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Proceedings of the Zonal Peer Review of the Assessment Framework for Units 1+2 Deepwater (*Sebastes mentella*) and Acadian Redfish (*Sebastes fasciatus*) and for Unit 3 Acadian Redfish

December 8 to 11, 2015
Mont-Joli, Quebec

Chair: Ghislain Chouinard
Rapporteur: Sonia Dubé

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Mont-Joli, Quebec G5H 3Z4

February 2017

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 Zonal Peer Review meeting of the Assessment Framework for Units 1+2 Deepwater (*Sebastes mentella*) and Acadian Redfish (*S. fasciatus*) and for Unit 3 Acadian Redfish. This meeting was held from December 8 to 11, 2015 at the Maurice Lamontagne Institute in Mont-Joli. Nearly 40 participants attended from DFO Science and Fisheries Management Branches, fishing industry, academia and non-governmental organizations. These proceedings provide an overview of the key points of the presentations and discussions along with recommendations and conclusions presented during the review.

SOMMAIRE

Ce document renferme le compte rendu de l'examen zonal par des pairs portant sur la révision du cadre d'évaluation pour le sébaste atlantique (*Sebastes mentella*) et le sébaste acadien (*S. fasciatus*) des unités 1 et 2 et pour le sébaste acadien de l'unité 3. Cette rencontre, qui s'est déroulée du 8 au 11 décembre 2015 à l'Institut Maurice-Lamontagne à Mont-Joli, a réuni près de quarante participants de la direction des sciences et de la gestion des pêches du MPO, de l'industrie des pêches, des universités et d'organisations non gouvernementales. Ce compte rendu contient l'essentiel des présentations et des discussions qui ont eu lieu pendant la réunion et fait état des recommandations et conclusions émises au moment de la revue.

INTRODUCTION

Redfish is a long-lived, cold water groundfish species found in the Atlantic and Pacific oceans. The two main redfish species in the Northwest Atlantic are the Acadian Redfish (*Sebastes fasciatus*) and the Deepwater Redfish (*Sebastes mentella).* A zonal peer review was held December 8 to 11, 2015, to review the assessment framework for Units 1+2 Deepwater and Acadian Redfish and for Unit 3 Acadian Redfish. This review contains two parts.

PART 1. REVIEW OF THE ASSESSMENT FRAMEWORK FOR UNIT 3 ACADIAN REDFISH

In March 2011, Fisheries and Oceans Canada (DFO) conducted a Recovery Potential Assessment (RPA), which found that Unit 3 Redfish biomass in 2010 was approximately 2,254,000 t, and that there was a 99% probability it would remain above 40% of Biomass at Maximum Sustainable Yield (BMSY) by 2070, based on catch levels at the time (DFO 2011). In October 2011, DFO conducted a second assessment of redfish primarily focused on defining limit reference points for Atlantic Redfish stocks (DFO 2012). The findings indicated that Unit 3 Redfish biomass was well above its limit reference point, was considered healthy, and continued to grow. A follow-up science framework and assessment meeting is scheduled for 2016–2017. This meeting would provide an opportunity to develop a model for the stock and assess its current status.

PART 2. REVIEW OF THE ASSESSMENT FRAMEWORK FOR UNITS 1+2 DEEPWATER (*SEBASTES MENTALLA*) AND ACADIAN REDFISH (*SEBASTES FASCIATUS*)

Units 1 and 2 Redfish (*Sebastes spp*) are distributed in the Gulf of St. Lawrence, as well as the Laurentian Channel and Laurentian Fan off Southern Newfoundland and Northeastern Nova Scotia. In 2011, a Recovery Potential Assessment estimated the biomass of both *S. fasciatus* and *S. mentella* in these areas to berelatively low. A subsequent 2011 meeting to establish biological limit reference points (LRP) for various Canadian managed redfish stocks found them to be in the critical zone of the precautionary approach, estimated at 44% (for *S. fasciatus*) and 8% (for *S. mentella*)of their LRP. Reference point estimates from these stocks were derived from a state-space Bayesian implementation of the Schaefer surplus production model (McAllister and Duplisea 2011, 2012). The Bayesian surplus production (BSP) model does not take into account available length composition data for these stocks. It was therefore agreed during the 2011 reference points meeting that other approaches would be considered in order to include these data in hopes of developing a more accurate population dynamics model (DFO 2012) leading to better management advice. Since the last assessment in October 2011 (DFO 2012), it has become evident that the 2011 and 2012 year-classes of redfish and especially *S. mentella* are very strong, and *S. fasciatus* in the southerly slopes and Laurentian Fan area of Unit 2 may be more closely related to redfish in Divisions 3LNO than redfish in Unit 1 and the remainder of Unit 2. A new assessment should therefore consider, first, how to protect these year-classes as pre-recruits in order to avoid compromising potential yield per recruit by landing too many small and juvenile fish, and, second, how to increase the level of spawning stock biomass in order to enhance future recruitment prospects.

