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Proceedings of the Regional Advisory Meeting of the Assessment Framework for the Northern Gulf of St. Lawrence (3Pn4RS) Atlantic Cod—Part 1: Review of Data Input

April 21–22 and May 12, 2021
Virtual meeting

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Canada

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 contains the proceedings of the regional peer review meeting on the assessment framework for the northern Gulf of St. Lawrence (3Pn, 4RS) Atlantic cod—Part 1: review of data input. The meeting, which was held virtually via Zoom on April 21–22 and May 12, 2021, brought together roughly 30 participants from science, management and the fishing industry. These proceedings describe the highlights of the meeting presentations and discussions and outlines the recommendations and conclusions resulting from the review.

INTRODUCTION

For more than 30 years, the assessment of northern Gulf of St. Lawrence (3Pn, 4RS) cod stock has included a virtual population analysis (VPA). As of 2015, the ASP has been performed using the National Oceanic and Atmospheric Administration's Virtual Population Analysis, VPA/ADAPT (NOAA 2014). This tool makes it possible to estimate several parameters of population dynamics as well as an indirect estimate of natural mortality (M). The pattern of residuals obtained for this stock suggests a lack of fit of the model. A new model should allow:

1. to estimate the variability of biomass and catches, and possibly include modelling censored catches;

2. to estimate natural mortality;

3. have the ability to integrate multiple data sources, including tagging, to improve the estimation of vital stock parameters;

4. provide the opportunity to make projections and ultimately to turn it into a custom model with fully integrated analyzes.

The regional peer review of the assessment framework for northern Gulf of St. Lawrence (nGSL) Atlantic cod was divided into two parts. Part 1, presented in this document, involved an examination of the data available for the development of a new model. These proceedings describe the main points of the presentations and deliberations resulting from the meeting, which was held virtually on April 21–22 and May 12, 2021, on the Zoom platform. The regional peer review process is open to all participants who are able to provide a critical outlook on the subject; consequently, participants from outside DFO are invited to take part in the discussions in accordance with the terms of reference for this meeting (Appendices 1 and 2). The proceedings also set out the recommendations made by meeting participants.

Part 2 of this regional peer review will take place at a later date. It will examine population dynamics models for nGSL cod, particularly those able to integrate unaccounted catches and natural mortality estimates.

PART 1: REVIEW OF INPUT DATA

The meeting chair, Caroline Senay, welcomed participants and went over the peer review process and objectives. Doug Swain (Fisheries and Oceans Canada, Moncton) and Noel Cadigan (Memorial University of Newfoundland) acted as external reviewers. After the participants were introduced, Claude Brassard outlined the terms of reference for the review. The purpose of this first meeting on the assessment framework for nGSL Atlantic cod is to examine the available data and their statistical treatment, for use in stock assessment models, among other things.

OTOLITH READING

Jean-François Lussier outlined the methodology for reading otoliths of nGSL cod (Divisions 3Pn, 4RS). Tests to compare the readings by otolith readers were conducted between 2016 and 2018 to ensure adequate knowledge transfer between readers. After stratification, otoliths are cut and polished and then the reference collection, composed of 475 otoliths, is read. An aging test is conducted and the otoliths from the current year are read (3 000 to 4 000 cod otoliths are read each year). The otoliths are obtained from the commercial fishery, fixed gear sentinel survey, mobile gear sentinel survey, Teleost survey and the

reproductive potential survey. Future plans include adding a second reader, digitizing the reference collection and using digital image analysis for age determination.

- It was pointed out that reader bias is known and taken into account.

- Better identifying the origin of the samples, particularly those obtained during the moratorium period, is important.

