**Proceedings of the
2019 Transboundary Resources Assessment Committee for
Eastern Georges Bank Cod and Haddock, and Georges Bank Yellowtail Flounder**

**Harry Hachey Conference Centre, St. Andrews Biological Station, St. Andrews, New Brunswick
July 9th to 11th, 2019.**

**TRAC Co-chairs: K.J. Clark (Canada)[1] and T. Trinko-Lake (U.S.A.)[2]
Meeting Chairperson: J.D. Neilson**

[1]Fisheries and Oceans Canada
St. Andrews Biological Station
St. Andrews, New Brunswick, Canada

[2]National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts, USA

Foreword

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

TABLE OF CONTENTS

ABSTRACT

The Transboundary Resources Assessment Committee (TRAC) met during 9 to 11 July 2019 in St. Andrews, New Brunswick, Canada, to review updated assessments (through 2018) of Eastern Georges Bank Atlantic Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder, and to consider a number of other related scientific issues. Results of these assessments will be used by the Transboundary Management Guidance Committee (TMGC) in developing management guidance for the 2020 fishing year for these transboundary resources.

RÉSUMÉ

Le Comité d'évaluation des ressources transfrontalières (CERT) s'est réuni du 9 au 11 juillet 2019 à St. Andrews, Nouveau-Brunswick, Canada, pour examiner les évaluations actualisées (jusqu'en 2018) concernant la morue de l'est du banc Georges, l'aiglefin de l'est du banc Georges et la limande à queue jaune du banc Georges, et pour étudier diverses questions scientifiques connexes. Les résultats de ces évaluations seront utilisés par le Comité l'orientation de la gestion des stocks transfrontaliers (COGST) pour formuler un avis sur l'orientation à donner à la gestion de ces ressources transfrontalières pour l'année de pêche 2020.

INTRODUCTION

The chair of the 2019 Transboundary Resources Assessment Committee (TRAC) meeting, Dr. John Neilson, welcomed participants (Appendix 1) to the 9 to 11 July, 2019 TRAC assessment of Eastern Georges Bank (EGB) Atlantic Cod (Gadus morhua), EGB Haddock (Melanogrammus aeglefinus), and Georges Bank (GB) Yellowtail Flounder (Limanda ferruginea). The TRAC was established in 1998 to undertake joint Canada / United States of America (U.S.) assessments of resources on Georges Bank. The 2019 TRAC Terms of Reference (TOR, Appendix 2) received approval from 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 by the Canadian TRAC co-chair, Kirsten Clark, of the TRAC review process which is documented online at http://www.bio.gc.ca/info/intercol/trac-cert/index-en.php and https://www.nefsc.noaa.gov/saw/trac/2018%20TMGC%20Guidance%20Document_FINAL.pdf. During the meeting, each working paper was presented by the science authors, followed by a discussion by the reviewers, assessment staff, co-chairs and designated resource managers and then a plenary discussion. The reviewers, assessment staff, co-chairs and designated resource managers then determined whether the plenary discussion changed any of their original recommendations. There were additional presentations for which working papers were not prepared.

The U.S. TRAC co-chair, Tara Trinko-Lake, presented the 2019 TOR (Appendix 2) and went on to explain the new Research and Management Track process for domestic U.S. stock assessment (https://www.nefsc.noaa.gov/nefsc/saw/pdfs/2019-aop-docs/nrcc20-process-doc-dec-2018-final.pdf). She noted that the U.S. has domestic research track assessments planned for haddock in 2021, cod in 2023 and yellowtail flounder in 2024. Discussions about Canadian participation in these processes and harmonizing TRAC benchmarks with the U.S. schedule will occur between Northeast Fisheries Science Center (NEFSC) and Fisheries and Oceans, Canada (DFO) over the next few months.

Two peer reviewers were invited to participate in the review of the assessments: David Keith (Canada) and Jason McNamee (U.S.). Both reviewers had served as TRAC reviewers previously.

GEORGES BANK YELLOWTAIL FLOUNDER

STOCK ASSESSMENT OF GEORGES BANK YELLOWTAIL FLOUNDER FOR 2019

Working Paper 2019/xx: Stock Assessment of Georges Bank Yellowtail Flounder for 2019
Science Leads (Working Paper): C.M. Legault and M. Finley
Presenter: C.M. Legault
Rapporteurs: Q. McCurdy and K. Clark

Presentation Highlights

The combined Canada/US Yellowtail Flounder catch in 2018 was 45 mt, with neither country filling its portion of the quota. Two of the three bottom trawl surveys increased, but all remained at low levels compared to their time series.

Several sources of uncertainty were identified including the challenges of characterizing catches and weights at age at such low abundance, catch misreporting and data biases due to observer effects at sea. There is a case before the courts in the U.S. regarding misreporting of catch by

a license holder with significant groundfish quotas and, although the amount of yellowtail landings in the court filings are less than 10 mt over four years, it is still a source of uncertainty because how much more misreporting actually occurred is not known. An investigation by the U.S. Groundfish Plan Development Team noted differences in fishing behaviour on observed and unobserved trips which likely biases catch data for all twenty groundfish stocks that were studied, including yellowtail flounder.

The empirical approach recommended at the 2014 Diagnostic Benchmark and modified during last year's TRAC was applied in this year's assessment update. The three recent bottom trawl surveys were scaled to absolute biomass estimates, averaged, and an exploitation rate applied to generate catch advice for the following year. Last year, the TRAC recommended an exploitation rate of 6% for catch advice. Applying this exploitation rate to this year's updated surveys results in catch advice of 199 mt for 2020. The full range of exploitation rates from the 2014 Diagnostic and Empirical Benchmark, 2% to 16%, applied to this year's surveys results in 66 mt to 531 mt.

Discussion

Given the format of the presentation, the chair made the decision to proceed through the discussion by Term of Reference.

Term of Reference 1

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.

Reviewers

It was noted that the U.S. Science and Statistical Committee (SSC) did not include the 2018 National Marine Fisheries Service (NMFS) spring survey result in their application of the empirical approach in 2018 because of issues with that survey, including lower coverage (39 tows rather than the usual 55+) and a lack of tows in traditional yellowtail habitat. These issues did not occur in the 2018 NMFS fall and the 2019 NMFS and DFO spring surveys and therefore there was no reason to remove any of the surveys from the current analysis.

The reviewers encouraged the leads to consider the spatial distribution of the stock. Interpretation of spatial patterns is more challenging because of the low abundance of yellowtail but it was suggested that presence/absence data are often more informative for stocks at such low levels than models based on total numbers. For example, if the fish are aggregated in only a few locations of preferred habitat, then those will be the areas of highest bycatch in other fisheries and therefore the ones that should be well monitored and protected.

Currently the three surveys (DFO spring, NMFS spring and fall) are simply averaged together. It was suggested that it might be useful to investigate methods of combining survey estimates to take into account both spatial and temporal information. Charles Adams at NEFSC has been leading work applying the vector-autoregressive spatio-temporal (VAST) modeling approach to cod, haddock and yellowtail flounder. To date these analyses have not shown any big differences from the current perception, but this approach could be useful for incorporating spatial information. It might not be so valuable at the current low survey estimates but could be beneficial if the stock recovers.

Research Recommendation: For the next TRAC benchmark, investigate techniques of combining survey estimates that take into account spatial and temporal information.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was asked why there was a lack of port sampling in the second half of 2018. The leads noted that it was difficult to find trips that only fished yellowtail on Georges Bank when catches were so low. For the purposes of the assessment, the science team had to assume that the proportions of lengths and ages in the second half of the year were similar to the first. This is an additional source of uncertainty.

Other Meeting participants

It was noted that it was important to include the information in the yellowtail flounder TRAC Science Report (TSR) that there were no anomalies in the three surveys used in this year's assessment and therefore there is no reason to remove any of the surveys from the empirical analysis.

