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Maritimes Region

Proceedings of the Reginal Peer Review of the Northwest Atlantic Spiny Dogfish (*Squalus acanthias*) Framework: Review of Data Inputs

September 19-20, 2017
Dartmouth, Nova Scotia

Chairperson – Kent Smedbol
Editor – Lottie Bennett

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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

A regional peer review meeting was held on September 19-20, 2017 at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia to conduct a review of the data inputs of the Atlantic Spiny Dogfish (*Squalus acanthias*) framework. As outlined in the Terms of Reference, the focus of the meeting was to describe the fishery-dependent and fishery-independent data sources from the United States of America (US) and Canada used to assess the population, evaluate factors affecting dogfish catchability, and to review proposed methods to standardize data from the USA for input into an assessment model. The assessment model will be reviewed at a separate meeting. Participation in this meeting included Fisheries and Oceans Canada (DFO), non-DFO scientists, Aboriginal organizations, and the fishing industry.

The Northwest Atlantic Spiny Dogfish is a transboundary resource with significant catches in Canada and the US. Although a joint Canada-US Transboundary Resources Assessment Committee (TRAC) assessment was held in early 2010, consensus on an assessment model was not reached. Both the US and Canada have continued to assess the stock independently since 2010. The last DFO framework review and assessment of Northwest Atlantic Spiny Dogfish occurred in January and May 2014 using data up to 2010. The accepted model was a forward-projecting stage-based, spatially explicit population dynamics model with two time steps. Efforts to incorporate more recent data into the framework model have not been successful. This is likely due to substantial changes in our understanding of dogfish catchability since the deployment of a new survey gear and vessel in the US in 2009. As well, recent research on day/night patterns of dogfish catchability suggested these might be a concern.

This proceedings document includes a summary of the presentation and is the record of the meeting discussions and conclusions. A Research Document resulting from this meeting will be published on the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat's (CSAS) Website as soon as it is available.

INTRODUCTION

Spiny Dogfish (*Squalus acanthias*) are small squaloid sharks found throughout coastal temperate oceans. The population in the Northwest Atlantic typically ranges from Newfoundland to Georgia and is the most abundant along the continental shelf from Nova Scotia to Cape Hatteras (Nammack et al. 1985, NEFSC 2006). The population migrates seasonally, concentrating in mid-Atlantic waters to southern Georges Bank in the winter and spring, moving northward in the summer, and returning to Southern New England, Georges Bank and the Gulf of Maine in autumn (Fowler and Campana 2015). Throughout their distribution, dogfish tend to school by size and by sex as they approach maturity.

Spiny Dogfish are considered to be a unit stock in Northwest Atlantic Fisheries Organization (NAFO) Areas 2-6 (Haist et al. 2010) with the majority of the population found in the United States of American (US) waters. Originally, the US and Canadian components of the stock were assessed independently. In 2010, an attempt was made to model the entire Northwest Atlantic population in a joint Canada-US Transboundary Resources Assessment Committee (TRAC) meeting, but consensus on an assessment model was not reached (Rago and Sosebee 2010). Since that time, the US has elected to meet its domestic management requirements by proceeding with a US-only stock assessment. Canada has attempted to continue with the population-level assessment. The last Fisheries and Oceans Canada (DFO) framework review and assessment of Northwest Atlantic Spiny Dogfish occurred in 2014, using data up to 2010 (Fowler and Campana 2015). The accepted model was a forward-projecting stage-based, spatially explicit population dynamics model with two time steps.

Efforts to incorporate more recent data into the framework model have not been successful. This is likely due to substantial changes in our understanding of dogfish catchability since the deployment of a new survey gear and vessel in the US in 2009. As well, recent research on day/night patterns of dogfish catchability suggested these might be a concern.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the Northwest Atlantic population of Spiny Dogfish as special concern. The species is currently under consideration for listing under the *Species at Risk Act* (SARA). A decision on whether or not to list had not yet been made as of the writing of this document

The meeting Chairperson, Kent Smedbol, introduced himself, followed by an introduction of meeting participants (Appendix 1). The Chair thanked meeting participants for attending the DFO Regional Peer Review Process. The Chair provided a brief overview of the Canadian Science Advisory Secretariat (CSAS) peer review process and invited participants to review the meeting Terms of Reference (Appendix 2) and Agenda (Appendix 3).

To guide discussions, a working paper had been prepared, which would be produced as a CSAS Research Document upon acceptance. The meeting Chair noted that the meeting Working Paper was for the purpose of meeting discussion, and was not to be used in any other forum, distributed, or cited. A CSAS Science Advisory Report was not a product of the meeting.

This Proceedings report is the record of the discussion of the meeting.