LANDINGS

Jordan Ouellette-Plante outlined the potential sources of landings data, for the purpose of compiling as many landings as possible (e.g., data from NAFO, which replaced ICNAF beginning in 1960; ZIFF data from 1985 to the present). ZIFF data are recorded by fishing trip and only involve the Canadian fleet. Although data on the nGSL stock became available in 1959, for the most part, they were not used until 1964; this is due to the fact that a monthly breakdown was not available and some landings were recorded as coming from Division 3P, which did not allow those exclusively from 3Pn to be filtered. The data on landings in the southern Gulf of St. Lawrence (sGSL) go back much further. However, the search for potential additional landings data does not really change the annual pattern of landings observed since 1964. The existing estimates do not take account of other variables (e.g., month, gear, country) that could have helped in better distinguishing the landings associated with nGSL cod.

- It was pointed out that the calendar year is used for the landings in the tables. The ZIFF files allow landings data to be processed by management year, which cannot be done with the NAFO data.

- It was felt that the same data used in the past—i.e., those published in research documents on nGSL cod (beginning in 1964)—should continue to be used.

- The effort put into this work, which was described as extremely painstaking, was highlighted. The annual updating of the time series data could easily be accomplished with current computer tools.

CATCH AT AGE DATA

Jordan Ouellette-Plante continued by outlining a new approach for determining catch at age (CAA) and catch at length (CAL). Over the years, the programs used to calculate CAA (CATCH.AWS, Visual Basic) for nGSL cod stock assessments had evolved, and shortcomings had been observed (transparency and reproducibility, plus groups, and the manual addition of inputs). A new, two-part framework was proposed for estimating CAA values, involving an R Markdown tool to document each step and an R library, "catchR," containing help functions and basic algorithms. Landings of the stock in the nGSL were divided into strata defined by year, month, NAFO unit area and gear category. Each stratum k had associated landings (Wk). In most cases, a single sample of either type (length frequency or age) could not be associated by Wk (landings). To calculate length frequency (LF) and age composition, values had to be imputed by using samples from other strata, a process that had previously been done manually. With the "catchR" R library, an automated approach was developed—and is therefore reproducible and transparent—by using the "get.samples" function.

The results were presented, as well as a few areas for discussion, including the absence of data for performing comparative analyses using the complete time series (1974–2018); a variation in the published values, which makes it difficult to compare the "catchR" results; a greater number of age than LF samples in certain years; and inconsistency between the LF and age data used. Alternative opinions could be added. Currently, all the samples used for a stratum are assigned

the same weight. Other criteria for determining when a sample size is sufficient should be explored.

- Having more age than LF samples in certain years was surprising since age is determined using LF subsamples. According to some participants, this could be due to the fact that some data could come from the fixed gear sentinel fisheries program and the bycatch from other fisheries.

- In terms of mass-length relations, it was suggested that their underlying premises be clarified in the research document, in order to ensure a sound analysis of residuals, among other things. Participants wondered about a possible spatial variation, as well as a variation according to gear type. There should be a way of examining the origin of samples more thoroughly in order to better evaluate spatial and gear-based variations. The level of associated uncertainty must also undoubtedly be taken into account.

- Questions arose over how adjacent years were defined in the case of one problematic 2021 stratum. In this specific case, the previous year and the current year were used. However, the use of adjacent years in the future (2020, 2021 and 2022) could affect the results of the current year's calculations since the 2022 data are not known yet.

- Questions were also raised about the impact of various levels of aggregation on the LF and CAA results. Higher levels of aggregation are associated with greater uncertainty, since they are less accurate. This could be explored in greater depth (e.g., similarity analysis between strata).

- Participants agreed that the "catchR" results would be used for 1993 and subsequent years and the literature would be used for the years before 1993.

- It was noted that the youngest and oldest cod, which are less abundant in the data, were the most difficult to predict and the age groups most likely to generate errors (overestimation and underestimation). Closely examining the proportions and ensuring the total was equal to 1 was recommended.

- For weight at age, it was proposed that smoothing be used to compensate for the age effect in the case of older individuals whose weight at age varies greatly.

- An effort must be made to quantify the uncertainty associated with catch at age.

- It was also suggested that the levels of aggregation for total landings be presented to provide a better picture of how landings are adequately sampled.

- The meeting participants agreed that the new approach proposed for estimating CAA is a great improvement. This work was extremely useful. The premises must be adequately explained, along with the analyses of residuals.

