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CERT

Comité d'évaluation des ressources transfrontalières

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TRAC

Transboundary Resources Assessment Committee

Proceedings 2011/01

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

Report of Meeting held 21-24 June 2011

Hachey Conference Centre
St. Andrews Biological Station
St. Andrews, New Brunswick, Canada

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FOREWARD

The purpose of these proceedings is to archive the activities and discussions of the meeting, including research recommendations, and 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.

TABLE OF CONTENTS

ABSTRACT

The Transboundary Resources Assessment Committee (TRAC) met during 21-24 June 2011 in St. Andrews, New Brunswick, Canada, to review updated assessments (through 2010) of Eastern Georges Bank 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 2012 fishing year for these transboundary resources.

RÉSUMÉ

Le Comité d'évaluation des ressources transfrontalières (CERT) s'est réuni du 21 au 24 juin 2011 à St. Andrews (Nouveau Brunswick) au Canada, pour examiner les évaluations actualisées (jusqu'en 2010) 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 d'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 2012.

INTRODUCTION

The Transboundary Resources Assessment Committee (TRAC) co-chairs, J.M. Porter and L. O'Brien, welcomed participants (Appendix 1) to the July 2011 TRAC assessment of Eastern Georges Bank cod *Gadus morhua*, Eastern Georges Bank haddock *Melanogrammus aeglefinus,* and Georges Bank yellowtail flounder *Limanda ferruginea*. The TRAC was established in 1998 to undertake joint U.S. / Canada assessments of resources in the Georges Bank transboundary region. Cod, haddock, and yellowtail flounder were the first species to be assessed by TRAC, followed by Atlantic herring *Clupea harengus*, spiny dogfish *Squalus acanthias* and Atlantic mackerel *Scomber scombrus*. The TRAC terms of reference (ToR) received prior approval from the Canada / U.S. Steering Committee, the Northeast Regional Coordinating Council (NRCC), the Gulf of Maine Advisory Committee (GOMAC), and the Transboundary Management Guidance Committee (TMGC).

Participants were reminded that the TRAC review process is two tiered, with assessment updates typically undertaken between more intensive benchmark reviews. A new benchmark for Eastern Georges Bank cod was recently established in April 2009 and the benchmarks for Eastern Georges Bank haddock and yellowtail flounder were established in 1998 and 2005 respectively, with assessments conducted annually since then.

The ToR and agenda for the meeting are provided in Appendices 2 and 3, respectively. During the meeting, each working paper was presented by one of the authors and then followed by a plenary discussion of that paper. Rapporteurs documented these presentations and discussions for the Proceedings.

In preparation for this meeting, Canadian scientists met with fishermen in Yarmouth, NS; minutes from this meeting are included in Appendix 4. The U.S. scientists met with fishermen in Gloucester, MA prior to the TRAC meeting (Appendix 5).

Draft ToR for the 2012 TRAC are provided in Appendix 6.

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

TRAC Presentation: Discards from the 2010 Canadian Scallop Fishery

Working Paper: Discards of Atlantic cod, haddock and yellowtail flounder from the 2010 Canadian scallop fishery on Georges Bank. TRAC Working Paper 2011/05.

Presenter: L. Van Eeckhaute

Rapporteur: K. Clark

Presentation Highlights:

Discards of Atlantic cod, haddock, and yellowtail flounder from the 2010 Canadian scallop fishery on Georges Bank were estimated from 24 observed trips. Data were insufficient to determine spatial differences in discard rates per hour but temporal trends were accounted for using a three month moving window calculation. Discards were estimated by applying the monthly discard rate per hour obtained by the three month moving window calculation to the total monthly effort in hours of the scallop fleet. Total annual estimated discards in 2010 were

highest for yellowtail flounder, at 200 mt, while those for Atlantic cod and haddock were 44 mt and 14 mt, respectively.

At the 2010 TRAC meeting, concern was expressed that the moving window estimates may be biased. To address this concern, four methods of calculating the discards (moving window, monthly, quarterly, and annual) were compared and precision estimates determined. Estimates of variance for the annual discards were determined for each method using bootstrapping and analytical techniques (no analytical estimates for moving window method due to auto-correlation). Variances for the monthly method were not calculated as often only one observed trip was available for a month.

All four methods produced similar results and none produced consistently higher or lower estimates indicating that none of the methods produce biased results. Coefficients of variation (CVs) for the variance estimates for the three methods were compared. Results show that no one method is superior and the moving window method is more often either the lowest CV, is tied with the lowest CV, or is very close to the lowest CV. The three month moving window method should continue to be used to calculate Canadian scallop fishery discards.

Discussion:

The chair noted that this paper was being presented to address a specific issue regarding the potential for bias in the discard estimates that was brought up at the 2010 TRAC meeting. In the future, unless the methodology changes, the discard calculations will not be presented in a separate working paper but will be included in the specific assessments.

The reviewers agreed that the three month moving average methodology worked as well as any of the other methods that were shown. The observation was made that the three month moving average showed less extreme CVs; this could be an advantage but it could also be that this method may obscure uncertainty. It was recommended to continue to use the three month moving average method to calculate discards from the Canadian scallop fishery.

Currently the moving average method uses only two months of data when calculating the values for January and December. It was recommended that in future years the value from December of the previous year be included in the calculation for the January of the assessment year and that the value for January of the following year be included in the calculation for the December of the assessment year.

TRAC Presentation: Survey design and implementation of DFO and NEFSC surveys

Working Paper: Survey Design Efficiency of DFO and NEFSC Surveys for Cod, Haddock, and Yellowtail Flounder on Georges Bank. TRAC Working Paper 2011/06.

Presenter: C.M. Legault

Rapporteur: H. Stone

Presentation Highlights:

Both the Canadian Department of Fisheries and Oceans (DFO) and the U.S. Northeast Fisheries Science Center (NEFSC) conduct bottom trawl surveys on Georges Bank using stratified random sampling, but use different area stratifications. Since both the DFO and

NEFSC surveys are ecosystem based, neither survey can be focused on a single species to take full advantage of variance reduction due to optimal sample allocation. However, the allocation and stratification effects can be measured for cod, haddock, and yellowtail flounder based on observed catches in the surveys over time. There is no obvious change in sampling allocation for any of the three surveys that would benefit all three species in terms of relative efficiency. Furthermore, any proposed changes for these three species would have to be considered in the larger context of the many other species that rely on the survey for abundance indices. One general result of this analysis is that the efficiency of all three surveys relative to simple random sampling is lower for yellowtail flounder compared to cod and haddock. Based on this analysis of survey design efficiency, all three surveys are considered to provide appropriate indices of population abundance for the three management units of cod, haddock, and yellowtail flounder evaluated in TRAC.

Discussion:

Canada (DFO) and the U.S. (NMFS) use different survey designs for their annual ecosystem surveys on Georges Bank. There are differences in the allocation of the number of stations to strata and in addition, the DFO survey has larger and fewer strata while the NMFS surveys have more strata but with generally smaller geographic area. The eastern Georges Bank (EGB) assessments for cod and haddock are based on the 5Zjm management unit so that it is necessary to split some of the strata (i.e., DFO: 5Z3/5Z4; NMFS: 19-22) used for calculating biomass and abundance indices for this region.

The analysis presented examined the effects of “allocation” (i.e., how stations are distributed among strata) and “stratification” (i.e., changes in mean density within and among strata) components for survey strata representing all of Georges Bank and Eastern Georges Bank only.

The randomization procedure used to select sampling locations within a stratum is based on the “whole stratum” area, and sometimes there may not be stations allocated to both portions of the strata which are split along the 5Zjm boundary. (Note: the strata are split after the stations have been allocated.)

Simple (non-stratified) random sampling may work better for GB yellowtail, given their patchy distribution. Even the very large catches of yellowtail in Canadian waters during the 2008 and 2009 DFO surveys did not have a strong influence on the results of the survey design efficiency calculations for “allocation”, which were mostly negative for GB yellowtail. This was in contrast to cod and haddock which had mainly positive values for the “allocation” component, implying that there is a good distribution of stations among strata for sampling both species.

Stratum efficiency is gained when there is more homogeneity within strata than across strata. While the allocation of stations to strata may be proportional to stratum area (i.e., for the NMFS surveys), this design feature may not be successful if all stations within a stratum are not sampled (i.e., due to weather or mechanical problems). This could result in no gains in efficiency for some years, however over the long term, there would be positive benefits from the stratified design.

