SCIENTIFIC COUNCIL MEETING – 21 - 25 SEPTEMBER 2020

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Scientific Council Annual Meeting Participants

21- 25 September 2020

SC participants from left to right:

First row: Dayna Bell MacCallum, Margaret Treble, Laura Wheeland, Mark Simpson, Carmen Fernández

Second row: Diana González Troncoso, Irene Garrido, Miguel Caetano, José Miguel Casas Sanchez, Karen Dwyer, Lisa Hendrickson

Third row: Kenji Taki, Martha Krohn, Antonio Ávila de Melo, Ricardo Alpoim, Alexei Orlov, Konstantin Fomin, Natalia Petukhova

Fourth row: Tom Blasdale, Andrew Kenny, Katherine Sosebee, Pablo Duran Muñoz, Liivika Näks

Missing from photo: Fernando González, Kalvi Hubel, Carsten Hvingel, Brian Healey, Cristina Ribeiro, Mariano Koen-Alonso, Pierre Pepin, Tom Nishida, Mar Sacau, Chris Darby, Lisa Readdy, Luis Ridao Cruz, Herlé Goraguer

REPORT OF SCIENTIFIC COUNCIL MEETING

21-25 September 2020

Chair: Carmen Fernandez Rapporteur: Tom Blasdale

I. PLENARY SESSIONS

The Scientific Council (SC) met by correspondence from 21 to 25 September 2020 to consider the various matters in its agenda. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), the European Union, France (in respect of St. Pierre et Miquelon), Japan, Norway, the Russian Federation, the United Kingdom and the United States of America. The Executive Secretary, Scientific Council Coordinator and other members of the Secretariat were in attendance.

The Council was called to order at 08:00 Halifax time (11:00 UTC) on 21 September 2020. The provisional agenda was **adopted** and the Scientific Council Coordinator was appointed the rapporteur. The opening session was adjourned at 13:00 h on 21 September 2020.

The Council and its Standing Committees met through 21-25 September 2020 to address various items in its agenda. The Council considered and adopted the reports of the STACPUB, STACREC and STACFIS Standing Committees on 24 September 2020.

The final session was called to order at 08:00 on 25 September 2020 and the Scientific Council agreed that the report of this meeting would be finalized by correspondence. The meeting was adjourned at 13:00 hours on 25 September 2020.

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

There were no Scientific Council recommendation requiring immediate attention at this meeting. A detailed review of recommendations was deferred to the June 2021 meeting.

III. JOINT SESSION OF COMMISSION AND SCIENTIFIC COUNCIL

The Commission and Scientific Council met in joint sessions on 21 and 22 September to discuss the 2018 NAFO performance review, the Scientific Council's response to requests for advice from the Commission, the reports of the joint SC/Commission Working Groups and other matters of common interest.

1. Implementation of 2018 Performance Review Recommendations

The Chair of the Commission, Stéphane Artano (France in respect of St. Pierre et Miquelon), referred the meeting to Commission Working Paper 22, update of the action plan for the recommendations. There was no further discussion of the working paper.

2. Presentation of Scientific Advice by the Chair of the Scientific Council

a) Response of the Scientific Council to the Commission's Request for Scientific Advice

The Chair of the Scientific Council (SC) presented the scientific advice formulated during the SC meeting in June 2020 (SCS Doc 20-14), except for northern shrimp in Division 3M which was formulated in September during an intersessional NAFO/ICES *Pandalus* Assessment Group (NIPAG) meeting (SCS Doc 20/22).

Due to the COVID-19 situation, SC was unable to address all of the Commission's requests during its June meeting and instead focused on those requests that were identified as priorities by the Commission. Consequently, several requests (Com. Requests 3, 4, 9, 16, 17,18) were deferred to be addressed in 2021. The SC chair advised the Commission that it may be possible to address some of these requests during the present meeting, but that it is likely that some will have to be carried over to 2021. SC requested that the Commission indicate, when formulating their request for advice in 2021, whether they still wish to receive responses to these deferred requests, and to bear in mind the additional work generated by these requests when formulating new requests.

b) Feedback to the Scientific Council Regarding the Advice and its Work during this Meeting

Feedback questions relating to 3M cod were submitted in advance of the meeting by the EU and Denmark (in respect of Faroes and Greenland). These were adopted by the Commission and referred to SC. A further question, also relating to 3M cod was submitted by the EU during the course of the meeting.

The Commission questions and SC responses are presented in section VII.2. of this report.

c) Other issues as determined by the Chairs of the Commission and Scientific Council

No issues were discussed under this item.

3. Meeting Reports of the Joint Commission–Scientific Council Working Groups

a) Working Group on Improving Efficiency of NAFO Working Group Process (E-WG), 2020

The report was presented by NAFO Executive Secretary, Fred Kingston. The Working Group agreed on the following recommendation via correspondence:

- 22 February – 05 March
- 19 April – 30 April
- 12 July – 23 July

Contracting Parties are not obliged to schedule meetings during these periods, but these dates may help in future planning of intersessional meetings.

This WG will continue under the same ToR next year.

The recommendations of E-WG were adopted by the Commission.

b) Joint Commission–Scientific Council Working Group on Risk-based Management Strategies (WG-RBMS), February and August 2020

The co-Chairs of WG-RBMS, Jacqueline Perry (Canada) and Fernando Gonzalez (EU), presented the work of WG-RBMS over its two meetings in 2020 (COM-SC Docs 20-01 and 20-04).

Key issues discussed during these two meetings included:

- The review of the NAFO Precautionary Approach framework
- 3LN redfish Conservation Plan and Harvest Control Rule
- Greenland Halibut MSE

- 3M Cod MSE

During the February meeting, WG-RBMS considered the Terms of Reference (ToR) for the PA review *(SCS Doc 16/15)* and agreed that these ToRs should continue to guide the work, noting that while the issues were previously discussed, many remained unresolved. The WG agreed on a plan for future work including the suggestion that the SC be asked to reconvene the NAFO Scientific Council Precautionary Approach Working Group (PA-WG). PA-WG was subsequently reconvened and held several meetings in 2020, reporting its progress to the SC's June meeting. In the August meeting WG-RBMS considered recommendations from the SC's June meeting, and further developed the workplan (involving the SC, WG-RBMS and the Commission) initially proposed by SC.

In 2020 WG-RBMS **recommends** that:

- **In relation to the Precautionary Approach Framework revision, the Commission endorses the workplan and funding proposal developed by WG-RBMS at their August meeting (COM-SC Doc 20-04).**
- **In relation to 3LN redfish Conservation Plan and Harvest Control Rule (Annex I.H of the NAFO CEM):**

a) **the Commission requests the Scientific Council to provide guidance on the process of conducting of a full review/evaluation of the management strategy at the end of the 7-year implementation period.**

b) **the Commission adopts a TAC of 18 100 t for 3LN Redfish, applicable for 2021 and 2022.**

c) **the Risk-based Management Strategy for 3LN Redfish outlined in Annex I.H of NAFO CEM be updated in accordance with Annex 5 of the WG-RBMS August meeting report (COM-SC Doc 20-04).**

The recommendations of WG-RBMS were adopted by the Commission.

c) Joint Commission–Scientific Council Working Group on Ecosystems Approach Framework to Fisheries Management (WG-EAFFM), August 2020

WG-EAFFM co-Chair Elizabethann Mencher (USA) presented the August 2020 report and recommendations (COM-SC Doc. 20-03). Three items were prioritized for the August meeting:

- *Work related to VMEs, including closed areas and progress on the 2021 re-assessment processes*
- *Progress of the work on the application of the Ecosystem Approach to Fisheries (EAF) Road Map*
- *Next steps for the review of Chapter 2 of the CEM*

In 2020 WG-EAFFM **recommends** that:

- **In relation to the re-assessment of VME closures, and acknowledging the Scientific Council advice regarding the status of VMEs, all closures listed in Chapter 2, Article 17, "Area Restrictions for Bottom Fishing Activities" are rolled over for one year.**
- **Black Coral taxa (Antipatharia) are added to the VME indicator species list. Consequently, Annex IE, part VI of the NAFO CEM "List of VME Indicator Species" should be appropriately amended.**
- **In relation to the 2021 re-assessment of bottom fishing as well as the discussion on the VME fishery closures, the Commission requests that Scientific Council provide input and analysis of potential management options, with the goal of supporting meaningful and effective discussions between scientists and managers at the 2021 WG-EAFFM meeting.**
- **The Commission, through STACTIC, insert a footnote in Annex II.N Fishing Logbook Information by Haul of the NAFO CEM, to clarify and match the definition of Start and End time of fishing in Annex II.M**
- **In relation to the Scientific Council's first recommendation with respect to COM request #5 and recognizing the limited nature of the 2020 virtual working group meeting, the Commission, through the**

WG-EAFFM, continue to consider this recommendation in 2021, and develop options of how ecosystem advice could inform management decisions, an issue which is directly linked to the results of the foreseen EAFM roadmap workshop.

- **Additionally, the Commission request the Scientific Council to continue its work to develop models that support implementation of Tier 2 of the EAFM Roadmap.**
- **In relation to the development of the ecosystem summary sheets, in particular consideration of non-fishery related activities, the Commission request Contracting Parties to proactively provide any relevant research to inform the Scientific Council's work, as well as identify scientific and management experts in non-fisheries related sectors to participate in Scientific Council and WG-EAFFM discussions. Further, that the Secretariat and the Scientific Council work with other international organizations, such as the FAO and ICES, to bring in additional expertise to inform the Scientific Council's work.**
- **In relation to Chapter 2, Article 24 of the CEM: STACTIC review the implementation of that chapter, and suggest, as necessary, any revisions to WG-EAFFM with a view to improve the effectiveness of management measures; and the Commission request the Scientific Council to also review the effectiveness of Chapter 2 from a scientific perspective and to report back at the 2022 WG-EAFFM meeting. Consequently, Article 24 of the CEM should read: the provisions of this Chapter shall be reviewed by the Commission at its Annual Meeting no later than 2022.**

In response to the recommendations, the EU expressed concern regarding the inclusion of new taxa in the VME list.

Canada suggested that the Ecosystem Approach workshop should be held in the first half of 2021 even if it is not possible to hold a face to face meeting.

The recommendations of WG-EAFFM were adopted by the Commission.

d) Joint Commission–Scientific Council Catch Estimation Strategy Advisory Group (CESAG), 2020

CESAG co-Chair, Kathrine Sosebee presented the report of various meetings of CESAG to the Commission.

In February 2020, CESAG examined preliminary catch estimates produced by the Secretariat, which incorporated gear and quarter but not mesh size. In April, the WG agreed finalized catch estimates for 2019, which were passed to SC on May 1.

In 2020 CESAG **recommends** that**:**

- **the Commission request STACTIC to review the haul by haul reporting template (Annex II.N of the NAFO CEM) and investigate the practicality of adding the codend mesh size or hook size to the reporting requirements.**
- **the Commission request STACTIC to continue to review current measures relating to reporting of catch by NAFO Division to identify and implement improvements which ensure the most reliable information is available for catch estimation, recognizing its importance in stock assessments.**
- **a meeting be held in February 2021 to review and discuss the MRAG report recommendations for potential further enhancements to the CESAG methodology of catch estimation.**

The recommendations of CESAG were adopted by the Commission.

4. Formulation of Request to the Scientific Council for Scientific Advice on the Management in 2022 and Beyond of Certain Stocks in Subareas 2,3, and 4 and Other Matters

In accordance with the procedure outlined in FC Doc. 12-26, a steering committee was formed to assist in the drafting of the Commission request. The committee consisted of the SC Coordinator, Leigh Edgar (Canada), Martha Krohn (Canada) and Cristina Ribeiro (EU). The committee met be correspondence during the week, presenting a draft of the Commission's requests to SC on 24 September.

IV. PUBLICATIONS

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

V. RESEARCH COORDINATION

The Council adopted the Report of the Standing Committee on Research Coordination (STACREC) as presented by the Chair, Karen Dwyer. The full report of STACREC is in Appendix II.

VI. FISHERIES SCIENCE

The Council adopted the Report of the Standing Committee on Fisheries Science (STACFIS) as presented by the Chair, Katherine Sosebee. The full report of STACFIS is at Appendix III.

VII. REQUESTS FROM THE COMMISSION

1. Requests deferred from the June Meeting

Because of the difficult meeting circumstances SC encountered this year, caused by the pandemic situation, requests # 3, 4, 9, 10, 13, 14, 16 and 18 (in NAFO/COM Doc. 19-29) could not be addressed by SC at its June meeting. For requests # 4, 14 and 16, the SC was able to provide a response in the September meeting (see responses below, although there was no time to present request # 4 in the Commission meeting); for the other requests this was not possible and a progress report is presented below.

i) Continue the evaluation of scientific trawl surveys in VME closed areas (COM request #3)

The Commission requests that Scientific Council continue its evaluation of the impact of scientific trawl surveys on VME in closed areas, and the effect of excluding surveys from these areas on stock assessments.

The following progress update was presented to SC in September:

Work for the EU Flemish Cap and the Canadian autumn and spring surveys is available from previous years:

NAFO SCR 16/40: Effect in mean catch and biomass index of removing stations in the closed Coral, Sponge and sea pen Protection Areas in the design of the EU Flemish Cap survey.

NAFO SCR 17/27: Examining the impact that excluding RV surveys from coral and sponge protection areas in Divisions 3LNO would have on Canadian RV survey trends for NAFO-managed fish stocks.

The work planned afterwards to complete this task did not occur as a result of other work commitments until September 2019. It was then agreed that this work would be completed in time for the June 2020 SC meeting, but due to the COVID-19 pandemic circumstances, this was not possible and the response to this request has been postponed to June 2021.

It is important to know the possible differences that may occur in the observed composition at length/age of the NAFO stocks from the trawl surveys, if these surveys are included or excluded from the VME closed areas. Up to now, studies have been made only for biomass indices in the case of the EU Flemish Cap survey, and biomass and length distribution in the case of the Canadian surveys. No work for the EU-Spain surveys in 3NO and 3L has been performed. More knowledge is necessary in this matter.

A workplan is developed from now to June 2021, in order to ensure that the work is finished by the June 2021 SC meeting.

1. Studies in the length and age distribution of the stocks in the EU Flemish Cap survey. An R script has been developed and is almost finished, in order to have the length/age abundance of the Flemish Cap stocks with and without the VME closed areas. An SCR will be presented in June 2021.
2. Studies in the biomass, length and age distribution of the EU-Spain surveys in 3NO and 3L. The same R script as in the case of the Flemish Cap survey is almost finished, in order to present the results for these two surveys. One or two SCRs will be presented with the results in June 2021.
3. Studies in the Canadian surveys. A review process evaluating both the impacts of science surveys on VMEs and the consequences of excluding surveys from VMEs on stock assessment/ecosystem data time series is being conducted by Canada in October 5-9. Since Canadian surveys cover both Canadian and NAFO closures and since many stocks extend across both the Canadian EEZ and the NRA, the analyses for this meeting will include both Canadian and NAFO closures. So, the outcomes of this meeting will be pertinent to both Canada and NAFO. An update on this meeting could be provided at the 2021 June SC meeting.

If the surveys are excluded from the VME closed areas, studies about possible options for non-destructive regular monitoring within closed areas will be necessary.

ii) Identify discard species/stocks with high survivability rates (COM request #4)

The Commission requests the Scientific Council to implement the steps of the Action plan relevant to the SC and in particular the tasks identified under section 2.2 of the Action Plan, for progression in the management and minimization of Bycatch and discards (COM Doc. 17-26), giving priority in 2020 to the identification of discard species/ stocks listed in Annex I.A. and Annex I.B of the NCEM with high survivability rates.

Scientific Council responded:

There are few discard survival rate studies involving NAFO fisheries and the species / stocks listed in Annex I.A. and Annex I.B of the NCEM. SC also notes that there is no clear definition of what is considered ‘high survivability’ rate.

The survival of discarded specimens depends on a multitude of factors related to both the biology and habitat of the species, as well as the conditions of their capture and subsequent release. As a consequence, discard survivability values from a given fishery can not be extrapolated to different fisheries. Furthermore, many of the existing discard survivability studies have been criticized for lacking appropriate experimental controls and/or for having experimental conditions that do not replicate real world conditions sufficiently well.

In order to know the survival of discards from NAFO fisheries, specific studies would need to be designed and carried out. SC notes that the design and development of these studies with the appropriate methodology would be quite complex and require considerable financial and technical means.

There are few discard survival rate studies involving NAFO fisheries and species / stocks listed in Annex I.A. and Annex I.B of the NCEM. To determine the species with high survivability rates, a literature review has been carried out focusing on the species / stocks (NCEM Annex I.A. and Annex I.B) and fisheries (trawl and longliners) that are conducted within the NRA. SC notes that there is no clear definition of what is considered ‘high survivability’ rate. The EU Scientific, Economic and Technical Committee for Fisheries (STECF, 2016) has highlighted that this is a subjective term that involves trade-offs between different management and societal objectives, driven by the management priority for that fishery at that particular time (e.g., improving stock sustainability; improving financial viability; or avoiding waste).

There are several published reviews summarizing the discard survival in other parts of the world (Broadburst *et al.*, 2006; Revill, 2012; Ellis *et al.*, 2017). Most of the studies were made in the field involving towed gears and took place in north Atlantic regions. An overview of the studied species in EU waters, their survival rates and corresponding references has been presented by Rihan *et al.* (2019). Many of the studies have been criticized for lacking appropriate experimental controls and/or for having experimental conditions that do not replicate real world conditions sufficiently, therefore failing to adequately describe the potential variability in survival at the fishery scale or the impact of the method used to estimate the survival rate (STECF 2014, 2015, 2016). Other related reviews compiled studies on the factors influencing mortality of discards (Davis, 2002; Davis and Ryer, 2003; Suuronen, 2005). Most studies agree that discard mortality varies considerably according to (a) species biology: body size, sex, presence/absence of swim bladder, fish condition, tolerance to stress, catch volume and composition; (b) environmental conditions: exposure to air, temperature of water and air, exposure to direct light, and depth fished (pressure and temperature change experienced by the fish); as well as with (c) fishing technical factors: nature of the gear (pot, gillnet, longline, mobile gear), deployment and retrieval of gear, towing speed and duration, handling procedure and duration. The interaction between these factors results in cumulative impacts on discarded fish and resulting survivorship. Much of the research work done on survival has been containment-based and focused on short-term survival (≤ 72 hours) and there is evidence that short-term survival studies may underestimate long-term survival by as much as 50% (Sangster *et al.* 1996). Studies indicate substantial variation in long-term survivorship, characterized either by a rapid initial decrease in survival before stabilizing, or a continual decline (Benoît *et al.* 2012). An additional variable source of discard mortality is introduced by predation by marine mammals (e.g. Couperus 1994), avian predators (Votier *et al.* 2004), and/or other fish upon release of discarded fish. Discards survival studies are increasingly using electronic tagging technology to track discarded fish and assess survival over a longer term period under real-world conditions (Capizzano *et al.*, 2016 and Capizzano *et al.*, 2019).

Due to the large number of factors that affect discard survivability, there can be significant variation in the survival rates of discarded species within individual studies (e.g. Revill, 2012). There are also large variations in a species' discard survival rate reported between studies. These large variations make it difficult to use values from a study in a particular fishery in other similar fisheries. Catchpole *et al.* (2017) reached a similar conclusion and reported that, due to the limited number of survival rate estimates available in the literature, it may be difficult for the time being to extrapolate values across fisheries or gear types and areas, and that more studies are needed to cover a larger scope of gears, species and areas. As the quality of existing studies can be quite variable, the ICES science group on Methods for Estimating Discard Survival recommended and adopted the use of critical review methodology to screen studies before their results are used, notably in meta-analyses (see e.g. ICES 2015, and other reports of the group).

Table 1.1 shows estimated discard survival rates for species in Annex I.A. and Annex I.B of the NCEM, or analogous species, from different studies carried out, especially in the North Atlantic, with similar gears to those used in the NRA. These species are grouped using similar biological characteristics: flatfish, gadoids, deep-sea species, skates and rays, redfish, crustaceans, molluscs and small pelagics. The reported survival rates are highly variable, even within the same species, and depend on many factors beyond those associated with the biology of the species. However, when encountered in similar fisheries, flatfish may generally be expected to have higher discard survivability than gadoids, while survival of redfish discards is considered negligible. The general characteristics of survivability for these groups of species are summarized below.

<u>Survival of flatfish, including the following species / stocks listed in Annex I.A. and Annex I.B: American plaice, Yellowtail flounder, Witch flounder and Greenland halibut.</u>

Discard survival of flatfish is considered to be higher than the survival of gadoids, due to the absence of swim bladder in adult stages; flatfishes are relatively less sensitive to the effect of changes in pressure. This may also indicate a less significant impact of the depth fished on survival of flatfish relative to round fish. Species of flatfish, for example, appear to have relatively good chances of survival (Kelle, 1976; Van Beek *et al.*, 1990), although there is substantial variation within and among flatfish species. One study indicates flatfish survival rates from trawl discards in the Western Baltic range from 0% to 100%, and may only be considered "high" (defined as >75% in this study; Kraak *et al.* 2019) in some species during the first quarter of the year (January-March). Flatfish may be more sensitive than round fish to suffocation in the codend of trawls from pressure on the operculum (Davis, 2002), although at least some flatfish species have low metabolic rates (associated with their more sedentary lifestyle), which may allow enhanced resistance to temporary air exposure during handling (Benoît *et al.*, 2013). The overall characteristics of flatfish make them a candidate for a variety of measures that could reduce discard mortality (Davis and Ryer, 2003).

Discard survival of Greenland halibut has not been quantified, but would be expected to be influenced by similar factors as those affecting other flatfish described here, as well as those relevant for deep-sea species (see below).

<u>Survival of gadoids, including the following species / stocks listed in Annex I.A. and Annex I.B: Cod and White hake.</u>

Fish with gas bladders generally experience significant mortality upon capture in fishing gear. There are studies suggesting that decompression may not be fatal in all cases; however, injuries produced by over inflation of the gas bladder in other organs may be irreversible and lead to death. Discard survival rate studies are mainly focused on cod and show a significant variability depending on the type of gear used.

