gear.

*Biomass.* The survey biomass index decreased from 2009 to 2012 and have since then remained at a low level (Fig. 4.6).

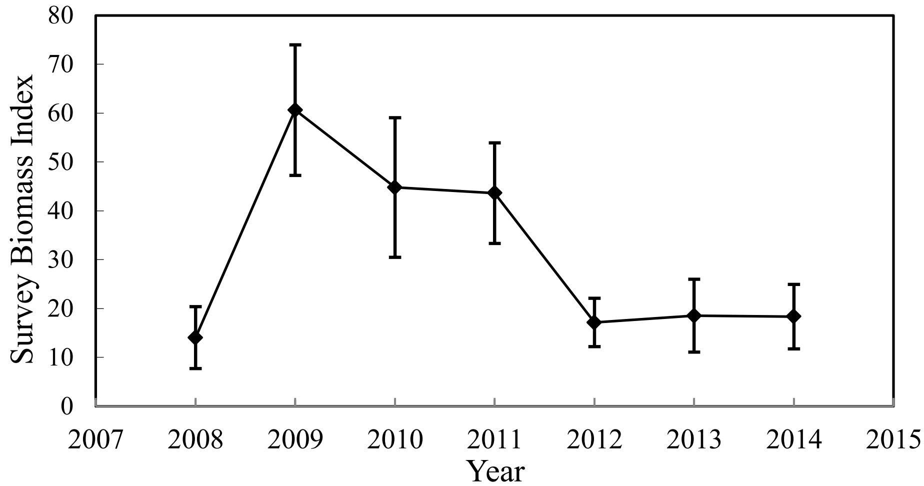



Fig. 4.6. Shrimp in Denmark Strait and off East Greenland: Survey biomass index from 2008- 2014 (± 1 SE).

The surveys conducted since 2008 indicate that the shrimp stock is concentrated in the area north of 65°N (Fig. 4.7).

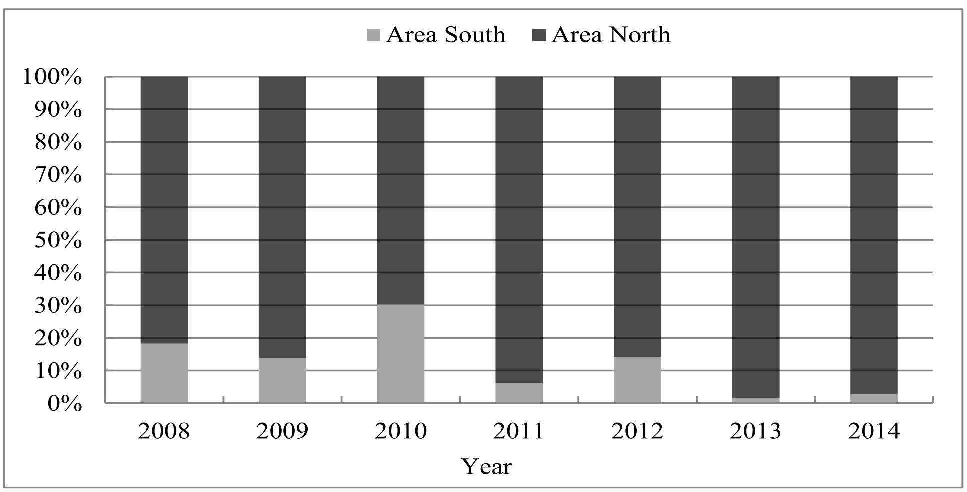



Fig. 4.7. Shrimp in Denmark Strait and off East Greenland: Distribution of Survey biomass North and South of 65°N (%) from 2008 - 2014.

*Stock composition.* The demography in East Greenland is dominated by a large proportion of females and shows a paucity of males smaller than 20 mm CL (Fig. 4.8).

Scarcity of smaller shrimp in the survey area stresses that the total area of distribution and recruitment patterns of the stock are still unknown.

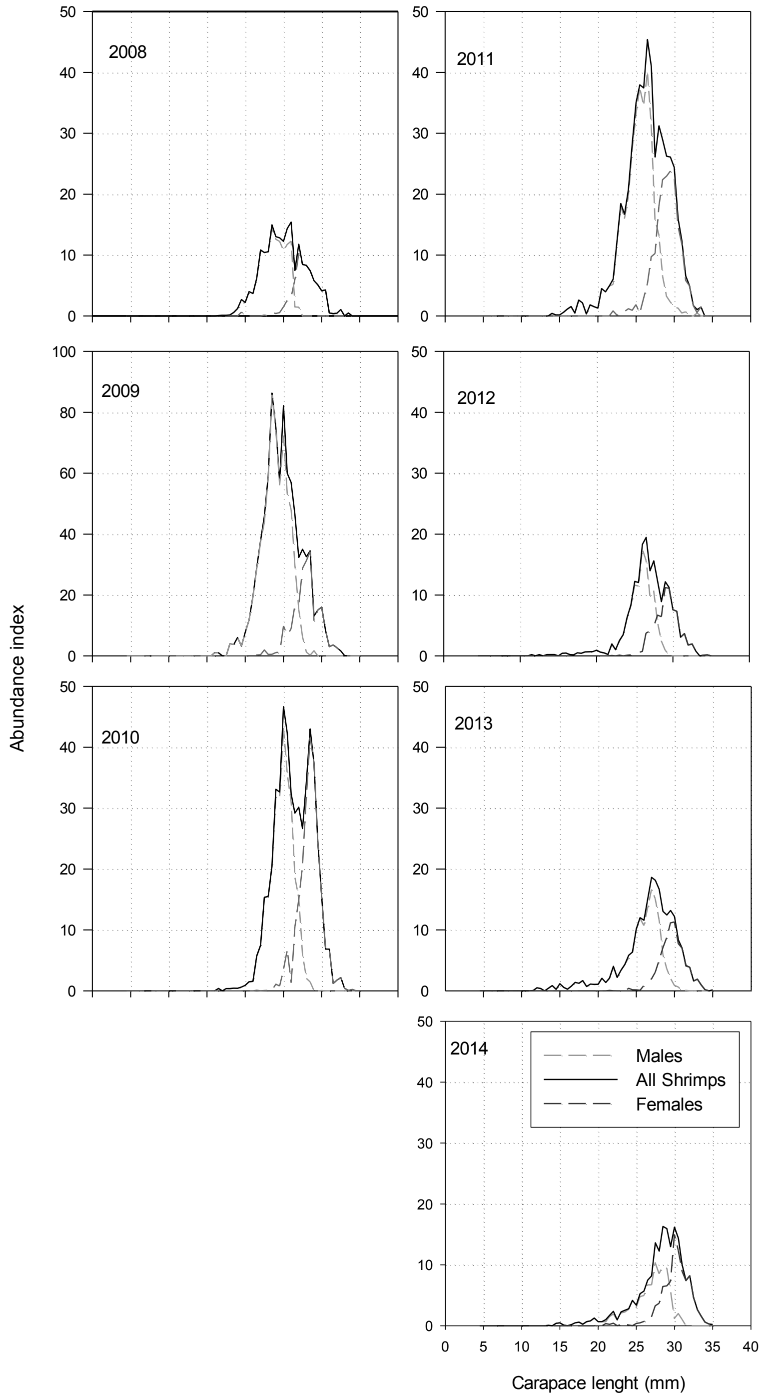



Fig.4.8. Shrimp in Denmark Strait and off East Greenland. Numbers of shrimp by length group (CL) in the total survey area in 2008 - 2014 (Please note that the scale in the figure for 2009 differs from other years).

## c) Assessment Results

*CPUE.* The overall CPUE index remained at a high level from 2000-2008, nearly doubled in 2009, but has been declining since, and in 2014 is close to the lowest level seen in the time series.

*Recruitment*. No recruitment estimates were available.

*Biomass*. The survey biomass index has decreased by around 70% since 2009.

*Exploitation rate.* Since the mid-1990s the exploitation rate index has decreased, reaching the lowest levels seen in the time series.

*State of the stock*. The stock size remained at a very low level in 2014 despite several years of very low exploitation rates.

**d) Reference points**

NIPAG is unable to determine precautionary reference points at this time.

**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. 08/75; 13/68, 74; 14/54, 56, 63, 65, 66.

**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 has since declined steadily to only 9 500 t in 2013 and 2014 (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 are boiling the shrimp on board and landing the product in Sweden to obtain a better price; in 2013, 28%. The rest were landed fresh in home ports. The overall TAC is shared according to historical landings, giving Norway 60%, Denmark 26%, and Sweden 14% in 2011 to 2014. 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. Since February 1st 2013, it is mandatory to use grids in all *Pandalus* trawl fishery in Skagerrak. (see section on Bycatch and ecosystem effects below).

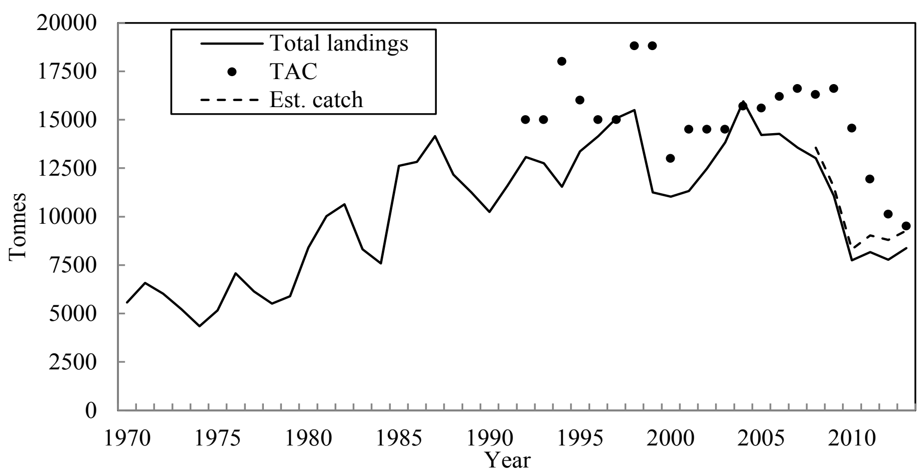



Fig. 5.1. Northern shrimp in Skagerrak and Norwegian Deep: TAC, total landings by all fleets, and total estimated catch including estimated Swedish discards for 2008-2013, Norwegian discards for 2009-2013 and Danish discards for 2009-2013.

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

| Year | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recommended TAC | 19.000 | 11.500 | 13.400 | 12.600 | 14.700 | 15.300 | 13.000 | 14.000 | 14.000 | 15.000 | 15.000 | 13.000 | 8.800 | * | 6.500 |
| 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 | 10.115 | 9.500 |
| Denmark | 2.072 | 2.371 | 1.954 | 2.470 | 3.270 | 3.944 | 2.992 | 3.111 | 2.422 | 2.274 | 2.224 | 1.301 | 1.601 | 1.454 | 2.026 |
| 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 | 4.796 | 5.162 |
| 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 | 1.521 | 1.191 |
| 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 | 7.771 | 8.379 |
| Est. Swedish discards | | | | | | | | | | 540 | 337 | 386 | 504 | 683 | 265 |
| Est. Norw. discards | | | | | | | | | | | 115 | 75 | 235 | 288 | 450 |
| Est. Danish discards | | | | | | | | | | | 36 | 53 | 123 | 92 | 185 |
| Total catch | | | 11.328 | 12.474 | 13.837 | 15.952 | 14.208 | 14.268 | 13.553 | 13.553 | 11.560 | 8.269 | 9.030 | 8.834 | 9.279 |

* Advice was to reduce catches

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 only 10 in 2007-2014. The efficiency of the fleet has increased due to the introduction of twin trawls and increased trawl size (SCR Doc. 14/65).

In Norway the number of vessels participating in the shrimp fishery has decreased from 423 in 1995 to 188 in 2013. Twin trawls were introduced around 2002, and the use is increasing. In 2011-2013 twin trawls were used by more than half of the Norwegian trawlers larger than 15 meters (SCR Doc. 14/63).

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, but during the last seven years the twin trawlers have increased their landings from 7 to over 50% of total Swedish *Pandalus* landings (SCR Doc. 14/65).

**Landings and discards.** 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, estimated as the sum of landings and discards, were generally decreasing between 2008-2012, to 8 800 t, but increased to 9 300 t in 2013 (Table 5.1 and Fig. 5.1).

Shrimps can be discarded for one of two reasons: 1) shrimp <15 mm CL are not marketable (and in Norway, not legal to land), and 2) to replace medium-sized, lower-value shrimps with larger and more profitable ones ("high-grading"). The Swedish fishery has often been constrained by the national quota, which may have resulted in high-grading. Based on on-board sampling by observers, discards in the Swedish fisheries were estimated to be between 12 and 31% of total catch for 2008 -2013, and Danish discards were estimated to be between 2 and 8% for 2009-2013. Discarding is illegal in Norwegian waters, but there are no observer data. From 2009 onwards Norwegian discards in Skagerrak are estimated by applying the Danish discards-to-landings ratio to the Norwegian landings. Assuming, in the absence of observer data from the Norwegian Deep, that Norwegian and Danish discards there are mainly made up of shrimp < 15 mm CL, discards from this area are estimated as the weight of catches of shrimp < 15 mm CL, obtained from length distributions of catches and mean weight at length.

**Bycatch and ecosystem effects.** Shrimp fisheries in the Norwegian Deep and Skagerrak have bycatches of 10-22% (by weight) of commercially valuable species, which are legal to land if quotas allow (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. Landings delivered by vessels using grids comprise 98-99% shrimp compared to only 78-84% in landings from trawls without grids (Table 5.2). Following an agreement between EU and Norway, the Nordmøre grid has been mandatory since 1st February 2013 in all shrimp fisheries in Skagerrak (except Norwegian national waters within the 4 nm limit). If the fish quotas allow, it is legal to use a fish retention device of 120 mm square mesh tunnel at the grid's fish outlet (Table 5.2). A corresponding agreement for shrimp fisheries in the Norwegian Deep has not yet been concluded (SCR Doc. 14/63). A discard ban for a range of commercial species for all fleets fishing in Skagerrak is to be introduced

The use of a fish retention device also prevents the escape of non-commercial species: 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 is available and the impact on stocks is difficult to assess.

Table 5.2. Northern shrimp in Skagerrak and Norwegian Deep: Landings by the *Pandalus* fishery in 2013. Combined data from Danish and Swedish logbooks and Norwegian sale slips (t).

| | SD IIIa, no grid | | SD IIIa, grid | | SD IIIa, grid+fish tunnel | | SD IVa East, no grid | |
|---|---|---|---|---|---|---|---|---|
| Species: | Landings (t) | % of total landings | Landings (t) | % of total landings | Landings (t) | % of total landings | Landings (t) | % of total landings |
| *Pandalus* | 21,8 | 56,5 | 540,9 | 98,3 | 6029,8 | 81,5 | 1170,8 | 81,3 |
| Norway lobster | 0,3 | 0,8 | 4,6 | 0,8 | 23,0 | 0,3 | 6,5 | 0,5 |
| Angler fish | 0,6 | 1,6 | 0,1 | 0,0 | 60,7 | 0,8 | 33,1 | 2,3 |
| Whiting | 0,1 | 0,2 | 0,0 | 0,0 | 3,2 | 0,0 | 1,1 | 0,1 |
| Haddock | 1,6 | 4,2 | 0,1 | 0,0 | 48,7 | 0,7 | 9,4 | 0,7 |
| Hake | 0,1 | 0,3 | 0,0 | 0,0 | 10,5 | 0,1 | 7,4 | 0,5 |
| Ling | 0,4 | 1,1 | 0,0 | 0,0 | 50,9 | 0,7 | 25,5 | 1,8 |
| Saithe | 8,2 | 21,3 | 1,2 | 0,2 | 526,3 | 7,1 | 83,8 | 5,8 |
| Witch flounder | 0,9 | 2,2 | 0,2 | 0,0 | 71,3 | 1,0 | 0,9 | 0,1 |
| Norway pout | 0,0 | 0,1 | 0,2 | 0,0 | 2,8 | 0,0 | 0,0 | 0,0 |
| Cod | 3,9 | 10,0 | 1,3 | 0,2 | 393,7 | 5,3 | 61,7 | 4,3 |
| Other marketable fish | 0,6 | 1,7 | 1,6 | 0,3 | 180,0 | 2,4 | 39,2 | 2,7 |

**b) Assessment Data**

***i) Fishery data***

Danish, Swedish and Norwegian catch and effort data from logbooks have been analyzed and standardized (SCR Doc. 08/75; 13/66, 72).

There was an upwards trend in the standardized LPUE for all three series from 2000 to 2007 followed by a decreasing trend until 2010; roughly stationary since then (Fig. 5.2).

Harvest rates (HR) were estimated from landings and corresponding biomass indices from the Norwegian survey. This year, the old survey time series was used to estimate the harvest rate back to 1984. The HR was high in the beginning of the time series but stabilized at a low level until 2009. Since then the HR increased until 2012 and shows thereafter a falling trend. Time series of standardized effort indices have also been estimated (Fig. 5.3). Standardized effort seems to have been fluctuating without any clear trend since the mid-1990s.

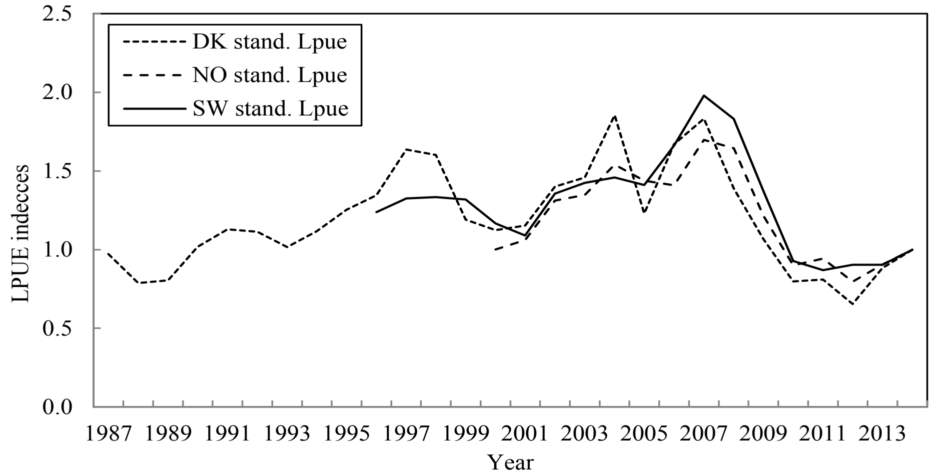



Fig. 5.2. Northern shrimp in Skagerrak and Norwegian Deep: Danish, Norwegian and Swedish standardized LPUE until 2014. 2014 data are preliminary. Each series is standardized to its last year.

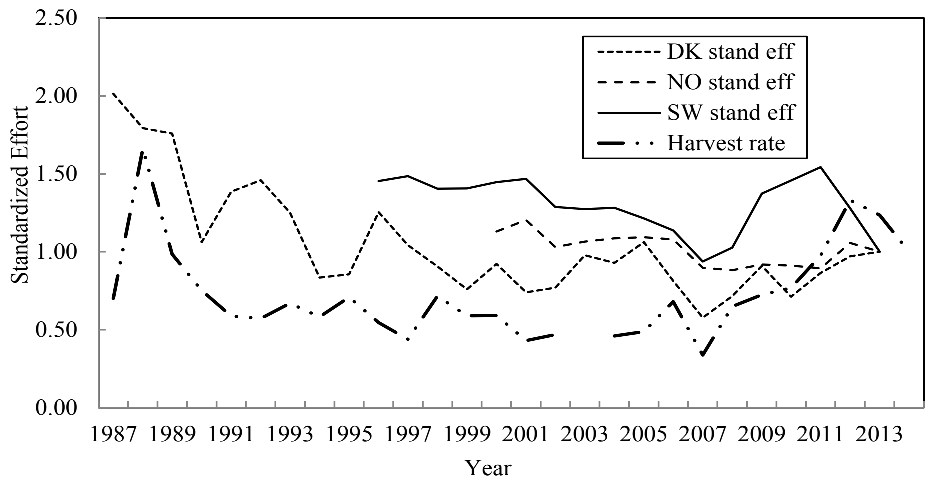



Fig. 5.3. Northern shrimp in Skagerrak and Norwegian Deep: Harvest rate (total catches/survey indices of biomass) and estimated standardized effort. Each series is standardized to its final year. The harvest rate in 2014 is the TAC/survey biomass index.

### *ii) Sampling of catches*

Length frequencies of the catches from 1985 to 2013 (SCR Doc. 13/66, 72) have been obtained by sampling. The samples also provide information on sex distribution and maturity. Numbers at length are input data to the newly developed length-based analytical assessment model for this stock.

### *iii) Survey data*

The Norwegian shrimp survey went through large changes in vessel, gear and timing in 2003-06, resulting in three series (SCR Doc. 13/71).

Biomass values from the first series were recalculated in 2012 in order to provide updated biomass estimates with standard errors. The recalculated values corresponded well with the old ones. The biomass index increased from 1988 to this series's maximum in 1997. A decrease in 1998-2000 was followed by an increase in 2001-2002, when this series was discontinued (Fig. 5.4). "Series 2" comprised a single point in 2003. The 2004 and 2005 values from the third series were similar. The fourth series peaked in 2007 and after that showed a steady decline, to a minimum in 2012. It increased slightly in 2013 and 2014.

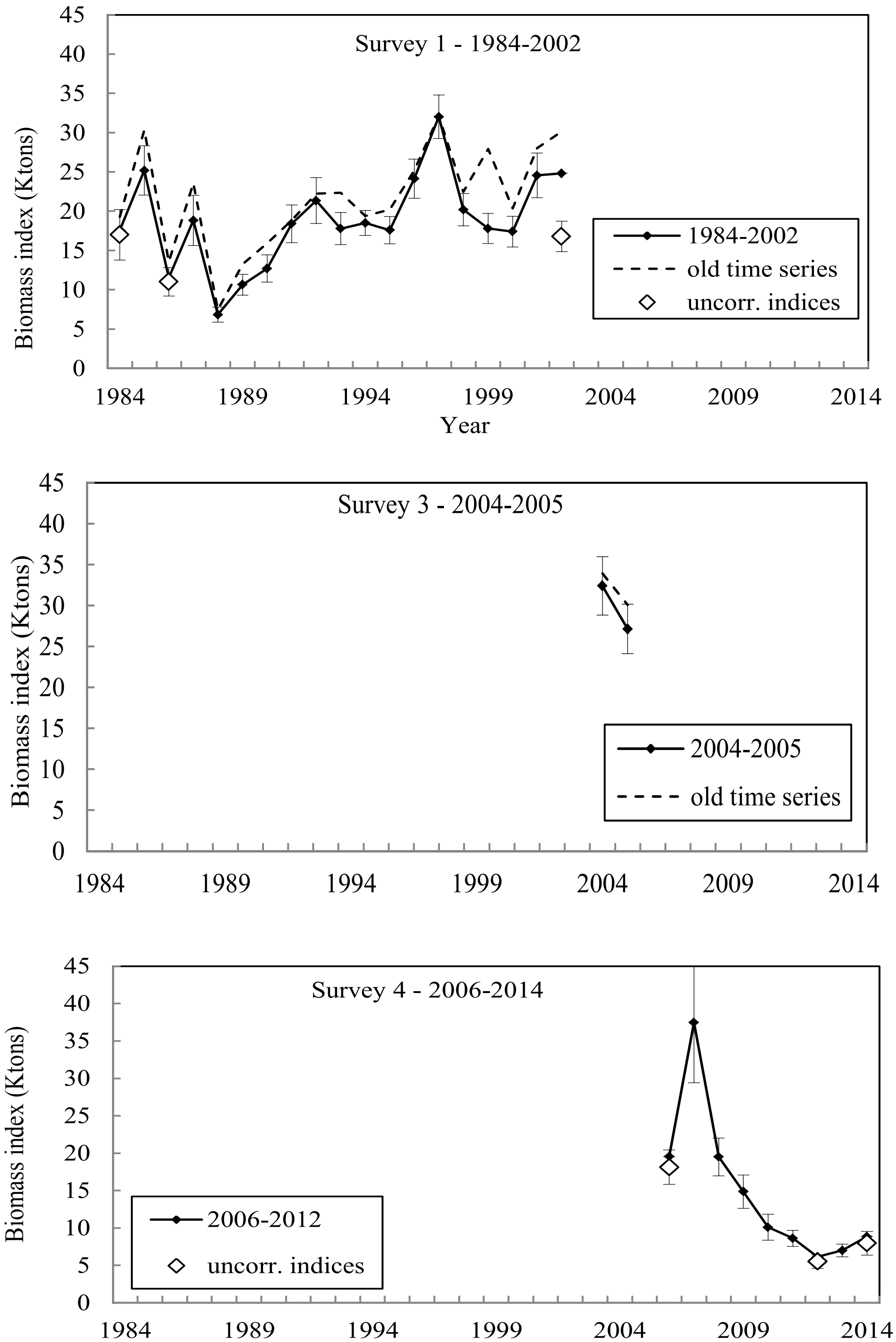



Fig. 5.4. Northern shrimp in Skagerrak and Norwegian Deep: Estimated survey biomass indices in 1984 to 2014. The 1984 – 2005 indices were re-calculated in 2012, providing SEs for the whole time series. Survey 1: October/November 1984-2002 with Campelen trawl; Survey 2: October/November 2003 with shrimp trawl 1420 (not shown); Survey 3: May/June 2004-2005 with Campelen trawl; Survey 4: January/February 2006-2014 with Campelen trawl.

The recruitment index value (abundance of age 1 shrimp) declined from 2007 to 2010 (Fig. 5.5). It increased in both 2011 and 2012, but decreased again in 2013. The 2014 value is the highest in the time series.