There was agreement from the reviewers, science staff, resource managers, TRAC co-chairs and other meeting participants that the authors had met the first term of reference.

<u>Term of Reference 2</u>

Provide catch advice for 2020 based on the empirical approach for a range of exploitation rates for 2020.

Reviewers

It was asked if yellowtail was one of the species for which an observer effect was demonstrated in the study done by the U.S. Groundfish Plan Development Team. There might be more incentive to discard in some years than others depending on areas fished but it was also noted that observer bias is not unidirectional.

In the current empirical approach, catch and discard uncertainty are not included in the analysis. There would be uncertainty around the calculated exploitation rate if it were based on catch. However, the exploitation rate applied in the current empirical approach is based on quota rather than catch.

Research Recommendation: If, in the future, the empirical method is changed so that exploitation rate is calculated using catch rather than quota, there should be a consideration of how to incorporated catch uncertainty.

Although not specifically a term of reference, there was discussion in the working paper about recruitment and depensation. The recruit and biomass relationship from the surveys was examined so no modeling was involved. Recent surveys show very little recruitment despite low exploitation. It was noted that this stock might be in a depensation pit.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was asked what the realized exploitation rate was for the current 2019 quota of 140 mt. With the increase in the surveys in 2019, the exploitation rate (quota/average survey biomass) is 4%. The proposed advice was to keep exploitation at or below 6% exploitation which is the average of exploitation between 2010 and 2016 when the TMGC set the quota in accordance with the TRAC recommendations and the average survey biomass declined by approximately 95%. There has been no change in the status of the stock to indicate that this 6% level should be revisited.

There was a request for an update on the status of the Canadian rebuilding plan for yellowtail flounder. The plan has been completed and was posted in July, 2019 (https://www.dfo-mpo.gc.ca/fisheries-peches/ifmp-gmp/flounder-limande/2018/index-eng.html). The plan is a domestic one and operationally requires that Canada keep its own removals within the advice provided by TRAC.

There was agreement from the reviewers, science staff, resource managers, TRAC co-chairs and other meeting participants that the authors had met the second term of reference.

<u>Term of Reference 3</u>

Describe any adjustments to the benchmark assessment model applied during the TRAC, including impacts on the advice given to TMGC.

No adjustments were made to the benchmark assessment model. However, information was presented by the authors on analyses currently being undertaken by Timothy Miller of NEFSC. Preliminary results from his work indicated that catchability (q) may be slightly higher than the current TRAC value of 0.31 which would translate into slightly lower biomass estimates. This higher q has not been applied to the DFO survey in Dr. Miller's analyses to date and is not currently being used in the TRAC empirical approach.

Reviewers

It was noted that at the present time the TRAC applies the q value of 0.31 to the DFO survey. In Table 12 of the working paper, the reviewers noted that the DFO survey swept area biomass values are almost always (8 out of 10 years) below the NMFS spring survey values which may indicate that q is different for the DFO survey. Survey catchability experiments were not conducted using the DFO survey gear (Western IIA trawl).

There was agreement from the reviewers, science staff, resource managers, TRAC co-chairs and other meeting participants that the authors had met the third term of reference.

<u>Term of Reference 4</u>

Consistent with 2018 TSR, update and comment on trends in relative F, and total mortality (Z).

Reviewers

Calculations of Z are hindered by zeros and very low numbers and therefore it is hard to draw conclusions based on such a low total number of fish caught in each survey. However, these analyses will have importance and relevance if the stock recovers.

The declines in weights and lengths at age of older yellowtail are similar to what is being seen across many stocks. This decline impacts mortality because smaller fish are more available as food. The cause is not known but it should be a big research priority across stocks.

Research Recommendation: Investigate potential causes and effects of decreases in weights and lengths at age across fish stocks.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

There has been an increase in the survey Z from the DFO survey and decreases in survey Z from the NMFS surveys. It was asked if there were any ideas about why this had occurred. The leads noted that the number of fish caught is small and so the difference between the surveys is within the noise around those estimates. It is important not to over-interpret any one value.

Other Meeting participants

With the exception of the DFO survey, it did not appear that survey Z is currently high. The values are fairly close to the long term average except for the final points which are based on very low or zero catches at age in the surveys. Again it is important not to over-interpret when dealing with such low numbers.

There was agreement from the reviewers, science staff, resource managers, TRAC co-chairs and other meeting participants that the authors had met the fourth term of reference.

<u>Term of Reference 5</u>

Describe the rationale for the range of exploitation rates provided by TRAC as catch advice compared to previous guidance.

Reviewers

The authors provided a history of the decision to recommend a quota at or below the level of 6% exploitation (≤ 199 mt). They proposed applying the same logic for the catch advice again this year. The reviewers were in agreement with this approach. It represents an increase in catch advice from 2018. There were small increases in the NMFS spring and fall surveys and it is important to protect those increases. This need to protect the stock should be reflected in the TSR.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

There was agreement with the approach to recommend the quota at or below the 6% exploitation level (≤ 199 mt).

Other Meeting participants

It was noted that there has been an increase in two out of the three surveys and it was asked what the reasons would be to increase the quota advice. Reasons include increase in survey biomass, expansion of the age structure, and an increase in the spatial distribution of the stock. Since increases in biomass and spatial distribution would automatically lead to higher quota advice based on the method used in the empirical approach even at the 6% exploitation rate, it is really evidence of age expansion that would justify a higher exploitation rate. Higher numbers of juveniles, for example, would not be enough to justify using a higher exploitation rate if they were not surviving into the older ages. A large number of juveniles might actually justify a lower exploitation rate in order to protect them.

At the 2014 benchmark the range of exploitation rates used to provide the advice was from 2 to 16%. This was revisited in 2017 after analyses of wing width to door width conversions and catchability (q). Before the survey q was changed, the exploitation calculation was higher because at same quota there was a higher biomass. The change in the value of q used, led to a change in the perception of the stock, adjusting the survey biomass estimates down and therefore reducing the calculated exploitation rates that were used to set the appropriate exploitation advice. The 6% value used to set the advice is the average exploitation from 2010 to 2016, when the average stock biomass declined by approximately 95%, and does not include 2017 and 2018 when quotas were set above the TRAC advice. If those years were included, average exploitation would be 8%. It was suggested that it was inconsistent to include in the analysis years when the TMGC set more conservative quotas than the TRAC advice, but not years when they went over the TRAC advice. It was noted, however, that the catch advice is to protect what remains and although it may seem inconsistent, if catch advice is set lower then it is in keeping with that philosophy of being more protective. In recent years the quota based on the 6% exploitation rate is still greater than has actually been caught. The current advice is based on the assumption that the relationship between where the quota is set and the realised catch continues. If the quota were to be fully caught, there would be a need to revisit the level of exploitation used to provide advice. There are many factors outside of biology that are human/management made that impact the catch. It was noted that low yellowtail quota has an impact on other species being caught.

It was suggested that, again this year, the statement that "fishing does not appear to be a major driver of stock status" should be included in the TSR. Reported catch does not appear to be driving the population but there are indications of depensation and that is why the stock is not recovering despite the low catch advice. Until the population increases, catches should be kept low.

There was agreement from the reviewers, science staff, resource managers, TRAC co-chairs and other meeting participants that the authors had met the fifth term of reference.

The chair indicated that the group had agreed that the authors had addressed all the terms of reference and supported the conclusions of the authors.