There are some specific studies on the survival rate of Atlantic cod (Palmer *et al.*, 2011). The factors affecting the mortality and survival of fish discarded by both commercial and recreational fisheries are numerous and complex, as is the case in other species. Many of the studies published on discard mortality utilized short-term studies to estimate the impacts in very controlled environments. Mortality estimates range from near 0 to 100%, with a mean in the range of 40-80%, depending on gear type and study.

<u>Survival of small pelagics, including the following species / stocks listed in Annex I.A. and Annex I.B: Capelin.</u>

Discard survival rates of small pelagics have not been studied broadly. There are not many available studies of discard survival of these species and very few with trawling gear typical of the fisheries in which capelin is caught in the NRA. Major problems in these fisheries are mortalities related to crowding and slipping (Lockwood *et al.*, 1983).

Discard survival from purse seines may be relatively high, as indicated by a recent experiment carried out in the Basque purse seine fleet (Arregi *et al.*, 2013). In this fishery, the use of technological equipment for fish handling has showed to be potentially effective in achieving high survival rates for some discarded species.

Experiments have been carried out with mackerel (Huse and Vold, 2010), horse mackerel, anchovy, and sardine, with survival rates higher than 50% for all species. It is worth highlighting that, in all cases, survival rates for horse mackerel were higher than 89%. Mortality rates of discarded herring varied between fisheries, with survivorship tending to be lower in trawls than in purse seines, and depending on season and size.

<u>Survival of deep-water species, including the following species / stocks listed in Annex I.A. and Annex I.B: Alfonsino.</u>

There is little information on survivability of discarded deep-sea fish in the literature. The majority of the studies carried out relate to sharks (Skomal & Mandelman 2012; Brooks *et al.*, 2015). When deep-sea species are captured, the changes in pressure imply that most species caught and subsequently discarded will not survive (Large *et al.*, 2003). Despite this general conclusion, there are species, like hagfish, that appear to survive quite well (Benoît *et al.* 2013), and those species lacking swim bladders may be expected to have relatively higher survival rates.

<u>Survival of skates and rays, including the following species / stocks listed in Annex I.A. and Annex I.B: Skates.</u>

There are several published reviews summarizing discard survivability of skates and rays (Broadburst *et al*., 2006; Revill, 2012; Ellis et al 2017). One of the most relevant studies on discards survivability of rays with trawl gear in the northwest Atlantic have been carried out by Benoît *et al.* (2012) and Mandelman *et al.* (2012). Survivability has been shown to vary by gear (Dapp et al. 2016), though great variability in survival rates has also been observed for different species for the same gear (Knotek *et al.*, 2018). Different survival studies of discards of these species were analyzed in Europe and their main conclusion was that these species have discard survival rates between 64% and 79% across all gears (STECF-17-21).

Survival of redfish

There is not much information on the survival of redfish discards in the North Atlantic. However, redfish (*Sebastes spp.*) have a closed swim bladder that expands uncontrollably when these fish are brought to the surface quickly; therefore, discarded redfish have been attributed a mortality rate approaching 100% (COSEWIC 2009; Rummer and Bennett 2005; Starr *et al.* 2002).

Survival of crustacean and molluscs, including the following species stocks listed in Annex I.A. and Annex I.B: Shrimp and Squid (*Illex*).

The survival rate of crustaceans largely depends on the extent of the physical damage caused by the fishing and sorting activities (Wassenberg and Hill, 1989). Discards of benthic crustaceans and molluscs tend to have a higher survival rate if discarded in the location in which they are caught.

Potential experiments to study discard survival rates.

ICES has been one of the organizations that has most studied methods to estimate survival rates of discards in recent times, with the goal of advising on the best approaches to produce accurate and robust estimates. ICES established a science group on Methods for Estimating Discard Survival (WKMEDS), referred to earlier in this document, which met multiple times since 2014, to provide guidance on methods to quantify discard survival robustly. Rihan *et al.* (2019) includes a brief summary of the different steps taken by this working group to develop methodologies for estimating survival rates of discards.

WKMEDS published its first draft, to provide guidance on how to quantify discard survival robustly, in April 2014 (ICES 2014). WKMEDS recommended: (i) assessments should be representative of discarded catch and practices, ideally at a fishery, gear type or area scale; (ii) methods should avoid biasing results through observation-induced mortality, and wherever possible demonstrated with appropriate controls; and (iii) the monitoring period should be sufficiently long to observe any delayed mortality attributable to the catch-and-discarding process.

To quantify lethal stress and discard survival, three methodologies were identified: captive observation, tagging/biotelemetry techniques, and vitality/reflex assessments (ICES 2014). In captive observation studies, samples of animals are selected from the discarded catch and monitored to provide estimates of survival rates. Tagging/biotelemetry techniques use tagging technologies to monitor post-release mortality of (tagged) organisms. Vitality assessments quantify the health of organisms at the time of discarding. By combining vitality assessments with one or both of the other two techniques, the at-capture condition may be correlated with an individual's likelihood of post-release survival (Davis 2010). Depending on the strength of such a correlation, a vitality index may be used as a proxy for survival (e.g., Barkley and Cadrin 2012; Morfin *et al.* 2017). The WKMEDS group also developed protocols for systematically reviewing survival assessments and meta-analysing survival data.

The SC notes that the design and development of discard survivability studies with the appropriate methodology is quite complex and requires considerable financial and technical means. For this reason, it is suggested that discard mortality studies only be undertaken for NAFO fisheries if a specific conservation concern is noted based on discard rates and/or stock trajectories.

Table 1.1 Estimated discard survival rates for species in Annex I.A. and Annex I.B of the NCEM, or analogous species. Studies highlighted in Grey indicate discard survival studies carried out in the NAFO Area that include species listed in Annex I.A. and Annex I.B caught with gear similar to those used in the NAFO fisheries.

Species	Gear	Area	Survivor Rate	Comments	Author
American plaice	Trawl	Gulf of St. Lawrence	52%	14-110h holding time	Benoit et al. (2012)
			0%-78%		Jean (2011)
			4%-88%	Various conditions/quality of fish held for 48hrs	Benoit et al. (2010)
		Northeast USA	17%-29%	(3 hr tows) after 72 hrs	Carr et al. (1995)
			44%-66%	44% in summer and 66% in spring at 24 hrs	Robinson and Carr (1993)
		Canada	0%-5%		Powles (1969)
	Shrimp trawl	Northeast USA	40%-97%		Ross and Hokenson (1997)
		Gulf of Maine	81%	1-2 hrs holding tank, avian predation after thrown back also mentioned in study with separate percentages	Hokenson and Ross (1993)
	Longline	Gulf of St. Lawrence	80%	estimate different species of fish	Benoit and Hurlbut (2010)
	Gillnet	Gulf of St. Lawrence	76%	estimate different species of fish	Benoit and Hurlbut (2010)
	RV otter trawl	North Sea	0%-54%	after 84 hours	Van Beek et al. (1990)
Yellowtail flounder	Trawl	New England	30%–60%		Barkley and Cadrin (2012)
		Northeast USA	66%-69%	(3 hr tows) after 72 hrs	Carr et al. (1995)
		Northeast USA	87%	87% in spring at 24 hrs	Robinson and Carr (1993)
	Shrimp trawl	Gulf of Maine	99%	1-2 hrs holding tank, avian predation after thrown back also mentioned in study with separate percentages	Hokenson and Ross (1993)

Witch flounder	trawl	Gulf of St. Lawrence	-	14-110h holding time, no survivor % estimated since only 29 individuals and only 1 of vitatlity class one. Fish usually in poor condition	Benoit et al. (2012)
			50%-75%	Various conditions/quality of fish held for 48hrs	Benoit et al. (2010)
	Shrimp trawl	Northeastern USA	36%-93%		Ross and Hokenson (1997)
		Gulf of Maine	71%	1-2 hrs holding tank, avian predation after thrown back also mentioned in study with separate percentages	Hokenson and Ross (1993)
European plaice	Otter trawl	ICES waters	43%-78%	Compilation of recent studies by different authors	Oliver, M., & McHugh, M. (2018)
	Beam trawlers	ICES waters	12%-35%		Uhlmann, S. et al. (2018)
	otter trawl	North Sea			Van Beek et al. (1990)
Summer flounder	trawl	Eastern US	18%	used telemetry	Yergey et al. (2012)
Cod	Trawl	Gulf of St. Lawrence	32%	14-110h holding time	Benoit et al. (2012)
		Gulf of St. Lawrence	20%-80%		Jean (2011)
		Gulf of St. Lawrence	2%-65%	Various conditions/quality of fish held for 48hrs	Benoit et al. (2010)
		Northeast USA	0%-25%	after 72 hrs for all treatments	Carr et al. (1995)
		Northeast USA	13%-51%	summer=13%, spring=51%	Robinson and Carr (1993)
	Shrimp trawl	Gulf of Maine	64%	1-2 hrs holding tank, avian predation after thrown back also mentioned in study with separate percentages	Hokenson and Ross (1993)
	Longline	Gulf of St. Lawrence	59%	short-term survival (<48 hours)	Benoit and Hurlbut (2010)

		US North West Atlantic	22%-47%	mean = 31% after 72 hrs (range = 22-47%)	Millikien et al. (2009)
	Trawl	North Sea	1%	small fish unaffected since not retained, a percentage of market size fish (39%) sustained serious injuries (eg. spinal fracture) that would affect long term health and survival	de Haan et al. (2016)
		North Sea	66%	88 hrs	Depestele et al. (2014)
		Barents Sea	99.7%	6 days after codend escape	Ingolfsson et al. (2007)
		North Sea	0%	15 min on deck	Evans et al. (1994)
		Norway	>=90%	at 12-16 days after codend escape	Soldal et al. (1993)
	Longline	North west Atlantic	31%-100%	3 day holding cages	Milliken et al. (2009)
			31%-81%	Lower temperatures and shallower depths	Rudolph et al. (2006)
	Handline/pots/otter trawl	/	91%	*gear types not significantly different. Study also included t-bar tags, fish held for 5 days	Brattey and Cadigan (2004)
	Handline	North of Iceland	57%	undersized cod: 32-54% mortality based on water depth, held in cages 4-9 days	Palsson et al. (2003)
	Rod and reel (rec)	Gulf of Maine	83.50%		Capizzano et al. (2016)
	Lab to simulate Danish seine	Lab	25%	10 min of air exposure	Humbostad et al. (2009)
White hake	trawl	Gulf of St. Lawrence	50%-100%	Various conditions/quality of fish held for 48hrs	Benoit et al. (2010)
	Longline	Gulf of St. Lawrence	87%	estimate different species of fish	Benoit and Hurlbut (2010)
		New England	22%-47%	various sizes and hook/injuries, paper also looks at seagull predation on undersized cod	Milliken et al. (1999)

Haddock	otter trawl	Northwest Atlantic	18%-85%		Beamish (1966)
Skates	Trawl	Gulf of St. Lawrence		various estimates rates over many years for different sp.	Benoit (2013)
		Gulf of Maine	77%	Amblyraja radiata	Mandelman et al. (2012)
		Gulf of St. Lawrence	97%	14-110h holding time	Benoit et al. (2012)
		Gulf of St. Lawrence	65% (43%-80%)	Raja sp, estimate different species of fish	Benoit et al. (2012)
		Gulf of St. Lawrence	42%-100%	Various conditions/quality of fish held for 48hrs	Benoit et al. (2010)
	Longline	Gulf of St. Lawrence	42%-100%	Raja sp, estimate different species of fish	Benoit and Hurlbut (2010)
	Trawl	North Sea	81%		Bird et al. (2018)
		Bristol Channel	57%-69%	See Enever et al. (2009)	Catchpole et al. (2017)
		North Sea	72%	Raja sp	Depestele et al. (2014)
		Western Channel	24%-84%	Different species	Ellis et al. (2012)
		VII ICES	55%-87%	Different skates species	Enever et al. (2009)
		UK waters	59%		Kaiser and Spencer (1995)
winter skate	sink gillnet	North Atlantic (US)	83%-89%	Mortality (11%=female, 17=male. 170hr hold time)	Sulikowski et al. (2018)
Redfish	hook-and-line	USA Pacific	70%-100%	USA Pacific Sebastes spp.	Hannah et al. (2012)
		USA Pacific	68%	21 spp. USA Pacific Sebastes. Various survival rates based on various traumas. 68% for 10 min hold after capture as well as 2day recompressed	Jarvis et al. (2008)
Shrimp	Shrimp beam trawl	Portugal	58%-100%	Misc. crustacea	Cabral et al. (2002)
	Fish beam trawl	UK	55%-100%	Misc. crustacea	Kaiser and Spencer (1995)

	Shrimp trawl	Australia	46%-100%	Misc. crustacea	Wassenberg and Hill (1993)
		Australia	33%-80%	Misc. crustacea	Hill and Wassenberg (1990)
		Australia	85%	Misc. Crustacea,survival after 8 hrs of sorting	Wassenberg and Hill (1989)
Spot prawn	lab experiment	USA Pacific	0%-100%	various exposure times and dropping from hieghts	Stoner (2012)
Crangon shrimp	beam trawl	Portugal	0%-96%	various sorting times, temperatures and tow times	Gamito (2003)
	shrimp trawl	UK	77%-80%	study is on undersized shrimp, includes seabird predation	Lancaster et al. (2002)
	shrimp trawl	Australia	65%	juvenile prawns	MacBeth et al. (2006)
Squid	beam trawl	U.K.	87%-100%	Mollusc in general	Kaiser and Spencer (1995)
	Shrimp trawl	Australia	100%	Mollusc in general	Wassenberg and Hill (1993)
squid – *Loligo*	trawl	Australia	2%	10 min exposure on deck	Hill and Wassenberg (1990)
Cephalopods general	shrimp trawl	Australia	55%	45% floating after discard (mortality)	Hill and Wassenberg (2000)
Herring	trawl		0%-56%	size dependant. 14 day observation in holding cages	Suuronen et al. 1996c
			12%-89%	codend escapees. 7 day post capture observations	Suuronen et al. 1996a
	purse seine simulation	North sea	40%-93%	various experiments with varying loss of scales	Olsen et al. (2012)
			1.6%-52%	Different stocking/crowding densities	Tenningen et al. (2012)
	seine and handline		45%-91%	season dependant - gear used as control for above experiment. 14 day observation in holding cages	Suuronen et al. 1996c

			87%-91%	held in cages 9-16 days. Control for above experiment	Suuronen et al. 1996a
Mackerel	purse seine		10%-50%	various stocking densities tested, 48 hr observation time	Lockwood et al. (1983)
Sardine	purse seine	Portugal	<20->80%	on month observation time, high variability between trials for % survival	Marcalo et al (2008)
General discussion on discard mortality					Benoit et al. (2020)
					Cook et al. (2019)
					Rihan et al (2019)
					Benoit et al. (2015)
					Knotek et al. (2015)
				Sub lethal effects examined	Wilson et al. (2014)
				review of studies if considered predation of discards	Raby et al. (2014)
				time to mortality experiments in air	Benoit et al. (2013)
					Revill (2012)
					Broadhurst et al. (2006)
				review of studies on collateral fishing mortality from towed gear	Ryer et al. (2004)
				review on discard mortality and studies	Davis (2002)

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iii) Identify areas and times where bycatch and discards of Greenland sharks have a higher rate of occurrence (COM request #9)

This request was deferred until June 2021

iv) Develop a 3-5 year work plan (COM request #10)

Due to time limitations, this was only discussed briefly in the meeting. Progress on this will continue in 2021.

v) Review submitted protocols for a survey methodology to inform the assessment of splendid alfonsino (COM request #13)

The SC notes that in relation to Commission request 13 on protocols for a survey methodology to inform the assessment of Splendid Alfonsino, an SCR (SCR 20/36) has been presented with a sampling plan for an acoustic survey of Kükenthal Peak (NAFO Division 6G) to quantify alfonsino (*Beryx splendens*) biomass, abundance and size composition. Due to the current COVID situation, the SCR has not been reviewed by the SC at its June or September 2020 meetings and it is postponed to the next meeting in June 2021. The SCR is available for review by SC members, who are requested to send comments and suggestions to the authors before March 2021.

vi) Presentation of the stock assessment and the scientific advice of Cod 2J3KL (Canada), Witch 2J3KL (Canada) and Pelagic Sebastes mentella (ICES Divisions V, XII and XIV; NAFO 1) (COM request #14)

Presentation of the stock assessment and the scientific advice of Cod 2J3KL (Canada), Witch 2J3KL (Canada) and Pelagic Sebastes mentella (ICES Divisions V, XII and XIV; NAFO 1) (COM request #14)

The COM request that the results of the stock assessment and the scientific advice of Cod 2J3KL (Canada), Witch 2J3KL (Canada) and Pelagic Sebastes mentella (ICES Divisions V, XII and XIV; NAFO 1) to be presented to the Scientific Council (SC), and request the SC to prepare a summary of these assessments to be included in its annual report.

Scientific council responded:

Cod in Divisions 2J3KL

The results of the most recent stock assessments and scientific advice of Atlantic cod (*Gadus morhua*) ("Northern cod", Divs. 2J3KL) were presented to Scientific Council (SC). The summary is as follows:

The Atlantic cod *Gadus morhua* stock on the Newfoundland and Labrador continental shelf in NAFO Divs. 2J3KL ("Northern cod") is typically assessed annually by Fisheries and Oceans Canada using an age-structured state-space model (Northern Cod Assessment Model; NCAM, Cadigan 2016a and 2016b). A conservation limit reference point (LRP) was established for Northern cod in 2010 (DFO 2010), re-evaluated in 2019 (DFO 2019a), and is defined as the average spawning stock biomass (SSB) during the 1980s. This reference point is the stock level below which serious harm is occurring and the ability to produce good recruitment is seriously impaired. This reference point also defines the boundary between the critical and cautious zones within Fishery and Oceans Canada's (DFO) Precautionary Approach (PA) framework (DFO 2009).

The 2019 stock assessment reported that the Northern cod spawning stock biomass (SSB) remained at 48% (95% CI = 37-63%) of the Limit Reference Point, in the Critical Zone of DFO's PA framework (DFO 2009; DFO 2019b) (Figure 1.2). SSB was 398 Kt in 2019 (95% CI = 306-518 Kt).

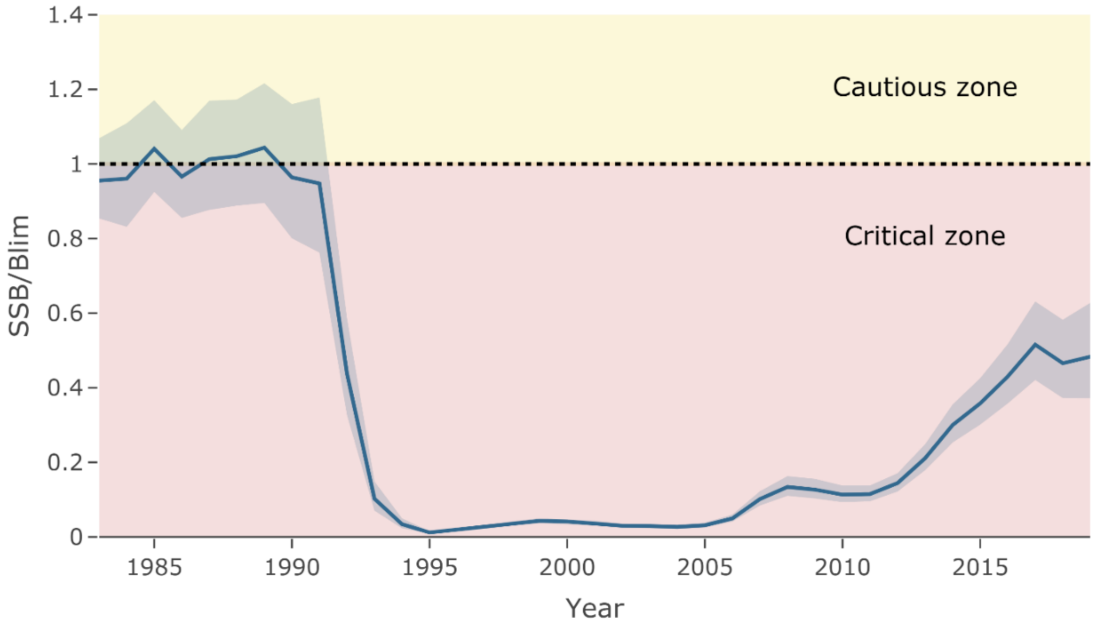

Figure 1.1. SSB/B_{lim} for Northern cod from NCAM (1983-2019) from the 2019 assessment.

The advice from this assessment stated: "Consistency with the DFO decision-making framework incorporating the precautionary approach requires that removals from all sources must be kept at the lowest possible level until the stock clears the critical zone". Projections carried out at that time with six catch scenarios ranging from zero to 1.3 times the model estimated catch for 2018 (13,796 t) indicated that the probability that SSB would reach the LRP by 2022 ranged between 6-9%.

In 2020, the global COVID-19 pandemic disrupted the full stock assessment scheduled for March 24-27 (DFO 2020 draft). Instead, a stock update was conducted remotely in lieu of a full assessment. The assessment model (NCAM) and associated projections were not run as part of this stock update.

Ecosystem conditions in the Newfoundland Shelf and Northern Grand Bank (NAFO Divs. 2J3KL) are indicative of limited productivity of the fish community. Total RV ecosystem biomass level remains much lower than prior to the ecosystem collapse in the early-1990s.

Recent declines in average cod stomach content weights as well as reductions in capelin and shrimp in the diet, coupled with an apparent relative increase in cannibalism, point to a limitation in food availability. With capelin forecasted to decline in 2020, cod productivity will likely be negatively impacted.

Annual average removals from the commercial (stewardship) fishery were 11,000 t over 2016-2019 (Figure 1.1) and removals from recreational catches were 1900 t (estimated from tagging data) over the same time period.