PRESENTATION AND DISCUSSIONS

REVIEW OF DATA INPUTS FOR THE ATLANTIC SPINY DOGFISH FRAMEWORK

Working paper: Changes to Survey Indices and Implications for Assessment of Spiny Dogfish, *Squalus acanthias*, in the Northwest Atlantic. CSAM Working Paper 2017/09.

Science Leads: G.M. Fowler and H. Bowlby
Rapporteur: L. Bennett

Presentation Summaries

Biology and Stock Structure

Background information was presented on the history of the fishery, data sources for abundance indices, and the life history of the Spiny Dogfish.

Evaluation of Data Inputs

The catchability of Dogfish was investigated and survey calibration options were presented, the validity of the approach to updating the US commercial catch composition was examined, and results of diel catchability studies were presented. In addition, methods to derive Canadian abundance-at-length estimated from US Spring surveys and the influence of temporal changes in sampling of the US Spring survey were examined, and a process error strategy to address these changes was presented**.**

Discussion

Biology and Stock Structure

The spatial coverage of the National Marine Fisheries Service (NMFS) Spring Survey and the Fisheries and Oceans Canada (DFO) Summer Survey were reviewed. The NMFS Spring Survey extends from Cape Hatteras to the Scotian Shelf while the DFO Summer Survey covers the Scotian Shelf and the Bay of Fundy, with coverage of the two surveys partially overlapping on Georges Bank.

Within Canada, there is limited data on catch-at-size. Since 2006, there has been no port sampling of dogfish and there are only approximately 350 dogfish length measurements in the Industry Surveys database. Port sampling and observer coverage is typically directed at larger commercial fisheries; however, size composition data will be needed if the fishery moves toward Marine Stewardship Council (MSC) certification.

Evaluation of Data Inputs

Since 2010, there has been no formal data-sharing agreement between the US and Canada; however, US commercial catch composition up to 2015 was provided for this assessment. In the intervening years, US catch composition was updated by projecting the 2010 catch composition to summarized catches available from US assessments. A comparison of the actual and projected sex and size compositions of US commercial catches indicate substantial discrepancies for sex and maturity stage. Moving forward it was recommended that trends from the NMFS Spring survey be used to update the population model rather than projected catch inputs for years where catch composition data are unavailable.

When sampled, four strata along the outer edge of the continental shelf have made large contributions to abundance estimates. Due to the number of species that are sampled in the NMFS Spring Survey, sample allocation cannot be optimized to minimize within-strata variance

for a species. The NMFS survey may not meet the minimum number of observations per strata required to estimate a mean and variance under the current stratification scheme. It was initially proposed that the assumed general process error be removed and replaced with an index sampling error where the process error varies proportionally to the number of missed outer slope strata (relative to the minimum stratified sampling limit of two sets). A process of error of 0.025, which would be attributed for each missing set in the outer four stratum, would replace the process error constant of 0.20. The maximum process error for a year would be 0.20 since there is a minimum of 2 sets per strata. Applying an index sampling error would weight years with increased sampling effort higher than other years with low sampling. The reviewer recommended a more systematic approach to assigning process error, whereby process error would be proportional to under-sampling of all strata.

Survey error within the model was discussed. Stratified errors-at-length are converted to standard deviations. The maturity-at-length values are allocated into numbers-at-length by maturity stage, which are then used to produce a weighted mean error. The stratified errors-at-length for a given year and sex are collapsed to juvenile and adult error values, which are treated as sigmas within the likelihoods in the model. An analysis of the data indicated that stratified abundance-at-length errors diverged between sexes. While the current framework model estimates abundance separately by sex, the same error structure is used for both sexes. It was proposed that future assessments separate error structures by sex as well as maturity stage.

To derive survey abundance estimates for prior Canadian dogfish assessments, a sex-specific length-weight relationship was used to convert biomass estimates and size composition data from the NMFS survey to abundance-at-length estimates. Stratified abundance-at-length estimates from the 2015 NMFS Spring survey did not match estimates derived from biomass data for previous Canadian assessments, which is likely a result of changes in the length-weight relationship over time. It was proposed that for years where length data is available, stratified abundance-at-length estimates from the NMFS survey should be used, rather than updating the abundance-at-length series calculated for previous Canadian assessments.