ESTIMATES FROM VIMS INDUSTRY-BASED SCALLOP DREDGE SURVEYS

Working Paper 2019/xx: Georges Bank Yellowtail Flounder Estimates from VIMS Industry-Based Scallop Dredge Surveys of Closed Area II and Surrounds
Science Leads (Working Paper): S.A. Roman and D.B. Rudders
Presenter: S.A. Roman
Rapporteurs: Q. McCurdy and K. Clark

Presentation Highlights

The Virginia Institute of Marine Science (VIMS) conducted fine scale spatial dredge surveys of Closed Area II (CAII) in 2005, 2007, 2008, 2011, 2012, 2013, 2016, 2017, 2018, and 2019 for the purposes of examining scallop abundance and distribution. The spatial extent of surveys varied between years. From 2005 – 2011, the traditional CAII scallop access area was surveyed. In 2012, a portion of the CAII groundfish closure and surrounds on the Northern Edge of Georges Bank (GB) were surveyed. In 2013, area in the Essential Fish Habitat and surrounds on the Northern Edge of GB were surveyed again. For 2016 – 2019, the traditional CAII scallop access area and surrounds along the southern flank of GB were surveyed. In 2018 and 2019, the survey domain was expanded to cover additional area along the southern flank of GB. Scallop and finfish catch were enumerated and length measurements were taken. Survey catches were examined to determine whether there were trends in yellowtail flounder abundance in the surveyed area. Results indicated a decline in yellowtail flounder abundance over the time period, as well as a truncation of the size distribution observed.

Discussion

The presenter indicated that there had been changes in survey domains, design and number of stations over time. Initially the survey was based on a systematic grid design, but was changed to a stratified random design in 2016. Despite these challenges, it was noted that this survey showed declining trends in biomass and a contraction of the length distribution, similar to the DFO and NMFS surveys. It therefore provides corroboration of decline on a smaller scale for discrete areas. It was noted that in 2019 there was an indication of more small fish but the magnitude was well below what was seen in the past at these sizes.

Reviewers

It was noted that this survey would be more useful if it was more consistent, but it was recognized that, since it is funded through a competitive grants process, it is dependent on the

priorities for that program. The request for funding for next year will be submitted in October and the results will be announced in February/March.

This survey has a high density of stations and showed the same trends as the research vessel trawl surveys. If there were a desire to examine yellowtail on a finer scale, the focus would be on core habitat, such as Closed Area II, and higher sampling densities. It was noted that there was a dedicated trawl survey in 2013 with higher sampling densities which also showed similar results to the DFO, NMFS spring and fall surveys.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

There was discussion on the choice of survey catchabilities used in working paper. Although a range was used based on the literature, the presenter indicated that using a value of 0.83 for the survey dredge and 0.25 for the commercial dredge would likely give the best estimates of biomass. The resulting biomass estimates are well below (approximately one tenth of) the average survey biomass estimated in the empirical approach.

Other Meeting participants

A presentation made by the Coonamessett Farm Foundation at the 2018 TRAC discussed an *Icthyophonus* sp. parasite as a possible source of increased mortality. Information on this parasite is not currently collected in the VIMS survey, but sampling could be added if it was viewed as valuable information. It was noted by science staff that this parasite is now being seen in the Cape Cod and Gulf of Maine region but not currently on Georges Bank based on cooperative research sampling.

The chair asked if the information presented in this working paper changed anyone's views on the catch advice. It did not but it was noted that work of this sort contributes to our understanding of the dynamics of yellowtail flounder on a small scale.

EASTERN GEORGES BANK HADDOCK

ASSESSMENT OF HADDOCK ON EASTERN GEORGES BANK FOR 2019

Working Paper 2019/XX: Assessment of Haddock on Eastern Georges Bank for 2019
Science Leads (Working Paper): M. Finley, E.N. Brooks, Q. McCurdy, M.A. Barrett and Y. Wang
Presenter: M. Finley
Rapporteurs: Q. McCurdy and K. Clark

Presentation Highlights

The total catch of eastern Georges Bank (EGB) haddock in 2018 was 12,495 mt of the 40,000 mt combined Canada/United States of America (USA) quota. The 2018 Canadian catch decreased from 13,377 mt in 2017 to 12,216 in 2018 mt while the USA catch in 2018 was 253 mt, an increase from the 2017 catch of 214 mt. Haddock discards from the Canadian scallop fishery and the USA groundfish fishery were estimated at 5 and 21 mt, respectively.

Positive signs of productivity include expanded age structure, broad spatial distribution, large biomass and three exceptional year classes and three strong year classes since 2000. On the negative side, condition has decreased substantially (some improvement in 2019) and size at age has declined.

Based on the previously accepted virtual population analysis (VPA) model, the 2019 beginning of year adult population biomass (ages 3+) is estimated at 167,476 mt. A preliminary estimate for the 2017 and 2018 year class is 11,000 million and 13,000 fish at age 1, respectively. The current age 1 estimate of the 2013 year class is 589 million fish, which is the highest in the time series

(1931-1955 and 1969-2019). The exceptional 2003 and 2010 year classes, estimated at 196 million and 96 million age-1 fish, respectively, are the second and third largest. Except for the strong 2000, 2011, and 2016 year classes and the exceptional 2003, 2010, and 2013 year classes, recruitment has fluctuated between 1.6-26.1 million since 1990. The results of this VPA indicated that fully recruited fishing mortality (F) increased to levels above the fishing mortality reference point (F_{ref} = 0.26) from 2010-2017. In 2018, F was estimated at 0.05. Projections based on this model indicated that, with 2019 catch equal to the 30,000 mt quota and F=0.26 in 2020, a total catch of 33,000 mt in 2020 would result in a neutral risk (50%) of exceeding $F_{ref.}$

Retrospective analyses indicated that the benchmark model has a strong tendency to underestimate F and overestimate biomass and age 1 recruitment when additional years of data are added. In an attempt to address this retrospective bias, a sensitivity forecast using the rho adjusted 2019 population numbers (ages 0-9+) for deterministic projections and risk assessments was conducted to beginning year 2022. Assuming a 2019 catch equal to the 30,000 mt total quota and F=0.26 (F_{ref}) in 2020 and 2021, a combined Canada/USA catch of 8,500 mt in 2020 results in a neutral risk (50%) that the 2020 fishing mortality rate would exceed F_{ref} = 0.26. A combined Canada/USA catch of 7,000 mt in 2021 results in a neutral risk (50%) that the 2021 fishing mortality rate would exceed F_{ref} = 0.26.

The impact of different assumptions on the partial recruitment (PR) on the age range that includes the exceptional 2013 year class were explored. Projections were run with a flat-topped PR (F=Fref for ages 5 to 8 in 2020 and 2021) and with the PR fixed to the ten year average at each age from 5 to 8. The 2020 catch projection (age 1+) using the flat-topped PR was slightly higher than the benchmark formulation, whilst the projection using the 10 year average was slightly lower. Age 1+ catch projections differed more in the second year with both exploratory runs providing higher catch projections than the benchmark formulation in 2021.

Given the current challenges with the retrospective and model diagnostics, information was presented from the 2012 VPA, the last model iteration that had no retrospective pattern. The 2003 year class was of exceptional size and in 2012 was of a similar age to the 2013 year class in 2019. The VPA estimated 3+ biomass, F at ages 5 to 8, and estimates of F corresponding to catch removed from the average survey biomass were contrasted with the current survey biomass to provide a measure of scale and potential guidance for appropriate catch advice.

Discussion

Given the format of the presentation, the chair made the decision to proceed through the discussion by topic rather than by Term of Reference.

Data Inputs

Reviewers

One of the assumptions of the VPA model is that the catch information is accurate. This is problematic when, based on a court case in the US, it is known that there are issues with the landings data. However, there is no information that can be used to estimate what the uncertainty might be around the catch. This is a large problem for this type of model. It was noted that haddock is one of the stocks for which there is a low incentive to discard, but that other species (e.g., cod) might have been misreported as haddock in the past. This would result in lower catches rather than higher ones.

Most of the landings from this management area are from the Canadian fishery and there is high observer coverage. It was recommended that a more in depth look at observed versus unobserved trips should occur at the next benchmark.

Research Recommendation: For the next benchmark, compare observed and unobserved trips to determine any differences.