It is possible that a “systematic” sampling design might help to spread out the distribution of stations. Given that there are many species sampled during these surveys, it may not be possible to improve the sampling design in a way which benefits all of them. The small strata located at the edge of the continental shelf have a steep slope and small geographic area and may actually be oversampled relative to the larger strata. Some efficiency might be gained by

reducing the allocation of stations to these strata and adding stations to those which are larger and more variable (i.e., in habitat type).

In the past, there has been some "emotional" reaction to changing the stratum boundaries and allocation of stations within. This has influenced the decision not to make changes in survey design and has limited the ability to add and subtract stations from strata.

Industry expressed concern over the size and diversity of habitat type in NMFS stratum 16, where there is high variability in the catches of yellowtail. Over the past few years sampling effort (# of stations) has increased in this stratum to help reduce some of this variability.

There may be additional variability in the catches of flatfish compared to other groundfish species due to the influence of diel (day/night) and tidal cycles on their behaviour. While these patterns may even out over several days of fishing, they could influence results in some of the smaller strata which have fewer stations and could be sampled over a relatively short time period (i.e., less than half a day).

Conclusions

There is no obvious change in sampling allocation or design for any of the surveys that would benefit all three species. While the relative efficiency is lower for yellowtail due to high variability in catches, it would be difficult to design strata that are specific for this species. It was concluded that it is appropriate to keep the current sampling design.

Some suggestions for improvement include looking at the possibility of splitting some of the NMFS strata along the 5Zjm boundary and re-allocating stations to ensure that both halves of the stratum are sampled. There could be some advantage to changing strata design, i.e., by collapsing smaller strata into a single larger one and also splitting the larger strata into smaller units. It would also be worth examining co-variance due to day/night differences. Another suggestion was to allocate 10% of tows annually based on priority needs from discussions between scientists and stakeholders. These tows could be used for special projects/situations. This approach is being used in the U.S., although it is not specifically 10% of the tows which are allocated differently each year in response to annual priorities. DFO has recently added an additional stratum with 3 stations (5Z9) to sample deeper waters along the northern edge of the bank during the February survey. This stratum covers an important geographic area where cod are found during winter months.

TRAC Presentation: Georges Bank Yellowtail Flounder Assessment

Working Paper: Stock Assessment of Georges Bank Yellowtail Flounder for 2011 TRAC Working Paper 2011/01.

Presenter: C. Legault

Rapporteur: H. Stone

Presentation Highlights:

The combined Canada/U.S. yellowtail flounder (*Limanda ferruginea*) catch decreased from 2009 (1,806 mt) to 2010 (1,160 mt) due mainly to a decrease in quota. The 2005 year class did not appear strong in any of the recent surveys and did not dominate the catch, causing the

assessment model to estimate the 2005 year class as only average. The 2005 year class had been estimated as one of the largest since the mid 1970s in the 2009 assessment. This change in perception of the 2005 year class caused the estimated spawning stock biomass to be lower than estimated in the last assessment. The recent trend in estimated spawning stock biomass is increasing, around 8,800 mt in 2010, but still well below the U.S. rebuilding target of 43,200 mt. The 2005 and 2006 year classes are estimated to be about average at 16.8 million and 17.1 million, respectively, the 2007 and 2008 year classes are well below average, and the 2009 year class is estimated to be the lowest in the time series at 0.9 million. Fishing mortality rates for fully recruited ages 4+ was estimated to be 0.13 in 2010, below the F_{ref} of 0.25. However, the retrospective pattern is becoming more pronounced in this assessment, with the estimates of F in 2008 and 2009 in last year's assessment being 0.13 and now estimated at 0.28 and 0.27, respectively. Assuming a 2011 catch equal to the 2,650 mt quota, a combined Canada/U.S. yield of about 1,600 mt in 2012 results from the deterministic application of F_{ref} = 0.25.

Discussion:

Fishery Data

Yellowtail flounder catches in 2010 were lower than in 2009; 42% of the total catch was attributed to discards. The estimate of catch from the assessment showed an additional 44 mt compared to the estimate from quota monitoring for calendar year 2010, but this difference was less than observed in the past. Slight differences in the estimation formulas/methods can result in differences in landings and discard estimates from quota monitoring vs. the assessment.

Discards from the U.S. large mesh trawl fisheries (cod end mesh > 14 cm) were mainly small fish from regulatory discarding. There are generally more discards below the minimum size limit in the U.S. fishery compared to the Canadian fishery. Overall, however, the U.S. fishery had slightly larger fish in the catch compared to the Canadian fishery since the latter was mostly discards from the offshore scallop fishery. A new management regulation in 2010 has required U.S. scallop vessels to retain legal-sized (≥ 33 cm) yellowtail, however, confusion regarding this rule led to discarding of yellowtail by scallop vessels this year.

Discards of GB yellowtail flounder in the U.S. scallop dredge fishery were estimated using observed discard rates expanded by total kept catch. During the 2010 TRAC it was noticed that the in-season monitoring estimate differed from that developed during the assessment in years the Georges Bank access areas are open. Discard rates in access areas are typically higher than outside the access areas. Work by the Scallop Plan Development Team since the 2010 TRAC suggests the differences may be due to different stratification schemes. In-season monitoring effectively stratifies by open and access areas, while the assessment only stratifies temporally by half-year. This may result in biased discard estimates. It was recommended to investigate whether estimates of yellowtail flounder discards in the U.S. scallop dredge fishery can be improved using stratification schemes that account for the access area program.

The catch at age/weights at age have been calculated using the same length/weight equations over the past several decades. It was noted that there could be some bias in the weights at age for younger ages and that it might be useful to explore the use of annual length/weight relationships. There has been an increase in weights at age with increasing population biomass, just the opposite of what might be expected if this relationship was density dependent. This could be related to diet or other correlated factors (i.e., environmental conditions).

Concern was expressed over the assumption of M=0.2 for age 6+. Since there are not many fish in the catch above age 8, then perhaps M is actually higher, although recent high F means few fish would survive to this age regardless of the M at this age.

Surveys

All the survey series used for this assessment (DFO, NMFS spring, NMFS fall, NMFS scallop) showed fairly consistent trends, with the exception of the two high values in 2008 and 2009 from the DFO survey. Current values are down compared to the 2000-2010 period indicating that stock biomass may be on the decline. Although the trends are "noisy" for yellowtail, there is consistency among surveys in recent years, which is important relative to population biomass.

Concern was expressed over how well the new trawl used by the FSV *Bigelow* works for capturing small yellowtail flounder, and if large numbers at length are down-weighted for conversion to FRV *Albatross IV* units. Further investigation of this issue during the meeting indicated that few yellowtail were captured at smaller lengths (i.e., < 20 cm TL) by the FSV *Bigelow* in the 2009-2011 surveys, so it is unlikely that large numbers of small fish were "lost" through the conversion factor.

The NMFS scallop survey is still used as a tuning index for age 1 yellowtail, however, age material is now being collected from this survey to develop age-specific indices for ages 1-6+. This survey appears to catch proportionally more small yellowtail compared to the bottom trawl surveys; the offshore scallop dredge fishes close to the bottom and is equipped with a small mesh liner which likely improves the capture and retention of small fish.

The discrepancy continues between relative F and survey Z (i.e., the survey Z remains high after 1995 and does not show a rapid decline like relative F). This discrepancy is the heart of the retrospective problem but it is not clear as to what is the actual cause. The solutions prescribed during the benchmark review (i.e., splitting survey time series) suggest that there is more support for estimates of survey Z rather than survey biomass.

Splitting the survey time series does not appear to be working as well at present as evidenced by the re-emergence of the retrospective pattern despite splitting the surveys. The fall back is that there are four different survey series which are showing consistent trends, although providing catch advice from just surveys is not simple.

VPA

The area allocation landings for the U.S. changed slightly for 2007, 2008, and 2009 which resulted in slight changes in catch, catch at age, and weights at age. However, these increases had very little influence on trends in F and biomass.

Residuals were large and negative in 2011 for older fish in the NMFS spring survey (ages 5 and 6+) and younger fish (ages 2 and 3) in the 2011 DFO survey, indicating that the model is predicting higher abundance for these age groups compared to the survey estimates, which showed strong declines in 2011.

The retrospective pattern, which re-emerged during the 2009 assessment, appeared to be even stronger in the current assessment despite the fact the survey time series was "split" in the VPA model to specifically address this problem. Retrospective analysis for the Split Series VPA did not indicate a strong tendency to over or underestimate recruitment (except for the 2005 year class), but it did indicate a tendency to underestimate F and overestimate biomass. Given that

q (based on areas swept) is in the order of 100% higher since the split (1994-1995), some process is going on that the model has tried to fix, even though the cause is not clear.

