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Proceedings of the Regional Advisory Meeting on the Assessment of the Quebec North Shore (4S) herring stocks in 2020

May 4-5, 2021
Virtual meeting

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

This document outlines the proceedings of the regional peer review meeting on the assessment of the Quebec North Shore (4S) herring stocks. This meeting, which was held virtually via Zoom on March 16-17, 2021 brought together twenty-five participants from science, management and industry. These proceedings detail the essential parts of the presentations and discussions held during the meeting, as well as the recommendations and conclusions made.

INTRODUCTION

The Quebec Region of Fisheries and Oceans Canada (DFO) is responsible for assessing several stocks of fish and invertebrate species harvested in the Estuary and Gulf of St. Lawrence. Most of these stocks are periodically assessed as part of a regional advisory process that is conducted at the Maurice Lamontagne Institute in Mont-Joli. This document consists of the proceedings of the meeting held on May 4-5, 2021 via the Zoom platform (virtual meeting), on the assessment of the Quebe North Shore (4S) herring stocks.

The objective of the meeting was to determine whether there were any changes in the resource's status and whether adjustments were required to the management plans based on the chosen conservation approach, with the ultimate goal being to provide a science advisory report on the management of the Quebec North Shore (4S) herring stocks for the 2021 and 2022 fishing seasons.

These proceedings report on the main points discussed in the presentations and deliberations stemming from the activities of the regional stock assessment committee. The regional peer review meeting is a process open to all participants who are able to provide a critical outlook on the status of the assessed resources. Accordingly, participants from outside DFO are invited to take part in the committee's activities within the defined framework for this meeting (Appendices 1 and 2). The proceedings also list the recommendations made by the meeting participants.

ASSESSMENT

Meeting chairperson Marie-Julie Roux welcomed the participants. She went over the peer review objectives and agenda. Attendees were then asked to introduce themselves. Stéphane Plourde presented DFO's national initiative to implement an ecosystem approach by integrating environmental variables into stock assessments in order to improve fisheries management decisions. This is a global shift in the approach to fisheries management in the context of climate change which is also aimed at meeting eco-certification requirements and international market standards. The biologist in charge of the review, Kim Émond, highlighted the work of her collaborators, presented the Terms of reference and briefly reviewed the highlights of the latest Science Advisory Report (2019).

COMMERCIAL FISHERY

The biologist provided an overview of the fishery, the management measures and the landing statistics by unit area and fishing gear as well as the temporal and spatial distribution of catches. The biologist also presented data on herring catches in directed fisheries for other species (mackerel, capelin, shrimp, cod). Quebec North Shore herring landings had been declining since 2017: they reached 1,482 t (or 33% of the TAC) in 2020, their lowest level since 2011. Almost all landings were made in the eastern end of unit area 4Sw.

- Concern was raised about one of the management measures: the "box" in the waters adjacent to the Lower North Shore, which is designed to protect the area by preventing trawlers from fishing too close to the coast.

- As noted in the summary of the most recent science advisory report, the decrease in landings since 2016 may be partly due to the management measures put in place in 2017 and 2018, along with weather conditions unfavourable for fishing activities, and an increased presence of herring at greater depths, which likely reduced their availability to fishing gear. The decrease in landings observed in 2020 appears to be related to lower fishing effort

directed at herring, given that demand focused primarily on capelin. The strong presence of small fish also limited catches, taking into consideration the existing management measures.

- Questions were raised about the significant increase in landings since the late 2000s. Some participants said that this could be linked to seiners entering the fishery.

- It was noted that the herring catch data for the shrimp fishery are taken from the ZIFF files. These are actually landings, which likely consisted of herring stuck in the Nordmore grate.

BIOLOGICAL INDICATORS

The proportion of the two spawning stocks in commercial catches was presented, along with the catch at age and several additional standardized biological indicators: cohort strength index, length and age at 50% maturity, mean length at age, mean weight at age, and relative condition index. The proportion of spring spawners in the landings increased from a mean of 7% during the 2008-2019 period, to a mean of 28% in 2020. Spring herring spawning stock catches in 2019 and 2020 consisted mainly of small fish from the 2017 year-class, and to a lesser extent, from the 2013 year-class. These findings are consistent with those for the herring stocks on the west coast of Newfoundland (4R). Fall herring spawning stock catches in 2019 and 2020 consisted mainly of fish aged 11 years and over. A new year-class (2016) was also observed in 2020.