The current VPA model assumes natural mortality (M) of 0.2. It was suggested that it might be worth investigating what M might be given the current life history characteristics. Hoenig's method or something similar could be used. From the U.S. perspective, the M=0.2 originally came from analyses as part of their domestic Groundfish Assessment Review Meetings (GARM) process. The original analyses were based on information from surveys in the 1960s. It was determined at the time that every age had the same survival, supporting M=0.2. It is possible that this has changed.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was noted that the average survey biomass that was shown in the presentation was not in the working paper. It was requested that this information be included in the reference document. It was also noted that this version of the average survey biomass was not adjusted by the survey catchability (q) derived from the VPA model and is therefore different from what was shown in the 2018 haddock interim report.

A question was raised as to why there were no midwater trawl samples in the US catch at size and catch at age. It was clarified that there was no midwater trawl fishery on the US side of eastern Georges Bank in 2018.

All Meeting Participants

Non q adjusted biomass indices were requested from the assessment team as homework for day 2 of the current meeting.

As was noted by the assessment leads in their presentation, there appears to be smearing of the ages of the 2012, 2013 and 2014 year classes in the catch at age. It was suggested that there should be a review of sampling intensity to ensure that all ages are being sampled appropriately for both the fishery and survey catch at age. Currently samples from the DFO survey are used to enhance the age length key in the first quarter because there are insufficient samples from the fishery. Despite any concerns regarding age smearing, the 2013 year class has been clearly observed and there is confidence that it is still exceptional.

There was agreement from the reviewers, science staff, resource managers, TRAC co-chairs and other meeting participants that the authors had adequately described the data inputs as required by the first Term of Reference.

Model Results and Diagnostics

Reviewers

The reviewers noted the troubling diagnostics and the worsening retrospective pattern for the model. It was suggested that it would be better to move away from the VPA model, perhaps to a statistical framework, although it was noted that this does not fix any data issues. Currently the model does not track the surveys well and is not providing useful information. It was noted by both the reviewers that identifying a better approach and applying it by a potential 2021 benchmark is ambitious.

If the results from the current VPA are not considered reliable, then the projections are not useful.

In some years the DFO survey q is above 1. It was asked if there was any reason to think that haddock are "jumping into the path of the trawl". There is no reason to expect this but there is a large standard deviation so that the range around q includes values less than 1.

It was asked if the model had been run with individual survey indices rather than using all three to see if the retrospective pattern was larger with one survey than others. This was done for the whole of Georges Bank and showed no single culprit. Similarly, it was done for eastern Georges Bank cod and again did not identify a survey that was worse than the others.

The reviewers asked if there was a link between temperature and the location of haddock that might cause differences in distribution. An industry representative indicated that fishers were observing this link and were using it to choose fishing locations.

> **Research Recommendation**: Investigate the link between temperature and haddock spatial distribution.

> *Science Staff, Designated Resource Managers and TRAC Co-Chairs*

The 2019 model run showed 3+ biomass in the range of 150,000 mt for the past 4 years and yet the fully recruited F was 0.5 with catches that were only 10% of the biomass. It was noted that the value of F for ages 5 to 8 was model derived and population weighted for each age group. The F was high because the catch at age shows high catches of very small year classes as a result of the smearing of the 2013 year class.

The Chair summarised the discussion up to this point. He noted that the results from the model should allow the reconstruction of the population over time and provide catch advice but that significant issues with the VPA had been identified. He asked the reviewers and then the science staff, designated resource managers and TRAC co-chairs if the model was still useful for management purposes. There was agreement from all that the model should be rejected but concern was expressed that there was no clear alternative approach.

It was suggested that the TRAC could comment on the current state of the stock relative to the 2009 to 2012 time period shown by the assessment team. The non-q adjusted survey biomass indices give a view of where the stock is in relation to the past. Catch advice could be provided in terms of adjusting the current quota and could be supported by the data, and not by anything produced by the model.

The surveys provide indices of numbers and biomass which can be used to show where the stock is now compared to the last few years. Recruitment can be identified from the indices without the model. When a really large year class is present, it is obvious in the survey data. The 2013 year class is large but is already age 6 and there are currently no other exceptional year classes so the abundance in the survey indices will decline. Aggregated survey indices can be used to guide the direction that the current quota should be adjusted.

The calculation of relative F is model free if there is no q adjustment of the surveys. It was suggested by the reviewers that this would be a useful indicator to include. The reviewers also suggested including a table showing positive and negative features of the stock; this would be similar to the one from the haddock interim report.

The Chair again summarised the discussion and requested that the group provide a list of additional homework items for the assessment leads to complete for the next day of the TRAC meeting. The purpose of the homework would be to give evidence that could be used to describe current stock status and where the TRAC thinks the stock is in relation to the past. In addition, the decision was made to reject the model for providing catch advice and it is therefore necessary to clearly justify this decision. The group requested the following:

- Swept area indices for biomass and number for all three surveys without any q adjustments.

- Length compositions from the surveys for the two most recent years and the time period when the exceptional 2003 year class was of similar age to the 2013 year class now (e.g. 2009 to 2011).
- Relative F values, catch and quota information for the same years as above.

Other Meeting Participants

There was some support expressed for looking back at the history of the stock for providing advice. The survey information that is being prepared as part of the homework must be model free and comfort was expressed with the list of homework that had been prepared.

HADDOCK SOMATIC GROWTH CHANGES ON EASTERN GEORGES BANK

Presentation: Understanding Haddock Somatic Growth Changes on Eastern Georges Bank
Science Leads: Y. Wang, A. Gharouni, K. Friedland and C. Melrose
Presenter: Y. Wang
Rapporteurs: Q. McCurdy and K. Clark

Presentation Highlights

Accompanying the recent biomass increase of Eastern Georges Bank haddock, there has been a significant decline in haddock growth. At the same time, Georges Bank has experienced environmental changes. To understand the mechanism of somatic growth changes, Generalized Additive Models (GAM) were used to relate biotic and abiotic variables to haddock growth on eastern Georges Bank. The selection of covariate variables was based on a conceptual model and data availability. The results showed that density dependent effects and possibly higher temperatures in the summer and fall have the most influence on haddock growth changes. This is consistent with the description in Clark et al. (1969) of a reduction in fish size following very strong cohorts.

Discussion

Reviewers

It was noted that GAM can include a wide range of variables, some of which might not explain much of the data. It was asked if the models could be simplified further. Had a stepwise method of removing one variable and then examining the AIC been done to see if this made much difference? It was noted that both AIC and ANOVA were used to determine the input variables and that variables with high concurvity were removed. If a variable was removed and the AIC did not change, the variable was left out.

Some of the features of GAMs were discussed, particularly the ability to get smoother curve fits. It was noted that you can constrain them a bit to see if the results make more sense. In this study, the authors started with the default and made changes when there were outcomes that did not make sense. If one variable is fixed, it impacts another. There is still a need to use expert judgement and not to rely entirely on the model.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

The conceptual model that was presented indicated that there was no information for the benthos. It was asked if there was a plan to use any information as a proxy for this but unfortunately, the information is not available in a form that can be used in the model. The lack of ecosystem data is a challenge.

The smearing of age classes around the 2013 haddock year class was raised as a potential issue for the model. This kind of error would show up in the residuals. However, there are so many samples for the strong year class, that it is not considered to be a problem.

It was suggested that the authors consider using an interaction term with year since it would be interesting to see how density dependence might vary over time. Out of sample prediction, such as removing 2011 and estimating to see how comparable the results are with and without these data might also be an interesting approach.

Other Meeting Participants

It was noted that the authors did not use the NMFS survey information for length at age.