For sensitivity analyses, each survey series (split at 1994-1995) was applied separately for tuning indices and results were compared. Also, for all series combined, the timing of the split was examined to determine if 1994-1995 continues to be appropriate. The NMFS spring and NMFS scallop surveys had a tendency to push the model towards a lower SSB and higher F, while the NMFS fall survey pushed the model towards a higher SSB and lower F. The DFO survey tended to track the results from the combined Split Series VPA. The sensitivity runs using the combined series with a change in the timing of the split resulted in lower F and higher B when the split was earlier than 1994-1995.

In general, the split series VPA was robust to model assumptions and the choice of data used, however, the 80% confidence interval (CI) did not appear to capture all of the variability from these separate model runs. In any case, it was not possible to determine the cause of the retrospective problem and there is still much uncertainty about where the split in the time series actually occurs. If there is no split in the time series, however, then the retrospective pattern becomes much more pronounced.

The Mohn's rho statistic was used to evaluate the magnitude of the retrospective pattern using seven peels. Rho was much lower in last year's assessment, and the concern is that it is now getting more extreme. This is particularly due to the most historical peel being in the opposite direction of the other six peels for both F and SSB. If the retrospective pattern continues next year, then dropping this opposite peel and replacing it with one in the same direction will lead to a much larger Mohn's rho value for both F and SSB. Application of Mohn's rho statistic was not part of the benchmark assessment as splitting the series addressed the retrospective pattern at that time.

While F has declined in recent years, something else may be causing an increase in mortality (or survey q's have changed dramatically). To reduce the retrospective pattern there would have to be a 3-5 fold increase in catch or M would have to increase from 0.2 to 0.6-1.0. While there are still not many older fish in the population (despite reductions in F), it is not clear why M would increase at older ages.

The group considered what could be done to improve this assessment for the future. It was noted that other assessments (i.e., EGB cod) suffer from this problem as well and considerable effort will be required to resolve these retrospective problems. The group concluded that there is really no other choice at present other than to use the benchmark methodology. While other model formulations have been examined for yellowtail, they have not been effective for very long and the retrospective problem continues to re-emerge.

Projections and Advice

Although the exploitation reference point (F_{ref}) was not updated this year, the current weights at age and fishery partial recruitment were used to compute $F_{0.1}$ and $F_{40\%MSP}$. The results showed that F_{ref} is robust to the changes observed in weights at age and fishery partial recruitment. It was therefore considered to be the appropriate metric to use again this year. Projections were done using a three-year average for partial recruitment and weights at age.

The group discussed how to provide advice and whether or not it was appropriate to adjust for the retrospective pattern. In the end, it was decided that while the Split Series model was the accepted model for providing catch advice, two alternative sets of projections were considered

informative regarding the uncertainty in catch advice: the Split Series model with an additional relative retrospective correction (rho adjustment) and the Single Series model with rho adjustment. These two additional comparisons were carried out in part to make sure that the model estimates of stock biomass (after rho adjustment) did not fall below the survey estimates of stock biomass.

Projections from the Single Series VPA model with rho adjustment were found to give very similar 2012 catch advice to the Split Series VPA without rho adjustment. The Split Series rho adjusted projection resulted in lower 2012 catch advice than the unadjusted Split Series projections. However, the Single Series VPA model with rho adjustment exhibited a decrease in median adult biomass for catch levels which exhibited an increase using the Split Series VPA model without rho adjustment.

Comparisons of residual sums of squares deviations (RSS) indicated that the Split Series models tend to be the best performing in terms of reducing RSS compared to the Single Survey Series model. However, it was pointed out that the Single Survey Series model has only half the number of catchability parameters which would result in an increase to the RSS. Thus, the Single Series model was not directly comparable to the other models. The timing of the split indicated that 1995/1996 was the best split, but that 1994/1995 (the split used in the Split Series VPA) was not much different. Splits much earlier or later than 1994/1995 had large increases in RSS, indicating a worse fit.

The history of management advice for this stock indicates that the assessment has not performed well; that is, catches below the recommended TACs have produced fishing mortality above F_{ref}. This summary will be included in the reference document.

TRAC Presentation: Eastern Georges Bank Cod Assessment

Working Paper: Assessment of Eastern Georges Bank Atlantic Cod for 2011. TRAC Working Paper 2011/03.

Presenter: Y. Wang

Rapporteur: K. Clark

Presentation Highlights:

Commercial Fishery

Combined Canada/U.S. catches in 2010 were 1,326 mt, including 221 mt of discards. Canadian catches decreased to 840 mt against a quota of 1,012 mt in 2010 from 1,209 mt in 2009, taken primarily between June and December by otter trawl and longline. Discards were estimated at 48 mt from the mobile gear fleet and 44 mt from the Canadian scallop fishery in 2010. U.S. catches decreased to 486 mt in 2010 from 628 mt in 2009, the otter trawl fleet accounted for 76% and the longline gear about 23% of the landings. The landings for 2007-2009 were re-estimated due to auditing of the commercial landings data base that included changes in area designation of landings. The effect on the total EGB cod landings was minimal. Estimated discards of cod for 2010 were 129 mt.

Size and Age Composition

The size and age compositions of the 2010 landings by the Canadian groundfish fishery were derived from port and at-sea samples from all principal gears. Comparison of port and at-sea length frequencies did not indicate any discrepancies for otter trawlers but fixed gear observer samples tended to have more small fish than the port samples. The size composition of cod discards from the 2010 Canadian scallop fishery was derived from at-sea sampling and the discards from otter trawlers were assumed to have the same size composition as their landings. The catch at age composition was obtained by applying quarterly fishery age length keys to the size composition.

The size and age compositions of the 2010 U.S. fishery landings on eastern Georges Bank were estimated using port samples of length frequencies and age structures collected from all principal gears and seasons by market category. The size and age composition of discarded fish were estimated using at-sea observer samples of length frequency and commercial and NEFSC survey age length keys from the same area and season.

Comparisons indicated good agreement between DFO and NMFS age readers. Catch has declined substantially for all the ages since 1995, and only ages 3 to 6 have contributed significantly to the catch. Contribution of older ages has not improved. The combined Canada/U.S. 2010 fishery age composition by number was dominated by the 2006 year class at age 4 (44%), followed by the 2007 year class at age 3 (23%) and the 2005 year class at age 5 (15%) and the 2003 year class at age 7 continued to make some contribution to the catch (7%). Since early 1990s, fishery weights at age show a downward trend. In 2010 the weight at age decreased for all ages except age 3.

Abundance Indices

The catch from NMFS spring, NMFS fall and DFO bottom trawl research survey series are used in the assessment. The spatial distribution of ages 3 and older cod caught in 2011 surveys were similar to those observed from surveys over the previous decade. With the exception of the 2003 and 2006 year classes, the survey abundance at age showed poor recruitment since the 1990 year class in all three surveys. There were very small catches of the 2003 year class in 2011, the 2006 year class appears prominent in the surveys, but not as strong as the 2003 year class. Initial indications for the 2010 year class are promising from the 2011 DFO and 2010 NMFS fall surveys. Compared with pre-1990 surveys, representation at older ages and younger ages in recent years continues to be poor. The survey biomass in 2011 for all the three surveys are lower than 2010, and NMFS spring survey is the second lowest in history. Except for age 6, the weights at age for all the ages in 2011 were lower than in the 2010 surveys. Cod condition, derived from the DFO survey, started to decline in recent years.

VPA Calibration

The “split M 0.2” and “split M 0.5” VPA model formulations established at the 2009 benchmark meeting were used in this assessment. The survey time series are split in 1993-1994. For the “split M 0.2” model formulation, the annual natural mortality rate, M, was assumed constant and equal to 0.2 for all ages in all years. For the “split M 0.5” model, M is fixed at 0.5 for ages 6+ during 1994-2010. Fishing mortality on age 9 for 1978 to 2010 was assumed to be weighted average fishing mortality on ages 7 and 8. Population abundance at ages 2-9 in the terminal year were estimated by ADAPT, age 1 was fixed at 1.5 million and was not calibrated by the survey abundance of age 1 in 2011.

