Fisheries and Oceans Canada | Pêches et Océans Canada

NOAA FISHERIES
NATIONAL MARINE FISHERIES SERVICE

***CERT***
**Comité d'évaluation des ressources transfrontalières**

***TRAC***
**Transboundary Resources Assessment Committee**

**Comptes rendus 2016/01** **Proceedings 2016/01**

# Proceedings of the Transboundary Resources Assessment Committee for Eastern Georges Bank Cod and Haddock, and Georges Bank Yellowtail Flounder

**Report of Meeting held**
**12-14 July 2016**

**Clark Conference Room**
**Northeast Fisheries Science Center**
**Woods Hole, Massachusetts, United States of America**

## Meeting Chairpersons

E.N. Brooks
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts, USA

K.J. Curran
Fisheries and Oceans Canada
Bedford Institute of Oceanography
Dartmouth, Nova Scotia, Canada

Ce document est disponible sur l'Internet à : This document is available on the Internet at :
http://www.mar.dfo-mpo.gc.ca/science/TRAC/trac.html

Canada

July 2016

## FOREWARD

The purpose of these proceedings is to archive the activities and discussions of the meeting, including research recommendations, uncertainties, and to provide a place to formally archive official minority opinions. As such, interpretations and opinions presented in this report may be factually incorrect or misleading, but are included to record as faithfully as possible what transpired at the meeting. No statements are to be taken as reflecting the consensus of the meeting unless they are clearly identified as such. Moreover, additional information and further review may result in a change of decision where tentative agreement had been reached.

## AVANT-PROPOS

Le présent compte rendu fait état des activités et des discussions qui ont eu lieu à la réunion, notamment en ce qui concerne les recommandations de recherche et les incertitudes; il sert aussi à consigner en bonne et due forme les opinions minoritaires officielles. Les interprétations et opinions qui y sont présentées peuvent être incorrectes sur le plan des faits ou trompeuses, mais elles sont intégrées au document pour que celui-ci reflète le plus fidèlement possible ce qui s’est dit à la réunion. Aucune déclaration ne doit être considérée comme une expression du consensus des participants, sauf s’il est clairement indiqué qu’elle l’est effectivement. En outre, des renseignements supplémentaires et un plus ample examen peuvent avoir pour effet de modifier une décision qui avait fait l'objet d'un accord préliminaire.

## ACKNOWLEDGEMENTS

This Proceedings includes contributions from Irene Andrushchenko, Liz Brooks, Dheeraj Busawon, Kirsten Clark, Kristian Curran, Chris Legault, Monica Finley, Michael Martin, Ryan Martin, Loretta O'Brien, and Yanjun Wang. Sincere appreciation is given to the peer reviewers of this meeting Hugues Benoît, Paul Nitschke, and Alexi Sharov. Appreciation is also given to the meeting rapporteurs. Last, all TRAC members are commended for their positive contribution to the meeting's discussion and advice.

## TABLE OF CONTENTS

## ABSTRACT

The Transboundary Resources Assessment Committee (TRAC) met on 12-14 July 2016 in Woods Hole, Massachusetts, United States of America, to review updated stock assessments of Eastern Georges Bank Atlantic Cod and Georges Bank Yellowtail Flounder, as well as an interim update stock assessment of Eastern Georges Bank Haddock. A post-meeting webinar was held on 4 August 2016 to discuss 'Other Items' on the agenda that were not addressed at the July meeting. Results of the stock assessments will be used by the Transboundary Management Guidance Committee (TMGC) in developing management guidance for the 2017 fishing year for these three transboundary resources.

## RÉSUMÉ

## INTRODUCTION

The Transboundary Resources Assessment Committee (TRAC) co-chairs, Liz Brooks and Kristian Curran, welcomed participants (Appendix 1) to the 12-14 July 2016 TRAC stock assessment of Eastern Georges Bank (EGB) Atlantic Cod (*Gadus morhua*) and Georges Bank (GB) Yellowtail Flounder (*Limanda ferruginea)*, as well as the interim update stock assessment of EGB Haddock (*Melanogrammus aeglefinus*). The TRAC was established in 1998 to undertake joint Canada/United States of America (U.S.) assessments of resources on Georges Bank. Cod, Haddock and Yellowtail Flounder were the first species to be assessed by the TRAC, followed by Atlantic Herring (*Clupea harengus)*, Spiny Dogfish (*Squalus acanthias)* and Atlantic Mackerel (*Scomber scombrus)*. The 2016 TRAC Terms of Reference (ToR) were approved by the Canada/U.S. Steering Committee, Canada/U.S. Transboundary Management Guidance Committee (TMGC), U.S. Northeast Regional Coordinating Council, and Canadian Gulf of Maine Advisory Committee.

Meeting participants were reminded that the TRAC review process is two-tiered, with stock assessments undertaken between more intensive stock benchmark reviews. A new benchmark for GB Yellowtail Flounder was established in 2014; a benchmark for EGB Cod was established in 2013; and a benchmark for EGB Haddock was established in 1998. Assessments are conducted annually for these three species. In 2015, however, members of the Canada/U.S. Steering Committee and Canada/U.S. Transboundary Management Guidance Committee (TMGC) supported pursuit of an interim update stock assessment for EGB Haddock in 2016. Provided that the stock projections are deemed to be optimistic by TRAC, an alternating stock assessment and stock interim update stock assessment is to be pursued for this species, as agreed upon at the preceding TRAC science assessment meeting. The ToR and Agenda for the 2016 meeting are provided in Appendix 2 and Appendix 3, respectively. Due to concern raised by U.S. steering committee members regarding the stock assessment benchmark formulation for EGB Cod, an empirical approach was included in the 2016 ToR, in order to assist in providing additional guidance regarding the status of this stock in support of informed catch advice.

The co-chairs briefly reviewed the roles and responsibilities of meeting participants and provided guidance on how ‘agreement’ would be achieved in support of any decisions that would be made. During the meeting, each working paper was presented by one of the science authors, followed by a plenary discussion of that paper. A post-meeting webinar was also hosted on 4 August 2016 to discuss ‘Other Items’ on the agenda that were not addressed at the July meeting due to time constraints. A List of Participants and Agenda for the webinar are provided in Appendix 4 and Appendix 5, respectively. This proceedings provides a record of discussion of the science assessment meeting and post-meeting webinar. Three peer reviewers were invited to participate in the review of the assessments: Paul Nitschke (U.S.), Alexei Sharov (U.S.), and Hugues Benoît (Canada). The 2017 TRAC assessment meeting will be held in St. Andrew’s, New Brunswick, Canada.

## EASTERN GEORGES BANK COD AND HADDOCK, AND GEORGES BANK YELLOWTAIL FLOUNDER ASSESSMENTS

### TRAC Presentation: Allocation Shares

| | |
|---|---|
| Working Paper: | Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Altantic Cod, Haddock and Yellowtail Flounder on Georges Bank Through Fishing Year 2017 |
| Science Lead (Working Paper): | D. Busawon & E.N. Brooks |
| Presenter: | D. Busawon |
| Rapporteurs: | E.N. Brooks, K. Curran & M. Palmer |

*Presentation Highlights*

Development of consistent management by Canada and the U.S. for the transboundary resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank led to a sharing allocation agreement. For Atlantic Cod and Haddock, the agreement is limited to the eastern Georges Bank management unit (Fisheries and Oceans Canada (DFO) Statistical Unit Areas 5Zj and 5Zm; United States of America (USA) Statistical Areas 551, 552, 561 and 562). The management unit for Yellowtail Flounder encompasses the entire Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; USA Statistical Areas 522, 525, 551, 552, 561 and 562). Two principles are incorporated into the sharing formulae to account for both historical utilization (based on reported landings from 1967 to 1994) and spatial-temporal changes in resource distributions (determined from U.S. National Marine Fisheries Service (NMFS) and DFO survey results that are updated annually).

From 2010 onward, utilization is to account for 10% and distribution for 90% of the allocation. This working paper used the 2015 NMFS and DFO survey results to update the calculation for the 2017 fishing year allocations. The resource distributions in 2015 were: 18% U.S. and 82% Canada for Atlantic Cod; 61% U.S. and 39% Canada for Haddock; and 66% U.S. and 34% Canada for Yellowtail Flounder. The 2017 fishing year allocations (calendar year for Canada; May 1, 2017, to April 30, 2018, for the U.S.), updated with the revised 2015 resource distributions, resulted in shares for Atlantic Cod of 20% U.S. and 80% Canada, for Haddock of 59% U.S. and 41% Canada, and for Yellowtail Flounder of 69% U.S. and 31% Canada. In 2017, TRAC will assess any impact of the delay in start of the 2016 NMFS spring survey on the biomass distribution of the three species. Analyses could include standard comparisons of the current biomass distribution relative to historical distributions, as well as trends in common spatial statistics (e.g. weighted mean location of the population with variance).

*Discussion*

There was considerable discussion regarding the timing of the 2016 NMFS spring survey, which was delayed by about a month. There was interest in characterizing whether the delay in survey timing could influence the observed distribution of species (in turn, impacting the allocation shares calculation) at the 2017 TRAC assessment meeting, and it is desired to know if the impact can be detected before next year's TRAC meeting. In addition, it was requested that more narrative be added to the working paper which described how analyses prior to the 2017 assessment might evaluate the delayed spring survey in context of the three species (Cod in particular) and it was suggested that preliminary analyses could be discussed, pursued, and presented to TMGC at an intercessional webinar prior to the 2017 assessment meeting. Additional text on this topic was added to the working paper following discussion with TRAC members.

Main points of clarification were related to how the three surveys were being used and how missing strata are filled. It was noted that for Haddock and Yellowtail Flounder, each survey is weighted equally in the allocation shares algorithm and that catchability is assumed to be equal on both sides of the Hague Line. For Cod, however, the DFO and the NMFS spring surveys in each year are averaged to characterize the distribution during the winter-spring period. This result is averaged with the NMFS fall survey distribution percentage, thereby giving equal weight to the winter-spring and summer- fall periods. It was further noted that there has not been a need to fill any gaps in strata in the last decade or so, but when required, adjacent strata or adjacent years have been used in the past. Another point of discussion was to clarify why several years changed in the allocation shares table. It was noted that the analyst changed between 2015 and 2016, so the code was re-run, resulting in several cases where the NMFS survey data for a given stratum-season-year differed by one tow. A meeting participant noted that changes in tow inclusion could have resulted in some changes in the distribution (NMFS spring 2013 totals change in swept area biomass of approximately 20,000 mt). No information was available at the meeting to explain why the tows differed between the run performed in 2015 and the run performed this year. It was requested by TRAC that this be explored further prior to the 2017 assessment given the potential impact of the single tow.

*Working Paper Revisions*

Proposed revisions to the working paper included: 1) for clarity, describe the three surveys used in the allocation shares analyses within the first sentence of the 'Resource Distribution' section of the manuscript (e.g., DFO Winter [February 2015], NMFS Spring [April 2015], and NMFS Fall [October 2015]); 2) add a sentence to the Abstract that identifies a need to explore and report to TMGC on any impacts of the delayed survey prior to the July 2017 assessment meeting; and 3) add a sentence to the manuscript that identifies factors to be considered in next year's allocation shares analyses for the three species; particularly, as it may relate to Cod.

