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CERT | *TRAC*

Comité d'évaluation des ressources transfrontalières

Comptes rendus 2014/02

Transboundary Resources Assessment Committee

Proceedings 2014/02

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

Report of Meeting held 23-26 June 2014

Stephen H. Clark Conference Room
Woods Hole Laboratory
Northeast Fisheries Science Center
Woods Hole, Massachusetts, USA

Meeting Chairpersons

L. O'Brien[1] and T. Worcester[2]

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

[2]Fisheries and Oceans Canada
Bedford Institute of Oceanography
Dartmouth, Nova Scotia, Canada

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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.

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ABSTRACT

The Transboundary Resources Assessment Committee (TRAC) met during 23-26 June 2014 in Woods Hole, Massachusetts, USA, to review updated assessments (through 2013) of Eastern Georges Bank Atlantic Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder and to consider a number of related scientific issues. Results of these assessments will be used by the Transboundary Management Guidance Committee (TMGC) in developing management guidance for the 2015 fishing year for these transboundary resources.

RÉSUMÉ

Le Comité d'évaluation des ressources transfrontalières (CERT) s'est réuni du 23 au 26 juin 2014 à Woods Hole (Massachusetts), aux États-Unis, pour examiner les évaluations actualisées (jusqu'en 2013) 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 2015.

INTRODUCTION

The Transboundary Resources Assessment Committee (TRAC) co-chairs, L. O'Brien (USA) and T. Worcester (Canada), welcomed participants to the June 2014 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 US / Canada 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 2014 TRAC Terms of Reference (ToR) received approval from the Canada / US Steering Committee, the Northeast Regional Coordinating Council (NRCC), the Gulf of Maine Advisory Committee (GOMAC), and the Transboundary Management Guidance Committee (TMGC).

Participants (Appendix 1) were reminded that the TRAC review process is two tiered, with assessment updates typically undertaken between more intensive benchmark reviews. A new benchmark for GB Yellowtail Flounder was established in April 2014; the benchmark for EGB cod was established in April 2013; the benchmark for EGB Haddock was established in 1998. Assessments are conducted annually for these three.

The ToR and agenda for the meeting are provided in Appendix 2 and Appendix 3, respectively. During the meeting, each working paper was presented by one of the authors and then was followed by a plenary discussion of that paper. Rapporteurs documented these presentations and discussions for the proceedings. Four reviewers were invited to participate in the review of the updated assessments: Heather Bowlby (Canada), Tim Miller (USA), Mark Showell (Canada), and Pat Sullivan (USA).

Draft ToR for the 2015 TRAC meeting, which will be held in St. Andrews, New Brunswick, Canada, are provided in Appendix 4.

Prior to the TRAC, US TRAC members participated in an Industry/Science meeting on 5 June, 2014 in New Bedford, Massachusetts to discuss data inputs to the assessments with industry. A list of attendees is provided in Appendix 5. DFO did not conduct a pre-TRAC meeting in 2014.

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 Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank Through Fishing Year 2015. TRAC Working Paper 2014/46.

Presenter: L. Van Eeckhaute
Rapporteur: T. Worcester

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. For Atlantic Cod and Haddock, the agreement is limited to the Eastern Georges Bank management unit (Department of Fisheries and Oceans (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 in the sharing formula to account for both historical utilization, based on reported landings during 1967 through 1994, and temporal changes in resource distributions, determined from National Marine Fisheries Service (NMFS) and DFO survey results that are updated annually. The initial (2003) sharing arrangement was based on 40% country utilization and 60% resource distribution. From 2010 onward, utilization will account for 10% and distribution for 90% of the allocation.

This report uses the 2013 DFO and NMFS survey results to update the calculation for the 2015 fishing year allocations. In 2013, cod was mostly found on the Canadian side of Georges Bank, especially during the NMFS fall survey. Haddock were more widespread in the NMFS surveys, but they were found primarily in US waters for all three surveys. Yellowtail Flounder were mostly on the Canadian side during the DFO survey but shifted into US waters for the NMFS fall survey.

After applying LOESS smoothing, using a 33-year time series (1981-2013), the resource distributions in 2013 were: 83% Canada, 17% USA for Atlantic Cod; 52% Canada, 48% USA for Haddock; and 33% Canada, 67% USA for Yellowtail Flounder. The 2015 fishing year allocations (calendar year for Canada; May 1, 2015, to April 30, 2016, for the USA), updated with the 2013 resource distributions, resulted in shares for Atlantic Cod of 81% Canada, 19% USA, for Haddock of 52% Canada, 48% USA, and for Yellowtail Flounder of 30% Canada, 70% USA.

Discussion

It was asked whether there was a potential copy error in Table 13. This was checked and it appears to be correct.

It was asked whether there is any requirement for stations to be evenly distributed between Canada and the US [in the DFO survey]. The response was that it is a stratified random design, but there are more stations on the Canadian side to increase precision of the estimates. The expectation is that there would be more variability in the US results given that there are fewer sets there.

It was reiterated that the survey is stratified based on area and depth.

TRAC PRESENTATION: EASTERN GEORGES BANK HADDOCK ASSESSMENT

Working Paper: Assessment of Eastern Georges Bank Haddock for 2014. TRAC Working Paper 2014/51.

Presenter: L. Van Eeckhaute
Rapporteur: L. Brooks

Presentation Highlights

The total catch of Eastern Georges Bank (EGB) Haddock in 2013 was 5,066 mt of the 10,400 mt combined Canada/USA quota. The 2013 Canadian catch decreased from 5,064 mt in 2012 to 4,631 mt while the USA catch in 2013 was 435 mt, a small decrease from the 2012 catch of 569 mt. Haddock discards from the Canadian scallop fishery and the USA groundfish, mid-water trawl and dredge fisheries were estimated at 10 and 91 mt, respectively. Under restrictive management measures, combined Canada/USA catches declined from over 6,504 mt in 1991 to a low of 2,150 mt in 1995, averaged about 3,600 mt during 1996 to1999 and have

generally increased since then. Catches reached a peak in 2009 at 19,855 mt and have declined since then as the outstanding 2003 year class moved through the fishery.

The length frequency of landings peaked around 40.5 to 42.5 cm, consistent with the dominance of the 2010 year class in the landings; however, the 9+ group dominated the first calendar quarter of the Canadian fishery and the first two quarters of the US fishery.

Stock status was based on results from the VPA that used the same formulation as the 2013 assessment. Adult population biomass (ages 3+) has increased from near an historical low of 10,300 mt in 1993 to 76,500 mt in 2003. It decreased to about 53,000 mt at the beginning of 2005 but subsequently increased to 121,500 mt in 2009, higher than the 1931-1955 maximum of about 90,000 mt. Adult biomass then decreased to 40,600 mt in 2012 but increased in 2013 and again in 2014 to 160,300 mt. The exceptional 2003 and 2010 year classes, estimated at 243 million and 334 million age-1 fish, respectively, are the largest observed in the assessment time series (1931-1955 and 1969-2013). The preliminary estimate for the 2013 year class is 1,546 million fish at age 1. Except for the strong 2000 and 2011 year classes and the exceptional 2003, 2010, and 2013 year classes, recruitment had fluctuated between 2.1 and 27.3 million since 1990. Fully recruited fishing mortality fluctuated between 0.27 and 0.47 during the 1980s, and increased in 1993 to a high of 0.55, the highest observed. Fully recruited fishing mortality was below F_{ref} = 0.26 during 1995 to 2003, fluctuated around 0.3 during 2004 to 2006, then declined and stayed below F_{ref} and was 0.16 in 2013.

Positive signs of productivity include expanded age structure, broad spatial distribution, large biomass, as well as three exceptional year classes and two strong year classes since 2000. On the negative side, condition has decreased substantially and size at age has declined. Year class strength from high spawning stock biomasses in the 2000s has been variable. Retrospective analysis shows that biomass is overestimated, F is underestimated, and recruitment is overestimated relative to the most recent assessment. The 2010 and 2011 year classes are both estimated about a third smaller than the retrospective estimates for the previous year.

A catch projection and risk analysis for 2015 were presented using the results from the VPA. The 2003 year class values were used for the 2010 year class for weights and partial recruitment due to similarity in growth, and the 2010 year class values were used for the 2013 year class. The most recent 3-year survey and fishery average weights at age were used as inputs for other year classes except for the 2011 year class where the average of the 2009 and 2007 year classes was used. Fishery partial recruitment (PR) was based on the 2003 to 2013 population weighted average. The PR used for the age 9+ group was 0.3, which is consistent with the model. Assuming a 2014 catch equal to the 27,000 mt total quota, a combined Canada/USA catch of 44,000 mt in 2015 results in a neutral risk (50%) that the 2015 fishing mortality rate would exceed F_{ref} = 0.26. The 2010 year class at age 5 is expected to contribute 85% of the catch biomass and the next highest contribution at 6% is expected from the 2011 year class at age 4. Biomass at the beginning of 2016 is projected to be 568,200 mt fishing at F_{ref} due to the contribution from the outstanding 2013 year class.

Discussion

A question was asked about the performance of the procedure used to allocate landings of Haddock to EGB, rather than just to GB. Three documents were uploaded to the shared drive; two documents detailed the allocation procedure for landings at the stock level; a third document explicitly summarizes the matching of landings from EGB at the A level.

A question was asked about observed catch vs. predicted catch (from previous projections) and if there was something that caused the fishery to change. It was hard to explain, but it was

suggested that perhaps larger fish were not as available in the second half of year because of spawning.

A question was asked about whether the discrepancies between observed and expected selectivity this year were worse than in the past. In response, it was noted that there has been a trend since 2011 where age 9+ observed selectivity has been lower than predicted but this discrepancy is the largest so far. In addition, there was a change in minimum size (from 18 to 16 inches, effective July 2013) for the USA fishery that may have contributed to the discrepancy in observed vs. expected PR.

A question for clarification was asked regarding the quota plot; it was noted that the calendar year was used for all values, but the quota values were for fishing year.

It was noted that several corrections were made to previous index values. A request was made to explore how much of a difference was caused when those corrections were made. New runs were performed to evaluate the impact.

With respect to growth, it was noted that the large year classes are not increasing in size beyond age 7 or 8. It was explained that this is typical of Haddock, not just those in the large year classes. The notable feature of the larger year classes is that their growth asymptotes at a lower maximum size.

Canadian fishery weights were derived with a weight-length relationship from 1985. Given the change in Fulton's K, it was asked whether that relationship should be re-estimated. The response was that it is on the 'to do' list.

It looks like Canadians were usually close to catching their quota, but, in the last 2 years, it appears that Canada has had trouble catching its quota. Also, it was noted that the longline fleet is not fishing Georges Bank (because of problems avoiding cod), so their part of quota is not being fished. Also, the mobile fleet expected the fish to reach the bank in fishable size, but they returned later than expected and weather was not favorable at that time; a big part of that is the lack of 9+ fish being available to gear.