Result

The biomass for ages 3+ was estimated at 3,288 mt from the "split M 0.2" model and 5,088 mt from the "split M 0.5" model in 2010, the second lowest in the time series from both models. The estimated fishing mortality (population number weighted average on ages 4 to 9) in 2010 were 0.41 and 0.25 from the "split M 0.2" and "split M 0.5" models, respectively, F has been consistently above F_{ref} = 0.18. Since 2000, the 2003 year class was the highest recruitment observed by either model, but was less than half of the average (about 10 million) during 1978-1990, when productivity was considered to be higher. The 2002 and 2004 year classes were the lowest on record in both models. Initial indications were that the 2007, 2008, and 2009 year classes were less than 2 million. Recruitment indices from the bottom trawl surveys for the 2010 year class were higher than those for recent year classes although they were not estimated in the VPA. Good spawning stock biomass is needed for higher recruitment expectation.

Surplus production has remained low since the mid 1990s and growth of ages 2 to 10 has typically accounted for the greatest percentage of the production. In 2010, yield exceeded surplus production. Resource productivity is currently very poor due to low recent recruitment and low weights-at-age.

Both assessment models exhibit a retrospective pattern in which perceptions of stock size were revised downward and fishing mortality were revised upward. The retrospective inconsistency in the 3+ biomass was approximately 88% for the "split M 0.2" model and approximately 62% for the "split M 0.5" model. If the retrospective pattern persists, the F in 2010 will be 39% higher than estimated above.

Projection

For projections, a three year average of fishery and survey weights at age was used except for the slower growing 2003 year class, which was based on cohort regressed values. Partial recruitment was based on recent 5 year average values. Catch in 2011 was assumed to be equal to the 1,050 mt quota. A combined Canada/U.S. catch of about 600 mt ("split M 0.2" model) and 1,050 mt ("split M 0.5" model) in 2012 will result in a neutral risk (50%) that F in 2012 will exceed Fref. A catch of 1,300 mt ("split M 0.2" model) and 900 mt ("split M 0.5" model) will result in a neutral risk (50%) that the 2013 adult biomass (ages 4+) will not increase from 2012. A catch of about 1,000 mt ("split M 0.2" model) and 300 mt ("split M 0.5" model) will result in a neutral risk (50%) that the 2013 adult biomass will not increase by 10% from 2012.

With the decreasing contribution of the 2003 year class over time and the lack of strong year classes to take its place, the population biomass will remain at a low level.

Discussion:

Input Data

The U.S. catch at age was updated for 2007 to 2009. Previously the U.S. age length key was augmented with Canadian ages, but since there was sufficient sampling to just use the eastern Georges Bank U.S. age length key, the catch at age was revised. It was noted that the revised U.S. catch at age down-weights the contribution of the 2003 year class. It was explained that when the Canadian samples were included, they swamped the age length key. The issue was not a discrepancy in aging between countries, but reflected a difference in the length frequencies of the catches.

The U.S. and Canadian assessment leads were asked by the group to provide the U.S. and Canadian age length keys and length frequencies for 2008 and 2009, preferably by quarter. These were provided along with an explanation of the differences between the old catch at age and the updated version for 2007 to 2009. There was some reallocation of the U.S. landings data which made a slight difference in the landings: a 9% increase in 2007 landings, a 3% decrease in 2008 and less than 1% increase in 2009. The discards were also adjusted because with the changes in the kept landings, the discard to kept ratios changed. As a matter of procedure, the discard calculations are repeated every year for the whole time series in case there have been changes in the landings or observer data bases.

The U.S. sampling protocol is one sample per 100 mt landed. A length sample is 100 fish and an age sample is 20 to 25 fish. For accounting purposes, a sample is not necessarily from a single trip – it may be a combination of length frequencies from several vessels within a calendar quarter because landings are usually small. For example, within a month it may take three sampled trips to get 100 lengths. The samples are stratified by quarter and market category. From 2007 to 2009 the sampling frequency was well within the protocol so there were sufficient U.S. age and length samples to categorize the catch. There was considerable discussion about how mixed trips from eastern and western Georges Bank are sampled when there is no requirement in the U.S. to keep the actual catch from the different areas separate, although a separate log is required. Samples from mixed trips are not included in the analysis.

There were differences between the proportions of fish at length in the U.S. and Canadian catches in 2008. The U.S. did not catch the larger fish (age 6) which corresponded to the weak 2002 year class. As independent corroboration, there were also very few six year olds in the Gulf of Maine fishery. In 2009 the U.S. still caught fewer of the large fish. It was concluded that the U.S. eastern Georges Bank age length key should be used for the construction of the U.S. catch at age, assuming there are sufficient U.S. samples.

The reviewers questioned whether Canadian or western Georges Bank ages should ever be used to augment the age length key. Cod distribute by age with older fish in deeper water so it is not surprising that there are differences by size in the fisheries. Attributing samples from one area to another would be inappropriate. It is important to keep the age length keys with the length frequencies from which they were sampled. It is not expected that updating the U.S. catch at age will make a big difference to the assessment; however it should be fully updated.

Surveys

In the NMFS fall survey a lot of small cod (2010 year class) were caught in a single tow on the Canadian side. These small fish also showed up in the NMFS spring and DFO spring surveys.

It was noted that there appeared to be a difference in the number of survey sets shown in the slides for the age 3+ distribution and the 2003 year class distribution from the 2011 NMFS spring survey. In reality the numbers of sets are the same, but the scales of the figures are different and the management area is not marked on the 2003 year class distribution figure. If the figures showing the distribution of the 2003 year class distribution by survey and year are to be in the research document, the management area should be included.

A question was raised about how the surveys conducted on the *Bigelow* were adjusted for biomass. A weight-length relationship was applied to each length category to produce the survey biomass trend figures.

Currently condition is evaluated by looking at weight at length for three individual length categories from the DFO spring survey. However, for the bigger length categories the sample sizes from the survey are very small. Fulton's K might be a better metric to use for condition and should be used in the future.

There was discussion about the large reduction in weight at age. This could translate to a considerable reduction in biomass based solely on the weight at age.

2011 VPA Calibration

When the two benchmark models were compared, the 'split M 0.5' estimated more fish, showed lower relative errors and was more consistent with the catch trends. However, the retrospective pattern indicated that both models overestimated the biomass and underestimated F. The retrospective, decrease in weights at age, and changes in partial recruitment were all cited as possible reasons for F consistently being above the reference level. The retrospective pattern is the same for both models but the magnitude is greater for the 'split M 0.2' despite the fact the survey time series was "split" in both VPA models and M was additionally increased on older ages in the split M 0.5 VPA model to specifically address this problem.

The survey date for the terminal year of the DFO spring and NMFS spring surveys was set at the beginning of the year rather than at the time that the survey actually occurred. In the future, it would be better to use the true survey date and put in the catch from the first few months of the year. The U.S. catch, however, would not be available since the area allocation is conducted on a full year basis.

In the VPA formulation, age 9 was the weighted average of ages 7 and 8. As a result, the large dome in q that was produced at age 10+ was partly an artifact of age 9 being an average of the younger ages, but also due to the use of the forward calculation of the plus group.

The stock-recruit plot showed two circles around two different time periods. It was noted that in order to get pre-1994 recruitment, there would need to be similar conditions not just higher biomass.

In 2009, the two benchmark split-survey models selected by the TRAC, had relatively minor retrospective patterns compared to models without the survey split. One of the advantages to the 'split M 0.2' model is that it harmonizes with the U.S. assessment for the whole of Georges Bank.

The retrospective issue was discussed in terms of possible causes and it was suggested that for the future, additional sensitivity runs could be made with higher M values and perhaps a ramped M.

One sensitivity analysis with higher M values was presented to the group. For this VPA run, M was equal to 0.2 for all ages prior to 1994. After 1994, M=0.2 for ages 1-5 and was estimated for ages 6+ as a single block. This VPA run showed a better retrospective for recruitment, 3+ biomass and F and much lower values for Mohn's rho. The estimated M ranged from below 0.4 in 2004 to 0.65 in 2011. In 2008 (the last year of data included in the 2009 benchmark) M was estimated to be 0.5, the same as the 'split M 0.5' model; this explains why that model performed so well in 2009. If M is estimated year by year, rather than in a block, it would be higher. The sensitivity run shows that there is still a retrospective problem. If M was fixed at 0.65, the retrospective persists in the future and if M is calculated in future years it would be expected to continue to increase. M is aliasing some change but the underlying cause is not known.

As the 2003 year class ages, it will be important to keep an eye on the mortality of the older ages (6+) for both model formulations. This is in keeping with the conclusion of the 2009 benchmark which stated: "Until the fate of the 2003 year class has been documented (ages 6+) it will be necessary to use these two models to adequately account for uncertainty in the assessment" (Wang et al. 2009).