QUESTIONNAIRE

An accurate accounting of the quantity and demographic composition of catches is the cornerstone of a reliable stock assessment. Stock assessment models increasingly incorporate otherwise unaccounted-for catches, either as a supplemental component or by using a censored catch approach. Hugues Benoît presented the results of a questionnaire survey involving interviews of long-time commercial harvesters in the nGSL, which was used to qualify and quantify the likely limits of unaccounted nGSL cod catches from the 1960s to the present. Unaccounted catches include unreported cod landings (including for personal use) and discards in the directed fishery, unreported catches of cod in fisheries directed at other species, and catches in the recreational fishery (unreported). The questionnaire was structured by fishery

periods (5) and consisted of 13 questions, some with several parts. Eight questions aimed to characterize the respondents and five questions, to characterize catches or their monitoring. A total of 14 respondents from Québec and 20 from Newfoundland participated, all of whom had over 20 years of experience in the commercial groundfish fishery.

Cod fishermen were strongly represented in this survey. The absence of respondents with mobile gear experience before the first moratorium is one weakness of the survey. The values for estimated unaccounted catches do not take account of discard survival in the figures for discards, or catch-and-release mortality in the recreational fishery. Respondents were asked to identify the type and frequency of catch monitoring during each period of the fishery. The type and frequency of monitoring are known to affect the accuracy of catch quantity figures. Specifically, reporting based on purchase slips is generally considered to be the least accurate since it is linked to sales and therefore income, which can encourage false declarations, underreporting to reduce the tax burden and, in some cases, overreporting in anticipation of the establishment of individual quotas based on catch history. The relatively low incidence of discards and the underreporting of catches in the directed cod fishery during periods 1 (before 1977) and 2 (1977–1994) sharply contrast with the data on discards in the Gulf redfish fishery. In contrast, the survey revealed substantial catches in the recreational fishery since the first moratorium.

- According to industry participants, the quantity of discards remains low because of the strong demand and because there is always a market for the entire catch.

- Participants wondered about how unaccounted catches should be taken into account in the future assessment model. This could be done by incorporating upper and lower limits for catches (censored catches).

- In addition, Indigenous landings were thought to be small, or to be already included in the recorded commercial catches. The figure of 53 t was cited in the quota reports.

- There have been some discussions on the methods used to estimate recreational catches based on the survey data. Hugues Benoît explained that the approach used was based on extrapolation from the data on the human population along the nGSL coasts, taken from the Canadian Census of Population.

DISCARDS

Hugues Benoît presented estimates of annual discards of nGSL cod in the directed commercial fisheries for cod, other groundfish, and northern shrimp. These values could be compared with those obtained from the questionnaire in order to determine potential limits for catches in a future censored catch assessment model for the stock. These discards are currently not taken into account in the assessment. At-sea observers are generally the only consistent, ongoing source of data on this metric. Benoît explained the method used, which involves collating landings data and linking them to at-sea observer data using a group hierarchy. Discards are estimated for each landings group using a ratio, followed by the estimation of cod discards in relation to landings in the various directed fisheries, and then totalling all the groups.

The results indicate that cod discards peaked in 1991 at over 5 300 t. Since 1994 and with the exception of 2000–2001, discards have hovered around 50 t annually. Estimated total discards represented from 7% to 15% of cod landings before 1993 and from 1% to 2% since then. This does not take account of potential "observer" effects (probable negative bias) or post-release survival effects (positive bias). The size composition of discards in most fisheries still needs to be assessed, although data are scarce.

- It was explained that, in the group hierarchy, aggregation by fishing gear was avoided because bycatch profiles can be very different.

- Participants wondered whether the bycatch results in the shrimp fishery were compared with those obtained in the shrimp stock assessment. Since a slightly different approach was used, the results would not be the same, but would certainly be fairly similar.

- Participants wondered whether it would be possible to improve the reliability of the confidence intervals for estimates.

- The possibility of extrapolating these results to landings was discussed but caution was recommended since the size structure of the catch in these fisheries is unknown.

