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FOREWORD

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 Resource Assessment Committee (TRAC) met during 13 – 16 June 2006 in Woods Hole, Massachusetts, USA, to review updated assessments (through 2005) of Eastern Georges Bank, Eastern Georges Bank haddock and Georges Bank yellowtail flounder, and to consider a number of related scientific issues. Results of the meeting will be used by the Transboundary Management Guidance Committee (TMGC) in developing management guidance for the 2007 fishing year for these transboundary resources.

RÉSUMÉ

Le Comité d'évaluation des ressources transfrontalières (CERT) s'est réuni du 13 au 16 juin 2006 à Woods Hole, au Massachusetts (É.-U.), pour examiner les évaluations actualisées (jusqu'en 2005) des stocks de morue et d'aiglefin de l'est du banc Georges ainsi que du stock de limande à queue jaune du banc Georges et pour examiner diverses questions scientifiques connexes. Les résultats de cette réunion serviront à orienter la gestion de ces ressources transfrontalières pour l'année de pêche 2007.

INTRODUCTION

TRAC Co-chairs, R. O'Boyle and W. Overholtz, welcomed participants (Appendix 1), noting that the first TRAC meeting was held in 1998. The TRAC receives its remit from the Transboundary Management Guidance Committee (TMGC). The TRAC review process is two tiered, a change introduced in 2002: annual assessment reviews are undertaken between more intensive, periodic benchmark reviews. The benchmark for Eastern Georges Bank cod was established in February 2002, while that for Eastern Georges Bank haddock was established in 1998. Yellowtail benchmark discussions were conducted during 25 – 26 January (data inputs) and 26 – 29 April 2005 (model formulations). This meeting will be applying these benchmarks to the most recent data on these resources to produce assessments to guide fisheries management in 2007.

Participants were reminded (a) that the TRAC is a forum for scientific review; (b) that management issues would not be considered; and (c) that the TRAC deliberations and conclusions would not be finalized until the Transboundary Status Reports (TSRs) had been made public.

The Terms of Reference 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, followed by a plenary discussion of that paper. Rapporteurs documented these discussions for the Proceedings.

GENERAL ISSUES

Teleost / *Needler* Comparison (S. Gavaris)

Rapporteur: R. O'Boyle

Presentation Highlights

The *Needler* was the designated vessel for conducting the DFO survey in 2006. The *Teleost* accompanied the *Needler* to conduct comparative fishing. Due to equipment failure, the *Needler* was unable to complete the survey. For the cod, haddock and yellowtail flounder assessments, it will be necessary to use six sets conducted by the *Teleost* in stratum 5Z3 to obtain proper coverage. Examination of the limited number of paired tows from 2005 and 2006 comparative fishing experiments indicated that a conversion factor might only be warranted for haddock. Results for cod and yellowtail flounder were more variable and inconsistent between years. The impact on the haddock stratified estimates of applying a conversion factor was nominal.

Discussion

It was clarified that the *Teleost* indices were converted to *Needler* "equivalents" using the conversion factors for the purpose of the assessments being reviewed at this meeting. Further, it was only the six *Teleost* sets without paired *Needler* sets that were converted. Overall, the adjustment resulted in a very small change (1%) to the 2006 survey index.

The TRAC considered that given the small change, it would have been preferable to use the unconverted dataset until more thorough analyses and review had been conducted. However, since the conversions have already been incorporated into the assessments to be reviewed at this meeting, the decision was made to proceed with the converted 2006 DFO survey dataset.

This was not considered an important issue for this year's assessments. However, if DFO discontinues use of the *Needler* and uses the *Teleost* in future surveys, TRAC will need to review the conversion factor analyses.

Discarding from Canadian Scallop Fisheries (L. Van Eeckhaute)

Van Eeckhaute, L., and S. Gavaris. 2006. Estimation of cod, haddock and yellowtail flounder discards from the Canadian Georges Bank scallop fishery for 2005. TRAC Working Paper 2006/13.

Rapporteur: R. O'Boyle

It was clarified that the proportion of dredge hauls observed on a scallop trip was used to adjust the observed discards to the total discards of that trip, which was then used with the logbook effort information to calculate discards by the fleet. It was asked how many trips were observed. In the first quarter, the percent observed was 8.4% and 9.1% for yellowtail and cod/haddock, respectively. In the second, third and fourth quarters, the percents were 2, 8.6 and 4.9, respectively. It was asked what would be the impact of calculating the discards without splitting by quarter. For yellowtail, the total discards would have been 352 mt as opposed to 317 mt; the discards of cod and haddock would also be similar.

There were questions on the interpolation methodology used to produce Figure 2 of the working paper. This figure showed an overall increase in haddock discarding since 2001, a decrease for yellowtail and no trend for cod.

There then followed discussion on the observer coverage of the USA scallop fishery. It was noted that in the analysis of USA discard patterns that no adjustment was made for the observer coverage of within trip hauls. It is assumed that the observer samples for the trip are representative of all sets made on that trip. The goal for observer coverage on the USA scallop fleet is 5%. It was pointed out that Canadian observer coverage in 5Zm could be better.