**TRAC Presentation: Georges Bank Yellowtail Flounder Assessment**

| | |
|---|---|
| Working Paper: | Stock Assessment of Georges Bank Yellowtail Flounder for 2016 |
| Science Lead: | C. Legault & D. Busawon |
| Presenter: | C. Legault |
| Rapporteurs: | E.N. Brooks, K. Curran & M. Palmer |

*Presentation Highlights*

The GB Yellowtail Flounder *(Limanda ferruginea)* stock is a transboundary resource in Canadian and U.S. jurisdictions. The working paper updated the last stock assessment of Yellowtail Flounder on Georges Bank, which was completed by Canada and the U.S. in 2015. The assessment takes into account advice from the 2014 Diagnostic and Empirical Approach Benchmark (hereafter 2014 Diagnostic Benchmark). During the Benchmark, it was decided to abandon the Virtual Population Analysis (VPA) model, which had previously provided stock condition and catch advice. This assessment followed that decision and did not provide any stock assessment model results. The combined Canada/U.S. Yellowtail Flounder catch in 2015 was 118 mt, with neither country filling its portion of the quota. This is the lowest catch in the time series, which began in 1935.

Despite the low catch, the mean of the three bottom trawl surveys declined, and the stock is at low abundance according to all three surveys, with no indication of incoming recruitment from any of the surveys. In 2015, landings were greater than discards, compared to 2014 when discards were greater than landings. In general, there has been a large decrease in relative fishing mortality (F) since 1995, which is coupled with a large total mortality (Z) observed since 1995. Unfortunately the stock is even lower than levels when it was previously declared as ‘collapsed’, despite continued large reductions in catch over recent years. In 2017, catch advice of 31 mt to 245 mt is recommended, using a constant exploitation rate of 2% to 16%.

*Discussion*

Response of the population model indicates that some parameter is changing through time (e.g., survey catchability (q) or natural mortality (M) have changed through time, but are not accounted for in the model). This suggests that the proportionality between the stock and survey is not constant through time; further, this proportionality is not accounted for in the Empirical Approach, which could lead to further unknowns in the catch advice. The science lead noted that catch estimates might also be biased, leading to further error. In general, while relative exploitation rates are low, Z appears to be high. This observation points to several possible explanations: 1) increases in M over time; 2) changes in q over time; or 3) catches have been higher than reported. To limit the possible influence of potential changes in the parameters, the current Empirical Approach only examines data from surveys in 2010 and onward.

It was suggested that an alternate method to calculate total Z, based on the approach of Sinclair (2001), which is a moving window approach that uses cohort as a factor and age as a covariate, could be pursued. This approach means that Z estimates are less influenced by terminal years in cohorts. A participant cautioned that Sinclair (2001) examined Northern cod, noting that similar work has not been conducted on Georges Bank. As such, the results of Sinclair (2001) may not be applicable to GB Yellowtail Flounder. The science lead was unfamiliar with the approach of Sinclair (2001), but did not expect it would change the outcome of the assessment in any significant manner. The science lead did indicate, however, that he would review this approach for possible inclusion in future stock assessments.

It was asked if other approaches could be adopted to get a better sense of what the stock is doing (e.g., another data source). In particular, where did the VPA model leave off and what are the next steps for reviving the model? The science lead noted that use of the VPA model was explored, but the amount of change needed to fix the diagnostics was not believed to be plausible (3-5x change in reported catches or M needed to fix the retrospective). A reviewer noted that based on experience in the Southern Gulf of St. Lawrence, where changes in M have approached 3-5x, his inclination would be to pursue a change in M. The reviewer subsequently asked how long an Empirical Approach would be used to assess the stock and the science lead replied that pursuit of a model-based assessment approach would not be entirely useful until there is a positive response of the stock to lower quotas.

There was a lot of discussion as to reasons why industry is not catching its yellowtail quota, and it was clarified that this is the result of active avoidance, no direct targeting, gear restrictions, area closures, and financial disincentives (e.g., low price relative to cost of leasing quota); all of which contribute to the quota not being caught. It was noted that regardless of the reason for low catches, the survey trends continue to decline. This led to a discussion that the stock does not appear to be responding to the low catches. The lead scientist noted that TRAC has discussed holding quota constant to see if any response is realized, rather than adjusting annual quotas up or down by a couple hundred tonnes per year. A participant noted that it would not take a very large year- class to have a significant impact on bycatch fisheries, and it was suggested that TRAC should start considering how to address a large year-class in the fishery before it is observed in the survey.

Discard mortality was discussed. It was noted that discard mortality is assumed to be 100%, which is based on a field study completed by Barkley and Cadrin (2012) that used RAMP analysis. The study found at least 90% discard mortality, so the assessment assumes 100% mortality as a conservative strategy. This was followed by discussion of survey catchability. Clarification was sought as to whether q=0.37 (adopted from the literature) assumed in the Empirical Approach factors in changes in size. The science lead responded that q is only incorporated in terms of biomass, although examining the length frequency between years demonstrated that the range of lengths observed has not changed, rather the absolute numbers observed have just gotten smaller and smaller. A participant noted that the NMFS survey gear is able to

catch much larger flatfishes than yellowtail. It was further noted that if growth has changed than the biomass available to the survey also may have changed, but there is no indication of this in the length frequencies of the survey catches. Further, there was a question regarding condition factor: is it improving or is it simply noise? The science lead noted that there is a recent upward move in the data, although condition still remains below historical observations.

There was a discussion as to whether the surveys were missing yellowtail aggregations (e.g., the Yellowtail Hole) and if yellowtail habitat was changing in response to changing water temperature. A participant with knowledge of the Canadian fishing industry noted that they cannot determine if an aggregate of yellowtail resides in the Yellowtail Hole, as they are not allowed to use gear that will catch yellowtail in this area (Canadian scallop draggers also do not frequent the area). The science lead noted that the two 'high fliers' observed in the DFO survey in 2008 and 2009 were not in the Yellowtail Hole. It was also noted that yellowtail are often observed in the southeast corner of Closed Area 2, and a question was asked as to whether they are still being seen there. An industry representative mentioned that there is a scallop bycatch survey that could be reviewed to address this question; however, there is no scallop fishing in that region now and most of the groundfish industry is not fishing out there either. A scientist involved in earlier bycatch survey work noted that bycatch rates in Closed Area 2 appeared to be seasonal, low in spring, and increase in July-September, although no explanation for the perceived pattern was offered. It was mentioned that there was a habitat camera (habcam) survey across Georges Bank in 2010-2011, and the waters were so warm that it may have precluded yellowtail habitat (processors were also receiving poorly- conditioned fish). There may be a relationship between usable habitat and bottom temperature.

There was a question about the bubble plots; specifically, focusing on the period of low recruitment, which is concurrent with low relative exploitation – is this a collapse or natural variability? The science lead noted that the proportion-at-age bubble plots are forced to sum up to unity (1) in a given year, so looking at bubble size for ages 6+, it is difficult for someone to interpret it as an 'increase'. In short, neither country is filling its quota and there is a lot of reasons for this, but despite these low catches the surveys continue to decline and this is problematic.

*Summary of Homework*

At the request of one of the reviewers, the science lead examined the possible density dependence between condition and stock abundance. Comparing survey biomass with the respective measure of survey condition, it was found that the NMFS spring correlation was -0.004, NMFS fall correlation 0.111, and DFO correlation -0.056 for males and -0.027 for females (when dropping the two 'high fliers' the correlation was
0.183 for males and 0.097 for females). In conclusion, there is no relationship or evidence of density dependence. A reviewer followed up by asking if the science lead thought the same would be true for abundance instead of biomass. The science lead responded that he would expect the same trend.

Regarding the previous day's homework for all TRAC participants to think about 2016 catch advice for yellowtail, there was concern expressed by a participant that if quota remained low, and the stock begins to increase, then it could become a choke stock given there would be the potential to quickly reach quota. Furthermore, concern was expressed that recruitment is not being observed given that the "sized fish" are not being efficiently sampled. It was pointed out, however, that if a recruitment pulse does not come in and high quotas and F continue to remove fish from a declining population stock abundance could be further compromised. Another individual commented that there were only three or four boats in New Bedford (a port in Massachusetts) that could target yellowtail, expressing concern that the low quota could close down other groundfish fisheries, as well as impact the scallop fishery. The co-chairs both acknowledged and were compassionate to this point, but noted TRAC's mandate is to provide catch advice using the best available science (and not with potential impacts to industry in mind).

There was a question related to Table 14 in the working paper, inquiring if there is any explanation for the apparent increase in the most recent DFO survey? The analyst replied that the surveys do not always line up exactly, but that the 2016 DFO value was the 8$^{th}$ lowest in the time series. The other low survey observations occurred in the 1990s; at that time, quotas were in the thousands of tonnes and the stock rebounded, although now the stock does not appear to be responding, so something different appears to be occurring. This prompted further discussion as to whether it makes sense to focus on F if it is not an important factor that is limiting the population. The reviewers responded that theory suggests if fishing is occurring at a sustainable level (i.e., near optimal F) then the stock might fluctuate but the long term average would also be near optimal. Furthermore, under a traditional stock assessment model, F competes with M for fish, so if M is high it might be assumed that catching the fish is the better option; however, this relationship could be perturbed if M increases depending on some other functional response, such as changing predator-prey dynamics, which could further increase M and hence the impact of F on the stock.

*Working Paper Revisions*

Proposed revisions to the working paper included: 1) add catch advice to text of the manuscript where Table 14 is noted, as catch advice values are only presented in the abstract and not in Table 14; and 2) add some text that provides greater context to the management history of the fishery.

**TRAC Presentation: Yellowtail Flounder Survey Catchability (Preliminary Results)**

| | |
|---|---|
| Presentation: | Rockhopper/Chain Sweep Relative Catch Efficiency Analysis |
| Science Lead (Working Paper): | M. Martin |
| Presenter: | M. Martin |
| Rapporteurs: | E.N. Brooks, K. Curran & J. Deroba |

*Presentation Highlights*

Preliminary results from a rockhopper/chain sweep relative catch efficiency study were presented. The study was motivated by an interest among both NEFSC assessment scientists and stakeholders to better understand the catch efficiency of the standard Bottom Trawl Survey (BTS) fishing gear, in hopes that the knowledge could serve to improve stock assessments. In particular, the goal was to estimate catch efficiency for standard BTS rockhopper sweep for several flatfish species, including yellowtail. Preliminary results suggested that alternative q values could be considered for incorporation into the TRAC yellowtail assessment, which might more adequately characterize the catchability of the survey gear compared to the q=0.37 presently used in the yellowtail assessment that was adopted from the primary literature. It was felt, however, that due to the timing of the presentation and preliminary nature of the findings, a revised q could not be considered in the 2016 assessment.