RECREATIONAL FISHERY

Natural mortality, estimated by sequential population analysis, is increasing. Some of the causes include unaccounted fishing mortality and predation, the extents of which are unknown. Claude Brassard presented an estimate of the potential cod harvest in the recreational fishery in the nGSL. These data resulted from a survey on the recreational fishery in Canada, the nGSL and 2J3KL cod stock assessments and the estimated potential harvest. According to the results, the potential harvest ranges between 150 t and 400 t annually.

- Participants were reminded that the objective of this process was to estimate an order of magnitude for the recreational fishery rather than to come up with a precise figure. The estimate remains below that for the commercial fishery.

- Some participants mentioned that probably less recreational fishing occurs in towns like Corner Brook because of access to a wide range of other activities. However, including this in the study and the statistics seemed fitting, particularly if a correction was used for this effect in the estimation of catches.

- It was noted that, in recent years, the proportion of the recreational fishery was greater than that of the commercial fishery, which could have more impact in the future model.

- According to industry participants, the catch along Newfoundland's west coast is closer to 80 t to 120 t annually. On the Lower North Shore, the industry estimates the recreational catch to be roughly 20 t annually, and 30 t for the entire North Shore. Recreational cod fishing is less popular on the Middle North Shore due to access to other activities and the fact that the cod are found at greater depths.

- Therefore, the figure is closer to the minimum value estimated in the past (150 t).

- Consequently, there seemed to be a consensus on the approach presented, which could be refined with industry collaboration in order to be closer to the reality.

TAGGING

Jordan Ouellette-Plante provided an overview of the results of the tagging program for nGSL cod in the commercial fishery. Along with aiming for a better understanding of the stock's biology, these various projects seek to determine the extent of the stock's interactions with other, neighbouring stocks. The tagging data could be used to differentiate between natural and fishing mortality, as well as in population models. A total of 100 973 individuals have been tagged since 1995, the start of the nGSL sentinel fishery tagging program. If we exclude 1996, when substantial tagging efforts took place (13 704 cod), roughly 3 500 cod have been tagged annually. A total of 8 152 tagged cod have been recaptured since the beginning of the tagging program and roughly 8% of the cod tagged annually are eventually recaptured. A large

percentage (~ 75%) of the cod recaptured between one and four years after tagging are found within a very small radius of the tagging site, which may indicate a homing phenomenon. Monthly recaptures in the nGSL show a monthly distribution that corresponds closely to the stock's known migratory movements.

- It was noted that a pilot tagging project was carried out in 4S from 2017 to 2020, in collaboration with ACPG and APBCN. The tagging data from this project were combined with those from the nGSL sentinel fishery tagging program. The second phase of the project will last until 2023 and will expand the tagging area westward.

- Major issues were raised concerning tag returns, including the participation rate (values that vary between tags) and the accurate characterization of returns.

- The implausibility of the late recaptures observed (over 15 years) was mentioned. A database error or the very late transmission of observations, for example, in batches, seems more likely. In 2015, the recapture of individuals from a very wide range of tagging years was also observed, suggesting that the tags were being returned in batches.

- The inconsistent spatial distribution of the tagging effort in the tagging area was observed.

- In addition, a lack of consistency was noted between the mortality rates resulting from the sequential population analysis (SPA) and those estimated from tagging, particularly for the 2000s.

- Therefore, participants wondered about the validity of using the tagging data in estimating mortality rates and in informing the future population model. Given the potential of the tagging data, exploring possible solutions would be useful (based on what is being done elsewhere) for improving tagging and tag returns.

- Participants also wondered about the method used for estimating, and discriminating between natural mortality and fishing mortality in a censored catch model and in the absence of tagging data, a complex issue in stock assessment models.