There was discussion about the inconsistencies between the metrics used in the assessments. The surveys provide estimates of high Z, not estimates of M, and the methodology that is being used in the VPA was designed to be effective when F is high relative to M. If the reference point of F=0.18 was based on yield per recruit when M has a value of 0.2, then the reference point for the 'split M 0.5' model would likely be much higher. At the benchmark, it was decided that because of the inability to adequately characterize a stock-recruitment relationship, and the uncertainty about the magnitude and persistence of any changes in natural mortality and weight at age, it is inappropriate to change F_{ref} until these model uncertainties are resolved. However, there was concern that the catch advice was using a reference point that was inconsistent with the model.

The two benchmark models estimate different recruitment, thus the projections should use separate geometric means for the recruitment estimates that are being input into the model. In the future, the same method should be applied to year 1 for the VPA in order to be consistent, but this was not considered necessary for the current assessment because the 2010 recruitment does not impact the projections through 2013. The projections were re-run using the five year geometric mean for the recruitment estimate in the projections and using a separate mean for each of the two benchmark models. The 2012 and 2013 catch was projected with the 2011 beginning year biomass. The results of the risk analysis from the updated projections were much closer to the deterministic projection results. For future assessments it was recommended to use the five year geometric mean for year 1 in the VPA.

There is a need to demonstrate how past management advice has performed. A retrospective of advice and its performance was prepared and presented to the group. This information will be included in the reference document.

Framing Advice

There was considerable discussion about the two models and how the results of these models should be presented. The negative signs are that the recruitment index is near the record low and the biomass is the lowest in the time series. The positive signs are that the three most recent surveys did indicate better recruitment for 2010, which is not included in the VPA, and the fishing fleet is still able to catch the quota.

It was agreed that it was important to indicate the magnitude of the problems with the current two benchmark formulations to management so that they can decide how to deal with them. Both models lead to the same conclusion and advice – catches need to be as low as possible. The retrospective is troubling and is another reason why it is necessary to be cautious. The numbers from the VPA and risk analysis need to be provided but should be framed with caveats.

TRAC Presentation: Eastern Georges Bank Haddock Assessment

Working Paper: Assessment of Eastern Georges Bank Haddock for 2011. TRAC Working Paper 2011/02.

Presenter: L. Van Eeckhaute

Rapporteur: T. Nies

Presentation Highlights:

Fishery

The total catch of eastern Georges Bank (EGB) haddock in 2010 was 18,794 mt under a combined Canada/U.S. quota of 29,600 mt. The 2010 Canadian catch decreased to 16,592 mt from 17,648 mt in 2009 while the U.S. catch decreased to 2,201 mt from 2,208 mt in 2009. Canada caught 94% of its quota while the U.S. caught 18%. Estimated discards from the Canadian scallop fishery were 14 mt. U.S. groundfish fishery regulated discards were 34 mt in 2009.

Canadian landings were highest for the month of August, followed by July and January. The 2010 Canadian winter fishery took place from January 1 to February 7. Most of the Canadian landings were made by otter trawlers with longliners landing a much smaller portion of the Canadian total. Catch from gillnet gear was very low. The Canadian landings were well sampled from both port and at-sea observers. Canadian otter trawl and longline landings peaked at 50.5 cm and gillnet landings at 52.5 cm.

The U.S. fishery is almost exclusively executed by otter trawlers. Landings for 2007, 2008 and 2009 were revised. The 2010 landings were fairly evenly spread amongst the 4 quarters with the “scrod” size category accounting for most of the landings. Length sampling was much lower than Canadian levels but was considered adequate so samples were not augmented from adjacent areas. Landings peaked at 50 to 54 cm and discards, mostly from the otter trawl fleet, peaked at 28.5 and 48.5 cm with a smaller peak at 10.5 cm.

Catch at Age

The DFO age reader, Derek Knox, provided ages for the Canadian fishery and survey and S. Sutherland provided ages for the U.S. Inter-reader age testing was conducted between the DFO and NMFS labs and intra-reader testing was conducted at both labs. Agreement was satisfactory and age determinations were considered to be reliable for estimating the age structure of catches and surveys.

The combined catch at age follows year classes well. The 2003 year class dominated the landings for both countries. Older ages are contributing more to the catch than during the 1990s. The observed catch in percent was very similar to what was predicted in 2009 and 2010. The observed fishery weight at age for the 2003 year class was lower than predicted (observed of 52.3 cm vs. a predicted length of 53.1 cm).

Indices

Length based conversion factors were used to make the *Bigelow* surveys equivalent to the *Albatross IV* catches for NMFS surveys since 2009, inclusive. All three surveys (2011 DFO and

NMFS spring and 2010 NMFS fall) had very high catches of the 2010 year class, especially the DFO and fall surveys. Five large catches of 2010 year class haddock were caught outside the 5Zjm area by the NMFS spring survey while catches in the 5Zjm area were smaller. Adult haddock were caught in abundance by all three surveys, although the signal from the NMFS spring was not as strong, and were distributed in the usual pattern. Catches of the 2009 year class were small. Catches of the 2003 year class were still strong relative to other year classes. Since about 2003, the adult biomass indices have been fluctuating without trend at a high level. Adult index values for the most recent surveys went up slightly for the NMFS fall survey, went down for the DFO survey and decreased substantially for the NFMS spring survey.

Size at Age

The 2011 DFO survey weights and lengths for ages 1 to 8 decreased. Survey sizes at age for the younger ages had exhibited a recent increasing trend but they decreased again in the last 1 or 2 years. Older ages have shown no recovery from the downward trend in weights at age. Except for age 3, the 2010 fishery weights at age decreased and exhibit a decline starting around 2001. Weights at length (condition) for representative lengths decreased from 2010 to 2011 and all are well below the series average. Most of the lengths examined are showing the lowest weights observed for the series. There is a trend towards lower condition since about 2001. The growth rate for the 2003 year class from age 7 to 8, was higher than the 2000 year class growth rate at the same age but growth has slowed. The 2010 year class size at age 1 is less than the 2003 year class at the same age.

ADAPT formulation

The benchmark formulation was applied with the minor changes that had been reported in previous assessments. Diagnostics and results were consistent with the previous assessment. A retrospective analysis showed no patterns of concern.

Results

Improved recruitment in the 1990s and the strong 2000 year class, lower exploitation, and reduced capture of small fish in the fisheries allowed the adult population biomass (ages 3+) to increase from near an historical low of 10,300 mt in 1993 to 83,600 mt in 2003. Adult biomass decreased to 59,700 mt in 2005 but subsequently increased to 162,800 mt in 2009 and was 93,400 at the beginning of 2011 (80% confidence interval: 74,300 mt – 111,300 mt), higher than the 1931-1955 maximum biomass of about 90,000 mt. The tripling of the biomass after 2005 was due to the exceptional 2003 year class, estimated at 304 million age 1 fish. The preliminary estimate for the 2010 year class is outstanding at 557 million age 1 fish which would make it the largest in the assessment time series: 1931-1955 and 1969-2010. The 2001, 2002, 2004, 2006, 2008 and 2009 year classes are below the average for the most recent 10-years (excluding the 2000, 2003 and 2010 year classes). Fishing mortality for ages 4+ fluctuated between 0.25 and 0.46 during the 1980s and showed a marked increase in 1992 and 1993 to about 0.5, the highest observed since 1971. Fishing mortality (ages 4+ for pre-2003 and ages 5+ for 2003 to present) was below F_{ref} = 0.26 from 1995 to 2003, fluctuated around F_{ref} during 2004 to 2006 and declined to below F_{ref} since then and was 0.15 (80% confidence interval: 0.13 – 0.19) in 2010. The determination of F_{ref} was based on analyses that assumed full recruitment to the fishery for ages 4 and older.