Overall, the discard analyses were accepted by the Committee for use in the assessments.

NMFS Production Ageing (J. Burnett)

Sutherland, S., N. Shepherd, S. Pregracke, and J. Burnett. 2006. Accuracy and precision exercises associated with 2006 TRAC production ageing. TRAC Working Paper 2006/12.

Rapporteur: R. O'Boyle

It was asked if the otoliths for which a consensus reading was reached were in fact the easiest otoliths to read. This was confirmed and it was thus pointed out that the ageing might be more variable than indicated. It was pointed out that this might be particularly an issue with yellowtail otoliths, which are difficult to read. The DFO/NMFS agreement on cod ageing was generally good although there were some differences that needed to be checked via the quality assurance protocol. It was asked if the recent growth rate changes were influencing the ageing. Haddock growth is very slow now but it has not been an issue. For cod, the issue had been the shift in growth seen in the 1980s and 1990s, but this is not an issue now. Yellowtail flounder are fast growing and, as there are not now a lot of older fish, this has not been an issue for this species.

It was pointed out that the ageing of the older fish is more critical to the assessments than that of the younger fish. DFO and NMFS employ different protocols to obtain otoliths from length frequency samples. DFO obtains otoliths stratified by length where NMFS obtains the otoliths as a random sample of all otoliths from the length frequency sample. It was suggested that to ensure representative coverage of all age/size groups, NMFS might consider adopting a length stratified sampling protocol to obtain otoliths.

Questions were asked on tagging age validation studies. While there is some material, more is needed. It was suggested that a tetracycline study, which can assist age discrimination in otoliths but not scales, would be useful.

There was the observation that 75% of the yellowtail flounder landed in New Bedford in 2006 were graded as large, but it did not seem that these fish were being sampled by the port technicians. While NMFS staff agreed to investigate this observation, the data presented in the working paper tended to suggest that these larger fish were being sampled.

Overall, it was agreed that NMFS has successfully made the transition in its ageing staff.

USA and Canadian Catch Size Composition

Gavaris, S., R. Mayo, J. Brodziak, J. Hunt, C. Legault, L. O'Brien, H. Stone, and L. Van Eeckhaute. 2006. Length composition comparisons of USA and Canadian fishery catches for Atlantic cod, haddock and yellowtail flounder. TRAC Working Paper 2006/08.

Rapporteur: R.K. Mayo

Presentation Highlights (S. Gavaris)

Length compositions of USA and Canadian landings, discards and total catch of cod, haddock and yellowtail flounder from the USA/Canada shared management area on Eastern Georges Bank from 1997-2004 were compared. Due to limited sampling, comparisons for some stocks could not be performed in all years. Notable differences exist in the length compositions of the discards of the two countries. USA discards are attributed to groundfish and sea scallop fisheries. In the groundfish fisheries in particular, discarding is associated with size culling. Canadian discards are attributed almost exclusively to the Canadian Georges Bank sea scallop fishery where all cod, haddock and yellowtail flounder caught are required to be discarded, regardless of size. In general, estimated discards for both USA and Canadian catches were low relative to landings, and had only a nominal effect on the length composition of the catch.

On average, the length composition of the USA and Canadian cod catches was similar, whereas the length composition of the haddock catch indicates that a higher proportion of small and large fish are caught by the USA fishery while the Canadian fishery catch is more peaked. The length composition of the yellowtail flounder catch indicates that a higher proportion of small fish are caught by the Canadian fishery. On balance, the differences in length composition between USA and Canadian catches of Atlantic cod, haddock and yellowtail flounder were small relative to the length range spanned by any age; therefore, the implications for conservation or yield are expected to be nominal. Low sampling, differences in discarding practices and the absence of direct comparisons during the same time of year and in the same area preclude any definitive interpretation that these marginal differences might be due to gear selectivity.

Discussion

The background and genesis of the topic was introduced. USA port samples were used to characterize the landings length composition and fisheries observer (sea sampling) data were used primarily to characterize the length composition of the discards. For Canada, port and sea sampling data were used to characterize the length composition of both landings and discards. For cod, USA samples from nearest areas west of 5Zj&m were used to augment the 5Zj&m samples. The objective is to discern consistent differences in the modes and tails of the length frequency distributions over time.

Cod

Length compositions of the landings are similar between countries. The USA discarded a higher proportion of smaller fish than Canada due to minimum size regulations, but the range of discarded fish is similar. The Canadian discards come from the sea scallop fleet which is required to discard all fish. Canadian sea sampling coverage of the groundfish fishery has averaged about 10% of the catch observed during the June-December fishery in recent years, and over 50% during the January-February fisheries in 2005 and 2006. There is currently 100% coverage in the 2006 June-December fishery and this will only be reduced if the haddock:cod ratio is favorable. USA observer coverage has been about 30% of trips since 2004. The percentage sea sampling coverage of the Canadian sea scallop fishery has been about 5%. Cod discards in the USA sea scallop fishery are minimal.