More detail was sought regarding the pattern of catches of Haddock from DFO survey that are west of 5Zjm area. Specifically, the question was asked whether, in the fall survey, there is evidence that the distribution was further west than in the past. The response was that this has not been evaluated.

There was substantial discussion about the bootstrap approach, bias correction, and variance. The bootstrap came from 1000 resamples of residuals from each survey. It was noted that DFO applies a bias correction between the model point estimate and the bootstrap estimated bias. The bias correction is not made in the USA software used to conduct the assessment of Yellowtail Flounder. A point was made that, unless the bias is very large, it is often not worth making the bias adjustment because of the increase it causes in variance. In general, it appears that bias is relatively minor for older ages and only appears substantial for the first couple of age classes. It was recommended to reconsider the practice of bias adjustment at some point in the future. For the present, it was suggested that it would be useful to simply note the value of the calculated bias.

There were some questions about the retrospective plots. It appears that there is a retrospective in the spawning stock biomass (SSB) estimate. It was pointed out that the SSB is only shown for ages 3-8, rather than 3-9+, and it was not clear how the plot would change (including 9+ would then have the 2003 year class in that SSB). Furthermore, among the peels, there does not appear to be a retrospective because all but the last peel hang together; between the last assessment and this assessment, something is different.

It was noted that since the calibration from the *Bigelow* to *Albatross IV* has been in effect, it seems more biomass is being observed at younger ages. It was asked whether 2.6 is the appropriate value to calibrate the fall index (especially for the young of the year). In response, it was explained that the calibration is fixed for sizes <18 cm because there was not a strong year class in the water when the calibration experiment was performed; consequently, there were insufficient observations to reliably estimate a calibration factor for those smaller sizes.

There was substantial discussion about the weights at age (WAA) being used in the assessment. Looking at growth curves for strong year classes, they plateau by age 8 or 9, so why does weight increase for the projected WAA between age 8 and age 9? What is the WAA in the fishery and survey? Are the assumptions consistent with the condition factor trend? Looking at cohorts down the diagonal for assumed WAA, they shrink because the projected WAA is smaller at subsequent ages—how do you explain this? The 2014 number at age (NAA) at 9+ is huge, so the WAA for that group is very important. The same point can be made for the 2010 year class; the assumed WAA increasing suggests stronger growth than surrounding year classes. The PR for 9+ WAA is 0.3, so it will not affect catch, but it will have a huge impact on estimated SSB. The weights assumed for the 2010 year class are the values obtained by the 2003 year class. The Jan-1 WAA are from the survey, not from the fishery, so the length-weight equation does not impact these values. A follow-up question was asked about how well predicted WAA (in recent assessments) compared to observed WAA (from this year's assessment). This was examined and reported back to the group; some of the projected WAA were larger than observed.

Regarding projection assumptions, it was noted that in the current fishing year the Canadian fishery is introducing a change in mesh to 145 diamond from 130 square, and the new gear seems to have higher proportion of fish in 40-45 cm range. In response, it was suggested that that is the size range of the exceptionally large 2010 year class, and rather than that being a gear availability effect, it simply reflects the most abundant size group of fish.

There was a lot of discussion about the poor performance from the 2012 projection. We appear to have caught half the fish we expected, and we ended up with half the biomass that was projected. That would have been problematic for a stock in worse shape. Is the margin of error due to inputs, data revisions, or assumptions? How does that impact our decisions this time about projections? It was noted that biomass estimates were good in the past because there was no retrospective. This year, the pattern changed in the most recent assessment, and that may explain why the projections were off.

The estimate of the 2013 year class is astronomical, five times higher than the 2010 year class, which was not considered to be realistic. It was suggested that some sensitivity analyses be conducted on these large year classes. There are different ways of doing this. Last year, TRAC looked at different PRs for the 2003 year class. TRAC could also assume the 2013 year class is the same size as the 2010 year class (70% reduction). This was done, and the catch advice is summarized for this case. Other sensitivities explored were to down weight the 2013 year class by 30% and 50%.

It was asked if TRAC could be shown how the 2003 and 2010 initial estimated year class size has changed with updated assessments. This was done and summarized; there was substantial revision between initial estimate and subsequent estimates.

Another sensitivity was suggested where the fall survey result and the 2014 survey points for the 2013 year class were dropped. The intention was to examine this, but the group decided that there was insufficient time to explore this on the final day of the TRAC, and they believed that the sensitivity analyses already conducted to scale the 2013 year class down would likely capture the range of uncertainty.

A question was asked about the assumption for F in the terminal year for the plus group. It was explained that F on age 8 is set equal to the weighted F of ages 5, 6, and 7 for 2002-2013; for 2002 and prior, it is set equal to the weighted F for ages 4, 5, 6, and 7.

TRAC PRESENTATION: GEORGES BANK YELLOWTAIL FLOUNDER ASSESSMENT

Working Paper: Stock Assessment of Georges Bank Yellowtail Flounder for 2014. TRAC Working Paper 2014/47.

Presenter: C. Legault
Rapporteur: B. Linton

Presentation Highlights

The combined Canada/USA Yellowtail Flounder catch in 2013 was 218 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, all three bottom trawl surveys declined to low values relative to their entire time series, and catch curve analyses indicate high total mortality rates (Z>1). All three bottom trawl surveys indicate below average recruitment recently. The declining trend in survey biomass in recent years to low levels, despite reductions in catch to low amounts, indicates a poor state of the resource.

This assessment updates the Split Series and Single Series virtual population analysis (VPA) formulations that were approved at the last benchmark assessment to estimate stock size and fishing mortality. It also adds four additional VPAs with M increased to 0.4 for the entire time series, and M increased to 0.4 for years 1973 to 2004 and increased to 0.9 or 1.0 for years 2005 onward in response to recommendations made at the 2014 Diagnostic Benchmark. All four constant M VPA formulations exhibit strong retrospective patterns and rho adjustments are recommended for both determining stock status and providing catch advice from these runs, while the increased M since 2005 VPA formulations do not exhibit retrospective patterns. Catches of less than 100 mt up to 300 mt are required to achieve the TMGC objective of not overfishing, but this advice does not account for the guidance to reduce the fishing mortality rate when stock conditions are poor.

The empirical approach recommended at the 2014 Diagnostic Benchmark was applied. The three recent bottom trawl surveys were scaled to absolute biomass estimates, averaged, and an exploitation rate of 25% was applied to generate catch advice of 553 mt. This amount of catch is greater than one of the individual surveys. There are also a number of sources of uncertainty that need to be considered, the most important being the exploitation rate to apply.

At the TRAC meeting, the decision was made to not use the VPA assessment model to evaluate stock status or provide catch advice. Instead the empirical approach was used to provide catch advice. The exploitation rate recommended for use with the empirical approach was changed from 25% to a range of 2% to 16% to be more consistent with the Eastern Georges Bank cod approach of reducing target F when M increased in recent year. This resulted in 2015 catch advice of 44 mt to 354 mt. Alternatively, a constant quota approach could be used, which would result in 2015 catch advice of 400 mt or less.

Discussion

[Editor's note: Discussions regarding the Georges Bank Yellowtail Flounder assessment and catch advice were particularly difficult this year due to the two benchmarks. For this reason, a longer and more complete record of the discussion is included for this stock than is typical.]

Data

Question: Did the catch curve analysis include all ages, or were some younger ages excluded? Response: A starting age of 3 was used for this analysis. Other starting ages were explored, and they all gave qualitatively similar results.

Question: Is the difference between Canadian and USA commercial landings due to spatial coverage issues? Response: Canadian landings have been low since 2003 because the Canadian fishery has been unable to find yellowtail. The USA fishery does not directly target yellowtail due to Closed Area II, except in a couple of years. Therefore, the difference is more of a fishery issue than a spatial coverage issue.

Question: There were no observer trips in the Canadian scallop fishery in September 2013 when effort was relatively high. If there were no observed trips, then how does the September discard rate get estimated? Response: Discard rates are estimated using a three month moving average. Therefore, the September discard rate is estimated using observed trips from August and October. In addition, trip month assignment is based on boarding date, which means a trip boarding in late August would catch most of its scallops in September. In the past, the total annual discard rate has been used to fill empty cells, and this gave similar results to the three month moving average approach.

Question: How are observers assigned to Canadian scallop trips? Response: It is supposed to be done randomly, but there has been low coverage in the southern area. Coverage of the southern area has improved recently, particularly in last two years. There also is an issue with the temporal coverage of observers. Observer coverage tends to be higher at the beginning and end of year relative to the middle of the year.

Question: How is Canadian observer coverage calculated? Response: Canadian observer coverage is calculated by dividing observer effort by fleet effort, both of which are reported in hours.

Question: Do the lower levels of discards in the Canadian scallop fishery relative to USA discard levels make sense given steps taken in the USA scallop fishery to reduce discards, and what steps have been taken by the Canadian scallop fishery to reduce discards? Response: The Canadian scallop fishery has used avoidance areas in peak months to reduce discards. Effort is estimated differently by the USA and Canada, which makes it difficult compare the two. USA and Canadian effort estimates should be put on the same scale, so that they can be compared. The data to do so exist and just need to be compiled.

VPAs

Question: In Single Series M0410 and Split Series M0409, were the post-2005 higher Ms only applied to older fish? Response: No, the higher Ms were applied to all ages. The presence of *Ichtyophonus* in the population is one possible explanation for increased M in recent years, but it is not the only possible explanation.

Two separate decisions were made regarding M at the empirical benchmark. First, based on several life history analyses, the decision was made to increase baseline M from 0.2 to 0.4. Second, the decision was made to further increase M in the recent time period, but no specific value for the higher M was decided upon. We profiled over different M values and selected M values that removed the retrospective pattern. Therefore, this exploration was more about removing the retrospective pattern, and less about modeling a causal mechanism.

Question: Why was 2005 chosen as the change point for M in Single Series M0410 and Split Series M0409? Response: The decision to increase M starting in 2005 came out of an analysis

that was done for the 2012 TRAC, where 2005 was the change point. That change point was carried forward in this analysis, but another change point could be used.

Question: Do the high recruitments predicted by Single Series M0409 and Split Series M0410 match up with the high DFO survey index values in 2008 and 2009? Response: No, they do not match up, and the high DFO survey values were high across all ages not just the recruits.

Question: Would large residuals in the age composition be expected due to those large predicted year classes in Single Series M0409 and Split Series M0410? Response: No, M is also high, so those year classes disappear quickly.

Question: While the change in M resolves the retrospective pattern, the resulting F series does not match the pattern in relative F. Would shifting the M change point earlier in the time series lead to a better match between predicted F and relative F? Response: It might. TRAC has not explored that yet.

Question: Is there some measure of uncertainty around the biomass estimates from the VPA? Response: Uncertainty estimates only exist in the last year. There are no uncertainty estimates for the rest of the time series (i.e., variance is effectively 0) because these are VPA estimates.