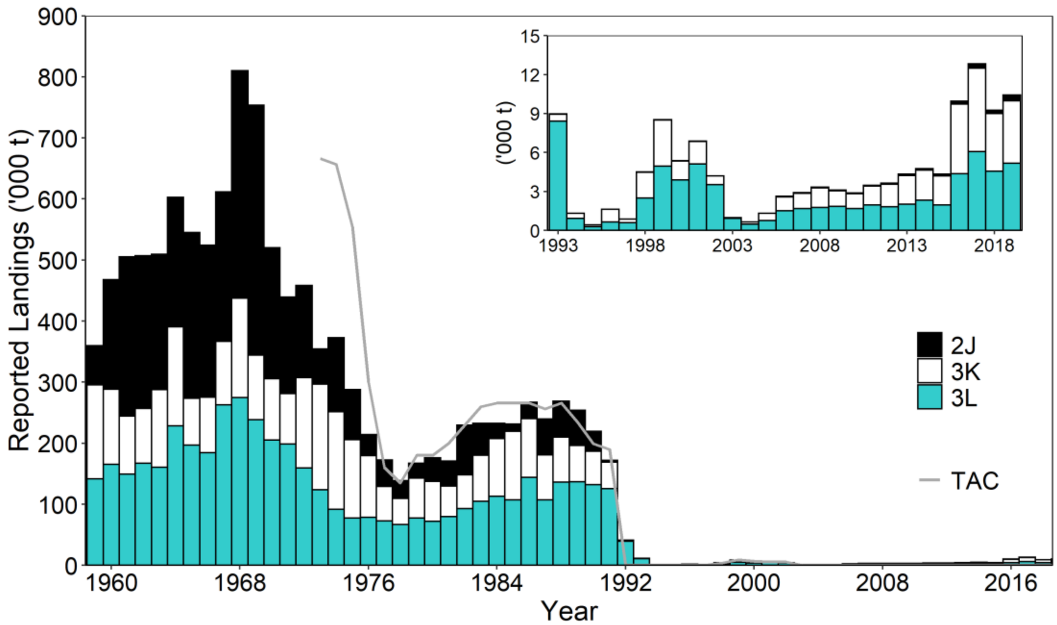

Figure 1.2. Landings (bars) and TAC (lines) for Atlantic Cod in Div. 2J3KL by Division from 1959 to 2019 (and inset plot show 1993-2019).

The fall 2019 observed RV cod survey biomass falls in the range of expected values based on projected values from NCAM from the March 2019 assessment (Figure 1.4).

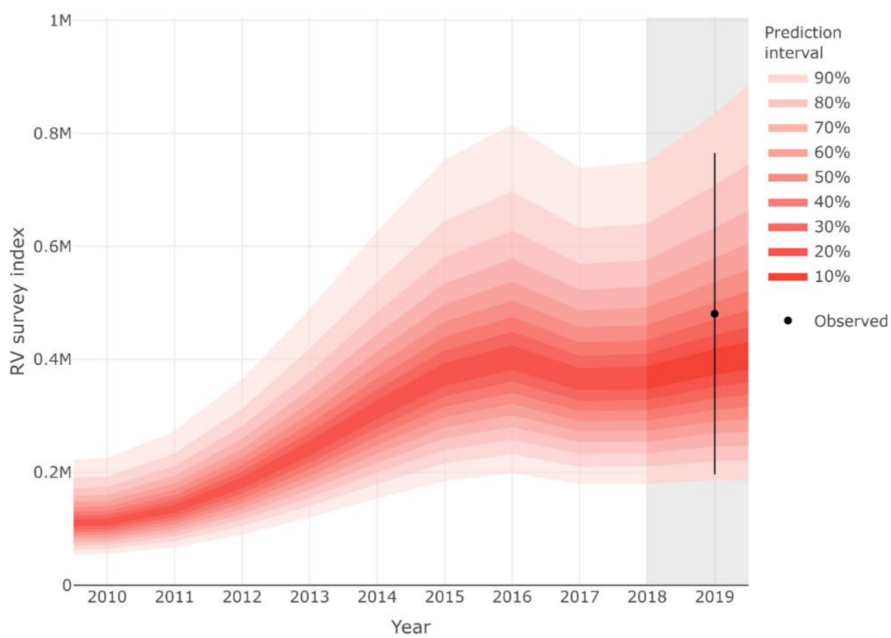

Figure 1.3. NCAM projected RV survey indices with prediction intervals (red envelope) from the 2019 stock assessment with observed RV biomass (black circles with 95% Confidence Intervals).

However, RV cod survey biomass indices increased between 2011-2016 and have subsequently leveled off, remaining low relative to the 1980s. Sentinel cod survey index increased from the early-2000s to 2014 but has since decreased.

Under current ecosystem conditions and recent levels of catch, the lack of increase in cod survey indices since 2016 suggests that stock growth may have stalled.

The 2020 stock update was consistent with the advice from the 2019 assessment; removals from all sources must be kept at the lowest possible levels.

SC comments

Scientific Council **endorsed** the conclusions of both the assessment results and advice. SC asked for some clarification on the objectives and management measures from the stewardship fishery, given that catches are occurring.

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Witch flounder in Divisions 2J3KL

The results of the most recent stock assessment and advice of witch flounder (*Glyptocephalus cynoglossus*) in Div. 2J3KL were presented to SC. The summary is as follows:

The last assessment of witch flounder in NAFO Divs. 2J3KL was completed by Fisheries and Oceans Canada (DFO) in May, 2018 (DFO 2019, Wheeland et al. 2019). This stock has been under moratorium in Canadian waters since 1995, and in the NAFO regulatory area since 1998. Bycatch of witch flounder averaged 106 t annually from 2015-19 (Figure 1.4), and is primarily taken in the Canadian Greenland halibut fishery.

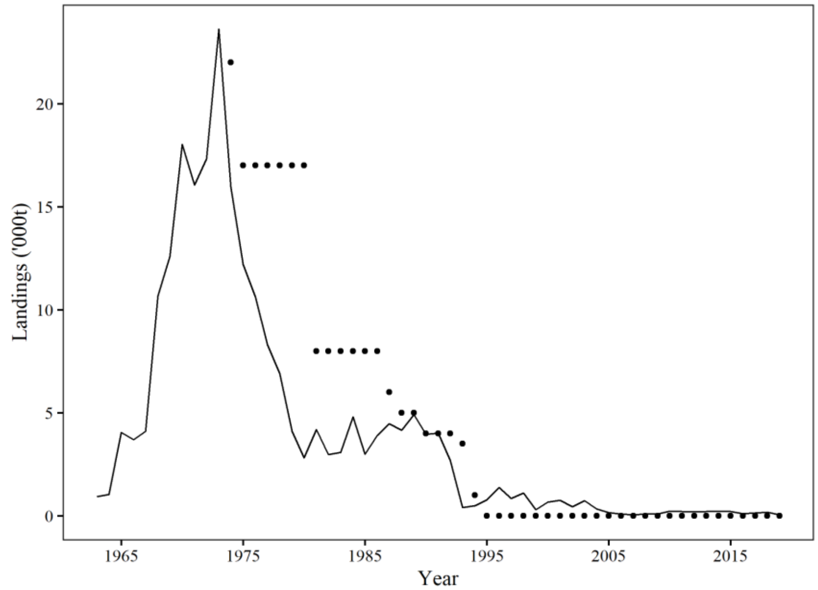

Figure 1.4. Landings (1963-2019, line) and TAC (points) for witch flounder in Div. 2J3KL.

The assessment of this stock is based on indices from Canadian-autumn RV surveys of NAFO Div. 2J3KL, and commercial catch (by-catch) data. A biomass Limit Reference Point (LRP) within the Canadian PA framework is set at B_{LIM} = 0.4 B_{MSY}-proxy, where the B_{MSY}-proxy is the average survey biomass of years 1983-1984 (DFO 2019). In 2016 and 2017, indices of biomass (Figure 1.5) and abundance reached the highest levels since 1990, but remained below the levels of the mid-1980s. Abundance of fish <23cm indicates improved recruitment since 2013 (Figure 1.6). B_{2017} was below the LRP, and the stock is in the Critical Zone of the Canadian Precautionary Approach framework. Consistency with the DFO decision-making framework incorporating the precautionary approach requires that removals from all sources must be kept at the lowest possible level until the stock clears the critical zone.

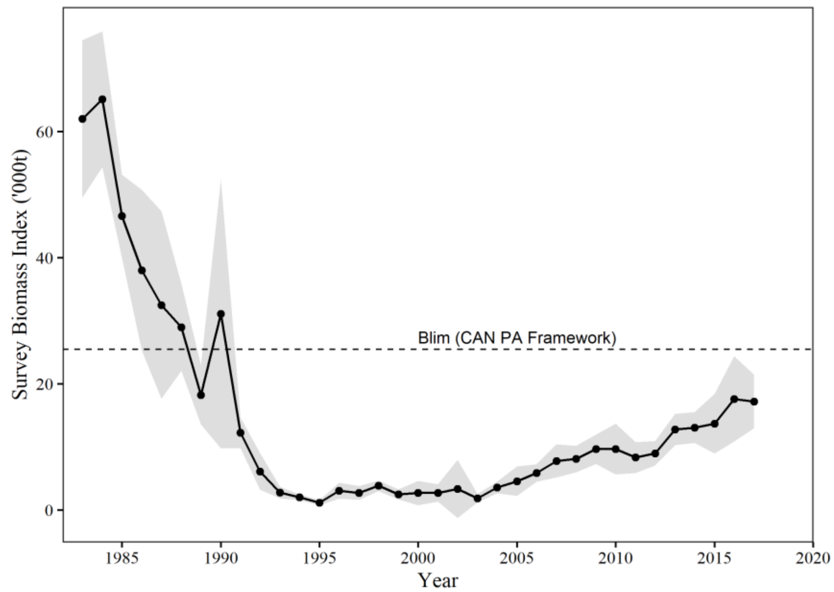

Figure 1.5. Survey biomass for witch flounder in Div. 2J3KL (1983-2017), shaded area represents the 95% CI. Horizontal line indicates B_{LIM} (40% B_{MSY}-proxy) under the Canadian PA framework.

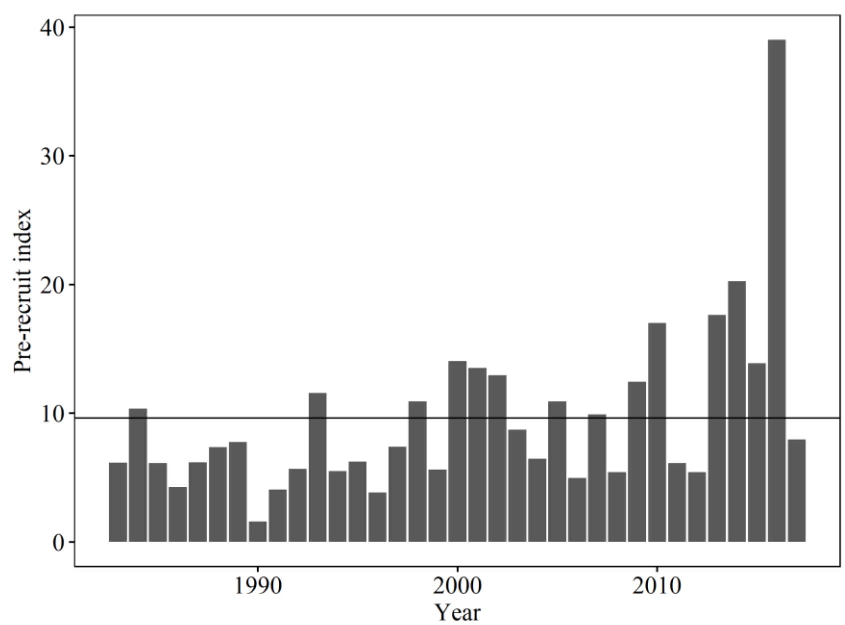

Figure 1.6. Pre-recruit index (abundance <23cm) for witch flounder in NAFO Div. 2J3KL (1983 to 2017). Horizontal line indicates the time series mean.

A full assessment by Canada-DFO of this stock is planned for early 2022. In years between full assessments survey biomass trajectory is monitored (see DFO 2019 for details on the agreed procedure) to determine if there is a need for an assessment. Survey indices from 2018 and 2019 have not been fully peer reviewed at this time, but an assessment has not been triggered.

SC comments

Scientific Council **endorsed** the conclusions of both the assessment results and advice. Scientific Council **noted** that a Limit Reference Point is also defined under the NAFO PA framework based on the B_{MSY}-proxy at the average survey biomass of years 1983-1984 (SCR Doc. 18-050 , NAFO SCS 18-19). However, under the NAFO framework B_{LIM} is set at 0.3 B_{MSY}-proxy. As of 2018 (the time of the last interim monitoring report from NAFO SC and the last Canada-DFO assessment) the stock remained below the LRP under both frameworks, and advice indicated no directed fishing for this stock.

References

DFO. 2019. Stock Assessment of Witch Flounder (*Glyptocephalus cynoglossus*) in NAFO Divisions 2J3KL. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/053.

Pelagic Sebastes mentella in ICES Divisions V, XII and XIV and NAFO Subarea 1

The results of the most recent stock assessments and scientific advice of pelagic redfish (*Sebastes mentella*) in ICES Divisions V, XII and XIV and NAFO Subarea 1 were presented to Scientific Council. The summary is as follows:

ICES considers that there are two pelagic stocks of the species in the Irminger Sea and adjacent waters:

- a Shallow Pelagic stock (NAFO 1-2, ICES 5, 12, 14, <500 m)
- a Deep Pelagic stock (NAFO 1-2, ICES 5, 12, 14, >500 m)

The decision to classify pelagic redfish as two stocks was not unanimous in ICES. Russia's position regarding the structure of the redfish stock in the Irminger Sea and adjacent waters is that there is a single stock of pelagic *Sebastes mentella* in that area.

The last ICES assessment of the two stocks ("Shallow Pelagic" and "Deep Pelagic" stocks) was in 2019. The stock relevant to NAFO is the shallower stock since is the one that extents more to the NAFO areas, catches of the Deep Pelagic stock are scarce or null in NAFO areas (Figure 1.7).

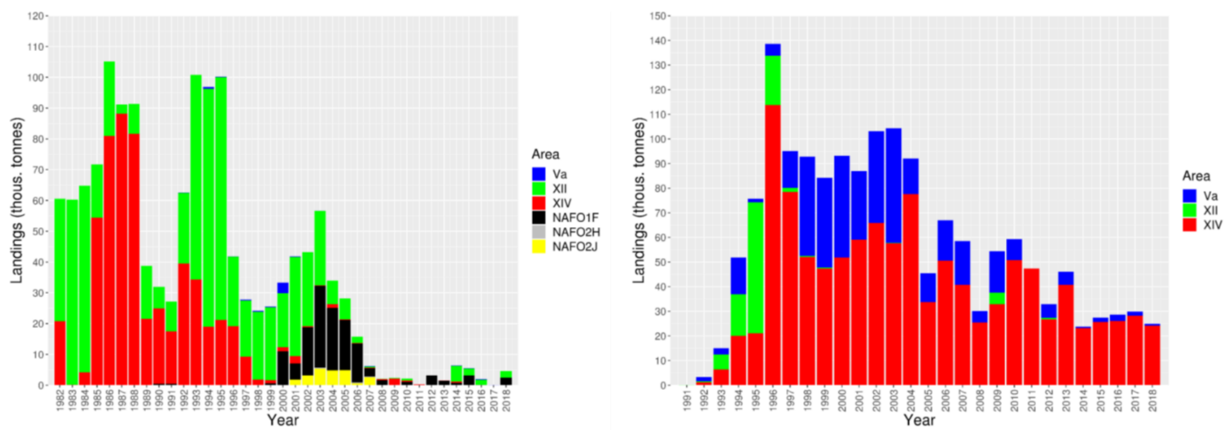

Figure 1.7. Catches of shallow pelagic stock (left panel) and deep pelagic stock (right panel) by area.

Acoustic surveys are conducted on pelagic redfish in the Irminger Sea and adjacent waters. An international trawl-acoustic survey (conducted by Iceland, Germany and Russia with Norway participating also in 2001) was carried out biennially 1999 – 2015 and then in 2018. The next survey is planned for 2021.

"Shallow pelagic" Stock Assessment

No analytical assessment is carried out due to data uncertainties and the lack of reliable age data. The assessment is based on survey indices, catches, CPUE and biological data.

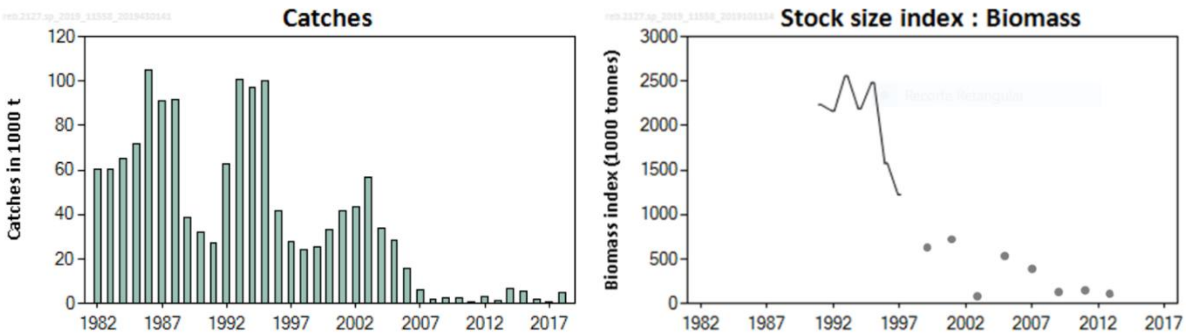

Figure 1.8. Beaked redfish in ICES subareas 5, 12, and 14 and in NAFO subareas 1 and 2 (shallow pelagic stock < 500 m). Left: Catch over time in thousand tonnes. Right: Stock size index (biomass) from the acoustic survey (in tonnes) in the Irminger Sea and adjacent waters. The line represents yearly values from 1991 to 1997 and points represent the international trawl-acoustic survey since 1999 (insufficient survey coverage after 2013).

The last available biomass index from the acoustic survey in 2013 indicates that the stock has declined to less than 5% of the estimates at the beginning of the survey time-series in the early 1990s (Figure 1.8). The exploitation rate for this stock is unknown.

ICES has advised that when the precautionary approach is applied, there should be zero catch in each of the years 2020 and 2021.

"Deep pelagic" Stock Assessment

The ICES assessment uses a length-structured model (Gadget).

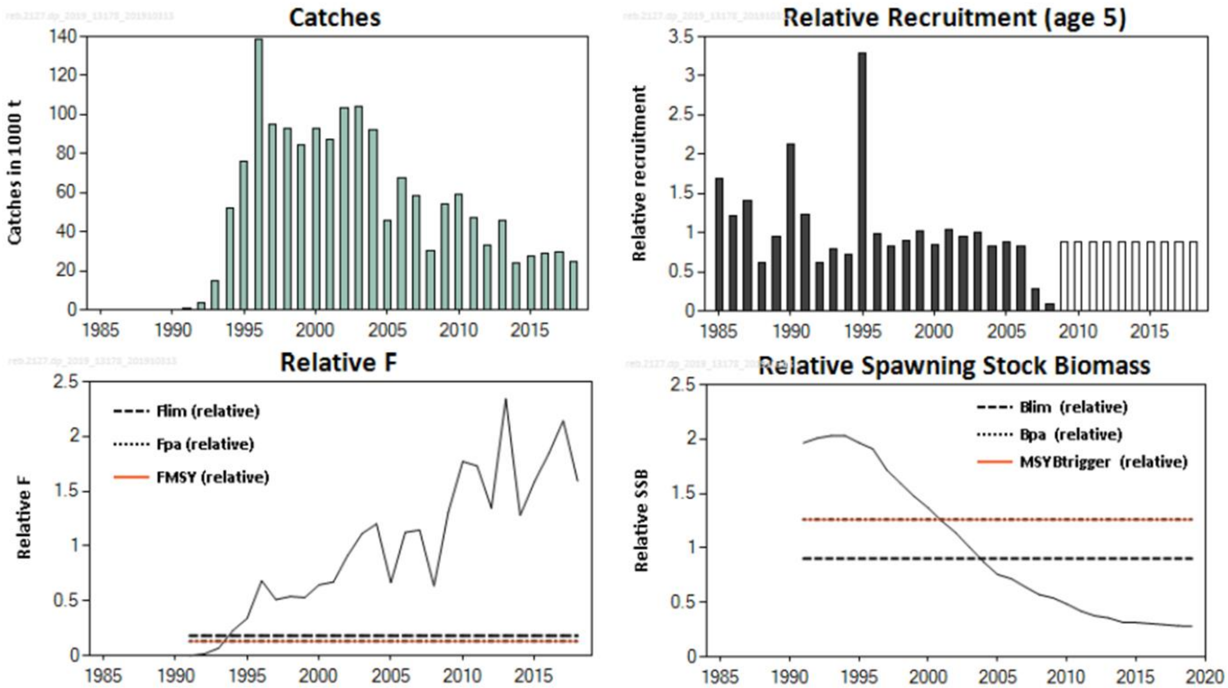

Figure 1.9. Beaked redfish in ICES subareas 5, 12, and 14 and in NAFO subareas 1 and 2 (deep pelagic stock > 500 m). Top left: Catches (thousand tonnes). Top right: Relative recruitment (R) at age 5. Relative recruitment (R) since 2009 is assumed to be at the geometric mean of 1985–2008. Bottom left: Relative fishing mortality (F). Bottom right: Relative spawning-stock biomass (SSB). R, F, and SSB are expressed relative to the average of the time-series (1985–2018 for R, 1991–2018 for F, and 1991–2019 for SSB).

The spawning-stock biomass (SSB) has been declining since the mid-1990s and has been below B_{lim} since 2005. The fishing mortality (F) shows an increasing trend since the beginning of the fishery in 1991. The F has been above F_{MSY} since 1994 and above F_{lim} since 1995. Recruitment (R) estimates were stable between 1996 and 2006. Recruitment estimates in 2007 and 2008 were low.

ICES has advised that when the MSY approach is applied, there should be zero catch in each of the years 2020 and 2021.

ICES comments relating to both "shallow" and "deep" pelagic stocks

The total catches by all countries fishing for pelagic redfish have considerably exceeded the sum of ICES advised catch for both shallow pelagic and deep pelagic redfish stocks. This is particularly clear since 2017, when the advice was for zero catch for both stocks.

In recent years ICES has not obtained catch estimates disaggregated by depth from all countries (ICES, 2019). ICES **recommends** that all countries should report depth information on a haul basis, in accordance with the NEAFC logbook format. Action is needed through NEAFC and NAFO to provide ICES with timely and complete information that may lead to more reliable catch statistics.

SC Comments

Scientific Council **endorsed** the conclusions of both the ICES assessment results and its advice. NAFO SC will work with the Secretariat to clarify the comment about catch information made by ICES in relation to NAFO.