Day 1 – Tuesday, December 8, 2015

BACKGROUND

The meeting chair, Ghislain Chouinard, welcomed participants (Appendix 1), and reviewed the meeting's objectives regarding the terms of reference (Appendix 2). The agenda for the four-day meeting was reviewed (Appendix 3) and a workplan was established.

PART 1. REVIEW OF THE ASSESSMENT FRAMEWORK FOR UNIT 3 ACADIAN REDFISH (*SEBASTES FASCIATUS*)

Survey data – Unit 3

Adam Cook presented DFO survey data on Unit 3 Redfish, which included survey and catch trend information on spatial distribution, abundance and biomass, length composition, condition and growth, habitat associations according to the size (< 22 cm and > 22 cm), as well as the survey's effectiveness. Mr. Cook said the 2015 biomass index was among the highest series indices since 1982, which included the 2008, 2009, 2011 and 2012 indices. This increase in biomass was reflected by an increase in the species' range.

Participants made comments and suggestions.

- There were questions regarding the effectiveness of the current survey and the usefulness of the data collected. In general, participants said it was important that objectives be clearly defined in order to optimize the survey and improve the focus of data analysis.
- With respect to the ongoing discussion on optimal survey design, it was suggested that strata be combined to reduce variability.
- Some participants suggested that day and night data be compared. It may be appropriate to make adjustments using a correction factor to obtain a standardized index.
- Regarding observed expansion of the redfish range, some participants said it would be interesting to examine range data based on length. It may also be worthwhile finding out whether this is consistent with commercial fishery data.
- When reviewing survey indices, some participants said it was important to consider changes in fishing gear and techniques that had occurred over the years.

Fishery data, observer coverage, and bycatch

Peter Comeau provided background information on the fishery in Unit 3, whose total allowable catch (TAC) has been set at 9000 t since 2000. He presented data on landings and age composition. The level of observer coverage was between 5% and 10%. The main bycatches in the directed redfish fishery are Haddock, Spiny Dogfish, and Pollock.

Participants made a few comments.

- There was greater uncertainty regarding landing data at the beginning of the series. However, participants thought it would be useful to include data from the 1960s. Participants also suggested that the catch per unit effort (CPUE) be examined, at least for the most recent years.
- It was noted that market conditions and management arrangements can influence landings. Both sources of information (survey and fishery) proved to be useful in assessing stocks.

However, it was important to take a closer look at the various factors that could influence fishery data (fleet gear and behaviour, regulations, the market, etc.).

- With respect to catch at length data, it was strongly recommended that the sampling procedure be reviewed to make it more robust, and that observer data be included.
- Industry and management would like to achieve a higher percentage of observer coverage: at 10% to 20%. However, coverage was limited due to the insufficient number of observers available.

Lastly, modelling work for Unit 3 stock was planned for 2016 and 2017, as well as a stock status assessment.

Day 2 – Wednesday, December 9, 2015

PART 2 REVIEW OF THE ASSESSMENT FRAMEWORK FOR UNITS 1+2 DEEPWATER (*SEBASTES MENTELLA*) AND ACADIAN REDFISH (*S. FASCIATUS*)

Overview of redfish biology

Claude Brassard provided a brief overview of redfish biology, particularly regarding both species' ranges, criteria for distinguishing the species, habitat along the slopes of banks and deep channels, the slow growth of this long-lived species, its ovoviviparous reproduction and episodic recruitment (at intervals of from 5 to 12 years).

- It was noted that the number of soft rays in the anal fin was one of the characteristics used to discriminate between the species. The number of soft rays varies between 6 and 10. There are generally 7 or less in *S. fasciatus* and 8 or higher in *S. mentella*. However, a number of 8 soft rays is not unusual in *S. fasciatus* and a number of soft rays less than 8 is also possible in *S. mentella*. The theoretical distribution of the number of rays between the five possible classes (6, 7, 8, 9 and 10) is available by species (identified on a genetic criteria basis). This theoretical distribution predicts the proportion of species present in a sample, based on the observed distribution of fin rays. A sub-sample of 30 fish is used to estimate species composition of a given trawling tow. This approach, which included a depth criterion in the fin rays were not sampled, was used in the analyses. Of course, there was some uncertainty in the analyses.

Survey data – Unit 1

Mr. Brassard continued his presentation on Unit 1 survey data. The abundance indices were presented for each survey (DFO survey and sentinel survey). It was encouraging to note that these indices had increased in recent years. In the case of the DFO survey, indices were broken down by species, and catch distributions were presented. Length frequency data were also provided for sentinel surveys.

