



Serial No. N6616

NAFO SCS Doc. 16/18

**SCIENTIFIC COUNCIL SEPTEMBER MEETING – 2016  
7-14 SEPTEMBER 2016**

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### SC-NIPAG Participants 2016



**Back Row:** Michael Kingsley, Kathy Sosebee(SC chair), Ole Eigaard, Mats Ulmestrand, Mikel Casas, Tom Blasdale,

**Front Row:** AnnDorte Burmeister, Nannette Hammeken-Arboe, Guldborg Søvik (NIPAG co-chair), Mikaela Bergenius, Massimiliano Cardinale, Don Power, Carsten Hvingel,

**Missing from photo:** Katherine Skanes



**Chairs:** Kathy Sosebee (NAFO SC chair) & Guldborg Søvik (NIPAG co-chair)

## **Report of the Scientific Council Meeting 7-14 September 2016**

Chair: Kathy Sosebee

Rapporteur: Tom Blasdale

### **I. PLENARY SESSIONS**

The Scientific Council met at the Northwest Atlantic Fisheries Centre, Bergen, Norway during 7-14 September 2016, to consider the various matters in its Agenda. Representatives attended from Canada, Denmark (Greenland), European Union (Denmark, Spain and Sweden), Norway and the United States of America. The Scientific Council Coordinator and Scientific Information Administrator were 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 7 September 2016.

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, Tom Blasdale, was appointed Rapporteur.

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

The concluding session was convened at 0900 hours on 14 September 2016. The Council then considered and adopted Sections III.1-4 of the "Report of the NAFO/ICES *Pandalus* Assessment Group" (NAFO SCS Doc. 16/17, ICES CM 2016/ACOM:15). 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 meeting adjourned at 1800 hours on 13 September 2016.

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 2015**

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. 16/17 and ICES CM 2016/ACOM:15.

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

#### **1. Request from Fisheries Commission**

The response of Scientific Council to the Fisheries Commission Request for Advice (Annex 1a) for shrimp in Div. 3LNO regarding stock assessment (Item 1) is given below.

### Northern Shrimp in Divisions 3LNO

Advice September 2016 for 2017

#### Recommendation for 2017

No directed fishery as 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	●	No directed fishery
Apply Precautionary Approach	●	$B_{lim}$ is defined. No fishing mortality reference point defined
Minimise harmful impacts on living marine resources and ecosystems	●	No directed fishery
Preserve marine biodiversity	●	Cannot be evaluated

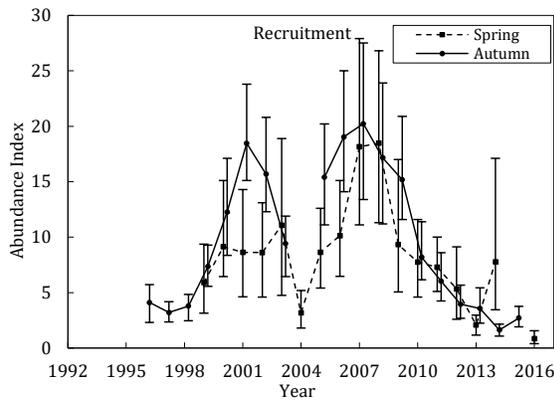
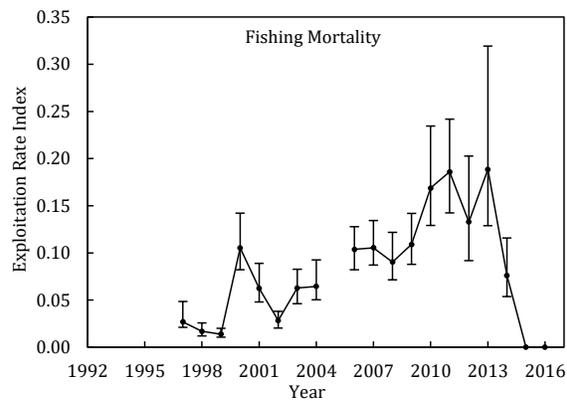
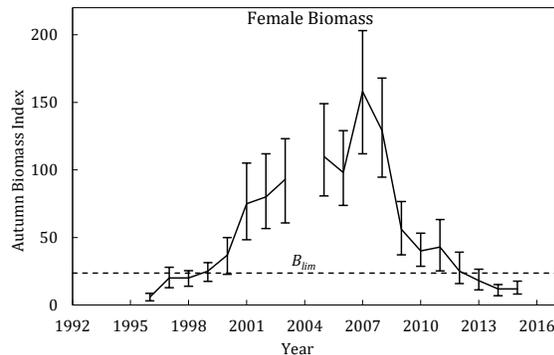
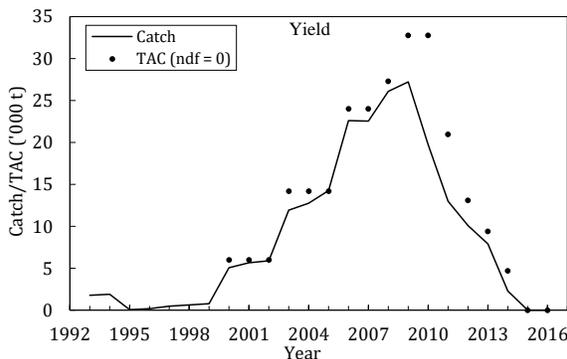
- OK
- Intermediate
- Not accomplished
- Unknown