*Discussion*

The mechanism of improved efficiency was discussed. It was noted that the study gear was designed to mimimize the escape of flatfish under the trawl by digging the gear into the bottom sediment (i.e., in an almost dredge like manner). The potential for herding effects were then discussed. The science lead noted that preliminary results suggested that no herding effects at any speed could be expected. A reviewer asked if the Bigelow survey exhibits more herding than the survey vessel used in the study and the science lead noted that the experiment was not designed to test this comparison, although the same sampling protocols were used. It was further noted that the chain sweep is much more efficient than a cookie sweep for flatfish. These studies are valuable because they provide a sense of what q could be, akin to an upper bound, which allows for ground-truthing of estimates that come out of the models. Last, day and night differences in the results were noted, although the Bigelow also does day and night tows that often yield different catch rates/efficiencies. Day/night trends are not presently being considered in the stock assessment models, but do not differ in trend.

There was a discussion on whether ‘wing spread’ versus ‘door spread’ should be used in the yellowtail assessment. The science assessment lead noted that door spread is presently used for assessment purposes, although somewhere in between door spread and wing spread is likely best (albeit closer to wing spread). Unfortunately, the work completed to date on this has been inconclusive. The science assessment lead indicated that empirical calculations by door spread and wing spread could be pursued

to evaluate scale differences. It was noted that Canada has done some paired tows comparing the catch of the US trawl and the Western IIa trawl from the same locations. The Western IIa caught fewer small (<20cm) yellowtail. It was noted that if the Western IIa is not efficient at catching small sizes, it may be less precise at estimating age 1 abundance. A science lead asked how efficient industry is at catching small yellowtail, as this can also be an input into the various stock assessment tools. A member of the Canadian industry noted that aside from scallop dredge, yellowtail has not been targeted in several years.

In terms of a revised q for yellowtail, preliminary results suggest that a q of about 0.28 (albeit 'eyeballed' during the discussion), assuming door spread, might be considered for use in future yellowtail assessments. It was cautioned, however, that using a lower q would only increase absolute biomass, which would not change the overall declining trend in biomass of yellowtail.

*Working Paper Revisions*

No working paper was prepared for this presentation.

**TRAC Presentation: Eastern Georges Bank Cod Assessment (Indicators and Projection Performance)**

| | |
|---|---|
| Working Paper & Addendum: | Biological and Fishery Indicators for Eastern Georges Bank Cod and Projection Performance of VPA and ASAP Cod Assessment Models |
| Science Lead (Working Paper): | E.N. Brooks, I. Andrushchenko, Y. Wang, L. O'Brien & K. Clark |
| Presenters: | E.N. Brooks & K. Clark |
| Rapporteurs: | E.N. Brooks, K. Curran & B. Linton |

*Presentation Highlights*

A suite of analyses of biological and fishery indicators were presented to examine indicators that provide information on cod status, population, and fishery trends. Results suggest that: 1) rebuilding has not occurred; 2) recruitment is poor; 3) age diversity has declined; 4) mean length has fluctuated around the average, although the maximum length of cod on eastern GB has declined, on average about 50 cm from early to late in the time series; 5) median maturity at age has fluctuated over the time series and is currently around age 2; 6) juvenile growth has been variable and declining, but shows an increase in recent years; 7) condition factor (K) has shown a consistent decline until about 2009 when K started to increase in all three surveys; 8) cod on eastern GB seem to prefer to stay within a narrow depth range on average even though temperature changes occur within that depth range; and 9) total mortality (Z) from catch curves indicates high total mortality for the entire time period, while relative fishing mortality (F) has shown a substantial decline since the early time period.

Quota and projection performance were then reviewed. If the current assessment models are correct (either VPA or ASAP), then quota advice in the past has been too high, likely inhibiting rebuilding (along with other biological factors). Looking at projection performance since the 2013 benchmark, both models (VPA and ASAP) have a tendency to overestimate projected SSB. Depending on whether it is assumed that the current year's assessment is less biased, or that the initial estimates of year class strength based on survey indices were closer to the truth than the converged estimates in the most recent assessment, then either the catch advice was over-estimated or the mortality resulting from something other than reported catch was under-estimated. Projection performance for the VPA M0.8 and the ASAP M0.2 models since the benchmark meeting in 2013 were also discussed, including a comparison of projection assumptions against subsequent assessment results.

In terms of VPA M0.8, since the 2013 benchmark the inputs for fishery and beginning of year weights-at-age in the VPA M0.8 projections have been similar or lower to the actual weights at age, leading to a more conservative projection of biomass. The recruitment value used in the 2013 VPA M0.8 projection was larger than the estimated population numbers at age 1 from subsequent assessments, meaning that this year class would have been over-estimated in the initial projection. The recruitment values used in the 2014 and 2015 projections were smaller than the estimated population numbers that subsequently came out of the 2015 and 2016 assessments, which would mean that these year classes would have been under-estimated in the initial projections. In general the partial recruitment (PR) at older ages was over-estimated in the VPA M 0.8 projections leading to an impression that there were more fish available to be caught than was actually the case.

*Discussion*

Indicators

There were several questions regarding the analyses of indicators. It was noted that two different approaches appeared to compare modeled results to survey results in the cod indicators and cod assessment working papers, and it was clarified that in the indicators working paper recruitment was being analyzed. It was asked if Bigelow-based conversions were accounted for in the analyses and it was confirmed that they had been. In terms of Fulton's K, it was noted that this can change if the denominator changes, so it was suggested that K be estimated in smaller blocks or using predicted weight, as an example, and it was confirmed that this would be reviewed. A reviewer suggested estimating Fulton's K in length blocks not using Fulton's K, rather using other condition factor metrics such as relative K to estimate condition. Similarly, it was noted that the maturity plots had different axes labels and that these should be consistent. It was also recommended that consistent terminology (e.g., strong versus noticeable) be used throughout all working papers.

It was noted that the survey seemed to under-sample large fish relative to maximum lengths that are caught in the fishery. However, the survey also suggests a general decrease in maximum length through time regardless of differences in absolute largest fish caught in the survey versus the fishery. Based on this, it was asked if a fishery trend can be evaluated and the science assessment team indicated that this could be explored further. It was further suggested that older fish might move to the edges of Georges Bank and not be caught by the NMFS Fall survey, resulting in the age-length keys from the survey not being representative of the maximum-sized fish being observed in the fishery. A reviewer noted, however, that when limitations are placed on the fishery it causes them to change their behavior and perhaps result in changes in maximum lengths of the fish being caught. Another reviewer noted that when survey vessels change comparative tows are performed to account for changes in the maximum fish caught between survey vessels.

A participant asked about absolute depletion and how the first five years were selected – calculation goes back to 1968. It was noted that depletion is sensitive to what five years you choose (and which data you include or not include in the virgin biomass estimate), with the science lead responding that the point of depletion has increased from the late-1960s/early-1970s to present. Last, it was asked if genetics research on change in growth of EGB Cod has been completed, suggesting that this would be valuable work to pursue. It was noted that this research has not been completed, although the science recognized that it could be completed and is worth further consideration.

Projection Performance

The discussion turned to projection performance. It was asked if ASAP assumed M=0.8 and it was clarified that ASAP assumed M=0.2 for all age classes, which explained the difference in scale between the two models. It was then asked if a cut-point was used in ASAP for recruitment and the science lead indicated that it was. It was further explained that the 15,000 mt spawning stock biomass (SSB) cut-point was based on visual inspection of the S-R plot, although there is a distinct difference in recruitment above and below the cut-point. It was clarified that the cut-point was used to prevent the incorporation of recruitments in projections that were higher than have been seen in recent years. It was acknowledged that the cut-point may need to be lowered further. It was suggested that another informative metric to look at might be the recruitment rate (R/SSB), with a need to determine if recruitments used in the projections are auto- correlated. A recent analysis of groundfish projections, however, revealed that bias in the initial numbers at age is the primary source of the differences between projected and estimated SSB.

A reviewer inquired about the weights-at-age of larger fish and how they might affect long-term projections. It was noted that in previous assessments this was addressed, and would require further exploration at any subsequent benchmark meeting (i.e., older fish weights at age). The reviewer then asked if shorter tows have resulted in the loss of large fish in recent survey years and the science lead clarified that length-based

calibration factors try to account for this. However, the NMFS fall survey age diversity plot only went up to aged 6+ fish, with the science lead noting that older fish are not captured in this survey, although they do show up in NMFS spring survey. With this in mind, a reviewer noted that there appeared to be some conflict in the data, with there being evidence of larger fish in the commercial data and no older aged fish showing up in the age-length key. A science lead indicated that this could be explored further as homework pending the availability of data.

A participant inquired about how the quota versus catch analyses was completed. The science lead noted that it was done by taking the 2015 VPA model and hind casting to the proposed quota. It was subsequently asked if the assessment models were re-run using the retrospective quotas from the 'quota versus catch' and the science lead indicated that this was not completed given that the survey indices would not reflect removals based on the plotted catches. The science lead further noted that the real quotas are below the VPA calculated quotas over the past two years, as the real quotas have been based on low risk and the VPA calculated quotas based on neutral risk.

The discussion focused on the catch and F assumptions used in the projections. It was noted that the VPA and ASAP modeled projections both used the same catch in the final assessment year and the same quota in the first year out, although they produced different projected catches in the second year out. It was suggested that projected-F and realized-F could be explored. It was then asked if realized-F versus F-target and realized catch versus quota were explored as potential metrics, where one would expect to see a 1-to-1 relationship. It was noted that this analysis was not used. It was then asked how sensitive the depletion plots were to missing points in the early years and/or the choice of the window size used to establish the starting stock size. The science lead responded that it could be sensitive, but it was a pragmatic decision to start somewhere and, regardless of the choice, the conclusions would remain the same given there has been a marked depletion of the resource.

*Working Paper Revisions*

Proposed revisions to the working paper included: 1) re-evaluate the fishery trend against findings from the survey in terms of maximum length and age, including a quick check of the age length keys to see if fish 90 cm and >90 cm are represented; 2) update the depletion figure to include data back to 1968; 3) explain the quota versus catch figure in more detail, including how the analysis was performed; and 4) use consistent terminology when describing year class strength.

**TRAC Presentation: Eastern Georges Bank Cod Assessment (2016 Assessment)**

| | |
|---|---|
| Working Paper: | Assessment of Eastern Georges Bank Atlantic Cod for 2016 |
| Science Lead (Working Paper): | I. Andrushchenko, L. O'Brien, R. Martin & Y. Wang |
| Presenters: | I. Andrushchenko & L. O'Brien |
| Rapporteurs: | E.N. Brooks, K. Curran & B. Linton |

*Presentation Highlights*

The combined 2015 Canada/USA Atlantic cod catches were 608 mt with a quota of 650 mt. Catches in all three research surveys increased since the 2015 assessment, but were still amongst the lowest in the time series. Both fishery and survey catches showed truncated age structure in recent years. The VPA M 0.8 model from the 2013 benchmark assessment was used to provide catch advice in conjunction with a consequence analysis of the uncertainties in the VPA M 0.8 and ASAP M0.2 model results. In the VPA M 0.8 model, M was assumed to be 0.2, except M=0.8 for ages 6+ since 1994, whereas in the ASAP model M=0.2 for all ages and years. The ASAP M0.2 model increased the CV on catches from 0.05 used in the 2015 formulation to 0.20 in the 2016 formulation to account for uncertainty in the reported catches. While management measures have resulted in a decreased exploitation rate since 1995, total mortality has remained high and adult biomass has fluctuated at a low level. Based on the VPA M0.8 results, the adult population biomass at the beginning of 2016 was estimated at 11,026 mt, which was about 20% of the adult biomass in 1978.