Participants asked a few questions and provided clarifications.

- It was noted that a correction factor was applied to the DFO survey to account for vessel changes in 1990 and 2004, following comparative missions. The same protocol has been applied to sentinel surveys for 20 years.
- With respect to distinguishing the species, the participants agreed that counting the soft rays on the anal fin of small individuals was more difficult, which led to uncertainty regarding species identification. This uncertainty seemed to decrease when fish reached 15, 16, and

17 cm. Thus, some individuals identified as *S. fasciatus* in 2014 were actually *S. mentella*, as confirmed by 2015 data.

- It became clear that year-classes of *S. mentella*, for 2011 and 2012 were very strong.

Survey data – Unit 2

The presentation delivered by Kris Vascotto focused on the catchability coefficient (q) of the Groundfish Enterprise Allocation Council (GEAC) survey in Unit 2. A literature review was conducted to estimate the value of q; the review stated that the evidence suggests that this is less than1.

The data from this survey were also presented, which included data for 2009, 2011, and 2014. The 2011 abundance index was the highest since 2001, although no clear trend was observed since the early 2000s.

- According to the participants, several factors can influence the value of q (gear, fishing sites, fish behaviour, etc.). However, it seemed difficult to consider all these factors without creating a biased view of reality by making too many assumptions.
- According to some participants, q should rather be considered as a model output which would need interpretation; they cautioned against imposing prior bounds on its value in assessments.
- A participant held the view that the absolute value of q was not meaningful, and rather it could be considered only as a measure relative to a particular survey, whose value did not affect the time-trend in the abundance index concerned.
- It was noted that the abundance indices presented by Mr. Vascotto were not broken down by species. However, a participant said that the 2000–2011 series of the GEAC survey had been converted (to a Teleost equivalent) and broken down by species (based on the criterion of the number of soft rays on the anal fin) during the last assessment. This conversion was used to compare Unit 2 data with Unit 1 data, and develop a combined abundance index.
- The participants agreed that it was important to break down data by species.
- Participants made a few clarifications on the conversion to Teleost equivalents. This correction was based on a comparative fishing experiment conducted in 2000 by the CCGS Teleost and the Cape Beaver (or its sister ship, the Cape Ballard), which includes data up to 2011.

Commercial catch data (Units 1 and 2)

Johanne Gauthier presented the commercial fishery data. She provided background information on this fishery, management measures, landings (not broken down by species), and the spatial distribution of catches.

Unit 1 pre-moratorium landing statistics (before 1995) indicated two high-catch periods supported by strong cohorts (1970 and 1980). In Unit 2, a significant proportion of catches come from the Laurentian Fan area and *S. fasciatus* in this area were more closely related to Division 3LNO than redfish in Unit 1 and the western part of Unit 2.

- Industry representatives believed that the distribution of catches in the Laurentian Fan area, and on either side of the Laurentian Channel, had more to do with fishing license conditions than availability of the resource.

- There were questions about the failure to achieve the TAC in Unit 2, which was mainly related to unfavourable market conditions.
- All observer catch at length data must be included.
- The participants wondered about the possibility of having access to other data for the assessment, particularly for Unit 2. Participants found it important that all available information be included.
- Reviewing sampling procedures to ensure they were sufficiently robust also appeared to be a priority. The various procedures should be harmonized.
- In general, meeting participants thought it was important to better understand what was happening, especially since new cohorts (2011 and 2012) were entering into the system.

Genetic stock structure

Alexandra Valentin presented the key parameters for understanding redfish recruitment, as well as the sampling method, and the findings on genetic stock structure.

The results indicated there was a single population of *S. mentella* in Units 1 and 2, and that the strong 1980 *S. mentella* year-class had supported the fishery for 20 years. However, *S. fasciatus* in Units 1 and 2 had two different genetic signatures: *S. fasciatus* in the southeastern part of Unit 2 had the same genetic signature as the *S. fasciatus* population in Division 3LNO, while in the rest of Units 1 and 2, *S. fasciatus* has its own genetic signature, characterized by an introgressive hybridization signal with *S. mentella*. The results also indicated that strong year classes (1973, 1985, 1988 and 2003) of *S. fasciatus* who disappeared from the Gulf of St. Lawrence before reaching adulthood were from the southeastern part of Unit 2; the disappearance from the Gulf would correspond to a migration back to their adult range, after few years using the Gulf as a feeding area. The results also indicated that the new strong year-classes observed in Unit 1 (2011 and 2012 year-classes) and in Unit 2 (2011 year-class) primarily consist of *S. mentella* with the typical genetic signature of the adult population of *S. mentella* in Units 1 and 2.