An SSB index, calculated as the number of berried females, follows the total biomass index (Fig. 5.6).

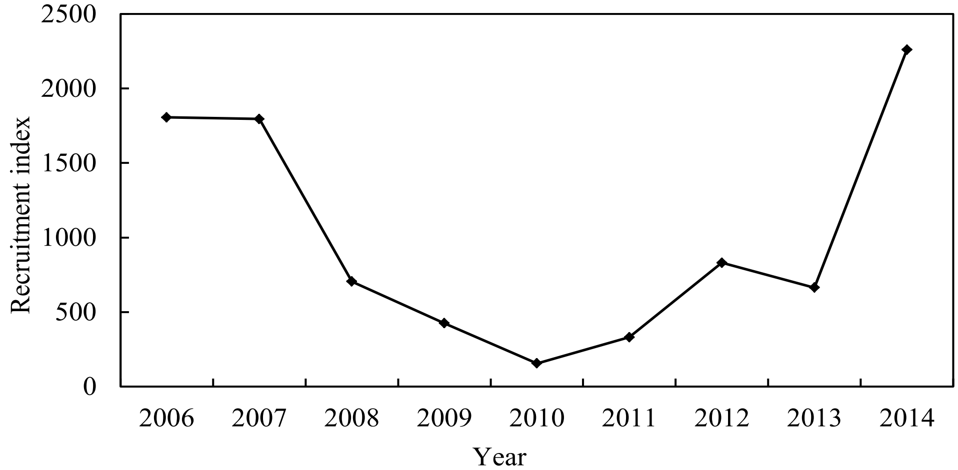



Fig. 5.5. Northern shrimp in Skagerrak and Norwegian Deep: Estimated recruitment index from 2006-2014.

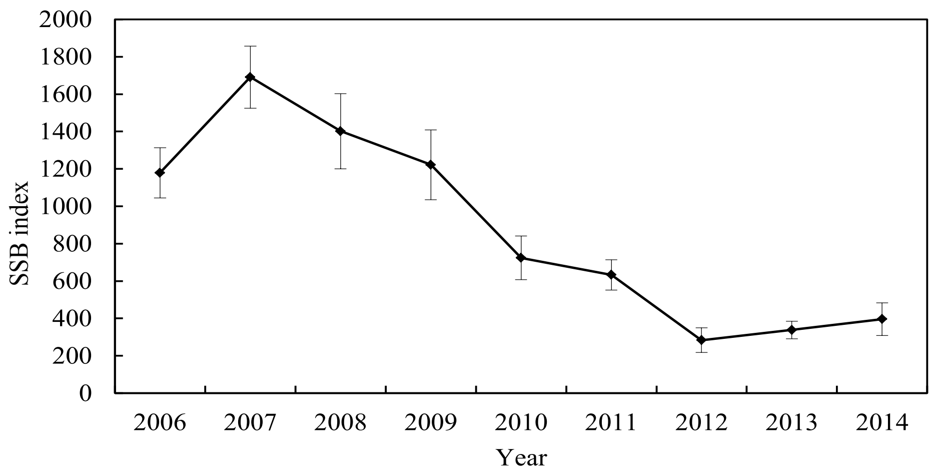



Fig. 5.6. Northern shrimp in Skagerrak and Norwegian Deep: SSB index from the Norwegian shrimp surveys in 2006-2014. Error bars are 1 SE.

### *iv) Predation index*

The large inter-annual variation in the predator biomass index (Table 5.3) is mainly due to variations in the indices for saithe and roundnose grenadier, which in some years are important components. These contributions depend heavily upon which stations are trawled as saithe is found on the shallowest stations and roundnose grenadier on the deepest ones. An index without these species is shown at the bottom of Table 5.3. The total index of shrimp predator biomass excluding saithe and roundnose grenadier has been at the same level during the 9 last years. The predator index increased during 2013 due to an increased abundance of both saithe and blue whiting.

Table 5.3. Northern shrimp in Skagerrak and Norwegian Deep: Estimated indices of predator biomass (catch in kg per towed nautical miles) from the Norwegian shrimp survey in 2006-2014.

| Species | | biomass index | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| English | Latin | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | mean |
| Blue whiting | *Micromesistius poutassou* | 0,13 | 0,13 | 0,12 | 1,21 | 0,27 | 0,62 | 3,30 | 29,03 | 1,88 | |
| Saithe | *Pollachius virens* | 7,33 | 39,75 | 208,32 | 53,89 | 18,53 | 7,52 | 5,66 | 112,80 | 14,13 | |
| Cod | *Gadus morhua* | 0,51 | 1,28 | 0,78 | 2,01 | 1,79 | 1,66 | 1,26 | 1,69 | 2,92 | |
| Roundnosed Grenadier | *Coryphaenoides rupestris* | 3,22 | 6,85 | 19,02 | 19,03 | 10,05 | 4,99 | 4,43 | 1,97 | 2,90 | |
| Rabbit fish | *Chimaera monstrosa* | 2,24 | 2,15 | 3,41 | 3,26 | 3,51 | 2,73 | 2,22 | 3,05 | 3,90 | |
| Haddock | *Melanogrammus aeglefinus* | 0,97 | 4,21 | 1,85 | 3,18 | 3,46 | 5,82 | 5,75 | 5,18 | 2,15 | |
| Redfish | Scorpaenidae | 0,18 | 0,40 | 0,26 | 0,43 | 0,80 | 1,02 | 0,37 | 0,47 | 0,48 | |
| Velvet Belly | *Etmopterus spinax* | 1,31 | 2,58 | 1,95 | 2,42 | 2,52 | 1,47 | 1,59 | 2,67 | 1,91 | |
| Skates, Rays | Rajidae | 0,41 | 0,95 | 0,64 | 0,17 | 0,60 | 0,88 | 0,98 | 1,00 | 2,25 | |
| Long Rough Dab | *Hippoglossoides platessoides* | 0,22 | 0,64 | 0,42 | 0,28 | 0,47 | 0,51 | 0,56 | 0,56 | 1,17 | |
| Hake | *Merluccius merluccius* | 0,98 | 0,78 | 0,64 | 2,56 | 1,60 | 0,56 | 0,52 | 1,06 | 0,69 | |
| Angler | *Lophius piscatorius* | 0,15 | 0,91 | 0,87 | 1,25 | 1,70 | 0,92 | 0,17 | 0,65 | 0,75 | |
| Witch | *Glyptocephalus cynoglossus* | 0,24 | 0,74 | 0,54 | 0,16 | 0,13 | 0,24 | 0,29 | 0,27 | 0,35 | |
| Dogfish | *Squalus acanthias* | 0,31 | 0,19 | 0,28 | 0,14 | 0,11 | 0,21 | 0,60 | 1,02 | 1,00 | |
| Black-mouthed dogfish | *Galeus melastomus* | 0,00 | 0,05 | 0,05 | 0,15 | 0,09 | 0,09 | 0,09 | 0,12 | 0,11 | |
| Whiting | *Merlangius merlangus* | 0,35 | 1,01 | 1,35 | 3,02 | 2,42 | 3,07 | 1,64 | 2,02 | 3,38 | |
| Blue Ling | *Molva dypterygia* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,01 | 0,01 | |
| Ling | *Molva molva* | 0,04 | 0,11 | 0,34 | 0,79 | 0,64 | 0,24 | 0,17 | 0,22 | 0,32 | |
| Four-bearded Rockling | *Rhinonemus cimbrius* | 0,06 | 0,14 | 0,04 | 0,03 | 0,05 | 0,03 | 0,09 | 0,04 | 0,06 | |
| Cusk | *Brosme brosme* | 0,20 | 0 | 0,02 | 0,05 | 0,13 | 0,29 | 0,04 | 0,10 | 0,05 | |
| Halibut | *Hippoglossus hippoglossus* | 0,08 | 0,07 | 3,88 | 0,09 | 0,20 | 0,05 | 0,19 | 0 | 0 | |
| Pollack | *Pollachius pollachius* | 0,06 | 0,25 | 0,03 | 0,13 | 0,12 | 0,15 | 0,07 | 0,24 | 0,65 | |
| Greater Forkbeard | *Phycis blennoides* | 0 | 0 | 0 | 0,01 | 0,04 | 0,02 | 0,05 | 0,06 | 0,12 | |
| Total | | 18,99 | 63,19 | 244,81 | 94,26 | 49,23 | 33,09 | 30,04 | 164,23 | 41,18 | 82,11 |
| Total (except saithe and roundnosed grenadier) | | 8,44 | 16,59 | 17,47 | 21,34 | 20,65 | 20,58 | 19,95 | 49,46 | 24,15 | 22,07 |

### *v) Assessment models*

Two assessment models were evaluated at the final benchmark session in 2013: a stochastic length-based assessment model (SCR Doc. 13/74) and a Bayesian surplus production model (SCR Doc. 13/070). The general performance of the two models, as well as the outputs (biological reference points and short term forecasts), were discussed during the benchmark session within the NIPAG meeting. 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 in individual years were somewhat pronounced. The analytical length-based model applies more detailed biological information in the assessment and therefore provides more immediate responses to change, and is the preferred model. However, the benchmark recommended the surplus production model continue to be applied each year for an initial period to verify performance of the length based model. The length-based model was in 2013 not fully operational to produce sufficient output for the ICES advice. This year, the model provided standard ICES output, but estimated catches were in disagreement with the observed landings. This could be due to errors in the estimated weight at age. Furthermore, concern was raised about model stability and it was recommended that retrospective analysis should be carried out. It was decided by the group that the suitability of $F_{0.1}$ as a proxy for $F_{msy}$ should be confirmed. This year, as last year, it was therefore decided to provide advice based on the production model (SCR Doc. 13/070, 14/056), although estimates of stock status from both models were presented.

***vi) Assessment Results***

**A. Length-based model (SCR Doc. 13/74).**

The stock development as estimated by the length based model is shown in Fig. 5.7 (SSB, fishing mortality ($F_{1-3}$) and numbers in 0-group). Fishing mortality has increased steeply since 2007 and is now at the highest level estimated at 0.96. The recent steep increase in modelled fishing mortality is difficult to explain in terms of recent trends in estimates of fishing effort, but is in better agreement with recent changes in HR. SSB has declined since 2006 to the lowest level observed in the time series. The estimated number of the 0-group declined steeply between 2005 and 2008 and remained at low levels until 2012 where after it increased to a very high level in 2013.

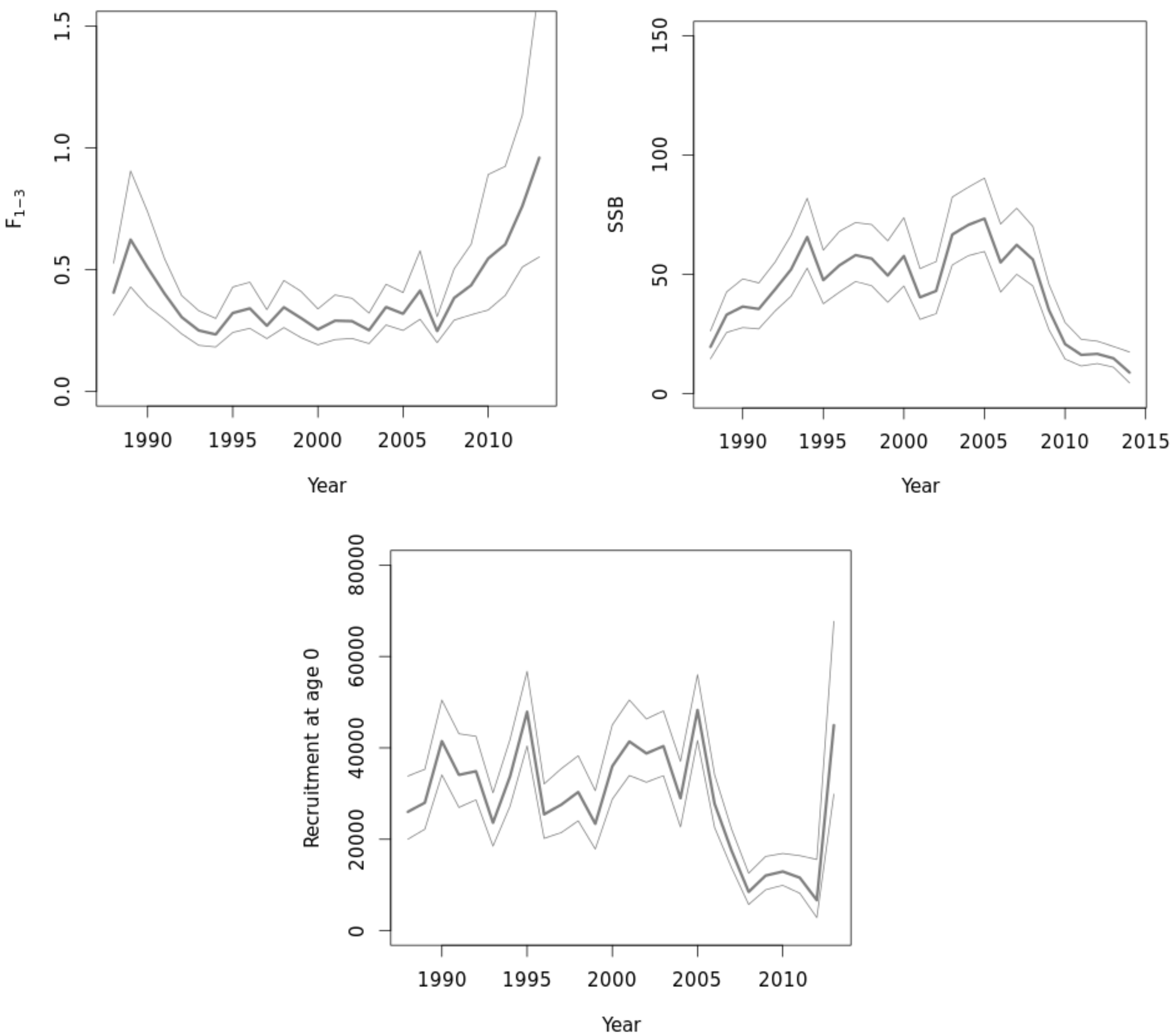



Fig. 5.7 Estimates of $F_{1-3}$, SSB (t) and recruits (millions) from the length-based model. Light grey lines represent 95% confidence intervals.

**B. Stock production model fitted by Bayesian methods using fishery catch and effort data and data from the Norwegian trawl survey (SCR Doc. 13/070).**

The input series of biomass indices span 1984-2014. Since the late 1980s the stock has varied with a slightly increasing trend until 2006 when it started to decline (Fig. 5.8). This is similar to the development of SSB according to the length-based model (Fig. 5.7). The median 2014 estimate is above $B_{msy}$ (Table 5.4). The estimated risk of stock biomass being below $B_{trigger}$ in 2014 was 4% and of being below $B_{lim}$, 1% (Table 5.4).

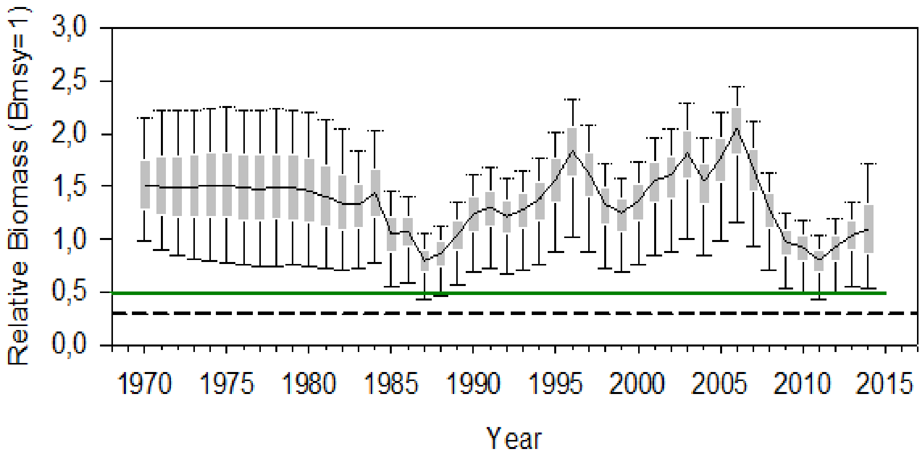



Fig. 5.8. Estimated time series of relative biomass ($B_t/B_{msy}$) 1970-2014. The solid black line is the median; boxes represent quartiles; the whiskers cover the central 90 % of the distribution. Dashed black line represents $B_{lim}$. Green line represents $B_{trigger}$.

Median estimate of fishing mortality has remained below $F_{msy}$ since 1990 (Fig.5.9). There is a 17% risk of $F_{2014}$ being above $F_{msy}$ (Table 5.4).

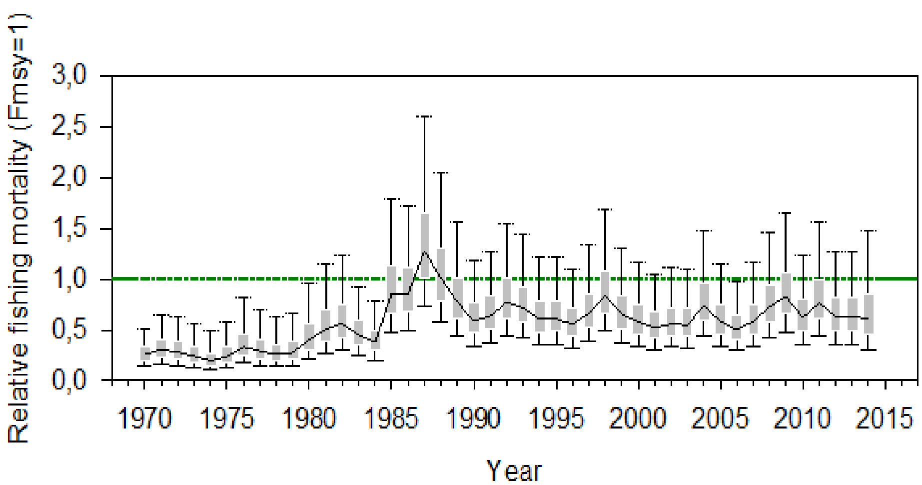



Fig. 5.9. Estimate of relative fishing mortality ($F_t/F_{msy}$) 1970-2014. The solid black line is the median; boxes represent quartiles; the whiskers cover the central 90 % of the distribution.

Table 5.4. Risk analysis 2013-2014

| Status | 2013 | 2014* |
|---|---|---|
| Risk of falling below $B_{lim}$ (0.3$B_{MSY}$) | 1% | 1% |
| Risk of falling below *Btrig* (0.5$B_{MSY}$) | 4% | 4% |
| Risk of falling below $B_{MSY}$ | 42% | 39% |
| Risk of exceeding $F_{MSY}$ | 13% | 17% |
| Stock size (B/Bmsy), median | 1.04 | 1.10 |
| Fishing mortality (F/Fmsy), median | 0.63 | 0.62 |
| Productivity (% of MSY) | 100% | 99% |

*Predicted catch = TAC

**d) Stock development and biological reference points**

*Reference points.* In 2009 ICES adopted a "Maximal Sustainable Yield (MSY) framework" (ACOM. ICES Advice, 2013. Book 1. Section 1.2) for deriving advice. It considers two reference points: $F_{msy}$ and $B_{trigger}$. In keeping with the reference points developed in 2006 and 2010 for the Barents Sea shrimp stock, 50% $B_{msy}$ was adopted as $B_{trigger}$ (NIPAG, 2006). Under the ICES PA two reference points are required; $B_{lim}$ and $B_{pa}$. Again in line with the Barents Sea shrimp stock, $B_{lim}$ was set at 30% $B_{msy}$ (NIPAG, 2006). $B_{pa}$ is not considered relevant in the presence of a risk analysis.

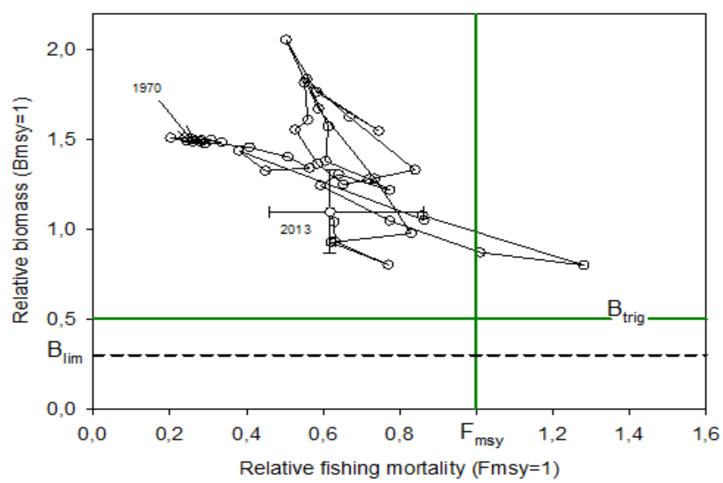



Fig. 5.10. Annual median estimates of biomass-ratio ($B/B_{MSY}$) and fishing mortality-ratio ($F/F_{MSY}$) 1970-2014. The reference points for stock biomass, $B_{trigger}$, and fishing mortality, $F_{msy}$, are indicated by green lines, $B_{lim}$, by a dotted line (quartile bars on the 2014 value)..

*Projections.* Given a catch of 9 279 t in 2013 and assuming a 2014 catch of 9 500 t (TAC), catch options from 6 000 t to 16 000 t were evaluated for 2015. Under all these catch options the risk of going below $B_{lim}$ is 1%. Catches of up to 14 000 t have a <50% risk of exceeding $F_{msy}$ and a 4% risk of falling below $B_{trigger}$ (Table 5.5).

Table 5.5. Catch option for 2015.

| | Catch option 2015 (ktons) | | | | | |
|---|---|---|---|---|---|---|
| | 6 | 8 | 10 | 12 | 14 | 16 |
| Risk of falling below $B_{lim}$ (0.3$B_{msy}$) | 1% | 1% | 1% | 1% | 1% | 1% |
| Risk of falling below $B_{trig}$ (0.5$B_{msy}$) | 4% | 4% | 4% | 4% | 4% | 4% |
| Risk of falling below $B_{msy}$ | 32% | 33% | 35% | 38% | 40% | 46% |
| Risk of exceeding $F_{msy}$ | 4% | 9% | 19% | 30% | 42% | 58% |
| Risk of exceeding 1.7$F_{msy}$ | 1% | 2% | 4% | 7% | 12% | 20% |
| Stock size ($B/B_{msy}$), median | 1,19 | 1,17 | 1,14 | 1,12 | 1,10 | 1,04 |
| Fishing mortality ($F/F_{msy}$), | 0,36 | 0,49 | 0,62 | 0,76 | 0,91 | 1,10 |
| Productivity (% of MSY) | 96% | 97% | 98% | 99% | 99% | 100% |

*Comparison of Assessment Models*

Two models are used in the assessment of this stock. One is length/age based, uses data on numbers at length from catches and survey, and tracks the age cohorts into which those numbers are converted. The other is a surplus-production model which considers only the dynamics of the stock biomass using series of indicators of biomass.

1. The models agree that SSB has decreased fairly drastically since about 2006.
2. The length-based model measures a rapid recent increase in fishing mortality, not evident in the results of the surplus-production model. This agrees with the recent HR, but not with the recent trajectory of fishing effort.
3. The length-based model would be able to take into account, in its predictions, the recent observation of a large number of age-1 shrimps in the stock, which the surplus-production model is not constructed to be able to do.
4. The length-based model estimates current SSB at below $B_{lim}$, while the surplus production model estimates SSB above $B_{trigger}$ throughout the series.
5. The length-based method estimates short-term yield of 26 700 t at $F_{msy}$, while the surplus production model would yield 14 800 t.

*Summary of Assessment*

*Mortality*. Fishing mortality has remained below $F_{msy}$ since 1990. There is a 17% risk of $F_{2014}$ being above $F_{msy}$.

*Biomass*. Stock biomass has been above $B_{trigger}$ throughout the history of the fishery. The risk that the biomass at the end of 2014 is below $B_{trigger}$ is less than 5%.

*Recruitment*. The abundance of age-1 shrimp in the survey catches increased in both 2011 and 2012, but decreased again in 2013. The 2014 value is the highest in the series.

*State of the Stock*. The stock declined steeply from 2006 to 2011, followed by a moderate increase from 2011 to 2014. It is however, estimated to be still well above $B_{trigger}$.

*Yield*. Catch options up to 14 000 t/yr have a risk below 50% of exceeding $F_{msy}$ in 2015.

**e) Management Recommendations**

NIPAG **recommends** that, for shrimp in Skagerrak and Norwegian Deep:

- *Sorting grids should be implemented in the Norwegian Deep in addition to the Skagerrak.*
- *Norwegian vessels >=12m in the Norwegian Deep should be required to complete and provide log books.*

**f) Research Recommendations**

NIPAG **recommends** that for shrimp in Skagerrak and Norwegian Deep:

- *In the length-based model, explore the replacement of 'weight at age' with 'weight at length' data from the fishery*

**g) Research Recommendations from the 2010-2013 meetings**

- *the Norwegian shrimp survey should be extended east to cover important shrimp grounds in Swedish waters.*

STATUS: No progress has been made. NIPAG reiterates this recommendation.

- *compare the results of the current assessment with those of an updated run including survey data collected early in the following year.*

STATUS: No progress has been made. NIPAG reiterates this recommendation.

- *the Stochastic assessment model as described in SCR Doc.10/70 should be implemented and MSY reference points should be established.*

STATUS: The benchmark assessment which was finalized during the NIPAG meeting in September 2013 chose the length based model as a basis for advice for the shrimp stock in Skagerrak and the Norwegian Deep. However, it was also decided that the Bayesian surplus production model would be run alongside the coming years, as a quality check of the forecast produced by the length based model.