ALLOCATION SHARES

Working Paper 2019/<mark>XX</mark>:   Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank through Fishing Year 2020
Science Leads (Working Paper): M.A. Barrett and E.N. Brooks
Presenter: M.A. Barrett
Rapporteurs: Q. McCurdy and K. Clark

Presentation Highlights

The development of consistent management by Canada and the USA for the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank led to a sharing allocation agreement by the TMGC. For Atlantic cod and haddock, the agreement is limited to the eastern Georges Bank management unit, whilst the management unit for yellowtail flounder encompasses all of Georges Bank east of the Great South Channel. The sharing formulae incorporate: 1) historical utilization based on reported landings from 1967 to 1994 and 2) spatial-temporal changes in resource distributions determined from the DFO and USA NMFS survey results that are updated annually. From 2010 onward, utilization has accounted for 10% and distribution for 90% of the allocation. The 2018 DFO and NMFS survey results were used to update the calculation for the 2020 fishing year allocations.

The resource distributions in 2018 were: 28% USA, 72% Canada, for Atlantic cod; 55% USA, 45% Canada, for haddock; and 71% USA, 29% Canada, for yellowtail flounder. The 2020 fishing year allocations (calendar year for Canada; May 1, 2020 to April 30, 2021 for the USA), updated with the 2018 resource distributions, resulted in shares for Atlantic cod of 29% USA, 71% Canada; for haddock of 54% USA, 46% Canada and for yellowtail flounder of 74% USA, 26% Canada.

Reviewers

The reviewers had no comments or questions.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was noted at last year's TRAC that there were some strata without data on the U.S. side and that it was assumed that these were zeros. This did not occur in 2018 and it has been discussed with the survey leads on both sides of the border to ensure that this issue does not reoccur.

Other Meeting Participants

 There were no comments or questions.

EASTERN GEORGES BANK HADDOCK ASSESSMENT HOMEWORK

Presentation Highlights

The assessment leads presented figures showing the three survey indices without any adjustment for catchability. The surveys were shown individually and then averaged together. It was noted that all three surveys are above the mean in their terminal years. They were also shown adjusted to the mean so that they could be compared to the VPA output. Length frequencies of haddock caught in each of the surveys were shown for 2010, 2018 and 2019 demonstrating that the 2013 year class is smaller at age than the 2003 year class was. The 2018 and 2019 NMFS fall surveys show some evidence of a second mode at a small size. The model free relative F trend (total catch divided by the three survey average) was also shown. It has declined in recent years. Finally, a draft of the proposed catch advice was shown, along with a table showing both the positive and negative features of the eastern Georges Bank haddock stock. It was proposed that both the drafted advice and the table be included in the haddock TSR.

Discussion

Reviewers

Concern was expressed with the inclusion of the NMFS fall survey in the calculation of relative F since that survey is considered to only be a good index for up to age 5 and therefore does not include the 2013 year class in 2019. It was agreed that relative F should be calculated for each survey and then the three numbers should be averaged together. If there is very little difference between the relative F calculated including or excluding the fall survey then it should be included to be consistent. It was also agreed that, since the DFO survey did not start until the mid-1980s, any time series using survey averages (including the calculation of relative F) should be from 1987 onwards so that all three surveys are included.

There was a discussion regarding the age at maturity of the stock. The ogive for the whole of Georges Bank is used and the age at maturity is considered to be age 3+. Based on this, the 2013 year class has already spawned three or four times so harvesting them at their current age does not prevent this year class from reproducing. However, the 2013 year class, with its slower growth, is exposed to higher mortality over a longer period than the faster growing 2003 year class that it is being compared to.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was reiterated that relative F should be calculated for each survey individually and then averaged together since the surveys are not q adjusted and therefore each has a different catchability.

Other Meeting Participants

The bullet in the table of positive and negative features of the stock that read, "Even if no catch were taken in 2020, biomass is projected to decline" was discussed. It was noted that the stock is currently considered healthy and in the absence of a model, there are no projections. Without the model, it can still be determined that the 2013 year class is carrying this stock and this year class is now declining in number as it ages. Therefore the statement is accurate and should be included in the table in the TSR.

The draft wording for catch advice was discussed in detail. There was consensus from the group to keep to the scientific facts. It was asked if there was a way to characterize quota advice in terms of risk but there was no agreement as to how this might be done. It was agreed that the advice should be for 2020 quota up to 30,000 mt (the current 2019 quota), but that quota in 2021 should be less than 30,000 mt. It was agreed that, although two year advice is being given, an interim report on this stock in 2020 would not be appropriate. The appropriateness of 2021 quota will need to be assessed at the 2020 TRAC meeting by comparing relative F values, weights at age, and survey trends.

The use of relative F in providing catch advice was discussed. Relative F will be recalculated for the TSR as requested by the reviewers and other science participants. It will be shown for the time series from 1987 onwards and the values from 2009 to 2011 (when the 2003 year class was of similar age to the 2013 year class now) will be compared to the rest of the time series and the current time period to see if catches of that magnitude were reasonable. The relative F in the 2009 to 2011 time period provides a threshold and some guidance.

SPATIO-TEMPORAL CHANGES IN ENCOUNTER PROBABILITY OF COD AND YELLOWTAIL ON GEORGES BANK

Presentation: Spatio-temporal changes in encounter probability of cod and yellowtail on Georges Bank
Science Leads: D. Keith
Presenter: D. Keith
Rapporteurs: F. Irvine and K. Clark

Presentation Highlights

This research is part of a project attempting to develop a methodological framework to evaluate existing closures. The project uses the time-area closures designed to protect spawning aggregations of Atlantic cod and yellowtail flounder from bycatch in the Canadian scallop fishery on Georges Bank as a case study. This presentation used the DFO Survey, NMFS Spring survey, and NMFS Fall survey to look at inter-annual and seasonal trends in the spatiotemporal distributions of cod and yellowtail across Georges Bank. For both species, general declines in probability of occurrence were observed in recent years and the survey data indicates that distributional shifts occur approximately every 3-5 years. For cod the surveys indicated a seasonal shift in the fall to the northeast corner of the bank. Yellowtail tend to be found consistently within a core region but the area of occurrence appears to expand and contract with changes in population abundance. The results could be used to inform management of existing closures by a) identifying regions in which the probability of occurrence is elevated, b) identifying the time of year in which probability of occurrence is highest, and c) providing a methodology to quantify the success of achieving specific management objectives.

Discussion

   Reviewer

The presentation was considered informative and it was noted that spatio-temporal information should be incorporated into any future benchmarks.

   Research Recommendation: Spatio-temporal information should be incorporated into future benchmarks for TRAC stocks.

   Science Staff, Designated Resource Managers and TRAC Co-Chairs

A stock that is at a very low level may be exhibiting a contraction of its range rather than a distributional shift. The current method used for defining the yellowtail cells (3.5 kg/tow) should likely be revised because of this contraction of range.

It was noted that it would be interesting to look into the temporal distribution of juveniles as well as adults.

Other Meeting Participants

Based on scallop surveys in the U.S., the highest chance of encountering yellowtail occurs between August and October. Changes in U.S. scallop gear have significantly reduced cod bycatch.

It was asked what factors were included in the analysis. Thirty three environmental factors were included based on random spatial field, sea surface temperature and, in the case of yellowtail, bottom type.

The DFO summer survey has covered the edge of eastern Georges Bank several times in recent years. It would be interesting to look at the summer distribution of yellowtail in those years.

> **Research Recommendation:** At a future yellowtail flounder benchmark, data from the summer DFO survey should be examined to see if it provides additional information on distribution.

PROGRESS OF THE ATLANTIC COD STOCK STRUCTURE WORKING GROUP

Presentation: Report on progress of the Atlantic Cod Stock Structure Working Group
Science Leads: R. McBride and K. Smedbol
Presenter: K. Smedbol
Rapporteurs: F. Irvine and K. Clark

Presentation Highlights

The Atlantic cod stock structure working group (ACSSWG) was formed by the U.S. National Oceanographic and Atmospheric Administration (NOAA) Fisheries in 2018 to determine the most appropriate representation of Atlantic cod stock structure for use in regional stock assessments based on currently available information. The ACSSWG is composed of 15 members from federal, state, academic, and other non-governmental organizations of both the US and Canada. The ACSSWG has met together twice, in addition to several conference calls and has engaged with the industry, stakeholders and others in two New Hampshire Sea Grant-sponsored symposia.