- Some participants wondered whether the sampling method could explain the difference in proportions of *S. mentella* and *S. fasciatus* observed in the genetic study versus surveys. However, Ms. Valentin reminded everyone that the study was not designed to estimate the percentage of each species, but to determine genetic stock structure based on signatures.

Redfish range in the Laurentian Fan area

Hugo Bourdages reviewed the redfish range in Units 1 and 2 in mature and immature individuals. In general, *S. fasciatus* inhabited shallower waters than *S. mentella*. Monitoring of the 2003 *S. fasciatus* cohort indicated a shift from Unit 1 to Unit 2, and then to the Laurentian Fan at 6 to 8 years of age. There appeared to be a greater proportion of *S. fasciatus* in this area, although the abundance of *S. mentella* was not negligible.

- Participants said that *S. fasciatus* in the Laurentian Fan area did not belong to the stock in Units 1 and 2, but to 3LNO stock. Participants wondered how to take this situation into account in assessments.
- The meeting recommended that sampling procedures be standardized.

Previous modelling work

Daniel Duplisea presented a brief overview of modelling work performed in recent years. Although few models had been developed before 2011, in part due to the complexity of this stock, it was important, in the current context, (COSEWIC process and precautionary approach) to fast track development work.

Thus, a surplus production model was developed to establish reference points for assessing stock status (McAllister and Duplisea 2011, 2012). An update of the model (McAllister and Duplisea 2015) revealed that the relative level of the biomass of *S. fasciatus* and *S. mentella* in Units 1 and 2 was low and in the critical zone of the precautionary approach, respectively at 28% and 14% of the limit reference point.

Two statistical catch at length models were also explored, and were to be discussed in the next few days of meeting (Duplisea et al.; Rademeyer and Butterworth). The purpose of this work was to develop a more accurate population dynamics model, and provide better management advice. These assessment approaches are based on statistical models that consider the size structure.

Brief overview of the two catch at length models

Daniel Duplisea and Doug Butterworth provided a brief overview of both catch at length models. They were to be reviewed in greater detail and discussed the next day. Mr. Duplisea and Mr. Butterworth said that the participants had to agree on the main components to be considered in these models (databases, assumptions and constraints). The Chair said that one of the objectives of this meeting was to agree on the choice of the “best” model, i.e. the most useful for stock assessments.

Day 3 – Thursday December 10, 2015

Presentation of catch at length models

Two statistical catch at length models were explored and presented by Mr. Duplisea (NOAA NFT SCALE software) and Mr. Butterworth (custom software). Several simulations were performed using each model, based on various assumptions, and the results were announced. There were some differences in how these models were fit to the data. There were lack-of-fit problems with both models, especially for the period around 1990, with high values for residuals over that period.

- Some participants believed this could be associated with discards and/or unreported catches from the large 1980 cohort, consisting primarily of *S. mentella*.
- It would also be interesting to verify whether or not the abundance of *S. fasciatus* had been underestimated for this period. It was suggested that the smooth proportions of each species assumed for the catches over time be examined, and that they be brought more in line with the raw data.

Both models were quite sensitive to natural mortality assumptions and some growth-related characteristics, including composition. Using these models, it was difficult to reconcile catch at length composition and abundance indices when assuming a constant value independent of age for M and when assigning an equivalent weight to surveys of Units 1 and 2.

- In one case (Butterworth), a better reconciliation was achieved by assuming a higher M (0.4) for ages 1 to 13, with a sharp drop to 0.05 at age 14.

- In the other case (Duplisea), the model was based on an age-independent value for M (*S. mentella*: 0.1; *S. fasciatus:* 0.12); for this model a better reconciliation was achieved by assigning more weight to the Unit 1 survey than the Unit 2 survey.
- In this second case (Duplisea), which was based on a constant age-independent M value, one participant suggested that this parameter be controlled indirectly by adjusting the reported catch levels to replicate the effects of a higher M for juveniles.

Some discussions focused on other tests that could be performed by varying certain assumptions, including for selectivity curves (Butterworth), growth curves, proportions by species, a value of M that changed for different periods, etc.

- However, some participants were of the opinion that including too many variations of assumptions in the set of models considered could increase uncertainty and over-complicate results.
- Uncertainty was considered inherent to models, which did not preclude further examination in order to better understand what was happening.

Assessment of modelling approaches

The two models provided appreciably different profiles of stock trends, status and recruitment. Assumptions concerning the value of M and its age-dependance varied between the models, and the same growth curves were not used, which could be contributory reasons for these differences.

Moreover, uncertainty in some databases (length composition for some years, unreported discards and catches) could be reduced by including observer data and/or industry data.

- In an attempt to obtain comparable analyses in order to make a more informed decision, participants suggested that a few assessment runs be repeated using standardized input values for both models (M, growth curve, selectivity).
- The results of this exercise were to be presented the following day.