- *collaborative efforts should be made to standardize a means of predicting recruitment to the fishable stock.*

STATUS: A workshop is scheduled for April 2014.

- *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: Work in progress

- *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 project "*Sustainable shrimp fishing in Skagerrak*" has detected weak genetic structure in the Skagerrak/North Sea region, primarily associated with fjords in the Skagerrak region (Knutsen *et al.* in prep.). The shrimp in Skagerrak and the Norwegian Deep most likely comprise one single stock, which is in agreement with the oceanic current pattern in the area. The benchmark assessment in September 2013 thus concluded that we have one single shrimp stock in the Skagerrak and Norwegian Deep area. The conclusion on the relation between the shrimp (stock units) in Skagerrak and the Norwegian Deep on the one hand and the Fladen Ground shrimp on the other hand will await finalization of data analyses (Knutsen *et al.* in prep.).

## 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 14/51, 53, 55, 63; 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 the "Loop Hole" (Fig. 6.1).

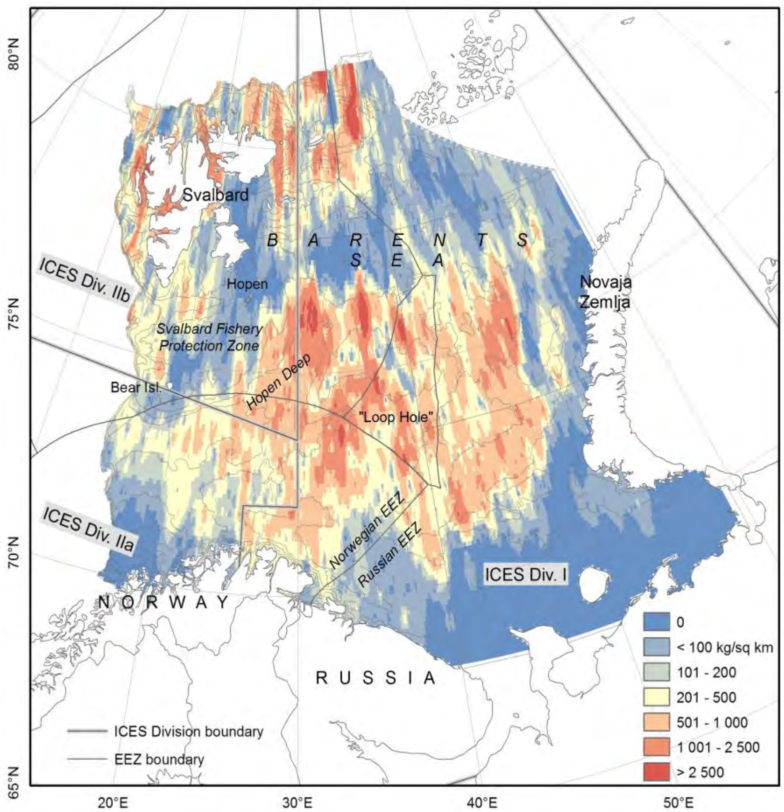



Fig. 6.1. Shrimp in the Barents Sea: stock distribution, mean density index (kg/km$^2$), based on survey data 2000-2010.

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 40 000 t/yr, 50–90% 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 is 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.* 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 20 000 t in 2013 and are predicted to remain at about that level in 2014.

Table 6.1. Shrimp in ICES SA I and II: Recent catches (2001–2014) in metric tons, as used by NIPAG for the assessment.

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Recommended TAC | - | 41 299[2] | 40 000 | 50 000 | 50 000 | 50 000 | 50 000 | 60 000 | 60 000 | 60 000 | 60 000 |
| Norway | 35918 | 37253 | 27352 | 25558 | 20662 | 19784 | 16779 | 19923 | 15208 | 8845 | 10000 |
| Russia | 2410 | 435 | 4 | 192 | 417 | 0 | 0 | 0 | 0 | 1067 | 2000 |
| Others | 4406 | 4930 | 2271 | 4181 | 7109 | 7488 | 8419 | 9867 | 10304 | 8773 | 9000 |
| Total | 42734 | 42618 | 29627 | 29931 | 28188 | 27272 | 25198 | 29790 | 25512 | 18686 | 21000 |

[1] Catches projected to the end of the year;
[2] Should not exceed the 2004 catch level (ACFM, 2004).

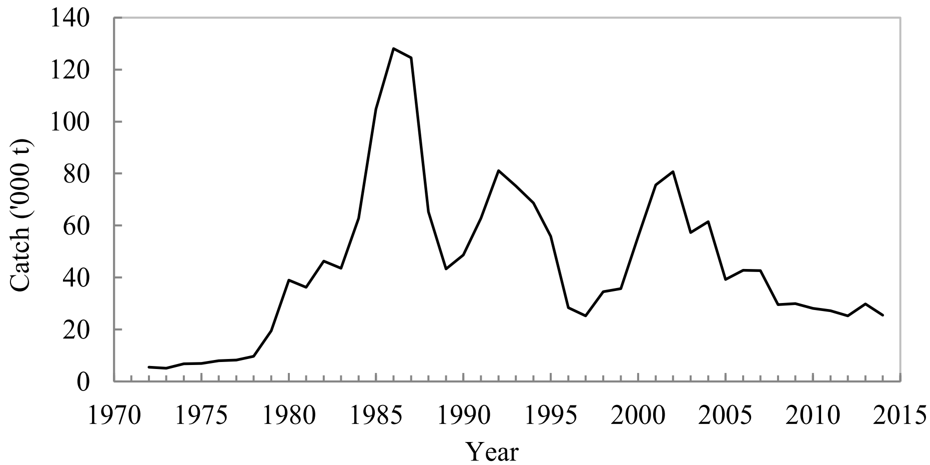



Fig. 6.2. Shrimp in ICES SA I and II: total catches 1970–2014 (2014 projected to the end of the year).

*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 at-sea inspections and research surveys and are corrected for differences in gear selection pattern (SCR Doc. 07/86). Area-specific bycatch rates are then multiplied by the corresponding shrimp catches from logbooks to give an overall bycatch estimate.

Since the introduction of the Nordmøre sorting grid in 1992, only small individuals of 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 and 67 million individuals/yr and redfish between 2 and 25 million individuals/yr from about 1992 to 2010 while 1-9 million haddock/yr and 0.5–14 million Greenland halibut/yr were registered in 2000–2004 (Fig. 6.3). In recent years there has been a decline in bycatch owing to reduced effort in the shrimp fishery. Details of bycatch are no longer reported by the ICES Arctic Fisheries Working Group. NIPAG will update this bycatch information at its 2015 meeting.

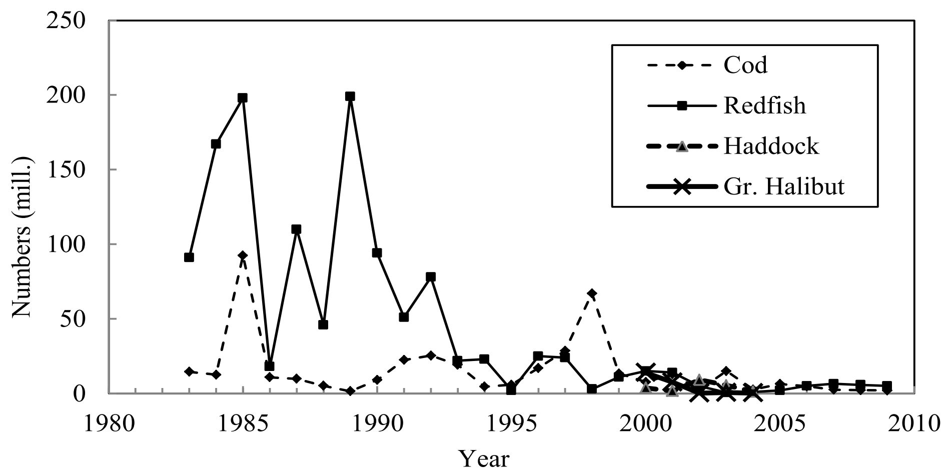



Fig. 6.3. Shrimp in ICES SA I and II: Estimated bycatch of cod, haddock, Greenland halibut and redfish in the Norwegian shrimp fishery (million individuals). No data available for 2010-14.

**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 using single trawls only. Double- and triple trawls were then introduced. An individual vessel may alternate between single and multiple trawling depending on what is appropriate on given fishing grounds.

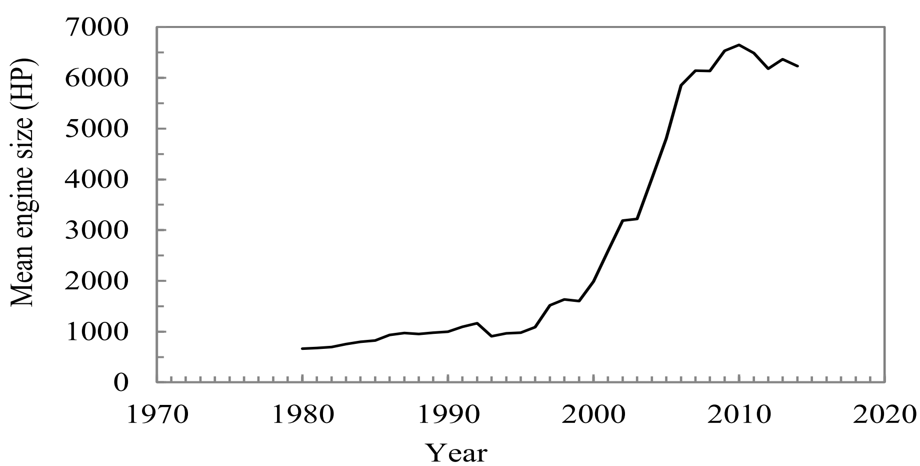



Fig. 6.4. Shrimp in ICES SA I and II: Mean engine power (HP) weighted by trawl-time, 1980–2014 (Norwegian data).

The fishery is conducted mainly in the central Barents Sea (Hopen Deep) and on the Svalbard Shelf along with the Goose Bank (south east Barents Sea) (Fig. 6.5). The fishery takes place throughout the year but may in some years be restricted by ice conditions. The lowest effort is generally in October through March, the highest in May to August.

Logbook data since 2009 show decreased activity in the Hopen Deep and around Svalbard, coupled with increased effort further east in international waters in the "Loop Hole" (Fig 6.5). Information from the industry points to decreasing catch rates and more frequent 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.

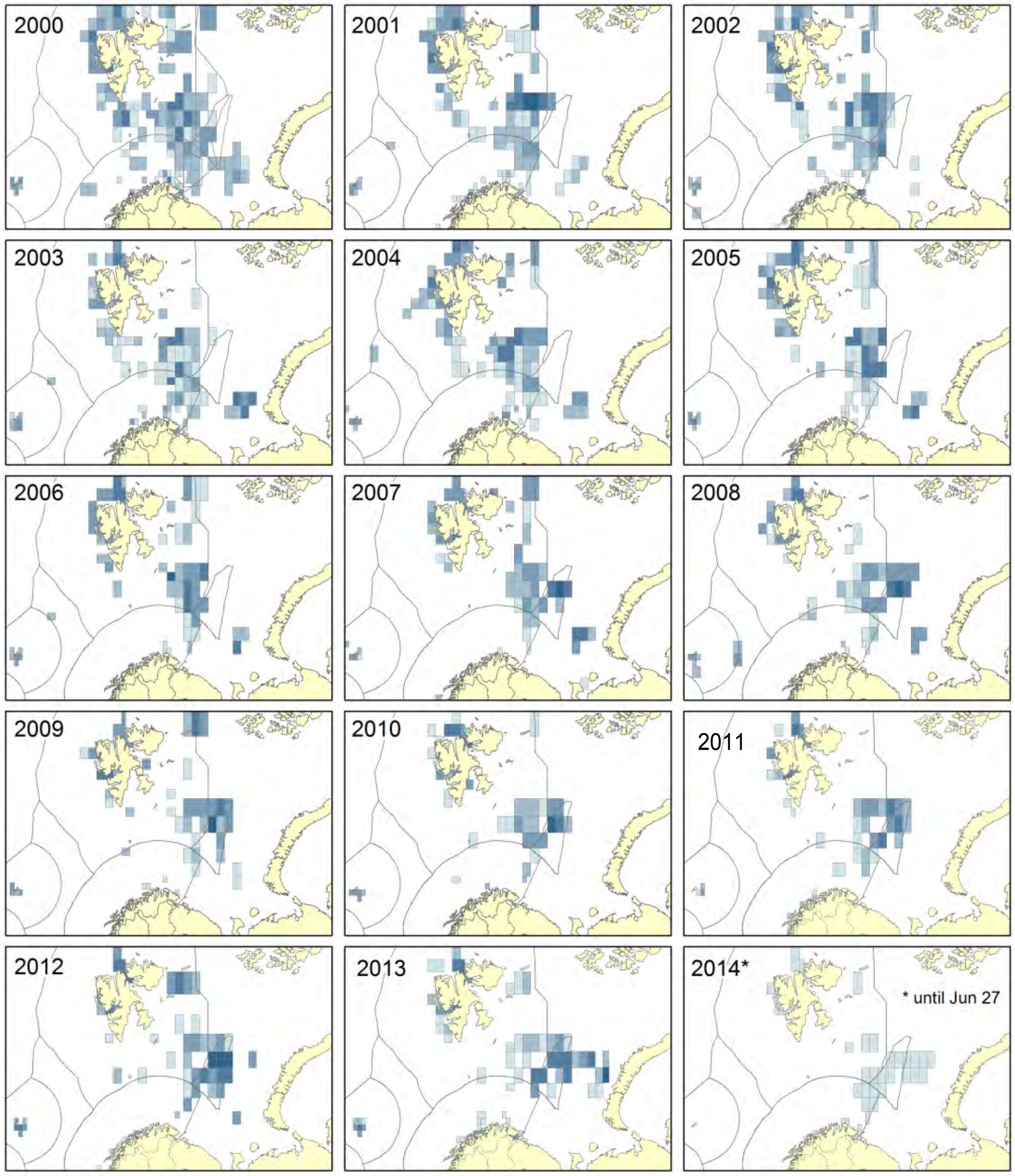



Fig. 6.5. Distribution of catches by Norwegian vessels 2000-2014 based on logbook information.

Norwegian logbook data were used in a multiplicative model (GLM) to calculate standardized annual catch rate indices (SCR Doc. 14/53). 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 used 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 provides an index 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 series in 1987 (Fig. 6.6). From then until 2011 it showed an overall increasing trend. The 2012-14 are however down significantly to below-average values.

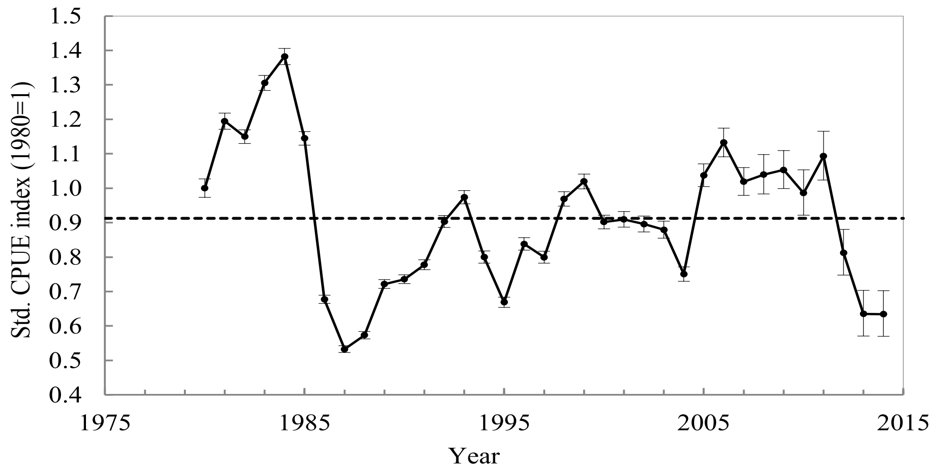



Fig. 6.6. Shrimp in ICES SA I and II: standardized CPUE based on Norwegian data. Error bars represent one standard error; dotted line is the mean of the series.

***ii) Research survey data***

Russian and Norwegian 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, 14/51). The main objectives have been to obtain indices for stock biomass, numbers, recruitment and demographic composition. In 2004, these surveys were replaced by a joint Norwegian-Russian "Ecosystem survey" which monitors shrimp along with a multitude of other ecosystem variables in the Barents Sea and around Svalbard (SCR Doc. 14/51, 14/55).

*Biomass*. The Biomass indices of the Norwegian and Russian shrimp surveys (survey 1 and 2) varied without trend between 1982 and 2005 (Fig. 6.7). 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. 6.7). The 2010 to 2013 values are back up close to that of 2006.

The geographical distribution of the stock in 2009-2012 was more easterly compared to that of the previous years (Fig. 6.8).

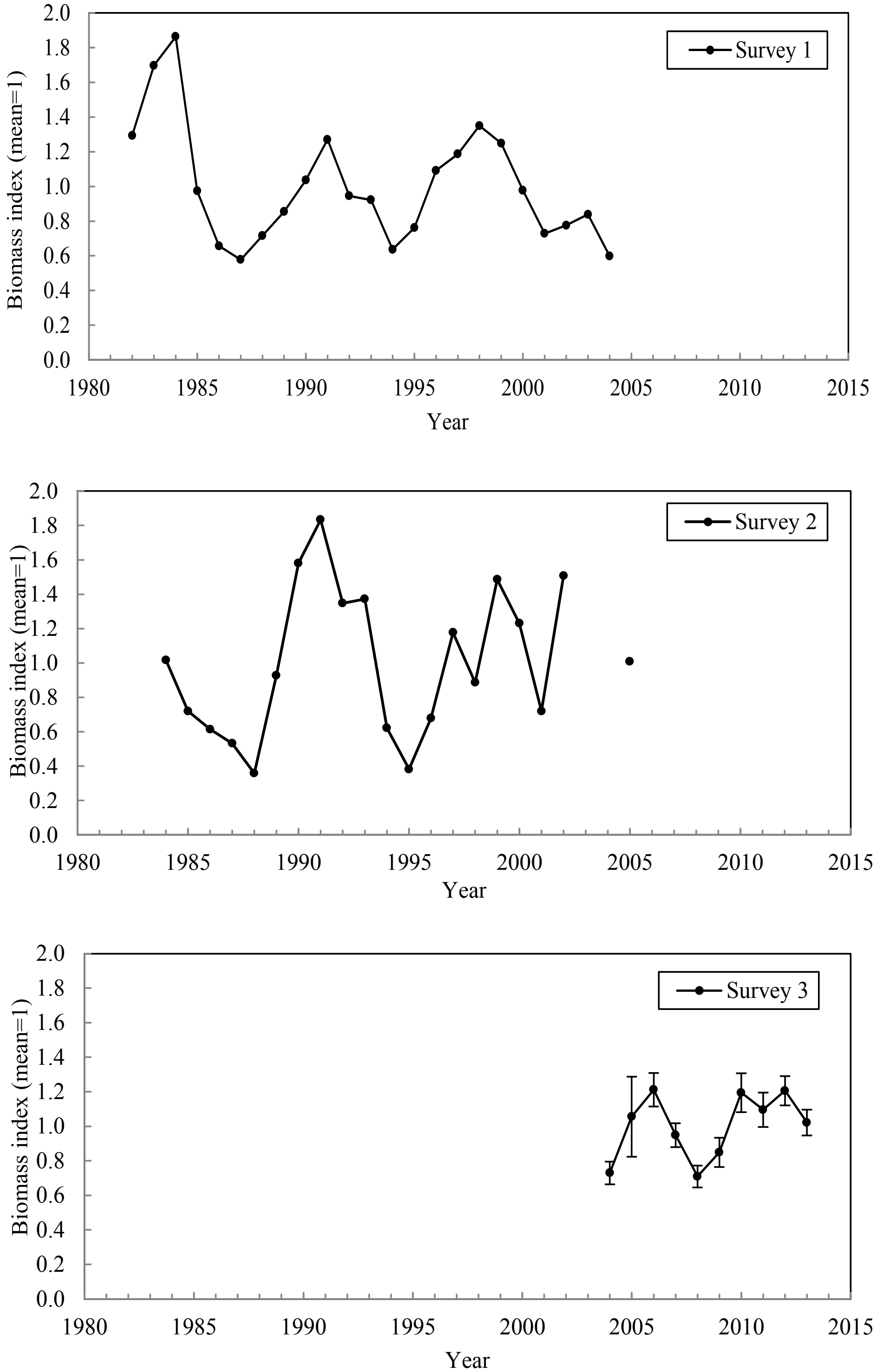



Fig. 6.7. Shrimp in ICES SA I and II: Indices of total stock biomass from the (1) 1982-2004 Norwegian shrimp survey, (2) the 1984-2005 Russian survey, and (3) the joint Russian-Norwegian ecosystem survey 2004-2013 (the 2014 survey data is not at the time of the NIPAG meeting). Error bars represent one standard error.

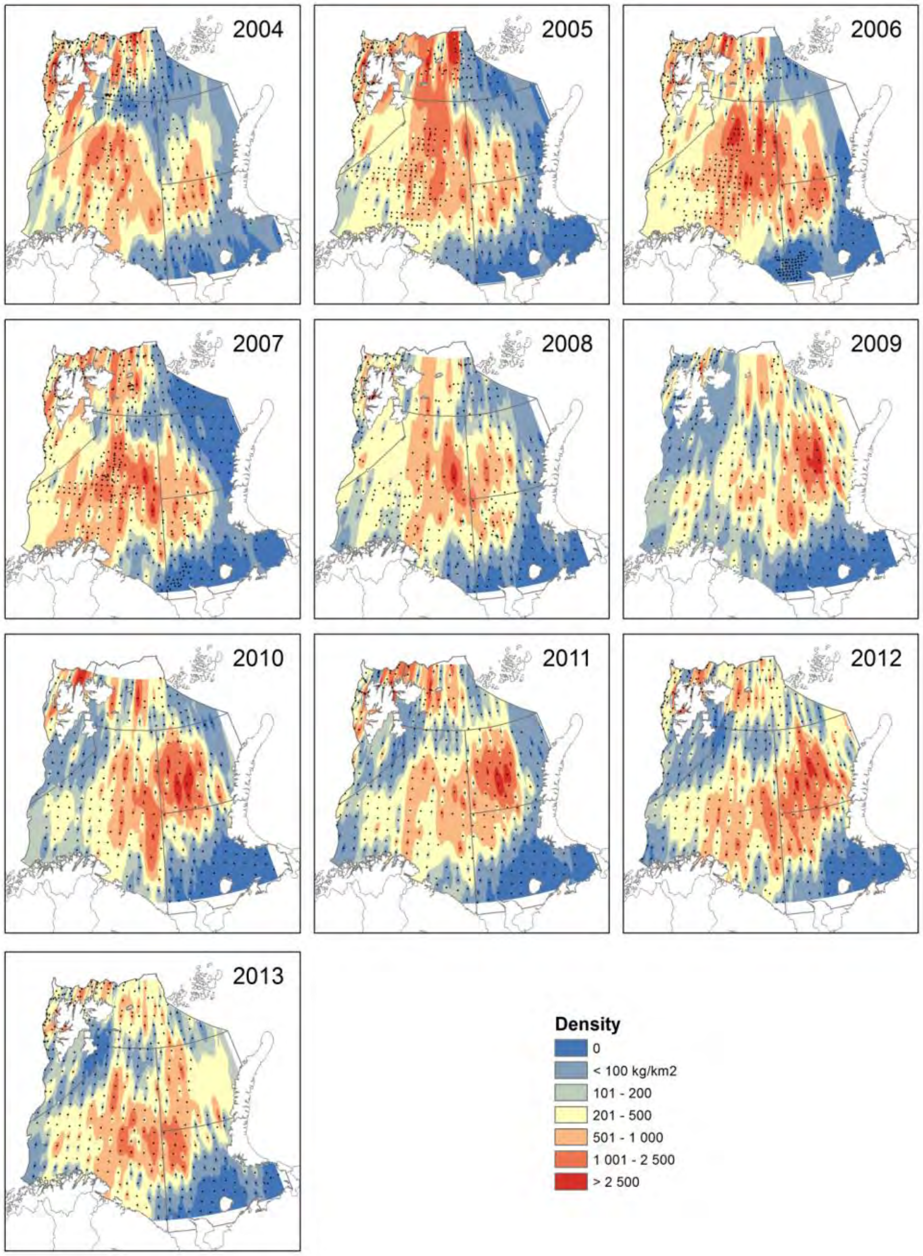



Fig. 6.8. Shrimp in ICES SA I and II: Shrimp density (kg/km2) as calculated from the Ecosystem survey data 2004–2013).

*Recruitment indices*. A recruitment index were derived from the overall size distributions based on Russian and Norwegian survey samples (SCR Doc. 14/55 and 14/51 respectively) as estimated abundances of shrimp at 13 to 16 mm CL. Shrimp at this size will probably enter the fishery in the following one to two years. This index has varied without trend since 2007 (Fig. 6.9).