Haddock

A slight difference exists in the haddock landings length composition between the two countries, with the Canadian fleet showing a size mode lower than that for the USA fleet. Discard length compositions are variable. Trip limits were not likely to be a factor in the USA discard size compositions, yet there were discards at sizes above the minimum size limit. Much of the variability is likely due to low sampling levels. The catch composition shows the same pattern as the landings because the discards are very low relative to the landings.

Discussion occurred about the interpretation of differences between fleets. K-S tests and plotting of the cumulative distribution may reveal further distinctions. This portrayal may be considered a proxy for a selection ogive. The K-S test is sensitive to the number of degrees of freedom and, with the number of fish measured, the degrees of freedom could be potentially large.

Observed differences may be due to gear effects, but also spatial differences in fleet activity. Analyses of these differences are not feasible because there are no areas where the two countries' fleets overlap.

Yellowtail Flounder

There is a more pronounced difference in the landings length compositions between the two countries, with the Canadian data exhibiting a smaller size mode. However, with respect to discards, the USA discards smaller-sized yellowtail than Canada because the Canadian discards primarily originate from the sea scallop fishery (in which fish of all sizes must be discarded), whereas the USA discards are primarily due to minimum landing size regulations. Overall, the Canadian catch length composition pattern is similar to the landings.

General Comments

The length composition changes are dynamic, reflecting management regulations, year class strength and fleet activity, and should be interpreted with this is mind. While differences have been noted, the causative factors are difficult to identify and cannot be predicted to persist in the future. Difference in length compositions are likely to translate to smaller differences in age composition when sizes are collapsed into age groups. Differences in weight would be more pronounced than differences in length.

Summary graphs were produced showing the cumulative length distribution of the average catch length compositions with length at age ranges indicated on the length axis.

Biomass Distribution

Gavaris, S., R. Mayo, and L. O'Brien. 2006. 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 2007. TRAC Working Paper 2006/07.

Rapporteur: L. O'Brien

Presentation Highlights (S. Gavaris)

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 proposal. The proposal was founded on agreement about management units, the principles upon which allocation shares would be determined, and computational formulae. For the 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; USA 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; USA 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, which are updated annually.

The country utilization distributions used in the sharing formula were based on landings during the period 1967-1994 and are: cod (60% CAN, 40% USA), haddock (55% CAN, 45% USA) and yellowtail flounder (2% CAN, 98% USA).

For each species, the annual percentage of biomass index on each side of the boundary line was calculated using a smoothing algorithm for the most recent 33 year time period with the terminal year being 2005 (used for allocation in fishing year 2007). The percentage of biomass of Eastern Georges Bank cod on the Canadian side progressively increased from about 50% in the early 1970s to above 80% in the late 1980s, and has since fluctuated between 82% and 85%. The percentage of biomass of Eastern Georges Bank haddock in Canadian waters gradually increased from about 80% in the early 1970s to almost 90% in late 1990s, and has subsequently declined to about 75%. The percentage of Georges Bank yellowtail flounder biomass on the Canadian side was about 20% in the 1970s, gradually increased through the mid-1990s to about 50%, but has recently declined. In 2005, the resource distributions were: cod (79% CAN, 21% USA), haddock (71% CAN, 29% USA) and yellowtail flounder (37% CAN, 63% USA).

The fixed resource utilization and the annually updated resource distributions were applied to the agreed sharing formula to determine annual country allocation shares for the two countries of each of the three transboundary groundfish species. For the 2007 fishing year, the allocations are: cod (74% CAN, 26% USA), haddock (67% CAN, 33% USA) and yellowtail flounder (28% CAN, 72% USA).

Discussion

Biomass allocation shares of cod, haddock and yellowtail flounder are estimated annually using protocols established by the TMGC. This year, the allocation shares were updated for fishing year 2007 using the DFO and NMFS 2005 surveys. The sharing agreement is based on historical utilization (1976-1994) and annual changes in resource distribution. For fishing year 2007, the allocation is based on 25% utilization and 75% distribution. Starting in 2010, the sharing agreement will exist in perpetuity, with a fixed formula of 10% utilization and 90% distribution.

In some years, after post-stratification of the Northeast Fisheries Science Center (NEFSC) survey, there were cases where no stations occurred within a stratum. In these cases, a value was inferred from nearby years and strata; however, this did not occur in 2005. Low values are denoted as “0”, and no data are represented by a blank cell.

The NEFSC will be acquiring a new vessel in the near future and at the same time the survey area will be re-stratified. These changes will have no effect on the estimation of biomass because the estimates are derived within each year, and over the same stock area.

Changes in the stratification will only effect the variance and not the mean of the biomass estimate.

The TRAC’s role in the sharing agreement is strictly to update the biomass distributions each year using the three surveys for Eastern Georges Bank cod and haddock and Georges Bank yellowtail flounder. Any reconsideration of the methodology or the sharing agreement is the responsibility of the TMGC.