#### 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 2015 the risk of being below  $B_{lim}$  is greater than 95%. Given expectations of poor recruitment, 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 provides a proxy for  $B_{lim}$  (23 700) (SCS Doc. 04/12).  $B_{lim}$  was updated from 19 330 to 23 700 as a result of revision of the series due to the incorporation of the new version of Ogmap.

**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 catches (NIPAG 2016).

Next full assessment is planned for 2017.

*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. Some other groundfish (e.g. redfish) which consume shrimps are known to have increased, but the impact on the shrimp stock has not been quantified.

Temperature in the stock area had been warming up to 2011 but was lower than average in 2014-2015. Effects of temperatures on shrimp distribution, recruitment, growth and survival are poorly understood.

**Fishery**

The fishery, until 2014, was a directed bottom trawl fishery and there is little or no bycatch of shrimp in other trawl fisheries. The fishery in Div. 3LNO is regulated by quota.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Enacted TAC <sup>1</sup>	24029	27306	32767	32767	20971	13108	9393	4697	ndf	ndf
STATLANT 21	22315	26097	27236	19745	13013	10099	7919	2282	0	
NIPAG <sup>2</sup>	23570	25407	25900	20536	12900	10108	8647	2289	0	

<sup>1</sup> Includes autonomous TAC as set by Denmark (in respect of Faroes and Greenland).

<sup>2</sup> NIPAG catch estimates have been updated using various data sources (see p. 13, SCR Doc 14/048).

**Effects of the fishery on the ecosystem**

No specific information available. General impacts of fishing gears on the ecosystem should be considered. An area of Divs. 3LNO has been closed to protect sponge, seapens and coral.

**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. 14/048, 15/048, /055; <http://www.dfo-mpo.gc.ca/Library/352955.pdf>

**2. Requests from Coastal States**

**a) Northern Shrimp in Subarea 1 and Div. 0A**

Scientific Council responded:

## Northern Shrimp in Subarea 1 and Div. 0A

Advice September 2016 for 2017

### 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 90 000 t in 2017 would entail an estimated mortality risk below 35%. Scientific Council therefore advises that catches in 2017 should not exceed 90 000 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	<span style="color: green;">●</span>	Stock status is both estimated and forecast relative to precautionary reference points