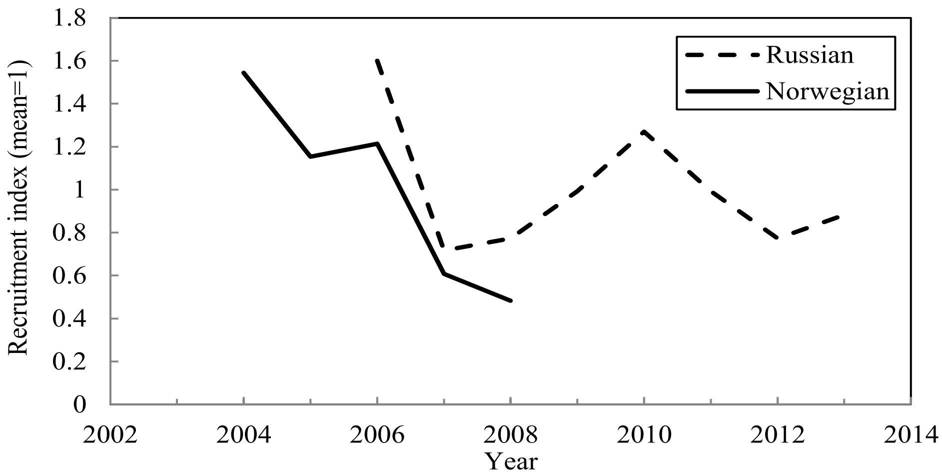



Fig. 6.9. Shrimp in ICES SA I and II: Index of recruitment: abundance of shrimp at size 13–16 mm CL based on Norwegian survey samples 2004-2008 and Russian survey samples 2006-2013.

*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 are mainly caught in areas where bottom temperatures are above 0°C. Highest densities are observed between zero and 4°C, while the upper limit of their preferred temperature range appears to lie at about 6-8°C. The eastward shift in shrimp distribution in recent years may be associated with changes in temperature (SCR Doc. 12/49).

**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.

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" probability density distributions of the parameters (SCR Doc. 14/63).

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 fishery catch rates for 1980–2014 (Fig. 6.6, SCR Doc. 14/53); and trawl-survey biomass indices for 1982–2004, 1984–2005 and for 2004–2013 (Fig, 6.7, SCR Doc. 14/51). These indices were scaled to true biomass by individual catchability parameters, $q_j$, 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. 14/53). 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 $\sigma_P^2$.

The observation equations had lognormal errors, $\omega$, $\kappa$, $\eta$ and $\varepsilon$, 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, $\omega$, $\kappa$, $\eta$ and $\varepsilon$ are treated as normally, independently and identically distributed with mean 0 and variances (observation error) $\sigma_C^2$, $\sigma_R^2$, $\sigma_{Ru}^2$ and $\sigma_E^2$ 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 previous assessments.

Table 6.2. Shrimp in ICES SA I and II : Summary of parameter estimates: mean, standard deviation (sd) and quartiles of the posterior distributions of selected parameters (symbols are as in the text; r = intrinsic growth rate, $P_0$ = the 'initial" stock biomass in 1969).

| | **Mean** | **sd** | **25 %** | **Median** | **75 %** |
|---|---|---|---|---|---|
| *MSY* (ktons), maximum sustainable yield | 269 | 193 | 122 | 220 | 369 |
| *K* (ktons), carying capacity | 3426 | 1809 | 2050 | 3031 | 4394 |
| *r,* intrinsic growth rate | 0.32 | 0.16 | 0.20 | 0.32 | 0.43 |
| $q_R$, catchability of survey 2 | 0.11 | 0.08 | 0.06 | 0.09 | 0.14 |
| $q_{Ru}$, catchability of survey 1 | 0.29 | 0.20 | 0.15 | 0.23 | 0.36 |
| $q_E$, catchability of survey 3 | 0.18 | 0.12 | 0.09 | 0.14 | 0.23 |
| $q_C$, catchability of CPUE index | 4.1E-04 | 2.8E-04 | 2.2E-04 | 3.3E-04 | 5.2E-04 |
| $P_0$, initial relative biomass (1969) | 1.51 | 0.26 | 1.33 | 1.50 | 1.68 |
| $P_{2014}$, relative biomass in 2014 | 1.53 | 0.42 | 1.25 | 1.50 | 1.76 |
| $\sigma_R$, coefficient of variation for survey 2 | 0.17 | 0.03 | 0.15 | 0.17 | 0.19 |
| $\sigma_{Ru}$, coefficient of variation for survey 1 | 0.34 | 0.05 | 0.30 | 0.33 | 0.37 |
| $\sigma_E$, coefficient of variation for survey 3 | 0.19 | 0.04 | 0.16 | 0.18 | 0.21 |
| $\sigma_C$, coefficient of variation for CPUE index | 0.14 | 0.02 | 0.12 | 0.13 | 0.15 |
| $\sigma_P$, coefficient of variation for process | 0.19 | 0.03 | 0.17 | 0.19 | 0.21 |

*Reference points.* Four reference points are considered: $F_{msy}$, $B_{trigger}$, $F_{lim}$ and $B_{lim}$. In the present assessment, $F_{msy}$ directly as is the probability of exceeding reference points. "buffer" reference points are obsolete due to the available risk analyses. $B_{lim}$ is set at 30% $B_{msy}$ (NIPAG, 2006), $B_{trigger}$ at 50% $B_{msy}$ and $F_{lim}$ at 1.7$F_{msy}$ (NIPAG, 2010).:

| | Type | Value | Technical basis |
|---|---|---|---|
| MSY approach | $B_{trigger}$ | $0.5B_{MSY}$* | Approximately corresponding to10th percentile of the $B_{MSY}$ estimate |
| | $F_{MSY}$ | * | Resulting from the production model. |
| Precautionary approach | $B_{lim}$ | $0.3B_{MSY}$ | The B where production is reduced to 50% MSY |
| | $F_{lim}$ | $1.7F_{MSY}$ | the F that drives the stock to $B_{lim}$ |

## d) Assessment Results

The results of this year's model run are similar to those of the previous years (model introduced in 2006). The conclusions drawn from the model have been found on investigation to be insensitive to the setting of the priors for initial stock biomass and carrying capacity (SCR Doc. 06/64 and 07/76).

*Stock size and fishing mortality.* A steep decline in stock biomass in the mid-1980s was noted following some years with high catches and the median relative biomass dropped nearly to 1 (Fig. 6.10, upper). Since the late 1980s, however, the stock has varied with a slightly increasing trend. The median 2013-14 values are above Bmsy. The estimated risk of stock biomass being below $B_{trigger}$ in 2014 was less than 1% (Table 6.3). The median estimate of fishing mortality has remained below Fmsy throughout the history of the fishery (Fig. 6.10 lower). In 2014, there is a less than 5% risk of the F being above Fmsy (Table 6.3).

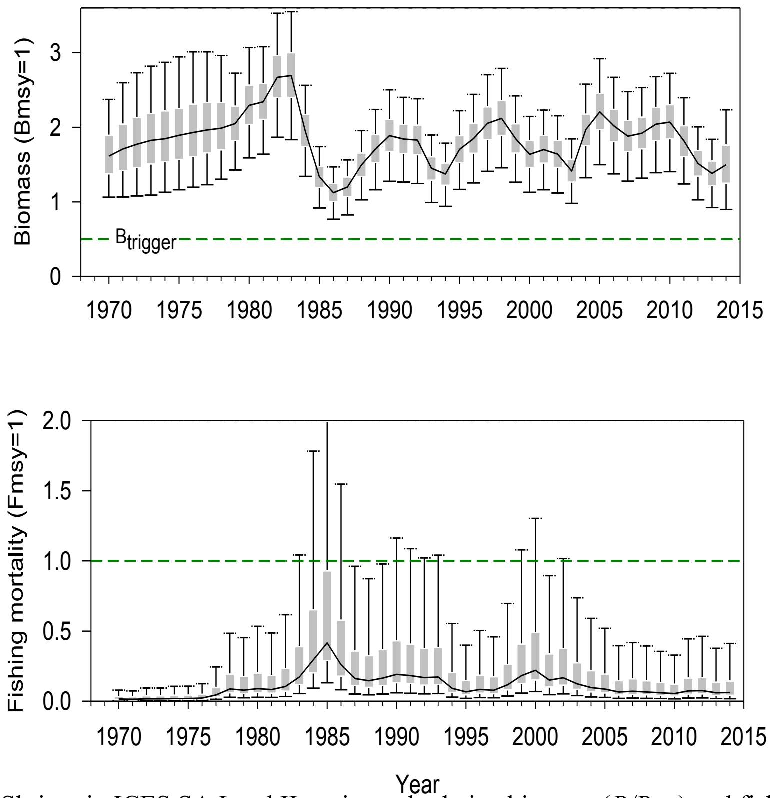



Fig. 6.10. Shrimp in ICES SA I and II: estimated relative biomass ($B/B_{msy}$) and fishing mortality ($F/F_{msy}$) for 1970–2014. Boxes represent inter-quartile ranges and the solid black line in the middle of each box is the median; the arms of each box cover the central 90% of the distribution. The broken lines are the $B_{trigger}$ and $F_{msy}$ references respectively.

Table 6.3. Shrimp in ICES SA I and II: stock status for 2013 and predicted to the end of 2014.

| Status | 2013 | 2014* |
|---|---|---|
| Risk of falling below $B_{lim}$ | 0.0 % | 0.0 % |
| Risk of falling below $B_{trigger}$ | 0.1 % | 0.3 % |
| Risk of exceeding $F_{MSY}$ | 1.1 % | 1.3 % |
| Risk of exceeding $F_{lim}$ | 0.6 % | 0.7 % |
| Stock size (B/Bmsy), median | 1.38 | 1.50 |
| Fishing mortality (F/Fmsy), | 0.06 | 0.06 |
| Productivity (% of MSY) | 85 % | 75 % |

*Predicted catch = 21 ktons

*Predictions.* Assuming a catch of 21 kt for 2014, catch options up to 70 kt for 2015 and 2016 have low risks of exceeding $F_{msy}$ (<10%), $F_{lim}$ (<5%), and of going below $B_{trigger}$ (<1%) in 2016 (Table 6.4) and all are likely to result in stock increase. At 90 kt the risk of exceeding $F_{msy}$ is <15% and that of going below $B_{trigger}$ is <5% but that of tranfressing $F_{lim}$ exceeds 5%.

Table 6.4. Shrimp in ICES SA I and II: Predictions of risk and stock status in 2016 associated with six optional catch levels for 2015—16.

| | Catch option 2015-16 (ktons) | | | | | |
|---|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | 70 | 90 |
| Risk of falling below $B_{lim}$ | 0.0 % | 0.1 % | 0.1 % | 0.1 % | 0.2 % | 0.2 % |
| Risk of falling below $B_{trigger}$ | 0.6 % | 0.7 % | 0.8 % | 0.9 % | 0.9 % | 1.1 % |
| Risk of exceeding $F_{MSY}$ | 2.5 % | 3.6 % | 5.2 % | 6.4 % | 8.3 % | 12.0 % |
| Risk of exceeding $F_{lim}$ | 1.2 % | 1.7 % | 2.6 % | 3.4 % | 4.0 % | 6.2 % |
| Stock size (B/Bmsy), median | 1.65 | 1.63 | 1.62 | 1.61 | 1.59 | 1.56 |
| Fishing mortality (F/Fmsy), | 0.08 | 0.11 | 0.14 | 0.17 | 0.20 | 0.26 |
| Productivity (% of MSY) | 58 % | 61 % | 61 % | 63 % | 65 % | 69 % |

The risks associated with ten-year projections of stock development assuming annual catch of 30 000 to 90 000 t were investigated (Fig. 6.11). For all options the risk of the stock falling below $B_{trigger}$ in the longer term (10 years) is less than 10%. Catch options up to 60 000 t, have a low risk (<10%) of exceeding $F_{MSY}$ after 10 years. Taking up to 90 000 t/yr will increase the risk of going above $F_{msy}$ by the end of the ten-year projection to around 15%.

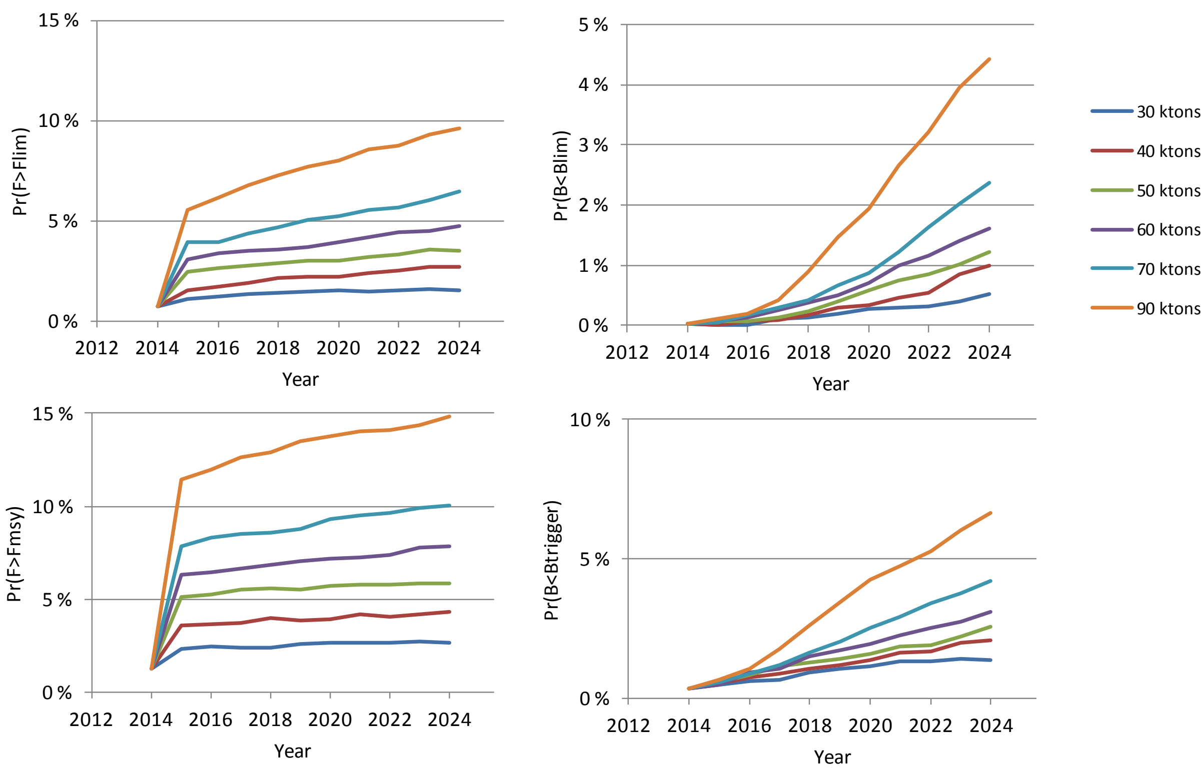



Fig. 6.11. Shrimp in ICES SA I and II: Projections of estimated risk of going below $B_{trigger}$ and $B_{lim}$, and of exceeding $F_{msy}$ and $F_{lim}$, given different catch options.

Yield predictions could be made for various levels of fishing mortality (e.g. at target fishing mortality=$F_{msy}$) but such estimates would have high uncertainty. Instead we have estimated yields at different levels of risk of exceeding the target of $F_{msy}$ (Table 6.5).

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 | 5 % | 10 % | 25 % | 35 % | 50 % |
| 2015 | 45 | 73 | 151 | 221 | 290 |
| 2016 | 45 | 74 | 151 | 219 | 286 |
| 2017 | 44 | 73 | 144 | 205 | 266 |
| 2018 | 44 | 69 | 137 | 196 | 255 |
| 2019 | 42 | 69 | 133 | 189 | 245 |

**Additional considerations**

*Model performance.* The model was able to produce good simulations of the observed data (Fig. 6.12). The differences between observed values of biomassindices and the corresponding values predicted by the model were checked numerically. They were found not to include excessible large deviation.

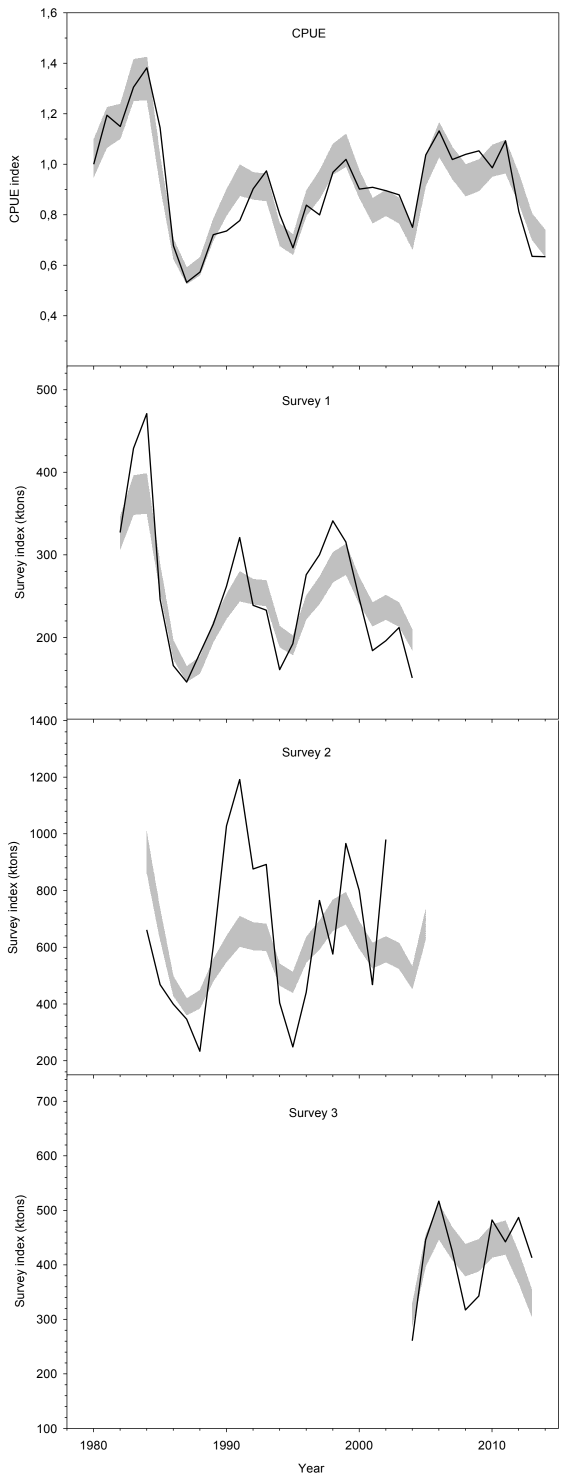



Fig. 6.12. Shrimp in ICES SA I and II: Observed (solid line) and estimated (shaded) series of the included biomass indices: the standardized catch-per-unit-effort (CPUE), the 1982–2004 shrimp survey (survey 1), a Russian survey index discontinued in 2005 (Survey 2) and the Joint Norwegian-Russian Ecosystem Survey (survey 3) until 2013. Grey shaded areas are the inter-quartile ranges of their posteriors.

*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 documented as capable of consuming large amounts of shrimp. Continuing investigations to include cod predation as an explicit effect in the assessment model have so far not been successful; it has not been possible to establish a relationship between the density of cod and the stock dynamics of shrimp. The cod stock in the Barents Sea has increased considerably within the last ten years. If predation on shrimp were to increase rapidly beyond the range previously experienced, the shrimp stock might decrease in size more than the model results have indicated as likely.

*Recruitment, and reaction time of the assessment model.* The model used is best at describing trends in stock development but estimates, and uses, long-term averages of stock dynamic parameters. Large and/or sudden changes in recruitment or mortality may therefore be underestimated in model predictions. However such changes have not been observed in the recent period.

*Rebuilding potential.* At 30% $B_{msy}$ ($B_{lim}$) production is reduced to 50% of its maximum. With an 80% confidence interval on *r* (the intrinsic rate of increase) ranging from 0.11 to 0.53 per year, it would take 4-14 years to rebuild the stock from $B_{lim}$ to $B_{msy}$ without a fishery.

**e) Summary**

*Mortality*. Fishing mortality has remained below $F_{msy}$ throughout the history of the fishery. In 2014 there is a less than 5% risk of the $F$ being above $F_{msy}$.

*Biomass*. Stock biomass has been above $B_{trigger}$ throughout the history of the fishery. The risk that the biomass at the end of 2014 is below $B_{trigger}$ is less than 1%

*Recruitment*. Recruitment indices have varied without trend in 2004 – 2013.

*State of the Stock*. The stock has declined since 2010, when it is estimated to have been close to the carrying capacity. Stock biomass is however estimated to be still well above $B_{trigger}$. The risks of stock biomass being below $B_{trigger}$ or of fishing mortality being above $F_{msy}$ at the end of 2014 are both less than 5%.

*Yield*. Catch options up to 70 000 t/yr, have a risk below 10% of exceeding $F_{msy}$ and below 5% of exceeding $F_{lim}$ in the coming 2 years. At a higher risk larger yields may be achieved. E.g. catches of more than 200 kt can be taken without exceeding the median estimate of $F_{msy}$.

*Special Comment.* In recent years the distribution of the stock has changed, and some of the traditional fishing grounds are now less attractive to the fishery. Access to certain other fishing grounds is restricted by closures to prevent bycatch, and by regulations requiring vessels to sail long distances to specified entry and exit points of the Russian EEZ.

**f) Review of Recommendations from 2012-13**

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 Joint Norwegian – Russian Ecosystem Survey.***

STATUS: There has been no progress on this recommendation.

- *Collaborative efforts should be made to standardize a means of predicting recruitment to the fishable stock.*

STATUS: There has been no progress on this recommendation.

- *Work to include explicit information on recruitment in the assessment model should be continued.*

STATUS: There has been no progress on this recommendation.

## 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 since 1972 (SCR Doc. 09/69). Total reported landings have fluctuated between zero since 2006 to above 8 000 t (Figure 7.1). 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.

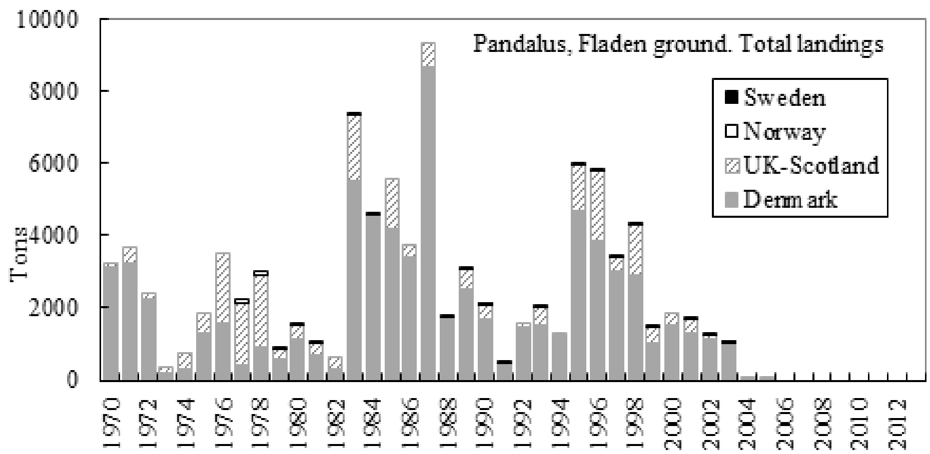



Fig. 7.1. Northern shrimp in Fladen Ground: Catches

## IV. OTHER BUSINESS

### 1. FIRMS Classification for NAFO Shrimp Stocks

The table as agreed in June was updated with the agreed classifications for the Northern shrimp stocks assessed this year.

| Stock Size (incl. structure) | Fishing Mortality | | | |
|---|---|---|---|---|
| | None–Low | Moderate | High | Unknown |
| Virgin–Large | | 3LNO Yellowtail flounder | | |
| Intermediate | 3M Redfish<br>3LN Redfish | SA0+1 Northern shrimp | 3M Cod | Greenland halibut in Uummannaq[1]<br>Greenland halibut in Upernavik[1]<br>Greenland halibut in Disko Bay[1] |
| Small | SA3+4 Northern shortfin squid | SA2+3KLMNO Greenland halibut<br>3LNO Northern shrimp<br>DS Northern shrimp | | 3NOPs White hake<br>3LNOPs Thorny skate |
| Depleted | 3M American plaice<br>3LNO American plaice<br>2J3KL Witch flounder<br>3NO Cod<br>3NO Witch flounder<br>3M Northern shrimp[2] | | | SA1 Redfish<br>SA0+1 Roundnose grenadier |
| Unknown | SA2+3 Roughhead grenadier<br>3NO Capelin<br>3O Redfish | 0&1A Offsh. & 1B–1F Greenland halibut | | SA2+3 Roundnose grenadier |

[1] Assessed as Greenland halibut in Div. 1A inshore
[2] Fishing mortality may not be the main driver of biomass for Div. 3M Shrimp

### 2. Future Meetings

An invitation was made to the group from Canada-Newfoundland and Labrador to host the September 2015 SC / NIPAG meeting in St. John's, NL, Canada. This suggestion was warmly received by NIPAG.

### 3. Chairs of Future Meetings

NIPAG considered the succession of the chairmanship and decided to accept an offer from Peter Shelton to continue for one more year, and to reconsider the question in 2015.

### 4. Development of a management plan for Norwegian Deep and Skagerrak Shrimp Fishery

NIPAG was informed that Norway has taken the first steps toward developing a management plan for the shrimp stock in Skagerrak and the Norwegian Deep, with a view towards eventually also soliciting cooperation from EU (Denmark) and EU (Sweden). In discussions, it was observed that active participation of the fishery and its managers would be essential and should be immediately enlisted. Information was exchanged on sources of information for possible content and structuring of fishery management plans.

### 5. SC/NIPAG Intersessional Workshop on Recruitment Signals

Scientific Council will hold an intersessional meeting by correspondence to investigate the appropriate recruitment signal which can be used in prediction, taking into account environmental and trophic factors. This was proposed to be hosted by the NAFO Secretariat using Webex.

## V. ADJOURNMENT

The NIPAG meeting was adjourned at 1500 hours on 17 September 2014. 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. Special thanks were given to the Greenland Institute of Natural Resources (Pinngortitaleriffik) for their hospitality during this meeting.