Fishing mortality was high prior to 1994 (0.33 to 0.51), but was estimated to be 0.05 in 2015. Recruitment at age 1 has been low in recent years. High M, lower weights-at-age in the population in recent years, and poor recruitment have contributed to the lack of rebuilding. In 2017, a 50% probability of not exceeding fishing reference point F=0.11 corresponds to catches of 1,319 mt. Due to the expected contribution of the strong 2010 and 2013 year classes, a catch of 1,319 mt is expected to result in a <25% chance of seeing a decrease in adult biomass from 2017 to 2018. In 2018, a catch of 1,483 mt corresponds to a 50% probability of not exceeding F=0.11 and a <25% probability that 2019 age 3+ biomass will be lower than 2018. However, given the extremely low SSB, the TRAC advises that management aim to rebuild SSB. It was noted that the age- length key from the DFO survey was used to convert NMFS spring survey lengths into catches-at-age. This will be updated once the NMFS spring survey age-length key is available. It was noted, however, that similarity in the age-length keys was explored, being comparable in 2015 but being slightly different in 2014.

A consequence analysis to understand the risks associated with assumptions of the VPA M 0.8 and ASAP M 0.2 models was examined in the projection and risk analysis. The consequence analysis reflects uncertainties in the assessment model assumptions. Despite model uncertainties, all assessment results indicate that low catches are needed to promote rebuilding.

*Discussion*

Virtual Population Analysis (VPA) M0.8

A reviewer inquired into the history of F=0.11. It was noted that when the 2013 TRAC benchmark meeting was held, and the VPA model with M=0.8 was introduced, it was felt that such a strong increase in M on ages 6+ could not support maintaining the same reference point as when M=0.2 on all ages. There was also no success in fitting a stock recruit curve to derive $F_{MSY}$. The science lead briefly described an alternate analysis that led to proposing that F=0.11 was more appropriate for use in the VPA M0.8. In addition, over the last decade or so PR in VPA M0.8 was estimated to be domed- shaped, yet the F reference points were calculated based on assuming a flat-topped PR. A reviewer asked how Fref would change if a domed PR was incorporated into the model and the science lead responded that using a flat PR would not be considered as being precautionary. Another reviewer inquired as to what the rationale was for changing M in those years (i.e., from M=0.2 to M=0.8). The science lead responded that it was the year when the residuals diverged the most.

Regarding the ages, the science lead evaluated the different age groups to be estimated and found that the best residual pattern to survey data was when ages 6+ had an increase in M. The reviewer noted that Figure 28 in the working paper still had year-block effects in the residuals, which is what happens when there is non-stationarity in a scaling parameter. It then was asked how dome-shaped F averaging compares to F=0.11, as well as what the appropriate metric would be to compare these. A participant suggested focusing on an average of F ages that are fully selected. A science lead indicated that the Harvest Control Rule (HCR) for all three stocks suggests that F should be reduced when conditions are poor, inquiring if guidance has been provided on this in the past. A TMGC representative indicated that this has not been interpreted in detail, rather considered biomass in context of F and risk level. It was acknowledged that there is a need to revisit this point for further consideration.

A participant noted that a significant percentage of the catch appeared to be part of the 2011 year class, suggesting that it would be interesting to track this in terms of stock structure (appears to be a correlation with NAFO 4X). A reviewer suggested that it would be good to explore a trend in effort versus a trend in catch, in order to better assess the overall impact of the fishery on the stock itself. A science lead indicated that no information is available on fishing effort from the Canadian side of Georges Bank. In response the reviewer suggested that knowing the scale of fishing (e.g., number of boats) over the years, and how this has changed, would still be helpful. A science lead noted that this is an easy question to ask, but is difficult to answer. The reviewer responded that even first order indicators of fishing effort would provide a start. Another science lead indicated that these indicators were explored in 2013, but deemed not acceptable for peer review. Representatives of industry indicated that both in Canada and in the U.S. the fishing effort for cod on Georges Bank is low relative to what it used to be.

A participant asked about the swept area biomass estimates, inquiring as to why in a number of years the DFO survey biomass estimate is greater than the VPA estimate. A science lead noted that survey q needs to be considered, as does the variation of survey. This trend, however, appears 6-years in a row in the DFO survey, suggesting that it is something more than just a modeled artefact.

Age Structured Assessment Program (ASAP) M0.2

The summary of findings, with a CV=0.2 on catches, indicated that fishing-mortality (unweighted, ages 5+) in 2015 was estimated to be about 0.39, SSB in 2015 was estimated at 1,577 mt, and the 2003, 2010, and 2013 year classes were estimated to be 2.5 million, 1.1 million, and 1.7 million age 1 fish, respectively. A retrospective bias adjustment was not needed. Overall, the findings indicated that productivity of the stock continues to be low, with more than two decades of poor recruitment and continued truncated age structure. The last year class that was above the time series average of 4.6 million fish occurred in 1990 (being 9.6 million fish).

A reviewer inquired as to why ASAP was used as an alternative model to compare with VPA M0.8. It was noted that the ASAP model was accepted in the 2012 assessment of Georges Bank cod. For the 2013 TRAC benchmark, the ASAP M0.2 and VPA M0.8 were both brought forward as potential model options for stock assessment purposes; the ASAP model being proposed for EGB Cod given it was being used to assess Georges Bank. It was decided at the 2013 TRAC benchmark that the VPA M0.8 would be used to provide catch advice, but that a consequence analysis would be included in the TRAC Status Report. It was acknowledged that there is a third Empirical Approach method to be considered at 2016 TRAC assessment meeting, with hopes that differences between the three assessment approaches could be resolved at a benchmark meeting yet to be planned for the short- to medium-term.

The discussion focused on M. A reviewer asked what might be driving M and a science lead indicated that seals may be the driver. However, the science lead further noted that during the Georges Bank cod benchmark meeting the marine mammal group did not have data to support increased predation by seals as a cause. The reviewer responded that lots of misinformation in seal diets and length composition exists and that he would be reluctant to take the studies of sampling at face value given they do not reflect pelagic feeding (they mostly reflect coastal feeding); fatty acid studies have also been put into question. The published research on seal predation has been called into question recently. Therefore, one should be careful bout drawing conclusions from any of those studies.

A reviewer asked if over-reporting is to be expected and the science lead noted that reporting is a difficult picture to reconstruct. It was asked if under-reported catch was integrated into the ASAP model and the science lead indicated that it was in so far as the increase in uncertainty on the catches with a CV=0.2. The Palmer and Wigley (2007) and Palmer and Wigley (2009) method was applied to estimate the U.S. mis- allocated catches during 2008-2015, however, the under-reported catches need more

exploration – missing catch continues to be an issue. It remained unclear why catches remained underestimated in the CV 0.2 model. It was hypothesized that this could be due to interactions between low interview rates (~10%), assignment of area by port agents, and quotas on other species (e.g., haddock) that may have been in effect. An alternative to this explanation is that it may be due to non-stationarity that is not being accounted for in the model. In general, there appeared to be a change point in the mid- 1990s, with underestimation of catch prior to that point and overestimated catch after the point.

It was noted that similar change points in the mid-1990s are apparent in several groundfish assessments. The change point was not always in the middle of the time series, but has remained consistent as new years of data have been added, suggesting that the model is not simply splitting a difference caused by unknown time-varying processes. It was asked if adjusting the catch time series based on the misallocation rates had been explored. The science lead indicated that it had not, as misallocation information for each year is not available. The science lead further noted that the misallocation analysis was done simply to demonstrate that a problem exists and that it would take a great deal more time and effort to reconstruct the catch time series to pursue this analysis in additional detail.

A participant inquired about lobster discard estimates for incidentally-caught cod. The science lead clarified that it was noted as preliminary in the working paper, as it has not been validated enough to include in the assessment at this time; as more trips are observed there will be greater confidence in the number. The participant subsequently asked if discard mortality has been applied to the lobster data and the science lead responded that it had not. Another participant noted that the VPA highlights a 2014 year class as being important, although the ASAP does not show this year class. The science lead indicated that this is likely an artefact of the 2016 surveys being included in the VPA and not in the ASAP.

At the 2015 TRAC, there was a request to run an ASAP sensitivity with M =0.8 for years 1994+ and ages 6+ for the 2016 TRAC. It was noted that in the ASAP sensitivity analysis the selectivity was not allowed to dome as in the VPA M0.8 model and patterns in the residuals suggested there are time-varying processes that are not accounted for (as in the VPA).

*Summary of Homework*

The science lead reported back on lengths, indicating that they are not truncated rather reflect missing ages (there does not appear to be any large fish). A participant noted that three or four years ago this matter was brought up by the fixed gear sector, who were made aware of the importance of having their landings sampled given they catch larger fish. In general, the maximum length caught in the Canadian fishery over time has declined since 2002. A reviewer questioned if larger fish are under-represented in the port sampling and the science lead indicated that the coverage is representative, with representative sub-samples being collected to get representative lengths for aging.

*Working Paper Revisions*

No revisions to the working paper were captured on record.

**TRAC Presentation: Eastern Georges Bank Cod Assessment (Empirical Approach)**

| | |
|---|---|
| Working Paper: | Investigation of an Empirical Approach for Providing Catch Advice for Eastern Georges Bank Cod |
| Science Lead (Working Paper): | E.N. Brooks, I. Andrushchenko, Y. Wang & L. O'Brien |
| Presenter: | E.N. Brooks |
| Rapporteurs: | E.N. Brooks, K. Curran & B. Linton |

*Presentation Highlights*

An empirical method was developed for providing quota advice for EGB Cod. This method adjusts recent quotas by recent population abundance trends. The average of three surveys (DFO spring, NMFS spring, and NMFS fall) is fit by a *loess* smoother and the slope in 3-year intervals is calculated (on a log-scale). The slope is used to adjust recent quotas. Uncertainty is characterized quantitatively by a bootstrap analysis on the fit of the *loess* smoother and qualitatively with a table of secondary indicators. The estimated slope from the most recent three survey years (2014-2016 for DFO and NMFS spring; 2013-2015 for NMFS fall) was applied to the average quota for years 2013-2015 (650 mt) to provide a range of quota advice for 2017.