Summarizing Annual Fishing Mortality

Rapporteur: S. Gavaris

The fishing mortality reference point represents equilibrium conditions for an age specific pattern of fishing mortality. The reference point can be represented as a scalar value for ages assumed to be fully recruited. The annual fishing mortality vector is transient and generally varies by age in Virtual Population Analysis (VPA). It is useful to derive a scalar metric of annual fishing mortality from the age specific vector for the purpose of comparison to the scalar fishing mortality reference point. A population weighted average fishing mortality approximates the total population mortality while a simple average fishing mortality measures the central tendency for the year classes included in the average. Both measures implicitly assume that the partial recruitment pattern is consistent with the partial recruitment used to derive the reference point.

If the management objective aims to keep the fishing mortality on each of the fully recruited year classes below the reference, then a simple average fishing mortality metric is more appropriate. If the management objective is to keep the total population fishing mortality on fully recruited ages below the reference, allowing for individual year classes to deviate somewhat, then a

population weighted average is more appropriate. In effect, the two approaches for summarizing fishing mortality provide different information that should be interpreted in the proper context.

Each approach presents computational challenges. When very strong or very weak year classes are included in a population weighted average, those year classes draw inordinately high or low influence, respectively. Since the simple average is taken over few ages typically, outliers caused by sampling variation (often for weak year classes) have high influence. Population weighted averages tend to be robust to outlier values associated with weak year classes. Other robust metrics (median, inverse variance weighting, narrowing age range, etc.) of central tendency have not been evaluated.

As the VPA formulation for yellowtail flounder sets the F on ages 4, 5 and 6+ to be equal, this is not an issue in that assessment. A narrow age range (ages 4-6) is used for cod, because of the dome-shaped partial recruitment. Therefore, it is not an issue in this assessment either. The average annual F for haddock is computed for ages 4-8 and is sensitive to these problems. Results from an investigation using Eastern Georges Bank haddock as an example may offer insights on best practices and guidelines. The fishing mortality patterns for this stock display many of the computational challenges. Simulation studies could also be informative as the "truth" is known. It was recommended that the empirical and simulation investigations be conducted and reviewed by TRAC.

Adjusting for Bias

Rapporteur: S. Gavaris

It was recognized at the outset that a distinction should be made between adjusting for bias in confidence distributions or risk analyses and adjusting for bias in point estimates. Adjustment for bias in confidence distributions or risk analyses is obtained using the bootstrap bias corrected percentile method (Efron and Tibshirani, 1993). A further refinement, referred to as the bias corrected and accelerated percentile method, for change in variance over the range of bootstrap estimates may also be incorporated, but often has not been used because the effect is generally subtle. Both theoretical results and simulation studies have established the superiority of the bias corrected and accelerated percentile method over the simple percentile method (references). The bias corrected and accelerated percentile method is recommended for general routine application (Efron and Tibshirani, 1993). By inference, and also from simulation results, the bias corrected percentile method can be recommended over the simple percentile method.

Adjusting for bias in point estimates is not as straight forward. A bias adjusted point estimate may have larger mean square error than the biased estimate. This may occur if the variance is large relative to the bias. While the statistical arguments for adjusting bias in point estimates are equivocal, there are some compelling pragmatic reasons. Fisheries management decisions are increasingly being made on the basis of probabilistic statements from confidence distributions or risk analyses. It is very desirable to have point estimates of these management quantities that roughly correspond with the median of the confidence distribution. As noted above, bias adjustment of confidence distributions or risk analyses is recommended. Experience has shown that bias adjusted point estimates achieve this alignment with the risk analyses. Another alternative could be to generate a VPA using the median "run", selected on the basis of a preferred management metric. This requires some investigation as the choice of management metric may affect which "run" is the median. If the bias is small, the adjustment for alignment may be inconsequential. Adjusting for bias requires additional computation. The alternative is to

report the point estimates and their respective bias along with an explanation for the misalignment with the probabilistic statements. This may introduce unnecessary complication.

All of the above pertains to statistical bias arising from the non-linearity of the model equations. The adjustment does not address any other sources of bias. An important recognized source of bias is the "retrospective" problem. Although the magnitude of the retrospective bias can often overwhelm the statistical bias, the statistical bias should always be considered.

Efron, B., and R.J. Tibshirani. 1993. An introduction to the bootstrap. Chapman & Hall, N.Y.

STOCK ASSESSMENTS

5Z Cod

Gavaris, S., L. O'Brien, B. Hatt, and K. Clark. 2006. Assessment of Eastern Georges Bank cod. TRAC Working Paper 2006/09.