FISHERY-INDEPENDENT SURVEYS

Hugues Benoît reviewed the various fishery-independent surveys, discussing the availability, duration and quality of the indices and information on nGSL cod provided by these surveys, which include research vessel multispecies bottom trawl surveys and the multispecies bottom trawl survey and the fixed gear surveys conducted under the sentinel fisheries program. Fishery-independent surveys actually began in 1990, when the collapse of the stock was already well under way and natural mortality was quite variable. The absence of indices covering the pre-collapse period could cause biases in the estimation of stock productivity and size. Although the bottom trawl and fixed gear surveys together cover the habitat of inshore and offshore cod in the nGSL, no single survey alone covers the stock's entire summer distribution.

Research vessel bottom-trawl survey in August

In terms of the August bottom-trawl survey in the nGSL, comparative fishing experiments using different vessels and gear types were reanalyzed, notably through Yihao Yin's estimation of relative catch efficiency, in order to extend the time series to 1984. An additional goal was to examine the possibility of developing a standardized series despite the absence of sampling in shallower strata before 1990 and to evaluate the quality of the indices—for example, their capacity to track cohorts. According to the results obtained, the vessel and gear calibrations appear to be appropriate. The time series that includes several combinations of vessels and gear allows cohorts to be tracked quite accurately. The extended time series provides a very

useful perspective on the stock. However, adjustments to the sampled strata need to be further examined. Even without any corrections, the biases caused by not sampling the shallower strata are not enormous.

- According to industry members, many cod are observed in inshore areas (e.g., Strait of Belle Isle, along the Lower North Shore, along the west coast of Newfoundland) and it would be a good idea to include them.

- The main discussion was on aligning the series covering different strata (1984–1989 and 1990+). There was good consistency between the series. The preferred approach was to estimate the corrections in the assessment model in order to propagate the uncertainty, which would provide the longest series (including the period before the stock collapse) and cover all the strata. The meeting participants were in agreement on this approach, which provides a useful perspective on the stock.

- Questions were raised on the extent of the change in the value for total mortality between 2015 and 2018, which doubled. Could this reflect the movement of the stock outside the survey area?

- It was noted that estimating total mortality by four-year groups was a commonly used method, which provides a smoothed average.

- This was not the opportune time to examine total mortality (causes and proportions). This aspect, particularly predation by grey seals, would be addressed as part of the rebuilding plan.

Mobile gear sentinel survey

Hugues Benoît presented the data from the sentinel bottom trawl survey, currently considered to be two distinct time series: 1995–2002 and 2003–present (which includes the new inshore strata). The results indicate that the sentinel bottom trawl survey allows the cohorts to be tracked very closely. The differences between the series, whether or not they include the inshore strata, are minimal and mainly affect the youngest ages. Here again, a correction could be estimated as part of the assessment model. It was concluded that the benefit/risk ratio favoured handling the data from this survey as a single series, from 1995 to today.

- It was pointed out that this was the only survey currently covering 3Pn.

- The meeting participants were in agreement with the proposed approach of treating the survey data as a single series.

Research vessel bottom-trawl survey in January

The January bottom trawl survey, which was conducted from 1978 to 1994 (excluding 1982) and mainly targeted redfish, does not allow an abundance index to be developed due to interannual changes in its spatial coverage. In addition, this survey was dropped from the cod stock assessment in the mid-1990s owing to its variable coverage and the increasing proportion of the stock found outside the survey area.

- The meeting participants were inclined to give less weight to this survey. It was also likely to be given less weight in the model. However, it could provide useful information on age structure and could be modelled by allowing for variable catchability. It was better to not rule it out from the outset.

Historical surveys

The historical surveys provide information notably on catch at age, derived from the fishery and research surveys. Catch curves from surveys before, during and after the expansion of the fishery can provide estimates of total mortality (Z). The value before expansion (Z=0.25) would likely represent the upper limit of natural mortality, with a value consistent with those for neighbouring cod stocks in the 1950s and 1960s.

- Questions were raised on how this information would be used in the assessment model (e.g., as "prior" data rather than strong data).