- It was noted that the samples came from fishery-dependent sources and their origin varies from year to year.

- It was pointed out that herring that spawn before July 1 are considered as spring spawners and those that spawn after July 1 are fall spawners. The capture date and the condition of the gonads can be used to identify the spawning group. Juveniles are identified on the basis of otoliths.

- The graph showing the proportion of each spawning stock in commercial catches revealed that the transition from spring to fall spawners, observed in 2008, was caused by a change in the seasonal distribution of catches.

- The large proportion of small fish observed in the commercial fishery in 2020 is believed to consist of 2- and 3-year-old spring spawners and 4-year-old fall spawners. This increase was also observed in 4R and is considered an encouraging sign for the future. The industry is expecting a substantial increase in the coming years.

- Various sources of uncertainty were identified: small sample size for spring spawners, fishery-dependent samples, potential bias in the classification of spring vs. fall spawners, and potential bias in age reading.

- With regard to the index of cohort strength graph, it was suggested that the cohort year be placed on the x-axis.

- While some participants equated the index of cohort strength with the fishery recruitment index, most felt that the expression "cohort strength" was a poor choice. "Index of the proportion of young fish (ages 3 to 5) in commercial catches" would be more accurate.

- It was also suggested that the use of the condition index be standardized to measure the same time point in the life cycle of both spawning components (spring and fall). For comparison purposes, it was also suggested that the gonadosomatic index and the condition index be linked.

- With respect to population structure and potential exchanges between 4Sw and 4R herring, funding was granted for an acoustic telemetry project with the aim of adding receivers to the existing network. This project will increase knowledge on the migration and mixing patterns of herring stocks in the northern Gulf.

ACOUSTIC SURVEY

Eight acoustic surveys have been conducted in the fall (October to November) in Subdivision 4Sw since 2009. A survey covering the entire coastal zone in Division 4S was also conducted in 2016 and 2018. In 2019, a second series of summer (August) acoustic surveys began in Subdivision 4Sw. The acoustic index of the spring spawning stock biomass in unit area 4Sw has been increasing since 2018, while the fall spawning stock biomass index has remained relatively stable.

- According to the biologist, if it is impossible to obtain an acoustic sample from 4Sw (e.g., fall 2020), a sample from 4Ra would be preferable to a commercial sample from 4Sw, which would not correspond to the survey period and would select for fish size.

- The graphs would be adjusted to better compare the estimated biomass magnitude from year to year.

- It was stated that there was interest in increasing the number of samples in 4Sw in the coming years, and that significant efforts had already been made in this regard.

- It was also specified that this index provides a snapshot of the total biomass (not the spawning stock biomass [SSB]) estimated during the survey. Another aspect mentioned was the uncertainty associated with the timing of the survey and potential interannual variations in herring catchability. Sampling in not optimal from the standpoint of representativeness. However, some consistency was observed between 4Sw and 4R, particularly with regard to the increase in the spring spawning biomass index since 2018.

- It was noted that the advent of the gillnet index fishery in the summer of 2021 would provide additional information to support the survey.

- Egg production ogives, which seem fairly consistent, could be appended to help assess the uncertainty associated with survey timing.

- Better knowledge of herring seasonal movements would also help reduce uncertainty.

- Questions were raised about the robustness of the biomass index for 4Sw given the various sources of uncertainty (collection and representativeness of samples, survey timing, and so on). One thing is certain: caution must continue to be exercised in interpreting this index, and consider only overall trends.

ENVIRONMENTAL EFFECTS

The following presentation focused on how the physical (temperature) and biological (timing and plankton quantity) environment influences the recruitment and body condition of 4S herring. The 2019 Brosset et al. study on 4R and 4T spring spawners shows a long-term trend of declining recruitment associated with a long-term decline in the abundance of cold-water copepods. For fall spawners, it was noted that optimal recruitment was dependent on warmer environmental conditions combined with a sufficient quantity of zooplankton. The same analyses were conducted for 4R herring. The methodology and results were presented. The annual condition of spring and fall spawners in 4S was found to be favoured by early spring environmental conditions and high abundance of *Calanus finmarchicus* and *C. hyperboreus*.