Rapporteur: L. O'Brien

Presentation Highlights (S. Gavaris)

Combined Canada/USA catches, which averaged about 17,500 mt between 1978 and 1992, peaked at 26,500 mt in 1982, declined to 1,800 mt in 1995, fluctuated around 3,000 mt until 2003 and subsequently declined again. Catches in 2005 were 1,200 mt, including 407 mt of discards. Canadian catches declined to 900 mt in 2005 from 1,300 mt in 2004. USA catches declined to 300 mt in 2005 from 1,100 mt in 2004. Adult population biomass declined from 44,000 mt in 1990 to 8,500 mt in 1995, subsequently increased to 19,000 mt in 2001, and was 17,000 mt at the beginning of 2006. Recruitment at age 1 of the 2003 year class, at 7.9 million, is the first above average cohort since the 1990 year class. The 2002 and 2004 year classes, at less than 1 million each, are the lowest on record. Fishing mortality for ages 4-6 increased sharply between 1989 and 1993 from 0.5 to 1.0. In 1995, fishing mortality declined to F_{ref}=0.18, but subsequently fluctuated above F_{ref} until 2004, when it declined to 0.17 and declined further in 2005 to 0.10. Assuming a 2006 catch equal to the 1,700 mt total quota, a combined Canada/USA catch of 2,900 mt in 2007 would result in a neutral risk (50%) that the fishing mortality rate in 2007 will exceed F_{ref}=0.18. A catch of 1,500 mt in 2007 would result in a neutral risk (50%) that the adult biomass would decrease from 2007 to 2008, and maintains the fishing mortality near F2005=0.1.

Discussion

Since 1994, Eastern Georges Bank (5Zjm) has been closed to fishing from January to June. Starting in 2005, fishing has been allowed to begin in January, and the fishery remains open until monitoring of maturity staging detects that peak spawning of cod is approaching and/or when the cod to haddock catch ratio becomes too high. In both 2005 and 2006, the fishery was closed by early February.

Eastern Georges Bank cod, while not a unit stock, is considered for transboundary management purposes a management unit, based on tagging and similar patterns in stock-recruit relationships, abundance indices and growth rates compared to the Georges Bank 5Z cod stock. Recruitment is estimated as the number of age 1 fish which are typically fish that have been spawned on Georges Bank; once these fish settle to the bottom they tend to stay in the area.

The gillnet fleet targets cod; however, cod landed by the otter trawl and longline fisheries are essentially bycatch during the second and third quarter of the year. The otter trawl fishery is capable of capturing larger cod, but seeks to avoid cod until the fourth quarter of the year. The otter trawlers use a separator panel, set high to avoid cod, i.e., the cod will swim down and out of the open cod end and haddock will swim up and into the closed cod end. Trawlers typically fish on the Bank whereas the longline fishery is off the Bank in deeper water.

USA discards doubled in 2005, due to the large 2003 year class coinciding with restrictive management measures. Vessels fishing under Category B Days-at-Sea (DAS) were not allowed to land cod, and were therefore discarding large numbers of fish. In addition, cod was not allowed to exceed more than 5% of the total landings on a groundfish trip, which also caused more discarding. Discards are estimated using a discard to kept ratio, which is based on the assumption of a linear relationship between catch and discard. With the current management measures, this assumption is most likely violated and thus increases the uncertainty of the discard estimate.

The cod:haddock landings ratio has been high for some USA otter trawlers that use a separator panel. Some of this can be attributed to poor rigging of the panel and the temporal distribution of cod and haddock. After July, there are fewer haddock in the western part of the USA-Canada management area, so the likelihood of catching cod increases.

Year effects occur several times throughout the times series in the residuals of observed survey indices and model estimates of abundance. The DFO survey has higher coverage of the area than the NMFS surveys; however, the number of tows conducted by each survey does not appear to influence the year effect since the residual pattern is similar between the three surveys. In some cases, the year effect is due to a single large tow. It is possible that the temporal distribution of the fish into and out of the area, in some years, influences these year effects.

There is little pattern in the retrospective analyses of F and biomass after implementation of the benchmark VPA formulation of estimating the oldest age for the last five years in the time series. Estimating the oldest age for the last five years has generated a dome-shaped fishery partial recruitment and higher abundance at the older ages. There is uncertainty about the reliability of the estimates for these older fish in the population and the sensitivity to model assumptions.

A dome-shaped partial recruitment (PR) is used in the projection. If a flat-top PR had been applied, more large fish would have been a forecast in the catch, which is not supported by the observed catch at age in recent years.

5Z Haddock

Van Eeckhaute, L., and J. Brodziak. 2006. Assessment of haddock on Eastern Georges Bank. TRAC Working Paper 2006/10.

Rapporteur: R.K. Mayo

Presentation Highlights (L. Van Eeckhaute)

The total catch of Eastern Georges Bank haddock in 2005 was 15,112 mt under a combined Canada/USA quota of 23,000 mt. The 2005 Canadian catch increased from 9,838 mt in 2004 to 14,542 mt, while the USA catch decreased from 1,962 mt in 2004 to 569 mt. The USA fishery

was closed in August when the cod quota was reached. Discards estimated from the Canadian scallop fishery were very low relative to the total catch. USA groundfishery discards were relatively high in comparison to the total catch, and amounted to 23% of the USA catch (in numbers). Eastern Georges Bank haddock catches fluctuated around 5,000 mt during 1985-1990. Under restrictive management measures, combined Canada/USA catches declined from over 6,400 mt in 1991 to a low of about 2,100 mt in 1995, averaged about 3,600 mt during 1996-1999, and have increased since then.