Day 4 – Friday, December 11, 2015

Redfish’s role as predator and prey

Hugo Bourdages presented the results of the work performed by Claude Savenkoff, which focused on the main prey and predators of redfish during different periods, as well as the preliminary findings of a redfish stomach sampling campaign. Shrimp appeared to be an increasingly important prey, particularly among large redfish. Mr. Bourdages illustrated the overlapping of small *S. mentella* and shrimp in the water column, while the range of large *S. mentella* was in deeper waters. In the case of *S. fasciatus*, the overlap with shrimp was observed for small and large individuals.

- Some participants suggested examining whether there were spatial differences in prey/predator patterns at the same depths.
- Participants also said small redfish were certainly an important prey for Greenland Halibut in recent years.

Modelling results based on parameters discussed by participants and comparison of models

There was only a short time for Mr. Duplisea and Mr. Butterworth to conduct the modelling exercises requested. The initial results did not reflect any appreciable improvements, and could not explain the differences between the models' outputs. More time would be needed to conduct a fuller comparison.

- Given the participants' concerns regarding the validity of some assumptions (M, growth curves, survey weighting), uncertainties in some databases, and differences in data adjustment methods, the participants were unable to determine which model best reproduced the stock trajectory of *S. mentella* and *S. fasciatus* in Units 1 and 2.
- It was therefore decided that small working groups would be created to review the data and the various assumptions used in the analyses in order to refine the approaches. If this exercise produces promising results, the models will be peer-reviewed and could contribute to the assessment of redfish stocks in Units 1 and 2.
- Some concerns were raised about the resources available to perform this work.

Definition of modelling requirements for the next stock assessment

The participants agreed on aspects of the model to be reviewed by the working groups for the next stock assessment, including four which were considered priorities. Discussions between these working groups are to be held to ensure the simulations are comparable.

The four aspects considered to be priorities are:

- The age-dependence of M
- Catch (unreported discards and catches)
- Growth curves for each species
- Composition by species of the commercial catches

Other aspects which should also be examined:

- Uncertainty about the appropriate location for the Unit 2 boundary.
- Year-dependence of M
- Density-dependence in the value of M
- Weighting of surveys relative to catch at length (CAL) data
- Weighting recruitment residuals
- Catch residuals penalty
- Survey selectivity
- Uncertainty in species discrimination of juveniles
- Inclusion of commercial CAL
- CAL classes (probability)

NEXT ASSESSMENT, FREQUENCY OF SCIENCE ADVISORY REPORTS AND REQUIREMENTS FOR INTERIM YEARS

Some discussions took place regarding the deadline for the next assessment and the frequency of Science Advisory Reports.

- Considering the needs of management and the likelihood of new individuals entering the fishery in the coming years (2017 and 2018), a Science Advisory Report should be produced in 2016, or in early 2017 at the latest.
- Participants found that the frequency of stock assessments should be set at two years.
- Brief monitoring of key indices (not all indices) was recommended for the interim years.

STOCK STRUCTURE REQUIREMENTS FOR ANY FUTURE PROCESSES

The focus should be placed on *S. fasciatus* with respect to priority stock structure requirements for any future processes. While the spatial and temporal distribution of *S. mentella* was very consistent, there was still much uncertainty regarding existing knowledge of *S. fasciatus* in Units 1 and 2, including the Laurentian Fan area. A strong year-class characteristic of both Unit 1 and Unit 2 has never been identified. However, the portion of individuals from strong year-classes of 2011 and 2012 identified as *S. fasciatus* have the typical genetic signature (i.e. the one characterized by an introgressive hybridization signal with *S. mentella*) of *S. fasciatus* adult in Units 1 and 2 (excluding the southeast portion of the Unit 2).

- Participants agreed that a *S. fasciatus* sampling project covering a very wide area would no doubt be useful in relation to the stock assessment and management issues.

RECAPITULATION

The meeting Chair gave a brief recapitulation. This meeting provided an opportunity to:

- Review survey and commercial catch data for Units 1, 2, and 3;
- Review catch at length models for redfish in Units 1 and 2;
- Reach agreement on model aspects to be reviewed by small groups to refine the modelling work for stocks in Units 1 and 2;
- Recommend harmonization of sampling procedures between regions;
- Specify the deadline for the next assessment and the frequency of Science Advisory Reports (Units 1 and 2);
- Prioritize stock structure requirements.

The Chair thanked the participants and adjourned the meeting.