References and source of information

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ICES 2020: ICES. 2020. North Western Working Group (NWWG). Draft Report. ICES Scientific Reports. 2:51. 431 pp. http://doi.org/10.17895/ices.pub.6051.

ICES Advice 2019 – reb.2127.dp – https://doi.org/10.17895/ices.advice.5606.

ICES Advice 2019 – reb.2127.sp – https://doi.org/10.17895/ices.advice.5607.

Stock Annexes
https://www.ices.dk/sites/pub/Publication%20Reports/Stock%20Annexes/2015/smn-sp_SA.pdf
http://ices.dk/sites/pub/Publication%20Reports/Stock%20Annexes/2015/smn-dp_SA.pdf

vii) Updates on the potential impact of activities other than fishing (COM request #16)

Continue to monitor and provide updates resulting from relevant research related to the potential impact of activities other than fishing in the Convention Area (for example via EU ATLAS project), and where possible to consider these results in the on-going modular approach concerning the development of Ecosystem Summary Sheets".

Scientific Council Responded:

SC conducted a preliminary assessment of seabed litter recovered from EU-Spain groundfish survey trawls in Division 3L. Results indicate a generally low occurrence and density of seabed litter with only 8.3% of the total hauls having seabed litter present, however, 62% of the seabed litter sampled were identified as being associated with both NAFO managed and non-managed fishing activities. To facilitate the on-going monitoring and assessment of seabed litter in the NAFO area, SC recommends to the Commission that standardized protocols for seabed marine litter data collection should be implemented by all Contracting Parties as part of their groundfish surveys.

SC reiterates its prior advice that there are a number of activities occurring in the NAFO Area (especially oil and gas activities) which have the potential to impact fisheries resources and the ecosystem, and that current expertise within SC WG-ESA in particular, and SC in general, is insufficient to fully assess the long term, cumulative impacts of these activities on the wider marine ecosystem and specifically VMEs.

SC notes that while there is an apparent significant spatial conflict between oil and gas exploration and proposed production activities, fisheries and VME in the Flemish Pass area, activities other than fishing occurring in the NRA are not formally, nor regularly reported to SC.

Furthermore, SC notes that in terms of trends of oil and gas activities, it is expected (based on current exploration leases and development projections) that oil and gas exploration activities are forecast to increase in the NRA until at least 2030.

Results from studies presented here, based on the EU ATLAS project and publicly available information, have been included where appropriate into the current 3LNO Ecosystem Summary Sheet (ESS), noting that periodic up-dates in the ESS of these activities is dependent on the significant commitment from

Contracting Parties (CPs) to provide the necessary expertise to evaluate the potential conflict between activities and the potential consequences or impacts of incidents associated with oil and gas activities.

Seabed litter in NAFO Division 3L

To assess the potential extent and magnitude of seabed litter in the NAFO Regulatory Area, SC reviewed the results of a pilot study conducted under the EU ATLAS project which analyzed an extensive database based on EU-Spain groundfish surveys in Division 3L (García-Alegre *et al.,* 2020). A total of 1,169 trawls were analyzed for the 2006-2017 period, ranging from 104 m to 1478 m depth. Litter items retained in the bottom trawl hauls were examined and recorded using a standardized litter monitoring protocol. Results indicate a generally low occurrence and density of seabed litter with only 8.3% of the total hauls having litter present with mean densities of 1.4 ± 0.4 items/km^2 and an average weight of 10.6 ± 5.2 kg/km^2. The highest densities of seabed litter were found in the deepest areas located in the Flemish Pass channel and down the northeastern flank of the Grand Bank. Fisheries were the principal source of seabed litter; 61.9 % of the hauls with litter present were fishery related (Fig. 1). In most cases litter consisted of small fragments of rope but in some, litter consisted of entire traps or nets. Plastics, metal, and other anthropogenic litter were the next most abundant categories. **SC recommends** to the Commission that *standardized protocols for seabed litter data collection should be implemented by all Contracting Parties as part of their groundfish surveys conducted in NAFO Regulatory Area. Implementation of such protocols would allow the regular monitoring and assessment of the spatial and temporal distribution of seabed litter.*

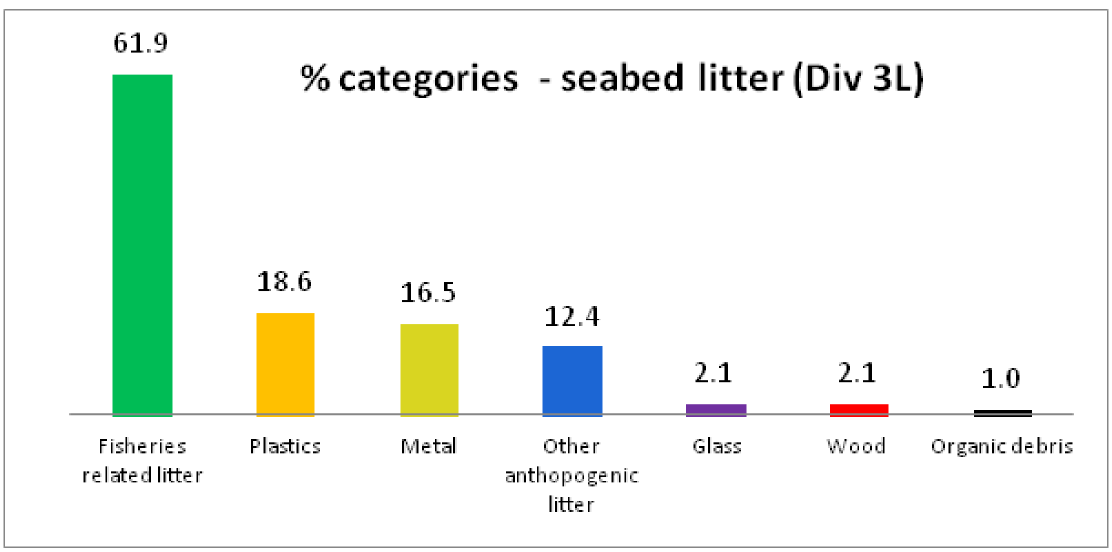

Figure 1.10. Percentage of the occurrence of the different litter categories by trawls with litter presence.

ATLAS Project: updates on potential impact of activities other than fishing - oil and gas

ATLAS (www.eu-atlas.org) is a multidisciplinary international project funded by the EU Horizon 2020 program. ATLAS is testing a generic Marine Spatial Planning (MSP) framework developed by the EU FP7 MESMA project to assess theoretical spatially managed areas (SMAs) in all 12 of the ATLAS Case Studies, one of which is the Flemish Cap/Flemish Pass within the NRA. Studies have shown the impacts of fishing on VMEs (NAFO 2016), while oil and gas can have detrimental environmental effects during each of the main phases of exploration, production, and decommissioning (Cordes et al., 2016), but the impact has not been assessed within the NRA. The present MSP exercise (Durán Muñoz *et al.,* 2020) pays special attention to the apparent significant spatial overlap between oil and gas exploration and proposed production activities, fisheries and VME in the Flemish Pass area, as well as to the potential conflicts between users of the marine space (e.g. reduction of fishing opportunities) and between users and the environment (Fig. 2). This map reveals the overlap (and potential conflicts) between different regulatory and jurisdictional frameworks (e.g. areas closed to bottom fishing are currently open to oil and gas exploration and production).

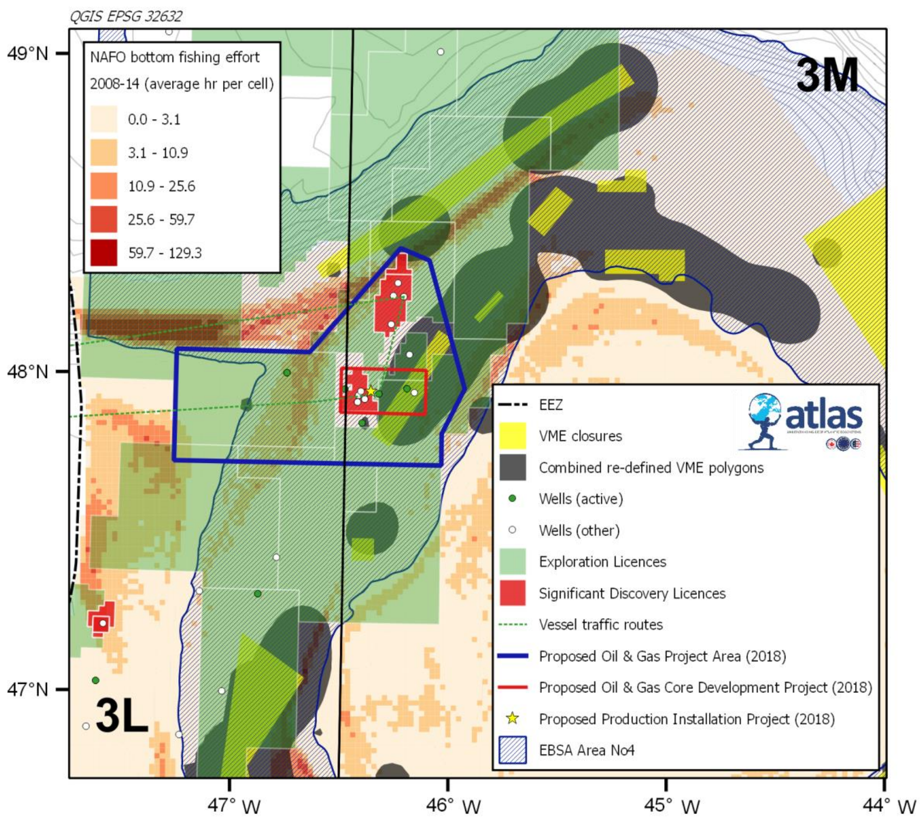

Figure 1.11. Map of the Flemish Cap-Flemish Pass area (Div. 3LM) showing the potential conflicts between different users of the marine space (e.g. oil and gas vs. fisheries) and between users and environment (oil and gas vs. VMEs). The yellow star indicates the location of the proposed production installation within the Bay du Nord Development Project (outlined in blue). Sources (2018): NAFO, C-NLOPB and CBD.

Synthesis of offshore petroleum activities in 3KLMN

Offshore petroleum activities have been occurring in NAFO divisions 3KLMN for decades. The first drilling activities began in the 1960s, reservoirs were discovered in the 1970s and by 1997 the first oil producing platform (Hibernia) began operation. Today the most intense offshore activity is concentrated in 3L with four petroleum producing platforms assembled in the Jeanne d'Arc basin area. 3KMN is currently subject to exploration activity only, except for the relatively recent significant development licenses located in the Bay du Nord area in 3M (Fig. 3).

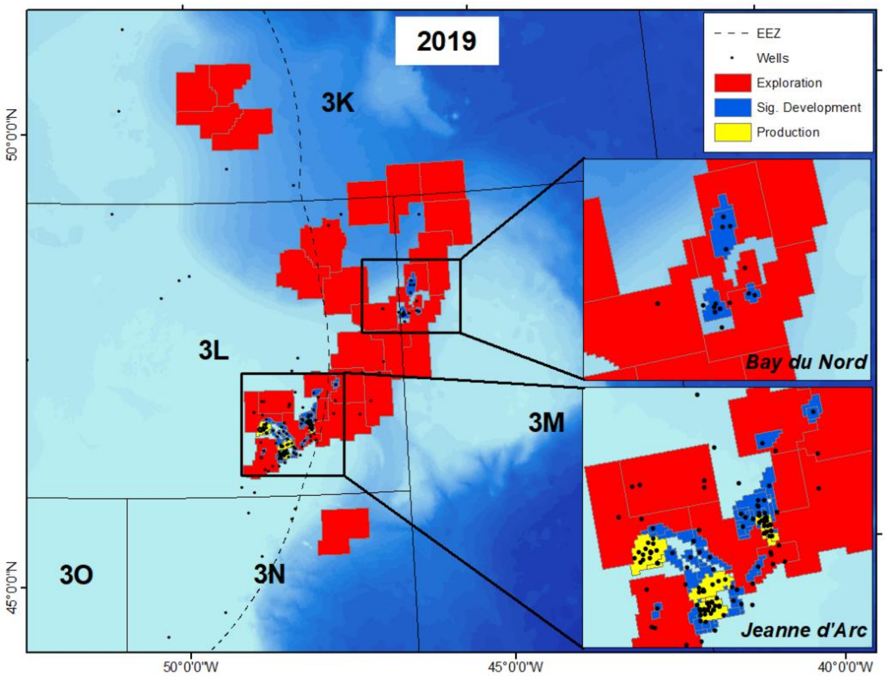

Figure 1.12. Offshore licenses and wells in 3KLMN (2019)

The number of wells and licensed areas over time in 3KLMN is shown in Fig. 4 using data obtained from the Canada-Newfoundland Labrador Offshore Petroleum Board (C -NLOPB).

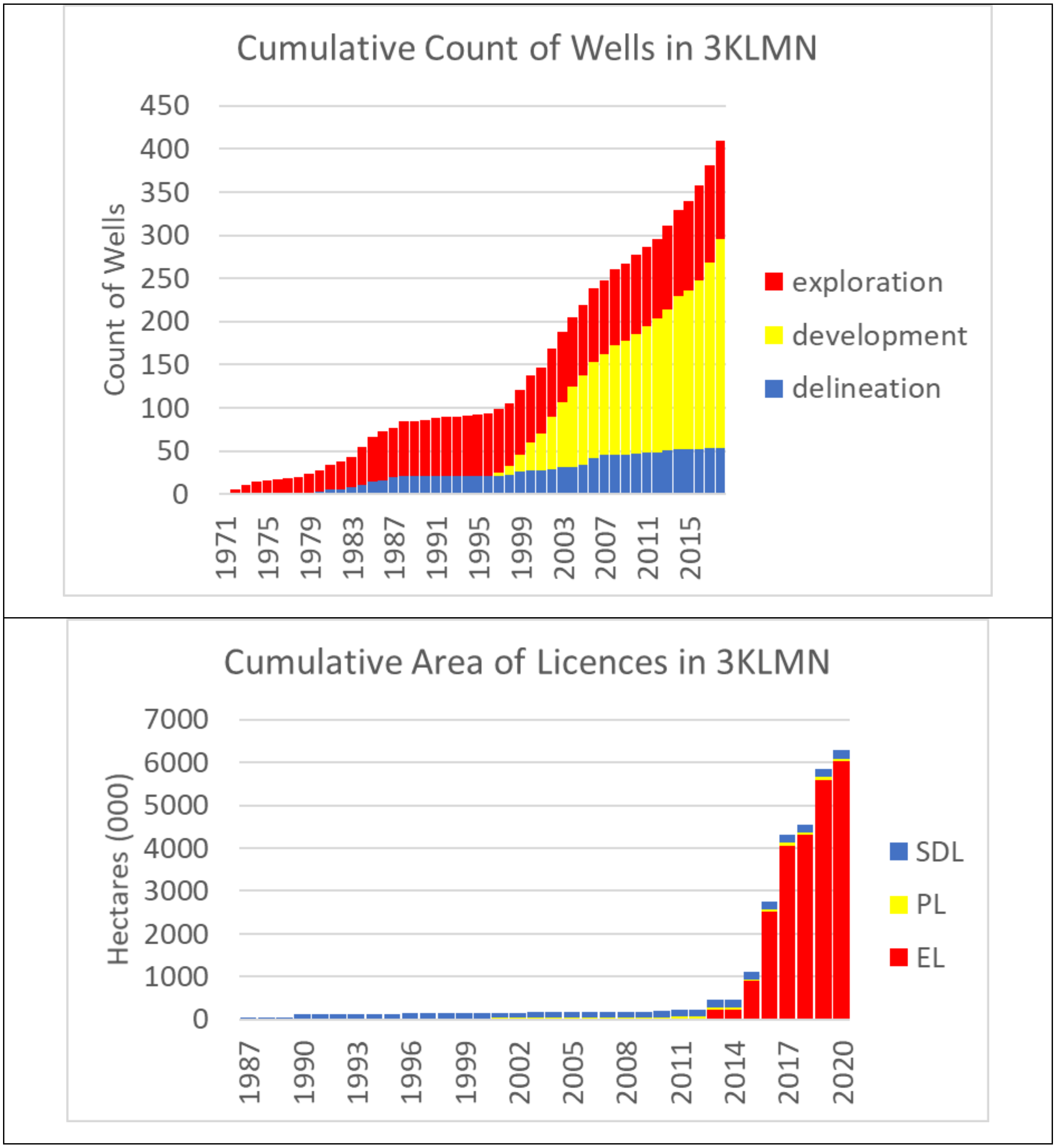

Figure 1.13. Cumulative number of offshore wells (top) and cumulative area of offshore licenses (bottom) in the 3KLMN region (source: www.cnlopb.ca). EL (exploration licenses), PL (production licenses), SDL (significant development licenses).

SC notes an increasing trend in oil and gas activities since the early 2000's and that this trend it is expected (based on current exploration licenses and development projections) to increase in the NRA until at least 2030. As of 2019, there are four offshore production fields on the Grand Banks and intense exploration activities along the eastern shelf break and Flemish Pass. Furthermore, during the period 2015-2019 there have been ten reported incidents of different types, with a major oil spill reported in 2018 (250,000 litres), and one in 2019 that occurred in the EEZ of the coastal state but extended into the NAFO Regulatory Area.

Results presented here have been included where appropriate into the current 3LNO Ecosystem Summary Sheet (ESS), noting that periodic up-dates in the ESS of these activities is dependent on the significant commitment from Contracting Parties (CPs) to provide the necessary expertise to evaluate the potential conflict between activities and the potential consequences or impacts of incidents associated with oil and gas activities.

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viii) Information on sea turtles, sea birds, and marine mammals that are present in NAFO Regulatory Area (COM request #18)

Scientific Council noted that WG-ESA, in their November 2019, prepared a draft response covering marine mammals and turtles, but not seabirds (SCS Doc. 19-25). SC agreed the following plan for finalizing the response to this request by June 2021:

- SC seabird experts (and any other needed participants) will plan to have a virtual meeting towards the end of 2020 (possibly WG-ESA in November 2020) to:
  - Exchange what information is available and discuss in light of currently available information in the response on marine mammals and turtles.
  - Plan what level of information will be included in the response for seabirds
  - Divide the work appropriately and plan a future virtual meeting to discuss progress during the first quarter of 2021.
- By April 2021 have draft seabird text to be combined with existing text on marine mammals and turtles.
- Finalize response to present to SC in June 2021.

2. Requests Received from the Commission during the Annual Meeting

i) Regarding 3M cod: From European Union (COM WP 20-12)

The COM in its request for scientific advice for 2021 asked the Scientific Council to provide advice on gear, including sorting grids, area and time-based measures that could be used to protect and improve the productivity of the 3M cod stock.

*With respects to the area closures, the Scientific Council in its June meeting responded to this COM request by advising that: "… **a seasonal closure** (no directed fishery on 3M cod during the first quarter of the year) would **protect spawning activity**, reducing the number of spawning fish that are captured and allowing them to spawn before becoming available to the fishery."*

*In its response the SC further advised that "The implementation of such measures should be **accompanied by a clear definition of the objectives** (determine if and how closure effectiveness could be monitored) and a **monitoring plan** to study the impact that these measures may have on the fishery and ecosystem."*

As regards the two points highlighted above from the SC response, the EU would like to seek further guidance from the Scientific Council on the following points:

1. *Should the seasonal closure of directed fisheries for 3M cod during the first quarter of the year be extended to the full Flemish cap area - NAFO division 3M - or should this prohibition instead, cover a particular area within the NAFO division 3M where the cod spawning biomass is likely to aggregate?*

   In the latter case, then the EU requests the SC to provide additional elements, based on the best available data, as to where the target fishery should be prohibited in light of the information available to identify the area for time/area closure.

Scientific Council responded:

There is no simple and general answer to which type of closure is better; the optimal closure design would be expected to depend on a multiplicity of factors. There are different opinions in the literature on the best type of closure to consider: seasonal, by area, or by area / season, although closure of a wide area seems to have the most support. Eero et al. (2019) concluded that "designing relatively small area closures appropriately is highly complex and data demanding and may involve trade-offs between positive and negative impacts on the stock. Seasonal closures covering most of the stock distribution during the spawning time are more robust to data limitations, and less likely to be counterproductive if sub-optimally designed."

In the case of 3M cod, it seems clear that the spawning season is the first quarter of the year. While there is no research vessel survey information during this part of the year, some general inferences can be made from commercial fisheries data. The cod trawl fishery in the first quarter is concentrated in a fairly small area where catch rates (CPUE) are higher and mean size of fish is larger than in other areas/seasons, likely indicating a major spawning area. However, the data from the cod longline fishery do not show any clear spatial concentration in its activity. Therefore, even if the trawl fishery allows identifying some important spawning areas, the limited spatial coverage of this fishery prevents from assuming that these are the only spawning areas within the Flemish Cap. Given the difficulty in identifying all spawning areas, the limited spatial distribution of this stock (restricted to the Flemish Cap), and the assumed objective of protecting the spawning activity of this stock, it is more appropriate to close the entire Flemish Cap to the fishery targeting cod during the identified spawning season than to close smaller areas. This option also has operational advantages in terms of simplicity of implementation and surveillance. It also reduces the effects of any displacement of fishing activity into areas with immature and recruiting fish.

In conclusion, the SC considers that, if a spawning closure is agreed, a total closure of the cod fishery in Flemish Cap during the first quarter of the year would be the preferred option to protect spawning activity based on the available data.

2. *What monitoring plan, besides the regular scientific campaigns and data collection programs carried out by CPs, would the SC advise to be put in place, considering the objective of the closures is to protect spawning biomass, to reduce spawning disturbance and therefore **contributing to decrease fishing mortality** and concomitantly **increase stock abundance?***

Scientific Council responded:

As the SC noted in its June report, the seasonal closure would protect spawning activity, reducing the number of spawning fish that are captured, and allowing them to spawn before becoming available to the fishery, but the spawning biomass itself is not protected by the closure (as the fish may still be caught in other quarters of the year). Therefore, a spawning closure will not result in decreases to fishing mortality.

Furthermore, while in principle improved recruitment might result from a spawning closure, there is no clear evidence that protecting fish during spawning directly translates into increases in recruitment/productivity, particularly at this time of low productivity of the stock.