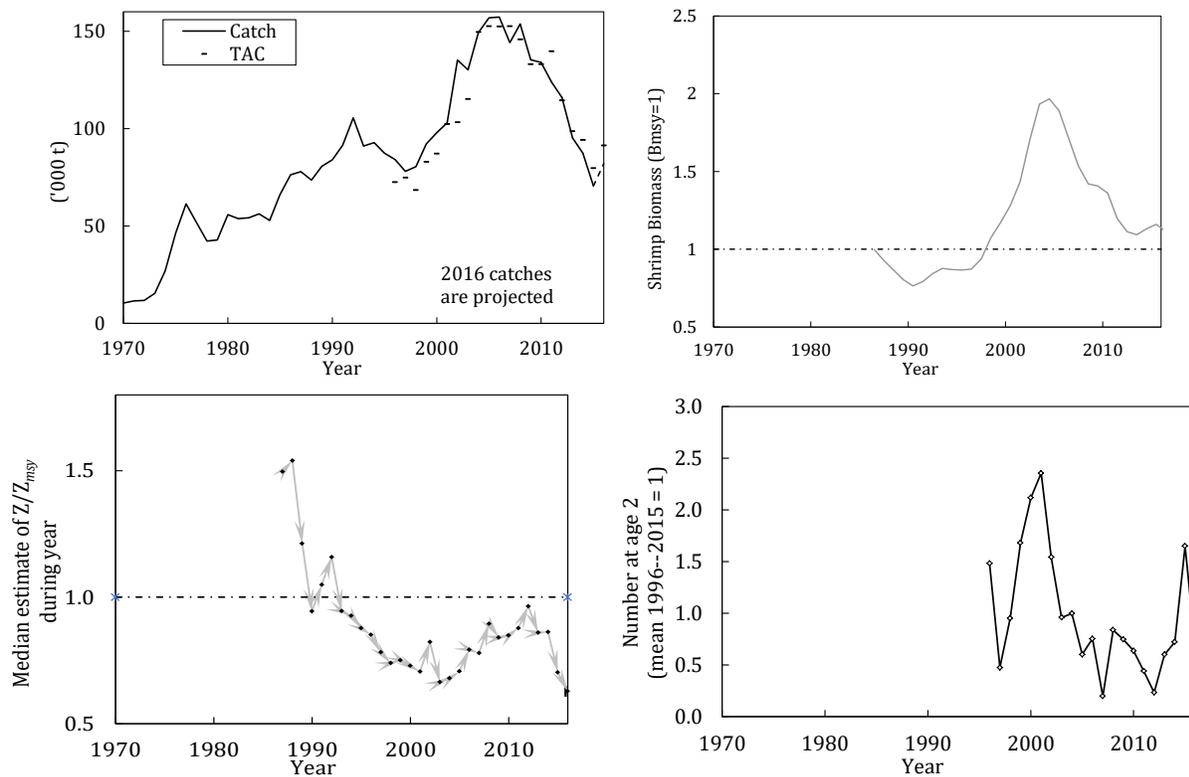
● OK

### 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

The stock is estimated to be 11% above  $B_{msy}$  and the risk of being below  $B_{lim}$  in 2016 is very low (<1%). Recruitment to the fishable biomass in 2017 is expected to be poor.



## Reference points

$B_{lim}$  is 30% of  $B_{msy}$  and the limit reference point for mortality is  $Z_{msy}$  (FC Doc. 04/18).

## Projections

Predicted probabilities of transgressing precautionary reference points in 2017 – 2019 under eight catch options and subject to predation by a cod stock with an effective biomass of 35 Kt.

35 000 t cod Risk of:	Catch option ('000 tons)							
	60	70	75	80	85	90	95	100
falling below $B_{msy}$ end 2017 (%)	32.6	33.2	34.2	34.8	35.4	35.0	35.4	36.5
falling below $B_{msy}$ end 2018 (%)	30.1	30.9	32.1	33.6	34.7	35.9	36.3	36.5
falling below $B_{msy}$ end 2019 (%)	28.0	29.6	31.1	32.4	34.1	35.2	36.5	37.6
falling below $B_{lim}$ end 2017 (%)	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
falling below $B_{lim}$ end 2018 (%)	0.0	0.0	0.1	0.2	0.1	0.2	0.1	0.2
falling below $B_{lim}$ end 2019 (%)	0.1	0.1	0.2	0.3	0.3	0.4	0.3	0.4
exceeding $Z_{msy}$ in 2017 (%)	15.9	20.1	23.0	25.8	28.7	32.0	35.2	38.9
exceeding $Z_{msy}$ in 2018 (%)	16.3	20.1	22.9	26.1	28.9	31.9	36.1	39.7
exceeding $Z_{msy}$ in 2019 (%)	16.4	20.1	23.0	26.0	29.6	32.9	36.2	39.4

## Assessment

The analytical assessment was run with the same basic model as in 2011–2015; minor changes in the coding (A duplication of the uncertainty applied to the estimable predation was removed; which reduces the margin for uncertainty applied in calculating future TACs) are described in SCR Doc. 16/47; and with updated data series.

The next assessment is scheduled for 2017.

### Human impact

Mortality related to the fishery has been documented. Other human 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. Other predation is likely but not explicitly considered. Shrimps might be important predators on, for example, fish eggs and larvae.

## 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:

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Enacted TAC <sup>1</sup>	145 717	132 987	132 987	139 583	114 425	98 596	94 140	79 561	93 426
STATLANT 21	148 550	133 990	129 179	123 195	114 970	91 802	88 834	70 091	-
NIPAG	153 707	135 369	133 985	123 853	115 943	95 288	87 358	70 650	82 000 <sup>2</sup>

<sup>1</sup>sum of TACs autonomously set by Canada and Greenland;

<sup>2</sup>provisional—projected to year end.

## 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

In 2016 the cod biomass density estimated by research trawl survey in West Greenland was about one-seventh of its value in 2015 and the index of its overlap with the shrimp stock also dropped to an 'effective cod biomass' of about 3 Kt, compared with values of 50–60 Kt in 2014–15. In choosing the value for the

effective cod stock biomass, it was considered unlikely that the low level of 2016 would be maintained in the prediction period. Therefore an effective cod biomass near the mean of the most recent three years, i.e. 35 Kt, was used as a basis for the forecasting of trajectories. In the recent past, TAC changes have been implemented in steps of limited size. Increases should follow a similar method. An increase in the TAC enacted for Greenland waters in 2015 was limited by a catch-smoothing rule.

**Source of Information** SCS Doc 13/04, FC Docs 04/18, SCR Docs 16/41, 42, 43, 44, 47.

**b) Northern Shrimp in Denmark Strait and off East Greenland**

*Advice September 2016 for 2017*

**Recommendation**

In 2016 the stock remains at a low level, comparable to previous years, and catches should not exceed 2 000 t.