The Working Group objectives are going forward in two phases. The product of phase one will be a NOAA Technical Memorandum that addresses the scientific support for biological stock structure of cod in US and adjacent waters (NAFO Divisions 5 and 6, with interactions with 4X). The report provides a holistic view from the following six disciplines: 1) spawning and early life; 2) genetic markers; 3) basic life history [abundance, growth, maturity]; 4) external or internal 'natural' markers, shape, or coloration; 5) applied markers, both conventional and technology tags; and 6) fisherman's ecological knowledge. This report is being drafted for peer-review by the New England Fishery Management Council (NEFMC) Science and Statistical Committee (SSC) during the period January-February 2020, with the expectation to present to the NEFMC April, 2020, meeting in Mystic, Connecticut.

Phase two has been separated from phase one, and has not yet begun. Its goal is to broadly consider potential actions to meet management objectives including but not limited to maintaining status quo, altering stock boundaries, spatial and temporal restrictions, and stock composition analysis. Another meeting where the 'phase one' report will be available, and a broad assemblage of constituents from fishery, monitoring, assessment, and management interests meet, and a 'white paper' summarizing a list of actions and associated pros and cons of each will be made available to the NEFMC and other interested parties for further action.

Discussion

   Reviewers

No comments

   Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was asked how much new information is being incorporated compared to older information that was already available and how likely it is that stock structure has remained consistent over time? The data type time series vary and the scale of aggregation for each type of data is variable. It is therefore important to consider the timeline when framing stock units. It was noted that to address spatial complexity, it is not always necessary to change the management units.

   Other Meeting Participants

There has not been a lot of involvement of Canadian stakeholders outside DFO. Some Canadian industry representatives were interviewed by Dr. DeCelles as part of this investigation. However, it was noted that it is important to distribute the information to Canadian stakeholders so that they can provide feedback. It was noted by members of the ACSSWG that there are opportunities for commenting on the process.

There was discussion about the information regarding parasites and stock discrimination. Industry is seeing seasonal changes in parasite load on Georges Bank. Perhaps this could be further sampled and examined.

   Research Recommendation: DFO Science should work with Canadian industry to look into collecting information on parasites.

EASTERN GEORGES BANK COD

DATA UPDATE FOR EASTERN GEORGES BANK COD IN 2019

Working Paper 2019/XX: Data Update for Eastern Georges Bank Cod in 2019
Science Leads: M. Barrett, C. Legault, F. Irvine and I. Andrushchenko
Presenter: M. Barrett
Rapporteurs: F. Irvine and K. Clark

Presentation Highlights

The combined 2018 Canada/USA Atlantic cod catches were 565 mt against a quota of 951 mt. Two of the three research survey biomass indices increased from last year, but all three remain below their time series average. Condition factor is at or above the long-term mean for the NMFS spring and fall surveys but remains at a low level in the DFO survey. Large cod continue to be missing from both fishery and survey catch compared to historical distributions. Relative fishing mortality continues to be low recently while survey total mortality continues to be high indicating that the increase in total mortality is driven by factors other than reported fishing.

Discussion

Reviewers

The three surveys often exhibit diamond patterns (e.g., one survey goes up, whilst the others go down). These divergent patterns cause issues for any model. There is a need to understand the spatial signal in the data for older ages, since this may be the source of some of the divergence.

The reviewers asked for clarification on what was expected for cod advice for 2020. The term of reference required that the TRAC identify and comment on changes in survey and fishery indicators (relative to the 2018 TRAC). It was noted that nothing in the input data is very different from what was seen in 2018 and therefore there is no reason to change the advice. Since there will be no cod TSR produced in 2019, advice and conclusions will be noted in the Proceedings.

It was noted that the Sinclair Z calculation for cod has the same challenge of low numbers of fish at older ages that was observed for yellowtail. In the most recent two years, the Sinclair Z calculation for ages 6 to 8 has no data for ages 7 and 8. The trend in Z at these older ages is therefore not reliable, making it hard to compare this year to previous years.

There looks like there is a pulse of small fish (30 to 40 cm) in the NMFS fall survey catch at length. These are likely age 1 fish and compared to the recent ten year average, this looks like a lot of fish. However, the stock has been historically low over the past ten years and it should be noted that this pulse of fish is only 10% of what was observed in the 1970s to the 1990s.

Science Staff, Designated Resource Managers and TRAC Co-Chairs

It was agreed that there were no obvious reasons to change the advice and conclusions this year.

Other Meeting Participants

Although there is no TSR for cod, there was agreement from the group that TRAC will report on the various biological factors and it will be noted in the Proceedings that there is nothing obviously different in the indices and input that that would change the advice from last year. The assessment team was asked to draft a consensus statement that would be reviewed and then included in the Proceedings.

ALTERNATIVE METHODOLOGIES FOR PROVIDING INTERIM CATCH ADVICE FOR EASTERN GEORGES BANK COD

Working Paper 2019/XX: Alternative Methodologies for Providing Interim Catch Advice for Eastern Georges Bank Cod
Science Leads: I. Andrushchenko, C. Legault, and M.A. Barrett
Presenter: I. Andrushchenko and C. Legault
Rapporteurs: F. Irvine and K. Clark

Presentation Highlights

Following the 2018 TRAC, poor diagnostics of both the VPA and Age Structure Assessment Program (ASAP) models for eastern Georges Bank cod resulted in the TMGC requesting that TRAC investigate alternative methodologies for providing catch advice. Two approaches were presented for further exploration: the Rose and the Data Limited Methods Tool (DLMtool). The Rose approach uses a variety of assessment models to address retrospective patterns and provide catch advice based on the ensemble of models through either a formulaic calculation or making trade-offs between short and long term consequences. The DLMtool provides a

simulation platform which mimics stock dynamics across a range of uncertainties, against which simple index-based management procedures for provision of interim advice can be tested. Pros and cons of both approaches were presented.

Discussion

The Chair initiated the discussion by asking if the assessment leads favoured one approach over the other. The leads agreed that both approaches had merit and they would be comfortable moving forward with either one of them. However, they stressed that TRAC needed to identify one of the approaches for further work since workload and time precluded the ability to pursue both.

Reviewers

The reviewers found both approaches interesting and appropriate. It was noted that the choice of models is very important with the Rose approach so as not to bias the results and there needs to be consideration of how the results of the suite of models will be assembled in the end. For example, the spawning stock biomass (SSB) from an ASAP approach would result with various scenarios with distributions around them. In order to aggregate the results from the ensemble of models, it would be possible to sample from all the posteriors, as in a Markov Chain Monte Carlo (MCMC) approach. However it was noted that simple averaging of results would not be appropriate. The Rose method would allow the calculation of reference points from each of the models used which could then be compared against their own or a global reference point. This approach could provide both catch advice and stock status. Simulations of this approach are difficult and it is challenging if a "bad" group of models is chosen. To do this well, a Management Strategy Evaluation (MSE) tool approach would need to be set up across the ensemble of models. This is not trivial and could not be done in a year.

The DLMTools approach is not an assessment model and will not provide a SSB estimate. Instead it is an approach to simulate the range of uncertainty and to test harvest strategies to assess if performance is consistent across this range of uncertainties. It requires generating operating models using history and predictive scenarios. The approach requires management objectives that have been provided by TMGC and other management bodies. There is a risk of not finding a single management procedure that is robust against all uncertainty. It has the advantage that it does not need a single correct view of stock dynamics and it integrates both science and resource management through the development of management procedures and the metrics used to evaluate performance. There was discussion about how the operating models (OMs) could be narrowed down to a manageable number. Natural mortality, misreported catch and a combination of both could be used, for example. The focus should be on covering the largest uncertainties.