If any closure is established, SC advises that it will be necessary to conduct ongoing analysis of the Flemish Cap cod fishery data in order to monitor the consequences of the management decisions (including the analysis of the redistribution of the fishing effort along the year and its potential effects on ecosystems, the variation of the cod catch composition in lengths/ages, and the bycatch levels of other fish species, benthos in general, and VME taxa in particular).

3. If flanking measures were adopted, such as:

i. time/area closure during the first quarter, with the objective as detailed in point 2; and
ii. the implementation of sorting-grids in the Div. 3M cod fishery gear, with the objective of reduce catch of small and immature individuals of cod;

how would that affect the projections for total biomass under the different scenarios for the projected years and notably would there be catches beyond 1000 t where the probability of being below B_{lim}, beyond the year 2021, would remain within the NAFO Precautionary Approach guidelines?

Scientific council responded:

SC advises that the suggested measures would not allow for catches above 1 000 t in 2021 without exceeding the PA framework limits in 2022.

If a seasonal closure proves to be effective in improving recruitment, it would affect the level of future recruitment, and hence, its effects on the stock would be observed in the medium / long-term; however, it would have little or no impact on short-term projections (2 years). In the short-term, this measure might result in lower average catch weights (as fish would be heavier in the first quarter, i.e. at spawning time, than in later quarters of the year) than used in the projections performed by SC in June. This, in turn, and assuming no other confounding effect would simultaneously occur, would also imply that a larger number of fish would need to be caught in order to reach the TAC, which is set in weight.

The implementation of sorting grids, which mainly affect the exploitation pattern of younger ages, would be expected to have a more immediate effect on the stock, because it would improve the protection of young fish by delaying their recruitment into the fishery. If the relatively good recruitment observed in 2019 (2018 cohort) holds true, implementation of sorting grids would increase the selection mean length and reduce the catch of the 2018 cohort in 2021 (when those fish will be of age 3), aiding in the recovery of the stock in the short-term.

SC is not at this point able to quantify the full effect of implementing these management measures.

ii) Regarding cod in 3M: From Denmark (in respect of the Faroe Islands and Greenland) (COM WP 20-17)

In its recommendation on 3M Cod for 2021, the SC notes again this year, as it did in its 2019 advice, that the strong year classes of 2009 to 2011 are dominant in the current SSB, but that subsequent recruitments (2012-2018) are much lower, leading to recent substantial declines in stock size and expectations that this will continue in the very near future under any fishing scenario.

At the same time, the SC report indicates a clear increase in recruitment to the stock in 2019, as shown in the graph on page 8 of the SC report (NAFO SCS Doc. 20/14). This has not, however, been taken into consideration in this year's SC advice when projecting the development of the SSB and calculating the probabilities of different fishing levels reaching or exceeding Blim and Flim in 2021, 2022 and 2023.

Although there is uncertainty in recruitment estimates for the current assessment year, the most recent survey data also suggests an increase in stock biomass for 2020 as a consequence of improved recruitment in 2019. As such, there are signs indicating that the decline in the stock in the coming years might not be as severe as the current projections indicate.

• *The Scientific Council is therefore requested to provide supplementary advice on the projected scenarios, taking into account the documented increase in recruitment in 2019.*

Scientific Council responded:

The current request notes that "the most recent survey data also suggests an increase in stock biomass in 2020 as a consequence of improved recruitment in 2019". SC understands this comment refers to the results of the 2020 EU survey in Division 3M. In this regard, SC notes that the results from the 2020 survey for the cod stock are preliminary, there has been no opportunity to subject them to sufficient quality checks or to any type of scientific analysis. As such, SC notes that it is too early to draw conclusions from those (preliminary) values at this stage.

The 3M cod stock assessment conducted by SC in June 2020 (SCS Doc. 20-14) is based on data until the end of year 2019. This followed the standard procedure for the assessment of this stock. The assessment does indeed indicate an increase in recruitment (age 1) in 2019, by comparison with the recruitment of previous years (2015-2018), which has been very low.

During the 2020 June SC meeting, the estimated value of recruitment (age 1) in 2019 was used to calculate stock abundance and biomass in 2019, as well as abundance at age 2 in 2020; in this respect, it was taken into account in the projections and included in the calculation of projected SSB in future years.

However, the recruitment assumed for the projected years (2020, 2021 and 2022) during the June SC meeting was taken from the Recruits per Spawner derived from the estimated recruitment for years 2016-2018 and not from the estimate of recruitment in 2019. This is the common procedure for most stock assessments, since the estimate of recruitment for the most recent year included in the stock assessment is more uncertain than the estimates of recruitment for earlier years, because information about cohort abundance is gained as more ages of the cohort are observed.

Despite the uncertainty of the 2019 recruitment estimate, and only to address the current request, a sensitivity analysis of the 3M cod projection has been performed, where the assumed recruitment for the projected years (2020, 2021, 2022) was taken from the Recruits per Spawner derived from the estimated recruitment of years 2017-2019. The results are virtually identical to those from the June projections and do not change the Scientific Council's perception of the recent dynamics of the 3M cod stock, since the recruitment in the projected years has very little impact on short-term forecasts, because small fish contribute very little to the fishery catches or the SSB.

iii) From European Union regarding 3M cod:

In its advice on TAC for COD 3M the SC has based its response in results from short-term projection (3years) with four fishing mortality levels; namely 2/3Flim, F=0, catch=1000t and catch=3000t.

The EU would like to request the SC the preparation of short-term projections for additional catch levels, notably catch levels between 1000t up to 1500t, and intermediate catch levels within 100 tons steps.

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.*

Scientific Council responded:

SC has conducted projections for catch levels between 500 t and 1500 t, at 100 t intervals, and the results are presented below.

SC notes that, although it is technically possible to conduct projections for any catch level and this has now been done for the additional catch levels requested, the uncertainty that exists in the projections of this stock prevents the SC from being able to reliably differentiate (based on scientific information) between fine-scale catch scenarios. SC does not consider that the resolution of the assessment framework in terms of risk-of-going-below-B_{lim} in relation to TAC predictions to be as fine as 100 tons.

	B		SSB		Yield
	Median and 80% CI				
Catch=500 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	500
2022	31624	(26499 - 37490)	19687	(16045 - 23502)	500
2023	28141	(23344 - 33786)	21528	(18030 - 25623)	
Catch=600 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	600
2022	31527	(26398 - 37390)	19644	(15968 - 23387)	600
2023	27960	(23170 - 33603)	21338	(17822 - 25480)	
Catch=700 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	700
2022	31430	(26299 - 37294)	19528	(15899 - 23311)	700
2023	27778	(22996 - 33421)	21168	(17674 - 25263)	
Catch=800 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	800
2022	31330	(26198 - 37196)	19428	(15824 - 23189)	800
2023	27595	(22823 - 33234)	21009	(17517 - 25132)	
Catch=900 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	900
2022	31236	(26099 - 37100)	19382	(15750 - 23145)	900
2023	27412	(22656 - 33053)	20878	(17402 - 24955)	
Catch=1000 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	1000
2022	31132	(25996 - 37004)	19282	(15658 - 23080)	1000
2023	27230	(22475 - 32877)	20679	(17248 - 24831)	
Catch=1100 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	1100
2022	31036	(25899 - 36901)	19188	(15512 - 22980)	1100
2023	27056	(22305 - 32690)	20528	(17066 - 24661)	
Catch=1200 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	1200
2022	30936	(25797 - 36806)	19126	(15443 - 22874)	1200
2023	26877	(22127 - 32505)	20391	(16915 - 24511)	
Catch=1300 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	1300
2022	30838	(25700 - 36709)	19032	(15379 - 22795)	1300
2023	26696	(21951 - 32315)	20207	(16724 - 24313)	
Catch=1400 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	1400
2022	30743	(25602 - 36611)	18950	(15274 - 22730)	1400
2023	26519	(21772 - 32140)	20058	(16535 - 24161)	
Catch=1500 tons					
2020	48698	(42129 - 55567)	35738	(30117 - 41335)	8531
2021	35740	(30110 - 41951)	23110	(18574 - 27833)	1500
2022	30641	(25497 - 36516)	18840	(15217 - 22615)	1500
2023	26340	(21592 - 31957)	19888	(16437 - 24047)	

	Yield			$P(SSB < B_{lim})$				$P(F > F_{lim})$			
	2020	2021	2022	2020	2021	2022	2023	2020	2021	2022	$P(SSB_{23} > SSB_{20})$
Catch=500t	8531	500	500	<1%	1%	8%	3%	4%	<1%	<1%	<1%
Catch=600t	8531	600	600	<1%	1%	8%	3%	4%	<1%	<1%	<1%
Catch=700t	8531	700	700	<1%	1%	9%	3%	4%	<1%	<1%	<1%
Catch=800t	8531	800	800	<1%	1%	9%	3%	4%	<1%	<1%	<1%
Catch=900t	8531	900	900	<1%	1%	9%	4%	4%	<1%	<1%	<1%
Catch=1000t	8531	1000	1000	<1%	1%	10%	4%	4%	<1%	<1%	<1%
Catch=1100t	8531	1100	1100	<1%	1%	10%	4%	4%	<1%	<1%	<1%
Catch=1200t	8531	1200	1200	<1%	1%	11%	5%	4%	<1%	<1%	<1%
Catch=1300t	8531	1300	1300	<1%	1%	11%	5%	4%	<1%	<1%	<1%
Catch=1400t	8531	1400	1400	<1%	1%	12%	6%	4%	<1%	<1%	<1%
Catch=1500t	8531	1500	1500	<1%	1%	13%	7%	4%	<1%	<1%	<1%

1

3. Further SC on COM request #6: Assessment of NAFO bottom fisheries in 2021

Although SC prepared a response to this request during the June SC meeting, and this response was presented to the Commission by the SC Chair, further work (with a view on the final response that SC will provide in 2021) was conducted by SC at its September meeting. A summary is presented here:

<u>Assess the overlap of NAFO fisheries with VME to evaluate fishery specific impacts in addition to the cumulative impacts:</u>

SC made further progress in assessing the overlap of NAFO fisheries with VME through an analysis of haul-by-haul log-book data in combination with VMS data for 2016 to 2018 and in establishing VMS data analysis procedures to generate standardized vessel trawl-track data products. Such analysis significantly improves the spatial definition of specific fishing areas within the NAFO footprint, reducing the number of spurious VMS pings included in the analysis.

SC recommends that NAFO Secretariat compile basic information (see Table 1.2) related to each directed fishery defined by stock and gear type (as defined previously), e.g., the types of fishing conducted, range of vessel powers (kW), range of vessel lengths, depth range of fishing, gear type including typical dimensions, target and bycatch species, and the spatial distribution of fishing effort (CEM Annex II.M. Part 1; Part 2 and Part 4 and Annex II.N). In the case of longline fisheries, collection and compilation of additional information (see Table 1.3) would be crucial to start the process of defining a more precise fishing footprint. This information would help improving knowledge about a longline representative fishing footprint since with the information that is currently available, it is not possible to obtain the real footprint for this fishery.

Table 1.2. TRAWL GEAR

Types of fishing conducted
Range of vessel powers (kW)
Range of vessel lengths
Depth range of fishing
Gear type (including dimensions)
Target and bycatch species
Spatial distribution of fishing effort

Table 1.3. LONGLINE

	Start line set					End line set					Start line haul					End line haul				
Line set number	Date	Time	Lat	Lon	Depth	Date	Time	Lat	Lon	Depth	Date	Time	Lat	Lon	Depth	Date	Time	Lat	Lon	Depth

Line set number	
Type of bottom longline used: automatic/manual	
Main Line length	
Line material	
Line diameter	
Number of hooks set	
Number of hooks lost	
Hook type	
Hook size	
Type of baits used	

4. Update on progress on the NAFO PA Framework review (COM request #8)

The Commission requests the Scientific Council to continue progression on the review of the NAFO PA Framework.

SC in June tasked a small subgroup to develop a funding proposal for submission to the EU in November 2020 to support work towards the review of the NAFO PA framework. The proposal prepared by the subgroup follows the workplan agreed by WG-RBMS at its August 2020 meeting (COM-SC Doc. 20-04) and covers the contracting of three external experts and organization of two workshops for scientists and managers to take place in March 2022 and late 2022/early 2023 respectively.

The work of this subgroup was presented to SC for discussion and to provide guidance for further development. In addition to a pro-forma standard grant application form, the sub-group drafted terms of reference for independent experts based on the SC PAF review working plan.

The terms of reference were discussed during the meeting and some suggestions were made:

- Provide a specific workplan for the experts and broader terms of reference for the working group.
- Define the different levels of involvement of the external experts, one of whom will co-Chair the technical group and will participate in all actions while the other external experts will provide inputs at all stages of the process, but will not follow day-to-day developments as closely.
- Broaden terms of reference making them less directive
- The working group will carry out a and b of each item
- external participates in c of each item with the working group

SC members agreed to provide additional comment to the WG-PAF Chair and the SC WG-RBMS co-Chair about the grant application or the terms of reference for the external experts within 2 weeks of closure of the SC meeting, i.e. no later than October 10.

VIII. MEETING REPORTS

a) Joint Commission – Scientific Council Working Group on the Ecosystem Approach Framework to Fisheries Management (WG-EAFFM)

This joint working group met by correspondence during 17–19 August 2019 and was co-chaired by Elizabethann Mencher (USA) and Carmen Fernandez (Chair of SC). The Scientific Council was advised of progress of this group by the co-chairs in their presentation of the report to the joint session of Commission and Scientific Council (see section III of this report).

SC elected Andrew Kenny (UK) as co-chair of WG-EAFFM, replacing the Chair of SC (who acted as co-chair of WG-EAFFM for the August meeting in an interim role).

b) Joint Commission–Scientific Council Working Group on Risk-based Management Strategies (WG-RBMS)

This joint working group met by correspondence on 6 February and during 20-21 August 2020. Both meetings were co-chaired by Jaqueline Perry (Canada) and Fernando González (EU). The Scientific Council was advised of progress of this group by the co-chairs in their presentation of the report to the joint session of Commission and Scientific Council (see section III of this report).

c) Joint Commission-Scientific Council Catch Estimation Strategy Advisory Group (CESAG).

CESAG met by correspondence on 24 April 2020, co-chaired by Katherine Sosebee (Scientific Council, USA) and Temur Tairov (Commission, Russian Federation). The report was presented to the Commission by Katherine Sosebee. Scientific Council deferred consideration of this report until its June 2020 meeting.

d) ICES/NAFO Working Group on Deep-water Ecology (WG-DEC)

WG-DEC met by correspondence during 4-8 May 2020 and was attended by Ellen Kenchington and Lindsay Beazley (Canada) representing NAFO. The report of WG-DEC was not finalized in time for the present meeting and discussion of this WG was deferred to June SC meeting, 2021.

e) ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals (WG-HARP)

Discussion of this working group was deferred to June 2021

IX. REVIEW OF FUTURE MEETING ARRANGEMENTS

1. Scientific Council meetings

a) Scientific Council, (in conjunction with NIPAG), 26 October to 2 November 2020

The Scientific Council shrimp advice meeting will be held by WebEx from 26 October to 2 November 2020 (excluding the weekend).

b) WG-ESA, 17- 26, November 2020

The Working Group on Ecosystem Science and Assessment (WG-ESA) meeting will be held by WebEx from 17 to 26 November 2020.

c) Scientific Council, June 2021

The Scientific Council meeting in June 2021 meeting is currently scheduled to be held in Halifax, Nova Scotia, Canada from 28 May to 10 June 2021,

d) Scientific Council (in conjunction with NIPAG), 2021

Dates and location to be determined.

e) Scientific Council, September 2021

The Annual meeting is currently scheduled to be held 21- 25 September 2021, in Halifax, Nova Scotia, unless an invitation to host the meeting is extended by a Contracting Party.

2. NAFO/ICES Joint Groups

a) NIPAG, 26 October to 2 November 2020

The joint NAFO/ICES *Pandalus* Assessment Group meeting will be held by WebEx from 26 October to 2 November 2020 (excluding the weekend).

b) NIPAG, 2021

Dates and location to be determined.

c) ICES – NAFO Working Group on Deep-water Ecosystem, 2021

Dates and location to be determined.

d) ICES/NAFO/NAMMCO WG-HARP

The date and location of the next ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals (WGHARP) meeting are unknown.

X. FUTURE SPECIAL SESSIONS

1. Progress on NAFO participation in the symposium "4th Decadal Variability of the North Atlantic and its Marine Ecosystems: 2010-2019"

The STACFEN Chair, Miguel Caetano, presented the following progress update:

The meeting is organised by ICES and will be held on 26-28 October 2021, in Bergen (Norway). STACFEN members Frederic Cyr and Paula Fratantoni have proposed a joint organization that brings added value for the knowledge of decadal oceanographic variations in the NAFO area, integrated in the North Atlantic region. One of the direct advantages is to promote evaluation of the oceanographic changes in the wider spatial context of the North Atlantic. The contributions from participants may generate new insights and discussion within STACFEN regarding the integration of environmental information into the stock assessment process.

These STACFEN members are also part of the Scientific Steering and Organizing Committees of the symposium.

The ICES symposium committee provided positive feedback on the NAFO participation in the organization of the Decadal Symposium. The committee also agreed to include NAFO in the name of the event from their first announcement, as "ICES/NAFO 4th Joint Symposium on Decadal Variability of the North Atlantic and its Marine Ecosystems: 2010-2019". Additionally, a proposal will be submitted for a NAFO scientist to act as a keynote speaker in the event. A list of three possible scientists was discussed and will be submitted to the Symposium Steering Committee.

<u>Symposium short description:</u>

> The Symposium will be the 4th one of an ICES series and will contribute to the recently promoted United Nations Decade of Ocean Science for Sustainable Development (2021-2030). It will summarize the status at the beginning of the decade and looking forward into the coming decade. In general, the main challenge will be to summarize and explain the hydro-biological variability observed during the decade of 2010-2019 in relation to longer term variability or change, and to quantify the interactions between the variability and change in the ocean environment with variability in plankton, fish, mammals and seabirds in the North Atlantic marine ecosystems. The symposium will be organized in three thematic sessions: Development of ocean climate; Impacts of climate variability on marine ecosystems; and the coming decade.

2. Information concerning Flatfish Symposium 2020

The SC Coordinator informed SC that, due to covid-19, the flatfish symposium will be postponed until 2021. All details will remain the same except the dates, which now are November 14-20, 2021.

3. Other potential future topics

No other proposals were received.

XI. OTHER MATTERS

1. Presentation of NAFO Scientific Merit Award to António Ávila de Melo

NAFO Scientific Council (SC) was pleased to present a Scientific Merit Award to António Ávila de Melo (EU-Portugal), to acknowledge and celebrate his contributions to SC over his career as a Research Scientist.

António Ávila de Melo with longtime NAFO colleague, friend, and fellow redfish fan, Don Power, at the NAFO Annual Meeting in Montréal, Canada, September 2017.

António has served the SC in numerous capacities, including his tenure as chair of the SC subcommittee STACREC (1992-1993) and his role as a Designated Expert (DE) for Div. 3M (since 1996) and 3LN (since 2003) redfish stocks. He has provided significant contributions over more than 3 decades to the assessment of various stocks, always aiming to help ensure their stability and the sustainability of the fisheries that rely on them.

In addition, António was one of two research scientists at the Portuguese fisheries institute responsible for the establishment of a Portuguese research team for the NAFO area, which has been active since 1988, and the Flemish Cap project, that also started in 1988. Since that time, António has participated in numerous other NAFO related projects and research surveys and was responsible for training several junior researchers.

António's knowledge, experience, guidance, patience and sympathy with both scientists and administrators were essential to the SC's work and crucial to the transmission of the SC's message. SC members congratulated António for his thorough and passionate contributions to the assessment of redfish stocks and to the general functioning of SC within NAFO. They thanked him for his wisdom and offered their good wishes for the future, hoping that he will continue to share with others his scientific knowledge, as well as his passion for music and for life as a whole.

XII. ADJOURNMENT

The meeting was adjourned at 13:00 on 25 September 2020.

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

Chair: Margaret Treble Contributor: Alexis Pacey

The Committee met by Webex, on Sept. 21-25, 2020, to consider publications and communications 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 (Portugal, and Spain), Japan, the Russian Federation, United Kingdom, 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 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.

4. Review of Recommendations in 2018

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

STACPUB reiterates the recommendation from 2018 and **recommends** that *the Secretariat and Chair of STACPUB work to develop guidelines for SCS documents.*

STATUS: This is still in progress. A draft has been prepared (scwp20-014) and comments are welcome.

STACPUB **recommends** that *the Secretariat continue to investigate solutions that would be compatible with reference management software.*

STATUS: This is still in progress. Finding a system that would allow citations to be easily uploaded to reference management software is ongoing. There is the possibility of having Crossref DOIs linked to the relevant datasets in DataCite by adding the DataCite DOIs in the metadata of the publications.

STACPUB **recommends** that *the Secretariat ensure options for figure formats are clearly provided in the instructions for authors for JNAFS.*

STATUS: This has been implemented. There is a table in the instructions-for-authors that describes the various formats suitable for JNAFS.

STACPUB **recommends** that *the Secretariat explore development of a "run-to-code" or other method that would simplify the process for figure prepartition by Designated Experts and other authors so that they can more easily provide an editable figure that fits the SC standards*.

STATUS: This has been implemented. There is a set of instructions developed by Anna Wall, NAFO intern, that explains and instructs "run-to-code" for figure preparations. This is suitable for R Statistical and Sigmaplot. It is on the JNAFS site with the instructions for authors and has been distributed to Scientific Council Designated Experts.

5. Review of Publications

a) Journal of Northwest Atlantic Fishery Science (JNAFS)

Volume 50-Regular issue: This volume was published in December 2019. Currently, Volume 51 has six articles in review with associate editors or in the revision/re-submit stage with the authors, and one is in production soon to be published.

b) NAFO Scientific Council Reports

The NAFO Scientific Council Reports 2019 (Redbook) volume (451 pages) was published May 2020 online. Ten copies of the Report will be printed with spiral binding.

c) NAFO Scientific Council Studies

There were no submissions for 2018.

d) NAFO Commission-Scientific Council Reports

These reports are found in the Meeting Proceedings of the Commission from September 2018-August 2019 (338 pages) and are printed and distributed in September 2019. Five copies were made with a spiral binding.

e) ASFA

Most science publications and documents have been submitted to ASFA as of March 31, 2020. This includes The *Journal of Northwest Atlantic Fishery Science* and SC Research/Summary Documents for 2019.

f) Poster/Information Materials

Recent updates to SC & fishery management procedures re: Cycle of Advice, as well as the SC poster have been completed.