It is recommended that a threshold for annual increases/decreases in catch advice be considered. A threshold is meant to limit the increase or decrease in annual average quota adjustment. The purpose of a threshold is to maintain some stability in catches and avoid large fluctuations that could be due to a year effect, especially given that only three years are being used to estimate the slope. For consideration, the TRAC proposed 20% as the maximum amount by which catch could increase or decrease between years. This is the same value specified in the control rule for a Management Strategy Evaluation of western component Pollock (DFO, 2011). Overall, the TRAC proposed that low risk quotas are appropriate for the cod resource. Productivity, which includes growth and recruitment, is low, and the stock has shown no signs of rebuilding.

*Discussion*

There was interest in how the *loess* bootstrap was conducted. The science lead clarified that the residuals from the *loess* fit were resampled, although this only accounts for uncertainty from fitting the *loess* (i.e., not from each of the individual indices). The science lead further clarified that one could account for that additional uncertainty by bootstrapping each of the survey indices and recalculating the average index and then fitting the *loess*. The science lead clarified that the Empirical Approach is still tied to the

assessment models, due to the recent quotas, to which the relative exploitation rates are applied (coming more or less from the VPA).

There was significant discussion regarding the proposed 20% threshold (or cap). A participant noted that a 20% cap for pollock is not necessarily applicable to EGB Cod and that simulations would have to be pursued to get a better proposed cap. The science lead indicated that under the current stock level the cap is unlikely to be triggered. The participant noted that a cap in general may not be needed given there are three surveys per year. In contrast, the participant felt that justifying a 20% cap based on the Empirical Approach tables would be more appropriate as a basis for a cap than, for example, using a cap for pollock. Another participant felt that the cap discussion was too brief, requiring more justification as to how 20% was determined. It was emphasized that the cap is an important aspect of the working paper, so this required additional information. The science lead acknowledged that the cap was not a well-detailed discussion, but cautioned that projecting too far out from models would not be advisable. Overall, it was felt that the cap idea required greater justification before it could be accepted; particularly, additional details should be included regarding the potential implications of incorporating a cap (e.g., what would this mean for Georges Bank cod, which does not have a cap).

A participant questioned why the Empirical Approach was based on quota and not catch. The science lead responded that TRAC had significant discussion on this topic, and that due to uncertainty in catch (e.g., effort), it was felt that quota was something that could be characterized with greater certainty. A participant noted that on the Canadian side there is a specific reason to base Empirical Approach catch advice on quota rather than catch. That is, the longliners hold a large portion of the Canadian quota, but do not use it because it is not economical for them to do so. If advice is based on catch than you might see a sequential ratcheting down of the quota over time, which would be due to economic rather than biological reasons. In general, TRAC's mandate is to evaluate fish stocks and not fishery effort; thus, quota and not catch is more consistent with this mandate.

A participant inquired if CV as a weighting approach with respect to zeroed values was considered. The science lead indicated that this was not considered, as the stock has not shown any signs of rebuilding. If there was a benchmark, and the Empirical Approach was the adopted approach, a lot of additional analysis would have to be pursued before it could be adopted with comfort. A science lead indicated that Figure 20 in the working paper did show the CVs over time, suggesting that there is no immediate concern regarding zeroes. It was then asked if the effects of inverse CV weighting on a rebuilding stock were considered (i.e., would it slow the increase of catch as the stock rebuilds?). It was noted that this would not affect advice coming out of the meeting given that the stock is not rebuilding. Perhaps, using the two-stage bootstrapping approach might help in such a situation, which is something that could be explored moving forward. Last, it was suggested that it might be helpful to tie the qualitative secondary indicators of the Empirical Approach to the HCR.

*Working Paper Revisions*

No revisions to the working paper were captured on record.

**TRAC Presentation: Eastern Georges Bank Cod Assessment (Comparison of VPA, ASAP and Empirical Approach Applications)**

| | |
|---|---|
| Working Paper: | A comparison of VPA, ASAP and Empirical Approach Applications to Eastern Georges Bank Cod |
| Science Lead (Working Paper): | Y. Wang |
| Presenter: | Y. Wang |
| Rapporteurs: | E.N. Brooks, K. Curran & J. Deroba |

*Presentation Highlights*

The 2016 catch advice from the VPA M0.8 model provided at the 2015 TRAC assessment meeting differed significantly from the advice provided by the ASAP model (used as a consequence analysis for EGB Cod by the TRAC and to assess cod for the entire Georges Bank by the USA). The TMGC expressed concern about significant management impacts for both countries from the divergent catch advice and the potential risk that this posed for cooperative management. There was a request from U.S. members to resolve the conflict between the international process and domestic process. The ToR for the 2016 TRAC cod assessment requested updating the 2013 benchmark VPA and ASAP models, the consequence analysis table, developing and applying an empirical approach, and reporting on any factors and risks that should be considered in interpreting the catch advice provided.

The aim of the comparative analysis is to promote a better understanding of the three approaches: VPA M 0.8 model, ASAP M 0.2 model, and an Empirical Approach, and to facilitate discussion on the 2017 catch advice. The difference among these three approaches should be kept in mind when discussing catch advice to ensure that advice is based on “best available science”. The role of TRAC is to provide the scientific basis for catch levels corresponding to risk and to provide guidance to fisheries management; it is not meant to be a decision maker. Research with some simulations would help quantify the risks of the uncertainty about M and the implications of managing under the assumption of the wrong M. It might even lead to TMGC choosing a model for management purposes, even if there is uncertainty about the M assumption.

*Discussion*

A reviewer felt that the assumptions in the models were not discussed in detail and should be considered further in a revised working paper. Another reviewer sought clarity on older fish being “let go”, as understanding the cause of unknowns of large fish would help inform modeled outputs. The science lead noted that the next benchmark meeting would have to look into the missing catch values (it was noted that it would be helpful to

see a working paper on missing catch values, in order to better understand the impact of this on the models). In general, the reviewers noted that both models were of concern. For VPA, residual patterns and the *ad hoc* nature in which the model has been changed is of concern and needs to be resolved. The ASAP model is of similar concern. Last, the Empirical Approach appeared to be a conservative approach over the short- term, but is not a viable option to provide catch advice over the long-term. More detailed thoughts from reviewers on the three approaches are provided below.

*Working Paper Revisions*

No revisions to the working paper were captured on record.

**TRAC Presentation: Eastern Georges Bank Haddock Assessment (Interim Update)**

| | |
|---|---|
| Working Paper: | Eastern Georges Bank Haddock Update 2016 |
| Science Lead (Working Paper): | D. Busawon & E.N. Brooks |
| Presenter: | D. Busawon |
| Rapporteurs: | E.N. Brooks, K. Curran & J. Deroba |

*Presentation Highlights*

Eastern Georges Bank Haddock has been showing positive signs over the past several years: five strong year classes in the last 13 years; expanded age structure; broad spatial distribution; and adult biomass at the beginning of 2015 is estimated to be the second highest in the time series. Given these positive signs, it was proposed that the assessments be moved to a two year stock assessment cycle on a trial basis (an alternating full stock assessment followed by an interim update stock assessment). In 2016, TRAC was tasked with preparing an update status report for haddock, guided by projections made in the 2015 assessment. The intent is to examine indicators of stock status (fishery and survey) and to determine if catch advice from the 2015 stock assessment is still appropriate. Indicators and catch advice from the 2015 assessment were subsequently reviewed for consideration of the 2016 catch advice.

*Discussion*

There was no significant discussion given the status report would be reviewed at a later point in the meeting.

*Working Paper Revisions*

No working paper was presented, with the status report to be reviewed at a later point in the meeting.

## REVIEW OF TRAC STATUS REPORTS

Rapporteurs: E.N. Brooks, K. Curran & T. Chute

*Discussion of Georges Bank Yellowtail Flounder*

The discussion primarily focused on two aspects of the advice: 1) survey catchability; and 2) basis for catch advice. As noted in the yellowtail assessment, the survey catchability of q=0.37 used in the assessment requires revisiting. Results of preliminary research suggested that q is perhaps lower than presently assumed in the assessment. As TRAC consider q in the context of catch advice for 2016, some participants questioned whether a lower q should be used this year. Further, it was noted that a review of q for yellowtail has been in the meeting ToR for the past two years, although no significant analyses has been explored on this topic for peer review. Given that the results of survey catchability presented at the meeting were preliminary, it was generally agreed that maintaining a q=0.37 for purposes of the 2016 assessment seemed reasonable, with an expectation that TRAC will make progress on exploring and agreeing upon a potentially-revised q for application to the 2017 yellowtail assessment.

There was discussion on three potential options for catch advice: 1) maintain 2016 quota of 354 mt; 2) maintain a constant exploitation rate of 2% to 16%; and 3) apply mean relative exploitation. It was agreed that the mean relative exploitation approach (option 3) was not worth pursuing, with the debate focusing on whether a constant quota approach (option 1) should be removed from the status report this year. It was noted that TMGC considered the first two options in 2015. In the end, TMGC agreed upon constant quota as the basis for 2015 catch advice, although there was no commitment to pursue a constant quota approach for 2016 catch advice. The science lead clarified that the constant quota approach was originally proposed as a means to avoid chasing annual noise in the surveys. Further, in context of the 2016 assessment, the science lead noted that maintaining a constant quota of 354 mt would be equivalent to increasing the relative exploitation rate by 36%. A participant noted that while TRAC considered constant quota in the past, the stock has not responded and so using 354 mt for a third year would be “risky” given trends continue to decline. In the end, it was agreed that the basis for catch advice would be to maintain a constant exploitation rate of 2% to 16%, but also acknowledge that the other two approaches did not yield significantly different results.

Other noteworthy points included: the need to note in the status report management constraints placed on the fishery that prevents them from catching their entire quota; note in the proceedings that low yellowtail recruitment is associated with low SSB, with recruitment presently at levels one would expect for current levels of SSB (with further exploration of this to be added as a research recommendation for 2017); and explore the potential impact of the delayed NMFS spring survey on next year’s assessment results, if applicable.

*Discussion of Eastern Georges Bank Cod*

Given the Empirical Approach and additional information presented for cod in 2016, the three reviewers were asked to summarize their thoughts regarding their preferred basis for providing catch advice:

Reviewer Thoughts: Paul Nitschke

Both the VPA and ASAP models suffer from major conflicting trends in the input data. However, the analytical models are useful for understanding the underlying conflicts in the data inputs. Each model attempts to deal with the issue by different means, but both models still suffer from a lack of fit to the surveys (large residual blocks in the VPA, lack of fit to the aggregated indices in ASAP). With the VPA model one would need to accept the assumption of a large increase in M at ages 6+ after 1994 and with the ASAP model we would need to accept a lack of fit to the catch (underestimating catch at the beginning and overestimated at the end of the time series), which also appears to have produced a spike in F near the end of the time series. If this is thought to be unrealistic and deemed unacceptable then one would need to accept the large retrospective pattern and rho adjustment with the ASAP model.

In the VPA the large increase in M assumption could perhaps be influencing the estimated doming in selectivity at the end of the time series. Doming may be a side effect of the M assumption, especially since a significant proportion of the fishery still seems to be directed on cod (60% longline and gillnet). Reasons for the larger, older fish not being vulnerable to the fishery are difficult to understand when a significant portion of the fishery is still directing on cod. Nevertheless, this selectivity change also results in concerns that Fref is no longer consistent or appropriate for projections. There are also overall concerns that projection performance seems to be overly optimistic in both the VPA and ASAP models.