Fixed gear sentinel survey

The fixed gear sentinel survey, launched in 1995 due to a collaborative effort by DFO and the fishing industry (groundfish harvesters), is a fishery conducted with gillnets and longlines, using largely standardized procedures and at-sea observer aboard the vessel. The purpose of this survey is to provide indices from inshore areas that are not well sampled by trawl surveys. Three fishery-independent indices can be obtained from the data from this survey: the summer longline, fall longline and summer gillnet indices. These indices track the cohorts very well and, in the case of the two summer indices, in a very similar way. The indices provide very smooth trends for total mortality (Z) that are very similar. However, the magnitude of the variation in Z is not consistent with that in the trawl surveys; it might be linked to movements inside and outside the areas covered by the fixed gear surveys, but could also reflect age-specific differences affecting Z. In addition, a trend toward the more inshore distribution of older cod is observed. Therefore, treating the indices derived from the fixed gear sentinel survey as fully proportional to abundance is disputable, although they will unquestionably be included in upcoming models. In terms of the analysis methods used previously for these data, the appearance of interactions between the main effects (year, area, month, and soak time), including the year, was observed over time. Therefore, reliably interpreting year effects without the influence of other effects is impossible, and stratified estimates have been adopted instead.

- It was pointed out that, on the southern coast of Newfoundland, the sites were chosen to represent traditional fishing areas, and therefore were not randomly selected. Some participants felt that the spatial coverage was reasonable.

- It was noted that, despite cuts in 4S in 2008, overall, the sites were retained. The spatial coverage is probably well distributed in 4S.

- Some comments and questions of clarification were raised on the calibration for longlining. It was noted that the weighting for older cod seemed to be excessive. The relative q for older cod should be improved. In addition, considerable variability in sites was noted between fishing areas. Participants wondered about the definitions of summer and fall. The important thing was to ensure that these two indices were independent.

- It was thought that some aspects could easily be re-examined, particularly the standardization of large fish and variations in average catch size per site.

- The index resulting from the longline survey included 75% of the data, while the index resulting from the gillnet survey included 98%. Data were excluded because they were obtained from sampling at sites or on dates that were no longer covered in the survey. Including this data could cause biases in the abundance estimates.

- The trend toward the more inshore distribution of older cod seems to be generalized, and no spatial effects appear to be confounded with depth.

- The greater sensitivity of the fixed gear survey to movements inside and outside inshore waters appears to be linked to the more limited coverage of depths in this survey compared to the mobile gear survey.

CONCLUSION

DISCUSSION POINTS

How should unaccounted catches be integrated in length frequencies and then in age composition?

- This information was said to be important in determining the demographic profile of unaccounted catches in particular.

- It was noted that annual discards in the cod and shrimp fishery could perhaps provide information on length frequencies (see the at-sea observer data). The turbot fishery could also perhaps provide a little information when cod are retained.

- The recreational fishery does not seem to provide any length frequency data. It was noted that the age structure of longline catches could come close.

- Information could be obtained directly from recreational harvesters in the medium term.

Should recreational fishery scenarios be added?

- Recent discussions have taken place between the industry and DFO Science to review the participation rate in the recreational fishery in 4S and along the west coast of Newfoundland in order to refine the estimate for the recreational fishery. The value of this estimate, deemed too high by industry representatives, was discussed at length. However, there was agreement on the quality of the survey conducted.

- Various scenarios within the model could be looked at in terms of the lower and upper limits, but they must be supported by facts.

- Should we consider putting more effort in the tagging data between now and September so that they can be integrated into the new model?

- Incorporating tagging data in the model by September appeared to be difficult given the issues raised (spatial coverage, return of tags in batches, varying value of tags). Assessing the extent of returns of tags in batches and determining if they also include high-value tags would be useful.

- A deadline on tag returns was suggested.

- It would be useful to ascertain what has been done elsewhere in similar situations to deal with the issues encountered.

- The tagging data appear to be very useful in estimating the mortality rate and informing the population model. The meeting participants agreed on the importance of continuing these efforts.

Other proposals on data from the fixed gear sentinel survey?

- Various challenges were encountered in standardization. The data needed a little cleanup.

- However, compared with the former method, the new standardization method used does not change the picture of the situation much. The overlap between the results obtained with the two approaches is reassuring. The data signals appear to be strong.