6. Other Matters

a) ASFA 2019 Board Meeting

The Senior Publications/Web Manager did not attend the 47th Annual Meeting of the Aquatic Sciences and Fisheries Abstracts (ASFA) Advisory Board.

b) JNAFS Editorial Board

We have welcomed another associate editor to the JNAFS editorial team. Dr David Deslauriers is a Professor of fish ecology and physiology at the Institute of Marine Sciences at the University of Québec at Rimouski (UQAR). Dr. Deslauriers' research specialization includes; bioenergetics, ecological modeling, freshwater and marine ecosystems.

JNAFS AEs are currently partitioned into general review expertise categories. We are top-heavy in the Fisheries Biology category, which really also includes stock assessment and perhaps ecology. There was a proposal to do away with the expertise categories and just list all of the AEs alphabetically. After some discussion STACPUB **recommends** that *the Associate Editors be surveyed to determine if they would agree to have the expertise categories removed from their profiles on the JNAFS website*.

c) Website link to PDFs

The Senior Pupblications/Web Manager continues to look for improvements to our ability to have easy access to reports and JNAFS articles.

7. Adjournment

The Chair thanked the participants for their valuable contributions, the rapporteur for taking the minutes and the Secretariat for their support.

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

Chair: Karen Dwyer Rapporteur : Tom Blasdale

1. Opening

The Committee did not meet in June 2020, due to the disruption caused by the COVID-19 pandemic. The SC meeting was preceded by a Webex on May 11, attended by relegates from the EU, Canada, Denmark in respect of Faroes and Greenland and the USA, during which information on biological surveys in the NRA were presented. In addition, there was a presentation on Canadian survey coverage and whether it was appropriate for use in various assessments using the guidelines set out in STACREC (NAFO 2019). This meeting was attended by the 2020 external reviewer, Hugues Benoit.

2. Appointment of Rapporteur

The Scientific Council Coordinator, Tom Blasdale, was appointed as rapporteur for this meeting.

3. Review of previous recommendations from 2019 and new recommendations from 2020

Previous recommendations were not examined at the June meeting and no new recommendations were made in 2020 due to constraints to the meeting from Covid-19.

a) Survey-related recommendations (previous and new recommendations)

In 2015, STACREC **recommended** that *an analysis of sampling rates be conducted to evaluate the impact on the precision of survey estimates.* As a separate aspect, in September 2017 STACREC discussed *possibilities for combining multiple surveys in different areas and at different times of the year to produce aggregate indices*.

In September 2019, it *was agreed that a speaker on this general topic would be invited to the June 2020 SC meeting, and the STACREC chair will take the lead in arranging this invitation.* However, due to the pandemic, it was not possible to have an invited speaker in June. However, a Canadian scientist attended the ICES WKUSER workshop (Workshop on Unavoidable Survey Effort Reduction) in January 2020 and presented information on survey coverage issues. Feedback from this meeting will be presented to STACREC in June 2021. The full report is available at: ICES. 2020. ICES Workshop on unavoidable survey effort reduction (WKUSER).

ICES Scientific Reports. 2:72. 92pp. http://doi.org/10.17895/ices.pub.7453

In 2019, STACREC made the following recommendation:

STACREC **recommends** the *following actions for future years whenever survey coverage issues arise*:

The STACREC report should contain, after the general survey presentation, a summary of the decisions and conclusions stock by stock regarding whether the survey can be used as a stock index for that year.

The mean proportion (over time) of total survey biomass in the survey strata missed that year should be calculated.

At this time, the following may be used as initial ("preliminary") guidelines based on the value of the mean proportion of total survey biomass in the survey strata missed in that year:

- If it is <10% : the survey index of that year is most likely acceptable.
- If it is between 10% and 20% : the survey index of that year is questionable and needs to be examined carefully before deciding whether it is acceptable.
- If it is >20% : the survey index of that year is most likely not acceptable. Any decision to accept it would require a clear and well justified rationale.

These are preliminary guidelines and sampling biases may also be relevant in the considerations for each specific stock and survey. In particular, the finer structure of the indices needs to be considered if they are used disaggregated by age or length in stock assessments.

It has been suggested that an added guideline might be: For age groups where there is a greater than 10% difference between total survey biomass in the survey strata missed that year in the index used (total or mean numbers), then it should be excluded from the model, if the model can handle missing values. However, there was no time to discuss this at the June 2020 meeting and therefore this discussion will be deferred to June 2021.

All other recommendations will be deferred to next year (2021).

4. Fishery Statistics

a) Progress report on Secretariat activities in 2019/2020

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. Dates of receipt of STATLANT 21A reports for 2017-2019 and 21B reports for 2017-2019 received prior to September 2020

Country/component	STATLANT 21A (deadline, 1 May)			STATLANT 21B (deadline, 31 August)		
	2017	2018	2019	2017	2018	2019
CAN-CA	31 May 18		9 Jun 20	31 May 18		
CAN-SF	05 May 18	29 Apr 19	17 Apr 20	11 Sep 18	30 Aug 19	2 Jul 20
CAN-G	30 Apr 18		14 May 20	24 Aug 18	23 Aug 19	
CAN-NL	17 May 18	17 May 19	30 Apr 20	7 Jun 18	4 Sep 19	31 Aug 20
CAN-Q						
CUB						
E/BUL						
E/EST	04 May 18	30 Apr 19	30 Apr 20	13 Sep 18	17 Dec 19	31 Aug 20
E/DNK	23 Apr 18	1 May 19	26 May 20	03 Sep 18	27 Aug 19	21 Aug 20
E/FRA						
E/DEU	25 Apr 18	30 Apr 19	18 May 20	30 Aug 18	19 Sep 19	02 Jul 20
E/LVA		24 Apr 19				
E/LTU	24 Apr 18	24 Apr 19		24 Apr 18	1 July 19	
EU/POL						
E/PRT	20 Apr 18	30 Apr 19	29 May 20	03 Sep 18	19 Sep 19	31 Aug 20
E/ESP	30 May 18		14 May 20	02 Aug 18	12 Dec 19	24 Jun 20
E/GBR	31 May 18			24 Jul 18		

FRO	18 May 18	22 May 19	3 Jun 20		18 May 19	22 Sep 20
GRL	30 Apr 18	29 Apr 19	24 Apr 20		22 Aug 19	25 Aug 20
ISL						
JPN	01 May 18	23 Apr 19	8 May 20	31 Aug	30 Aug 19	28 Aug 20
KOR						
NOR	23 Apr 18	25 Apr 19	27 May 20	16 Aug 18	26 Aug 19	08 Sep 20
RUS	04 May 18	14 May 19	27 May 20		20 Aug 19	25 Aug 20
USA	10 Jul 18	10 Jun 19				
FRA-SP	18 May 18	14 Mar 19	8 May 20	5 Jul 18		
UKR						

5. Research Activities

a) Biological Sampling

i) Report on activities in 2019/2020

STACREC reviewed the list of Biological Sampling Data for 2019 prepared by the Secretariat and noted that any updates will be inserted during the summer. The SCS Document will be finalized for the September 2020 Meeting.

ii) Report by National Representatives on commercial sampling conducted

Canada-Newfoundland (SCS Doc. 20/11, plus information within various SC assessment 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 for the following stocks/species: Greenland halibut (SA 2 + Div. 3KLMNO), Atlantic salmon (SA 2+3+4), Arctic char (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 2,3, and 4). Additionally, a summary of recent stock assessments and research projects on several of marine species are included in this report. This format of this report was changed for 2020 and now follows the format of research reports carried out by other Contracting Parties. STACREC recommended scientists review this to determine its utility.

Denmark/Faroe Islands (SCS 20/08):

Data on catch rates were obtained from trawl and longline fisheries in NAFO Div 3M for Atlantic cod from 2014 to 2019 (n=1219, NAFO-observers). Length frequencies (NAFO-observers and crew members) were also available from 2014 to 2019 (number of samples, n=219). In addition, weight measurements were taken by crew members from 2014 to 2019 (n=83). The fishery has been conducted exclusively by longliners since 2017.

Denmark/Greenland (SCR 19/32, SCS 20/12):

Data on catch rates were obtained from trawl, gillnet, and longline fisheries in NAFO Div 1A-F for Arctic char, Atlantic halibut, Atlantic salmon, Atlantic cod, capelin, snow crab, Greenland halibut, roundhead grenadier, roundnose grenadier, lumpfish, polar cod, redfish, saithe, scallops, Greenland shark, dogfish shark, Northern shrimp, skate, tusk and wolffish. Length frequencies from Greenland were available for Greenland halibut trawl (1AB, 1CD), longline (1A and 1D inshore), and gillnet (1A inshore) fisheries; for cod trawl offshore (Div. 1C and 1E), longline (1A and 1D inshore, 1D, 1D, 1E and 1F), gillnet (1A and 1D inshore), handline (1CD inshore); and pound nets (inshore 1B-D) fisheries. A total of 264 length samples were taken, and 62060 individuals including Greenland halibut and cod were measured in NAFO Div. 1-F. A total of 104 otolith in 1A and 4247 otoliths in 1C-F were collected from cod.

EU-Germany (NAFO SCS Doc 20/10):

Data on catch rates were obtained from trawl catches for Greenland halibut in Div. 1C and 1D.

EU-Estonia (NAFO SCS Doc. 20/06) :

Catch rate data was obtained from two fishing vessels in Subarea 3. The main target species were redfish, cod and Greenland halibut. NAFO observers took length samples of these species and yellowtail flounder.

EU-Portugal (NAFO SCS Doc. 20/09):

Data on catch rates were obtained from trawl catches for: redfish (Div. 3LMNO); Greenland halibut (Div. 3LMN) and cod (Div. 3M). Data on length composition of the catch were obtained for: redfish (*S. mentella*) (Div. 3LMNO); American plaice (Div. 3MNO); cod (Div. 3MN); Greenland halibut, redfish (*S. marinus*) and roughhead grenadier (Div. 3LM); thorny skate and witch flounder (Div. 3M).

EU-Spain (NAFO SCS Doc. 20/07):

A total of 10 Spanish trawlers operated in Div. 3LMNO NAFO Regulatory Area (NRA) during 2019, amounting to 1,264 days (18,686 hours) of fishing effort. Total catches for all species combined in Div. 3LMNO were 16,124 tons. In addition to NAFO observers (NAFO Observers Program), 7 IEO scientific observers were onboard Spanish vessels, comprising a total of 257 observed fishing days, around 20% coverage of the total Spanish effort. 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 content analyses and collecting material for reproductive studies. Otoliths of these four species were also taken for age determination. In 2019, 376 length samples were taken, with 45,831 individuals of different species examined to obtain the length distributions.

One Spanish trawler operated during 2019 in Div. 6G NAFO Regulatory Area using a midwater trawl gear. The fishing effort of this trawler was 8 days (33 hours). The most important species in catches was the *Beryx splendens* and Greenland shark *(Somniosus microcephalus)*. In 2019, 19 length samples were taken, with 683 Alfonsino individuals examined to obtain the length distributions.

Japan (NAFO SCS Doc. 20/05):

In 2018, one Japanese otter trawler operated in Div. 3L, 3M, 3N and 3O. The total catch (10 species) including discards was 2,789 tons. Target species (main fishing Divisions) (catch) were Greenland halibut (3L) (1,075 tons), redfish (3LM) (1,058 tons) and yellowtail flounder (3N) (348 tons). Number of size measurement for Greenland halibut, redfish and yellowtail flounder were 2,250, 5,693 and 750 respectively.

Russia (NAFO SCS Doc. 20/13):

Catch rates were available from Greenland halibut (Divs. 1ACD, 3LMN, with bycatch statistics), Atlantic cod (Div. 3LMNO), redfish (Divs. 3LN, 3M, 3O, with bycatch statistics), yellowtail flounder (Div. 3N), skates (Div. 3LMNO), witch flounder (Div. 3LMNO), roughhead grenadier (Div. 3LM), roundnose grenadier (Div. 3LN), white hake (Div. 3NO) and Atlantic halibut (3LMNO). Length frequencies were obtained from Greenland halibut (Divs. 1A, 1D, 3LMN), redfish (*Sebastes fasciatus* in Divs. 3LN, *S. mentella* in Div. 3L), roughhead grenadier (Divs. 3LM), roundnose grenadier (Divs. 3LM), witch flounder (Divs. 3L), skates (*Amblyraja radiata* in Divs. 3LM), blue wolffish (Divs. 3LM), blue antimora (*Antimora rostrata* in Divs. 3LM), black dogfish (*Centroscyllium fabricii* in Div. 3O), threebeard rockling (*Gaidropsarus vulgaris* in Div. 3L), red hake (*Urophycis chuss* in Div. 3L), greater eelpout (*Lycodes esmarkii* in Div. 3L) and Marlin-spike grenadier (*Nezumia bairdii* in Div. 3L). Age-length distribution for Greenland halibut in Divs. 3LMN, as well as statistics on marine mammal occurrences and VME indicator species catches, are also available.

USA (SCS Doc. 20/18):

The report described catches and survey indices of 37 stocks of groundfish, invertebrates and elasmobranchs. Of note, the indices for Gulf of Maine cod, Georges Bank cod, Georges Bank yellowtail flounder, Southern New England yellowtail flounder, and Georges Bank winter flounder and thorny skate were among the lowest values in the time series. No Atlantic halibut were caught in the strata set used for the stock. Gulf of Maine and Georges Bank haddock decreased while still remaining above average. Barndoor skate decreased from a time series high but remained high. Research on the environment, plankton, finfishes, marine mammals, and apex predators were described. Descriptions of cooperative research included a longline survey in the Gulf of Maine and shark tagging. Other studies included age and growth, food habits, tagging studies and observer trips.

b) Biological Surveys

i) Review of survey activities in 2019 and early 2020 (by National Representatives and Designated Experts)

A Webex meeting was held May 11 to review the survey activities and data by contracting parties prior to the Scientific Council meeting in June and to evaluate whether the survey coverage was useful for stocks; in particular Greenland halibut. The change in vessel to complete surveys off Canada/Greenland was also discussed.

Canada – Newfoundland and Labrador (SCR Doc. 20/02, 04, 05):

Research survey activities carried out by Canada (Newfoundland and Labrador Region) were summarized, and stock-specific details were provided. The major multispecies stratified-random surveys carried out by Canada in 2019 include a spring survey of Divs. 3LNOPs and an autumn survey of Divs. 2HJ3KLNO. Both surveys were completed with the Campelen 1800 survey trawl.

The 2019 spring survey in Div. 3LNOPs continued a time series begun in 1971. It was conducted from late April to mid-June, and consisted of 451 successful tows (478 planned) covering 128 of 129 planned strata, to a maximum depth of 732m, by the research vessels CCGS Alfred Needler and CCGS Teleost. Coverage of Div. 3L has been incomplete in three of the last six years.

The 2019 autumn survey was conducted from mid-September to mid-December in Divs. 2HJ3KLNO, and consisted of 486 tows (674 planned) covering only 158 of 208 planned strata to a maximum depth of 1500m in 2HJ3KL and 732m in 3NO. In the 2019 Canadian autumn survey there were major coverage issues, with a total of 50 incomplete strata (primarily in deep-water on the edge of the shelf) in NAFO Divs. 2HJ and 3KL. Some of the shallower strata had only the minimum number of sets covered, reducing the precision of estimates.

STACREC noted continued concern over deficiencies in the spatial coverage of the Canadian surveys in recent years, and the impact on the ability to detect signal from noise in regards to evaluating trends in biomass and abundance of various species. The reduced survey coverage is generally considered to have led to increased, albeit unquantified, uncertainty with respect to the provision of scientific advice. In addition to impacts on individual stock assessments, deficiencies in survey coverage also add uncertainty to the results of research on environmental (STACFEN) trends and ecosystem status, functioning and productivity (WG-ESA).

Coverage issues in the 2019 Canadian spring survey were considered minor (a single missed strata) and did not warrant removing this data point from relevant assessments conducted in 2020. In the 2019 Canadian autumn survey, however, there were major coverage issues, with a total of 50 incomplete strata. As these missed strata were primarily in deep-water (>750m) on the edge of the shelf, they had little to no influence on survey indices for most of the fish resources assessed by NAFO SC (3NO cod, 3LNO American plaice, 3LNO yellowtail flounder, 3NO witch flounder, 3LN redfish, 3O redfish, 3NOPs white hake, 3LNOPs thorny skate) which occupy shallower waters. The missed strata, however, typically accounted for most of the biomass index (~75%) for roughhead grenadier and therefore the 2019 autumn survey should not be used in future assessments of this stock. For Greenland halibut, the 2019 autumn survey point for Divs. 2J3K was considered "questionable" since an average of 12% of the survey biomass was found in the missed strata in previous years. Further examination revealed that MWPT was only minimally influenced (1%) by the incomplete strata and therefore the 2019 data point for Divs. 2J3K should be considered suitable for the harvest control rule currently being used for this stock. However, differential biases in the age-disaggregated data (with younger ages biased high and older ages, including the 10+ age group, biased low) and trends over time in the extent of the bias for some ages (especially for older ages) caused by the strata missed in 2019 raise concerns about the use of the 2019 data for any age-based assessment model. It was decided that sensitivity tests should be run on the indices/ages for each model.

Canada – Subarea 0A (SCR 20/07)

A multi-species bottom trawl survey of southern 0A (0A-South) (to approximately 72^{o} N) was carried out in the Northwest Atlantic Fisheries Organization Subarea 0 during August 15-25, 2019. This is the earliest the survey has been conducted, about 6 weeks earlier compared to most previous surveys, and 10 weeks earlier than the 2017 survey (Treble 2018). The FV Helga Maria was chartered to conduct the 2019 survey, following the 2018 retirement of the RV Pâmiut. The Alfredo III trawl gear remained unchanged and was used at randomly selected stations between 400 and 1500 m. Deep-water surveys began in 0A-South in 1999 and were completed every second year between 2004 and 2014, then annually between 2015 and 2017. Surveys in 0B have been less frequent: 2000, 2001, 2011 and 2013 to 2016.

STACREC discussed the change in fishing vessels used to carry out the survey and whether the 2019 indices were comparable, especially in light of the earlier time period. The data reviewed suggested the change in vessel had an effect on the catchability at depths > 700 m, where Greenland halibut are known to be abundant. In addition, the earlier timing of the 0A-South survey in 2019 likely resulted in an unknown portion of the stock being beyond the survey area. As a result the comparability between 2019 and previous surveys is questionable and the results were not recommended for use in the 2020 assessment.

However, although the survey used to provide the age 1 abundance index also experienced vessel changes in 2018 and 2019, the results are considered to be comparable with those from earlier years.

Denmark/Greenland (SCR 20/03, 06, 12, 15):

The Greenland Shrimp and Fish trawl survey in West Greenland in NAFO Div. 1A-F (100- 600 m) was initiated in 1988. From 1988 to 2019, several vessels conducted the survey: from 1991 to 2017, the surveys were conducted onboard RV Paamiut, with chartered commercial vessels of similar size used from 1988-1990 and 2018 (Sjudarberg), and 2019 (Helga Maria). All the standard gear from the research vessel Pâmiut (such as cosmos trawl, doors, all equipment such as bridles, Marport sensors on doors, headlines, etc.) were used on the chartered commercial vessels in attempt to make the survey identical as possible. No survey was conducted in East Greenland in 2018 and 2019. The survey was carried out between June and July, onboard FV Helga Maria using the Cosmos gear with a mesh size 20 mesh liner in the cod-end. The survey follows a buffered stratified random sampling. A total of 198 valid hauls were conducted. Survey results including biomass and abundance indices for Greenland halibut, cod, deep sea redfish, golden redfish, American plaice, Atlantic wolfish, spotted wolfish and thorny skate were presented as Scientific Council Research Documents.

STACREC noted that a different vessel was used for the 2018 surveys and another in 2019. After discussion, indices are considered to be comparable with those from earlier because it was shown that gear performance parameters remained constant at depths < 700 m (but not > 700 m). Therefore the indices were utilized for redfish but not Greenland halibut in Subarea 0A or offshore 1A and 1B.

The Greenland halibut gillnet survey in 1A inshore was initiated in 2001 in the Disko Bay. The survey normally covers 4 transects and each gillnet set is compiled of five different nets with different mesh size (46, 55, 60, 70 and 90 mm half mesh). From 2011 to 2015, the surveys in Uummannaq and Upernavik gradually changed from longline surveys to gillnet surveys. In 2019, 107 gillnet stations were set. Results are presented as Scientific Research Document.

EU-Spain and EU-Portugal (SCR 20/08, 09, 10, 11, 12 13):

The Spanish bottom trawl survey in NAFO Regulatory Area Div. 3NO was conducted from June 8th to 24th 2019 on board the R/V Vizconde de Eza. The gear was a Campelen otter trawl with 20 mm mesh size in the cod-end. Following the method used last year, a total of 115 valid hauls were taken within a depth range of 47-1450 m according to a stratified random design. A hydrographic profile was cast in each fishing station. Survey results, including abundance indices and length distributions of the main commercial species, 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 2019, the bottom trawl survey in Flemish Pass (Div. 3L) was carried out on board R/V Vizconde de Eza using the usual survey gear (Campelen 1800) from August 3rd to 23rd. 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 96. Survey results, including abundance indices and length distributions of the main commercial species, are presented as Scientific Council Research documents. Samples for histological (cod) and aging (Greenland halibut, American plaice, roughhead grenadier and cod) studies were taken. One hundred hydrographic profile samplings were made in a depth range of 120-1359 m.

The EU (Spain and Portugal) 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 July 1st to 27th, 2019. 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 successful hauls was 180. Survey results including abundance indices of the main commercial species and age distributions for cod, redfish, American plaice, roughhead grenadier and Greenland halibut are presented as a Scientific Council Research document. Samples for histological assessment of sexual maturity of cod, redfish, Greenland halibut and roughhead grenadier were taken. Oceanography studies continued to take place.