Very few signs of improvement in the stock are seen in the raw model inputs and other biological data. Both the model estimates of SSB and the index trends show that the stock is at or near record lows at the end of the time series. Past quotas have not resulted in any sign of improvements in the stock. Finding reasons for why quotas should be increased is difficult to justify when looking at the raw data inputs. However, on a slightly positive note there are some weak indications for a relatively stronger 2013 year class (Canadian catch at age and some weak indication in the surveys).

The Empirical Approach using status quo exploitation rates seems to give reasonable results. There is some general concern that this approach may give advice that is too variable over time. The use of adjusting the quota for EGB Cod with this method seems to be reasonable since the quota is not much higher than the recent catches. However, justification for adjusting the recent quota would be more difficult to make if the quota was significantly higher than the catch.

Reviewer Thoughts: Hugues Benoît

Based on the catch curve analysis, which provides an estimate of Z, and the estimates of relative F, it is a reasonable hypothesis that M has increased considerably over time. Here M is taken to include the mortality from all sources other than those due to known fishing, which are accounted for by F. Failure to account for long-term increases in M is known to be a cause of the retrospective patterns observed for both models.

Both models are lacking, although the ASAP appears to be a worse model. First, it ignores the survey indices resulting in severe residual patterns. Given the consistency among the indices from the different surveys and the ability of those surveys to track cohorts, there is no reason to doubt the surveys and therefore real cause for concern that the model fits the surveys catches at age so poorly. Second, the ASAP estimates a trend in F that is inconsistent with relative F and with expectation about how F should have changed given the various management measures that have been implemented over the years. Third, the ASAP assumes time-invariant, flat-topped PR vectors in each of two periods. This assumption is unverified despite potentially having important consequence for our perception of stock status. Thus, ASAP is a potentially misleading model to use.

In terms of VPA, the residual pattern is concerning and the retrospective patterns, though small in recent times, still indicate that the model is generally over-predicting. The imposed change in M in the model likely accounts for some of a 'true' increase M, though not adequately, as the true changes are likely to have been gradual and perhaps not limited to the oldest ages. This could explain the patterns in residuals and the retrospective pattern. The assumed change in M and the estimation of 2009 catch appear somewhat *ad hoc*. While these changes may have improved model fit from a statistical standpoint, their current implementation is not well justified and lacks realism. A revised model should seek to include greater realism in age- dependent M-trends. Nonetheless, currently the VPA model appears inadequate for the provision of catch advice.

On the Empirical Approach, it is a constant exploitation rate model. You need to ask if this is consistent with the management approach for the stock; that is, is the intent to keep exploitation rate fixed regardless of stock status? Furthermore, the Empirical Approach is based on past total allowable catch (TAC) levels which were derived from models that cannot fully be trusted. Therefore, to the extent that these models overestimated abundance and underestimated exploitation rates, the Empirical Approach will perpetuate unsustainable harvesting decisions. However, based on the available stock status indicators, current rates of exploitation do not appear to be harming the stock presently and may therefore be adequate for short term use. Furthermore, given that the surveys appear to track the stock dynamics reasonably well, as evidenced from their ability to track cohorts, the Empirical Approach should provide some response to short term changes in stock status should they occur.

Consequently, the Empirical Approach appears to be an acceptable interim solution for providing catch advice as more appropriate revised assessment models are developed.

Reviewer Thoughts: Alexei Sharov

The TRAC used VPA M0.8 model to provide catch advice since 2013, following the 2013 benchmark assessment, in conjunction with a consequence analysis of the uncertainties in the VPA M0.8 and ASAP M0.2 model results. A significant increase in estimated 2017 and 2018 quota is due to the expected contribution of relatively strong 2010 and 2013 year classes. The projected low risk VPA based quota for 2017 is 1,138 mt, while neutral risk quota is 1,319 mt. Performance of the VPA method has not changed much in 2016 with some diagnostics indicating the same problems in model fit as seen before. However, the VPA results were used by the TRAC in 2015 to develop quota recommendations and model performance has not changed principally in 2016. The status of the stock in 2016 is described using the results of VPA0.8 model as well. If the VPA0.8 based quota is to be considered, it is recommended to use a low risk quota (1138 mt) as an upper limit of the potential range. This recommendation is based on the concern that the strength of the 2013 year class may be overestimated and the history of the retrospective pattern, which may lead to an overestimation of biomass and underestimation of fishing mortality, resulting in exceeding the target fishing mortality.

The ASAP assessment results generally are presented for the purpose of consequence analysis ("what if we were wrong" scenario). Nonetheless, quota values were also generated by ASAP and considered by TRAC. In contrast to VPA0.8, ASAP uses an assumption on constant natural mortality of M=0.2 and, consequently, estimates stock biomass being low, while fishing mortality is estimated to be high. The resultant 2017 quota of 515 mt is less than a half of VPA M0.8 low risk scenario. This is primarily due to the low M used in the ASAP model. The quota value is most conservative in the considered range and will be most effective if the fishing mortality reduction is the major goal of the management, considering the status of the stock. However, the model clearly has difficulty fitting the data, particularly the survey indices and shows strong retrospective bias, indicating inadequate description of population dynamics, which makes the ASAP results unreliable.

The Empirical Approach method adjusts recent quotas by population biomass trend derived from fitting the average of the three surveys to a *loess* smoother (DFO spring, NMFS spring, NMFS fall). This method maintains recently achieved exploitation at the constant level. This appears to be a conservative approach, because it relies on a three year based smoother. Thus, it will require a very significant change in survey values in order to have some response (increase or decrease) in the adjustment factor derived by this method. As a result, the response in quota will be delayed and at the smaller scale compared to the actual change in the survey indices. As a consequence, the quota will not be adequately (proportionally) increased when stock biomass sharply increases, and likewise not

adequately reduced if the biomass sharply declines. On the other hand, this method is guarding against random fluctuations due to sampling error being translated into quota changes. The application of the Empirical Approach method for the 2017 and 2018 quota calculation can be considered conservative because an application of the smoothing technique results in relatively small adjustment factor applied to recent low quotas under historically low constant exploitation rate.

A projection based on the VPA M0.8, assuming the full 2016 quota will be taken and assuming that the same level of fishing mortality (F=0.062) will be maintained in 2017 and 2018, seems to be the most adequate. It accounts for the fact that relative exploitation rate in recent years has been low and stable, suggesting that fishing effort is stable as well. In addition, it accounts for the expected increase in biomass due to the contribution of the relatively strong 2013 year class as indicated by the fishery independent surveys. At the same time, the estimated quota of 719 mt appears to be conservative relative to the VPA M0.8 low risk option.

Overall, TRAC participants supported a 'middle-ground' for catch advice for 2016, as guided by the range of information presented at the meeting.

*Discussion of Eastern Georges Bank Haddock (Interim Update Report)*

There was minimal discussion on this report given it was an update. It was noted that the VPA-estimated year class is unexpectedly high, yet the survey has not increased proportionally. This raised questions about the accuracy of the VPA-estimated year class (the rho has not reduced but also has not decreased). The primary discussion focused on what level of risk should be assumed for the catch advice. It was concluded that none of the information presented warranted a change in the level of risk that should be assumed for the catch advice. It was agreed that TRAC maintain a neutral risk for catch advice.

## OTHER BUSINESS

Rapporteurs: E.N. Brooks, K. Curran

A post-meeting webinar was held on 4 August 2016 to discuss 'Other Items' on the agenda that were not addressed at the July meeting. A List of Participants and Agenda for the webinar are provided in Appendix 4 and Appendix 5, respectively. The following is a summary of the webinar discussion.

*Terms of Reference for 2017*

The TRAC co-chairs clarified that the intent of the discussion of ToR for 2017 was not to reach any definitive agreement, rather to get a sense of TRAC views that could be considered in developing draft TOR for further review. The 2016 meeting ToR were used as a starting point for discussion. For EGB Cod, it was suggested that the

biological and fishery indicators could be updated to include the additional year, although it was recognized that there is no need to compare projection assumptions against past assessment results given this was completed in 2016.

In terms of the Empirical Approach, given an EGB Cod benchmark is not feasible prior to the 2017 assessment meeting, it was agreed that both the benchmark formulation (i.e., VPA M0.8 with an ASAP M0.2 consequence analysis) and Empirical Approach be pursued in 2017. It was further agreed that the Empirical Approach method adopted in 2016 should be applied in 2017, noting that at the peer review meeting it was suggested that a two-stage bootstrapping approach might be explored as one means of improving the Empirical Approach method moving forward. Overall, the 2017 catch advice should again consider of all scientific analytical results that are presented and discussed. Last, it was agreed that use of the Empirical Approach in 2016, in support of catch advice for that year, was not considered consensus by TRAC that an Empirical Approach was adopted as a new benchmark formulation for EGB Cod.

In terms of EGB Haddock, TRAC believed it would be helpful to revisit prior to the 2017 assessment. In terms of GB Yellowtail Flounder, TRAC encouraged continued exploration of a revised ‘q’ value to be used in the 2017 assessment. In terms of Allocation Shares, it was agreed that an evaluation of the potential impact of the delayed NMFS spring survey (2016) on the allocation formulae is of importance, with a similar evaluation to be undertaken for each of the three stock assessments.

*Research Needs*

There was a discussion on information gaps and research needs that could be pursued prior to the 2017 assessment meeting, in order to better inform the 2017 stock assessments themselves. Topics of importance for TRAC participants included:

- Allocation Shares/RV Spring (2016) Timing Sensitivity Analysis;
- All Stock Assessment/RV Spring (2016) Timing Sensitivity Analysis;
- Evaluate Yellowtail Flounder survey catchability (q); and
- Additional EGB Cod research items (assuming no Benchmark before 2017) included:
    - Explore the misallocation of cod in the EGB stock unit;
    - Evaluate how responsive the Empirical Approach would be to changing Cod stock dynamics; and
    - Look at geospatial analysis and historical time series of condition factor, effect of survey delays in previous years, and the distribution in size of fish (aggregation).

It was agreed that TRAC co-chairs would compile a list of information gaps and research needs that could be pursued prior to the 2017 stock assessment meeting, in order to prioritize and weight them against available resources, in discussion with management for further communication to TMGC. It was noted, that any feasibility of

evaluating Yellowtail ‘q’ prior to the 2017 stock assessment would have to be considered within the context of an on-going NEFSC reprioritization.

Following the discussion a participant provided an overview of the newly-announced *DFO Priorities and Partnership Fund*. It was noted that the Fund is intended to be used to invest in opportunities to build scientific capacity and collaboration within the international ocean and freshwater science communities. The primary focus of the Fund is to help leverage resources to augment scientific knowledge and collaboration in areas of relevance to DFO’s mandate. It was noted that a funding proposal has been submitted to support collaborative science and sharing of information (i.e., an initial workshop and staff exchange in year 1) between DFO and NEFSC on science needed to support ecosystem-based management approaches, including the identification of areas where collaborative research would advance our knowledge and ability to incorporate ecosystem information into stock assessment advice, as well as to further explore opportunities for collaborative monitoring/modelling.