**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.

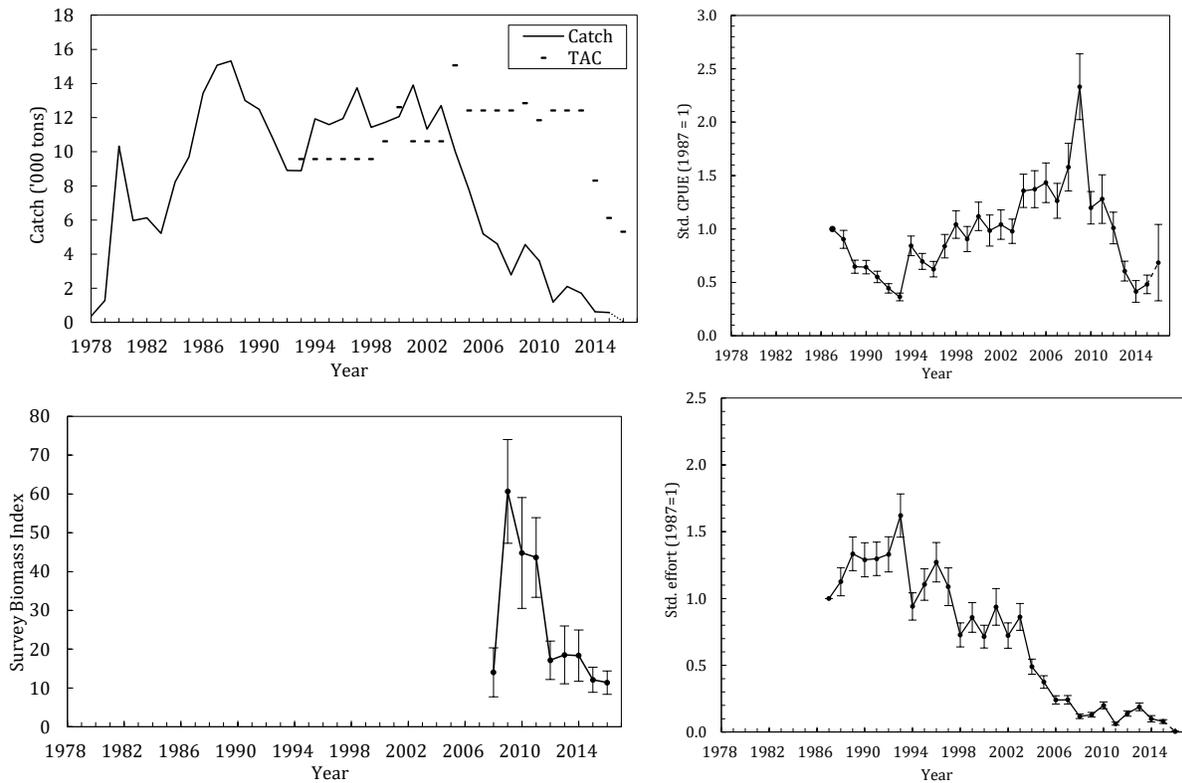
Advice is based on qualitative evaluation of biomass indices in relation to historic levels.

**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 remains at a very low level in 2016 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:

	2009	2010	2011	2012	2013	2014	2015	2016
Enacted TAC	12835	11835	12400	12400	12400	8300	6100	5300
SC Recommended TAC	12400	12400	12400	12400	12400	2000	2000	2000
NIPAG	4555	3602	1199	2109	1717	622	576	49 <sup>1</sup>

<sup>1</sup> To July 2016

**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 corals.

**Source of Information**

SCR Doc. 16/045, 16/046

## V. OTHER MATTERS

### 1. Scheduling of Future Meetings

The schedule of future meetings

#### a) Scientific Council Meetings

##### *i) Scientific Council, 19 – 23 Sep 2016*

Scientific Council noted the Scientific Council meeting will be held at the Convention Center Plaza America in Varadero, Cuba, 19-23 September 2016.

##### *ii) Scientific Council, June 2017*

Scientific Council agreed that its June meeting will be held on 1 – 15 June 2017, at St Mary’s University, Halifax.

##### *iii) Scientific Council (in conjunction with NIPAG), Sep/Oct 2017*

This meeting will be held September or October 2017 (venue and dates to be decided).

##### *iv) Scientific Council, Sep 2017*

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

##### *v) Scientific Council, June 2018*

The Scientific Council June meeting is scheduled for 1 - 14 June 2018.

#### b) NAFO/ICES Joint Working Groups

##### *i) NIPAG, 6 – 13 Sep/October 2017*

This meeting will be held September or October 2017 (venue and dates to be decided).

##### *ii) WG-DEC, 15 – 19 February 2017*

The next meeting of the ICES – NAFO Working Group on Deepwater Ecosystems is scheduled to take place at ICES Headquarters, during 15 – 19 February 2017.

##### *iii) WG-HARP, September 2016*

WG-HARP will continue its work by correspondence. The next meeting of the ICES – NAFO Working Group on Harp and Hooded Seals is scheduled to take place in during 26-30 September 2016.