- It was emphasized that encountering various issues in standardization is common. The new approach offers a number of improvements over the old one (e.g., time windows, coastline). Some aspects could be reviewed, particularly the standardization of large fish and the variation in the average catch size per site. It would also be useful to deal with both series of indices in the model (fixed and mobile gear).

- According to the participants, the new method is extremely valuable in the context of the new assessment model.

DOCUMENTS TO BE PUBLISHED

The following four documents will be published:

1. CatchR
2. Questionnaire
3. Surveys (DFO and sentinel)
4. Catches: landings, discards and recreational fishery

APPENDIX 1—TERMS OF REFERENCE

Northern gulf of St-Lawrence Cod (3Pn, 4RS) Assessment Framework

Regional Advisory Meeting—Quebec Region

Part 1: April 21–23, 2021
Part 2: September 13–15, 2021

Virtual Meeting
Chairperson: Caroline Senay

Context

The assessment framework meeting will focus on the available data and methodology for estimating the population size and other indicators of the stock status of Atlantic cod in the northern Gulf of St. Lawrence (Subdivision 3Pn and NAFO Divisions 4R and 4S) (DFO 2019; Brassard et al. 2020).

For more than 30 years, the assessment of this stock has included a virtual population analysis (VPA). As of 2015, the ASP has been performed using the National Oceanic and Atmospheric Administration's Virtual Population Analysis, VPA/ADAPT (NOAA 2014). This program is a model for estimating the age structure of a population, it was developed from the model of Gavaris (1988), in which features from other versions of ADAPT were incorporated. This tool makes it possible to estimate several parameters of population dynamics as well as an indirect estimate of natural mortality (M). The pattern of residuals obtained for this stock suggests a lack of fit of the model.

A new model should allow; 1) estimate the variability of catches, and possibly include modelling censored catches; 2) estimate natural mortality; 3) have the ability to integrate multiple data sources, including tagging, to improve the estimation of vital stock parameters; 4) to provide the opportunity to make projections and ultimately to turn it into a custom model with fully integrated analyzes.

This assessment framework meeting will review the data available for the establishment of a new model (Part 1) and examine models of population dynamics of 3Pn, 4RS cod, in particular those that may incorporate unaccounted for catches and estimation of natural mortality (Part 2).

Part 1: Review of data available for modelling

Objectives

The objective of this first part is to examine the available data, and their statistical treatment, which would be used for the population estimation models including:

- Catches at age in the commercial fishery;

- Unaccounted catches;

- Catches at age and standardized indices from scientific surveys:
  - DFO research vessel surveys,
  - Mobile sentinel fisheries,
  - Sentinel fisheries with gillnets, and
  - Sentinel longline fisheries.

Part 2: Revision of the estimation models (at age) of the population

Objectives

Evaluate potential assessment models for possible use as the basis for providing science advice on cod in the northern Gulf. If a model is found to be appropriate for the assessment of 3Pn, 4RS cod, it would be used subsequently during the next stock assessment and could be used in the development of a recovery plan. Specifically, the framework meeting will address the following:

- Evaluate potential assessment models to determine if they provide a sufficient framework for providing scientific advice on the impact of exploitation on 3Pn, 4RS cod, in particular estimating the stock size (biomass and abundance), recruitment, fishing mortality, and potentially natural mortality of the population.

- Provide direction on projection methods for future catch options.

- Provide direction for an approach to estimating reference points for this stock.

- Discuss whether the assessment methodology has the potential to support quantitative evaluation of harvest control rules.

- Identify uncertainties and knowledge gaps.

- Identify priority short and medium-term research recommendations to improve data sources, assessment model formulation and estimation, and projection methods.