*Review of Interim Update Approach for EGB Haddock*

There was a brief discussion regarding the Interim Update Approach for EGB Haddock, which was adopted for the first time in 2016. In general, TRAC participants felt that the update approach was informative about risk and provided an appropriate projection. It was noted, however, that if ages 3-8 information is not available for inclusion in subsequent update reports, TRAC may consider excluding Figure 2 from the document. It was also noted that in absence of aging data, length data from fishery catch and surveys could be included. In contrast, if age data could be incorporated into subsequent update reports, there is a need to again discuss how this data could be interpreted and how the format of the report could be revised (e.g., if age-structured data differs from modeled projections, this would allow for interpretation of year class strength in interim years). In general, TRAC participants were supportive of considering use of an Interim Update Approach for EGB Haddock in 2018 (the approach was not dismissed outright based on its first use in 2016) pending further consideration and discussion of the approach at 2017 stock assessment meeting. Last, it was noted *by some* that the intent of adopting the Interim Update Approach for EGB Haddock was to free up time for TRAC to pursue other TRAC-related analyses, and it was encouraged that TRAC continue to keep this point in mind within its annual work planning exercise.

*Publication Timelines*

It was noted that the Canadian-based TRAC website is outdated in terms of the availability of recent TRAC publications. The Canadian co-chair recognized this, noting that it is a function of an on-going Government of Canada-wide website transformation project, which has made it difficult to access and updated the website on a frequent basis. It was proposed that TRAC publications be provided to the U.S. co-chair for posting to the NOAA/NEFSC TRAC website.

*Benchmarks*

It was noted that both the EGB Cod and EGB Haddock benchmarks are outdated and require attention. Both co-chairs indicated that a need for TRAC benchmarks is considered in Canada and the U.S. on an annual basis, within the broader consideration of domestic fishery benchmark requirements. In terms of prioritizing an EGB Cod versus EGB Haddock benchmark in the short-term, it was noted by the U.S. co-chair that work is underway in the U.S. to evaluate GB and EGB Cod stock structure, which is likely to lead into a benchmark in coming years (so no sense for TRAC to contemplate an EGB Cod benchmark at this time). In contrast, the last EGB Haddock benchmark was completed in 1998, when the stock was in poor shape, suggesting that the current benchmark formulation used to provide catch advice may be outdated given that the stock is now in better shape.

Canada indicated that it is open to considering an EGB Haddock benchmark in the short-term, recognizing that this would depend on U.S. availability to participate. In absence of an EGB Haddock benchmark in the short-term, participants agreed that it would be worth evaluating certain elements of the benchmark formulation to see if it remains applicable to current stock conditions (with further consideration to pursue this work prior to the 2017 stock assessment, reporting any analyses back to TRAC via a mid-year intercessional webinar). Elements of EGB Haddock that could be explored over the short-term, in absence of a benchmark, include: evaluation of the retrospective, Fref, PR, discussion of HCR, and selectivity, to name a few. It was agreed, however, that any work load akin to a ‘mini-benchmark’ should not be pursued via an intercessional.

*Length of Meeting & Interim Meeting*

There was a brief discussion regarding the length of the 2017 assessment meeting to be held 10-14 July 2017, in St. Andrews, NB. The co-chairs noted that TRAC has been pressed for time over the past two years, during its annual assessment meetings, to complete all agenda items. It was asked if TRAC participants preferred a 3-day meeting (with any missed items to be discussed via post-meeting webinars) or if they were open to longer meetings (e.g., 3.5-4 days in length). It was agreed that longer meetings are preferable to post-meeting webinars, if this meant all agenda items could be addressed at one time and in person. In terms of a need for a TRAC intercessional prior to the 2017 assessment meeting, TRAC co-chairs were open to this opportunity pending further discussion on the 2017 ToR and required research items necessary to inform TRAC prior to drafting the 2017 stock assessments. Again, TRAC co-chairs committed to compiling a list of priority research topics for review with management, followed by communication back to TMGC as to what additional work could be completed prior to the 2017 assessment. A need for an intercessional webinar in 2017 would be considered at that time.

*Other Topics*

The U.S. co-chair provided an update regarding discussion amongst U.S. TRAC participants on a 'special consideration' to be included in the EGB Cod TRAC Status Report, which was not discussed at the July 2016 meeting. The Canada TRAC indicated that it did not have any strong views for or against the proposed text that was being contemplated, so deferred any discussion to the U.S. to complete.

A need for TRAC to review its policy/guideline regarding roles and responsibilities of TRAC participants was also raised. A participant expressed concern with a recent trend for TRAC to place emphasis on the identified peer reviewers to guide points of indecision within the meeting. The participant further noted that greater limitations might be required on participants; particularly, those participants with a perceived 'conflict of interest' in the advice being provided. The Canadian co-chair cautioned that any limitations on participation could limit the available expertise in which TRAC could draw upon; emphasizing that in his view broad participation, and placing emphasis on the impartial views of identified peer reviewers to guide indecision, was more in-line with science-based peer review principles, compared to any more limited peer review process.

## CONCLUSIONS

The co-chairs of the meeting thanked participants for attending the 2016 TRAC assessment of EGB Cod, EGB Haddock, and GB Yellowtail Flounder. The co-chairs committed to finalizing the TSRs by late-July/mid-August. Revised draft TSRs were circulated for review only to those meeting participants in attendance on Day 3 of the meeting, with opportunity to provide comment within a defined period of time. All comments received were considered within the final TSRs that were approved by Canada and the U.S. on or before August 17, 2016. Copies of all final, English language TSRs were made available to meeting participants via email on August 17, 2016. Last, the TRAC co-chairs committed to finalizing all working papers and the meeting proceedings within two months of the meeting, but would continue to communicate with meeting participants if such a timeline could not be met. It is intended that all TRAC publications will be made available in French and English on the TRAC website: http://www.bio.gc.ca/info/intercol/trac-cert/index-en.php and on the NEFSC website: http://www.nefsc.noaa.gov/saw/trac/.

## SOURCES OF INFORMATION

Barkley, A.S., and S.X. Cadrin. 2012. Discard mortality estimation of yellowtail flounder using reflex action mortality predictors. Transactions of the American Fisheries Society 141: 638-644.

Palmer, M.C., and S.E. Wigley. 2009. Using positional data from vessel monitoring systems to validate the logbook-reported area fished and the stock allocation of commercial fisheries landings. North American Journal of Fisheries Management. 29: 928-942.

Palmer, M.C., and S.E. Wigley. 2007. Validating the stock apportionment of commercial fisheries landings using positional data from Vessel Monitoring Systems (VMS). U.S. Department of Commerce, Northeast Fisheries Science Centre Reference Document 07-22. 44pp.

Sinclair, A.F. 2001. Natural mortality of cod (Gadus morhua) in the Southern Gulf of St Lawrence. ICES Journal of Marine Science. 58: 1-10.

# APPENDICES

## *Appendix 1. List of Participants*

| Jul-12 | Jul-13 | Jul-14 | Name | Affiliation |
|---|---|---|---|---|
| **United States Participants:** | | | | |
| x | x | x | Alexander, Terry | Northeast Fisheries Management Council (NEFMC) |
| x | x | x | Alger, Brett | NOAA / GARFO |
| x | x | x | Brooks, Liz | NOAA / NEFSC |
| x | x | x | Brown, Russell | NOAA / NEFSC |
| x | x | | Cadrin, Steve | NEFMC / SSC |
| x | x | x | Canastra, Richie | Industry |
| x | x | x | Cournane, Jamie | NEFMC |
| x | x | | DeCelles, Gregory | State of Massachusetts, Division of Marine Fisheries |
| x | x | x | Etrie, Libby | Industry |
| x | x | x | Heil, Sarah | NOAA / GARFO |
| x | x | x | Karp, Bill | NOAA / NEFSC |
| x | x | x | Legault, Chris | NOAA / NEFSC |
| x | x | x | Minkiewicz, Drew | Industry |
| x | x | x | Nies, Tom | NEFMC |
| x | x | x | Nitschke, Paul | Plan Development Team (PDT) |
| x | x | x | O'Brien, Loretta | NOAA / NEFSC |
| x | x | x | Odell, Jackie | Industry |
| x | x | x | O'Keefe, Cate | State of Massachusetts, Division of Marine Fisheries |
| x | x | x | Peros, Jonathon | NEFMC |
| x | x | | Quinn, John | NEFMC |
| x | x | | Raymond, Maggie | Industry |
| x | x | x | Sharov, Alexi | NEFMC / SSC |
| x | x | x | Simpkins, Mike | NOAA / NEFSC |
| | | x | Stockwell, Terry | NEFMC |
| x | x | x | Tooley, Mary Beth | NEFMC |
| **Canada Participants:** | | | | |
| x | x | x | Andrushchenko, Irene | DFO / PED (SABS) |
| x | x | x | Belliveau, Ray | Charlesville Fisheries Limited / MG < 65 ITQ |
| x | x | x | Benoît, Hugues | DFO Gulf / Science |
| x | x | x | Busawon, Dheeraj | DFO / PED (SABS) |
| x | x | x | Clark, Kirsten | DFO / PED (SABS) |
| x | x | x | Curran, Kristian | DFO / CSAS |
| x | x | x | d'Entremont, Alain | Scotia Harvest Seafoods Inc. / O'Neil Fisheries Ltd. |
| x | x | x | d'Entremont, Shawn | Inshore Fisheries Ltd. |
| x | x | x | Finley, Monica | DFO Maritimes / Population Ecology Division (SABS) |
| x | x | x | Ford, Jennifer | DFO Maritimes / Resource Management |
| x | x | x | Martin, Ryan | DFO Maritimes / Population Ecology Division (SABS) |
| x | x | x | Vascotto, Kris | Groundfish Enterprise Allocation Council |
| x | x | x | Wang, Yanjun | DFO Maritimes / Population Ecology Division (SABS) |

| Jul-12 | Jul-13 | Jul-14 | Name | Affiliation |
|---|---|---|---|---|
| x | x | x | Worcester, Tana | DFO Maritimes / CSAS |

x – attended meeting on that day

## Appendix 2. Terms of Reference

### *Transboundary Resources Assessment Committee (TRAC) Assessment of Eastern Georges Bank Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder*

July 12-14, 2016
Woods Hole, MA
USA

Chairpersons: Liz Brooks (United States of America) and Kristian Curran (Canada)

**Objectives**

The Transboundary Resources Assessment Committee (TRAC) annually obtains requests for harvest advice on transboundary resources from the Transboundary Management Guidance Committee (TMGC). For the following resources: Eastern Georges Bank Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder:

Cod:

- Provide a summary of biological and fishery indicators of the state of cod in the eastern GB management area.
- Provide a review of projection performance for VPA and ASAP since the benchmark meeting in 2013, including a comparison of projection assumptions against subsequent assessment results.
- Update the benchmark VPA and ASAP models and the consequence analysis table**.**
- Develop and apply an empirical approach:
    - Identify how surveys will be used;
    - Identify and explain an appropriate starting point (catch amount or quota) for applying the empirical approach. To the extent possible, characterize uncertainties and sensitivities.
    - Recommend thresholds for annual increases/decreases in catch advice.
- Provide catch advice in consideration of all scientific analytical results that have been presented and discussed. Describe the rationale for how the catch advice was chosen, recognizing that it may depart from the approach outlined in the 2013 Benchmark Proceedings. Similar to the catch advice approach used for other stocks, to the extent possible, the catch advice should cover a range from a low to neutral (higher) risk of exceeding the fishing mortality reference and/or from a higher probability of a stock increase to a lower probability of a stock increase.
- Report on any factors and risks that should be considered in interpreting the catch advice provided.