Both the Rose and the DLMTools approaches are labour intensive. The Rose approach has a much bigger workload over time since it requires running multiple models and, if retrospective patterns occur, multiple fixes. However, this approach can provide advice over multiple years. The DLMTools approach requires considerable work from both Science and Management in setting up the OMs, MPs and harvest control rules (HCRs). Once in place, it can be used on an annual basis to provide advice for several years before the OMs, MPs and HCRs need to be reviewed again.

The reviewers asked if the approaches were being suggested as an interim solution for providing cod catch advice since both approaches require considerable input and further work before they can be operational. It was noted that this could not happen before next year but that it was hoped it could be a bridging solution if a benchmark did not occur in the next few years. It could, however, be a longer term solution.

The workload required for both approaches was discussed again. The Rose approach represents a greater workload on an annual basis; however, it was noted that the DLMtools approach should not be used for a long period without reviewing the OMs, MPs and HCRs. The involvement of resource managers in the DLMtools approach was noted as a positive attribute. Again it was noted that the management procedure selected in the DLMtools approach would be applied annually whereas the Rose approach, with models that are performing well, could provide multiple years of catch advice.

It was observed that in many of the stocks where a MSE approach has been taken, the advice has tended to be very conservative in order for the advice to be robust to a wide range of uncertainties. It was noted that this might be the case with the DLMtools approach for cod. A lot of work might be required to get advice that cannot be used. If the OMs, MPs and HCRs are well thought through, this need not be the case.

The Chair summarised the discussion of the Science Staff, Designated Resource Managers, Reviewers and TRAC Co-Chairs and asked the group if they agreed that both approaches (Rose and DLMtools) are valid? There was consensus that both were valid approaches. The Chair then asked if one approach was preferred over the other. The group liked the clarity of setting up management objectives in the DLMtools approach and felt that, if TMGC and others were willing and able to put in the work required for setting it up, this approach would be preferred and would require less investment after the initial year. The workload with the Rose approach is heavy and does not decrease after the first year; however, the output is a lot more understandable to those outside Science. It was agreed that the DLMTools approach would be presented to the TMGC as the preferred approach. If the TMGC and resource management are unable to commit to the time requirement for providing the input for DLMTools, then the Rose approach could be pursued instead.

Other Meeting Participants

It was noted that the development of either of these approaches was more typical of the type of work that would be done for a benchmark. It was agreed that it could not be completed in time to provide advice next year and that a longer term goal, such as a potential benchmark in three or four years, was more appropriate. In the interim, unless something radically different shows up in the data, the catch advice need not change.

It was asked if the assessment team were considering using the current harvest strategy and fishing mortality reference point (F_{ref}) as a starting point for the DLMTools approach. DLMTools is a simulation approach and not a stock assessment model so the approach will not provide a measure that can be compared to the negotiated F_{ref}. It does not give stock status but instead tests the harvest strategy against the metrics that have been agreed to ahead of time. This means that TMGC will need to be willing to accept advice that is presented differently than they have received from VPA and ASAP models in the past. Concern was expressed that MSE-type processes are usually long and laborious and that agreement on management objectives is challenging with domestic stocks, let alone international ones. There was also concern expressed that it will take more than a year to get the required input for the MPs and Oms to start the DLMTools approach.

SUMMARY OF CONCLUSIONS FOR COD

In the absence of a TSR for cod, the assessment team was asked to summarise the advice and approach that will be followed until the next benchmark for this stock. The summary was reviewed, edited and accepted by the reviewers, science staff, designated managers and TRAC

co-chairs at the TRAC meeting. There was also consensus for the summary from all other meeting participants.

It was agreed that:

> Until a benchmark assessment occurs for Eastern Georges Bank Cod, the TRAC will annually update the biological and fishery indicators of the state of cod including condition factor, swept area survey biomass indices, fishery and survey catch at length, relative F, total mortality (Z), and catch and will identify and comment on any changes in these indicators. Evidence of a persisting large recruitment event or substantial change in biomass trends for all three surveys (DFO, NMFS Fall and Spring) over multiple years would trigger a discussion of catch advice in TRAC. In the absence of this trigger, the TRAC catch advice from 2018 will remain in effect until a benchmark occurs.

> In the interim, the DLM tools approach for providing catch advice will be pursued by the assessment team. TRAC advises that the development of the DLM tools approach would require the development of quantifiable management objectives by TMGC at an intercessional meeting in 2019. If TMGC provides these management objectives, the assessment team will develop candidate management procedures (harvest control rules) and proposed metrics to measure against the management objectives. This would then go back to TMGC for approval. The assessment team would continue development of operating models throughout this time period. This process would take several years with the goal of completion by the next benchmark.

DRAFT TERMS OF REFERENCE FOR 2020

The draft terms of reference for the 2020 meeting of TRAC were presented by the TRAC co-chairs, Kirsten Clark and Tara Trinko-Lake. The meeting is tentatively scheduled from July 7 to 9, 2020 in Woods Hole, MA. The draft terms of reference will be presented to TMGC for editing and approval.

CONCLUSIONS

The meeting chair and TRAC co-chairs thanked participants for attending this year's TRAC meeting. The TSRs for haddock and yellowtail flounder will be finalized by mid- to late-July 2019, based on discussion at the meeting, and they will be made available to participants on the NEFSC website: http://www.nefsc.noaa.http://www.nefsc.noaa.gov/saw/trac/gov/saw/trac/ and after translation into French, on the DFO TRAC website at http://www.bio.gc.ca/info/intercol/trac-cert/index-en.php.The TSRs and TRAC advice for cod will be presented at the September 2019 TMGC meeting. Working papers are to be revised, as recommended at the meeting, and published as TRAC Reference Documents in the coming months.

APPENDICES

APPENDIX 1. LIST OF PARTICIPANTS

Country	Name	Affiliation	Day 1 (Tues)	Day 2 (Wed)	Day 3 (Thurs)
US	Alexander, Terry	NEFMC	x	x	
Canada	Andrushchenko, Irene	DFO Maritimes	x	x	
Canada	Archibald, Devan	NGO			x
Canada	Barrett, Melanie	DFO Maritimes	x	x	x
Canada	Belliveau, Ray	Industry	x	x	x
US	Brooks, Liz	NOAA / NFMS / NEFSC	x	x	x
US	Christopher, Pete	NOAA (web)	x		
Canada	Clark, Kirsten	DFO Maritimes	x	x	x
Canada	Cooper-MacDonald, Kathy	DFO Maritimes	x	x	x
US	Cournane, Jamie	NEFMC	x	x	x
Canada	Couture, John	TMGC	x	x	
Canada	d'Entremont, Alain	TMGC Co-chair	x	x	x
US	Etrie, Libby	Industry	x	x	x
Canada	Faure, Anne	NGO	x	x	x
Canada	Finley, Monica	DFO Maritimes	x	x	x
Canada	Ford, Jennifer	DFO Maritimes	x	x	x
Canada	Greenlaw, Michelle	DFO Maritimes	x	x	x
Canada	Irvine, Fonya	DFO Maritimes	x	x	x
Canada	Karbowski, Chelsey	NGO	x	x	x
Canada	Keith, David	DFO Maritimes (Reviewer)	x	x	x
US	Trinko Lake, Tara	NOAA / NFMS / NEFSC	x	x	x
US	Legault, Chris	NOAA / NFMS / NEFSC	x	x	x
Canada	Martin, Ryan	DFO Maritimes	x	x	
US	McBride, Richard	NOAA (web)		x	
Canada	McCurdy, Quinn	DFO Maritimes	x	x	x
US	McNamee, Jason	NOAA / SSC (Reviewer)	x	x	x
US	Minkiewicz, Drew	Industry	x	x	x
Canada	Neilson, John	Meeting Chair	x	x	x
US	Nies, Tom	NEFMC	x		
US	Peros, Jonathan	NOAA / (web)	x	x	x
US	Roman, Sally	Academia	x		
US	Simpkins, Mike	NEFSC - NOAA	x	x	x
Canada	Smedbol, Kent	DFO Maritimes	x	x	
US	Stockwell, Terry	TMGC co-chair (web)	x		
US	Talmage, Spencer	NOAA (web)	x	x	x