Adult population biomass has steadily increased from near an historical low of about 9,000 mt in 1993 to about 74,000 mt in 2003. Adult biomass subsequently decreased to about 50,000 mt at the beginning of 2005, but increased in 2006 to well beyond the 1931-1955 maximum biomass of about 123,000 mt. The 2003 year class is estimated to be 338 million age-1 fish, similar to the previous year's estimate and the largest ever observed in the assessment time series. The 2000 and 1998 year classes are strong (72 and 26 million age-1 fish, respectively). In contrast, the 2001 and 2002 year classes are weak and estimates of the 2004 year classes suggest it is also relatively weak. Initial estimates of the 2005 year class (28 million age-1 fish) suggest that it is similar in size to the 1998 year class. Fishing mortality has been below the reference threshold (F_{ref}) of 0.26 since 1995, but was above the reference level in 2005 (F_{4+}=0.29). Reduced fishing mortality and lower bycatches of juveniles have increased haddock survival rates and led to greater abundance of older fish. The population age structure shows good representation older age classes. Productivity has diminished in recent years due to reductions in average fish size at age.

With an assumed total catch of 22,000 mt in 2006, a combined Canada/USA catch of 26,000 mt in 2007 would result in a neutral risk (50%) that fishing mortality in 2007 would exceed F_{ref}. A catch of 22,000 mt would result in a low risk (25%) that fishing mortality in 2007 would exceed F_{ref}.

The outstanding 2003 year class was expected to contribute substantially (32%) to the 2005 catch, but the contribution was negligible (1%) due to a failure to recruit to the fishery. Future catches were highly dependent on the growth of this year class and its slow growth will continue to impact its recruitment to the fishery and has already resulted in fishing pressure above F_{ref} on the older ages in 2005. If the Total Allowable Catch (TAC) in 2006 is caught, fishing mortality will be higher than F_{ref} on the fully recruited older ages (F5+=0.5). This has been exacerbated by the two weak year classes preceding the 2003 year class.

The risk analysis does not include uncertainty due to changes in weights at age and partial recruitment, which are the biggest sources of uncertainty for future catches. Growth of the 2003 year class, upon which future catches are highly dependent, is difficult to predict making the prediction of future weights at age and partial recruitment subject to high uncertainty. Several projections were shown, a "base" projection which used 2005 fishery weights at age and partial recruitment and the 2006 survey weights to represent beginning of year population weights at age. Two alternate projections were examined which used lower weights and partial recruitment to reflect the smaller sizes at age of the 2003 year class which will be the dominant year class in the population and fishery. These projections produced substantially lower catch biomasses in 2007.

Discussion

Canada took almost its entire 2005 quota, but USA took only a small fraction because of early closure of the fishery due to cod bycatch. USA discards were heavily dominated by the 2003 year class. In 2005, the Canadian length composition of otter trawl, longline and gillnets were

almost identical. Typically, the length composition of haddock taken in the longline fishery is larger than in the other two gear types.

The 2005 catch at age (CAA) was dominated by 2000 year class as predicted. The 2003 year class did not show up in 2005 CAA as predicted, in both numbers and weight. The 2005 commercial weight-at-age (WAA) included the Quarter 1 winter fishery. When WAA were recomputed without Quarter 1, there were negligible differences.

There were questions regarding how long the downward trend in survey WAA was going on. For older ages, this trend was apparent almost since the beginning of the DFO survey. For younger ages, the trend began around 2000. The apparent changes prior to 1999 are small compared to the inter-annual variability.

Three projection scenarios were discussed. The first, termed "optimistic", used 2005 partial recruitment and growth. The second, termed "pessimistic", used partial recruitment and the lowest observed growth in the series. The third, termed "most pessimistic", used projected growth of the 2003 year class. The growth rates affect when the 2003 year class will become fully recruited. At these growth rates, the year class should be fully recruited to the fishery by 2008, but may not be if growth rates decline further.

There were questions regarding the purpose of selecting a set of mean weights for projections, for illustration or for providing management advice. If the purpose is for providing management advice, the mean weights must reflect some reality. The choice of lowest mean weights was questioned. Lowest values were obtained from the entire matrix and TRAC agreed that is not appropriate to select very low weights that may represent anomalies.

TRAC offered the following guidance for re-running projections:

1. Use the optimistic projection scenario and call this the "Base" run.

2. Make one alternative projection run with the following inputs:
    - Use the expected mean weights and PR of the 2003 year class. For the weights at age, take the average slope of the upper three lines in Figure 41 and apply this to the 2003 year class.

Another question arose concerning use of the 2003 year class partial recruitment for subsequent year classes. It was noted that the 2004 year class seems to exhibit an even lower growth rate than the 2003 year class, and the 2005 year class also shows low mean weights and lengths in the surveys, so it is appropriate to continue to apply the lower partial recruitment for these subsequent year classes.

TRAC agreed to reconsider the 2006 catch input at a value less than the 2006 TAC based on the possibility than neither country take their 2006 quotas. TRAC will suggest that the 2006 quota must be reduced to conserve the 2003 year class in the Special Considerations section of the TSR.