Projection

Projection inputs for the 2003, 2005 and 2010 year classes were based on growth specific to those year classes, the approach employed in previous assessments when dominated by particular year classes like the 2003. No growth was assumed for the 2003 year class and the inputs for the 9+ age group were based on the 2003 year class only as 9+ will be dominated by this year class. The 2003 year class growth rates were used to estimate growth for the 2010 year class. The 2011 survey and 2010 fishery weights at age were used for inputs for other year classes, unless it was considered appropriate to use the three-year averages, i.e, to avoid using the lower weights at age of the 2003 year class and when weights at age had dropped within a cohort. Fishery partial recruitment was based on the most recent five years and a partial recruitment for 9+ of 0.5 was used as indicated from the model results. The 2012 catch and biomass was projected to the beginning of 2013. Assuming a 2011 catch equal to the 22,000 mt combined quota, a combined Canada/U.S. catch of 13,500 mt in 2012 results in a neutral risk (50%) that the 2012 fishing mortality rate would exceed F_{ref} = 0.26 and 3+ biomass is projected to be 163,200 mt at the beginning of 2013. The 2003 year class is expected to comprise 54% of the 2012 catch biomass. A catch of 12,300 mt in 2012 would result in a low risk (25%) that the 2012 fishing mortality rate will exceed F_{ref}. There was almost no chance that the biomass would decrease from 2012 to 2013 by 0%, 10% or 20%.

Alternate ADAPT formulation to explore partial recruitment on age 9

The 2003 year class will continue to contribute a significant part of the catch when it enters the 9+ group in 2012. At the 2010 TRAC, there was concern about the partial recruitment at age 9+. Previous assessments have indicated a domed partial recruitment (for age 9+) which would have a significant effect on catch projections. At the 2010 TRAC it was recommended to include age 9 as a tuning index for the DFO and NMFS spring surveys as an exploratory exercise.

This model has a strong residual pattern for age 9 showing positive residuals in the early part of the time series and negative residuals for the last 8 (DFO survey) to 12 (NMFS spring survey) years. In comparison to population parameters from the default benchmark model, it reduces the population estimates for recent years and increases F. Estimates of partial recruitment are similar to the default benchmark model. This model results in a low partial recruitment for the strong 2000 year class at age 9 of 0.36. In comparison, the default benchmark model gives a partial recruitment of 0.32 for the age 9+ group in 2009 which would be dominated by the strong 2000 year class.

As a test of the influence of partial recruitment on the projected catch of the 2003 year class, a catch projection for 2012 which used a partial recruitment on age 9+ of 0.3 instead of 0.5 was run. This resulted in a drop of age 9+ fish from 7,350 to 4,521 mt and an F_{ref} catch of 10,700 mt.

Discussion:

Update of EGB Haddock Data Inputs – Commercial Fishery

Discards of small haddock in the U.S. fishery, while a small part of the overall catch, were a substantial portion of U.S. discards and increased from earlier years. Participants suggested investigating the source of these discards. Future assessments should examine whether there are discards from the U.S. mid-water trawl fishery.

Update of EGB Haddock Data Inputs – Surveys

The U.S. spring and fall bottom trawl surveys, and the Canadian spring bottom trawl survey, continue to track each other well. Abundance of older ages is increasing. Survey size at age, both length and weight, decreased from the previous year. There is a trend to lower condition since 2001. There is good agreement on aging by NMFS and DFO agers.

Application of the Benchmark Formulation for EGB Haddock

Assessment results were consistent with previous years. There are some year and cohort patterns evident in the residuals. The VPA results generally fit with survey trends. While recruitment is variable and generally low from very high biomass, there are too few observations above 100,000 mt to draw firm conclusions on a density dependent effect on recruitment.

It was suggested future model formulations could use correct survey dates for 2011 surveys, by including the quarter 1 catches. It was concluded this was not feasible because of a lack of U.S. catch data.

The NMFS fall survey since 2003 has been above the VPA results, while the other two surveys are lower. This pattern should be examined if it continues in the future.

Projections and Assessment Advice for EGB Haddock

The rationale for projection inputs was discussed at length. Concern was expressed that many of the assumptions (e.g., growth, selectivity) were ad hoc and not based on well-documented decision rules. Some of these decisions differed from those approved in the last benchmark (1998) but it was explained that the strategy used had been necessitated by the requirement to describe the growth of the exceptionally strong 2003 year class, which would comprise a major part of the catch projection. There were also concerns raised that the F_{ref} was established using a flat-topped selectivity pattern, but the assessment showed a decline in selectivity at older ages which was then applied for the projection.

The weight at age assumed for the 2003 year class was also discussed. There is evidence this year class has stopped growing, so projection runs assumed minimal growth. Industry participants also questioned why selectivity would decline on the older fish if they were not expected to grow. An explanation offered was that lower partial recruitment was an alias for increased natural mortality or movement of haddock to areas that were inaccessible to the fishery, but it was not possible to ascertain the actual mechanism.

As a result of these discussions, alternate projections were examined with the following characteristics:

- partial recruitment on age 9+ of 1 and 0.5;
- partial recruitment on age 2 (2010 year class) based on the partial recruitment for the 2003 year class at age 2;
- weights at age for the 2010 year class to match the 2003 year class at the same age;
- fishery weights at age for the 2003 year class assumed to be constant at the value observed in 2010 (i.e., no increase in fishery weights for the 2003 year class after 2010); and
- assume median recruit level for the last ten years (vs. mean).

Illustrative five year projections suggested that catch will decrease through 2013 due to the decline of the 2003 year class then increase substantially in 2014 as the 2010 year class enters the fishery. Participants decided to investigate a constant catch approach to provide additional

information to managers. Projections with constant catches of 22, 20, 18 etc. to 14 thousand mt for 2012 and 2013 were provided. Results showed that such an approach would reduce variability in catches but F_{ref} would be exceeded for several years. If the initial estimate of the 2010 year class is estimated high, the variability in future catches while fishing at F_{ref} is not as dramatic as initially estimated.

TRAC agreed to use the partial recruitment on older ages that was used to determine F_{ref}, i.e., a value of 1, for the partial recruitment on older ages in the projections. A research recommendation was identified to examine the partial recruitment at older ages. The 2003 year class would be able to provide reliable information as a large number will survive to populate the 9+ group.

There is a need to demonstrate how past management advice has performed. A retrospective of advice and its performance was prepared and presented to the group. Except for the years when the 2003 year class projection inputs were overly optimistic, the advice for 5Zjm haddock performed well. This information will be included in the reference document.

There was a consensus to accept the assessment.

TRAC Presentation: Allocation Shares

Working Paper: Update of Allocation Shares for Canada and the U.S. of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank Through Fishing Year 2012. TRAC Working Paper 2011/04.

Presenter: L. Van Eeckhaute

Presentation Highlights:

Development of consistent management by Canada and the U.S. for the transboundary resources of Atlantic cod, haddock and yellowtail flounder on Georges Bank led to a sharing allocation proposal. The proposal was founded on agreement about management units, the principles upon which allocation shares would be determined, and computational formulae. For the purpose of developing a sharing proposal, agreement was reached that the transboundary management unit for Atlantic cod and haddock would be limited to the eastern portion of Georges Bank (DFO Statistical Unit Areas 5Zj and 5Zm; U.S. Statistical Areas 551, 552, 561 and 562). The management unit for yellowtail flounder would comprise the entire Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; U.S. Statistical Areas 522, 525, 551, 552, 561 and 562). Two principles were incorporated in the computational formulae of the sharing proposal to account for both historical utilization, based on reported landings during 1967 through 1994, and temporal changes in resource distributions, determined from NMFS and DFO survey results that are updated annually. From 2010 onward, utilization will account for 10% and distribution 90% of the sharing formula.

The 2010 U.S. NMFS and DFO survey results were used to update the calculation of the 2012 fishing year allocations. Some values for the 2009 NMFS surveys were updated for haddock and yellowtail flounder. These changes were minor and did not influence the final resource sharing allocations.

The resource distributions in 2010 were: Atlantic cod: 78% Canada, 22% U.S., haddock: 57% Canada, 43% U.S. and yellowtail flounder: 56% Canada, 44% U.S.. The 2012 fishing year

allocations (calendar year for Canada; May 1, 2012 to April 30, 2013 for the U.S.), updated with the 2010 resource distributions, resulted in shares for Atlantic cod of 76% Canada, 24% U.S., for haddock 57% Canada, 43% U.S., and for yellowtail flounder 51% Canada, 49% U.S..

Discussion:

There was consensus to accept the document.

TRAC Presentation: Multi-year Assessment

Working Paper: Multi-year TRAC Assessments and Projections. TRAC Working Paper 2011/07.

Presenter: L. O'Brien

Rapporteur: L. Brooks, J. Porter

Presentation Highlights:

At the July 2010 TRAC meeting, the Committee discussed a proposal to have a multi-year assessment cycle rather than annual assessments as currently conducted for Eastern Georges Bank cod and haddock management units and the Georges Bank yellowtail flounder stock. The TRAC forwarded this proposal to the TMGC and to the SC, and both committees agreed to review a TRAC working paper discussing the advantages and disadvantages and outlining the details of a multi-year assessment cycle.