Question: The independent point estimates of biomass from the empirical benchmark are conditioned on the assumed selectivity. What selectivity assumptions were made to generate these point estimates? Response: Some of the biomass point estimates are specific to certain size ranges. For other point estimates, it is unclear to which sizes they apply.

Different biomass point estimates in the same year do not always agree with each other. Therefore, the uncertainty of those point estimates (represented by the error bars) is likely underestimated.

Question: Some of the VPA biomass estimates are higher than the independent biomass point estimates. Would that be grounds for rejecting those runs? Response: No, the rejection criteria based on the biomass point estimates are directional. The biomass point estimates represent the biomass in portions of GB, not all of GB (except for one of the point estimate). Therefore, the VPA estimates should be greater than the independent point estimates. This is just a diagnostic to see if the VPA is producing biomass estimates that are unrealistically low.

Question: If the survey indices were derived only using stratum 16, would they look different from indices derived using all strata? Response: The indices would look the same since the 1990s because stratum 16 is where the yellowtail are concentrated. Prior to the 1990s, the indices might look different.

Question: What M was used for the yield per recruit (YPR) analyses for Single Series M0409 and Split Series M010 scenarios? Response: The final M values (0.9 and 1.0, respectively) were used when estimating YPR.

Question: Age 2 seems young for reaching 50% maturity. Is that realistic? Response: Several analyses have indicated the early maturation of GB yellowtail. This early age of maturation has been consistent over time; it is not just a recent phenomenon.

Question: According to the Split Series M02 projections, it looks like 400 mt would be caught in 2014 and the rest of the fish would be caught in 2015. Is that correct? Response: That is not quite correct because that is looking at the 3+ biomass. There is also incoming recruitment to replace those losses, but it still is a perilous situation.

Question: The recruitment assumption (10 year geometric mean) used in projections gives unrealistic increases in biomass. What level of recruitment would produce stable biomass levels? This would give an idea of how much we might be overestimating recruitment.

Response: For Single Series M0409 and Split Series M0410, it would have to be reduced quite a bit, but we do not know by how much. For Single and Split Series M02 and M04, it might take half as much as recruitment as is currently used. Also, what is assumed about recruitment does not affect the catch advice, just the projected biomass trend. In general, the geometric mean recruitment is anywhere from 2 to 6 times higher than the most recent three years of recruitment. You could use most recent recruitments to inform the projections, but those final recruitments generally are poorly estimated, because they are not well represented in the data.

Question: Do you have a recommendation on how to generate catch advice from the VPA? Response: If TRAC wants to go with a VPA run, then we should narrow down which run to focus on, and then determine an initial recruitment to plug into the projections. Again, the recruitment assumptions will not really change the catch advice, only the projected biomass.

Question: Will we need to reevaluate F_{ref} with these new VPA runs? Response: If we use Single or Split Series M04, Single Series M0409, or Split Series M0410, then $F_{ref} = 0.25$ is probably not appropriate. Even if F_{ref} is increased, for example, to $F_{ref} = 0.6$, then you still do not see large increases in catch.

Question: In the past, you would need to increase catch five-fold to remove the retrospective pattern. Have the catch multipliers changed with the new baseline M of 0.4? Response: The decision to go from M = 0.2 to 0.4 was not made based on dealing with retrospective, and that change alone did not remove the retrospective pattern. The M multiplier was introduced to address the retrospective pattern. A catch multiplier could also be used to address the retrospective pattern, but that has not been explored yet.

Empirical Approach

The empirical approach catch advice is greater than the actual catches, and the actual catches are still leading to declining biomass. That suggests the empirical approach may not be appropriate for setting catch advice in this situation.

TRAC Discussions and Decisions

As a straw-man, a suggestion was made to use the rho-adjusted Split Series M04 for catch advice. The Split Series models were introduced to remove the retrospective pattern, but are currently unsuccessful at that task. Therefore, it might make more sense to use a Single Series formulation of the VPA. There is no a priori reason to choose Split over Single Series.

Questions: What is the role of the reviewers in this situation where there are two benchmarks (i.e., the model benchmark and the empirical benchmark)? Do we have to rely on one or both of the benchmarks, or can we deviate from them and generate catch advice as we feel is best? The ToR says that we need to use the benchmarks. The empirical approach can be rejected, used alone, or in conjunction with the VPAs for catch advice. Response: There has been a history of modifying the benchmark model as necessary. For background, the last model benchmark put forward the single series model, a minor change model (i.e., single series with expanded ages and no plus group), and a major change model (i.e., split series with expanded ages and a nonlinear relationship between the indices and population abundance). When updated that next year, the major and minor change models had problems. Therefore, the ages were collapsed back into an age 6 plus group, and the nonlinearity assumption was removed. These modifications left only a single series model and a split series model, which went forward into later assessments.

It appears that M = 0.2 is no longer on the table. Therefore, it would make sense to proceed with baseline M = 0.4, then decide whether or not M has increased in recent years. Based on

that decision, the appropriate Single and Split Series models would be used to generate catch advice.

There are problems with all of the VPAs. The Single and Split Series M02 and M04 runs produce biomass estimates that are generally less than the independent biomass estimates. The Single Series M0409 and Split Series 0410 estimated recruitment series that are not supported by the observed data.

At the empirical benchmark, a 25% exploitation rate was found to be robust to different M values for setting catch advice. Now that baseline M has been increased to 0.4 and new data have been added, the exploitation rates are sensitive to the M value selected, because $F_{40\%}$ increases more rapidly with increasing M compared to the empirical benchmark.

One option for moving forward would be to choose a preferred VPA and select an appropriate exploitation rate for the empirical approach, and then decide to use one or both to give catch advice.

Questions: How should we interpret point 2 of the ToR? Does the term "2005 benchmark" refer to the original 2005 VPA model or the annually adjusted models? Response: That ToR refers to the annually adjusted models. We should clearly document the changes that have been made to the original 2005 VPA model. Those changes are documented in Table 19 of the working paper.

Question: Is it correct that Single and Split Series M04 eventually reach the same biomass because they have converged? Response: Yes. Even the Split Series M0409 and Single Series M010 converge to the same biomass, but it takes them longer due to the higher Ms at the end of the time series.

We can probably pick apart each of the VPA runs. For example, the Split Series M04 is giving far less biomass than the industry survey estimates. Given this, it was proposed that the empirical approach should be used. Previously, we agreed to pick a VPA run(s) and then decide whether we should use it alone, use it with the empirical approach, or drop the VPA and just use empirical approach. Questions were asked about what information from the VPA, if any, was used in the empirical approach.

Question: Does the empirical approach incorporate uncertainty in catchability assumption? Response: No, but we could account for that uncertainty.

The VPA has not performed well since the benchmark. We should not abandon the VPA, but should use the empirical approach for catch advice. Remember that the empirical approach gives catch advice higher than the VPA advice. We do not have to use VPA to get the exploitation rate for the empirical approach. Expert opinion is used to determine exploitation rate for some Canadian stocks. It was asked whether this would be too big of a departure from the empirical benchmark.

The Split Series M0409 and Single Series M0410 should be taken off the table. It is interesting to know what level of M removes the retrospective pattern, but that should not be the basis for catch advice.

The VPAs have the ability to forecast stock dynamics, which allows you to explore different "what if" scenarios. The empirical approach lacks that forecasting capability. You just set your catch, and wait to see what happens next year.

Question: How was the 25% exploitation rate chosen for the empirical approach? Response: A mass balance analysis showed that all of the fish deaths could not be explained by the realized catch and assumed M. Therefore, M appears to have increased, but we do not know by how much. YPR/ total spawning biomass (TSB) averaged 25% for $F_{40\%}$ and $F_{0.1}$ over a range of Ms

(0.4-1.1), so the empirical benchmark did not need to pick a specific M value. YPR/TSB was no longer so robust when updated using Split Series M04. A change in the selectivity pattern led to more rapid increase in F relative to the increase in M. If you decreased F as M increased, then TSB would increase and YPR would decrease leading to even lower catch advice.

Neither the VPA nor the empirical approach inspires confidence. Catch advice from the VPA has failed to produce the desired response in the surveys. The empirical approach produces catch advice that is greater than the VPA advice.

Question: Could a control rule be constructed for empirical approach? For example, decrease catch if surveys continue to decline over X number of years. Response: Yes, we could construct an infinite number of control rules, but we do not have a clear way to pick between them. Normally, we would use a management strategy evaluation (MSE) to guide the choice. But you cannot conduct an MSE with the empirical approach, so it would be difficult to come up with anything other than an ad hoc control rule. If you do not have the information you need, then an ad hoc control rule might be adequate.

Question: How did the selectivity change with the update of the empirical approach? Response: Ages 4-6 are fully selected still, but selectivity for ages 1-3 increased.

The VPA identified that a change has occurred. The empirical benchmark allowed us to see what the data could tell us about that change. A lot of effort was put into understanding the survey Zs, but no smoking gun was found. Even though the exploitation rate is not as robust as at the empirical benchmark, the empirical approach can still be used with the exploitation rate conditioned on an assumed Z. The empirical approach cannot be used to forecast, but the VPA forecasts have not been reliable. If the group felt that the survey Zs are a valid measure of Z, then that could be incorporated into the empirical approach.

The Split Series M0409 and Single Series M0410 models apply the high M across all ages. Therefore, the models have to build up a lot of recruits for enough to survive to later ages. Question: Have you explored applying a lower M to younger ages (i.e., ages 1 and 2)? That might help with the extreme recruitment events. Response: We did not explore that, due to time constraints. Adding runs quickly increases the dimensionality of the analysis.

Question: Have you tried estimating the M in recent years? Response: In a previous TRAC assessment, a random walk was used to model M, and the estimates ranged from 0.2 to 1.7 with the higher M values applied to ages 3+. There does not seem to be enough information to pick a cut-off age for applying a higher M.

The VPAs are unreliable, but they are consistent in the direction of the bias. The biomass estimates are biased high, and the empirical approach produces catch advice that is greater than the VPA advice. So, while the VPAs are uncertain, they are not uncertain in all respects.

Currently on the table for the VPAs are the rho-adjusted Split and Single Series M04 runs and four increasing M runs: Split Series M0409 and Single Series M0410, both rho-adjusted and unadjusted. The Split Series M0409 and Single Series M0410 models can be thought of as another form of rho adjustment, because M was selected to remove the retrospective pattern.

Question: What was the M estimated from the tagging analysis? Response: A number of M estimates were produced (e.g., by sex, by open/closed area). The estimates covered a wide range of values, but were higher than 0.4. The analysis only provides estimates for the recent time period, so the analysis cannot show whether or not M has increased in recent years.

The TRAC agreed to drop the four Split Series M0409 and Single Series M0410 runs, because they have no technical basis.