# PART I: SCIENTIFIC COUNCIL MEETING, 22-26 SEPTEMBER 2014

## Contents

# REPORT OF SCIENTIFIC COUNCIL MEETING

**22-26 September 2014**

Chair: Don Stansbury Rapporteur: Neil Campbell

## I. PLENARY SESSIONS

The Scientific Council met at the Palacio de Congresos Mar de Vigo, Vigo, Spain, during 22-26 September 2014, to consider the various matters in its agenda. Representatives attended from Canada, European Union (France, Portugal, Spain and the United Kingdom), France (with respect to St. Pierre et Miquelon), Norway and the Russian Federation. 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 0930 hours on 22 September 2014.

The Chair welcomed participants to the 36th Annual Meeting and thanked the European Union, Spain and the City of Vigo Authorities for 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 Marine Stewardship Council, Ecology Action Centre, and the FAO as observers to this meeting.

The Council and its Standing Committees met through 22-26 September 2014 to address various items in its agenda. The Council considered and adopted the reports of the STACFIS and STACREC Standing Committees on 26 September 2014. The final session was called to order at 0900 hours on 26 September 2014. The Scientific Council then considered and adopted its report of this meeting. The meeting was adjourned at 1100 hours on 26 September 2014.

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

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

## II. REVIEW OF SCIENTIFIC COUNCIL RECOMMENDATIONS

There were no recommendations arising from the 2013 or 2014 Scientific Council Meetings.

## III. RESEARCH COORDINATION

The Council adopted the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chair, Kathy Sosebee. 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, Brian Healey. The full report of STACFIS is at Appendix II.

## V. REQUESTS FROM THE FISHERIES COMMISSION

### 1. Requests deferred from the June Meeting

#### a) Availability of data and progress towards quantitative assessments (Item 10)

*The Scientific Council provides advice for a number of stocks based only on qualitative assessments of survey trends and catches (e.g. Div. 3NO white hake, Div. 3O redfish). For some of these stocks the advice is to lower the TAC to recent level of catches. On the other hand, there is an important effort in biological sampling, collection of fishing activity data and fishery independent surveys. There is also an important progress in providing more data to the*

*Scientific Council such as VMS. In spite of these efforts, no progress has been reached regarding quantitative assessments of many stocks. The Fisheries Commission requests the Scientific Council to provide an overview for all stocks on what biological and fishery information is currently available by Contracting Party and what is necessary to improve in terms of data collection in order to develop quantitative assessments and biological reference points for stocks managed by NAFO.*

Scientific Council deferred this request to its June 2015 meeting.

**b) Bycatch and the development of a Div. 3LN Redfish Management Strategy (requested by WG-RBMS)**

*The Working Group recommends Scientific Council comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN Redfish.*

Preliminary information from one fleet operating in this fishery was available to Scientific Council. Bycatch rates are variable, ranging from 5 to 40%. Bycatch in the Div. 3LN redfish fishery appears to be depth dependent. Analysis of bycatch by depth in each Division would be required to fully answer this request. It was not possible to perform such an analysis at the September meeting.

**2. *Ad hoc* Requests from Current Meeting**

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

**Cod in Div. 3M**

*1. It is noted that the stock of cod in 3M is rebuilding following the reduction in fishing mortality and improved recruitment and that SSB is currently estimated to be well above* $B_{lim}$ *with a high probability.*

*The EU Flemish Cap survey taking place every year in June/July is the only fishery independent information available for the assessment of cod in Division 3M since 1988. This survey is the only tuning information used in the assessment for the years 1988-2013, since no fishing fleet catch/effort is used for tuning. The assessment of cod in Division 3M is therefore highly dependent on the data quality obtained from the EU Flemish Cap survey. In 2013, the survey was impacted by activity of oil and gas prospection by [a seismic exploration vessel] (see letter of 1 July 2013 from the Head of the scientific campaign to the Scientific Council Chair) and the estimates of Div. 3M cod 1 year olds and biomass decreased substantially in relation to 2012. The increasing trend of biomass observed since 2006 and projected by last year's assessment for 2014 and 2015 was this way inverted.*

*The Scientific Council is requested to:*

*a) Provide an opinion on the possible impact that the oil and gas prospection activity might have had in the abundance index of Div. 3M cod.*

*b) Compare the abundance indices of different demersal stocks of the 2013 EU Flemish Cap survey in order to assess if decreases were also observed for other demersal species in Div. 3M and if there might have been a year effect in the survey of 2013, possibly consequence of the oil and gas prospection.*

*c) Provide any preliminary information available of the 2014 Flemish Cap survey regarding cod in order to assess if the decrease in the abundance index is confirmed also in 2014.*

Scientific Council responded:

a) Scientific Council cannot evaluate at this moment the impact of the activity of the seismic vessels on the abundance index of Div. 3M cod.

b) With the exception of cod none of the declines were substantial, and in general were a continuation of recent trends. At present it is not clear whether the 2013 survey results are due to a year-effect.

c) Preliminary information indicates the abundance decline has been confirmed, however, biomass has increased. Scientific Council will fully review these survey results during the next assessment.

*2) The Scientific Council reviewed document SCR Doc. 14/018 where different assumptions over the natural mortality parameter (M) are analysed. The adopted stock assessment of 3M cod assumes a constant M over age, time and gender (estimate around 0.15) while the document indicated that M variable over three age classes and* *three periods of time provides estimates of around 0.2, which are more consistent with natural mortalities assumed for other cod stocks in the NAFO and ICES areas, Therefore, despite all the uncertainty around M, the constant M assumption adopted for scientific advice seems highly unlikely when considering the biology of the stock.*

*The Scientific Council is requested to:*

*a) Compare the estimated natural mortality value for Div. 3M cod to M values used in other cod stocks in the Atlantic and explain the rationale for a divergence and possible bias introduced due to cannibalism and other natural mortality factors.*

*b) Provide the value of* $F_{max}$ *if M = 0.2. Please provide the Biomass, Spawning Stock Biomass and yield projections for these values of* $F_{max}$.

*c) A frequent approach to estimate* $F_{max}$ *is by taking the mean of the last three years for the mean weights and exploitation pattern by age (PR). However, the SC decided to take only the values of the last year to estimate* $F_{max}$*. Explain what would have been the value of* $F_{max}$ *if the mean of the last three years had been used for the mean weights and PR.*

*d) Estimate the projected biomass (B and SSB) and the resulting fishing mortality in 2015 and 2016 with a TAC in 2015 of 14 521 t. What is the probability of the biomass to fall below* $B_{lim}$ *in 2016? Please compare with the projected biomass in 2015 and 2016 for the scenario* $F_{2015} = F_{max}$.

*e) Assuming that the TAC is set at 10 838 t for 2015 and is fished entirely, that the biomass evolves in accordance with the projections and* $F_{max}$ *is constant, provide the foreseen yield at* $F_{max}$ *(=0.145) for 2016.*

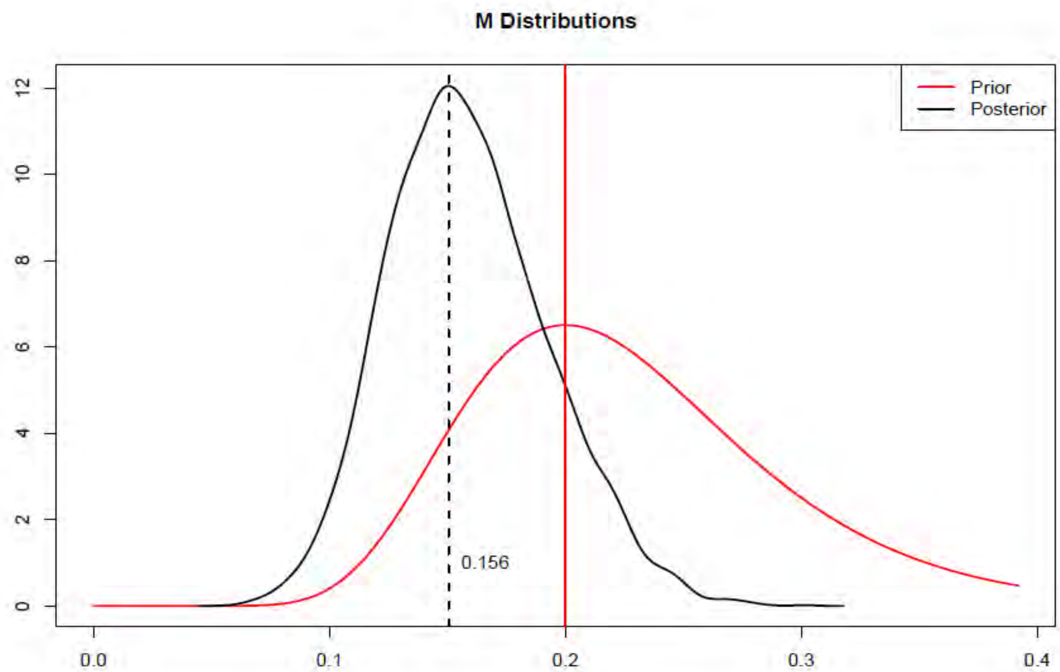
Scientific Council responded:

a) Mortality (*F* and *Z*) used in some assessments of cod are as follows:

| Cod Stocks | M | *Z* |
|---|---|---|
| Northern Cod (Div. 2J3KL) | | 0.57* |
| Flemish Cap (Div. 3M) | 0.16* | |
| Southern Grand Bank (Div. 3NO) | 0.2 | |
| Southern Newfoundland (Div. 3Ps) | | 0.44* |
| Gulf of St. Lawrence (Div. 3Pn4Rs) | 0.2-0.4 | |
| Southern Gulf of St. Lawrence (Div. 4TVn) | 0.66* | |
| Eastern Scotian Shelf (Div. 4VsW) | 0.36* | |
| Southern Scotian Shelf and the Bay of Fundy (Div. 4X5Yb) | 0.76* | |
| Eastern Georges Bank (Div. 5Zjm) | 0.8 | |
| Gulf of Maine | 0.2-0.4 | |
| Georges Bank | 0.2 | |
| Norwegian Coastal Waters (ICES Subarea I and II (inshore)) | 0.2 | |
| North-East Arctic (ICES Subareas I and II (offshore)) | 0.2 | |
| Faroe Plateau (ICES Subdiv. Vb1) | 0.2 | |

*estimated values – others are fixed

The following figure shows the input (prior) and estimated (posterior) values of M for Div. 3M cod from the 2014 assessment. The probability that M <= 0.2 is 88.1%.




Scientific Council was not able to address divergence and possible bias introduced due to cannibalism and other natural mortality factors at this meeting.

b) Scientific Council reiterates that the median value of M in Div. 3M Cod is estimated to be 0.156 in the 2014 assessment. The M=0.2 scenario constitutes a new assessment. Scientific Council thus considers these figures to be illustrative only and not a basis for management advice. If a higher value of M is assumed, yield is increased.

| | $F_{max}$ 2013 input data | |
|---|---|---|
| | M=0.156 | M=0.2 |
| 5% | 0.085 | 0.100 |
| 50% | 0.145 | 0.165 |
| 95% | 0.235 | 0.265 |

| | M=0.156 | | | M=0.2 | | |
|---|---|---|---|---|---|---|
| | Total Bio | SSB | Yield | Total Bio | SSB | Yield |
| 2014 | 66953 | 44869 | 14521 | 74246 | 48902 | 14521 |
| 2015 | 85528 | 58341 | 10838 | 94311 | 62277 | 13073 |
| 2016 | 134970 | 79646 | | 145070 | 81554 | |

c) Scientific Council took only the values for the mean weight-at-age and exploitation pattern by age in 2014 due to the strong trends seen in these values over recent years. This approach was consistent with the approach taken for mean weights in the 2013 Div. 3M cod assessment.

| | $F_{max}$ | |
|---|---|---|
| | SC Assessment | 3-Year Average |
| 5% | 0.085 | 0.095 |
| 50% | 0.145 | 0.130 |
| 95% | 0.235 | 0.180 |

| | SC Assessment | | | 3-Year Average | | |
|---|---|---|---|---|---|---|
| | Total Bio | SSB | Yield | Total Bio | SSB | Yield |
| 2014 | 66953 | 44869 | 14521 | 76021 | 42770 | 14521 |
| 2015 | 85528 | 58341 | 10838 | 99414 | 61049 | 11962 |
| 2016 | 134970 | 79646 | | 150535 | 81507 | |

Scientific Council considers the figures from the "3-year average" scenario to be illustrative only and not a basis for management advice.

d) *Estimate the projected biomass (B and SSB) and the resulting fishing mortality in 2015 and 2016 with a TAC in 2015 of 14 521 t. What is the probability of the biomass to fall below $B_{lim}$ in 2016? Please compare with the projected biomass in 2015 and 2016 for the scenario $F_{2015} = F_{max}$.*

| | $F$=$F_{max}$ | | | Constant Catch = 14521 | | |
|---|---|---|---|---|---|---|
| | Total Bio | SSB | Yield | Total Bio | SSB | $F$ |
| 2014 | 66953 | 44869 | 14521 | 66953 | 44869 | 0.260 |
| 2015 | 85528 | 58341 | 10838 | 82450 | 58314 | 0.199 |
| 2016 | 134970 | 79646 | | 120584 | 75315 | |

| | P($B$<$B_{lim}$) | | |
|---|---|---|---|
| | 2014 | 2015 | 2016 |
| Constant catch | <5% | <5% | <5% |
| Catch=$F_{max}$ | <5% | <5% | <5% |

e) Due to uncertainty in recruitment of the 2010 and 2011 years classes, Scientific Council considers that projection of management options can be provided for 2015 only. Scientific Council considers the figures for 2016 yields, SSB and biomass are illustrative only and not a basis for management advice.

| | Total Bio | SSB | Yield |
|---|---|---|---|
| 2014 | 66953 | 44869 | 14521 |
| 2015 | 85528 | 58341 | 10838 |
| 2016 | 134970 | 79646 | 18588 |

**Redfish in Div. 3LNO**

*3) The Population Structure of Sebastes mentella and Sebastes fasciatus in NAFO Divisions 3LNO has been studied in the past, including the genetic markers. A conclusion is that redfish in Division 3LN and 3O are part of a same biological stock. However, at the moment, redfish in these Divisions is managed through two separated stocks. The scientific Council is therefore requested to:*

*a) Indicate if there is any biological reason to define two different redfish management areas in NAFO Divisions 3LNO.*

*b) Assess the consequence of merging the 3O and 3LN redfish stocks into a single management area with a single TAC, taking into account the possibility that the fishing effort could be more concentrated in Divisions 3LN.*

a) In 2005, Scientific Council responded to a similar question from Fisheries Commission as follows:

*"Regarding redfish in Divisions 3L, 3N and 3O, Scientific Council is requested to: review all available information and provide advice regarding whether the current management units (3LN and 3O) or any alternative may be the most appropriate."*

In 2005, Scientific Council responded as follows:

"The Council noted that results were available from a study of redfish population structure pertinent to the long standing recommendation on the appropriateness of Div. 3LN and Div. 3O as management units (SCR Doc. 05/50). The study compared genetic and morphometric characteristics of *S. fasciatus* and *S. mentella* based on samples within Div. 3LNO and Div. 3P area. For *S. fasciatus*, the results obtained suggested no difference in the biological characters studied amongst Div. 3L, Div. 3N and Div. 3O. It further suggested that *S. fasciatus* from Div. 3LNO and from the Subdiv. 3Ps area adjacent to Div. 3O form a population that exchanges individuals with redfish in the Laurentian Channel (Div. 3P4V). Therefore Div. 3O could be influenced by migration events originating from or towards the Laurentian Channel area (Div. 3P4V). For *S. mentella*, the results suggested Div. 3L is different from the Laurentian Channel area. These results confirmed the findings of a study by Roques *et al.* (2001).

"The latter study also found no genetic difference among samples of *S. mentella* from Div. 3LN, Div. 3O and Subarea 2 + Div. 3K. The Council noted statistically non-significant genetic differences between areas could be obtained from a relatively low mixing rate between these areas.

"Most studies the Council has reviewed in the past have suggested a close connection between Div. 3LN and Div. 3O, particularly between Div. 3O and Div. 3N for both species of redfish. While many of the studies suggested a single management unit, differences observed in population dynamics between Div. 3O and Div. 3LN suggest that it would be prudent to keep Div. 3O as a separate management unit. This is also the suggestion of the 2005 study (SCR Doc. 05/50) with regard to the argument that Div. 3O may act as a buffer zone between surrounding populations."

There is no new information since 2005. SC reiterates that although there is a genetic connection between Div. 3O and Div. 3LN and other adjacent areas, differences observed in population dynamics, such as length- and age-structure of the populations, between Div. 3O and Div. 3LN suggest that it would be prudent to keep Div. 3O as a separate management unit.

b) Scientific Council responded:

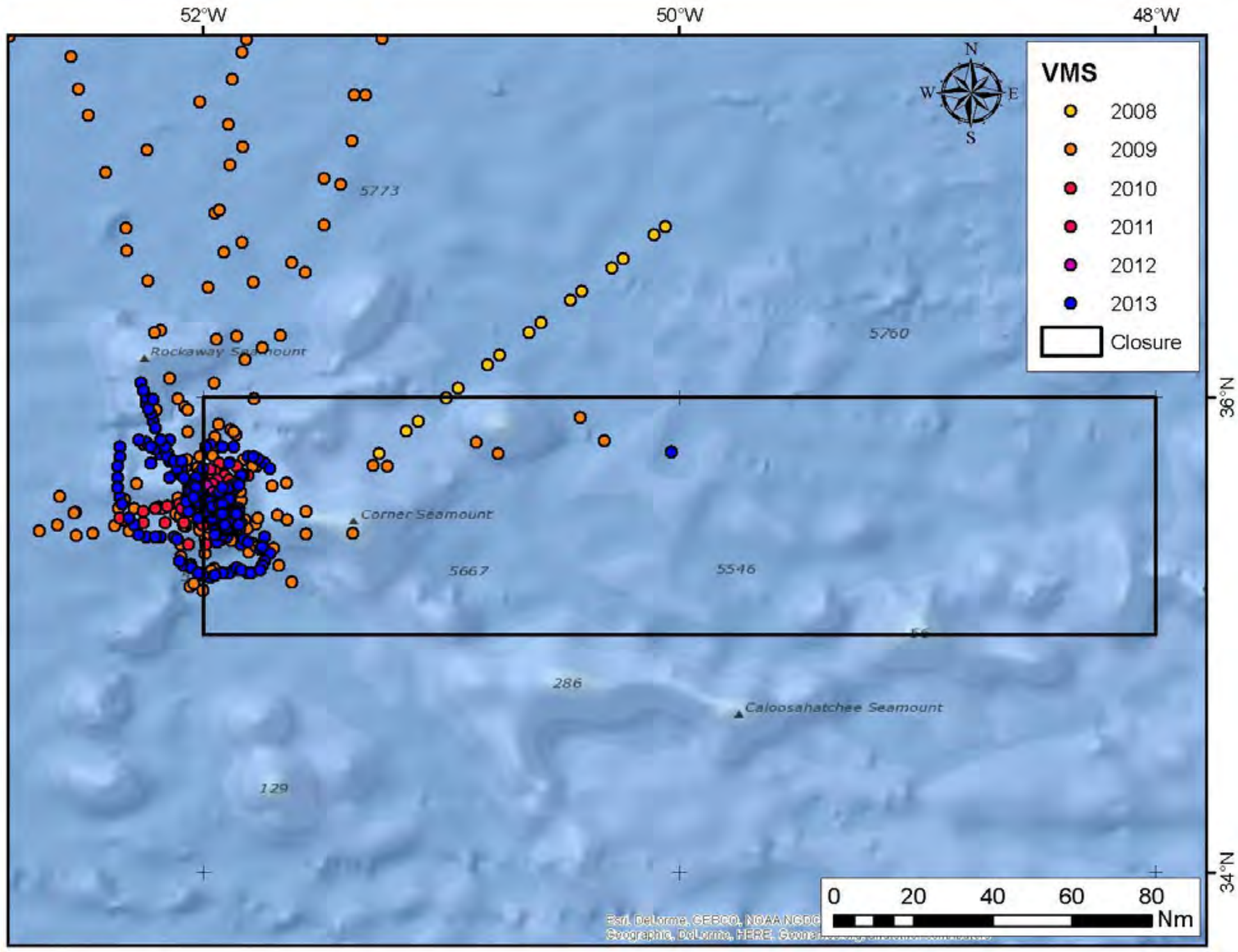
As noted in response to 3.a, the council considers that it would be prudent to keep Div. 3O as a separate management unit due to the differences observed in redfish population dynamics between the two zones and the uncertainty about the stock as a single biological unit. Given these uncertainties there would be a risk in combining the TACs from Div. 3O and Divisions 3LN. Concentrating fishing effort in Div. 3LN, with a combined TAC for Div. 3LNO, would lead to an exploitation level well above what is considered the MSY level for redfish in Div. 3LN.

**Seamount Fisheries**

*4) The SC is requested to present records of the spatial distribution of past seamount fisheries in the NRA, including seamount fisheries with mid-water trawls, or, if appropriate, confirm that the presentation in SCS Doc. 13/20 (V.1.c)) provides a comprehensive record.*

Existing bottom fishing area were defined as areas where VMS data and/or other available geo-reference data indicating bottom fishing activities have been conducted at least in two years within a reference period of 1987 to 2007 (SCS Doc. 09-21). At the time footprint was developed there was an assumption that the seamounts were closed to bottom-trawling. The putative footprint polygons on the seamounts were therefore not included in the final footprint definition. As the exploratory protocol and management measures for seamounts evolved the perception that the seamounts were closed persisted but was not reflected in the NCEM.

Scientific Council has no reason to believe the data presented in SCS Doc. 13/20 is not comprehensive. In addition, the distribution of VMS data from 2008 – 2013 is presented below. Data from 2010 – 2013 is filtered to data at fishing speeds (0.5 – 5.0 knots).




*5). The SC is requested to define the use of the term "historical" in the advice statement concerning seamount fisheries.*

In this context, "historical" refers to the 20-year period used in the definition of the fishing footprint, although Scientific Council notes that the fishery for Alfonsinos on Corner Rise Seamount began earlier than this, in 1976 (Vinnichenko, 1997).

Vinnichenko, V.I., 1997. Russian investigations and deep water fishery on the Corner Rising Seamount in Subarea 6. *NAFO Scientific Council Studies,* **30,** 41–49.

**Significant Adverse Impacts**

*6) In 2006, UNGA adopted Resolution 61/105 calling for an assessment of the risk of significant adverse impacts (SAI) of fishing activities on Vulnerable Marine Ecosystem (VME). Then FAO was invited to develop guidance to support the implementation of the Resolution and adopted international Guidelines for the Management of Deep Sea Fisheries in the High Seas in 2008 taking into account the balance between the protection of VMEs and the rational utilization of fisheries resources.*

*The guidelines were adopted by NAFO as measures to avoid SAI on VMEs when fishing vessels encounter VME indicator species. Article 15.10 of NCEM states that "the term "encounter" means catch of a VME indicator species above threshold levels as set out in Article 22.3." It also states that "Any encounter with a VME indicator species or merely detecting its presence is not sufficient to identify a VME."*

*Scientific Council (2014) reported that there are high concentrations of VME indicator species in the areas proposed for the establishment of closed areas.*

*Are there VME indicator species in the areas in excess of the threshold levels stipulated in Article 22.3? Are there any quantified criteria adopted by Fisheries Commission other than the threshold levels stipulated in Article 22.3?*

Scientific Council responded:

The threshold levels indicated in Article 22.3 relate to amounts of VME indicator species expected to be observed in a typical commercial tow whose track goes over grounds that contain VME-indicator species at densities that correspond to VME habitats.

The thresholds used to delineate these VME habitats are not those of Article 22 of the CEM, but both reflect equivalent VME densities on the bottom.

Differences in threshold values are associated to their intended purposes: 1) a scientific threshold used to determine areas of significant concentrations of VME indicator species (i.e. VME habitat), and 2) the threshold used for the encounter provision during commercial operations mentioned in Article 22.3.

VME thresholds are determined quantitatively using a kernel density analysis. This analysis provides thresholds to identify "hotspots" in the biomass distribution derived from research vessel trawl survey data, by looking at natural breaks in the spatial distribution associated with changes in local density. These natural breaks allow defining of significant area polygons. The methodology was peer-reviewed and published in the primary literature (Kenchington *et al.,* in press). Current scientific thresholds from this method are:

| | |
|---|---|
| Sponges: | 75kg |
| Large gorgonian coral: | 0.6kg |
| Small gorgonian coral: | 0.15kg |
| Sea pens: | 1.4kg |

The by-catch thresholds for the encounter provision for sponges and seapens were calculated with a GIS model which used the VME indicator species data from research surveys and VMS fishing effort data to generate realistic commercial trawl by-catch. The thresholds generated for the purpose of the encounter provision in the NCEM are:

| | |
|---|---|
| Sponges: | 300kg |
| Sea pens: | 7kg |

The current by-catch threshold for coral was calculated by scaling up from a scientific threshold to the duration of a commercial tow (FC Doc. 09/06).

| | |
|---|---|
| Corals: | 60kg |

Kenchington, E., F. J. Murillo, C. Lirette, M. Sacau, M. Koen-Alonso, A. Kenny, N. Ollerhead, V. Wareham and L. Beazley. 2014. Kernel density surface modelling as a means to identify significant concentrations of vulnerable marine ecosystem indicators. *PLOS ONE* (accepted).