The draft document, outlining the advantages and disadvantages and details of conducting multi-year assessments, was presented to the TRAC. TRAC reviewed the document and comments and edits were incorporated into the working draft. A final draft will be sent to TRAC members by the end of July for any further comments, and the final document will be prepared and forwarded to the TMGC during August. The TMGC will then forward the document for discussion at the September meeting of the Steering Committee in Halifax, NS.

Discussion:

There was consensus that the current annual cycle is not giving the TRAC sufficient time to evaluate the issues in the assessments and to make improvements. Moving to multi-year assessments would allow the TRAC to shift effort to follow-up on problems and improve assessments and thus improve management performance. This is consistent with how other assessments are conducted in Canada and the U.S. where few stocks are assessed annually.

In addition to the approach using multi-year projections, another approach using stable catch advice with survey trend monitoring was discussed. It was suggested that the document outline harvest control rules as triggers (using survey trends), either to update projected catch or to recommend doing an assessment sooner than later. The use of survey trends is an approach taken for most of the Scotian Shelf stocks in Canada where the quota is held steady between multi-year assessments unless the survey indices indicate that the biomass has changed and the assessment needs to be reviewed. There was some discussion that while monitoring the stock in the interim years is important, the proposed TRAC Interim Status Report review in the working paper is very intense and time consuming and should be simplified.

It was agreed that although the timing of TRAC was discussed in the working document, it was not germane to the multi-year assessment issue and would be dealt with under Other Business.

It was agreed that the presenter would revise the draft based on the discussion and circulate a new draft to the participants for their comment and ultimate agreement. The reference document needs to be completed by the end of July 2011 in order to give TMGC sufficient time to review and consider the proposal.

OTHER BUSINESS

Scheduling of TRAC

The meeting time of TRAC has always been constrained by (1) U.S. data availability and (2) management requirements in both countries. This leaves a narrow window to conduct the assessments, interpret the results and address any unexpected issues, and then conduct the assessment review. The need to have assessment results provided to managers no later than September, in both countries, prohibits conducting the TRAC any later than late July/early August. Conducting the TRAC in June has always been problematic for the NEFSC due to the difficulty of obtaining and processing the data, including the May availability of U.S. landings data and also the age data from the spring bottom trawl survey (conducted in March and April). In the last few years, that window of time has been further reduced by the extension of the NEFSC surveys by two weeks (it now finishes in mid-May), and by the additional Terms of Reference to address management requests. It is not an issue for DFO to provide previous year's landing data and the current year winter survey data in a timely fashion for cod and haddock. For yellowtail flounder, DFO relies on the U.S. for ageing its data, which has not been problematic in recent years but could become so in future years if the NEFSC accelerates its assessment schedule for other species.

An additional month for data processing would help the NEFSC in this regard. However, conducting the TRAC in July or early August is problematic for DFO due to the research bottom trawl survey being conducted at that time, which limits the availability of participants and potential reviewers. The DFO group is small and finds it difficult to rationalize changing competing work schedules because of the delay in getting U.S. commercial catch data and ageing.

Conclusion: The timing for availability of U.S. commercial catch statistics and survey age data is potentially compromising the quality of the TRAC assessments due to lack of time to prepare and review the assessments. No solution is proposed though several alternatives were discussed. One proposal is to hold the TRAC assessment in May or June and use less data (e.g., exclude the current NEFSC spring survey data, and possibly the previous year's U.S. commercial landings data). Alternatively, if the TRAC was to be held in late August or early September to allow sufficient time to take advantage of as much new data as possible, the managers would have to change the timing of their process.

RECOMMENDATIONS

Discards

- In future, unless the methodology changes, the discard calculations will not be presented in a separate working paper but will be included in the specific assessments.

- Continue to use the three month moving average method to calculate discards from the Canadian scallop fishery.
- Include the December values from previous years and January values from the next year in the calculation of the 3 month moving average.

Survey Design
- Continue with the current sampling design.

Assessments - general
- The retrospective patterns associated with the cod and yellowtail assessments is the single biggest issue facing the TRAC and it is a priority to identify the cause and to mitigate. It is recognized that the retrospective problem is larger than TRAC itself and will probably not be solved from within. Until the retrospective patterns are understood and can be mitigated, it is not recommended that TRAC proceed with benchmark assessments as had been recommended at previous TRACs.
- Include the summary table of how past management advice has performed for the three stocks in the reference document.
- Document the source of F_{ref} for cod and haddock and determine the suitability in light of changes in the fishery (e.g., changes in partial recruitment on the oldest ages), biological characteristics, and current assessment methods. Recommend revision to F_{ref} if needed.

Yellowtail Assessment
- The group emphasized the requirement to resolve the retrospective problem (see above) for this assessment as the sole priority. Though numerous sensitivity analyses were presented, the group concluded that there is no other choice at present other than to use the benchmark methodology.
- Investigate whether estimates of yellowtail flounder discards in the U.S. scallop dredge fishery can be improved using stratification schemes that account for the access area program.

Cod Assessment
- The U.S. eastern Georges Bank age length key should be used for the construction of the U.S. catch at age and the U.S. catch at age from before 2007 should be updated taking out the Canadian age length keys.
- In the future, use Fulton's K as a metric for condition.
- Conduct sensitivity analyses with higher M values and perhaps a ramped M.
- For future assessments use the five year geometric mean for year 1 in the VPA.

Haddock Assessment
- Future assessments should examine whether there are discards from the U.S. mid-water trawl fishery.
- The NMFS fall survey since 2003 has been above the VPA results, while the other two surveys are lower. This pattern should be examined if it continues in the future.
- The last haddock benchmark assessment was in 1998; the current procedure of calculating haddock projections is very complex. It was recommended that a protocol for calculating haddock projections be developed based on principles and decision rules. The goal is to have an objective protocol that can be applied independent of the assessment lead.
- The 2003 haddock year class will be 9 years old in the next assessment; further work evaluating the partial recruitment on haddock older ages is recommended.

CONCLUSIONS

The 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, and for an interesting and productive meeting. In particular, thanks were extended to the reviewers for their excellent contributions to the process. 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. The TRAC status reports would be presented in the autumn to the TMGC.

Working papers were expected to be modified as recommended by this meeting, and published as TRAC Reference Documents in the coming months. The Chairs commented on the need to have reference documents completed and available in a timely manner as a part of the process. The lead scientist for yellowtail stated the yellowtail reference document would be completed by the end of August, and Canada committed to having their documents completed and posted within 4 months (October 2011).

The meeting adjourned at noon on 24 June 2011.

APPENDICES

Appendix 1. List of Participants.

Name	Affiliation	Phone	Fax	Email
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Appendix 2. Terms of Reference.

Transboundary Resources Assessment Committee
Assessment of Georges Bank Cod, Haddock and Yellowtail

June 21-24, 2011

St. Andrews Biological Station

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
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.

- 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.

- For a range of total catch values in 2012, estimate the risk that the 2012 fishing mortality rate would exceed 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder) respectively. Include a table showing the 2012 catches corresponding to low (25%), neutral (50%) and high (75%) probability that the F would exceed 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder) respectively.

- For a range of total catch values in 2012, estimate the risk that the biomass at the beginning of 2013 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2012.

- Review the biomass distribution relative to the U.S./Canada boundary, updating results with the 2010 survey information, and apply the allocation shares formula.

- Review details of survey design and implementation for both the DFO and NEFSC groundfish surveys including e.g. criteria for strata definition, station selection, and station allocation. Evaluate survey design efficiency for each survey for cod, haddock, and yellowtail flounder.

- Draft terms of reference for the 2012 TRAC assessment of cod, haddock and yellowtail.

- Other matters: alternate assessments.