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APPENDIX 1- LIST OF PARTICIPANTS

Name	Affiliation	Dec. 8	Dec. 9	Dec. 10	Dec. 11
Aeberhard, William	Dalhousie University	X	X	X	X
Bernier, Denis	DFO – Science - Quebec		X		
Bourdages, Hugo	DFO – Science - Quebec	X	X	X	X
Bourdages, Yan	ACPG		X	X	X
Brassard, Claude	DFO – Science - Quebec	X	X	X	X
Butruille, Frédéric	DFO – Fisheries Management - Gulf		X	X	X
Butterworth, Doug	University of Cape Town	X	X	X	X
Castonguay, Martin	DFO – Science - Quebec	X	X	X	X
Chouinard, Nicolas	ACPG		X		
Chabot, Denis	DFO – Science - Quebec	X	X	X	
Chapman, Bruce	GEAC	X	X	X	X
Chouinard, Ghislain	DFO – Science - Quebec	X	X	X	
Chouinard, Raoul	ACPG		X		
Comeau, Peter	DFO – Science - Maritimes	X	X		
Cook, Adam	DFO – Science - Maritimes	X	X		
Cotton, Allen	ACPG		X	X	X
Courchesne, Sandra	DFO – Fisheries Management - Ottawa		X	X	X
Cyr, Charley	DFO – Science - Quebec		X	X	X
Desgagnés, Mathieu	DFO – Science - Quebec	X	X	X	X
Doniol-Valcroze, Thomas	DFO – Science - Quebec	X	X	X	X
Dubé, Sonia	DFO – Science - Quebec	X	X	X	X
d'Entremont, Alain	GEAC	X	X	X	X
Duplisea, Daniel	DFO – Science - Quebec	X	X	X	X
Ford, Jennifer	DFO – Fisheries Management - Maritimes	X	X		
Gauthier, Johanne	DFO – Science - Quebec	X	X	X	X
Krohn, Martha	DFO – Science - Ottawa		X	X	X
Lambert, Yvan	DFO – Science - Quebec		X	X	X
Lévesque, Ginette	DFO – Fisheries Management - Quebec		X	X	X
Linton, Brian	NMFS – NOAA	X	X	X	X
McQuinn, Ian	DFO – Science - Quebec			X	X
Paul, Martin	Atlantic Policy Congress	X	X	X	
Plourde, Stéphane	DFO – Science - Quebec			X	
Sainte-Marie, Bernard	DFO – Science - Quebec		X	X	X
Samuel, Clément	ACPG		X		
Valentin, Alexandra	DFO – Science - Quebec	X	X	X	X
Vascotto, Kris	GEAC	X	X	X	X
Voutier, Jan	GEAC	X	X	X	X

APPENDIX 2- TERMS OF REFERENCE

Assessment Framework for Unit 1+2 Deepwater (*Sebastes mentella*) and Acadian Redfish (*Sebastes fasciatus*) and for Unit 3 Acadian Redfish

Zonal Peer Review – Quebec, Maritimes and Newfoundland and Labrador Regions

December 8-11, 2015
Mont-Joli (Québec)

Chairperson: Ghislain Chouinard

Part 1: Data Framework review in Unit 3 for Acadian Redfish (Sebastes fasciatus) – December 8, 2015

Context

Redfish is a long-lived, cold water groundfish species found in both the Atlantic and Pacific oceans. In the Northwest Atlantic, two main redfish species exist: Acadian Redfish (*Sebastes fasciatus*) and Deepwater Redfish (*Sebastes mentella*). Acadian Redfish, which is found from the Gulf of Maine to the Labrador Sea, is considered two designated units (DU): Atlantic population and Bonne Bay population. Redfish in Unit 3 constitute that portion of the Atlantic population DU residing on the central and western portions of the Scotian Shelf. In April 2010, both redfish species were assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened and Special Concern, respectively, due to evidence of declines in some stocks. In March 2011, Fisheries and Oceans Canada (DFO) conducted a Recovery Potential Assessment, concluding that Redfish Unit 3 biomass in 2010 was approximately 2,254,000 tonnes, with the stock having a 99% chance of staying above 40% of Biomass at Maximum Sustainable Yield (BMSY) by 2070 based on catch levels at the time (DFO 2011). In October 2011, DFO conducted a second assessment on Redfish with the key objective of defining limit reference points for Atlantic redfish stocks (DFO 2012). It was concluded that Redfish Unit 3 biomass was well above its limit reference point, considered healthy, and exhibiting increased growth. The intent of this science framework meeting is to review data inputs in support of evaluating the Redfish Unit 3 stock. It is intended that a follow-up science framework and assessment meeting would occur in 2016-2017, which would model the stock and assess its current status.

Objectives

- Review and evaluate biological and fishery information on Unit 3 Redfish stock status and characterize the uncertainty of the results. In particular, provide survey and catch trend information on distribution, biomass, length composition, age composition and condition, highlighting any trends over the long-term (length of assessment) and most recent period (5 years).
- Report on any spatial/temporal component to Unit 3 Redfish age structure.
- Report on frequency and distribution of Observer coverage in the Unit 3 Redfish fishery, identifying adequacy of coverage.
- Report on the bycatch of non-target species in the Unit 3 Redfish fishery and identify any notable changes in the occurrence of these species relative to previous years. In addition, report on Unit 3 Redfish bycatch captured in other fisheries.