Evaluation of Survey Catchability Issues and Data Standardization

There was a substantial discussion on possible standardization techniques related to a change in survey vessel in the NMFS Spring Survey. In 2009, a new survey vessel, the *Henry B. Bigelow*, employing a new trawl type, replaced the *Albatross IV*, and affected the catchability of dogfish during the survey with differences in size composition of catches between vessels. It was suggested that calibration between vessels could be achieved either by standardizing catches between vessels, e.g., modelling framework proposed in Miller (2013), or by partitioning the inputs into sex and maturity blocks and calculating separate catchability estimates for each block. If the data were to be partitioned, it was suggested to perform all of the model estimation in the same construct (e.g., binomial/beta-binomials models or quasi-binomial Generalized Linear Models) so the Akaike Information Criterion (AIC) of individual models could be compared to determine the importance of the various factors used to partition the data (e.g. size or sex). Survey results from the Bigelow and the Albatross indicate that the largest differences in catchability between the vessels pertain to juveniles.

Approaches to estimate catchability were presented. The population assessment model estimates catchability by time blocks that separate the Bigelow from the Albatross. Options discussed include not calibrating the survey data inputs and allowing the model catchability estimation to evaluate it or calibrating the survey inputs and combining the adjacent Albatross and Bigelow time periods as one catchability block for estimation. During the second part of the Framework review, it was recommended that fits from a model that incorporates the calibrated

NMFS Spring survey index with one estimate for catchability (q) be compared with a model that splits the uncalibrated NMFS Spring survey index into the Bigelow and Albatross time periods and estimates two survey catchabilities.

Inclusion of diel catchability differences into the model used to estimate survey abundance estimates was discussed. In 2016, a study of diel catchability patterns of dogfish was published, contending that NMFS survey abundance estimates may be overestimated by up to 50% (Sagarese et al. 2016). The authors suggest that vertical migration could account for dogfish being less available to the survey trawl during the night and an increased daytime availability could be due to feeding, aggregation behavior, or herding on the bottom.

Abundance estimates within Sagarese et al. (2016) were calculated using data from both the spring and fall US surveys, and included inshore strata that are outside of the stock definition of dogfish. The resultant biomass estimate is higher than is calculated from the NMFS Spring survey since it is accounting for catches outside of the NMFS Spring survey area. Within the population model, catchability is partially determined by availability of the population; therefore, catchability needs to be customized to the available time series data. The Canadian assessment model exclusively uses data from the NMFS Spring survey and excludes strata that are not part of the stock definition. Moving forward, the assessment model will use the same data sources and stock definition for the dogfish assessment as in the most recent Canadian framework.

Other differences related to the assumed length-at-maturity relationship and the incorporation of one year of data from a new survey vessel in the Sagarese et al (2016) study were discussed. It was proposed that any diel standardization should use the transition between pelagic and demersal behaviour, as opposed to maturity to separate the juvenile and adult stages. It was proposed that incorporating any data from the Bigelow should be avoided in diel standardization of the Albatross. Despite just being one year of data, the difference in the catchability of the Bigelow in comparison to the Albatross had a substantial impact on the standardized abundance estimate.

Although differences in day/night catchability could affect variance and introduce year effects, an analysis of the variability in the proportion of day/night sets by strata over years indicate there have not been systematic changes in the proportion of day/night sets throughout the survey time series; thus, diel patterns are not expected to cause systematic bias. There was consensus that diel calibration would be excluded from the model. Meeting participants reached consensus to calibrate between vessels by using a quasibinomial General Linear Model to estimate the calibration factors for the Bigelow catches partitioned by sex for three subgroups (pup, juvenile and adult).

DOCUMENTS

It was agreed that the working paper by Fowler and Bowlby (WP 2017/09) should be published as a CSAS Research Document. All meeting products will be published on the on Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat's (CSAS) Website as soon as they are available. This proceedings Document constitutes the record of meeting discussions and conclusions.

REFERENCES CITED

Fowler, G.M., and Campana, S.E. 2015. Framework Assessment and 2013 Update Using a Stage-based Population Model for Spiny Dogfish (*Squalus acanthias*) in the Northwest Atlantic. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/065.

Haist, V., Fowler, M., and Campana, S. 2010. A Length-Based, Spatially Explicit Population Model for Spiny Dogfish (*Squalus acanthias*) in the Northwest Atlantic. TRAC Ref. Doc. 2010/01.

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Rago, P.J., and Sosebee, K.A. 2010. Biological Reference Points for Spiny Dogfish. Northeast Fish. Sci. Cent. Ref. Doc. 10-06

Sagarese, S., Frisk, M.G., Cerrato, R.M., Sosebee, K.A., Musick, J.A., and Rago, P.J. 2016. Diel Variation in Survey Catch Rates and Survey Catchability of Spiny Dogfish and their Pelagic Prey in the Northeast U.S. Continental Shelf Large Marine Ecosystem. Mar. Coast. Fish. 8(1): 244-262.