#### c) NAFO Working Groups

##### *i) WG-ESA, 8- 17 Nov, 2016*

The Working Group on Ecosystem Science and Assessment will meet at the IPMA, Lisbon, Portugal, 8-17 November, 2016.

### 2. Topics for Future Special Sessions

No special sessions were proposed. Scientific Council noted the thoughts of the group that a special session on growth and aging of prawns may be beneficial at a future time, however some work needs to be carried out beforehand.

### 3. Other Business

## VI. ADOPTION OF SCIENTIFIC COUNCIL AND NIPAG REPORTS

The Council at its session on 14 September 2016 considered and adopted Sections III.1-4 of the “Report of the NAFO/ICES *Pandalus* Assessment Group” (SCS Doc. 16/17, ICES CM 2016/ACOM:15). The Council then considered and adopted its own report of the 7-14 September 2016 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, Tom Blasdale, and Dayna Bell, Scientific Information Administrator for their support during the meeting. The Chair then offered thanks to the ICES and NAFO Secretariats for their support in general, and to Northwest Atlantic Fisheries Centre, Bergen, for hosting the meeting and for supporting a social gathering. The report was adopted at the close of the meeting, subject to a two week period for editorial changes. All participants were then wished a safe journey home and the meeting was adjourned at 1800 hours.

**APPENDIX 1. PROVISIONAL AGENDA – SCIENTIFIC COUNCIL MEETING**  
**Institute of Marine Research, Bergen, Norway, 7-14 September 2016**

- I. Opening (Chair: Kathy Sosebee)
  1. Appointment of Rapporteur
  2. Adoption of Agenda
  3. Attendance of Observers
  4. Plan of Work
  
- II. Review of Recommendations in 2015
  
- III. NAFO/ICES *Pandalus* Assessment Group (Co-chairs Kathy Sosebee and Guldborg Søvik)
  
- IV. Formulation of Advice (see Annexes 1–3 of Appendix I)
  1. Request for Advice on TACs and Other Management Measures (Item 1, Annex I)
    - a) Northern shrimp (Div. 3LNO)
  
  2. Requests from Coastal States (Items 5 and 6 of Annex II, item 2 of Annex III)
    - a) Northern shrimp (Subareas 0 and 1)
    - b) Northern shrimp (in Denmark Strait and off East Greenland)
  
  3. Monitoring of Stocks for which advice was provided in 2014 (Item 1 Annex I)
    - a) Northern shrimp in Div. 3M
  
- 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

**ANNEX 1. FISHERIES COMMISSION'S REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2017 AND BEYOND OF CERTAIN STOCKS IN SUBAREAS 2, 3 AND 4 AND OTHER MATTERS**

1. 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).

<u>Yearly basis</u>	<u>Two year basis</u>	<u>Three year basis</u>
Northern shrimp in Div. 3LNO	American plaice in Div. 3LNO Cod in Div. 3M Redfish in Div. 3M Northern shrimp in Div. 3M Thorny skate in Div. 3LNO White hake in Div. 3NO Witch flounder in Div. 3NO	American plaice in Div. 3M Capelin in Div. 3NO Cod in Div. 3NO Northern shortfin squid in SA 3+4 Redfish in Div. 3O Witch flounder in Div. 2J+3KL Yellowtail flounder in Div. 3LNO

To implement this schedule of assessments, the Scientific Council is requested to conduct the assessment of these stocks as follows:

In 2016, advice should be provided for 2017 for Northern shrimp in NAFO Div. 3LNO

In 2016, advice should be provided for 2017 and 2018 for American plaice in Div. 3LNO and for Thorny skate in Div. 3LNO.

In 2016, advice should be provided for 2017, 2018 and 2019 for Redfish in Div.3O, Witch flounder in Div. 2J+3KL and Northern shortfin squid in SA 3+4.

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 bycatch in other fisheries, provide updated advice as appropriate.

2. The Fisheries Commission adopted in 2010 an MSE approach for Greenland halibut stock in Subarea 2 + Division 3KLMNO (FC Doc. 10/12) and agreed to use it until 2017 (FC Doc.13/23). 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 Doc. 10/12.
  - b) Advise on whether or not an exceptional circumstance is occurring.
3. The Fisheries Commission adopted in 2014 an MSE approach for Redfish in Division 3LN (FC Doc. 14/24). This approach uses a Harvest Control Rule (HCR) 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. The Fisheries Commission request Scientific Council conduct a full assessment in 2016 to evaluate the effect of removals in 2014 and 2015 on stock status.
4. 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.