The Split Series runs were created to address the retrospective pattern, yet those runs still exhibit a retrospective pattern, so it is unclear why the Split Series models are still being carried forward. The Split Series runs have a retrospective pattern now, but back in time the split did help correct some of the retrospective pattern. The Split Series runs also have lower Mohn's rho values than the Single Series runs. However, there is no empirical evidence for a split, and no need to include one if it does not improve the current situation. One option would be to carry both the Split and Single Series forward along with the empirical approach, but not use any of them for catch advice. Instead, we could recommend a constant quota set below the level of recent catches.

Question: Have you looked at moving split forward in the time series? Response: No, we have not explored that due to time and dimensionality constraints.

Question: Why was the split placed in 1995? Response: An analysis identified that time period as a time of change, but no mechanism for that change was identified.

Single Series M04 and Split Series M04, when rho-adjusted, produce terminal biomass estimates below most of the independent biomass point estimates.

The Split Series M04 biomass trend appears to match the survey trend of declining biomass better than the Single Series M04.

The Split and Single Series M04 models produce catch advice lower than recent realized catches. But that catch advice assumes F = 0.25, which may not be appropriate with the new M = 0.4.

The Single and Split M04 runs were chosen as the VPA models to carry forward for comparison with the empirical approach. Both M04 runs fail the partial survey comparison and exhibit strong retrospective patterns.

Question: What happens if we decide to reject the VPAs? Response: We would fall back on the empirical approach or reject the empirical approach as well and develop a new approach at this meeting.

A constant quota approach was proposed. Holding catch constant for a time would eliminate one source of uncertainty, making it easier to detect any response by the stock. The VPA runs suggest that catches should be lower than recent quotas, while the empirical approach produces higher quotas.

It was asked how TRAC would track stock status and determine reference points if the VPAs were rejected. If you cannot track status, then you cannot comply with the Magnuson-Stevens Act. The VPAs could be carried forward for this purpose, with the acknowledgment that the existing issues still need to be addressed.

There still seems to be a scale issue with the VPAs, because the biomass estimates are less than the survey biomass estimates as well as the independent biomass estimates. You need to be careful when looking at Table 17 because the fall survey is lagged by one year. Also, we should not cherry pick survey biomass estimates, but we should consider the variability across surveys. The empirical approach does this by averaging the three survey biomass estimates.

The VPAs and empirical approach could be used to provide bounds on the catch advice.

It was asked whether consideration was given to averaging survey index values across years for the empirical approach, to smooth over inter-annual variability. The response was, yes, that had been considered, but it was decided to follow the simple recipe in the end.

It was asked how a rebuilding plan would be formulated if the VPAs were rejected. The old B_{msy} estimate is no longer valid with the change in baseline M to M = 0.4. The rebuilding year (i.e., 2032) is so far in the future, that no rebuilding projections were considered.

We will still be collecting data every year, and can continue to monitor survey Zs and other data signals. As long as the conflict between F and Z remains, the VPA will continue to have problems. Therefore, we do not need to rerun VPAs ever year, until the conflict in data signals is resolved.

Question: How do the Split Series M0409 and Single Series M0410 runs compare to the empirical approach results? Response: It is a case of comparing apples to oranges because the exploitation rates are not the same. If you used similar exploitation rates, then the results likely would be similar.

It might be best to go with a constant quota until the data suggest that an analytical approach has a chance to work.

The empirical approach recipe can be adjusted to deal with the fact that the 25% exploitation rate is not as robust as first thought. You can choose an appropriate higher M, which would likely give you an exploitation rate around 10%. Catch advice would be generated using that new exploitation rate.

We should avoid inconstancies between the advice we offer for cod and yellowtail. For cod, we are decreasing F as M increases. For yellowtail, we are increasing F as M increases. That inconsistency in advice would be hard to explain.

It would be good to keep the VPAs because they provide an idea of what is going on in a broad sense. We could do so without using them for catch advice. On the other hand, if the VPAs are not being used for anything, then time and energy could be directed elsewhere. Just looking at the raw data could provide the same information. Keeping the VPA model also keeps the same debate and discussion coming up over and over again every year. The model allows for exploration of the data in ways that just looking at the data might not. The mass balance analysis basically provides the same information as the VPAs.

The TRAC decided to reject the VPAs for catch advice.

List of quantities to monitor each year:

- Survey trends
- Survey Z
- Age structure of surveys and catch
    - Particularly recruitment events

Question: If we proceed with annual data monitoring, then should we have some kind of control rule to suggest what to do if things change? Response: Specifying a constant quota is one way forward. We also could average surveys, calculate percent change in the average survey each year, and adjust catch by that percentage.

Work has been done to look at control rules for data and information poor stocks, but those techniques assume the stock will respond to changes in catch (e.g., decrease catch and biomass increases). We do not see that kind of response in yellowtail. We keep decreasing catch, but the survey indices continue to decline.

Main issues with the empirical approach:

- Uncertainties in survey indices and catchability are not accounted for in the simple recipe.

- One of the surveys has swept area biomass estimates less than the catch advice.
- The empirical approach catch advice exceeds the catch advice from the VPAs.

Options for providing catch advice:

- Use current empirical approach.
- Adjust the exploitation rate from 25% to a more appropriate value.
- Specify a constant quota.
- Calculate an exploitation rate from current catch/current survey.

Ratios of quotas to average survey biomass estimates have ranged from 10% to 36% across recent years, while ratios of realized catch to average survey biomass have ranged from 4% to 16% across recent years.

Question: How was the catchability value (0.37), which is used to scale the survey indices, derived? Response: It is a literature value that comes from two studies: one study in Alaska and another in the North Sea. A survey is planned to obtain an empirical estimate of the catchability of our survey gear.

Question: Did $F_{0.1}$ show a similar response as $F_{40\%}$ when empirical approach was updated (i.e., F increased more rapidly with increasing M)? Response: Yes, $F_{0.1}$ showed the same response as $F_{40\%}$ when the empirical approach was updated.

The VPAs suggest that the survey selectivities are domed, so it was asked why we are using flat-top selectivity for the empirical approach. The empirical approach partial recruitments come from the fishery, which is flat-topped in the VPAs. The only evidence for domed survey selectivity comes from the VPAs that the TRAC rejected. Then the fishery selectivity pattern used in the empirical approach is also suspect because it comes from the VPAs.

To be consistent with the cod assessment, F should be held constant or decrease with M increasing, which would produce decreasing exploitation rates. This would give you exploitation rates around 5%, which is similar to what we see looking at realized catch/average survey biomass, but we still need to specify an M to obtain an exploitation rate.

There should be information in the mass balance analysis to help us determine an appropriate M. We also could use survey Zs to get a handle on M. Survey Zs are around 1.0. Even with an M from the survey Zs, there is still the issue of using partial recruitments from the VPA. The issue is with the inputs to the empirical approach, not with the approach itself.

We should make it clear that we are talking about constant quotas not constant catch. Otherwise, we can end up in a feedback loop where the quota is lowered when the catch comes in under the previous quota. The difficulty with a constant quota strategy is determining at what level to set the quota, given that the survey indices continue to decrease even as realized catches decrease. You also need to determine how long to specify the constant quota to see a response by the stock.

One option for calculating an exploitation rate for the empirical approach would be to take a straight average of quota/average survey biomass across years, which gives an exploitation rate of 17%. It is risky to take straight average across years, when the stock has declined so much over that time period (i.e., from around 20,000 mt to around 2,000 mt).

It would be helpful for the TMGC to have some flexibility in setting catch advice. Perhaps the TRAC could provide a range of possible exploitation rates.

It would be helpful to list the pros and cons of constant quota and constant exploitation rate (i.e., empirical approach) strategies.

Constant quota:

- Reduces source of variability, would hold quota constant and then see how the stock responds.
- Risk is that the quota does not respond to changes in biomass.
  - If set too high, drives stock down.
  - If set too low, then forgoing yield.
- It is hard to figure out when to change the quota.

Constant exploitation rate:

- Responds to changes in biomass.
- It is hard to choose an exploitation rate to apply.
- There is uncertainty in survey indices and catchability.

A straw man proposal is to set a constant quota around 200-300 mt (i.e., less than recent realized catches). It might be more appropriate to set a constant quota at the current quota (i.e., 400 mt).

The YPR analysis shows that the expected number of spawning events is less than 1.0 for M ranging from 0.4 to 1.1.

We could use the range of YPR/TSB across the range of M values from the YPR analysis as the range of possible exploitation rates (7-21%) for the TMGC.

When F is set to 0.1 then YPR/total spawning biomass (TSB) ranges from 2-5% over the range of M, and the expected spawning is slightly above or below 1.0, depending on the M value.

If you use the current F_{ref} = 0.25 with results from the Split Series M04 model in the YPR analysis, then YPR/TSB range from 3-11% across the range of M. These ratios could serve as a limit for exploitation rate.

Question: Was M = 0.4 an empirically derived quantity? Response: It is the central tendency from a broad range of M values from various life history and tagging study analyses presented at the empirical benchmark. If you follow the rule of thumb that F should not exceed M, then the YPR analysis says that the exploitation rate should not exceed 16%.

We could combine criteria such that F cannot exceed M, and that you have an expected spawning of at least 1.0, which would lead to an exploitation rate less than 11%.

It was asked why we are looking at M = 0.4, when survey Zs indicate that M is higher.

We can present the TMGC with either a range of exploitation rates or a maximum exploitation rate. We should provide a rationale for the range, and discuss the implications of selecting values from the upper and lower ends of the range

The TRAC decided to recommend exploitation rates ranging from 2-16% based on YPR/TSB from the Split Series M04 run with average weight at age, maturity, and Ms ranging from 0.4-1.1.

- If M = 0.4 and very low F, then expected spawning = 1.0 and YPR/TSB = 5%.
- If M = 1.0 and very low F, then expected spawning < 1.0 and YPR/TSB = 2%.
- If M = 0.4 and F = 0.4, then expected spawning < 1.0 and YPR/TSB = 16%.
- If M = 0.4 and F = 0.25, then expected spawning = 1.0 and YPR/TSB = 11%.
- If M = 1.0 and F = 0.5, then expected spawning < 1.0 and YPR/TSB = 7%.

This approach uses information from the VPA along with empirical approach, and can be considered a combination. This still is the same empirical approach presented before. We just are updating how the exploitation rate is selected.

If we assume Z = 1.0, then YPR/TSB ranges from 2- 21% for different combinations of F and M, with YPR/TSB decreasing as M increases.

We should note that the exploitation rate associated with a constant quota of 400 mt is 14%.

Question: Is expected spawning >= 1.0 a goal we are trying to achieve? Response: An expected spawning value less than 1.0 does not necessarily mean that the stock will collapse. We do not know what value of expected spawning is needed to sustain the stock. It is a measure of risk that we want to report, but we do not know exactly how to interpret it. It was asked whether we should report expected spawning, if we cannot clearly explain it. We can report the actual values of expected spawning, and allow them to represent a relative measure of risk associated with the different exploitation rates. Expected spawning does provide a relative measure of the stock's productivity and ability to rebuild.