**Thorny Skate in Div. 3LNO**

*7) For Div. 3LNO Thorny skate, if you were to apply the same method of calculating the reference points as has been recently adopted for 3NO witch flounder (where the two highest points in the time series of the biomass index is used as a proxy for $B_{msy}$), can you comment on what the likelihood would be that thorny skate biomass index would be below $B_{lim}$.*

Scientific Council responded:

The method applied to define reference points for witch flounder cannot be directly applied to thorny skate. The rationale to use the two highest points in the survey series as a proxy for $B_{msy}$ for witch flounder in Div. 3NO was based upon both the survey biomass index as well as the corresponding trends in fishery landings, including those prior to the initiation of the survey. Given the shorter time-series of landings in Div. 3LNO thorny skate, it is unclear if there is justification to assume that this stock was near $B_{msy}$ in the years when the highest survey values were observed. However, it is anticipated that reference points for thorny skate in Div. 3LNOPs may be developed during June 2015.

## VI. MEETING REPORTS

### 1. Joint Fisheries Commission – Scientific Council – WGEAFFM

This joint working group met during 9 – 11 July 2014, and was chaired by Robert Day (Canada) and Andrew Kenny (EU-United Kingdom) (FC-SC Doc 14/03). The Scientific Council was advised of progress in this group by the Chairs in their presentation of the report to the joint session of Fisheries Commission and Scientific Council.

### 2. Joint Fisheries Commission – Scientific Council – WGRBMS

This joint working group met during 5 – 7 February 2014, and was co-chaired by Carsten Hvingel (Norway) and Kevin Anderson (Canada) (FC-SC Doc 14/02). The Scientific Council was advised of progress in this group by the Chairs in their presentation of the report to the joint session of Fisheries Commission and Scientific Council. Responses to the group are detailed under Other Business.

### 3. Joint Fisheries Commission – Scientific Council – WGCR

This joint working group met during 3 – 4 February 2014, and was chaired by SC Chair Don Stansbury (Canada) (FC-SC Doc. 14/01). The Scientific Council was advised of progress in this group by the Chair in their presentation of the report to the joint session of Fisheries Commission and Scientific Council. Scientific Council commented on the revised terms of reference for this group (FC-SC Doc. 14/04).

### 4. Fisheries Commission – WGBDS

This Fisheries Commission Working Group met at the NAFO Secretariat. 7 – 8 July 2014, and was chaired by FC Chair Sylvie Lapointe (Canada). The Scientific Council was advised of progress in this group by the Chair in her presentation of the report to Fisheries Commission.

## VII. SPECIAL SESSIONS

There were no proposals for future special sessions. Scientific Council received a report on one symposium which NAFO recently co-sponsored.

### 1. ICES IMR Symposium: Effects of fishing on benthic fauna, habitat and ecosystem

NAFO was a co-sponsor of the symposium on the "Effects of fishing on benthic fauna and habitat: Change in ecosystem composition and functioning in response to fishing intensity, gear type and discard", 17 – 19 June 2014 in Tromsø, Norway, funding the attendance of Mariano Koen-Alonso (DFO-Canada), and two keynote speakers, Barry O'Neill (Marine Scotland-Science, UK) and Michael Kaiser (University of Bangor-UK). The Symposium was organized by Institute of Marine Research (IMR-Norway) and attended by more than 100 scientists from 18 countries including Europe, New Zealand, Australia and North America. The objectives of the symposium was to review the physical and biological effects of fishing activities to sea bottom ecosystems, look at various technical conservation measures designed to mitigate these effects and ultimately try to quantify the overall ecosystem impact. The symposium was structured around fisheries impacts on different seabed types and communities with sessions divided into the following themes:

- Soft bottom/infauna (macrobenthos) community composition
- Mixed bottom/epifauna and habitat forming megafauna
- Gear effects and development.

*Highlights of the symposium*

The Symposium covered a wide variety of topics and approaches in 44 oral presentations (including 7 key note papers) and 28 posters. Thirty papers dealt with trawling impacts on the benthic community composition and ecological functioning and 14 papers dealt with technological innovations to mitigate the trawling impact. Four papers used a modelling approach to explore trawling impacts and 2 dealt with indicators for trawling impact. The six key note papers reviewed the session topics: effects on soft bottom communities with main focus on shallow North Sea, effects on mixed bottom communities covering VMEs (e.g. coral and sponge communities) from continental shelf to deep sea mounts, bottom impact from fishing gear and gear development. The gears covered were otter trawls targeting crustaceans and roundfish, dredges targeting scallops, beam trawls targeting flatfish, and long lines.

*Trawling impact*

The majority of papers reported on field studies dealt with changes in benthos that was studied along a trawling intensity gradient. The studies showed that the effect of trawling was context dependent and differed between habitats. Trawling impacts were generally less in areas of high natural disturbance. Although there are difficulties around confidentiality issues and data access for VMS data they were widely used to quantify the trawling gradients. Problems related to the use of VMS data as proxy for pressure were discussed. Depending on depth, gear and bottom type quantification of pressure on the seafloor and benthos from VMS data can be a major challenge. However, results of studies attempting to collate VMS data across large geographic areas and countries were presented and looked promising.

*Recovery*

Relatively few studies dealt with the recovery of the benthic ecosystem, however re-growth in a protected coral reef was presented (poster).

*Ecosystem functioning*

Key note papers emphasized the importance of biodiversity in the functioning and resilience of benthic ecosystems. The number of papers dealing with ecosystem functioning were relatively few, in particular experimental studies in the field. Only one paper studied the effect of bioturbation on the nutrient dynamics and the benthic-pelagic coupling. Two papers used a modelling approach to study the impact of trawling on ecosystem functioning. Most other papers tackled the problem by relating the community composition in terms of functional traits (bioturbation, biodeposition, etc) with the trawling intensity. Two papers addressed the question how trawling may influence the food of benthivorous fishes.

*Tool development for ecosystem based management*

Few papers dealt with the development of tools to be used in fisheries management.

*Gear innovations*

Five papers dealt with gear innovations and studied how these may mitigate the adverse impacts on the benthic ecosystem. Promising results were reported on reducing sea bed contact by using (semi-) pelagic otter boards. Four papers studied the effect of pulse trawls tested in the North Sea flatfish and brown shrimp fisheries, either in field experiments or in laboratory experiments.

Overall, the following observations can be made.

The trait based approach to estimate the effect of trawling on ecosystem functioning is adopted globally with great expectations; however studies on mixed bottoms and large long-lived organisms are few in Europe. There is a need for empirical studies on ecosystem functioning to test the assumptions that are inherent in traits analysis due to lack of ecological information on species level.

VMS data analysis needs further standardization and more detailed quantitative descriptions of the major fishing gears used are required to estimate trawling impact at a comparable scale across regions and across fishing gears.

There is a need to develop tools to be used in integrating the benthic ecosystem in the ecosystem approach to fisheries management. First explorations were presented at the Symposium.

The research questions addressed and the approach taken are relevant and represent the state of the art.

## VIII. REVIEW OF FUTURE MEETING ARRANGEMENTS

### 1. Scientific Council, 29 May – 11 June 2015

Scientific Council agreed that its June meeting will be held on 29 May – 11 June 2015, at St Mary's University, Halifax.

### 2. Scientific Council (in conjunction with NIPAG), 9 – 16 Sep 2015

An invitation to host the meeting was given by Canada to be held in St. John's, NL, Canada. This invitation was accepted by the meeting. The agreed dates are 9 – 16 September, 2015.

### 3. Scientific Council, 21 – 25 September 2015

Scientific Council noted that the Annual meeting will be held 21 – 25 September in Halifax, Nova Scotia, Canada, unless an invitation to host the meeting is extended by a Contracting Party.

### 4. Scientific Council, 3 - 16 June 2016

Scientific Council agreed that its June meeting will be held on 3 – 16 June 2016, at St Mary's University, Halifax.

### 5. NAFO/ICES Joint Groups

#### a) WGDEC, March 2015

The next meeting of the ICES – NAFO Working Group on Deepwater Ecosystems is scheduled to take place at ICES Headquarters, Copenhagen, Denmark, during March 2015.

#### b) NIPAG, 9 – 16 September 2015

This meeting will be held 9 – 16 September 2015, St Johns, NL, Canada.

### 6. NAFO SC Working Groups

#### a) WGESA, 18 - 27 November, 2014

The Working Group on Ecosystem Science and Assessment will meet at the NAFO Secretariat, Dartmouth, Nova Scotia, Canada, 18 - 27 November, 2014.

#### b) WGHARP, 17 – 21 November 2014

The next meeting of the ICES – NAFO Working Group on Harp and Hooded Seals is scheduled to take place in Quebec City, Canada, during 17 – 21 November 2014.

## IX. OTHER MATTERS

### 1. Election of Officers – STACFEN Chair

Scientific Council thanked Estelle Couture (Canada) for her service as chair of STACFEN. Andrew Cogswell (Canada) was elected as her replacement.

### 2. Report of the Joint FC/SC Meeting

Scientific Council and Fisheries Commission held a joint session to review the four working groups and promote good dialogue between NAFO bodies. The Scientific Council Chair raised the issue of Scientific Council workload. Some Scientific Council representatives provided examples to illustrate the problem. The amount of request items and the diversity of the requests were compounded by delayed availability of some scientific data from the flag States and Contracting Parties to the scientists. Scientific Council appealed to Fisheries Commission to be more mindful in the formulation of request for scientific advice and to Contracting Parties to send more scientists and experts to the SC meetings.

### 3. Review of FAO VME Database Content

Scientific Council reviewed the content of the FAO VME database. The group suggested some revisions to content, requested a number of fields be excluded from the public release and referred instead to a WebEx meeting in early February to approve. Scientific Council requested the Secretariat to contact the Project Coordinator in advance of this meeting to clarify a number of points.

**4. WG-RBMS Requests and the PA Framework**

Scientific Council had extensive discussions and these are the points which were agreed and thought to be helpful to the work of the Working Group.

*"Discuss the relevance and implications of having $F_{lim}$ at $F_{msy}$":*

1. $F_{lim}$=$F_{msy}$ is a requirement under the NAFO Convention (GC doc 08/3).
2. MSY can only be obtained if uncertainty in the assessments is negligible, i.e. this implies that in general fishing is carried out at a level below MSY.
3. $F_{lim}$=$F_{msy}$ means that a potential $F_{target}$ should be lower than $F_{msy}$: as the uncertainty in estimation of $F_{msy}$ grows, $F_{target}$ must be further reduced from $F_{msy}$ .
4. By analogy (and since $F_{msy}$ and $B_{msy}$ are linked in equilibrium in such a way that, if $F_{msy}$ cannot be a target, neither can $B_{msy}$), $B_{target}$ should be higher than $B_{msy}$. As the uncertainty in estimation of $B_{msy}$ grows, $B_{target}$ must be further above $B_{msy}$.
5. Inconsistent with current management plans that specifies $B_{msy}$ as a target.
6. Inconsistent for some stocks where NAFO TACs imply $F$ greater than $F_{lim}$.
7. $F_{lim}$ at $F_{msy}$ is a more conservative approach than $F_{msy}$ as a target

*"Discuss the relevance and implications of having $F_{msy}$ as a target":*

1. Not in agreement with the the NAFO Convention (GC Doc. 08/3).
2. Consistent with current management plans that specifies $B_{msy}$ as a target
3. Consistent with advice for some stocks (e.g. Div. 3M cod) that use $F_{msy}$ proxies as targets
4. $F_{msy}$ as a target is a less conservative approach than $F_{lim}$ at $F_{msy}$

*"Consider the utility of buffers (particularly $B_{buf}$) in the framework and in management plans and provide advice on whether the use of buffers is considered appropriate for stocks which have $B_{lim}$":*

1. When uncertainty can be estimated $\underline{B_{buf}}$ is not needed
2. When uncertainty cannot be quantified, the buffer can be a useful qualitative measure of uncertainty with respect to limit reference points, and may be useful to delineate stock status zones.

*Scientific Council further discussed:*

1. Economic optimum $B$ is slightly larger than $B_{msy}$
2. In multispecies scenarios MSY is often lower than that calculated in single species analysis

**5. Multispecies modelling of the Flemish Cap**

Alfonso Pérez Rodríguez presented the GADCAP project, an EU Marie Curie program project which deals with the development of a GADGET (Globally applicable Area Disaggregated General Ecosystem Toolbox) multispecies model for the Flemish Cap cod, redfish and shrimp. This project started in January 2014, with a duration of two years, and will be developed under the supervision of Daniel Howell, from the Institute of Marine Research in Bergen, Norway. The isolation, its relative ecological and biological simplicity, the apparent connection in the dynamic of cod, redfish and shrimp and the availability of data from commercial fleet and research surveys, make the Flemish Cap a suitable system to develop a multispecies model.

The goals of GADCAP are

1) Monospecies models for cod, redfish and shrimp;

2) Connecting these species in a Multispecies model;

3) Management strategy evaluation (depending on the positive evolution of the project).

The most important researchers from different institutions and countries, like Spain (IIM and IEO), Portugal (IPMA) and Canada (DFO), most of them members of the Scientific Council of NAFO, are collaborating in this project, both providing survey and commercial fleet information and their long experience with these databases and the stocks being modeled.

**6. Timetable of assessments**

Noting the increasing workload of Scientific Council, and the upcoming analysis of Significant Adverse Impacts and review of the Greenland halibut harvest control rule, Scientific Council provided feedback to Fisheries Commission on the timetable and frequency of assessments. As a result, a number of stocks were moved from biennial to triennial assessments, or vice-versa.

## 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 26 September 2014 considered and adopted its own report, with the usual caveat that there will be minor corrections.

## XI. ADJOURNMENT

There being no other business, the meeting was adjourned at 1300 hours on 26 September 2014. The Chair thanked the Hosts of this annual meeting and the Secretariat for their usual great support. The Chair also noted that this was long-time Secretariat's member Barbara Marshall's last annual meeting and wished her well in her retirement.

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

Chair: Kathy Sosebee Rapporteur: Barbara Marshall

The Committee met at the Palacio de Congresos Mar de Vigo, Vigo, Spain, during 26 September 2014, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal, Spain and UK), 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 on.

#### b) Review of STATLANT 21

##### *i) Submission of data*

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 2011-2013 up to 19 September 2014.

| Country/Component | STATLANT 21A (deadline, 1 May) | | | STALANT 21B (deadline 31 August) | | |
|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2011 | 2012 | 2013 |
| CAN-CA | 24 Apr 12 | 21 May 13 | 30 Apr 14 | 21 May 12 | 21 May 13 | 30 Apr 14 |
| CAN-M | | | | | | |
| CAN-SF | 14 May 12 | 21 Apr 13 | | | 6 Sep 13 | |
| CAN-G | 29 Apr 12 | 9 May 13 | | | 1 Sep 13 | |
| CAN-N | 30 Mar 12 | 30 Apr 13 | 30 Apr 14 | 6 Sep 12 | 9 Sep 13 | 29 Aug 14 |
| CAN-Q | 19 Jun 12 | | | | | |
| CUB | 4 May 12 | 7 May 13 | | | | |
| E/BUL | | 21 May 13(NF) | | | 21 May 13(NF) | |
| E/EST | 17 May 12 | 2 May 13 (revised 6 Jun 13) | 22 May 14 | 2 Sep 12 | 1 Sep 13 | 29 Aug 14 |
| E/DNK | 18 May 12 | 17 May 13 | 21 Aug 14 | 21 Aug 12 | 9 Sep 13 | 21 Aug 14 |
| E/FRA-M | 21 May 12 | 4 Jun 13 | 22 May 14 | | | |
| E/DEU | 26 Apr 12 | 28 May 13 | 28 Apr 14 | 7 Jul 12 | 1 Sep 13 | 29 Aug 14 |
| E/LVA | 17 May 12 | 22 Apr 13 | | 24 Aug 12 | 6 Sep 13 | |
| E/LTU | 2 May 12 | 27 May 13 | | 31 Aug 12 | 23 Oct 13 | |
| E/POL | 26 Apr 12 (no fishing) | | | 26 Apr 12 (no fishing) | | |
| E/PRT | 8 May 12 (revised 29 May 12) | 23 Apr 13 | 22 May 14 | 14 Nov 12 | 4 Oct 13 | 29 Aug 14 |
| E/ESP | 30 May 12 | 28 May 13 (revised 29 May 13) | 22 May 14 | 3 Sep 12 | 30 Aug 13 | 25 Aug 14 |
| E/GBR | 26 Apr 12 | 8 May 13 | 23 May 14 | | 1 Sep 13 | 20 Aug 14 |
| FRO | 30 Apr 12 | 2 Jun 13 | | 27 Aug 12 | 2 June 13 | 12 Jun 14 |
| GRL | 19 Apr 12 | 30 Apr 13 | 5 May 14 | 6 Sep 12 | 9 Sep 13 | 29 Aug 14 |
| ISL | 31 May 12 | 23 May 13 (NF) | 23 May 14 | 20 Aug 12 | 23 May 13 (NF) | 8 Sep 14 |
| JPN | 25 Apr 12 (no fishing) | 26 Apr 13 (NF) | | 25 Apr 12 (no fishing) | 26 Apr 13 (NF) | |
| KOR | | | | | | |
| NOR | 27 Apr 12 | 30 Apr 13 | 22 May 14 | 2 Sep 12 | 6 Sep 13 | 26 Aug 14 |
| RUS | 29 Apr 12 | 21 May 13 | 12 May 14 | 6 Sep 12 | 24 Oct 13 | 28 Aug 14 |
| USA | 21 May 12 | 21 May 13 | 29 May 14 | | | |
| FRA-SP | 14 May 12 | 21 May 13 | | 24 Aug 12 | 9 Sep 13 | 30 Jul 14 |
| UKR | | | | | | |

**3. Research Activities**

**a) Surveys Planned for 2014 and Early-2015**

Designated Experts were requested to check and update the information contained in SCS Doc. 14/20.

**4. Other Matters**

**a) Review of SCR and SCS Documents**

There were no documents presented.

**b) Other Business**

There was no other business

**5. Adjournment**

The report was reviewed and the meeting was adjourned at 1000 on 26 September 2014.

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

Chair : Brian Healey Rapporteur: Various

The Committee met at the Palacio de Congresos Mar de Vigo, Vigo, Spain, during 22-26 September 2014, to consider the various matters in its Agenda. Representatives attended from Canada, European Union (Estonia, France, Portugal, Spain and UK), 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. Nomination of Designated Experts

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 2015 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 | Danny Ings | Tel: +1 709-772- | danny.ings@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 | Eugene Lee | Tel: +1 709-772- | eugene.lee@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 | Joanne Morgan | Tel: +1 709-772-2261 | joanne.morgan@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 |

## 3. Other Matters

### a) Review of SCR and SCS Documents

No documents were presented.

### b) Other Business

There being no other business the 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 1030 hr on 26 September, 2014.

## PART J: MISCELLANEOUS

## A – FISHERIES COMMISSION AND SCIENTIFIC COUNCIL *AD HOC* WORKING GROUP ON CATCH REPORTING, 3-4 FEBRUAURY 2014 - AGENDA

1. Opening
2. Appointment of Rapporteur
3. Adoption of Agenda
4. Review of Terms of Reference
5. Review and follow-up to the Peer Review Expert Panel 2013 Recommendations
6. Evaluation of potential approaches and data sources (e.g. daily catch data, tow by tow data, log books, etc) to validate STATLANT 21 data and/or provide catch estimates
7. Prioritization of stocks for initial consideration
8. Consideration of term of reference (governance, participation) if it is advised that this ad hoc WG continues
9. Recommendations to forward to the Fisheries Commission and Scientific Council
10. Other Matters
11. Adoption of the Report
12. Adjournment

**B - FISHERIES COMMISSION AND SCIENTIFIC COUNCIL JOINT WORKING GROUP ON RISK-BASED MANAGEMENT STRATEGIES, 5-7 FEBRUARY 2014 - AGENDA**

1. Opening
2. Appointment of Rapporteur
3. Adoption of Agenda
4. Review of Terms of Reference
5. Review and Update of the Precautionary Approach Framework
6. Review and Update of existing interim Conservation Plans and Management Strategies
7. 3NO Cod
8. 3LNO American Plaice
9. Follow-up to WGFMS-CPRS 2013 Recommendations
10. Evaluation and finalization of General Framework on Risk-based Management
11. Discussion on development of alternative strategies for stocks that may not be suited to formulaic rules and/or for stocks where reference points do not exist or cannot be developed.
12. Development of CPRS
    a. 3NO witch flounder
    b. 3LN redfish
    c. 3M cod
    d. 3L shrimp
13. Approach and workplan to review the Greenland Halibut Management Strategy Evaluation in 2017
14. Recommendations to forward to FC and SC
15. Other Matters
16. Adoption of the Report
17. Adjournment

## C - THE *AD HOC* SCIENTIFIC COUNCIL WORKING GROUP ON CATCHES OF COD IN DIVISON 3M – AGENDA

An *ad hoc* subgroup of Scientific Council met via WebEx on 5 May 2014 to discuss progress to date and determine a plan of action on the issue of estimating catches for use in the Div. 3M cod assessment.

## D - SCIENTIFIC COUNCIL *AD HOC* WORKING GROUP ON MANAGEMENT STRATEGIES FOR REDFISH IN DIV. 3LN, 13 MAY 2014

1. Opening
2. Appointment of rapporteur
3. Adoption of agenda
4. Review of recommendations
5. Review of operational models
6. Discussion on alternate HCR
7. Review of performance statistics
8. Discussion of exceptional circumstances
9. Discussion of review process (*i.e.* biennial assessment of the stock)
10. Other Matters
11. Adoption of Report
12. Adjournment

## E – SCIENTIFIC COUNCIL MEETING, 31 MAY - 12 JUNE 2014 – AGENDA

I. Opening (Scientific Council Chair: Don Stansbury)
   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
      a. General Discussion
      b. Stock Assessment Review and Assignment of Reviewers
      c. Procedures for interim monitoring reports
   7. Housekeeping issues

II. Review of Scientific Council Recommendations in 2013

III. Fisheries Environment (STACFEN Chair: Estelle Couture)
   1. Opening
   2. Appointment of Rapporteur
   3. Adoption of Agenda
   4. Review of Recommendations in 2013
   5. Invited speaker
   6. Integrated Science Data Management (ISDM) Report for 2013
   7. Review of the physical, biological and chemical environment in the NAFO Convention Area during 2013
   8. Interdisciplinary studies
   9. Update of the on-line Annual Ocean Climate and Environmental Status Summary for the NAFO Convention Area
   10. Formulation of recommendations based on environmental conditions during 2013
   10. 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 2013
   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) Access to documents on the NAFO website
      b) ICES/NAFO Gadoid Symposium
      c) Future of JNAFS
   7. Adjournment

V. Research Coordination (STACREC Chair: Kathy Sosebee)

1. Opening
2. Appointment of Rapporteur
3. Review of Recommendations in 2013
4. Fishery Statistics
   a) Progress report on Secretariat activities in 2013/2014
      i) STATLANT 21A and 21B
5. Research Activities
   a) Biological sampling
      i) Report on activities in 2013/2014
      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 2013 (by National Representatives and Designated Experts)
      ii) Surveys planned for 2014 and early 2015
   c) Tagging activities
   d) Other research activities
6. Review of SCR and SCS Documents
7. Other Matters
   a) Summary of progress on previous recommendations
   b) Stock Assessment Spreadsheets
   c) Standardization of Conversion Factors
8. Adjournment

VI. Fisheries Science (STACFIS Chair: Brian Healey)

1. Opening
2. General Review of Catches and Fishing Activity
3. Stock Assessments
   1. Greenland Halibut (*Reinhardtius hippoglossoides*) in SA 0, Div. 1A offshore and Div. 1B-F (fully assessed)
   2. Greenland Halibut (*Reinhardtius hippoglossoides*) Div. 1A inshore (fully assessed)
   3. Roundnose Grenadier (*Coryphaenoides rupestris*) in Subareas 0 and 1 (fully assessed)
   4. Demersal Redfish (*Sebastes* spp.) in SA 1 (fully assessed)
   5a. Wolffish in Subarea 1 (fully assessed)
   5b. American plaice (*Hippoglossoides platessoides*) in Subarea 1 (fully assessed)
   6. Cod (*Gadus morhua*) in Div. 3M (fully assessed)
   7. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3M (monitor)
   8. American Plaice (*Hippoglossoides platessoides*) in Div. 3M (fully assessed)
   9. Cod (*Gadus morhua*) in NAFO Div. 3NO (monitor)
   10. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Divisions 3L and 3N (fully assessed)
   11. American Plaice (*Hippoglossoides platessoides*) in Div. 3LNO (fully assessed)
   12. Yellowtail flounder (*Limanda ferruginea*) in Div. 3LNO (monitor)
   13. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO (fully assessed)
   14. Capelin (*Mallotus villosus*) in Div. 3NO (monitor)
   15. Redfish (*Sebastes mentella* and *Sebastes fasciatus*) in Div. 3O (monitor)
   16. Thorny skate (*Amblyraja radiata*) in Div. 3LNO and Subdiv. 3Ps (fully assessed)
   17. White Hake (*Urophycis tenuis*) in Div. 3NO and Subdiv. 3Ps (monitor)
   18. Roughhead Grenadier (*Macrourus berglax*) in Subareas 2 and 3 (monitor)
   19. Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 2J+3KL (monitor)

20. Greenland Halibut (*Reinhardtius hippoglossoides*) in SA 2 + Div. 3KLMNO (management strategy)
21. Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4 (monitor)