FC further requests that:

- a) that Scientific Council should take into account the protection afforded to VME areas outside the NAFO fisheries footprint in the calculation of the VME area and biomass at risk of bottom fishing impact;
  - b) that Scientific Council refine VME kernel density analysis polygon boundaries, taking into account current understanding of distribution patterns in relation to environmental variables.
5. FC requests the Scientific Council consider widening the scope of the NAFO coral and sponge identification guides to include other relevant species on seamounts.
  6. FC requests that Scientific Council consider options to expedite a risk assessment of scientific trawl surveys impact on VME in closed areas, and the effect of excluding surveys from these areas on stock assessments.
  7. FC requests the Scientific Council consider, based on analysis of logbook data and patterns of fishing activity, to be conducted by the Secretariat, to examine relative levels of bycatch and discards of 3M cod/redfish, and stocks under moratoria in the different circumstances (e.g. fisheries, area, season, fleets, depth, timing)
  8. It is difficult to match the current  $F_{lim}$  proxy with the 3M cod assessment results given by the 2015 Bayesian XSA assessment. These results were presented to SC in June and used for short term (2016-2017) projections under several  $F$  options (NAFO SCR 15/33 González-Troncoso, 2015); NAFO SC June 2015 Report). Focusing on the last assessment and projections, assuming at the same time a candidate  $F_{lim} = F_{30\%SPR} = 0.131$ , they would imply that:
    - During the past five years (2010-2014) 3M cod has been exploited at an average  $F_{bar}$  level over two fold  $F_{lim}$ .
    - While SSB was sustained at a high average level representing 87% of the highest estimated SSB of the 1972-2014 interval (36 7041 on 1972).
    - The two highest year classes since 1992 occurred in 2011-2012.

Under these circumstances the Scientific Council is requested to analyze whether the current  $F_{lim}$  value for 3M cod is currently underestimated and to revise if required the relevant fishing mortality and biomass reference points appropriately.

9. The stock of redfish 3M covers catches of three *Sebastes* species and the scientific advice is based on data of only two species (*S. mentella* and *S. fasciatus*). Golden redfish, *Sebastes marinus* (aka norvegicus), represents part of the catch but has not yet been subject to a full assessment in NAFO. The Scientific Council is requested to explore the possibility and options of an individual assessment of the golden redfish (*S. marinus*, aka norvegicus) and of including this species in the scientific advice for 2018-2019. The Scientific Council is also requested to advice on the implications for the three species in terms of catch reporting and stock management.
10. As part of the Greenland halibut's MSE review scheduled for 2016-2017, the SC is asked to specifically monitor and evaluate Contracting Parties surveys with the aim of optimizing resources in order to avoid duplication of data, identify data gaps and streamline survey methodologies, so that all data is used in the assessment.
11. Article 23 NCEM foresees a reassessment of bottom fishing activities in 2016. The NAFO Roadmap for Developing an Ecosystem Approach to Fisheries extends the work of the Scientific Council to include the assessment of potential impacts of activities other than fishing. Also, impacts of human activities in ecosystems should not be analyzed in isolation since cumulative effects might occur representing more than the sum of the individual factors. The Scientific Council is therefore requested to develop a workplan

at its meeting in 2016 that will allow to address and analyze the potential impact of activities other than fishing (eg. oil and gas exploration, marine cables, ocean dumping, marine transportation) on NAFO VMEs, in particular VME closed areas.

12. The Fisheries Commission requests the Scientific Council to conduct a full assessment of Greenland halibut in Subarea 2 + Division 3KLMNO (using both XSA and SCAA<sup>1</sup>) and to consider the weighting of each survey as a first step to inform the 2017 MSE review.
13. The Fisheries Commission requests the Scientific Council to advise on how many SSB points above 30,000t are considered sufficient to conduct a review of  $B_{lim}$  of cod in 3NO.
14. The Fisheries Commission requests the Scientific Council to provide survey biomass trend(s) of witch flounder in Div. 3M for as long as data is available.
15. The Fisheries Commission requests the Scientific Council to review the results of the 2015 Canadian in situ photographic surveys for non-coral and sponge VME indicator species on Grand Bank (tail of Grand Bank) in relation to previous analyses presented in 2014 (that modelled their distribution using research vessel survey trawl bycatch data), and to identify areas of significant concentrations of non-coral and sponge VME indicator species using all available information.
16. Recognizing the importance of the 3M cod fishery to NAFO.

Mindful that even though the current SSB is well above  $B_{lim}$ , the recruitment of the two most recent years is low.

Noting that according to the Scientific Council stock assessment we are currently fishing only on two year-classes – once they are depleted in about two years time prospects for a continued fishery at the current level is not likely to be possible.

Further noting that recent assessment of the stock has shown some year-to-year instability and that estimation of risk levels associated with given fishing mortalities cannot be calculated at this time, which further adds to our concern for the future of this fishery and its management.

It is proposed that Scientific Council organize a full benchmark review of the 3M cod assessment in two stages: For 2016 Scientific Council will agree on a standardized approach and prepare a plan for the benchmark process at NAFO including required resources. For 2017 SC will review the benchmark assessment methodology for 3M cod.

<sup>1</sup>SCAA will not be possible unless a contractor can be hired.

**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:  $2/3 F_{msy}$ ,  $3/4 F_{msy}$ ,  $85\% F_{msy}$ ,  $75\% F_{2015}$ ,  $F_{2015}$ ,  $125\% F_{2015}$ ,
- For stocks under a moratorium to direct fishing:  $F_{2015}$ ,  $F = 0$ .