For reference, we should note that if M = 0.4 and F = 0, then expected spawning = 1.4. Likewise, if M = 1.0 and F = 0, then expected spawning = 0.25.

It would be helpful to report Z values along with M, F, expected spawning, and YPR/TSB. We could select a range of likely Zs, and then only report exploitation rates that fall within that range of Zs. It does not make sense to report exploitation rates associated with Zs that we do not think are realistic.

A summary of things we know about the stock:

- Survey indices are declining
- Declines cannot be explained by catches and assumed M
- Even as catches decline, the survey indices continue to decline.

We need to narrow things down and be specific, based on what we know.

YPR/TSB values of 2-16% results in catch advice ranging from 44 mt to 354 mt. The constant quota of 400 mt is similar to the catch advice associated with YPR/TSB = 16%. The risks associated with the constant quota could be folded into the discussion of the constant exploitation rate.

Remember that the TSR will be going to the SSC as well as the TMGC, and that the two groups may not agree on their acceptance of the assessment. We should try to be clear when writing this up to help foster agreement.

TRAC PRESENTATION: EASTERN GEORGES BANK COD ASSESSMENT

Working Paper: Assessment of Eastern Georges Bank Cod for 2014. TRAC Working Paper 2014/49.

Presenter: Y. Wang
Rapporteur: T. Worcester

Presentation Highlights

The combined 2013 Canada/USA catches were 463 mt, which was the lowest in the time series. Catches included 54 mt of discards. The total quota for 2013 was 600 mt. The 2013 fishery age composition was dominated by the 2010 year class at age 3, and the 2009 year class at age 4 also made a substantial contribution. Catch from the 2014 DFO and NMFS spring surveys

decreased from 2013. The DFO survey catch was the lowest in the time series, catch from the other two surveys remained low. Survey weights at age, as well as fish condition, continued to be lower than values observed in the mid-1990s. Both the fishery and the survey catches show truncated age structure in recent years and the contribution to the catch of fish older than age 7 has been small.

The Virtual Population Analysis (VPA) "M 0.8" model from the 2013 benchmark was used to provide catch advice. In this model, natural mortality (M) was fixed at 0.2 for all the ages in all years except M = 0.8 for ages 6+ from 1994 onwards. Compared to the 2012 assessment, there is retrospective bias in SSB and F from the 2013 and 2014 assessments that is caused by the substantial reduction in the estimated size of the 2003 year class. Sensitivity analyses suggest that this low estimate of the 2003 year class may be an outlier due to uncertainties in the estimation of 2003 year class at age 9. These uncertainties had greater impact on the historical trajectory of biomass and F, but had little impact on the estimation of other year classes in the terminal year.

The adult biomass, recruitment, and F estimates presented below are from the VPA "M 0.8" model. The adult population biomass at the beginning of 2014 was estimated at 11,179 mt, which is about 20% of the adult biomass in 1978. Fishing mortality was high prior to 1994 and is estimated at 0.04 in 2013. The increase in biomass since 2005 was largely due to recruitment and growth of the 2003 and 2010 year class. The 2003 year class is estimated to be the highest recruitment since 1998 (excluding 2010). The current estimate of the 2010 year class is stronger than the 2003 year class based on the 2013 assessment, but still well below the pre-1990 average (about 10 million) when the productivity was considered to be higher. The 2012 year class is the lowest on record. 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. The continuing poor recruitment and low weights-at-age since the early 1990s and the assumed high natural mortality on ages 6+ since 1994 are important factors for this lower productivity.

At this meeting, it was agreed that F = 0.11 was an appropriate fishing reference point for the VPA "M 0.8" model based on the analyses presented. A projection analysis was also run at the current F_{ref} = 0.18, which was derived with an assumption of M = 0.2 in the assessment. A 50% probability of not exceeding F = 0.11 implies catches less than 1,150 mt. However, given the extremely low SSB, management should try to realize the growth potential from the 2010 year class to rebuild the spawning stock biomass. A catch of 225 mt would result in a greater than 75% risk that 2016 adult biomass would decrease. Even under F = 0 in 2015, there is a greater than 50% risk of a decrease in adult biomass from 2015 to 2016. Comparisons with the sensitivity analyses that adjusted for the 2003 year class indicates similar catch advice.

Discussion

There were some questions about how total mortality (Z) was calculated for EGB cod; for example, whether it is calculated differently from yellowtail and whether it was based on fully selected ages. The response was that cod are fully selected around 4 or 5 in the DFO survey. It was clarified that the data was only presented to 2013. It was unclear why the smoothed lines did not appear to go through the middle of the data points, so it was clarified that negative Zs were not plotted in these figures. It was suggested that negative values should be plotted to demonstrate the uncertainty in the data. It was noted that Z has increased on both younger (4-5 years) and older (6-8 years) fish, thus potentially impacting the whole age structure; however, it was also noted that older fish still have higher Zs.

There was a question about the scaling factor to go from catch in the survey to swept area abundance and whether it was comparable to yellowtail. The response was that it would have been the same before the yellowtail benchmark; however, estimates of swept area for yellowtail have switched to using the door spread instead of the wingspread, while cod still uses the wingspread.

It was asked why gutted weight was used to calculate condition. The response was that whole weight would be affected by the gonad in spring versus fall. There are some published papers suggesting, when using gutted weight, if condition (Fulton's K) is below 0.7, this will affect mortality.

It was noted that recruitment for 2013 was not estimated, but there are signs of it in the surveys.

There was some discussion of the stock recruitment relationship diagram (Figure 39). It was asked where the 2010 year class would be likely to end up on the plot if it was allowed to grow. The response was that, even with low F, it will still be low.

It was noted that, in the Canadian fishery, older cod are observed on St. Pierre Bank, but they are not seen anywhere else. It was asked whether older cod are being found elsewhere in the USA. The response was that, based on the last assessment, older cod were observed in the Gulf of Maine but not in increased numbers. There is truncation in the age structure, but it has expanded beyond what is seen on Georges Bank. It was suggested that additional tagging should be done to find out where the older cod were going.

Clarification was sought on why F was reported on ages 4-9 rather than on ages 3-9 (i.e., why are age 3 not included), especially since the fishery is catching a lot of age 3 fish. The response was that age 3 fish are not fully recruited, i.e., the PR is high but not 1 for age 3. The benchmark agreement was to use ages 4-9. Looking at the fishing history, a change in mesh size has meant a change from age 3 to age 4. It was suggested that F should be clearly defined and used consistently, and then it should not matter whether it was on ages 4-9 or ages 3-9.

It was asked whether the drop off in the 9+ group has been consistent through the assessment. The response was yes, this is part of the model set-up. It was also asked whether the F is applied to the older ages. The response was that, no, F is not applied to 10+ fish. 10+ fish do not seem to be available to the fishery (or the surveys). The same drop off is observed in the surveys. Even early in the time period (1978), the 10+ fish have been a small proportion of the catch (<1%). It was noted that the software set-up between DFO and NMFS is a little different.

It was asked whether a DFO survey catchability (q) of 1 was normal or a new phenomenon. The response was that the DFO survey has had a higher q than the other surveys. This would imply a very high efficiency. It was asked whether this is believable. One explanation might be that cod are aggregating in northern Georges Bank (Canadian waters) in spring.

It was noted that the working paper mentions a "retrospective", but it was unclear on whether the Mohn's rho was calculated. The response was that Mohn's rho was not calculated, as the retrospective was not considered to be significant. It was suggested that the working paper text should more clearly explain what the bias/difference might be if it is not a typical retrospective.

There was some discussion of the plots that compared the outputs of the four different model runs (e.g., Figure 33). It was asked whether these results could be compared with the observed data (survey data) to see which one(s) might be closer to the state of nature. It was noted that this is the intent of showing the plot of the residuals. However, if you did this, the results would be closer to the "2012 M0.8" and "est 2003yc" runs. Text reiterating that the benchmark is underestimating the 2003 year class was suggested.

It was noted that since M has increased on 6+ fish, an even greater decrease in biomass in 2017 was expected.

Working Paper: Assessment of Eastern Georges Bank Cod for 2014. APPENDIX A. 2014 Statistical Catch at Age (ASAP) Model Update for TRAC. TRAC Working Paper 2014/49.

Presenter: L. O'Brien
Rapporteur: T. Worcester

Presentation Highlights

This assessment presents an update of the statistical catch at age model 'Age Structured Assessment Program' (ASAP) reviewed at the 2013 April Eastern Georges Bank cod benchmark model meeting. The ASAP model was not chosen by the TRAC as a benchmark model for stock status or catch advice; however, the TRAC agreed to apply the ASAP model results in a consequence analysis of projection results.

The ASAP model was chosen to explore as an alternative model to the VPA during the EGB cod benchmark, in part, because an ASAP model had recently been accepted as the new benchmark model for the NEFSC GB cod assessment, replacing the VPA that had historically been applied since 1978. Prior to 2004, both the EGB and GB cod assessments had been conducted with VPA and had similar formulations. After the 2002 EGB cod benchmark review, the assessments started to diverge. While it is not mandatory that the two assessments be similarly formulated, given that EGB cod, a subcomponent of the Georges Bank stock, is managed by the Transboundary Management Guidance Committee (TMGC) and the whole stock is managed by the New England Fishery Management Council (NEFMC), similarly scaled biomass estimates would allow for compatibility in management decisions.

ASAP was used to derive estimates of instantaneous F in 2013 and stock size in 2013. A retrospective analysis was performed for terminal year F, SSB, and age 1 recruitment. Stochastic projections from model results were performed to provide estimated landings and SSB in 2015-2016.

Discussion

It was clarified that surveys are treated the same way as the catch, with an overall amount of catch that's matched with a lognormal proportion. Zero is allowed as a possible result of the multinomial.

It was asked why the Rivard weights were used. The response was that this is what is used in the GB cod assessment.

It was clarified that the autocorrelation plots were provided to ensure that the burn-in phase has been passed. No further thinning is required, and no further burn-in is required.

It was asked whether the ASAP model was run with a higher M. The response was that a run with M = 0.4 from 1994 onward was done and also a run with M = 0.4 on age 6+ from 1994 onward. The latter run resulted in SSB of 8,146 mt and when rho adjusted is 6,015 mt, so there is a bias.

A question was asked about what it meant to the presenter that the model always underestimates the survey catch, i.e., not a good fit to the surveys. Variability can be added to the surveys. Without the variability, the model fits better but the diagnostics are worse. There is a trade off in that the survey age structure is different from the catch age structure. It was asked whether the survey is declining faster than the catch would predict.

It was asked what the objective function results were from the M 0.8 and M 0.2 runs. The response was that, using M 0.8, it is 3111, and, using M 0.2, it is 3163. This is not Akaike information criterion (AIC). Objective functions and AICs are not the same. It would be useful to see the difference in the AICs.