Country	Name	Affiliation	Day 1 (Tues)	Day 2 (Wed)	Day 3 (Thurs)
Canada	Vascotto, Kris	Industry	x	x	x
Canada	Wang, Yanjun	DFO Maritimes	x	x	x

APPENDIX 2. 2019 TERMS OF REFERENCE

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

July 9-11, 2019
St. Andrews, NB
Canada

Meeting Chair: Dr. John Neilson

TRAC Co-chairs: Kirsten Clark (Canada) and Tara Trinko-Lake (United States of America)

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:

- Update the following biological and fishery indicators of the state of cod in the eastern GB management area with 2018-2019 data: condition factor, swept area survey biomass indices, fishery and survey catch at length, relative F, total mortality (Z), and catch.
- Identify and comment on changes in survey and fishery indicators (relative to the 2018 TRAC).
- Investigate alternative methodologies of providing catch advice, and report on the most promising approaches. Describe plans for further investigation of the identified approach, which will be reviewed at the 2020 TRAC and will then provide catch advice until a benchmark assessment can be completed for this resource.

Haddock:

- Apply the benchmark assessment for haddock to report on the status of the stock, updating results for the latest information from fisheries, including discard estimates and research surveys, and characterize the uncertainty of estimates.

- Describe any adjustments to the benchmark assessment model applied during the TRAC including impacts on advice given to TMGC.

- Evaluate and quantify, if possible, scientific uncertainty of the assessment output (stock status determination and catch projection), discussing current practices of characterization and alternative methods of evaluation.

- Provide analyses to account for retrospective bias on stock biomass and fishing mortality estimates for haddock, if appropriate.

- For a range of total catch values in 2020 and 2021, estimate the risk that the respective fishing mortality rate would exceed $F_{ref} = 0.26$ for haddock. Include a table showing the 2020 and 2021 catches corresponding to low (25%), neutral (50%), and high (75%) probability that the F would exceed $F_{ref} = 0.26$ for haddock.

- For a range of total catch values in 2020 and 2021, estimate the risk that the biomass at the beginning of 2021and 2022 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2020 and 2021 for haddock.

- In view of model diagnostics and model uncertainty, comment on whether two-year advice is appropriate.

<u>**Yellowtail Flounder:**</u>

- 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 2020 based on the empirical approach for a range of exploitation rates for 2020.
- Describe any adjustments to the benchmark assessment model applied during the TRAC, including impacts on the advice given to TMGC.
- Consistent with 2018 TSR, update and comment on trends in relative F, and total mortality (Z).
- Describe the rationale for the range of exploitation rates provided by TRAC as catch advice compared to previous guidance.

<u>**Allocation Shares:**</u>

- Review the biomass distribution relative to the U.S./Canada boundary, update results with the 2018 survey information, and apply the allocation shares formula.

<u>**Other:**</u>

- Report on any changes to the surveys that might impact the assessments such as changes to vessels, timing, area coverage, etc. Describe any potential impacts of these changes.
- Provide an update, if any are available, on targeted research that would help identify mechanisms contributing to changes in stock productivity
- Report on progress of the Atlantic Cod Stock Structure Working Group
- Draft terms of reference for the 2020 TRAC assessment of Eastern Georges Bank Atlantic Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder.
- Provide an update on research related to haddock growth.

Expected Publications

- **TRAC Transboundary Status Reports** for the Eastern Georges Bank Haddock and Georges Bank Yellowtail Flounder management units.
- **TRAC Reference Documents** for Allocation Shares, Eastern Georges Bank Haddock management unit, Eastern Georges Bank Atlantic Cod and Georges Bank Yellowtail Flounder management units.
- **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
- Public and stakeholders/rightsholders

APPENDIX 3. 2019 TRAC AGENDA

Transboundary Resources Assessment Committee (TRAC) Assessment of Georges Bank Yellowtail Flounder and Eastern Georges Bank Haddock and Exploration of Approaches for Eastern Georges Bank Cod

Harry Hachey Conference Centre
St. Andrews Biological Station
St. Andrews, New Brunswick, Canada
July 9th to 11th, 2019

DAY 1 (Tuesday, July 9, 2019)

Time	Topic	Leads
09:00 – 09:15	Welcome & introduction: TRAC Co-Chairs and Meeting Chair	Kirsten Clark (Cdn) Tara Trinko-Lake (US) John Nielson
09:15 – 10:15	Georges Bank Yellowtail Flounder Inputs: Commercial Fishery & Surveys	Chris Legault (US) Monica Finley (Cdn)
10:15 – 10:30	***Break***	
10:30 – 11:30	Georges Bank Yellowtail Flounder Empirical Analysis Discussion	Chris Legault (US) Monica Finley (Cdn)
11:30 – 12:00	Georges Bank Yellowtail Flounder Estimates from VIMS Industry-Based Scallop Dredge Surveys of Closed Area II and Surrounds	Sally Roman and David Rudders (US)
12:00 – 13:00	***Lunch***	
13:00 – 15:00	Eastern Georges Bank Haddock Inputs: Commercial Fishery & surveys Application of the VPA Formulation and VPA Projections	Monica Finley (Cdn) Liz Brooks (US)
15:00 – 15:15	***Break***	
15:00 – 16:00	Eastern Georges Bank Haddock continued Discussion	Monica Finley (Cdn) Liz Brooks (US)
16:00 – 16:30	Understanding the mechanism of somatic growth changes of Eastern Georges Bank haddock	Yanjun Wang (Cdn)
16:30 – 17:00	Allocation Shares	Melanie Barrett (Cdn) Liz Brooks (US)

DAY 2 (Wednesday, July 10, 2019)

Time	Topic	Leads
09:00 – 09:45	Summary of Day 1 and homework	John Neilson (Chair) Haddock and Yellowtail stock leads (Cdn and US)
09:45 – 10:05	Spatio-temporal changes in encounter probability of cod and yellowtail on Georges Bank	David Keith (Cdn)
10:05 – 10:30	Report on progress of the Atlantic Cod Stock Structure Working Group	Kent Smedbol (Cdn)
10:30 – 10:45	*__Break__*	
10:45 – 12:00	Eastern Georges Bank Cod Biological and Fishery Indicators Changes in fishery and survey indicators relative to 2018 TRAC	Melanie Barrett and Irene Andrushchenko (Cdn) Chris Legault (US)
12:00 – 13:00	*__Lunch__*	
13:00 – 15:00	EGB Cod Alternative methodologies of providing catch advice	Irene Andrushchenko (Cdn) Chris Legault (US)
15:00 – 15:15	*__Break__*	
15:15 – 17:00	Alternative methodologies of providing catch advice continued Discussion	Irene Andrushchenko (Cdn) Chris Legault (US)

DAY 3 (Thursday, July 11, 2019)

Time	Topic	Leads
09:00 – 10:00	Summary of Day 2 and homework	John Nielson
10:00 – 10:15	*__Break__*	
10:15 – 11:15	Review Georges Bank Yellowtail TSR	Chris Legault (US) Monica Finley (Cdn)
11:15 – 12:15	Review Eastern Georges Bank Haddock TSR	Monica Finley (Cdn) Liz Brooks (US)
12:15 to 12:45	Draft ToR for 2020 TRAC	Kirsten Clark (Cdn) Tara Trinko-Lake (US)
12:45 – 13:45	*__Lunch__*	
13:45 – 15:00	TSR Edits	Cdn & US editorial committee
15:00 – 15:15	*__Break__*	
15:15 – 16:00	TSR Edits and Wrap up	Cdn & US editorial committee