Expected Publications

- Proceedings
- Research document(s)

Participation

- Fisheries and Oceans Canada (DFO) (Science and Fisheries Management Branches)

- Industry

- Academia

- Non-Governmental Organizations

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APPENDIX 2—LIST OF PARTICIPANTS

Name	Affiliation	April 21	April 22	May 12
Andrushchenko, Irene	DFO — Science	x	-	x
Benoît, Hugues	DFO — Science	x	x	x
Bois, Samantha	ACPG	x	x	-
Boudreau, Mathieu	DFO — Science	x	-	x
Bourdages, Hugo	DFO — Science	x	x	x
Brassard, Claude	DFO — Science	x	x	x
Cadigan, Noel	Memorial University	x	x	x
Carruthers, Erin	FFAW	x	x	x
Chamberland, Jean-Martin	DFO — Science	x	-	x
Cyr, Charley	DFO — Science	x	x	x
Denis, Marcel	ACPG	x	x	-
Desgagnés, Mathieu	DFO — Science	x	-	-
Dubé, Sonia	DFO — Science	x	x	x
Duplisea, Daniel	DFO — Science	x	-	-
Émond, Kim	DFO — Science	x	-	-
Gauthier, Johanne	DFO — Science	x	-	-
Karbowski, Chelsey	Oceans North Canada	x	-	-
Labbé-Giguère, Stéphanie	DFO — Fisheries management	x	x	x
Lussier, Jean-François	DFO — Science	x	x	x
Nadeau, Paul	APBCN	-	x	x
Ouellette-Plante, Jordan	DFO — Science	-	x	x
Pomerleau, Corinne	DFO — Science	x	-	-
Plourde, Stéphane	DFO — Science	x	-	-
Senay, Caroline	DFO — Science	x	x	x
Simard, Émilie	DFO — Science	x	-	-
Spingle, Jason	FFAW/UniFor	-	x	-
Swain, Doug	DFO — Science	x	x	x
Trottier, Steeve	DFO — Fisheries management	-	-	x
Van Beveren, Elisabeth	DFO — Science	x	-	x
Vascotto, Kris	AGC	x	-	x
Wang, Yanjun	DFO — Science	x	-	-
Yin, Yihao	DFO — Science	-	x	x

APPENDIX 3—AGENDA

Agenda for the meeting on the assessment framework for the northern Gulf of St. Lawrence (3Pn4RS) cod stock—Part 1: review of data input, April 21- 23, 2021

Day 1—April 21, 2021

Time (EDT)	Topic	Scientist	Document
8:00-8:20	Chair Introduction	Caroline Senay	-
8:20-8:45	Round table	Caroline Senay	-
8:45-9:15	Terms of Reference	Claude Brassard	-
9:15-9:45	Aging with otoliths	Jean-François Lussier	-
9:45-10:30	Landings	Jordan Ouellette-Plante	Document1_EN
10:30-11:00	Break		
11:00-12:00	Catch-at-age	Jordan Ouellette-Plante	Document2_EN
12:00-12:30	Break		
12:30-2:00	Questionnaire	Hugues Benoît	Document3_EN
2:00-2:30	Break		
2:30-3:30	Discards at sea	Hugues Benoît	Document4_EN

Day 2—April 22, 2021

Time (EDT)	Topic	Scientist	Document
8:00-8:20	Summary day 1	Caroline Senay	-
8:20-10:30	Recreative fishery	Claude Brassard	Document5_EN
10:30-11:00	Break		
11:00-12:00	Tagging	Jordan Ouellette-Plante	Document1_EN
12:00-12:30	Break		
12:30-2:00	Research survey (nGSL and Gadus)	Hugues Benoît	Document6_EN
2:00-2:30	Break		
2:30-3:30	Research survey (Sentinel mobile gear)	Hugues Benoît	Document6_EN

Day 3—April 23, 2021*

Time (EDT)	Topic	Scientist	Document
8:00-8:20	Summary day 2	Caroline Senay	-
8:20-10:30	Research survey (Sentinel fixed gear)	Hugues Benoît	Document6_EN
10:30-11:00	Break		
11:00-12:00	Research survey (Sentinel fixed gear)	Hugues Benoît	Document6_EN
12:00-12:30	Break		
12:30-2:00	Conclusion	All	-
2:00-2:30	Break		
2:30-3:30	Conclusion	All	-

* Due to a power outage, Day 3 of the meeting has been moved to May 12, 2021.