Y. Wang looked at Zs from catch and surveys, and they look similar.

It was noted that F is applied on ages 5+. This is done for the GB assessment. This means that the model is not telling us about what the fishery is doing to the fish it is catching. The fishery is happening on not fully recruited ages. PR on age 4 is 0.76. It would be possible to lower it to age 4 (as with the VPA model).

As discussed previously, because there is a selectivity pattern, it does not matter what the age range used is as long as the selectivity pattern is defined and used consistently. The intent is to summarize a vector using a single number. This relies on the PR being consistent (easier than for the VPA).

Questions were asked related to the survey qs from the ASAP versus VPA models.

Concern was expressed about high qs and survey fits.

When the NEFSC installed the new trawl, it was supposed to have minimal herding. It was agreed that this was not the time to talk about the effect of the new trawl on survey q.

It was noted that there is similar patterning in the residuals as compared to the VPA.

Recommendations

- Compare AICs for the ASAP M 0.2 run and M 0.8 run.
- Determine whether F on 5+ or 4+ is appropriate for the ASAP model.
- Use consistent weights for ASAP and VPA models.

Working Paper: Eastern Georges Bank Atlantic Cod Assessment of Eastern Georges Bank Cod for 2014 : Consequence Analysis: Risks Associated with 2015 Projected Catch. TRAC Working Paper 2014/49.

Presenter: L. O'Brien
Rapporteur: T. Worcester

Presentation Highlights

The risks associated with potential management actions taken during 2015 are examined with a consequence analysis by undertaking stock projections under the competing assumptions of the 'state of nature'. The two states of nature are the VPA "M 0.8" model and the ASAP M 0.2 model, both presented at the 2013 cod benchmark model meeting (Claytor and O'Brien, 2013) and updated through 2014 for this 2014 assessment. At the benchmark model meeting, the TRAC agreed to apply the VPA "M 0.8" model for providing catch advice; however, given that F_{ref} = 0.18 is no longer consistent with that model, the TRAC also agreed to provide a consequence analysis of projected catch at two different fishing mortality rates from both models.

The analysis presents the consequences of management actions taken by setting projected catch according to the VPA "M 0.8" model if the true state of nature is such that M has remained unchanged at 0.2 and stock productivity is best reflected by the ASAP M 0.2 model, and conversely, if management actions were taken by setting projected catch according to the ASAP M 0.2 model while the true state of nature is such that M has increased to 0.8 on older ages since 1994 and stock productivity is best reflected by the VPA "M 0.8" model.

A catch of 1,150 mt at F = 0.11, would result in a decrease in biomass of 10% in the VPA "M 0.8" model and of 5% in the ASAP "M 0.2" model. A catch of 489 mt at F_{ref} = 0.18 would result in at least a minimum 10% increase in the 2016 biomass based on the ASAP "M 0.2" model; however, the biomass in 2016 would decrease by 5% based on the VPA "M 0.8" model.

The consequence analysis reflects the uncertainties in the assessment model assumptions. Despite these uncertainties, all assessment results indicate that low catches are needed to promote rebuilding.

Discussion

It was asked why there appears to be a roughly 25% increase in SSB biomass from 2013 to 2016 in the ASAP model. It was clarified that this was just growth. The mean weights that are used in ASAP model are a bit different from the VPA model. If the same weights are used, the difference would be less, but the primary difference is the different M used.

It was agreed that both models indicate a need to keep the quota low – low or lower than last year.

It was suggested that a joint proposal (for fisheries managers) from the assessment leads would be useful, so that the risks associated with it could be discussed.

The pros and cons of both models were discussed. With the VPA, there was some lack of understanding about the change in trend, though the catch advice with the sensitivity runs is quite consistent. Use of diagnostics indicates the VPA is the better model. It still has problems, but it was felt that there was a need to pick the best model. Some problems could be explained.

One reviewer suggested that it would be useful to see how the two models compare in terms of what they are saying about the productivity of the stock. It could be useful to evaluate spawners per recruit, and maximum reproductive rate. This could be used to determine the level of F at which the population is no longer able to replace itself. However, it was felt that this would be more helpful in setting an F_{ref} than in picking the most appropriate assessment model.

There was some discussion of the available data and what the assessment results mean for managers. It was suggested that there is limited recruitment for the EGB cod stock and stock status is poor. Others suggested that there has been a small amount of recruitment in the past few years, and this is from very low biomass. This recruitment does show up in the ASAP model, but it is scaled down. It was felt that changing F is not going to help with the productivity issue or age structure. Until productivity changes, the EGB cod stock is not going to get better. Advice to management would be to keep F as low as possible.

It was asked whether it was necessary to propose an F. Catch advice recommendations are provided in other TRAC Status Reports (TSRs).

It was noted that the biomass number in 2013 reflects when the 2010 year class enters the fishery. When dealing with small numbers, the percent change can be misleading. It is important to consider recent trends in biomass.

It was suggested that the consequence analysis gives the science advice, and it is up to TMGC to decide from there. However, it is still important to provide useful text around the results of this table. Assessment leads were asked to provide draft text for review.

TRAC PRESENTATION: GREY SEALS IN USA WATERS

Discussion: Grey Seals in USA Waters

Presenter: G. Waring
Rapporteur: T. Worcester

Presentation Highlights

Grey Seals were extirpated from US waters by historical bounty programs in New England waters. In the early 1980s, Grey Seal began recolonizing New England coastal waters along the coasts of Maine and Massachusetts, particularly in the Cape Cod region. Based on brand marks on some of the adult animals it was determined that they were from Sable Island, where DFO had a program to brand all pups. By the 1990s, Grey Seals began pupping/breeding in US waters and reestablished a pupping colony on Muskeget Island, located in eastern Nantucket Sound. Subsequently, the population continued to increase in numbers, expand their range, and establish additional pupping colonies in the Cape Cod region and in mid-coast Maine.

Since the late 1990s, and on an intermittent basis, the NEFSC has been conducting seasonal monitoring surveys of the major harbor and Grey Seal haulout sites in southeastern, MA (i.e., Plymouth to Nomans Island). Over time, these surveys have documented that Grey Seals now share or have displaced harbor seals from several sites, and that Grey Seals have established a year-around presence in Cape Cod waters. The largest Grey Seal haul-out site is Monomoy Island, located off Chatham.

Although we do not have a total population estimate for Grey Seals, (see below), in the 2014 stock assessment report we presented a single day's count (15,696) from the March 2011 SE MA monitoring surveys as a minimum number of Grey Seals in New England waters. We know this is negatively biased.

In the early 2000s, NEFSC also began aerial monitoring surveys of the major Grey Seal pupping colonies. While the goal has been to conduct 3 to 5 surveys over the pupping season (mid-December - early February), in some years only a single survey was conducted around the peak pupping period. Pup production is one component of the data required to model the estimated total population. This is the protocol used in Atlantic Canada and the UK. However, an important component of the data is to collect the pup molt stages, to ensure that we do not double count pups. We are still counting the archive of data. The most recent data indicate that about 2,700 pups were born on Muskeget during the 2013-2014 pupping year.

Grey Seal diet data has been obtained from several small scale scat and stomach analyses studies (e.g., graduate student work), and additional stomach processing by the NEFSC. All scat collections are from the Cape Cod and eastern Nantucket Sound region, collected on sandy beaches to tidal bars. Stomachs are obtained from fishery bycatch and encompass a broader region (i.e, Gulf of Maine to waters south of Cape Cod). None of these data indicate a Grey Seal preference for specific prey (excluding scat that frequently has 100% sand lance otoliths). This work indicates differences in prey items which reflects the geographic distribution of the two data sets (Ampella 2009).

Grey Seals are primarily bycaught in sink gillnet gear and anecdotal data indicates that they depredate the catch - however, this level has not been quantified. Grey Seals also interact with the herring purse seine fishery, where observers and at-sea monitors report that they are feeding on herring while in the net. There are no reports of Grey Seals being killed in these nets, they either swim out on their own or escape during net pumping or retrieval.

In June 2013, the NEFSC collaborated with Duke University researchers and attached seven GPS satellite and two other satellite tags on non-pup Grey Seals capture in Chatham Harbor. Most of the animals remained in the Chatham area or traveled further north along Cape Cod and south along Monomoy Island throughout the summer and early autumn. The seals began moving into eastern Nantucket Sound later in autumn prior to the start of the pupping season. A couple of adult females remained on Muskeget Island for a time period that was consistent with pupping/nursing. Seals also traveled to waters south of Nantucket, and one made an excursion close to Sable Is. All tags stopped reporting by late February 2014, which may have been associated with the start of the seasonal molt or battery failure. Overall, most of the habitat information that we have on Grey Seals is associated with haul-outs, as opposed to offshore (e.g., Georges Bank) waters.

Discussion

A question was asked about the historical population estimate for Grey Seals in the USA. The response was that there are no historical estimates for Grey Seal populations in the eastern USA. There is limited data available from bounty records. There is some information on distribution (historically down as far as North Carolina). There is no pupping south of Cape Cod yet. Grey Seals appear to be replacing harbor seals at some sites. There may be some exclusion of harbor seals by Grey Seals.

It was noted that there is a published paper on predation of Atlantic cod by harbor seals (belly biting).

There was discussion of recent tagging of Grey Seals. Last June, attempts were made to tag adult Grey Seals: 9 electronic tags were put on seals in Chatham Harbor. They were very easy to catch. They did cross the border into Canadian water. D. Bowen's tags also cross into USA waters, so there is good evidence of cross border movement; however, the degree of movement is not known. Tagged seals tended to stay around Chatham in the summer, then, before breeding season, they started to disperse. One animal went to Georges Bank. Some went to a new groundfish fishing area.

It was noted that white shark studies are also looking at the movement of Grey Seals (in terms of predation).

Lots of Grey Seals are being observed in the USA herring fishery.

It was asked whether Yellowtail Flounder were found in the diet of Grey Seals. This was not known.

It was noted that the stomach contents of seals that were found feeding on cod aggregations in Canada had diets with a much greater percentage (up to 60%) of cod.

Observers are being encouraged to bring in whole animals, as these provide better information on diet.

It was asked if the question of targeting could be addressed by comparing the relative proportions of certain fish species in seal stomachs with the relative proportions of fish species in the area the seal was foraging in. The response was that some work has been done on this (or something like this) but that the data were not available yet. If requested, some related publications would be made available to TRAC for its consideration at a future meeting.

It was suggested that work should be done with the protected species group to try to get funding to help answer this question.