<u>Second Presentation on 2003 Year Class Growth Rates and Partial Recruitment</u>

The calculated fishery and population weights for the 2003 year class are in the range of previous observations for a strong year class.

The growth rate of the 2003 year class was estimated using the observed instantaneous growth rates from the 1998, 1999 and 2000 year classes. The predicted growth rate at length was applied to the observed 2006 DFO survey length of the 2003 year class at age 3. Average fishery lengths were determined by interpolating between beginning of year lengths using the observed patterns from nearby year classes. The length estimates were then converted to weights using the length weight relationship and were reduced by 10% to account for the observed reduction in fish condition in recent years.

Recent partial recruitment values were compared to beginning year (survey) lengths to help determine PR values for the 2003 year class. A value of 0.3, which is about 10% less than the partial recruitment for age 4 in 2005, was judged to be appropriate for the 2003 year class at age 4. The value of 0.3 is supported by the recent three year average. The PR value for this year class will have the biggest influence on the 2007 near term projection.

5Z Yellowtail

Legault, C.M., H.H. Stone, and K.J. Clark. 2006. Stock assessment of Georges Bank yellowtail flounder for 2006. TRAC Working Paper 2006/11.

Rapporteur: K. Clark

Presentation Highlights (C. Legault)

The combined Canada/USA yellowtail flounder (*Limanda ferruginea*) catch decreased from 2004 (7,275 mt) to 2005 (4,150 mt) due to both a decrease in quota and the inability of Canadian fishermen to fill their portion of the quota. Spawning stock biomass has decreased recently, and is currently low at about 5,400 mt, indicating that more stock rebuilding is needed. Recruitment improved during the early 2000s compared to the period 1980 to the mid-1990s, but is now returning towards those levels, averaging 16 million age-1 fish during the past five years. Fishing mortality for fully recruited ages 4+ was close to or above 1.0 between 1973 and 1994, declined to less than 0.6 in 2002 and 2003 (well above the reference point of F_{ref}=0.25), spiked upward in 2004 to above 1.0, and remained above 1.0 in 2005. Truncated age structure in the surveys and changes in geographic distribution indicate current productivity may be limited relative to historical levels. Assuming a 2006 catch equal to the 3,000 mt quota, a combined Canada/USA yield of about 1,250 mt in 2007 has a neutral risk, about 50%, of exceeding F_{ref}=0.25.

Discussion (June 13, 2006)

There was some discussion of the calculation of yellowtail flounder discards in the USA Georges Bank sea scallop fishery. Concern was expressed that a higher discard rate is assumed for the open area. It was noted that during the 1999 and 2000 scallop Special Access Program (SAP) in Closed Area II (CAII), the fleet showed an ability to avoid yellowtail bycatch until the end of the program when catches were made rapidly as the quota filled.

After the presentation of Figure 18 of the working paper, showing that the USA survey catches are concentrated in stratum 16, there were some questions about this stratum. It was explained that stratum 16 contains most of Closed Area II and the Yellowtail Hole. The USA surveys have 10 random stations in stratum 16 so they do not always have a station in the Yellowtail Hole, but the Canadian survey always has stations there.

Concern was expressed that the Georges Bank stock may not be a separate unit and could be mixing with Cape Cod yellowtail. A mixing of these two stocks might contribute to the lack of coherence of the cohorts and this, in turn, would cause problems in a Virtual Population Analysis (VPA). It was explained that, although there may be some mixing, tag returns show that this occurs at a very low level. In the past, there were some year classes that tracked through the age structure of Georges Bank yellowtail, but with full recruitment at age 3 and an F of 1, there is not much chance of year classes progressing through the age structure. Factors that could contribute to the lack of coherence in the cohorts include insufficient sampling, noisy surveys, a patchy distribution of fish by age and problems with ageing (although the latter has been documented to be minimal).

At the 2005 Benchmark, the lack of old fish was highlighted. It was concluded that either these fish were there and died early of natural causes (and therefore never showed up in the fishery), or the survey catchability of young ages increased so that it looked like the fish were there when they were not. This cannot be resolved without more research.

There was discussion about using an approach that takes spatial aspects into account. The issues that have arisen since 1995 may be influenced by a Closed Area II effect. The lack of a Canadian directed fishery also indicates that something is going on spatially. A spatial analysis is complicated by the fact that there are a limited number of survey tows that you can examine from this area.

The concentration of the survey catches in stratum 16 could be explained by q going up in this stratum but not in others. A possible mechanism for the increase in q was suggested. The bottom in stratum 16 is mostly flat sand except along the edges where it is rocky. It was suggested that perhaps the survey fishing gear fishes better on a flat smooth bottom. Alternatively, the yellowtail may have been reduced in abundance in open areas by high fishing mortality rates, leaving yellowtail only in areas closed to fishing.

It was asked if there was much Canadian directed effort for yellowtail in 2005. The response was that there was effort throughout the season, but the fish were not there.