Part 2: Assessment Framework for Unit 1+2 Deepwater (Sebastes mentella) and Acadian redfish (Sebastes fasciatus) – December 9-11, 2015

Context

Unit 1 + 2 Redfish (*Sebastes* spp.) are distributed in the Gulf of St. Lawrence as well as the Laurentian Channel and Laurentian Fan areas off southern Newfoundland and Northeastern Nova Scotia. Both *S. fasciatus* and *S. mentella* in these areas are considered to be in a low relative biomass state and a 2012 peer review meeting showed them to be in the precautionary approach critical zone at 44% and 8% of their biomass limit reference points, respectively. These long lived species have proven difficult to age and age based modelling approaches have not as yet been applied successfully to either of these stocks. Reference point estimates from these stocks are the result of fitting a state-space Bayesian implementation of the Schafer surplus production model, BSP (McAllister & Duplisea 2011, 2012). BSP does not make use of the length composition data available for these stocks and it was agreed at the 2012 reference point meeting that further approaches would be considered that could include these data in hopes of more accurately modelling population dynamics and improving management advice. Furthermore, both of these species display spasmodic recruitment characteristics and approaches which can more explicitly model recruitment should be advantageous.

It has become apparent since the last evaluation in March 2012 (DFO 2012), that the 2011 and 2012 year classes of *S. fasciatus* and especially *S. mentella* are very strong and *S. fasciatus* in the south-eastern part of Unit 2 may be more closely related to Redfish in 3LNO than to Unit 1 and the western part of Unit 2. A new assessment should therefore consider how to both protect these year classes as pre-recruits, to avoid compromising yield per recruit potential by harvesting too heavily at relatively younger/smaller ages, and to enhance the level of the spawning stock biomass potential for the purpose of facilitating future recruitment prospects.

Objectives

Review of indices of abundance, fishery data and biological data for both species:

- Review indices of abundance in DFO research vessel surveys, industry surveys and commercial index fisheries
- Review fishery data inputs including spatial and temporal distribution, size composition
- Review comparative fishing experiments and conversion methods for GEAC-Teleost April 2015

Assessment of Model(s) to Monitor Stock Status and Productivity for both species:

- Review plausible method(s) to estimate the current status, specifically, stock size, size composition and fishing mortality, as the basis to provide advice to managers outlining their scope for use, strengths and weaknesses and how advice can be provided from these methods.
- Determine methodology to characterize stock productivity including reference points for fishing mortality and spawning stock biomass and past, current and projected states relative to these points for each species.
- Determine plausible forecasting method(s) for providing advice on a range of harvest levels associated with various fishing strategies including risk of being above or falling below biological reference points at different time frames (e.g. 5 years, 10 years, 25 years). Discuss the reliability of projections over different time periods.
- Discuss the potential and likely contribution of the 2011 and 2012 year classes to the fishery and to reproductive biomass over the cohorts' life spans and strategies for optimising their utilization and contribution towards future recruitment.

Minimal set of diagnostics, sensitivities and justifications expected from model fitting approaches:

- Residuals from survey abundance
- Residuals from composition data
- Retrospective analysis going back at least 10 years
- Sensitivity to main productivity parameters of stock
- Sensitivity to data weighting assumptions
- Sensitivity to fishery and survey selectivity assumptions particularly the proportion of biomass generated from selectivity assumptions if selectivity is considered domed or non-sigmoidal
- For Bayesian assessments, sensitivity to bounds/priors including a clear statement when a posterior median parameter estimate is in improbable areas of the prior or at the bounds
- Justification for all parameters, especially model-scaling parameters (e.g. K and/or q) of model which strongly impact reference point estimates and sustainability of catch scenarios
- Selection of key run and justification. Any sensitivity runs identified as such with its particular purpose stated including a statement of plausibility relative to key run (quantitative or qualitative)
- Sensitivity to catch, especially in the early part of the time series where catches are less certain and likely underestimated

Establish a schedule for future processes and interim year advice:

- Establish a full assessment review period as well as interim-year advice utilizing the guidance provided by the March 2015 document from TESA
- Provide guidance on inter-framework review activities, including the procedure and frequency of providing fisheries management advice and events that would trigger an earlier-than-scheduled assessment
- Discuss data availability and resources required for dealing with potential stock structure issues that would be important for any future peer review process on stock structure

Establish requirements for model output for the assessment meeting in 2016. Minimally:

- Fittings expected
- Diagnostics expected
- Projections expected

Other information relevant to the physical and ecological context of redfish in the Unit 1+2 stock area