TRAC PRESENTATION: FISHING REFERENCE POINTS FOR THE EGB COD VPA "M 0.8" MODEL

Presenter: Y. Wang
Rapporteur: T.Worcester

Presentation Highlights

The fishing mortality reference point calculation for the VPA "M 0.8" model was presented at the 2013 EGB cod benchmark meeting. In that analysis, the LOESS smooth method was used to characterize the stock-recruitment relationship due to the failure of a parametric model fit. In the choice of the smoothness parameter, the biological implication was considered. For biomass less than any observed value, recruitment would be expected to decline with biomass and eventually go to the origin (0, 0). For biomass greater than the observed value, a parsimonious assumption would be to expect recruitment to neither increase nor decrease. The selected LOESS smooth parameter was 0.52. However, at the benchmark meeting, some reviewers expressed concern about the "arbitrary" choice of the smoothness parameter, and AIC was recommended to be used as criteria. Based on AIC selection, the fitted curve showed multiple maxima and minima, which suggested that AIC was not suitable for the choice of smoothness parameter in this case. Another study also showed that cross validation tends to under-smooth rough and over-smooth smoother time series (Hall and Johnstone, 1992).

At the benchmark, a reviewer asked about the variance of the fishing mortality reference point. A non-parametric bootstrap analysis was applied to the LOESS smooth calculation; however, an optimal choice of smoothness parameter was not easily obtained from the bootstrap samples.

G*loss*, the slope of a replacement line that gives an equilibrium point at the lowest observed SSB (Cook, 1998; O'Brien, 1999), was used as a proxy for F_{crash}. Any F higher than G_{loss} should result in an equilibrium stock size below the lowest observed value or stock collapse, which would be an F to avoid. The current $F_{ref} = 0.18$ was compared with the G_{loss}. A range of smoothness parameters from 0.5 to 1 was used to capture the uncertainties in the calculation of G_{loss}. The bootstrap method was applied to derive the distribution of G_{loss}. It showed that there is a high probability of current $F_{ref} = 0.18$ exceeding G_{loss}, which implied fishing at $F_{ref} = 0.18$ would result in an equilibrium stock size below the lowest observed value or stock collapse, which would be contrary to the TMGC stock rebuilding plan. This analysis demonstrated that a lower value than 0.18 would be a more appropriate F reference point for the VPA "M 0.8" model.

Discussion

It was asked whether a replacement line could be added for $F_{0.11}$. The graph shows the replacement line at $F_{0.18}$. It should be below this, but it is not clear how far below.

It was asked whether the replacement line was calculated for the whole time period or the recent time period. It was calculated for the whole time period.

It was clarified that an assumption is being made that the current high M regime will persist. Given this, it was not clear that historic data should be included in the analysis if there was no expectation of returning to a previous state. It was suggested that, at a minimum, the data points could be color coded (colored differently) for the time before and after M was thought to have changed.

It was asked whether efforts were made to maximize yield. The response was yes, the maximum sustainable yield (MSY) calculations were done.

Working Paper: Reference Points for Eastern Georges Bank Cod. TRAC Working Paper 2014/50.

Presenter: A. Cook
Rapporteur: T. Worcester

Presentation Highlights

A VPA model (VPA.8) that incorporated recent increasing M with age was used to provide stock assessment advice for Eastern Georges Bank cod. This model sets M at 0.2 for all ages except for ages 6+ beginning in 1994 for which M is 0.8. Previously, fisheries reference points calculated using a LOESS smoothed stock recruitment relationship (SR) in the Sissenwine-Shepard production model yielded F_{msy} = 0.125, but $F_{95\%FMSY}$ = 0.11 was preferred as a reference point due to uncertainty around the SR and the high M. There were concerns surrounding the arbitrary nature of the LOESS smoother used in the calculation of this F.

The VPA output from the VPA.8 model was used to estimate an F reference point by applying a Sissenwine-Shepard production model with either a domed or flat partial recruitment (PR) curve and a Beverton-Holt SR for early (high production), late (low production) and full time series (switching production). The profile likelihoods from the Beverton-Holt models were used to assess plausibility of F_{MSY} reference points. There was considerable uncertainty in the maximum likelihood point estimates for the SR and F reference points. A decision theoretic approach was used to estimate an F reference point by maximising the expectation of catch by integrating across the likelihood surface of the Beverton-Holt SR parameters. Attempts to model the SR in ways that reflect apparent productivity changes did not improve the ability to predict productivity, so the full time series of data is considered for defining reference points. $F_{maxE(C)}$, or the F that maximises the expectation of catch, which is thought to be less variable and to lessen the risk of overexploitation relative to F_{MSY}, was 0.097 (approximately 0.1) for a flat top PR and 0.118 (approximately 0.12) for a domed PR, which were proposed as the range for reference points for the Eastern Georges Bank cod stock VPA.8 model.

Discussion

It was clarified that this analysis was for Eastern Georges Bank (EGB) cod, though the graph was labeled “Georges Bank” (GB).

Questions were asked about where the PR came from in this analysis, since a domed PR is not typically used (it generates phantom fish) for cod on EGB. The response was that a flat top was used, but it did not seem to impact the results. Later, it was suggested that the analysis be re-run using the domed PR. This was presented later in the meeting [Resulted in F_{MSY} = 0.096 instead of F_{MSY} = 0.079 and $F_{maxE(C)}$ = 0.0118 versus F_{maxEC} = 0.097. This was considered a slight difference.]

It was noted that yield was scaled in the graphs, and it was asked what the actual yield would have been. The response was that it would be quite large. Information used for the analysis was at the intercept where data were better (i.e., useful for developing an F reference point), but not further out (i.e., not useful for biomass reference points).

It was asked why the LOESS smoothing approach was not used (instead of Beverton-Holt). The response was that this approach produced a multiple equilibrium state (crossing or close to crossing the line in a couple of places). The preference was to go with another source of information if there was something else available to provide reasonable advice. Also, the LOESS smooth seemed somewhat arbitrary. If the span is increased, it produces a straighter relationship similar to the Beverton-Holt.

It was asked why a straight linear model without density dependence, which was in line with the Beverton-Holt, was not investigated further. The response was that it was not explored further because the framework had been set up for the Beverton-Holt. Since the delta AICs were similar, it made sense to go with what was used previously.

There was some interest from a reviewer in the shape of the constrained additive model. There was patterning in the residuals, with negative residuals. Given this, it was suggested that time period could be added as a factor (could apply a knot in the middle). It was agreed that this was a good suggestion.

It was asked whether methods for looking at uncertainty in inputs had been considered. There are lots of different approaches to this, but time constraints prevented looking at these.

It was asked whether this analysis produced evidence of a change in productivity or whether there were just lots of data points at the origin. If you look at the relationship, it is essentially a straight line. There is lower recruitment than you'd expect given depensation at lower biomass. Alternatively, it is possible that cod is at the origin. We are treating this relationship as a straight line with not a lot of information on whether the current state is different from the 1970s or whether it is possible to return to a previous state.

It was noted that the shape of the Beverton-Holt curve was influenced by where the data falls on the curve. Having data only near the origin makes it seem like the curve is different than it actually is. However, this is not evidence that the productivity cannot return to a previous state.

It was asked whether it is possible to get from the cloud of low recruitment to the cloud of higher recruitment under current conditions. The answer to this question was not known. It is unclear what recruitment would be required under current M to get to the upper cloud. However, it is expected to be difficult. Even if recruitment is well above average and F is really low, with high M, it would still be difficult to reach high spawning stock biomass.

It was noted that this was the cloud using the new M = 0.8. Questions were asked about what it looked like with the previous M = 0.2. The response was that it looked different (cloud may shift to the left, i.e., lower recruitment and SSB) but the scatter is similar.

In the comparison with other cod stocks, it was noted that the productivity on GB appears much lower than the other stocks. These graphs were scaled to stock area so that they would be directly comparable. This would suggest that GB has never been productive, which seemed strange to some. It was noted that Myers was using a very different stock area for GB, and he was showing a straight line stock recruit relationship. Spawner per recruit is much lower than the other areas. There was speculation on how the stock managed to maintain itself, either through movement or migration. It was suggested that it would be interesting to see the average yield for these stocks.

While GB has been productive with lots of fishing, there has not been nearly as much fishing as in other areas. Some were not surprised that the productivity was lower given the smaller scale of the fishery. For Haddock, productivity was improved by keeping fishing mortality low.

It was asked whether this could be a time series effect. The time series for EGB starts in 1978; however, the population has been fished heavily for 400 years. It was noted that Labrador and Newfoundland have also been fished heavily for decades. The presenter could not recall what time series were used for the other areas.

If this approach is used, there is a need to look at the consequences of being in the low productivity regime.

It was noted that if you try to split the time series, there is not enough information to inform either parameter. If you use the full time series, it is possible to at least estimate the alpha.

However, if TRAC feels that there is a new regime, then good fitting is not the most important thing to consider.

It was troubling to some that biomass reference points could not be generated from this approach. It was suggested that careful wording was needed to explain why advice on fishing mortality reference points was possible but not on biomass reference points. Given that other work shows that it is easier to set F reference points than biomass reference points, some felt comfortable going forward with the proposed F as long as there were caveats. It was felt to be appropriate for the short term. For evaluating F_{MSY}, this approach was felt to be ok, but it was agreed that it would not be a good approach for estimating B_{msy}.

It was suggested that confidence bounds around the estimate be included. This was provided later in the meeting.

It was suggested that there is a need for a consistent approach with the other stocks.

It was suggested that TRAC is not ready to propose a new F_{ref} to TMGC. However, it was unclear on what additional work would be required before TRAC was prepared to propose a new F_{ref}. All the work that was requested has been completed.

Summary

- This was felt to be a thorough analysis and a reasonable approach.
- Results from the two different approaches presented (see previous presentation) were similar.
- It was agreed that an appropriate fishing mortality reference point for the VPA.8 was something less than the current $F_{ref} = 0.18$.
- There were a few questions about:
  - flat-topped PR (analysis was run with and without showing limited difference),
  - variance around the estimates (provided), and
  - whether the current low productivity regime will persist or may return to some previous state (no reason to believe that it cannot return, but may be hard with low to average recruitment; this approach assumes that return is possible).
- Some concern was expressed that biomass reference points cannot be calculated using this approach, but an explanation can be provided and caveats placed on the use of the results.
- No other suggestions were provided.
- There was no apparent reason to reject the analysis.
- TMGC should be asked to decide.

If the stock looks like its heading in a different direction, it should be re-evaluated. Given the data available, this is an appropriate approach. The EGB cod stock is well below the asymptote, and well below a biological reference point. Existing guidance is that F should be reduced when the stock is in poor condition.

This analysis generated a fishing mortality reference point of 0.12. However, projections were already done using an F = 0.11 (based on the previous analysis). The difference in the values of 0.12 and 0.11 was considered to be inconsequential; thus, fishing mortality reference point of 0.11 for the VPA M0.8 model was proposed.

OTHER BUSINESS

TRAC discussed scheduling of the TRAC to a date later than the end of June. No resolution was reached, so it was agreed that a white paper outlining the issues with different timing scenarios would be written and presented to the TMGC and Steering Committee in September, with the expectation that an alternative TRAC meeting time would be agreed to at those meetings.