4. Stocks under a Management Strategy Evaluation (FC Item 3a)
   a) Greenland halibut in SA 2 and Div. 3KLMNO 5
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))
   For 2015
   - Witch flounder in Div. 3NO
   For 2015 and 2016
   - Redfish in Div. 3LN
   - American plaice in Div. 3LNO
   - Thorny skate in Div. 3LNO
   For 2015, 2016 and 2017
   - American plaice in Div. 3M

   b) Monitoring of Stocks for which Multi-year Advice was provided in 2012 or 2013 (Item 2)
   - Redfish in Div. 3M
   - Cod in Div. 3NO
   - Yellowtail flounder in Div. 3LNO
   - Capelin in Div. 3NO
   - Redfish in Div. 3O
   - White hake in Div. 3NO
   - Witch flounder in Div. 2J + 3KL
   - Squid (Illex) in SA 3+4

   c) Special Requests for Management Advice
      i) Greenland halibut TAC (Item 3A) and exceptional circumstances in Greenland halibut MSE (Item 3b)
      ii) Reference points for cod in Div. 3M (Item 5)
      iii) Reference points for witch flounder in Div. 3NO (Item 6)
      iv) Full assessment of cod in Div. 3M and advice for 2015 (Item 7)
      v) Development of MSE workplan for cod in Div. 3M (Item 8)
      vi) Selectivity in Div. 3M cod and redfish fisheries (Item 9)
      vii) Availability of data and progress towards quantitative assessments (Item 10)
      viii) Development of MSE for redfish in Div. 3LN (Item 11)
      ix) Risk assessment for SAI on VME elements and species (Item 12)
      x) Summary of data available for identification of VMEs (Item 13a)
      xi) Extent of current closures and areas for prioritization by WGEAFFM (Item 13b)
      xii) Impacts of removing candidate VME closures from survey design (Item 14)
      xiii) Occurrence of sea pens around areas 13 and 14 (Item 15)
      xiv) Standardization of conversion factors (Item 16)

2. Coastal States
   a) Request by Denmark (Greenland) for Advice on Management in 2014 (Annex 2)
      i) Roundnose grenadier in SA 0+1 (Item 1)
      ii) Golden redfish, Atlantic wolfish, Spotted wolfish and American plaice in SA 1 (Item 2)
      iii) Greenland halibut in inshore areas of Div. 1A (Item 4)
      iv) *Pandalus borealis* east of Greenland and in the Denmark Strait (in conjunction with ICES). (Item 6)
   b) Request by Denmark (Greenland) and Canada for Advice on Management in 2014
      i) Greenland halibut in Div. 0A and the offshore area of Div. 1A, plus Div. 1B (Annex 2, Item 3.1; Annex 3, Item 1)
      ii) Greenland halibut in Div. 0B + Div. 1C-1F (Annex 2, Item 3.2, Annex 3, Item 1)
      iii) *Pandalus borealis* in SA 0 + 1 (Annex 2, Item 5; Annex 3, Item 2)
   c) Request by Canada for Advice on Management in 2014
      i) Harvest strategies for North Atlantic harp seal

VIII. Review of Future Meetings Arrangements
1. Scientific Council (in conjunction with NIPAG), 10 – 17 Sep 2014
2. Scientific Council, 22 – 26 Sep 2014
3. Scientific Council, Jun 2015
4. Scientific Council (in conjunction with NIPAG), Sep 2015
5. Scientific Council, Sep 2015
6. NAFO/ICES Joint Groups
   a) NIPAG, 10 – 17 Sep 2014
   b) NIPAG, 2015
7. WGEAFM
8. WGDEC
9. WGRP
10. WGHARP

IX. Arrangements for Special Sessions
1. Future Special Sessions
   a) ICES IMR NAFO Bottom Trawl Symposium, Tromso, Norway, 16 – 19 June 2014
   b) Suggestions for symposia

X. Meeting Reports
1. Working Group on Ecosystem Science and Assessment (WGESA), Nov 2013
2. Report from ICES-NAFO Working Group on Deepwater Ecosystems (WGDEC), Mar 2014
3. Report from Joint FC-SC Working Group on Risk Based Management Strategies (WG-RBMS), Feb 2014
4. Report from ad hoc Joint Working Group on Catch Reporting (WG-CR), Feb 2014
5. Meetings attended by the Secretariat:
   a) Eurostat Fisheries Statistics Working Group
   b) EU Data Collection Framework Revision Stakeholders Workshop
   c) FAO VME Database Workshop
6. ICES/NAFO Symposium on "Gadoid Fisheries: The Ecology and Management of Rebuilding"
7. World Conference on Stock Assessment Methods
8. Ad Hoc SC Working Group on Div. 3M Cod Catches
9. SC Working Group on Development of a Management Strategy for Div. 3LN Redfish

XI. Review of Scientific Council Working Procedures/Protocol
   1. General Plan of Work for September 2014 Annual Meeting
   2. Other Matters
      i) Colour coding of summary sheet indicators
      ii) Other business

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
      i) North-west Atlantic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas (EBSAs)
      ii) Progress on Performance Assessment Recommendations
      iii) Protocol for development of management strategy evaluations

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

**F - FISHERIES COMMISSION AND SCIENTIFIC COUNCIL WORKING GROUP ON THE ECOSYSTEM APPROACH FRAMEWORK TO FISHERIES MANAGEMENT, 9-11 JULY 2014 - AGENDA**

1. Opening
2. Appointment of Rapporteur
3. Adoption of Agenda
4. Review of Terms of Reference
5. Engagement with Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB): Update and possible next steps
6. Consideration of Scientific Advice
    a. Review of Vulnerable Marine Ecosystems (VMEs) and fishery closures
        i. Summary of data available for identification of VMEs (Request 13a)
        ii. Occurrence of sea pens around Areas 13 and 14 (Request 15)
        iii. Extent of current closures and areas for prioritization (Request 13b) – Management responses to the available information
        iv. Consideration of removing candidate VME closures from survey design (Request 14)
    b. Significant Adverse Impact (SAI) on VME elements
        i. Risk assessment for SAI on VME elements and species (Request 12)
        ii. Workplan towards the assessment of NAFO bottom fisheries by 2016
7. Review of the provisions of Chapter II – Bottom Fisheries in the NAFO Regulatory Area --- of the NAFO Conservation and Enforcement Measures (NCEM) for the implementation of Article 24; and recommendations to the Fisheries Commission
8. Input and guidance on the development and application of Ecosystems Approach to Fisheries (EAF) Roadmap
    a. Overview of the EAF Roadmap: purpose and goals
    b. Operational expectations
    c. Consideration of workplan and prioritization
9. Recommendations to forward to Fisheries Commission and Scientific Council
10. Other Matters
    a. Corner Rise Seamount Splendid Alfonsino fisheries
    b. Convention on Biological Diversity
    c. Dr Enrique Cardenas Retirement
11. Adoption of Report
12. Adjournment

## G - SCIENTIFIC COUNCIL MEETING, 10-17 SEPTEMBER 2014 - AGENDA

I. Opening (Chair: Don Stansbury)

1. Appointment of Rapporteur
2. Adoption of Agenda1
3. Attendance of Observers
4. Plan of Work

II. Review of Recommendations in 2013

III. NAFO/ICES Pandalus Assessment Group (Co-chairs Brian Healey and Michael Kingsley)

IV. Formulation of Advice (see Annexes 1–3 of Appendix I)

1. Request from Fisheries Commission (Items 1 and 4 of Annex 1)
   a) Northern shrimp (Div. 3M)
   b) Northern shrimp (Div. 3LNO)
2. Requests from Coastal States (Items 5 and 6 of Annex 2, Item 2 of Annex 3)
   a) Northern shrimp (Subareas 0 and 1)
   b) Northern shrimp (in Denmark Strait and off East Greenland)
   c) Harvest Control Rules (Item 7 of Annex 2)

V. Other Matters

1. Scheduling of Future Meetings
2. Topics for Future Special Sessions
3. Other Business

VI. Adoption of Scientific Council and NIPAG Reports

VII. Adjournment

## H - NAFO/ICES *PANDALUS* ASSESSMENT GROUP (NIPAG) MEETING, 10–17 SEPTEMBER 2014 - AGENDA

I. Opening (Co-chairs: Brian Healey and Michael Kingsley)

1. Appointment of Rapporteur
2. Adoption of Agenda1
3. Plan of Work

II. General Review

1. Review of Recommendations in 2013
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

- FIRMS Classification for NAFO Shrimp Stocks

V. Adjournment

## I - SCIENTIFIC COUNCIL MEETING, 22-26 SEPTEMBER 2014 – AGENDA

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 2014 and early 2015
4. Other Matters
   a) Review of SCR and SCS Documents
   b) Other Business

IV. Fisheries Science

1. Opening
2. Nomination of Designated Experts
3. Other Matters
   a) Review of SCR and SCS Documents
   b) Other Business

V. Requests from the Fisheries Commission

1. Requests deferred from the June Meeting
   a) Availability of data and progress towards quantitative assessments (FC Request 10)
2. Ad hoc Requests from Current Meeting

VI. Meeting Reports

1. Joint Fisheries Commission – Scientific Council WG-EAFFM
2. ICES IMR Symposium: Effects of fishing on benthic fauna, habitat and ecosystem function.

VII. Review of Future Meeting Arrangements

VIII. Future Special Sessions

IX. Other Matters

1. Election of officers – STACFEN chair
2. Report of the Joint FC/SC Meeting

X. Adoption of Reports

1. Committee Reports of STACFIS and STACREC
2. Report of Scientific Council

XI. Adjournment

## ANNEX 1. FISHERIES COMMISSION'S REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2015 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 2014 Annual Meeting, for the management of Northern shrimp in Div. 3M and in Div. 3LNO in 2015. The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation) in accordance to Annex A or B as appropriate.

2. Fisheries Commission requests that the Scientific Council provide advice for the management of the fish stocks below according to the assessment frequency presented below. The advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation).

| 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. 3LNO | Witch flounder in Div. 3NO |
| White hake in Div. 3NO | |
| 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 2014, advice should be provided for 2015 only for Witch Flounder in Div. 3NO, for 2015 and 2016 for American plaice in Div. 3LNO, Redfish in Div. 3LN, Thorny skates in Div. 3LNO and for 2015, 2016 and 2017 for American plaice in Div. 3M.

Advice should be provided using the guidance provided in **Annexes A or B as appropriate**, or using the predetermined Harvest Control Rules in the cases where they exist.

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. The Fisheries Commission adopted in 2010 an MSE approach for Greenland halibut stock in Subarea 2 + Division 3KLMNO (FC Doc. 10/12). This approach considers a survey based harvest control rule (HCR) to set a TAC for this stock on an annual basis. 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 Document 10/12.

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

4. The scientific advice for Div. 3LNO shrimp is based on the assessment of fishable biomass and the trends of exploitation rates. Interactions between stocks are likely to occur and may substantially contribute to the total mortality of shrimp.

   The Fisheries Commission requests the Scientific Council to incorporate as much as possible information on stock interaction between these stocks in the management advice of Div. 3LNO shrimp and to provide sustainable exploitation rates on that basis.

5. The Fisheries Commission requests the Scientific Council to continue the work on reference points and provide $B_{msy}$ and $F_{msy}$ for cod in Div. 3M.

6. The Fisheries Commission requests the Scientific Council to provide reference points for Div. 3NO witch flounder including $B_{lim}$, $B_{msy}$ and $F_{msy}$ through modelling or proxies.

7. The Fisheries Commission requests the Scientific Council to conduct a full assessment of Div. 3M cod and provide advice for 2015 on a range of management options and associated risks regarding reference points, according to Annexes A or B.

8. The Fisheries Commission requests the Scientific Council to develop a work plan to perform a Management Strategy Evaluation for Div. 3M cod, to explore operating models that could be used and report back through the Working Group on Risk-Based Management Strategies.

9. The Fisheries Commission requests the Scientific Council to analyze and provide advice on management measures that could improve selectivity in the Div. 3M cod and Div. 3M redfish fishery in the Flemish Cap in order to reduce possible by catches and discards. The objective is to reduce the mixed fisheries between cod and redfish, the by-catch of non-targeted stocks and to analyze if the selectivity pattern could be improved to reduce the catch of undersized fish.

10. The Scientific Council provides advice for a number of stocks based only on qualitative assessments of survey trends and catches (e.g. Div. 3NO white hake, Div. 3O redfish). For some of these stocks the advice is to lower the TAC to recent level of catches. On the other hand, there is an important effort in biological sampling, collection of fishing activity data and fishery independent surveys. There is also an important progress in providing more data to the Scientific Council such as VMS. In spite of these efforts, no progress has been reached regarding quantitative assessments of many stocks. The Fisheries Commission requests the Scientific Council to provide an overview for all stocks on what biological and fishery information is currently available by Contracting Party and what is necessary to improve in terms of data collection in order to develop quantitative assessments and biological reference points for stocks managed by NAFO.

11. The Fisheries Commission requests the Scientific Council to explore models that could be used to conduct a Management Strategy Evaluation for Div. 3LN redfish and report back through the Working Group on Risk-Based Management Strategies during their next meeting.

12. The Fisheries Commission requests the Scientific Council to continue to develop work on Significant Adverse Impacts in support of the reassessment of NAFO bottom fishing activities required in 2016, specifically an assessment of the risk associated with bottom fishing activities on known and predicted VME species and elements in the NRA.

13. Considering that the current closures for VME indicators (i.e. species and elements in Annex I.E VI and VII) established under Chapter II of the NAFO Conservation and Enforcement Measures (NCEM) are due for revision in 2014, the Fisheries Commission requests the Scientific Council to:

    a. Summarize and assess all the data available collected through the NEREIDA project, CP RV surveys, and any other suitable source of information, to identify VMEs in the NRA, in accordance to FAO Guidelines and NCEM.

    b. Based on these analyses, evaluate and provide advice in the context of current closures specified in the NCEM for the protection of VMEs and prioritize areas for consideration by the Ecosystem Approach to Fisheries Working Group.

14. Recognizing the work done in NAFO to prevent significant adverse impacts to vulnerable marine ecosystems, and the need for effective stock assessments;

    Further recognizing that modifications to survey designs occur on regular basis in fisheries surveys in many cases,

    Fisheries Commission requests that Scientific Council investigate the impacts of removing the closed areas from the survey design for relevant stock surveys for consideration in the review of closed areas in 2014.

15. The Fisheries Commission Working Group on Vulnerable Marine Ecosystems (WGFMS-VME) considered the scientific advice available at the time of its last meeting held in April 2013. No consensus was reached between Contracting Parties regarding specific management measures that are best suited in protecting areas 13 and 14 as reflected in Figure 2 of the Working Group report (NAFO/FC Doc. 13/3) and defined by the coordinates indicated in page 10 of that report.

    New information from the EU Flemish Cap survey was expected to be available on sea pens later in 2013, which would help to clarify what type of management measures would best suit areas 13 and 14.

The Fisheries Commission requests the Scientific Council to provide the Fisheries Commission with the preliminary results or analysis, regarding occurrence of sea pens in areas towed close to areas 13 and 14 and advise if these reveal significant concentrations of VME indicators.

16. The Fisheries Commission requests the Scientific Council to evaluate and provide recommendations on the methodology for establishing standardized conversion factors outlined in STACTIC WP 13/3.

**ANNEX A: Guidance for providing advice on Stocks Assessed with an Analytical Model**

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:

**1.** For stocks assessed with a production model, the advice should include updated time series of:

- Catch and TAC of recent years
- Catch to relative biomass
- Relative Biomass
- Relative Fishing mortality
- Stock trajectory against reference points
- And any information the Scientific Council deems appropriate.

Stochastic short-term projections (3 years) should be performed with the following constant fishing mortality levels as appropriate:

- For stocks opened to direct fishing: 2/3 $F_{msy}$, 3/4 $F_{msy}$, 85% $F_{msy}$, 75% $F_{2013}$, $F_{2013}$, 125% $F_{2013}$,
- For stocks under a moratorium to direct fishing: $F_{2013}$, $F = 0$.

The first year of the projection should assume a catch equal to the agreed TAC for that year.

Results from stochastic short term projection should include risks of stock population parameters increasing above or falling below available biomass and fishing mortality reference points. The table indicated below should guide the Scientific Council in presenting the short term projections.

Limit reference points

| | | | | P(F>Flim) | | | P(B<Blim) | | | P(F>Fmsy) | | | P(B<BmsyP | | | P(B2016 > B2013) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F in 2014 and following years* | Yield 2014 (50%) | Yield 2015 (50%) | Yield 2016 (50%) | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | |
| 2/3 $F_{msy}$ | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |
| 3/4 $F_{msy}$ | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |
| 85% $F_{msy}$ | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |
| 0.75 X $F_{2013}$ | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |
| $F_{2013}$ | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |
| 1.25 X $F_{2013}$ | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |
| $F$=0 | t | t | t | % | % | % | % | % | % | % | % | % | % | % | % | % |

**2.** For stock assessed with an age-structured model, information should be provided on stock size, spawning stock sizes, recruitment prospects, historical fishing mortality. Graphs and/or tables should be provided for all of the following for the longest time-period possible:

- historical yield and fishing mortality;
- spawning stock biomass and recruitment levels;
- Stock trajectory against reference points

And any information the Scientific Council deems appropriate

Stochastic short-term projections (3 years) should be performed with the following constant fishing mortality levels as appropriate:

- For stocks opened to direct fishing: $F_{0.1}$, $F_{max}$, 2/3 $F_{max}$, 3/4 $F_{max}$, 85% $F_{max}$, 75% $F_{2013}$, $F_{2013}$, 125% $F_{2013}$,
- For stocks under a moratorium to direct fishing: $F_{2013}$, $F = 0$.

The first year of the projection should assume a catch equal to the agreed TAC for that year.

Results from stochastic short term projection should include:

- The 10%, 50% and 90% percentiles of the yield, total biomass, spawning stock biomass and exploitable biomass for each year of the projections
- The risks of stock population parameters increasing above or falling below available biomass and fishing mortality reference points. The table indicated below should guide the Scientific Council in presenting the short term projections.

| | | | | Limit reference points | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $P(F > F_{lim})$ | | | $P(B<B_{lim})$ | | | | $P(F>F_{0.1})$ | | | $P(F>F_{max})$ | | | | $P(B_{2016} > B_{2013})$ |
| $F$ in 2014 and following years* | Yield 2014 | Yield 2015 | Yield 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | | |
| $F_{0.1}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| $F_{max}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| 66% $F_{max}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| 75% $F_{max}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| 85% $F_{max}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| 0.75 X $F_{2013}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| $F_{2013}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |
| 1.25 X $F_{2013}$ | t | t | t | % | % | % | % | % | % | | % | % | % | % | % | % | | % |

**ANNEX B Guidance for providing advice on Stocks Assessed without a Population Model**

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.

The following graphs should be presented, for one or several surveys, for the longest time-period possible:

a) time trends of survey abundance estimates
b) an age or size range chosen to represent the spawning population
c) an age or size-range chosen to represent the exploited population
d) recruitment proxy or index for an age or size-range chosen to represent the recruiting population.
e) fishing mortality proxy, such as the ratio of reported commercial catches to a measure of the exploited population.
f) Stock trajectory against reference points

And any information the Scientific Council deems appropriate

## ANNEX 2. DENMARK (ON BEHALF OF GREENLAND) REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2015 OF CERTAIN STOCKS IN SUBAREAS 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 provide advice on the scientific basis for the management of Roundnose grenadier in Subarea 0 + 1 for 2015-2017.

2. Advice for golden red fish *(Sebastes marinus),* demersal deep-sea redfish *(Sebastes mentella)* American plaice *(Hippoglossoides platessoides),* Atlantic wolffish *(Anarhichas lupus)* and spotted wolffish *(A. minor)* in Subarea 1 was in 2011 given for 2012-2014. Denmark (on behalf of Greenland) requests the Scientific Council to provide advice for redfish *(Sebastes marinus),* American plaice *(Hippoglossoides platessoides),* Atlantic wolffish *(Anarhichas lupus)* and spotted wolffish *(A. minor)* on the scientific basis for the management of in Subarea 1A for 2015-2017.

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 2015 separately for Greenland halibut in 1) the offshore area of NAFO Division 0A and Division 1A plus Division 1B and, 2) NAFO Division 0B plus Divisions 1C-1F. The Scientific Council is also asked to advice on any other management measures it deems appropriate to ensure the sustainability of these resources.

4. Advice for Greenland halibut in Division 1A inshore was in 2012 given for 2013-2014. Denmark (on behalf of Greenland) requests the Scientific Council for advice for Greenland halibut in Division 1A inshore for 2015-2016.

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 2014 to provide advice on the scientific basis for management of Northern shrimp *(Pandalus borealis)* in Subarea 0 and 1 in 2015 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 2015 and for as many years ahead as data allows for.

## ANNEX 3. REQUESTS FOR ADVICE FROM CANADA

1. Greenland halibut (Subareas 0 and 1)

The Scientific Council is requested, 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 to specifically advise on TAC levels for 2015, separately, for Greenland halibut in Divisions 0A+1A (offshore) and 1B, and Divisions 0B+1C-F.[2] The Scientific Council is also asked to provide advice on any other management measures it deems appropriate to ensure the sustainability of these resources.

a) It is noted that at this time only general biological advice and/or catch data are available, few standard criteria exist on which to base advice. The stock status should be evaluated in the context of management requirements for long-term sustainability and the advice provided should be consistent with the precautionary approach and include likely risk considerations and implications as much as possible, including risks of maintaining current TAC levels and any risks and available details of observations that would support an increase or decrease in the TACs.

b) Recognizing that this is a data poor fishery, and that no model exists at this time to provide risk-based advice to inform management options, the Scientific Council is also asked to identify what would be required in order to provide risk based advice in the future.

The following graphs should be presented, for one or several surveys, for the longest time-period possible:

- historical catches;
- abundance and biomass indices;
- 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;
- stock trajectory against reference points

Any other information the Scientific Council feels is relevant should also be provided.

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 2015 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;

[2] The Scientific Council has noted previously that there is no biological basis for conducting separate assessments for Greenland halibut throughout Subareas 0-3, but has advised that separate TACs be maintained for different areas of the distribution of Greenland halibut.

- 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 2014 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.

3. Seals

Canada requests the Scientific Council to explore the impact of proposed harvest strategies that would maintain the North Atlantic harp seal population at a precautionary level of a PA framework, using the Canadian levels as a case study, and that would have a low risk of decreasing below the critical level.