APPENDICES

APPENDIX 1: LIST OF MEETING PARTICIPANTS

Name	Affiliation
Baker, Lori	Eastern Shore Fisherman's Protective Association
Bennett, Lottie	DFO Science, Maritimes Region
Bowlby, Heather	DFO Science, Maritimes Region
Deller, Sarah	DFO Species at Risk Management, Maritimes Region
Ford, Jennifer	DFO Resource Management, Maritimes Region
Fowler, Mark	DFO Science, Maritimes Region
Jayawardane, Aruna	Maliseet Nation Conservation Council
Kavanagh, Sana	Confederacy of Mainland Mi’kmaq
Miller, Tim	NOAA / NFMS / NEFSC
Simpson, Mark R.	DFO Marine Fish Species at Risk, Newfoundland Region
Smedbol, Kent	DFO Science, Maritimes Region
Stone, Heath	DFO Science, Maritimes Region

APPENDIX 2: TERMS OF REFERENCE

Northwest Atlantic Spiny Dogfish Framework Part 1: Review of Data Inputs

Regional Advisory Process – Maritimes Region

September 19-20, 2017
Dartmouth, Nova Scotia

Chairperson: Kent Smedbol

TERMS OF REFERENCE

Context

The Northwest Atlantic Spiny Dogfish is a transboundary resource with significant catches in Canada and the United States (USA). Although a joint Canada-US Transboundary Resources Assessment Committee (TRAC) assessment was held in early 2010, consensus on an assessment model was not reached. Both the US and Canada have continued to assess the stock independently since 2010.

The last DFO framework review and assessment of Northwest Atlantic Spiny Dogfish occurred in January and May 2014 using data up to 2010 (Fowler et al. 2015). The accepted model was a forward-projecting stage-based, spatially explicit population dynamics model with two time steps. Efforts to incorporate more recent data into the framework model have not been successful. This is likely due to substantial changes in our understanding of dogfish catchability owing to recent research on day/night patterns as well as the deployment of a new survey vessel in the US in 2009. Both would affect the main abundance index used to assess the population.

Fisheries Management has requested annual updates for Northwest Atlantic Spiny Dogfish. DFO Science has determined that a new framework assessment is required to meet this request.

Objectives

The objectives of the Regional Advisory Process are to:

1. Describe the USA and Canadian data used in an assessment.
    - Commercial and recreational fishery characteristics (catch composition, discards, discard mortality)
    - Description of the survey data used to develop indices of abundance
    - Stock definition

2. Evaluate factors affecting dogfish catchability, including their implications for abundance estimation.
    - diel patterns
    - changes to survey methodology and vessel; focused on the USA spring survey (sampling of outer slope strata, catchability at length).
3. Review proposed methods to standardize the abundance index from the US spring survey for input into an assessment model.

Expected Publications

- Proceedings
- Research Document

Expected Participation

- DFO Science
- DFO Fisheries and Aquaculture Management
- Provincial representatives
- Aboriginal Communities/Organizations
- Industry Representatives
- Academia
- Invited external experts
- Environmental Non-Governmental Organizations

Reference

Fowler, G.M., and Campana, S.E. 2015. Framework Assessment and 2013 Update Using a Stage-based Population Model for Spiny Dogfish (*Squalus acanthias*) in the Northwest Atlantic. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/065.

APPENDIX 3: MEETING AGENDA

Northwest Atlantic Spiny Dogfish Framework

Regional Peer Review – Maritimes Region

19-20 September 2017
King Boardroom
Bedford Institute of Oceanography
Dartmouth, Nova Scotia

Chairperson: Kent Smedbol

DRAFT AGENDA

DAY 1 (Tuesday, September 19, 2017)

Time	Topic
9:00 - 9:30	Welcome & Introductions
9:30 - 10:00	Description of Biology and Stock Structure
10:00 - 10:30	Overview of Past Dogfish Assessment
10:30 - 10:45	Break (hospitality provided)
10:45 – 12:00	Summary of Dogfish Data Inputs
12:00 - 1:00	Lunch (hospitality not provided)
1:00 – 1:30	Overview of Data Input Issues
1:30 – 3:00	Evaluation of Data Input Issues • Estimation Methods • Catch Composition Assumptions
3:00 – 3:15	Break (hospitality not provided)
3:15 – 4:30	Evaluation of Survey Catchability Issues (Diel Catchability) and Data Standardization

DAY 2 (Wednesday, September 20, 2017)

Time	Topic
9:00 - 9:15	Recap of Day 1
9:15 – 10:30	Evaluation of Survey Catchability Issues (Bigelow Catchability) and Data Standardization
10:30 - 10:45	Break (hospitality provided)
10:45 - 12:00	Next Steps
12:00 – 12:15	Wrap up