- A few clarifications were made concerning the methodology.

- It was noted that *C. hyperboreus* and *C. finmarchicus* do not respond to the same environmental variables (difference in phenology). They have a very different "timing" and life cycle, which respond to different environmental dynamics.

- It was noted that for the index of cohort strength, it might be useful to include older individuals (e.g., ages 5 to 8), although the younger stages make it possible to explore an interesting link with the environment (e.g., survival). With regard to integrating several ages, there would likely be a lot of noise. It is therefore necessary to find the best compromise between proper sampling and the goal of survey efforts.

- Given the possible links between 4S and 4R herring, could we eventually have an assessment model that can integrate 4S and 4R? The first step would be to fully investigate the potential exchanges between these regions, an aspect that is covered by the acoustic telemetry project which aims to assess seasonal movements. It would be useful to incorporate genetic studies to gain a better understanding of the population structure.

- It was recalled that a previous genetic study had revealed two divergent patterns: a temporal pattern related to seasonal reproduction (spring and fall) and a spatial pattern related to latitude.

CUMULATIVE STOCK PRODUCTIVITY INDEX

The objective is to develop an index that integrates available information in order to better understand how stock productivity has changed over time. The productivity indicators used are size at age 6, and condition and proportion at ages 3 to 5. The sum of annual anomalies was standardized. A cumulative index was presented for each spawning stock. The sum of the anomalies in the three stock productivity indicators was positive in 2020 for the spring spawning stock but has been mainly negative for the fall spawning stock since 2009.

- It was noted that the indicator for the proportion of herring ages 3 to 5 could not be standardized (month, gear, area).

- Some participants indicated that it would be interesting for this index to include weight at age, which is a more traditional stock productivity variable. It was pointed out that nothing prevents the use of weight and length at age. However, some believed that this could be redundant.

- With the improvement in standardization (thanks to comments received in 2019), the index is now considered to be more robust.

CONCLUSION

HIGHLIGHTS AND RECOMMENDATIONS

The highlights are presented and the participants comment on them. Comments having to do with stylistic rewording are not reported.

- For the last highlight, a request is made to clarify what is meant by "evidence". Biomass and productivity indices were stable for fall spawners and had recently increased for spring spawners. Some participants suggested replacing the word "evidence" with "data", whereas others preferred "evidence". The use of "evidence" was agreed on.

- There were also questions about the relationship between the productivity index and the conclusion in the highlight. Age structure was considered potentially more appropriate than productivity. It was proposed that in the analysis of commercial catch-at-age and the abundance of young fish, instead of focusing on biomass and productivity indices, information should be provided on the relative importance of young cohorts.

- It was indicated that the uncertainty associated with the acoustic index precluded its use for drawing conclusions about the stock status. The use of total biomass (even if not broken down by spawning group) could potentially help reduce uncertainty.

- It was believed that the exploitation rate would not be very high since the herring stock is aging. However, it is too early to come up with an accurate estimate of the exploitation rate given all the sources of uncertainty.

- It was recalled that limited data approaches had been presented (inputs review). A working paper would be published shortly and would provide helpful information.

- As for the highlight concerning landings, it should be noted that the decrease could be partly attributable to decreased fishing effort.

- The highlight on the proportion of spring spawners in the landings indicated that the catches in 2019 and 2020 consisted of "small fish" from the 2017 year-class.

- Spring herring spawner catches in 2019 and 2020 consisted mainly of small fish from the 2017 year-class, and to a lesser extent, from the 2013 year-class. These findings are consistent with those for the herring stock in 4R.

- It was suggested that the age composition of the commercial catches of spring spawners, which is consistent for the 4S and 4R stocks, be discussed under the second highlight, which deals with spring spawners. The research document could specify how to interpret this consistency.

- With regard to fall spawning herring in commercial catches, it was pointed out that a new year-class (2016) was observed in 2020.

- In the highlight concerning the acoustic index, the comparison with 4R was removed, as it would be discussed in the research document. Only trends would be presented given the uncertainties associated with this index.

- It was noted that the objective of the terms of reference related to the biological attributes derived from the *Teleost* survey was not discussed—despite its potential usefulness in corroborating an increase in the abundance of small herring.