Transparency

In the interest enabling full evaluation and reproducibility of approaches explored as well as the longer term goal of continuity of the assessment methodology, contributors are expected to:

- make all data publically available in electronic format upon request
- provide a working document with publication expected as a CSAS research document
- make available all model code and inputs for the meeting and afterwards, upon request in electronic format and ideally should also be provided as a research document appendix. Reasonable conditions of use to protect intellectual property are acceptable as long as they do not compromise scrutiny of methods and/or continuity of the assessment of Unit 1+2 redfish. Non-DFO model code can be provided on the condition that it not be circulated for purposes other than peer review and further assessment of this stock and will be utilized only for these stocks by meeting participants or their designates.

Expected Publications

- CSAS Proceeding
- CSAS Research Document(s)*

*Drafts of documents should be provided at least one week before the scheduled start of the meeting

Participation

- Fisheries and Oceans Canada (DFO) (Science and Ecosystems and Fisheries Management sectors)
- Aboriginal Communities/Organizations
- Provincial Representatives (NS, NB, NL, QC)
- Fishing Industry
- Non-governmental Organizations
- Academics and Other External Experts

References

DFO. 2011. Recovery potential assessment of redfish (*Sebastes fasciatus* and *S. mentella*) in the northwest Atlantic. DFO Can. Sci. Advis. Sec., Sci. Advis. Rep. 2011/044. (Erratum: June 2013).

DFO. 2012. Reference points for redfish (*Sebastes mentella* and *Sebastes fasciatus*) in the northwest Atlantic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/004. (Erratum: June 2013).

McAllister, M. and Duplisea, D.E. 2011. Production model fitting and projection for Atlantic redfish (*Sebastes fasciatus* and *Sebastes mentella*) to assess recovery potential and allowable harm. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/057 vi + 75 p.

McAllister, M. and Duplisea, D.E. 2012. Production model fitting and projection for Acadian redfish (*Sebastes fasciatus*) in Units 1 and 2. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/103 iii + 34 p.

APPENDIX 3- AGENDA

Day 1 - Tuesday December 8, 2015

9:00	Welcome, objectives, Terms of Reference and agenda	Ghislain Chouinard
9:30	Survey Data	Adam Cook
10:15	*Break*	
10:30	Survey Data	Adam Cook
11:00	Spatial/temporal component to Unit 3 Redfish age structure	Peter Comeau
Noon	*Lunch*	
1:00	Frequency and distribution of Observer coverage in the Unit 3 Redfish fishery, identifying adequacy of coverage	Peter Comeau
1:45	Bycatch of non-target species in the Unit 3 Redfish fishery and Unit 3 Redfish bycatch captured in other fisheries	Peter Comeau
2:30	*Break*	
2:45	Discussion	Ghislain Chouinard
4:30	End of Day 1	

Day 2 - Wednesday December 9, 2015

9:00	Welcome and agenda	Ghislain Chouinard
9:15	Biology of redfish overview	Claude Brassard
9:30	Survey data in Unit 1	Claude Brassard
10:15	*Break*	
10:30	Survey data in Unit 2	Kris Vascotto
11:30	Commercial data	Johanne Gauthier
Noon	*Lunch*	
1:00	Stock structure genetics	Alexandra Valentin
1:45	Biomass proportions in the fan area	Hugo Bourdages
2:00	Previous modelling work	Daniel Duplisea
2:45	*Break*	
3:00	SCALE model and fits	Daniel Duplisea
5:00	End of Day 2	

Day 3 – Thursday December 10, 2015

9:00	Welcome and Re-cap of Day 2	Ghislain Chouinard
9:15	Production model fits	Daniel Duplisea
10:15	*Break*	

10:30	Statistical catch at length model	Doug Butterworth
Noon	*Lunch*	
1:00	Statistical catch at length model	Doug Butterworth
2:00	Discussion - Evaluation of modelling approaches	Ghislain Chouinard
2:45	*Break*	
3:00	Discussion - Evaluation of modelling approaches	Ghislain Chouinard
4:00	Discussion - method selection, range of use scope	Ghislain Chouinard
5:00	End of Day 3	

Day 4 – Friday December 11, 2015

9:00	Welcome and Re-cap of Day 3	Ghislain Chouinard
9:15	Discussion - establish modelling requirements for Redfish stock assessment	Ghislain Chouinard
10:15	*Break*	
10:30	Establish requirement and schedule for interim year advice	Daniel Duplisea
11:30	Redfish role as predator and prey	Hugo Bourdages
Noon	*Lunch*	
1:00	Requirements for any future process on stock structure	Ghislain Chouinard
2:30	*Break*	
2:45	Wrap-up	Ghislain Chouinard
4:00	End of meeting	