Haddock:

- Update the latest information from fisheries, including discard estimates and research surveys.
- Describe appropriateness of the projection from the previous assessment based on recent survey data.
- Advise on whether the stochastic projections from the 2015 assessment continue to adequately characterize the risks and uncertainties of the catch advice that was provided.

- Review the 2016 interim update approach for effectiveness and provide recommendations on usefulness and/or improvement.

Yellowtail Flounder:
- Apply the benchmark assessment (i.e., empirical approach) for yellowtail flounder, update results for the latest information from fisheries, including discard estimates and research surveys, and characterize the uncertainty of estimates.
- Provide catch advice for 2017 based on the empirical approach for a range of exploitation rates and, if appropriate, any other approach (e.g., constant quota) that includes catch advice for 2017 and 2018. Catch advice based on the empirical approach should consider information on survey catchability, if available.
- Report on catchability studies for flatfish if information is available.
- Discuss criteria for identifying when and how to change the management approach for yellowtail flounder.
- Describe any adjustments to benchmark assessment models applied during the TRAC, including impacts on the advice given to TMGC.
- Evaluate and quantify, if possible, scientific uncertainty of the assessment output (catch projection), discussing current practices of characterization and alternative methods of evaluation.

Allocation Shares:
- Review the biomass distribution relative to the U.S./Canada boundary, update results with the 2015 survey information, and apply the allocation shares formula.
  Note any changes to surveys (e.g., timing) that should be considered in the 2017 allocation shares.

Other:
- Draft terms of reference for the 2017 TRAC assessment of Eastern Georges Bank Atlantic Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder.
- Other matters.

## Expected Publications

- **TRAC Transboundary Status Reports** for the Eastern Georges Bank Atlantic Cod management unit and Georges Bank Yellowtail Flounder management unit.
- **TRAC Transboundary Status Update** for the Eastern Georges Bank Haddock management unit.
- **TRAC Reference Documents** for Eastern Georges Bank Atlantic Cod management unit, Georges Bank Yellowtail Flounder management unit, and Allocation Shares.
- **TRAC Proceedings** of meeting discussion.

## Participation

- DFO Maritimes scientists and managers
- NMFS Northeast Region scientists and managers
- Canadian and U.S. fishing industry
- U.S. State and Canadian Provincial (NB and NS) representatives
- NEFMC representatives
- Scientific and Statistical Committee (SSC) representatives

## Appendix 3. Agenda

### *Transboundary Resources Assessment Committee (TRAC) Assessment of Georges Bank Yellowtail Flounder, Eastern Georges Bank Cod, and Eastern Georges Bank Haddock*

Clark Conference Room (Aquarium Bldg), Northeast Fisheries Science Center
Woods Hole, Massachusetts, United States of America
12-14 July 2016

**DAY 1 (Tuesday, July 12, 2016)**

| Time | Topic | Leads |
|---|---|---|
| 09:00 – 09:30 | Welcome & introduction (co-chairs) | Liz Brooks (US)<br>Kristian Curran (Cdn) |
| 09:30 – 10:00 | Allocation shares | Dheeraj Busawon (Cdn)<br>Liz Brooks (US) |
| 10:00 – 11:00 | GB Yellowtail Flounder Assessment:<br>1. Inputs: commercial fishery & surveys<br>2. Application of the benchmark formulation<br>3. Catch advice | Chris Legault (US)<br>Dheeraj Busawon (Cdn) |
| 11:00 – 11:15 | ***Break*** | |
| 11:15 – 12:30 | EGB Cod Assessment:<br>1. Biological and fishery indicators for Eastern Georges Bank Cod and projection performance of VPA and ASAP cod assessment models<br>2. Assessment of Eastern Georges Bank Atlantic Cod for 2016<br>3. Investigation of an Empirical Approach for providing catch advice for Eastern Georges Bank Cod<br>4. A comparison of VPA, ASAP and Empirical Approach applications to Eastern Georges Bank Cod | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US)<br>Liz Brooks (US)<br>Yanjun Wang (Cdn) |
| 12:30 – 13:30 | ***Lunch*** | |
| 13:30 – 15:00 | EGB Cod Assessment (cont) | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US)<br>Liz Brooks (US)<br>Yanjun Wang (Cdn) |
| 15:00 – 15:15 | ***Break*** | |
| 15:15 – 17:00 | EGB Cod Assessment (cont) | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US)<br>Liz Brooks (US)<br>Yanjun Wang (Cdn) |

**DAY 2 (Wednesday, July 13, 2015)**

| Time | Topic | Leads |
|---|---|---|
| 09:00 – 09:30 | Review of previous day (co-chairs) | Liz Brooks (US)<br>Kristian Curran (Cdn) |
| 09:30 – 10:30 | Homework from previous day | All (US)<br>All (Cdn) |
| 10:30 – 10:45 | ***Break*** | |
| 10:45 – 12:30 | GB Yellowtail Flounder status report | Chris Legault (US)<br>Dheeraj Busawon (Cdn) |
| 12:30 – 13:30 | ***Lunch*** | |
| 13:30 – 15:00 | EGB Haddock status update report | Dheeraj Busawon (Cdn)<br>Liz Brooks (US) |
| 15:00 – 15:15 | ***Break*** | |
| 15:15 – 16:00 | EGB Haddock status update report (Cont'd) | Dheeraj Busawon (Cdn)<br>Liz Brooks (US) |
| 16:00 – 17:00 | EGB Cod status report | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US) |

**DAY 3 (Thursday, July 14, 2015)**

| Time | Topic | Leads |
|---|---|---|
| 09:00 – 09:30 | Review of previous day (co-chairs) | Liz Brooks (US)<br>Kristian Curran (Cdn) |
| 09:30 – 10:30 | EGB Cod status report (cont'd) | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US) |
| 10:30 – 10:45 | ***Break*** | |
| 10:45 – 12:30 | EGB Cod status report (cont'd) | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US) |
| 12:30 – 13:30 | ***Lunch*** | |
| 13:30 – 15:00 | EGB Cod status report (cont'd) | Irene Andrushchenko (Cdn)<br>Loretta O'Brien (US) |
| 15:00 – 15:15 | ***Break*** | |
| 15:15 – 16:15 | Conclusions of report reviews (cont'd) | All (US)<br>All (Cdn) |
| 16:15 – 17:00 | Other business and close:<br>1. Terms of Reference for 2017<br>2. Review of Interim Update Approach | Liz Brooks (US)<br>Kristian Curran (Cdn) |

| | | |
|---|---|---|
| | 3. Other business (as necessary)<br>4. Meeting adjournment | |

## *Appendix 4. List of Participants – Post-meeting Webinar*

| Aug-4 | Name | Affiliation |
|---|---|---|
| **United States Participants:** | | |
| x | Brooks, Liz | NOAA / NEFSC |
| x | Brown, Russell | NOAA / NEFSC |
| x | Cadrin, Steve | NEFMC / SSC |
| x | Canastra, Richie | Industry |
| x | Cournane, Jamie | NEFMC |
| x | DeCelles, Gregory | State of Massachusetts, Division of Marine Fisheries |
| x | Legault, Chris | NOAA / NEFSC |
| x | Nies, Tom | NEFMC |
| x | O'Brien, Loretta | NOAA / NEFSC |
| x | Quinn, John | NEFMC |
| x | Sharov, Alexi | NEFMC / SSC |
| x | Simpkins, Mike | NOAA / NEFSC |
| x | Tooley, Mary Beth | NEFMC |
| **Canada Participants:** | | |
| x | Andrushchenko, Irene | DFO / PED (SABS) |
| x | Benoît, Hugues | DFO Gulf / Science |
| x | Clark, Kirsten | DFO / PED (SABS) |
| x | Curran, Kristian | DFO / CSAS |
| x | Finley, Monica | DFO Maritimes / Population Ecology Division (SABS) |
| x | Ford, Jennifer | DFO Maritimes / Resource Management |
| x | Martin, Ryan | DFO Maritimes / Population Ecology Division (SABS) |
| x | Vascotto, Kris | Groundfish Enterprise Allocation Council |
| x | Wang, Yanjun | DFO Maritimes / Population Ecology Division (SABS) |
| x | Worcester, Tana | DFO Maritimes / CSAS |

## *Appendix 5. Agenda – Post-meeting Webinar*

**Transboundary Resources Assessment Committee (TRAC) Assessment of Georges Bank Yellowtail Flounder, Eastern Georges Bank Cod, and Eastern Georges Bank Haddock**

WebEx Webinar
4 Aug 2016

| Time | Topic |
|---|---|
| **2:00 – 2:15 AST**<br>(1:00 – 1:15 EST) | Welcome & (co-chairs)<br>• Additions to Agenda<br>• Status of 2016 Meeting Products |
| **2:15 – 2:30 AST**<br>(1:15 – 1:30 EST) | Review of Haddock Interim Update:<br>• Informative about risk and appropriateness of projection?<br>• Alternate analyses<br>• Pursue in 2018(?) |
| **2:30 – 2:45 AST**<br>(1:30 – 1:45 EST) | Prioritization of Benchmarks:<br>• Available Resources<br>• Domestic Activities<br>• Prioritization (Cod versus Haddock) |
| **2:45 – 3:00 AST**<br>(1:45 – 2:00 EST) | 2017 Intercessional(s) & Assessment Meeting:<br>• Approach on how to proceed and report back to TRAC prior to 2017 Assessment<br>• Length of 2017 Assessment Meeting (July 10-14, 2017, St. Andrews, NB) |
| **3:00 – 3:30 AST**<br>(2:00 – 2:30 EST) | Research Needs:<br>• Allocation Shares/RV Spring (2016) Timing Sensitivity Analysis<br>• Yellowtail q,<br>• All Stock Assessment/RV Spring (2016) Timing Sensitivity Analysis<br>• Additional Cod research (assuming no Benchmark before 2017) |
| **3:30 – 4:00 AST**<br>(2:30 – 3:00 EST) | 2017 Terms of Reference<br>• We'll use 2016 TOR as starting point |
| **4:00 AST**<br>(3:00 EST) | Adjournment |