- The "annual" condition and spring "environmental" conditions were specified in the highlight on the condition of spring and fall spawners. "Large calanoids" would be replaced by *Calanus finmarchicus* and *C. hyperboreus*.

- In the anomalies highlight, the following was agreed on: "The sum of the anomalies of the three stock productivity indicators (size at age 6, and condition and proportion at ages 3 to 5) ..." The term "anomaly" would be defined in the research document.

The wording of the conclusion clearly reflects the consensus among the participants. It reads as follows:

Evidence available up to 2020 (commercial catches at age, abundance of young fish) indicates that current catch levels are not expected to pose a significant short-term risk to herring stocks in 4S.

FUTURE RESEARCH WORK

The work considered to be a priority by participants aims to:

- Review the stock structure in Divisions 4S and 4R (2021-2024);

- Continue the acoustic survey in 4Sw (summer and fall);

- Improve commercial and scientific sampling during the acoustic survey;

- Improve the estimate of the acoustic biomass index;

- Develop and integrate the ecosystem approach;

- Review the method of classifying spring and fall spawners;

- Improve the agreement rate for age estimates between the two otolith readers, especially for ages 9 and up (workshop).

INTERIM YEAR

The next assessment is scheduled for winter 2023, with no update until then. The next 4S acoustic survey will be conducted in 2021 (August and fall).

APPENDIX 1 - TERMS OF REFERENCE

Assessment of Quebec North Shore (4S) herring stocks in 2020
Regional Peer Review - Quebec Region

May 4-5, 2021
Virtual meeting

Chairperson: Marie-Julie Roux

Context

Since 1992, the Quebec North Shore (NAFO Division 4S) herring stocks are managed using a preventive Total Allowable Catch (TAC) of 4,000 t due to the lack of scientific information to establish a formal TAC. In 2019, the TAC has been increased to 4,500 t while maintaining a maximum catch level of 4,000 t in Subdivision 4Sw to encourage dispersion of fishing effort. Between 1984 and 2010, herring landings averaged 476 t per year. Since 2011, catches have significantly increased and average 3,515 t per year for the period 2011-2018. Almost all of the catch comes from the eastern end of Subdivision 4Sw.

Since 2009, eight fall acoustic surveys have been conducted in the 4Sw subdivision. A second series of summer acoustic surveys has been initiated in 2019 in 4Sw. Data collected during these surveys are used to calculate biomass indices of the two spawning stocks which, along with commercial fishery data, are the main source of information used to assess the status of the Quebec North Shore herring stocks.

The last assessment of the two herring spawning stocks in 4S dates back to 2019. The Fisheries and Aquaculture Management Branch has requested a scientific advice on these stocks for the 2021 and 2022 fishing seasons. The purpose of this review was to determine whether changes had occurred in the status of the resource that required adjustments to the management plan based on the conservation approach adopted.

Objectives

Provide a scientific advice of the spring and fall spawning herring stocks in NAFO Division 4S (Quebec North Shore) for the 2021 and 2022 fishing seasons. This advice shall include:

- An evaluation of the status of the herring stocks, based on:
  - o commercial fishery statistics following the 2019 and 2020 seasons (overall distribution of landings, breakdown by unit area, month and fishing gear);
  - o an update of the main biological indicators from sampling commercial data;
  - o biological characteristics of catches from the multidisciplinary groundfish and shrimp survey in the Estuary and northern Gulf of St. Lawrence;
  - o results of the 4Sw unit area acoustic surveys in 2019.
- Ecosystem approach: to assess whether current environmental conditions appear to be conducive/unfavorable to stock productivity (recruitment based on catches-at-age from commercial fishery and condition index).
- The identification and prioritization of research projects to be considered for the future.
- Perspectives and/or recommendations on harvest levels for 2021 and 2022 fishing seasons based on available data.

Expected Publications

- Science Advisory Report

- Proceedings
- Research Document

Expected Participation

- Fisheries and Oceans Canada (DFO) (Science and Fisheries Management sectors)
- Fishing industry
- Provincial representatives
- Academia
- Aboriginal communities/organizations
- Environmental non-governmental organizations

APPENDIX 2 - LIST OF PARTICIPANTS

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