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( $F > F_{msy}$ )			P( $B < B_{msy}$ )			P( $B_{2019} > B_{2016}$ )						
F in 2016 and following years*	Yield 2017 (50%)	Yield 2018 (50%)	Yield 2019 (50%)	2016			2017			2018			2016			2017			2018			
				%	%	%	%	%	%	%	%	%	%	%	%	%	%	%				
$2/3 F_{msy}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
$3/4 F_{msy}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
$85\% F_{msy}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
$F_{msy}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
$0.75 X F_{2015}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
$F_{2015}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
$1.25 X F_{2015}$	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:  $F_{0.1}$ ,  $F_{max}$ ,  $2/3 F_{max}$ ,  $3/4 F_{max}$ ,  $85\% F_{max}$ ,  $75\% F_{2015}$ ,  $F_{2015}$ ,  $125\% F_{2015}$ ,
  - For stocks under a moratorium to direct fishing:  $F_{2015}$ ,  $F = 0$ .
- 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

F in 2016 and following years*	Yield 2017	Yield 2018	Yield 2019	Limit reference points						P( $B_{2019} > B_{2016}$ )										
				P( $F > F_{lim}$ )			P( $B < B_{lim}$ )				P( $F > F_{0.1}$ )			P( $F > F_{max}$ )						
				2016	2017	2018	2016	2017	2018		2016	2017	2018	2016	2017	2018				
$F_{0.1}$	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	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
$0.75 X F_{2015}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
$F_{2015}$	t	t	t	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
$1.25 X F_{2015}$	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 2017 OF CERTAIN STOCKS IN SUBAREAS 0 AND 1**

1. **Roundnose Grenadier:** For Roundnose Grenadier in Subarea 0 + 1 advice was in 2014 given for 2015-2017. Denmark (on behalf of Greenland) requests the Scientific Council to continue to monitor the status of Roundnose Grenadier in Subareas 0 and 1 annually, and should significant changes in the stock status be observed (e.g. from surveys) the Scientific Council is requested to provide updated advice as appropriate.
2. **Golden Redfish, Demersal Redfish, American Plaice, Atlantic Wolffish and Spotted Wolffish:** Advice on Golden Redfish (*Sebastes marinus*), Demersal Deep-sea Redfish (*Sebastes mentella*) American Plaice (*Hippoglossoides platessoides*), Atlantic Wolffish (*Anarhichas lupus*) and Spotted Wolffish (*Anarhichas minor*) in Subarea 1 was in 2014 given for 2015-2017. Denmark (on behalf of Greenland) requests the Scientific Council to continue to monitor the status of these species annually, and should significant changes in stock status be observed the Scientific Council is requested to provide updated advice as appropriate.
3. **Greenland Halibut, offshore:** 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 2017 and as long time ahead as considered appropriate separately for Greenland Halibut in 1) the offshore areas 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. **Greenland Halibut, inshore:** Advice on Greenland Halibut in Division 1A inshore was in 2014 given for 2015-2016. Denmark (on behalf of Greenland) requests the Scientific Council for advice on Greenland Halibut in Division 1A inshore for 2017-2018.
5. **Northern Shrimp, West Greenland:** Subject to the concurrence of Canada as regards Subarea 0 and 1, Denmark (on behalf of Greenland) requests the Scientific Council before December 2016 to provide advice on the scientific basis for management of Northern Shrimp (*Pandalus borealis*) in Subarea 0 and 1 in 2017 and for as many years ahead as data allows for.

The Scientific Council is asked to consider, if the advice for Subarea 0 and 1 could be limited in north to 73°30'N owing to the fact, that stock assessment is based on data from scientific survey and logbooks within the area 60°N to 73°30'N.

6. **Northern Shrimp, East Greenland:** 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 2017 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 2017, separately, for Greenland halibut in Divisions 0A+1A (offshore) and 1B, and Divisions 0B+1C-F<sup>1</sup>. 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<sup>2</sup>.

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.

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<sup>1</sup> 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.

<sup>2</sup> Canada encourages the Scientific Council to continue to explore opportunities to develop risk-based advice in the future, including the implications of increases in the TAC (e.g. by 10, 15 or 25%), noting that data conditions do not allow for such advice at this time.