Expected Publications

TRAC Transboundary Status Reports the eastern Georges Bank cod and haddock, and Georges Bank yellowtail flounder management units.
TRAC Reference Documents for eastern Georges Bank cod and haddock, and Georges Bank yellowtail flounder management units.
TRAC Proceedings of meeting discussion

Participants

DFO Maritimes scientists and managers
NMFS Northeast Region scientists and managers
Canadian and U.S. fishing industry
U.S. State and Canadian Provincial representatives (NB and NS)
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

Hachey Conference Centre
St. Andrews Biological Station

21-24 June 2011

DRAFT AGENDA (subject to drift)

21 June – Tuesday

9:00 – 9:15	Welcome and Introduction (Chairs)
9:15 – 9:45	Discards from the 2010 Canadian Scallop Fishery
9:45 – 10:30	Update of GB Yellowtail Data Inputs –commercial fishery & surveys Application of the Benchmark Formulation for GB Yellowtail Projections and Assessment Advice for GB Yellowtail
10:30 – 10:45	Break
10:45 – 12:30	GB Yellowtail continued
12:30 – 1:30	Lunch
1:30 – 3:00	Update of EGB Cod Data Inputs – commercial fishery & surveys Application of the Benchmark Formulation for EGB Cod Projections and Assessment Advice for EGB Cod
3:00 – 3:15	Break
3:15 – 4:00	EGB Cod continued
4:00 – 5:00	Survey design and implementation of DFO and NEFSC surveys

22 June – Wednesday

9:00 – 10:30	Update of EGB Haddock Data Inputs – commercial fishery & surveys Application of the Benchmark Formulation for EGB Haddock Projections and Assessment Advice for EGB Haddock
10:30 – 10:45	Break
10:45 – 11:30	EGB Haddock continued
11:30 – 12:30	Multi-year Assessment
12:30 – 1:30	Lunch
1:30 –1:45	Allocation Shares for 2012
1:45 - 3:00	GB Yellowtail report preparation
3:00 – 3:15	Break
3:15 – 5:30	Continue YT report, start Cod report preparation

23 June – Thursday

9:00 – 12:00	continue report writing EGB Haddock report preparation

12:00 – 1:00 Lunch

1:00 – 3:00 Report Review
3:00 – 3:15 Break
3:15 – 4:45 Report Review
4:45- 5:30 Development of 2011 TRAC cod/haddock/yellowtail Terms of Reference
Other Business (as required)

24 June – Friday

9:00 – 12:00 Report Review, as required

Appendix 4. TRAC Pre-Assessment Meeting, Canada

TRAC Pre-Assessment Meeting, June 2, 2011
Rodd Grand Yarmouth
7:30 to 10:30 pm

Lou Van Eeckhaute gave a brief presentation on the TRAC process and some introductory information for the Eastern Georges Bank (EGB) cod and haddock and Georges Bank (GB) yellowtail flounder stocks. A participants list is proved at the end of the Appendix. Assessment data input presentations for EGB haddock (by L. Van Eeckhaute), EGB cod (by Yanjun Wang) and GB yellowtail flounder (by Heath Stone) were presented. Following are comments / questions raised:

5Zjm Haddock

- In 2010, there were low longline landings of haddock reported for June due to reduced fishing activity because of the presence of dogfish and also because of concern over potential high cod bycatch.
- In the U.S. haddock fishery, the minimum size limit of 19 inches was recently changed to 18 inches. All haddock below the minimum size are discarded.
- Small haddock (likely the 2010 yc) have recently been captured in the U.S. mid-water trawl fishery for herring. Large bycatches (> 2%) have resulted in closures of the herring fishery in the western part of the bank.
- There was discussion about the decline in weights at age of the 2003 yc, which may be related to density dependent factors (because this yc was so large), limited food supply and changing environmental conditions which could affect ecosystem productivity.
- It was pointed out that both LAA and weights at age of haddock have shown considerable variability over the past 5 decades and that it may be inversely related to relative abundance. For example in the 1990s haddock weights at age appears to have been higher when population biomass was low.
- Favourable environmental conditions may have influenced the success of what appears to be a very strong 2010 year class (produced by the 2003 yc). It was suggested that in some years there may be a correlation between the timing of peak chlorophyll concentrations and peak haddock spawning activity to produce these strong year classes.
- There was a brief discussion on the impact of seismic exploration on the survival of fish (haddock) larvae and whether this type of activity could be a source of additional mortality to incoming year classes.

5Zjm Cod

- weights at age has shown a general declining trend over time. Variability in the abundance of sand lance, squid and other forage species has probably influenced long term trends in weights at age.
- The 2010 quota was not reached primarily due to the 12% holdback from the bycatch reserve.
- There were indications that discarding of small cod may have occurred in the GB longline fishery during the month of September, 2010. This observation was based on differences in size composition between samples collected at sea (observer) and at dockside (port), with the at-sea samples showing greater proportions of smaller fish in the catch, although no discards were calculated because of low observer coverage. Data from these observed trips were used in estimates of cod discards by quarter.
- A Canadian port sampler mentioned that smaller fish did not show up until late in the year in the LL port samples. He suspected small fish were being discarded from the fishery.

- Cod from U.S. fishery under 22'' is not allowed to be landed.
- Recently, U.S. fishermen have been catching cod in Area 6 on the western part of Georges Bank. Concern was expressed as to whether some of these fish could have moved west from eastern Georges Bank (5Zjm). In particular, industry expressed concern that a portion of the 2003 year class may be lost to the Canadian fishery on eastern Georges Bank. It was noted that the Cape Cod fleet has recently shifted their cod-directed fishing activity to more southern grounds on the western part of the bank and that recent cod-tagging studies indicate cod movement/leakage in all directions on the bank. Is eastern Georges Bank a nursery area for the entire Bank? A request was made by industry to investigate the relative abundance of the 2003 year class in the fishery catch at age and survey indices for western Georges Bank (SA 6).

5Zhjmn Yellowtail

- Most of the yellowtail flounder discards in 2010 originated from the large mesh (cod end mesh > 6.5 inches) trawl fishery after their allocations have been reached. Discards were also reported from the offshore scallop fishery and the small mesh trawl fishery (i.e., for squid and silver hake).
- Approximately 30 tagged yellowtail flounder originating from a large scale tagging project in CAII were captured shortly after the tagging event in Canadian waters during the summer of 2009, indicating that yellowtail flounder undertake transboundary movements. Industry reported that yellowtail have also been captured by mid-water trawl indicating that they are capable of off-bottom movements and probably take advantage of tidal current assisted transport.
- Both little and winter skates were captured in the Canadian directed yellowtail fishery in the Yellowtail Hole during the early 2000s (H. Stone, personal observation). Up to 25% of the total catch was skates in 2001 and 2003, but before this fishery stopped in 2004 it may have been even higher.
- Scales are currently used to age Georges Bank yellowtail flounder because growth patterns (annuli) on whole otoliths and otolith thin-sections have proven to be too difficult to interpret. Currently, the NMFS lab ages scale samples collected during the DFO survey, so that age interpretations for the 3 survey series are consistent.
- Industry noted that occasionally there have been incidences of shark attacks on the cod end of trawls during fishing operations for yellowtail flounder.

Participants:

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Appendix 5 . TRAC Pre-Assessment Industry/Science Meeting, USA

TRAC Pre-Assessment Meeting, June 2, 2011
Ma. Division of Marine Fisheries
Gloucester, Ma.
10:00 am – 1:00 pm

NEFSC staff presented an overview of the 2010 catch and survey data to be used in the June TRAC assessments for Georges Bank yellowtail flounder (Chris Legault), Eastern Georges Bank cod (Loretta O'Brien) and Eastern Georges Bank haddock (Liz Brooks). Chris Legault presented observer data, by month for 2006-2010 by gear type for the three species. Participants are listed in the table below.

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Appendix 6. 2012 Draft Terms of Reference.

Transboundary Resources Assessment Committee
Assessment of Georges Bank Cod, Haddock and Yellowtail

Date TBD, 2012

Woods Hole

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
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.

- 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.

- For a range of total catch values in 2013, estimate the risk that the 2013 fishing mortality rate would exceed 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder) respectively. Include a table showing the 2012 catches corresponding to low (25%), neutral (50%) and high (75%) probability that the F would exceed 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder) respectively.

- For a range of total catch values in 2013, estimate the risk that the biomass at the beginning of 2014 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2013.

- Review the biomass distribution relative to the U.S./Canada boundary, updating results with the 2011 survey information, and apply the allocation shares formula.

- Document the source of F_{ref} for cod and haddock and determine the suitability in light of changes in the fishery, biological characteristics, and current assessment methods. Recommend revision to F_{ref} if needed.

- Draft terms of reference for the 2013 TRAC assessment of cod, haddock and yellowtail.

- Other matters.

Expected Publications

TRAC Transboundary Status Reports the eastern Georges Bank cod and haddock, and Georges Bank yellowtail flounder management units.
TRAC Reference Documents for eastern Georges Bank cod and haddock, and Georges Bank yellowtail flounder management units.
TRAC Proceedings of meeting discussion

Participants

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