VME data from the 2019 EU (Spain and Portugal) bottom trawl groundfish surveys in NAFO Regulatory Area (Divs. 3LMNO):

New data on deep-water corals and sponges were analyzed from the 2019 EU (Spain and Portugal) bottom trawl groundfish surveys. The data was made available to the NAFO WGESA to improve mapping of Vulnerable Marine Ecosystem (VME) species in the NAFO Regulatory Area (Divs. 3LMNO).

"Significant" catches (according to the NAFO definition from groundfish surveys) of deep-water corals and sponges were provided and mapped together with the closed areas. Distribution maps of presence and catches above threshold for RV data of sponges, large gorgonians, small gorgonians and sea pens following the thresholds were presented.

Sponges: were recorded in 100 of the 395 tows (25.3% of the total tows analyzed), with depths ranging between 156 - 1359 m. Significant catches of sponge (≥ 75 kg/tow) were found in three tows. Two of these catches were located in Flemish Pass area inside the KDE sponge polygon and inside closure area number 2.

The third record was found besides closed area number 13 inside the KDE sponge polygon. Sponge catches for these tows ranged between 134.21 - 289.77 kg.

Large Gorgonians: were recorded in 6 of the 395 tows (1.52% of total tows analyzed), with depths ranging between 207 - 1155 m. None of the tows have significant catches of large gorgonians (≥ 0.6 kg/tow).

Small Gorgonians: Small gorgonians were recorded in 41 tows (10.37 % of total tows analyzed), with depths ranging between 262 - 1438 m. No significant catches (> 0.15 kg/tow) were recorded.

Sea Pens: Sea pens were recorded in 122 tows (30.88% of total tows analyzed), with depths ranging between 109 - 1438 m. No significant catches (> 1.4 kg/tow) were recorded.

USA (SCS Doc. 20/18):

The USA conducted a spring survey in 2019 covering NAFO Subareas 4, 5 and 6 aboard the FSV *Henry B. Bigelow*. All planned strata were covered, although the number of tows per stratum was slightly reduced. The survey was conducted in a normal time frame. The US conducted an autumn survey in 2019 covering NAFO Subareas 4, 5, and 6 aboard the FSV *Henry B. Bigelow*. All planned strata were covered and the timing of the areas covered was similar to that in the past. Biomass indices were presented for 33 stocks and abundance for the two squid stocks.

c) Other Research Activities

No items were reported for this section.

6. Other Matters

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

During the 2019 STACREC meeting, it was suggested that there should be a better organized process for requesting and submitting data for stock assessment and other processes, such as National Research Reports. There was no time to discuss this during this meeting, but it is an item to be discussed in a future STACREC meeting.

b) Annual submissions of information to NAFO: National Research Reports, Inventories of biological surveys, List of biological sampling data, List of tag releases, RV surveys on a stock by stock basis

Discussions on the above information has been ongoing for the past two years and further discussion will continue in June 2021.

<u>National Research Reports:</u>

STACREC concluded that these reports are useful and they should continue to be produced. At the September Annual Meeting in 2019, it was determined that the format of the National Research Reports has not changed since ICNAF and this format could be updated based on what SC members felt worked best. The Canadian Research Report used a different format in June 2020, but there was no time to discuss its utility. The needed direction may be towards a National Sampling Report instead of a National Research Report. It was noted that a tool, e.g. Rmarkdown, could be useful for producing consistent reports.

Further discussion will be deferred until June 2021.

<u>List of biological sampling data:</u> This information is annually collated into an SCS document in Excel format. It was concluded that there is utility in the information provided in the current tables and in having the information publicly available as is the case with the current SCS document. No changes were suggested at this stage.

<u>RV surveys on a stock by stock basis:</u> STACREC will continue to develop a format for these tables. It was agreed in 2019 that STACREC members preferred Excel spreadsheets rather than text files.

Serial No.	SCS Doc.	Title
N6962	SCS Doc. 19/16	Available Data from the Commercial Fisheries Related to Stock Assessment (2018) and Inventory of Biological Surveys Conducted in the NAFO Area in 2018 and Biological Surveys Planned for 2019 and Early-2020
N6963	SCS Doc. 19/17	Tagging 2018
N6964	SCS Doc. 19/18	List of Biological Sampling Data for 2018
N6965	SCS Doc. 19/19	A Compilation of Research Vessel Surveys on a Stock-by-stock Basis
N7106	SCS Doc. 20/16	List of Biological Sampling Data for 2019
N7105	SCS Doc. 20/15	Available Data from the Commercial Fisheries Related to Stock Assessment (2019) and Inventory of Biological Surveys Conducted in the NAFO Area in 2019 and Biological Surveys Planned for 2020 and Early-2021
N7107	SCS Doc. 20/17	A Compilation of Research Vessel Surveys on a Stock-by-stock Basis

7. 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 11:00 hours on 24 September 2020.

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

Chair: Katherine Sosebee Rapporteur: Tom Blasdale

I. OPENING

The Committee met by correspondence from 21 to 25 September 2020 to consider the various matters in its agenda. Representatives attended from Canada, Denmark (in respect of Faroe Islands and Greenland), the European Union, France (in respect of St. Pierre et Miquelon) Japan, Norway, the Russian Federation, the United Kingdom and the United States of America. The Executive Secretary, Scientific Council Coordinator and other members of the Secretariat were in attendance.

II. ASSESSMENTS DEFERRED FROM THE JUNE 2020 MEETING.

1. Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4

Interim Monitoring Report (SCR Doc. 98/59, 75; 6/45; 16/21, 34REV; 19/ 42; 20/2, 10REV, 11)

a) Introduction

Illex illecebrosus has a lifespan of less than one year and is considered a single stock throughout its range from Newfoundland to Florida, in NAFO Subareas 2-6. However, the Subareas 3+4 and Subareas 5+6 stock components are assessed and managed separately by NAFO and the U.S.A. Mid-Atlantic Fishery Management Council, respectively. The Canada Department of Fisheries and Oceans (DFO) has not implemented a management plan for *Illex* fisheries that occur within their Exclusive Economic Zone (EEZ) in Subarea 3, the commercial and recreational inshore jig fisheries, and Subarea 4 (the historical Scotian Shelf fishery). The small *Illex* fishery that occurs off St. Pierre et Miquelon within the EEZ of France (in respect of St. Pierre et Miquelon) is also not managed. The stock assessment is data-poor and in-season stock assessments and annual biomass projections are not currently possible. Therefore, as of 2019, the SA 3+4 *Illex* assessments have been conducted in September instead of June to be able to incorporate the Div. 4VWX July survey indices for the current year. Indices of relative biomass and mean body weight were computed using data from the Div. 4VWX surveys conducted by the DFO. These indices were used to assess stock status (i.e., whether the Subareas 3+4 stock component was at a low or high productivity level) during the current year. The Subareas 3+4 nominal catch divided by the Div. 4VWX biomass index was used to assess annual relative exploitation rates. Such rates can only be computed through year *t*-1 because squid catch data for the current year were not available for SA 3+4 in time for presentation of the assessment results at the September Annual Meeting.

b) Data Overview

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. There were no catches from Subarea 3 during 2013-2015. During 1999-2011, catches from Subareas 3+4 were low during most years (average = 1 078 t), compared to catches during 1976-1981 (average = 80 645 t), and ranged between about 57 t in 2001 to 6 981 t in 2006 (Figure 1.1). Catches in Subareas 3+4 were less than 50 t during 2012-2015 and reached the lowest level in the time series (since 1953) during 2015 (14 t). Thereafter, catches increased to 2 734 t in 2019 (of which 186 t were harvested in the NRA), the highest since 2006, but were only slightly above the average catch (2 510 t) for the 1982-2016 low productivity period. During 2000-2019, when the Subareas 3+4 TAC was 34 000 t, 2.7% of the TAC was harvested on average, with a peak of 20.5% in 2006. The majority of the catches during this period were harvested in Subarea 3 within the Canadian EEZ by the inshore jig fishery.

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

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TAC SA 3+4	34	34	34	34	34	34	34	34	34	34
STATLANT 21 SA 3+4	0.1[1]	0.1[1]	<0.1[1]	<0.1[1]	<0.1[1]	<0.1[1]	0.2[1]	0.4[1]	<0.1[1]	2.7[1]
STATLANT 21 SA 5+6[2]										
STACFIS SA 3+4	0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.4	1.5	2.7
STACFIS SA 5+6[2]	15.8	18.8	11.7	3.8	8.8	2.4	6.7	22.5	24.1	27.1
STACFIS Total SA 3-6[3]	15.9	18.9	11.7	3.8	8.8	2.4	6.8	22.9	25.6	29.8

[1] Includes amounts (< 0.1 t to 18 t during 2010-2011 and 0.2 t to 47 t during 2012-2019) reported as 'Unspecified Squid' from Subarea 4 because they were likely *I. illecebrosus* based on the geographic distribution of each species.

[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.

[3] STACFIS Total SA 3-6 catches were computed as catches harvested in the NRA (NAFO CESAG database) plus catches recorded in the USA and CA (Newfoundland and Maritimes Regions) commercial catch databases.

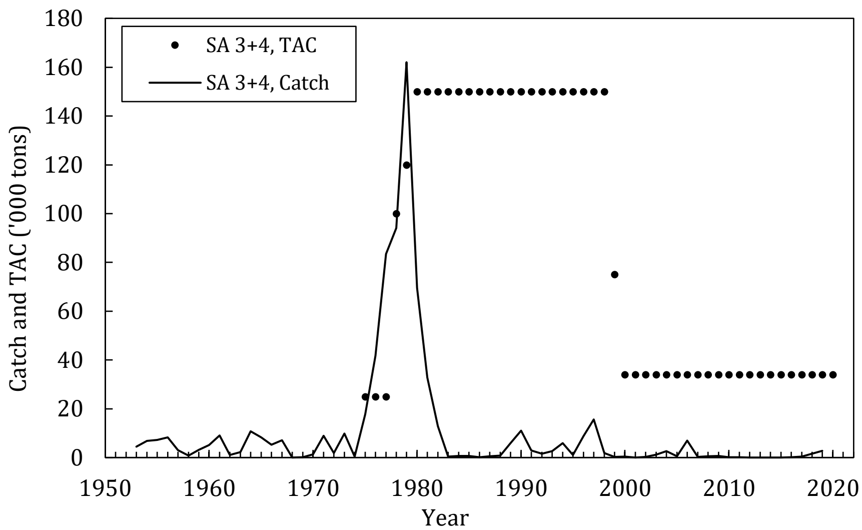

Figure. 1.1. Northern shortfin squid in Subareas 3+4: nominal catches and TACs.

Relative biomass indices, derived using data from the Canadian surveys conducted during July in Div. 4VWX, fluctuated widely after 2003 (Figure. 1.2). Biomass indices generally declined between 2004 and 2013, from a level near the high productivity period mean of 13.2 to the lowest level on record, respectively. During 2014-2016, biomass indices remained much lower than the 1982-2016 low productivity period average of 2.6, but then increased in 2017 to 16.1; the third highest level of the time series and greater than the 1976-1981 high productivity period average. However, since 1982, each year of high biomass (i.e., 1992, 2004 and 2006) during the low productivity period was followed by a much lower biomass level. Persistence of high biomass levels in 2018 could not be confirmed because a biomass index was not computed due to inadequate sampling of a majority of the *Illex* strata set because of survey vessel mechanical problems. However, the 2019 biomass index which was included in the 2019 September assessment, indicated that biomass was twice as high (32.1) as the 2017 index and was the second highest value in the time series. However, during 2020, the biomass index (8.2) decreased to a level below the high productivity period average (but remained higher than all but two of the biomass indices during 1982-2016).

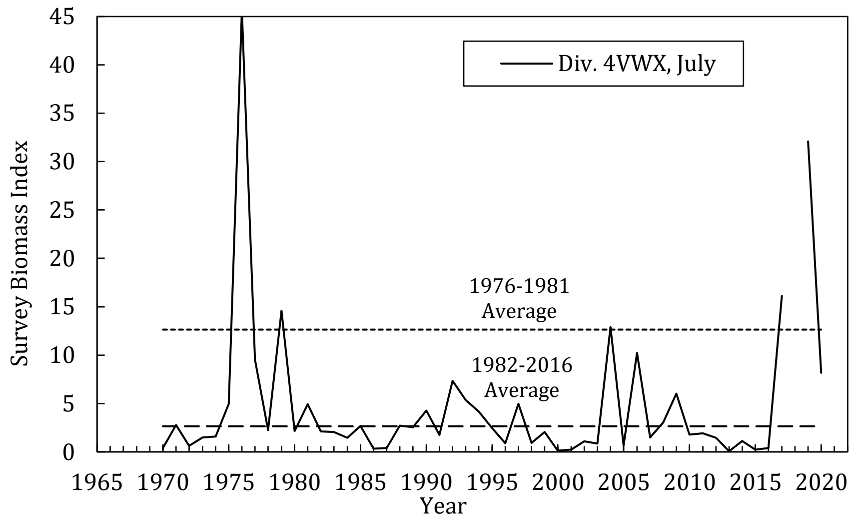

Figure. 1.2. Northern shortfin squid in Subareas 3+4: survey biomass indices from the July survey in Div. 4VWX.

The mean body weight of squid caught during the July Div. 4VWX surveys averaged 150 g during the 1976-1981 high productivity period (1976-1981) and 80 g during the low productivity period (1982-2016). Mean body weight increased from the lowest level of the time series in 1983 (27 g) to the second highest level of the low productivity period (121 g) in 1999 (Figure. 1.3). Between 2000 and 2006, mean body weight increased to a low productivity period peak of 137 g, but then gradually declined to 42 g in 2013. Following wide fluctuations around the low productivity average during 2014-2016, mean body weight increased to a level similar to 2006 in 2017 (134 g). For the reason explained above, mean body weight was not computed for 2018, so it is unknown whether mean body weight was above the high productivity period average for two consecutive years. During the 2019 assessment, the Scientific Council noted that the 2019 mean body weight (163 g) was above high productivity period average for the first time since 1979 and concluded that the status of the Subareas 3+4 stock component may be moving toward a high productivity period. However, this level of high biomass did not persist for a second year; instead mean body weight dropped below the high productivity average to 123 g in 2020 (but remained higher than all but one year during 1982-2016).

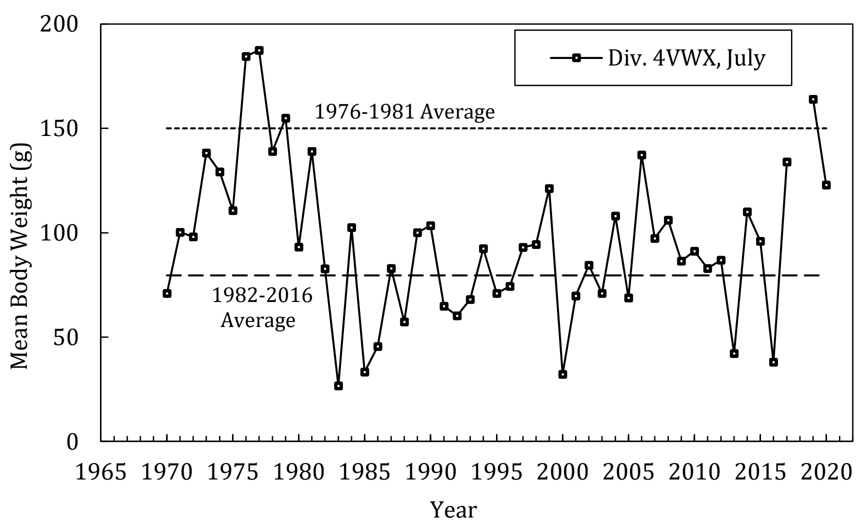

Figure. 1.3. Northern shortfin squid in Subareas 3+4: mean body weights of squid from the July survey in Div. 4VWX.

Catch/biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index) / 10 000) were much lower than the 1982-2016 mean (0.12) during most years since 2001 and the ratio was 0.01 in 2019 (Figure. 1.4). The 2020 ratio could not be computed because the Subareas 3+4 catches were not available for SA 3+4 in time for the preparation of this assessment.

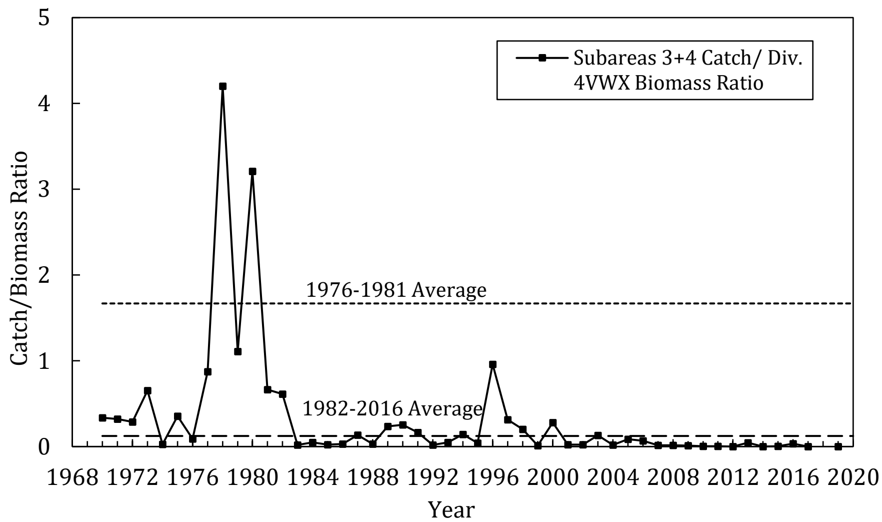

Figure. 1.4. Northern shortfin squid in Subareas 3+4: catch/biomass ratios (SA 3+4 nominal catch/Division 4VWX July survey biomass index) / 10 000).

c) Conclusion

In 2019, the Scientific Council concluded that the Subareas 3+4 stock component may be moving toward a high productivity period based on the fact that the 2017 and 2019 biomass indices and the 2019 mean body weight index were above their respective high productivity period means. However, without the 2018 survey indices, the SC could not determine whether similarly high values persisted for two consecutive years, and therefore, recommended (and the Commission adopted) status quo catch advice of 34 000 t; the maximum TAC adopted for low productivity years.

The high biomass and mean body weight indices of 2019 did not persist in 2020, and instead declined to levels midway between their respective low and high productivity period means. However, the 2020 values of both indices were greater than most of the values for 1982-2016. Unless catches were under-reported, the high biomass indices in 2017 and 2019 did not translate into similarly high catches in the Subarea 3+4 fisheries; instead relative exploitation rates continued to remain extremely low during these years. The reason for the low exploitation rates during these two years was not due to a TAC constraint. During 2000-2019, only 2.7% of the 34 000 t TAC was harvested on average, with a maximum of 20.5% in 2006. Since 2000, most of the Subareas 3+4 catches were harvested in Subarea 3 within the Canadian EEZ, by the inshore jig fishery, rather than from within the NRA.

In combination, the large decrease in biomass and mean body size indices, from above the high productivity period average in 2019 to below it in 2020, and the continued low exploitation rates in recent years do not support an increase in the status quo catch advice (34 000 t).

The next assessment is planned for 2022.

d) Research Recommendation

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.

III. OTHER MATTERS

1. Nomination of Designated Experts

There were no changes to the current Designated Experts for stocks.

2. Other matters

a) Review of SCR and SCS Documents

No SCRs were submitted to this meeting.

b) FIRMS Classification for NAFO Stocks

STACFIS reiterates that the Stock Classification system is not intended as a means to convey the scientific advice to the 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 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 3LN Redfish			
Intermediate	3M Northern shrimp[3] SA3+4 Northern shortfin squid	SA0+1 Northern shrimp[1] DS Northern shrimp[1] SA 0+1 (Offshore) Greenland halibut 3M Redfish[3] SA2+3KLMNO Greenland halibut	3M cod	Greenland halibut in Disko Bay[2] SA1 American Plaice SA1 Spotted Wolffish
Small	3NOPs White hake 3NO Witch flounder 3LNOPs Thorny skate			Greenland halibut in Uummannaq[2] Greenland halibut in Upernavik[2]
Depleted	3M American plaice 3LNO American plaice 3NO Cod 3LNO Northern shrimp			SA1 Redfish SA1 Atlantic Wolffish
Unknown	SA2+3 Roughhead grenadier 3NO Capelin 3O Redfish	1B-C Greenland halibut Inshore	1D Greenland halibut Inshore 1E-F Greenland halibut Inshore	6G Alfonsino

[1]Shrimp will be re-assessed at the SC shrimp meeting in November 2019
[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

c) Other business

i) Invited speaker

In 2019, STACFIS discussed having an invited speaker attend the June 2020 Scientific Council meeting, in conjunction with STACREC on the topic of combining surveys for the purpose of developing more fulsome indices wherever possible. This person may also be an external reviewer for the meeting.

Hughes Benoît was invited to perform this role in 2020 but due to the Pandemic situation it was not possible for him to give the talk. The SC chair will invite Dr. Benoît to give this talk in June 2021.

IV. ADJOURNMENT

The meeting was adjourned on 25 September 2020.

APPENDIX IV. SCIENTIFIC COUNCIL AGENDA, SEPTEMBER 2020

Note: items listed under agenda item VII.1 (*Requests/advice requested by the Commission (in NAFO/COM Doc. 19-29) deferred from the June 2020 Scientific Council Meeting*), will be addressed as far as possible during this meeting. However, due to time and other constraints, it is likely that many will be deferred to the June 2021 Scientific Council meeting. If the NAFO Commission communicates that responses from Scientific Council on these requests are needed for consideration at the 2020 Annual Meeting or before June 2021, additional meeting days may be added during September 15-17 2020.