There was discussion on TRAC membership, documentation, the role of reviewers, and expanding the length of the TRAC meeting beyond three days. TRAC agreed to present a white paper to the TMGC and Steering Committee outlining these issues, and request their recommendation.

CONCLUSIONS

The co-chairs of the meeting thanked participants for attending this year's TRAC assessment of Eastern Georges Bank Cod, Eastern Georges Bank Haddock and Georges Bank Yellowtail Flounder. The TRAC status reports for each of these species would be finalized in the coming weeks, based on the discussion of the meeting, and they would be made available to participants in French and English on the TRAC website: http://www.bio.gc.ca/info/intercol/trac-cert/index-eng.php. The TRAC status reports would be presented in the autumn to the Transboundary Management Guidance Committee. Working papers were expected to be modified as recommended by this meeting and published as TRAC Reference Documents in the coming months.

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APPENDICES

APPENDIX 1. LIST OF PARTICIPANTS JUNE 2014.

Name	Affiliation
Loretta O'Brien (Co-Chair)	NEFSC, USA
Tana Worcester (Co-Chair)	DFO/BIO/Dartmouth, Canada
Adam Cook (via teleconference)	DFO/BIO/Dartmouth, Canada
Alain d'Entrement	Industry, Canada
Brian Linton	NEFSC, USA
Carl MacDonald	DFO/Dartmouth, Canada
Chris Kellogg (via teleconference)	NEFMC, USA
Chris Legault	NEFSC, USA
David Pierce (via teleconference)	MADMF
Drew Minkiewicz	
Fiona Hogan	NEFMC, USA
Fred Serchuk	NEFSC, USA
Greg DeCelles	SMAST, USA
Heath Stone (via teleconference)	DFO/St. Andrews, Canada
Heather Bowlby (Reviewer)	DFO/BIO/Dartmouth, Canada
Jamie Cournane	NEFMC, USA
Jim Odlin (via teleconference)	Industry, USA
Jim Weinberg	NEFSC, USA
Liz Brooks	NEFSC, USA
Lou Van Eeckhaute	DFO/St. Andrews, Canada
Mark Showell (Reviewer)	DFO/BIO/Dartmouth, Canada
Mark Terceiro	NEFSC, USA
Michael O'Conner	TMGC Co-Chair, Canada
Mike Palmer	NEFSC, USA
Pat Sullivan (Reviewer)	Cornell University/SSC, USA
Pal Nitschke	NEFSC, USA
Paul Rago	NEFSC, USA
Ritchie Canastra (via teleconference)	Industry, USA
Sarah Heil	NMFS/GARFO, USA
Steve Cadrin	SMAST, USA
Susan Wigley	NEFSC, USA
Tim Miller (Reviewer)	NEFSC, USA
Tim Nickerson	Industry, Canada
Tom Nies	NEFMC, USA
Vic Vecchio	NMFS, USA
Yanjun Wang	DFO/St. Andrews, Canada

APPENDIX 2. TERMS OF REFERENCE.

Transboundary Resources Assessment Committee

Assessment of Eastern Georges Bank Cod, Haddock and Georges Bank Yellowtail

June 23-26, 2014
Woods Hole, Ma.

TERMS OF REFERENCE

Context

The 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:

- Apply the benchmark assessments to report on the status of the stocks, updating results for the latest information from fisheries, including discard estimates and research surveys, and characterize the uncertainty of estimates.
- Depending upon the outcome of the GB Yellowtail Flounder empirical approach benchmark, results from the empirical method will either be considered alone as a basis for catch advice or considered along with the current virtual population analysis (VPA from 2005 benchmark) modeling results and relevant VPA sensitivity runs as have been conducted in the past.
- Describe any adjustments to benchmark assessment models 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 sensitivity analyses to account for retrospective bias on stock biomass and fishing mortality estimates for Cod, Haddock, and Yellowtail Flounder, if appropriate.
- For a range of total catch values in 2015, estimate the risk that the 2015 fishing mortality rate would exceed F_{ref} values, i.e. 0.18 (Cod), 0.26 (Haddock) and 0.25 (Yellowtail Flounder) respectively. Include a table showing the 2015 catches corresponding to low (25%), neutral (50%) and high (75%) probability that the F would exceed F_{ref}.
- • For a range of total catch values in 2015, estimate the risk that the biomass at the beginning of 2016 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2015.
- Review the biomass distribution relative to the US/Canada boundary, updating results with the 2013 survey information, and apply the allocation shares formula.
- Identify alternate fishing reference points that are appropriate for the Cod VPA M=0.8 model.
- For Yellowtail Flounder, if recommended by the GB Yellowtail Flounder empirical approach benchmark, provide catch advice consistent with newly defined fishing mortality reference points developed for an empirical approach (noting that any change in F_{ref} used to provide catch advice would need to be negotiated) and synthesize all the available information used to provide recommendations on catch advice.
- Draft terms of reference for the 2015 TRAC assessment of cod, haddock and yellowtail.
- Other matters.

Expected Publications

- *TRAC Transboundary Status Reports* for the eastern Georges Bank Cod and Haddock, and Georges Bank Yellowtail Flounder management units.
- *TRAC Reference Documents* for eastern Georges Bank Cod and Haddock, Georges Bank Yellowtail Flounder management units, and the allocation shares.
- *TRAC Proceedings* of meeting discussion

Participants

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

APPENDIX 3. MEETING AGENDA.

Transboundary Resources Assessment Committee

Assessment of Eastern Georges Bank Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder

Stephen H. Clark Conference Room
NEFSC Woods Hole Laboratory

23-26 June 2014

AGENDA

June 23rd – Monday

9:00 – 9:15	Welcome and Introduction (Co-Chairs)
9:15 – 10:30	Allocation Shares for 2015
	Update of EGB Haddock Data Inputs – commercial fishery and surveys. Application of the Benchmark Formulation for EGB Haddock. Projections and Assessment Advice for EGB Haddock.
10:30 – 10:45	BREAK
10:45 – 12:00	GB EGB Haddock continued
	Update of GB Yellowtail Data Inputs – commercial fishery and surveys
12:00 – 1:00	LUNCH
1:00 – 3:00	Application of the VPA Benchmark Formulation for GB Yellowtail VPA Projections and Assessment Advice for GB Yellowtail
3:00 – 3:15	BREAK
3:15 – 5:00	GB YT Benchmark Empirical Approach and Assessment Advice

June 22nd – Tuesday

9:00 – 10:30	Update of EGB Cod Data Inputs – commercial fishery and surveys
	Application of the VPA Formulation and VPA Projections for EGB Cod
10:30 – 10:45	BREAK
10:45 – 12:00	Application of the ASAP Formulation and Projections for EGB Cod
12:00 – 1:00	LUNCH
1:00 – 3:00	EGB cod continued
	Consequence Analysis and Assessment Advice
3:00 – 3:15	BREAK
3:15 – 5:00	Revisit EGB Haddock, GB Yellowtail Flounder
	Fishing Mortality Reference Points for EGB Cod Report Preparation (EGB Haddock)

June 25th – Wednesday

9:00 – 12:00 Report Preparation (EGB Haddock, GB Yellowtail)

11:50 – 1:00 LUNCH (need to break early for seminar set-up)

1:00 – 3:00 Report Preparation (GB YT)

3:00 – 3:15 BREAK

3:15 – 5:00 EGB Cod Report Preparation

June 26th – Thursday

9:00 – 10:30 Report Preparation (EGB Cod)

10:30 – 10:45 BREAK

10:45 – 12:00 Final Report Review

12:00 – 1:00 LUNCH

1:00 – 3:00 Development of 2015 TRAC Cod/Haddock/Yellowtail Terms of Reference

Other Business:

Timing of 2015 TRAC|
TRAC Reference Documents
TRAC website
Multi-year assessments, other

3:00 – 3:15 BREAK

3:15 – 5:00 Continue Other Business

Adjourn

APPENDIX 4. 2015 TRAC ASSESSMENT DRAFT TERMS OF REFERENCE

Transboundary Resources Assessment Committee

Assessment of Eastern Georges Bank Cod, Haddock and Georges Bank Yellowtail

Month, days, 2015
St. Andrews, NB

TERMS OF REFERENCE

Context

The 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:

- TRAC is proposing the TRAC meet the last week in August or early September.
- Apply the benchmark assessments to report on the status of the stocks, updating results for the latest information from fisheries, including discard estimates and research surveys, and characterize the uncertainty of estimates.
- Describe any adjustments to benchmark assessment models 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 sensitivity analyses to account for retrospective bias on stock biomass and fishing mortality estimates for eastern Georges Bank Atlantic Cod and Haddock, if appropriate.
- For a range of total catch values in 2016, estimate the risk that the 2016 fishing mortality rate would exceed F_{ref} values. Include a table showing the 2016 catches corresponding to low (25%), neutral (50%) and high (75%) probability that the F would exceed F_{ref} for Atlantic Cod and Haddock
- For a range of total catch values in 2016, estimate the risk that the biomass at the beginning of 2017 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2016 for cod and Haddock.
- For Georges Bank Yellowtail Flounder, provide catch advice based on method (i.e. constant quota or constant exploitation) chosen by TMGC.
- Review the biomass distribution relative to the US/Canada boundary, updating results with the 2014 survey information, and apply the allocation shares formula.
- For Georges Bank Yellowtail Flounder initiate exploration of MSE or control rules for determining the effectiveness of potential harvest strategies.
- Draft terms of reference for the 2016 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 and Haddock, and Georges Bank Yellowtail Flounder management units.

- **TRAC Reference Documents** for eastern Georges Bank Atlantic Cod and Haddock, Georges Bank Yellowtail Flounder management units, and the allocation shares.
- **TRAC Proceedings** of meeting discussion.

Participants

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

APPENDIX 5. LIST OF PARTICIPANTS AT JUNE 2014 INDUSTRY/SCIENCE PRE-TRAC MEETING.

Name	Affiliation
Brian Rothschile	SMAST, USA
Chris Legault	NMFS/NEFSC, USA
Fiona Hogan	NMFS/NEFSC, USA
Giulia Gorelli	SMAST, USA
Greg DeCelles	SMAST, USA
Greg Power	GARFO, USA
Jackie Odell	NSC, USA
Larry Alade	NMFS/NEFSC, USA
Liz Brooks	NMFS/NEFSC, USA
Loretta O'Brien	NMFS/NEFSC, USA
Mary Beth Tooley	NEFMC/TMGC, USA
Rich Canastra	Base, NE, USA
Saang-Yoon Hyun	SMAST, USA
Sarah Heil	NMFS/NERO, USA
Steve Cadrin	SMAST/SCC, USA
Terry Alexander	NEFMC/TMGC, USA
Tom Nies	NMFS/NEFMC, USA
Vito Giacalone	NSC, USA