## LIST OF SCR AND SCS DOCUMENTS – 2014

### SCR Documents

| Doc No. | Serial No | Author | Title |
|---|---|---|---|
| SCR Doc. 14-001 | N6284 | Mads Hvid Ribergaard | Oceanographic Investigations off West Greenland 2013 |
| SCR Doc. 14-002 | N6292 | O.A. Jørgensen | Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2013 |
| SCR Doc. 14-003 | N6293 | Rasmus Nygaard and Ole A. Jørgensen | Biomass and Abundance of Demersal Fish Stocks off West and East Greenland estimated from the Greenland Institute of Natural Resources Shrimp Fish Survey, 1988-2013 |
| SCR Doc. 14-004 | N6294 | Boris Cisewski | Hydrographic conditions off West Greenland in 2013 |
| SCR Doc. 14-005 | N6295 | Diana González-Troncoso and Xabier Paz | Results for Greenland halibut, American plaice and Atlantic cod of the Spanish survey in NAFO Div. 3NO for the period 1997-2013 |
| SCR Doc. 14-006 | N6296 | Diana González-Troncoso 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. 14-007 | N6297 | Diana González-Troncoso 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. 14-008 | N6298 | Zeliang Wang and Blair J.W. Greenan | Physical oceanographic conditions on Newfoundland Shelf / Flemish Cap – from a model perspective (1990-2012) |
| SCR Doc. 14-009 | N6299 | Adriana Nogueira, Xabier Paz and Diana González-Troncoso | Persistence and Variation on the Groundfish Assemblages on Flemish Cap (NAFO Divisions 3M): 2004-2013 |
| SCR Doc. 14-010 | N6300 | E. Colbourne, J. Holden, J. Craig, D. Senciall, W. Bailey, P. Stead and C. Fitzpatrick | Physical Oceanographic Environment on the Newfoundland and Labrador Shelf in NAFO Subareas 2 and 3 during 2013 |
| SCR Doc. 14-011 | N6302 | I. Yashayaev, E.J.H. Head, K. Azetsu-Scott, M. Ringuette, Z. Wang and S. Punshon | Environmental Conditions in the Labrador Sea during 2013 |
| SCR Doc. 14-012 | N6303 | Esther Román, Concepción González-Iglesias and Diana González-Troncoso | Results for the Spanish Survey in the NAFO Regulatory Area of Division 3L for the period 2003-2013 |
| SCR Doc. 14-013 | N6304 | D. Hebert and R. G. Pettipas | Physical Oceanographic Conditions on the Scotian Shelf and in the eastern Gulf of Maine<br>(NAFO areas 4V,W,X) during 2013 |
| SCR Doc. 14-014 | N6306 | G. Maillet, B. Casault, P. Pepin, C. Johnson, S. Plourde, M. Starr, C. Caverhill, H. Maass, J. Spry, S. Fraser, C. Porter, G. Redmond, T. Shears | Ocean Productivity Trends in the Northwest Atlantic During 2013 |
| SCR Doc. 14-015 | N6309 | Bruce Bradshaw, Luc Bujold, Graham Glenn, Mathieu Ouellet, Krista Sun, Anh Tran<br>Krista Sun, Anh Tran | Oceanography and Scientific Data NAFO Report 2013 |
| SCR Doc. 14-016 | N6310 | Esther Román, Ángeles Armesto and Diana González-Troncoso | Results for the Atlantic cod, roughhead grenadier, redfish, thorny skate and black dogfish of the Spanish Survey in the NAFO Div. 3L for the period 2003-2013 |

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|---|---|---|---|
| SCR Doc. 14-017 | N6311 | Mónica Mandado | Results from Bottom Trawl Survey on Flemish Cap of July 2013 |
| SCR Doc. 14-018 | N6312 | Diana González-Troncoso and Fernando González-Costas | 3M cod assessment for different assumptions over M |
| SCR Doc. 14-019 | N6313 | Fernando González-Costas and Diana González–Troncoso | Biological Reference Points of 3M cod |
| SCR Doc. 14-020 | N6314 | M. A. Treble | Report on Greenland halibut caught during the 2013 trawl survey in NAFO Division 0B |
| SCR Doc. 14-021 | N6316 | Anna Chrysafi and Ole A. Jørgensen | MSY from catch and resilience |
| SCR Doc. 14-022 | N6317 | A. M. Ávila de Melo, Nuno Brites, R. Alpoim, and Diana González Troncoso | An ASPIC Based Assessment of Redfish (S. mentella and S. fasciatus) in NAFO Divisions 3LN (assuming that the highest apparently sustained historical average level of catch is a sound proxy to MSY) |
| SCR Doc. 14-023 | N6318 | M.R. Simpson, C.M. Miri, and R. Collins | Assessment of Thorny Skate (Amblyraja radiata Donovan, 1808) in NAFO Divisions 3LNO and Subdivision 3Ps |
| SCR Doc. 14-024 | N6319 | Robert Johnston and Katherine Sosebee | History of the United States Bottom Trawl Surveys, NAFO Subareas 4-7 |
| SCR Doc. 14-025 | N6320 | Rasmus Nygaard | Assessment of Demersal Redfish in NAFO Subarea 1 |
| SCR Doc. 14-026 | N6321 | Garry Stenson | The Status of Harp and Hooded Seals in the North Atlantic |
| SCR Doc. 14-027 | N6322 | 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 Doc. 14-028 | N6324 | 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 1982-2013 |
| SCR Doc. 14-029 | N6325 | E. Lee, P. Regular, B. Brodie, R.M. Rideout, K. Dwyer, D. Ings, J, Morgan | An assessment of the witch flounder resource in NAFO Divisions 3NO |
| SCR Doc. 14-030 | N6326 | Carsten Hvingel and Michael C.S. Kingsley | Limit reference Flim at Fmsy – a Flimsy point?<br>On some possible revisions of the NAFO Precautionary Approach framework |
| SCR Doc. 14-031 | N6327 | K.S. Dwyer, M.J. Morgan, W.B. Brodie, R. Rideout, D. Maddock Parsons, B.P. Healey and D. Ings | Survey indices and STATLANT 21A bycatch information for American plaice in NAFO Div. 3LNO |
| SCR Doc. 14-032 | N6328 | Rasmus Nygaard | Assessment of Other Finfish in NAFO Subarea 1 |
| SCR Doc. 14-033 | N6329 | V. Khlivnoy and P. Zavoloka | Russian Research on Greenland Halibut (*Reinhardtius hippoglossoides*) in the West Greenland Area in 2001-2013 |
| SCR Doc. 14-034 | N6330 | K.S. Dwyer, M.J. Morgan, W.B. Brodie, R. Rideout, D. Maddock Parsons, B.P. Healey and D. Ings | VPA for American plaice in Div. 3LNO |
| SCR Doc. 14-035 | N6331 | Diana González-Troncoso, Fernando González-Costas, Brian Healey, Joanne Morgan and Carsten Hvingel | Assessment of the Cod Stock in NAFO Division 3M |
| SCR Doc. 14-036 | N6332 | R. Alpoim, D. González-Troncoso and A. M. Ávila de Melo | An Assessment of American Plaice (Hippoglossoides platessoides) in NAFO Division 3M |

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| SCR Doc. 14-037 | N6333 | Rasmus Nygaard | Assessment of wolffish in NAFO subarea 1 |
| SCR Doc. 14-038 | N6334 | Rasmus Nygaard | Trawl, gillnet and longline survey results from surveys conducted by the Greenland Institute og Natural Resources in NAFO Division 1A Inshore |
| SCR Doc. 14-039 | N6335 | M.J. Morgan, R.M. Rideout, D. Ings, P.M. Regular, B. P. Healey | Greenland halibut (Reinhardtius hippoglossoides) in NAFO Subarea 2 and Divisions 3KLMNO: stock trends based on annual Canadian research vessel survey results. |
| SCR Doc. 14-040 | N6336 | G. Dauphin, J. Morgan, P. Shelton | Operating Models for Management Startegy Evaluation of Div. 3LN Redfish |
| SCR Doc. 14-041 | N6338 | Rasmus Nygaard | Assessment Greenland Halibut Stock Component in NAFO Division 1A Inshore |
| SCR Doc. 14-042 | N6339 | Vinnichenko V.I., Kanishchev A.A., Fomin K.Yu., Gavrilik T.N. and Zavoloka P.A. | Occurence of Deep-water Corals and Sponges Within NAFO Regulatory Area Based on the Data of Observations Onboard Russian Fishing Vessels During 2008-2013 |
| SCR Doc. 14-043 | N6340 | Aldo P. Solari | A Bayesian Approach to the Assessment of West Greenland Halibut: Rationale and Critique. |
| SCR Doc. 14-044 | N6341 | Fernando González-Costas, Diana González-Troncoso, David Miller, Agurtzane Urtizberea, Ane Iriondo and Dorleta García | Developing of a 3M cod MSE |
| SCR Doc. 14-045 | N6342 | Estelle Couture and Rick Rideout | Standardizing the traffic light approach for reporting on Convention Objectives |
| SCR Doc. 14-046 | N6348 | Nanette Hammeken Arboe | Catch Table Update for the West Greenland Shrimp Fishery |
| SCR Doc. 14-047 | N6349 | Casas, J.M., E. Román, J. Teruel, and M. Álvarez | Northern Shrimp (*Pandalus borealis*, Krøyer) from EU-Spain Bottom Trawl Survey 2014 in NAFO Div. 3LNO |
| SCR Doc. 14-048 | N6350 | D.C. Orr and D.J. Sullivan | The 2014 assessment of the Northern Shrimp (*Pandalus borealis*, Kroyer) resource in NAFO Divisions 3LNO |
| SCR Doc. 14-049 | N6351 | J. M. Casas | Northern Shrimp (*Pandalus borealis*) on Flemish Cap Surveys 2014 |
| SCR Doc. 14-050 | N6352 | J. M. Casas | Assessment of the International Fishery for Shrimp (*Pandalus borealis*) in Division 3M (Flemish Cap), 1993-2014 |
| SCR Doc. 14-051 | N6353 | C. Hvingel and T. H. Thangstad | Research survey results pertaining to northern shrimp (*Pandalus borealis*) in the Barents Sea and Svalbard area 2004-2013 |
| SCR Doc. 14-052 | N6354 | AnnDorte Burmeister and Michael C.S. Kingsley | The West Greenland trawl survey for *Pandalus borealis*, 2014, with reference to earlier results |
| SCR Doc. 14-053 | N6355 | Carsten Hvingel and Trude H. Thangstad | The Norwegian fishery for northern shrimp (*Pandalus borealis*) in the Barents Sea and round Svalbard 1970-2014 |
| SCR Doc. 14-054 | N6356 | G. Søvik and T. H. 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 2014 |
| SCR Doc. 14-055 | N6357 | Zakharov D.V. | Results of Russian investigations of the northern shrimp in the Barents Sea in 2004-2014 |
| SCR Doc. 14-056 | N6358 | Carsten Hvingel | An assessment of the North Sea shrimp stock using a Bayesian surplus production model |
| SCR Doc. 14-057 | N6359 | Helle Siegstad | Results of the Greenland Bottom Trawl Survey for Northern shrimp (*Pandalus borealis*) Off East Greenland (ICES Subarea XIV b), 2008-2014 |
| SCR Doc. 14-058 | N6360 | Michael C. S. Kingsley | Numbers of Age-2 Shrimps in West Greenland—again |

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|---|---|---|---|
| SCR Doc. 14-059 | N6361 | Michael C. S. Kingsley | A Provisional Assessment of the Shrimp Stock off West Greenland in 2014 |
| SCR Doc. 14-060 | N6362 | Nanette Hammeken Arboe | The Fishery for Northern Shrimp (*Pandalus borealis*) in Denmark Strait / off East Greenland 1978 - 2014 |
| SCR Doc. 14-061 | N6363 | Nanette Hammeken Arboe | The Fishery for Northern Shrimp (*Pandalus borealis*) off West Greenland, 1970–2014 |
| SCR Doc. 14-062 | N6364 | Michael C. S. Kingsley | Revised treatment of cod survey data in assessing the West Greenland stock of *Pandalus borealis* |
| SCR Doc. 14-063 | N6367 | G. Søvik and T. H. Thangstad | The Norwegian Fishery for Northern Shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east), 1970-2014 |
| SCR Doc. 14-064 | N6368 | Carsten Hvingel | Shrimp (*Pandalus borealis*) in the Barents Sea – Stock assessment 2012 |
| SCR Doc. 14-065 | N6370 | M. Ulmestrand, S. Munch-Petersen, G. Søvik and O. Eigaard | The Northern shrimp (*Pandalus borealis*) Stock in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa East) |
| SCR Doc. 14-066 | N6371 | Martin Jørgensen, Sten Munch-Petersen, Anders Nielsen, Guldborg Søvik, Mats Ulmestrand, Jennifer Devine, Ole Ritzau Eigaard | Introducing time-varying natural mortality in the length-based assessment model for the *Pandalus Borealis* stock in ICES Div. IIIa and IVa east |
| SCR Doc. 14-067 | N6397 | M. C. S. Kingsley | Shrimps and Cod in West Greenland, and How Many of the One are Eaten by the Other |
| SCR Doc. 14-068 | N6407 | Ane Iriondo, Niels Hintzen, Fernando González-Costas, David Miller, Diana González-Troncoso and Agurtzane Urtizberea | Spatial and seasonal fleet activity and cod distribution in Flemish Cap |
| SCR Doc. 14-069 | N6412 | P. Pepin *et al.* | Ecoregions (Final) |
| SCR Doc. 14-070 | N6413 | R. Anderson *et al.* | Impacts of Other Activities |

**SCS Documents**

| Doc No. | Serial No | Author | Title |
|---|---|---|---|
| SCS Doc. 14-001 | N6278 | | FC Request for Advice |
| SCS Doc. 14-002 | N6280 | Greenland | Request for Advice 2015 |
| SCS Doc. 14-003 | N6281 | Canada | Request for Advice 2015 |
| SCS Doc. 14-004 | N6285 | | Report of the *ad hoc* Scientific Council Working Group on Catches of Cod in Division 3M. |
| SCS Doc. 14-005 | N6286 | | Report of the Scientific Council - 13 May (3LN Redfish MSE) |
| SCS Doc. 14-006 | N6287 | F. González-Costas, D. González-Troncoso, G. Ramilo, E. Román, M. Casas, M. Mandado, M. Sacau, J. L. del Rio and. J. Lorenzo | Spanish Research Report for 2013 |
| SCS Doc. 14-007 | N6288 | T. Reilly | Historical ICNAF catch stats |
| SCS Doc. 14-008 | N6289 | | List of Sampling Data 2013 |
| SCS Doc. 14-009 | N6290 | | Tagging 2013 |
| SCS Doc. 14-010 | N6301 | J. Vargas, R. Alpoim, E. Santos and A. M. Ávila de Melo | PORTUGUESE RESEARCH REPORT FOR 2013 |
| SCS Doc. 14-011 | N6305 | K.A. Sosebee | United States Research Report for 2013 |
| SCS Doc. 14-012 | N6307 | Greenland Institute of Natural Resources | Denmark/Greenland Research Report for 2013 |
| SCS Doc. 14-013 | N6308 | K. Fomin and V. Khlivnoy | Russian Research Report for 2013 |
| SCS Doc. 14-014 | N6315 | D. Richards | Canadian Research Report for 2013 Newfoundland and Labrador Region |
| SCS Doc. 14-015 | N6323 | H. O. Fock and A. Akimova | German Research Report for 2013 |
| SCS Doc. 14-016 | N6337 | S. Sirp | Estonian Research Report for 2013 |
| SCS Doc. 14-017 | N6343 | | Report of the SC 30 May-12 June 2014 |
| SCS Doc. 14-018 | N6365 | | Report of NIPAG – 10-17 September 2014 |
| SCS Doc. 14-019 | N6366 | | Report of Scientific Council ( Shrimp) Meeting - 10-17 September 2014 |
| SCS Doc. 14-020 | N6394 | | Report of the Scientific Council September - 22-26 September 2014 |
| SCS Doc. 14-021 | N6395 | | Available Data from the Commercial Fisheries Related to Stock Assessment (2012) and Inventory of Biological Surveys Conducted in the NAFO Area in 2013 and Biological Surveys Planned for 2014 and Early-2015 |
| SCS Doc. 14-022 | N6396 | | Year to Year Surveys by Stock |
| SCS Doc. 14-023 | N6410 | | WG-ESA Report |
| SCS Doc. 14-023 | N6415 | Canada | Standardized Conversion Factors in the NAFO Regulatory Area: Pilot Project |

## LIST OF REPRESENTATIVES, ADVISERS, EXPERTS AND OBSERVERS, 2014

| | |
|---|---|
| A | Fisheries Commission and Scientific Council *ad hoc* Working Group on Catch Reporting, 3-4 February 2014 |
| B | Fisheries Commission and Scientific Council Joint Working Group on Risk-Based Management Strategies, 5-7 February 2014 |
| C | Scientific Council *ad hoc* Working Group on Catches of Cod in Division 3M – 5 May 2014 |
| D | Scientific Council *ad hoc* Working Group on Management Strategies for Redfish in Div. 3LN, 13 May 2014 |
| E | Scientific Council Meeting, 31 May - 12 June 2014 |
| F | Fisheries Commission and Scientific Council Working Group on the Ecosystem Approach Framework to Fisheries Management, 9-11 July 2014 |
| G | Scientific Council Meeting, 10-17 September 2014 |
| H | NAFO/ICES *Pandalus* Assesment Group (NIPAG) Meeting, 10–17 September 2014 |
| I | Scientific Council Meeting, 22-26 September 2014 |
| * | Representing Scientific Council |

| CANADA | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
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| Chapman, Bruce | Executive Director, Groundfish Enterprise Allocation Council, 1362 Revell Dr., Manotick, ON K4M 1K8<br>Phone: +613 692 8249 – Email: bchapman@sympatico.ca | | B | | | | F | | | |
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| Couture, Estelle | Fish Population Science, Fisheries and Oceans Canada, 200 Kent Street (Stn. 12S53), Ottawa, ON K1A 0E6<br>Phone: +613-990-0259 – Email: estelle.couture@dfo-mpo.gc.ca | | B | | | E | | | | I |
| Day, Robert | Director, International Fisheries Management Bureau, Fisheries and Oceans Canada, 200 Kent St., Ottawa, ON K1A 0E6<br>Phone: +613 991 61 35 – Email: robert.day@dfo-mpo.gc.ca | A | B | | | | F | | | |
| Dauphin, Guillame | Science Br., DFO Newfoundland & Labrador, P.O. Box 5667, St. John's, NL A1C 5X1<br>E-mail: guillame.dauphin@dfo-mpo.gc.ca | | B | | D | E | | | | |
| Dwyer, Karen | Science Br., Fisheries & Oceans Canada, P.O. Box 5667, St. John's, NL A1C 5X1<br>Phone: +709-772-0573 – E-mail: karen.dwyer@dfo-mpo.gc.ca | | | | | E | | | | |
| Dwyer, Shelley | Resource Policy & Development Officer, Government of Newfoundland and Labrador, 30 Strawberry Marsh Road, St. John's, NL A1B 4J6<br>Email: shelleydwyer@gov.nl.ca | | B | | | | | | | |
| Gilchrist, Brett | Senior International Fisheries Officer, International Fisheries Management Bureau, Fisheries and Oceans Canada, 200 Kent St., Ottawa, ON K1A 0E6<br>Phone: +1 613 991 0218 – Email: brett.gilchrist@dfo-mpo.gc.ca | A | B | | | | F | | | |

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| 2011 | Dr. Vladimir Rikhter | AtlantNIRO, Kaliningrad, Russian Federation |
| 2013 | Bill Brodie | DFO, St. John's, NL, Canada |
| 2013 | Jean-Claude Mahé | IFREMER Lorient, France |

## LIST OF RECOMMENDATIONS IN 2014

### From the FC-SC Joint Working Group on Risk-Based Management Strategies – 5-7 Feb 2014

### 8. Approach and workplan to review the Greenland Halibut Management Strategy Evaluation in 2017

In order to provide the Fisheries Commission with the opportunity to approve the review of the Greenland halibut MSE during its 2017 September meeting, the following work plan was proposed:

5. Until 2016 Scientific Council will continue to evaluate the harvest control rule based on the primary indicators (catches and surveys indices).

6. During its 2016 June meeting Scientific Council should update two assessment models, one XSA based and one SCAA based, and evaluate the development of the stock since the introduction of the MSE.

### 9. Recommendations to forward to FC and SC

1. In order for the WG to start the process of revising the PA framework the WG **recommends** SC provide feedback on the following:

- Discuss the relevance and implications of:
- having $F_{lim}$ at $F_{msy}$
- $F_{msy}$ as a target
- These analyses should include situations where quantitative analysis of uncertainty are limited and situations where uncertainty has been well incorporated into evaluation of Harvest Control Rules.
- Consider the utility of buffers (particularly $B_{buf}$) in the framework and in management plans and provide advice on whether the use of buffers is considered appropriate for stocks which have $B_{lim}$.

Note: the WG recommends that $B_{isr}$ is not considered part of the PA (but may be used as an interim milestone to aid decision making).

- The working group noted that SC, in its 2013 June report, concluded that reference points can theoretically be constructed for all stocks, and that this work is given high priority. The WG recommends SC provide a status report and possible timelines for this work for consideration of Fisheries Commission in September 2014.
- In its assessments and advisory sheets, the working group **recommends** Scientific Council provide a table or list of reference points available for each stock that includes information on their derivation, and if reference points are missing, explain why.

4. The WG **recommends** SC discuss selection of operating models and evaluate the Div. 3LN Redfish management strategy relative to the performance statistics prior to the 2014 Annual Meeting (Annex 7).
5. The WG **recommends** SC comment on likely by-catch levels associated with the implementation of the proposed HCR for 3LN Redfish.
6. The WG **recommends** SC to discuss selection of operating models and evaluate the Div. 3M Cod management strategy prior to the 2015 Annual Meeting.

### From the 30-May-12 June Scientific Council Meeting

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

- STACFEN **recommends** that *consideration of support for one invited speaker to address emerging issues and concerns for the NAFO Convention Area during the June Meeting.*
- STACFEN **recommends** that *further studies be directed toward integration of environmental information with changes in the distribution and abundance of resource populations.*

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

- STACPUB **recommends** that *in order for authors to receive an SCR number they must submit a Title, Author and Abstract or Description of the document*.
- STACPUB **recommends** that *an excerpt from the Scientific Council meeting report that contains the advice and answers to the Fisheries Commission and coastal states requests be prepared and placed in a prominent place on the public website for easy accessibility*.
- STACPUB **recommends** that *the Secretariat work on providing direct links to key pages of the NAFO website and continue to provide easier access to documents and other information. STACPUB asked that these tasks be given a high priority by the Secretariat*.
- **STACPUB recommends** that *the NAFO Secretariat investigate options to promote the Journal using social media*.
- **STACPUB recommends** that the *NAFO Secretariat improve the visibility of the Journal by placing a prominent link directly on the NAFO website's homepage.*

There were no recommendations for Scientific Council from STACREC.

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

- STACFIS **recommends** that *the Secretariat use the information from VMS data to construct measures of effort (e.g. as in SCR 13/01) and compare this information to effort reported via DCR, as a means to validate these effort records*.

**For Witch Flounder in Div. 3NO**

Due to the uncertainty associated with the data the Scientific Council **recommends** that *the stock should undergo another full assessment in 2015*.

**For Spotted Wolffish in SA1**

The Scientific Council reiterated the **recommendation** that *the easily discernible species be separated in catch statistics*.

**From STACFIS**

**2. General Review of Catches and Fishing Activity**

STACFIS noted that both the ad-hoc WG on catch reporting (SCS Doc. 14/04) and STACTIC (FC Doc. 14/03) have had encouraging discussions about the provision of haul by haul logbook data to the Secretariat. STACFIS considers that the provision of haul by haul data is of critical importance to the auditing process for the reliability of STATLANT data and **recommended** that *such data be submitted to Secretariat in real time if possible for use by the Scientific Council for assessment purposes*. More generally, this data should be available for all fisheries affecting NAFO managed stocks. Further, STACFIS **recommended** that *the Secretariat use the information from VMS data to construct measures of effort (e.g. as in SCR Doc. 13/01) and compare this information to effort reported via DCR, as a means to validate these effort records*. Given that DCR information is only available for fisheries operating in the NRA, priority should be towards Div. 3M cod, Div. 3LNO American plaice and SA 2+ Div. 3KLNMO Greenland halibut, followed by any stock having an assessment in 2015.

**4. Redfish in SA1**

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

**05b. American plaice in Subarea 1**

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

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 American plaice in the by-catch.*

**6. Cod in Div. 3M**

STACFIS **recommended** that *an age reader comparison exercise be conducted*.

STACFIS **recommends** that *the most recent catch at age figures will revised*.

**7. Redfish in Div. 3M**

STACFIS **recommended** that, *in order to confirm the most likely redfish depletion by cod on Flemish Cap, and be able to have an assessment independent approach to the magnitude of such impact and to the size structure of the redfish most affected by cod predation, the existing feeding data from the past EU surveys be analyzed and made available.*

STACFIS 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**

STACFIS **recommends** that *several input frameworks be explored in both models (such as: q's; M (e.g. in relation to $F_{0.1}$); ages dependent of the stock size; the proxies and its distribution in the VPA-type Bayesian model).*

Due to the recent improved recruitment at low SSB, STACFIS **recommends** *to explore the Stock/Recruitment relationship and $B_{lim}$.*

**10. Redfish in Div. 3LN**

STACFIS **recommends** that *risks associated with the stock falling below $B_{lim}$ in the various projection scenarios be presented*.

**11. American plaice in Div. 3LNO**

STACFIS **recommended** that *investigations be undertaken to compare ages obtained by current and former Canadian age readers.*

STACFIS **recommends** that *investigations be undertaken to examine the retrospective pattern and take steps to improve the model.*

**13. Witch flounder in Div 3NO**

STACFIS **recommends** *further investigation of survey indices of witch flounder in Div. 3NO in conjunction with those of Subdiv. 3Ps.*

Considering that Canadian autumn surveys are no longer planned for the deep waters of in Div. 3NO beyond 400 fathoms (732m), STACFIS **recommends** that *indices of abundance and biomass be developed that are comparative to the strata covered in the spring surveys.*

STACFIS **recommends** that *research into surplus production modelling in a Bayesian framework continue for Div. 3NO witch flounder*.

**14. Capelin in Div. 3NO**

STACFIS reiterates its **recommendation** *that initial investigations to evaluate the status of capelin in Div. 3NO should utilize trawl acoustic surveys to allow comparison with the historical time series.*

**15. Redfish in Div. 3O**

STACFIS **recommended** that *for Redfish in Div. 3O, a recruitment index be developed for this stock*.

**16. Thorny skate in Div. 3LNO**

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

STACFIS **recommends** that *survey indices be investigated to compare catch rates in relation to depth in the spring and autumn surveys, stock distribution and comparison between Div. 3LNO and Subdivision 3Ps.*

**17. White hake in Div. 3NO**

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

**21. Northern shortfin squid in SA 3+4**

STACFIS **recommended** that *gear/vessel conversion factors be computed to standardize the 1970-2003 relative abundance and biomass indices from the July Div. 4VWX surveys*.

**From the FC-SC WGEAFFM, 9-11 July 2014**

**9. Recommendations to forward to Fisheries Commission and Scientific Council**

7. That the FC and SC support continuing analysis by the WG of areas on the Tail of the Grand Bank (Div. 3O closure and related areas).

8. That the FC and SC support continuing analysis by the WG of areas 13 and 14 (Eastern Flemish Cap), and FC consider possible closed areas, if proposals are made at the Annual Meeting.

10. That priority attention by FC and SC and their constituent bodies be given to the areas identified in Annex 5 that include external factors (e.g. climate change and oil and gas development), bycatch and discards, multispecies interactions, and VMEs including concluding the assessment of bottom fisheries for 2016.

11. That FC and SC consider the revised Terms of Reference at their September 2014 joint session and have FC and SC adopt the revisions in their respective meetings. Consideration could also be given to making terms of reference consistent across all joint FC-SC working groups.

12. Request that the SC provide annual updates to the FC-SC Working Group on Ecosystem Approach Framework to Fisheries Management pertaining to the 2016 review of significant adverse impacts of NAFO bottom fisheries on VMEs in the NRA.

**From the NIPAG Meeting, 10-17 September 2015**

**1. Northern Shrimp in Div. 3M**

For Northern Shrimp in Div. 3M NIPAG **recommends** that *further exploration of the relationship between shrimp, cod and the environment be continued in WGESA and NIPAG encourages the shrimp experts to be involved in this work.*

**3. Northern Shrimp in SA 0+1**

- *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;*
- *the relationship between estimated numbers of small shrimps and later estimates of fishable biomass should be investigated anew.*

NIPAG **recommends** that *the structure and coding in the assessment model of the relationship between cod biomass, shrimp biomass and estimated predation should be reviewed, including an analysis of the error variation*.

NIPAG **recommends** *that further refinements to the "partial MIXing" method of estimating numbers at age should be explored*.

Survey trends inshore and offshore are divergent and NIPAG **recommends** *exploration of the nature and implications of this divergence*.