Provisional 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. Joint Session of Commission and Scientific Council

1. Implementation of 2018 Performance Review Panel recommendations
2. Presentation of scientific advice by the Chair of the Scientific Council
    a) Response of the Scientific Council to the Commission's request for scientific advice
    b) Feedback to the SC regarding the advice and its work during this meeting
    c) Other issues as determined by the Chair of the Commission and of the Scientific Council
3. Meeting Reports and Recommendations of the Joint Commission–Scientific Council Working Groups
    a) Working Group on Improving Efficiency of NAFO Working Group Process (E-WG), 2020
    b) Joint Commission–Scientific Council Working Group on Risk-based Management Strategies (WG-RBMS), August 2020
    c) Joint Commission–Scientific Council Working Group on Ecosystems Approach Framework to Fisheries Management (WG-EAFFM), August 2020
    d) Joint Commission–Scientific Council Catch Estimation Strategy Advisory Group (CESAG), 2020 (no discussion required)
4. Formulation of Request to the Scientific Council for Scientific Advice on Management in 2022 and Beyond of Certain Stocks in Subareas 2, 3 and 4 and Other Matters

IV. Publications (STACPUB Chair: Margaret Treble)

Opening

Appointment of Rapporteur

Adoption of Agenda

Review of Recommendations in 2019

Review of Publications

a) Annual Summary

  i) Journal of Northwest Atlantic Fishery Science (JNAFS)

  ii) Scientific Council Studies

  iii) Scientific Council Reports

Other Matters

Adjournment

V. Research Coordination (STACREC Chair: Karen Dwyer)

1. Opening

3. Appointment of Rapporteur

4. Review of Recommendations in 2019

5. Fishery Statistics

  a) Progress report on Secretariat activities in 2019/2020

    i) Presentation of catch estimates from the CESAG, daily catch reports and STATLANT 21A and 21B

6 Research Activities

  a) Biological sampling

    i) Report on activities in 2019/2020

    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 2019 and early 2020 (by National Representatives and Designated Experts)

    ii) Surveys planned for 2020 and early 2021

  c) Tagging activities

  d) Other research activities

7. Review of SCR and SCS Documents

8. Other Matters

   a) Summary of progress on previous recommendations

   b) NAFO Catch Estimates Methodology Study

9. Adjournment

VI. Fisheries Science

1. Opening

2. Nomination of Designated Experts

3. Other Matters

   a) Review of SCR and SCS Documents

   b) Assessments deferred from the June meeting

      i) Northern shortfin squid in SA 3+4 (interim monitoring report)

   c) Review of FIRMS classification of NAFO stocks

   d) Other Business

VII. Requests from the Commission

Requests/advice requested by the Commission (in NAFO/COM Doc. 19-29) deferred from the June 2020 Scientific Council Meeting

Continue the evaluation of scientific trawl surveys in VME closed areas (COM request #3)

Identify discard species/stocks with high survivability rates (COM request #4)

Identify areas and times where bycatch and discards of Greenland sharks have a higher rate of occurrence (COM request #9)

Develop a 3-5 year work plan (COM request #10)

Review submitted protocols for a survey methodology to inform the assessment of splendid alfonsino (COM request #13)

Presentation of the stock assessment and the scientific advice of Cod 2J3KL (Canada), Witch 2J3KL (Canada) and Pelagic *Sebastes mentella* (ICES Divisions V, XII and XIV; NAFO 1) (COM request #14)

Provide updates on relevant research related to the potential impact of activities other than fishing in the Convention Area (COM request #16)

Information on sea turtles, sea birds, and marine mammals that are present in NAFO Regulatory Area (COM request #18)

Ad hoc Requests from Current Meeting

Further progress on items related to COM requests (in NAFO/COM Doc. 19-29)

COM request #6: assessment of NAFO bottom fisheries in 2021

With regards to the overlap of NAFO fisheries with VME, Scientific Council should finalize the specification of data and information to be included in the directed fishery summaries

COM request #8: NAFO PA Framework review

Scientific Council should further elaborate on the work plan for the next 1-2 years

VIII. Review of Future Meeting Arrangements

IX. Future Special Sessions

1. Progress on 2021 symposium with ICES on Decadal Hydro-Biological Variability of the North Atlantic for the decade 2010-2019

2. Information concerning Flatfish Symposium 2020

X. Other Matters

Meeting reports

a) ICES/NAFO Working Group on Deep-water Ecology (WGDEC)

b) ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals (WGHARP)

XI. Adoption of Reports

1. Committee Reports of STACPUB, STACFIS and STACREC

2. Report of Scientific Council

XI. Adjournment

ANNEX 1. THE COMMISSION'S REQUEST FOR SCIENTIFIC ADVICE ON MANAGEMENT IN 2021 AND BEYOND OF CERTAIN STOCKS IN SUBAREAS 2, 3 AND 4 AND OTHER MATTERS

(from SCS Doc. 20/01)

Following a request from the Scientific Council, the Commission agreed that items 1, 2, 7, 8 and 11 should be the priority for the June 2020 Scientific Council meeting.

1. The Commission requests that the Scientific Council provide advice for the management of the fish stocks below according to the assessment frequency presented below. In keeping with the NAFO Precautionary Approach Framework (FC Doc. 04/18), the advice should be provided as a range of management options and a risk analysis for each option (rather than a single TAC recommendation) and the actual risk level should be decided upon by managers.

Yearly basis	Two-year basis	Three-year basis
Cod in Div. 3M Northern shrimp in Div. 3M	Redfish in Div. 3M Northern shrimp in Div. 3LNO Thorny skate in Div. 3LNO Witch flounder in Div. 3NO Redfish in Div. 3LN White Hake in Div. 3NO	American Plaice in Div. 3LNO American Plaice in Div. 3M Capelin in Div. 3NO Northern shortfin squid in SA 3+4 Redfish in Div. 3O Yellowtail flounder in Div. 3LNO Greenland halibut in Div. 2+3KLMNO Cod in Div. 3NO Splendid alfonsino in SA 6

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

In 2020, advice should be provided for 2021 for Cod in 3M and Northern shrimp in 3M. With respect to Northern shrimp in 3M, SC is requested to provide its advice to the Commission prior to the 2020 Annual Meeting.

In 2020, advice should be provided for 2021 and 2022 for: Thorny Skate in 3LNO,

In 2020, advice should be provided for 2021, 2022 and 2023 for: American Plaice in 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, currently Greenland halibut 2+3KLMNO.

The Commission also requests the Scientific Council to continue to monitor the status of all other 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 Commission requests the Scientific Council to conduct an update assessment of Greenland halibut in Subarea 2+Div 3KLMNO and to compute the TAC using the agreed HCR and determine whether exceptional circumstances are occurring. If exceptional circumstances are occurring, the exceptional circumstances protocol will provide guidance on what steps should be taken.

3. The Commission requests that Scientific Council continue its evaluation of the impact of scientific trawl surveys on VME in closed areas, and the effect of excluding surveys from these areas on stock assessments.

4. The Commission requests the Scientific Council to implement the steps of the Action plan relevant to the SC and in particular the tasks identified under section 2.2 of the Action Plan, for progression in

the management and minimization of Bycatch and discards (COM Doc. 17-26), giving priority in 2020 to the identification of discard species/ stocks listed in Annex I.A. and Annex I.B of the NCEM with high survivability rates.

5. The Commission requests the Scientific Council to continue to refine its work under the Ecosystem Approach and report on these results to both the WGEAFFM and WGRBMS.

6. In relation to the assessment of NAFO bottom fisheries in 2021, the Scientific Council should:

   - Assess the overlap of NAFO fisheries with VME to evaluate fishery specific impacts in addition to the cumulative impacts;
   - Consider clearer objective ranking processes and options for objective weighting criteria for the overall assessment of significant adverse impacts and the risk of future adverse impacts;
   - Maintain efforts to assess all of the six FAO criteria (Article 18 of the FAO International Guidelines for the Management of Deep Sea Fisheries in the High Seas) including the three FAO functional SAI criteria which could not be evaluated in the current assessment (recovery potential, ecosystem function alteration, and impact relative to habitat use duration of VME indicator species).
   - Continue to work on non-sponge and coral VMEs (for example bryozoan and sea squirts) to prepare for the next assessment.

7. The Commission requests Scientific Council to conduct a re-assessment of VME closures by 2020, including area #14.

8. The Commission requests the Scientific Council to continue progression on the review of the NAFO PA Framework.

9. The Commission requests Scientific Council continue to work with WG- BDS and the Secretariat to identify areas and times where bycatch and discards of Greenland sharks have a higher rate of occurrence. This work will support WG-BDS in developing appropriate management recommendations, including safe handling practices for live release of Greenland sharks, for consideration by the Commission at its 2021 Annual Meeting.

10. The Commission requests Scientific Council to continue to develop a 3-5 year work plan, which reflects requests arising from the 2019 Annual Meeting, other multi-year stock assessments and other scientific inquiries already planned for the near future. The work plan should identify what resources are necessary to successfully address these issues, gaps in current resources to meet those needs and proposed prioritization by the Scientific Council of upcoming work based on those gaps.

11. The Commission requests that Scientific Council do an update assessment for 3LN redfish and five year projections (2021 to 2025) to evaluate the impact of annual removals at 18 100 tonnes against the performance statistics from NCEM Annex I.H: If this level of catch does not result in fulfilling these performance statistics, SC should advise the level of catch that would.

12. The Commission request that the Scientific Council present the Ecosystem Summary Sheet for 3LNO for presentation to the Commission at the 2020 Annual Meeting.

13. The Commission request the Scientific Council review submitted protocols for a survey methodology to inform the assessment of Splendid Alfonsino. The Scientific Council to report on the outcome of this work at next Commission annual meeting.

14. The COM request that the results of the stock assessment and the scientific advice of Cod 2J3KL (Canada), Witch 2J3KL (Canada) and Pelagic *Sebastes mentella* (ICES Divisions V, XII and XIV; NAFO

1) to be presented to the Scientific Council (SC), and request the SC to prepare a summary of these assessments to be included in its annual report.

15. The Commission to ask the Scientific Council to advise on the possible sustainable management methods for northern shrimp in Div. 3M, including quota, fishing effort, periods, reporting or other technical measures. This advice should be provided before the intersessional work by the end of this year.

16. The Commission requests Scientific Council to continue to monitor and provide updates resulting from relevant research related to the potential impact of activities other than fishing in the Convention Area (for example via EU ATLAS project), and where possible to consider these results in the on-going modular approach concerning the development of Ecosystem Summary Sheets.

17. The Commission requests the Scientific Council to provide advice on gear, including sorting grids, area and time-based measures that can be used to protect and improve the productivity of the 3M Cod stock.

18. The Commission requests the Scientific Council to provide information to the Commission at its next annual meeting on sea turtles, sea birds, and marine mammals that are present in NAFO Regulatory Area based on available data.

ANNEX A: Guidance for providing advice on Stocks Assessed with an Analytical Model

The 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_{2019}, F_{2019}, 125% F_{2019},
    - For stocks under a moratorium to direct fishing: F_{2019}, 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(B2022 > B2018)
F in 2019 and following years*	Yield 2020 (50%)	Yield 2021 (50%)	Yield 2022 (50%)	2020	2021	2022	2020	2021	2022		2020	2021	2022	2020	2021	2022		
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_{2018}	t	t	t	%	%	%	%	%	%		%	%	%	%	%	%		%
F_{2018}	t	t	t	%	%	%	%	%	%		%	%	%	%	%	%		%
1.25 X F_{2018}	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_{2019}, F_{2019}, 125% F_{2019},
- For stocks under a moratorium to direct fishing: F_{2019}, 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>F0.1)			P(F>F_{max})				P(B2022 > B2018)
F in 2019 and following years*	Yield 2020	Yield 2021	Yield 2022	2020	2021	2022	2020	2021	2022		2020	2021	2022	2020	2021	2022		
F0.1	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_{2018}	t	t	t	%	%	%	%	%	%		%	%	%	%	%	%		%
F_{2018}	t	t	t	%	%	%	%	%	%		%	%	%	%	%	%		%
1.25 X F_{2018}	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.

APPENDIX V: EXPERTS FOR PRELIMINARY ASSESSMENT OF CERTAIN STOCKS

The Designated Experts for 2020 were:

From the Science Branch, Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans, St. John's, Newfoundland & Labrador, Canada

Cod in Div. 3NO	Rick Rideout	rick.rideout@dfo-mpo.gc.ca
Redfish Div. 3O	Danny Ings	danny.ings@dfo-mpo.gc.ca
American Plaice in Div. 3LNO	Laura Wheeland	laura.wheeland@dfo-mpo.gc.ca
Witch flounder in Div. 3NO	Dawn Maddock Parsons	dawn.parsons@dfo-mpo.gc.ca
Yellowtail flounder in Div. 3LNO	Dawn Maddock Parsons	dawn.parsons@dfo-mpo.gc.ca
Greenland halibut in SA 2+3KLMNO	Paul Regular	paul.regular@dfo-mpo.gc.ca
Northern shrimp in Div. 3LNO	Katherine Skanes	katherine.skanes@dfo-mpo.gc.ca
Thorny skate in Div. 3LNO	Mark Simpson	mark.r.simpson@dfo-mpo.gc.ca
White hake in Div. 3NO	Mark Simpson	mark.r.simpson@dfo-mpo.gc.ca

From the Department of Fisheries and Oceans, Winnipeg, Manitoba, Canada

Greenland halibut in SA 0+1	Margaret Treble	margaret.treble@dfo-mpo.gc.ca

From the Instituto Español de Oceanografia, Vigo (Pontevedra), Spain

Roughhead grenadier in SA 2+3	Fernando Gonzalez-Costas	fernando.gonzalez@ieo.es
Splendid alfonsino in Subarea 6	Fernando Gonzalez-Costas	fernando.gonzalez@ieo.es
Cod in Div. 3M	Diana Gonzalez-Troncoso	diana.gonzalez@ieo.es
Shrimp in Div. 3M	Jose Miguel Casas Sanchez	mikel.casas@ieo.es

From the Instituto Nacional de Recursos Biológicos (INRB/IPMA), Lisbon, Portugal

American plaice in Div. 3M	Ricardo Alpoim	ralpoim@ipma.pt
Golden redfish in Div. 3M	Ricardo Alpoim	ralpoim@ipma.pt
Redfish in Div. 3M	Antonio Ávila de Melo	amelo@ipma.pt
Redfish in Div. 3LN	Antonio Ávila de Melo	amelo@ipma.pt

From the Greenland Institute of Natural Resources, Nuuk, Greenland

Redfish in SA1	Rasmus Nygaard	rany@natur.gl
Other Finfish in SA1	Rasmus Nygaard	rany@natur.gl
Greenland halibut in Div. 1A	Rasmus Nygaard	rany@natur.gl
Northern shrimp in SA 0+1	AnnDorte Burmeister	anndorte@natur.gl

Northern shrimp in Denmark Strait	Frank Rigét	frri@natur.gl

From Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Russian Federation

Capelin in Div. 3NO	Konstantin Fomin	fomin@pinro.ru

From National Marine Fisheries Service, NEFSC, Woods Hole, Massachusetts, United States of America

Northern Shortfin Squid in SA 3 & 4	Lisa Hendrickson	lisa.hendrickson@noaa.gov

APPENDIX VI. LIST OF SUMMARY (SCS) DOCUMENTS

Summary Documents (SCS)

SCS Doc No.	Serial No.	Author	Title
SCS Doc. 20/16	N7106	NAFO	List of Biological Sampling Data for 2019
SCS Doc. 20/19	N7123	NAFO	Report of the Scientific Council, 21-25 September 2020

APPENDIX VII. LIST OF PARTICIPANTS, SEPTEMBER 2020

SCIENTIFIC COUNCIL CHAIR	
Fernandez, Carmen	Instituto Español de Oceanografía (IEO). Madrid, Spain. Tel: +34 (985) 308 672 - Email: carmen.fernandez@ieo.es
CANADA	
Dwyer, Karen Vice-Chair of Scientific Council & Chair of STACREC	Science Branch, Fisheries & Oceans Canada, P.O. Box 5667, St. John's, NL. A1C 5X1 Tel.: +709-772-0573 - E-mail: karen.dwyer@dfo-mpo.gc.ca
Healey, Brian	Science Branch, Fisheries & Oceans Canada, P.O. Box 5667, St. John's, NL A1C 5X1 Tel.: +709-772-8674 – E-mail: brian.healey@dfo-mpo.gc.ca
Koen-Alonso, Mariano	Science Branch, Fisheries & Oceans Canada, P.O. Box 5667, St. John's, NL. A1C 5X1 E-mail: Mariano.Koen-Alonso@dfo-mpo.gc.ca
Krohn, Martha	Senior Science Advisor, Fisheries & Oceans Canada, 200 Kent Street, Ottawa, ON K1A 0E6, Tel.: +613-998-4234 – E-mail: martha.krohn@dfo-mpo.gc.ca
Pepin, Pierre	Fisheries & Oceans Canada, P. O. Box 5667, St. John's, NL A1C 5X1 E-mail: pierre.pepin@dfo-mpo.gc.ca
Simpson, Mark	Science Branch, Fisheries & Oceans Canada, P.O. Box 5667, St. John's, NL. A1C5X1 Tel.: +709-772-4841 - E-mail: mark.r.simpson@dfo-mpo.gc.ca
Treble, Margaret Chair of STACPUB	Fisheries & Oceans Canada, Freshwater Inst., 501 University Cres., Winnipeg, MT Tel.: +204-984-0985 - E-mail: margaret.treble@dfo-mpo.gc.ca
Wheeland, Laura	Science Branch, Fisheries & Oceans Canada, P.O. Box 5667, St. John's, NL. A1C 5X1 Tel.: +709-687-8357 - E-mail: Laura.Wheeland@dfo-mpo.gc.ca
DENMARK (IN RESPECT OF FAROE ISLANDS AND GREENLAND)	
Ridao Cruz, Luis	Nóatún 1, P.O. Box 3051, FO-110 Tórshavn, Faroe Islands Tel.: +298 353900 - E-mail: luisr@hav.fo
EUROPEAN UNION	
Alpoim, Ricardo	Instituto Português do Mar e da Atmosfera, I. P., Av. de Brasilia, 1449-006 Lisbon, Portugal Tel.: +351 21 302 7000 - E-mail: ralpoim@ipma.pt
Ávila de Melo, António	Instituto Portugues do Mar e da Atmosfera, I.P., Av. de Brasilia, 1449-006 Lisbon, Portugal Tel.: +351 21 302 7000 - E-mail: amelo@ipma.pt
Caetano, Miguel Chair of STACFEN	Instituto Português do Mar e da Atmosfera (IPMA), Division of Oceanography and Marine Environment, Rua Alfredo Magalhães Ramalho, 6, 1495-165 Algés, Portugal Tel: +351 21 302 7070 – Email: mcaetano@ipma.pt

Casas Sanchez, José Miguel	Instituto Español de Oceanografia, Aptdo 1552, E-36200 Vigo (Pontevedra), Spain Tel: +34 986 49 2111 – E-mail: mikel.casas@ieo.es
Durán Muñoz, Pablo	Instituto Español de Oceanografia, Subida A Radiofaro, 50, 36390 Vigo (Pontevedra), Spain E-mail: pablo.duran@ieo.es
Garrido Fernández, Irene	Instituto Español de Oceanografía E-mail: irenegarridof@hotmail.com
González-Troncoso, Diana	Instituto Español de Oceanografia, Subida A Radiofaro, 50, 36390 Vigo (Pontevedra), Spain Tel.: +34 9 86 49 2111 - E-mail: diana.gonzalez@ieo.es
González-Costas, Fernando	Instituto Español de Oceanografia, Subida A Radiofaro, 50, 36390 Vigo (Pontevedra), Spain Tel.: +34 9 86 49 2111 - E-mail: fernando.gonzalez@ieo.es
Näks, Liivika	Head of the Unit of Ocean Fisheries, Estonian Marine Institute, University of Tartu. E-mail: liivika.naks@ut.ee
Ribeiro, Cristina	DG MARE, Rue Joseph II, 99, B-1049, Brussels, Belgium Tel: +32 2 298 1663 - Email: Cristina-RIBEIRO@ec.europa.eu
Sacau, Mar	Instituto Español de Oceanografia, Subida A Radiofaro, 50, 36390 Vigo (Pontevedra), Spain Email: mar.sacau@ieo.es
FRANCE (IN RESPECT OF ST. PIERRE ET MIQUELON)	
Goraguer, Herlé.	French Research Institute for Exploitation of the Sea(IFREMER), Quai de l'Alysse, BP 4240, 97500, St. Pierre et Miquelon Tel: +05 08 41 30 83 – Email: herle.goraguer@ifremer.fr
JAPAN	
Nishida, Tom	Associate Scientist, National Research Institute of Far Seas Fisheries, Agency, 5-7-1, Orido, Shimizu-Ward, Shizuoka-City, Shizuoka, Japan Tel: +81 (54) 336 5834– E-mail: tnishida@affrc.go.jp
Taki, Kenji	Associate Scientist, National Research Institute of Far Seas Fisheries, Agency, 5-7-1, Orido, Shimizu-Ward, Shizuoka-City, Shizuoka, Japan E-mail: takisan@affrc.go.jp
NORWAY	
Hvingel, Carsten	Institute of Marine Research, P.O. Box 1870, N-5817 Bergen, Norway Tel: +47 95980565 E-mail: carsten.hvingel@imr.no

RUSSIAN FEDERATION	
Fomin, Konstantin	Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO), 6 Knipovich St., Murmansk 183763 Tel.: +7 8152 436 177 E-mail: fomin@pinro.ru
Orlov, Alexei	Russian Federal Research Institute of Fisheries & Oceanography (VNIRO), K. 17, V. Krasnoselskaya, Moscow, 107140 E-mail: orlov@vniro.ru
Petukhova, Natalia	Russian Federal Research Institute of Fisheries & Oceanography (VNIRO), K. 17, V. Krasnoselskaya, Moscow, 107140 E-mail: ng_petukhova@mail.ru
UNITED KINGDOM	
Darby, Chris	CEFAS, Lowestoft Laboratory, Lowestoft, UK E-mail: chris.darby@cefas.co.uk
Kenny, Andrew	CEFAS, Lowestoft Laboratory, Lowestoft, UK E-mail: andrew.kenny@cefas.co.uk
Readdy, Lisa	CEFAS, Lowestoft Laboratory, Lowestoft, UK E-mail: lisa.readdy@cefas.co.uk
UNITED STATES OF AMERICA	
Hendrickson, Lisa	National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543 E-mail: lisa.hendrickson@noaa.gov
Sosebee, Katherine Chair of STACFIS	National Marine Fisheries Service, NEFSC, 166 Water St., Woods Hole, MA 02543 Tel.: +508-495-2372 - E-mail: katherine.sosebee@noaa.gov
NAFO SECRETARIAT	
Bell MacCallum, Dayna	Scientific Information Administrator Email: dbell@nafo.int
Blasdale, Tom	Scientific Council Coordinator Email: tblasdale@nafo.int