## 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 over the next 5 years. The implications of catch options ranging from 30,000 t to the catch corresponding to  $Z_{MSY}$ , in 5,000 t increments, should be forecast for 2017 through 2021 if possible, and evaluated in relation to precautionary reference points of both mortality and fishable stock biomass. Results should include a partitioning of the future estimable removals between catches and estimable predation for the various catch options requested. The present stock size and fishable stock size should be described in relation to those observed historically and those to be expected in the next 5 years under the various catch options requested, and any other options Scientific Council feels worthy of consideration.
- b) Management options should be provided within the Northwest Atlantic Fisheries Organization Precautionary Approach Framework. Uncertainties in the assessment should be evaluated and presented in the form of risk analyses related to the limit reference points of  $B_{lim}$  and  $Z_{MSY}$ .
- c) Presentation of the results should include the following:
  - a graph and table of historical yield and fishing mortality for the longest time period possible;
  - a graph of biomass relative to  $B_{MSY}$ , and recruitment levels for the longest time period possible.
  - a graph of the stock trajectory compared to  $B_{lim}$  and/or  $B_{MSY}$  and  $Z_{MSY}$ ;
  - graphs and tables of total mortality ( $Z$ ) and fishable biomass for a range of projected catch options (as noted in 2 a) for the years 2017 to 2021 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.

**APPENDIX II. LIST OF RESEARCH (SCR) AND SUMMARY (SCS) DOCUMENTS****RESEARCH DOCUMENTS (SCR)**

SCR Doc. 16-041	N6590	A.Burmeister and M.C.S. Kingsley	The West Greenland trawl survey for <i>Pandalus borealis</i> , 2016, with reference to earlier results.
SCR Doc. 16-042	N6591	A.Burmeister and M.C.S. Kingsley	A provisional Assessment of the shrimp stock off West Greenland in 2016
SCR Doc. 16-043	N6592	N. Hammeken Arboe	The Fishery for Northern Shrimp ( <i>Pandalus borealis</i> ) off West Greenland, 1970–2016
SCR Doc. 16-044	N6593	N. Hammeken Arboe	Catch Table Update for the West Greenland Shrimp Fishery
SCR Doc. 16-045	N6594	H. Siegstad	Results of the Greenland Bottom Trawl Survey for Northern shrimp ( <i>Pandalus borealis</i> ) Off East Greenland (ICES Subarea XIV b), 2008-2016
SCR Doc. 16-046	N6595	N. Hammeken Arboe	The Fishery for Northern Shrimp ( <i>Pandalus borealis</i> ) in Denmark Strait / off East Greenland 1978 – 2016.
SCR Doc. 15-047	N6596	M. C. S. Kingsley	A Stock-Dynamic Model of the West Greenland Stock of Northern Shrimp
SCR Doc. 16-048	N6598	C. Hvingel	Shrimp ( <i>Pandalus borealis</i> ) in the Barents Sea – Stock Assessment 2016
SCR Doc. 16-049	N6599	Carsten Hvingel and Trude H. Thangstad	The Norwegian fishery for northern shrimp ( <i>Pandalus borealis</i> ) in the Barents Sea and round Svalbard 1970-2016
SCR Doc. 16-050	N6600	Carsten Hvingel and Trude H. Thangstad	Research survey results pertaining to northern shrimp ( <i>Pandalus borealis</i> ) in the Barents Sea and Svalbard area 2004-2015
SCR Doc. 16-051	N6602	J. M. Casas	Northern Shrimp ( <i>Pandalus borealis</i> ) on Flemish Cap Surveys 2016
SCR Doc. 16-052	N6603	Casas, J.M., E. Román and M. Álvarez	Northern Shrimp ( <i>Pandalus borealis</i> , Krøyer) from EU-Spain Bottom Trawl Northern Shrimp ( <i>Pandalus borealis</i> , Krøyer) from EU-Spain Bottom Trawl Northern Shrimp ( <i>Pandalus borealis</i> , Krøyer) from EU-Spain Bottom Trawl Survey 2016 in NAFO Div. 3LNO
SCR Doc. 16-053	N6604	G. Søvik and T. H. Thangstad	Results of the Norwegian Bottom Trawl Survey for Northern Shrimp ( <i>Pandalus borealis</i> ) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east) in 2015
SCR Doc. 16-054	N6605	G. Søvik and E. Johnsen	Abundance and biomass of northern shrimp ( <i>Pandalus borealis</i> ) from the annual Norwegian shrimp survey in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east) estimated using the new open source software StoX
SCR Doc. 16-055	N6606	Mikaela Bergenius, Massimiliano Cardinale, Ole Ritzau Eigaard, Guldborg Soevik and Mats Ulmestrand.	An assessment of the Norwegian Deep/Skagerrak shrimp stock using the Stock Synthesis statistical framework
SCR Doc. 16-056	N6607	Ulmestrand et al	The Northern shrimp ( <i>Pandalus borealis</i> ) Stock in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa East)

SCR Doc. 16-057	N6608	G. Sovik	Norweigan Fishery
SCR Doc. 16-058	N6610	K. Skanes	3LNO Shrimp

**SUMMARY DOCUMENTS (SCS)**

<b>SCS No.</b>	<b>Ser. No.</b>	<b>Author(s)</b>	<b>Title</b>
SCS 16/17	<b>N6611</b>	NAFO	NIPAG Report
SCS 16/18	N6616	NAFO	SC Report

**APPENDIX III. LIST OF REPRESENTATIVES, ADVISERS AND EXPERTS****CANADA**

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