Concern was expressed about the use of the discard to kept (d:k) ratio for calculating the USA trawl discards. Changes in management measures and fishing practices complicate this sort of calculation. For example, there was a period early in the year when management measures prohibited the catch of yellowtail, which would influence the calculation of d:k. When the individual d:k is calculated for individual yellowtail trips in 2005, the relationship is linear and seems to hold, but this is a problem that needs to be kept in mind for future calculations, especially as new management programs are introduced. As more special programs are introduced it becomes increasingly difficult to make discard estimates. Either more observer coverage is required for each new program or a more conservative approach has to be taken to calculating discards. The data collection system is not keeping up with the management programs.

There was discussion of the weight at age figure. The total fishery weight at age has been going up since 1995, and it was asked if this was the case for the survey weights at age. Unfortunately, the USA surveys do not have a sufficiently large enough sample size to examine this and, in the past, there was an ageing concern with the Canadian data, so the approach has been to look at this by length groups. When this is done, the opposite trend is observed, although survey weight at length and fishery weight at age are not really comparable. It was proposed that the average length and weight at age from the DFO survey should be examined in the future, even though the data only go back to 1986.

Recommendation: The average length and weight at age from the DFO survey should be examined.

The figure showing a drop in the relative F was discussed. The decreased quota between 2005 and 2006 forced the numerator to go down, thereby affecting the calculation of F; however, quota was not a limiting factor on the Canadian side. This figure was presented to show a general trend and a lot of significance should not be attributed to the inter-annual variation.

There was considerable discussion regarding the merits and drawbacks of the two VPA formulations that were run: the Base Case VPA and the Major Change VPA. An additional VPA formulation that was recommended at the benchmark was not used this year since it did not work well either this year or in 2005. There was debate as to whether the group favored one VPA formulation over the other and if this should be reflected in the summary, but no conclusion was reached.

There were several problems with the Major Change VPA in this year's assessment. The Major Change VPA produces a bimodality with greater than 20% of cases coming very close to the boundary. It may not be appropriate to do a risk calculation for the Major Change VPA but if one is attempted, the second mode would need to be removed. By doing risk plots, we might be under-representing the uncertainty coming out of the model. The Major Change model is more conservative and follows the survey trend since 2000 more closely than the Base Case scenario, and there was discussion as to whether or not this point should be made in the summary. Despite this, the bootstrap issue clearly indicates a problem – perhaps it is over-parameterized. It was suggested that in order to understand what is happening in the Major Change VPA, the individual cases need to be examined to see why 20% are "hitting the wall". This may not be feasible.

One of the Co-chairs pointed out that the purpose of this assessment is to take the conclusions from the benchmark, apply them and give advice. The question was posed that with all the uncertainty should the group provide the same package of information as last year? No conclusion was reached.

One of the reasons that the directionality of the Major Change VPA is similar to the indices is that it produces high fishing mortalities. The large increase in the F shows that the model is having problems. The source of this is where ages 9+ are zeroes or very small, generating large F values. The strategy used in the benchmark assessment was to use an average, but this does not work when abruptly in 2005 several age classes are gone. This is causing the problem with the bootstrapping.

The suggestion was made that a new version of the Major Change VPA should be rerun using ages 6+ and a split in the time series in 1995. This may eliminate some of the problems inherent in the Major Change VPA.

Action: Chris Legault to rerun the base case VPA with a 6+ age group and a split in the time series in 1995. This will be presented on June 14, 2006.

Discussion (June 14, 2006)

Chris Legault presented the rerun of the Major Change VPA with a 6+ age group and a split in the time series in 1995. This VPA formulation will be referred to as the Major Change 6+ VPA in these proceedings.

Fishing mortality at age with the Major Change 6+ formulation does not have the missing catch at the high ages that caused problems with the original Major Change VPA. A single F is applied for ages 4 and older, and these values are high in 2004 and 2005 for both the Major Change VPA, as presented on June 13, and the Major Change 6+ VPA. In the 2004 catch, ages 4 and 5 were dominant, which is different from the catch in 2003 and 2005. The dominance of these age classes occurred because there was a fishery in the closed area in 2004 and larger fish were caught. In 2005, the large fish were not caught in the fishery in as high proportions as 2004 nor were large fish caught in the surveys, indicating that they were no longer there. The model, therefore, produces high F values to explain the disappearance of these age groups.

The Major Change 6+ VPA has comparable residual and retrospective patterns to the Major Change VPA and the projected yield is very similar. The parameter estimates show relative errors in the 30% range and low biases less than 10%. Unlike the original Major Change VPA, the Major Change 6+ bootstrap provides a normal distribution for F and SSB.

Plots of the 3+ and 1+ biomass produced by the Base Case and the Major Change 6+ VPA formulations were examined. The Major Change 6+ formulation shows a decrease in both 3+ and 1+ biomass graphs which is consistent with the survey trends, although this decrease in biomass occurred more recently than the decrease in the survey trends.

The approach that should be taken for the management advice was discussed. The uncertainty in the model formulations needs to be stated. The power function in the original benchmark formulation of the Major Change VPA was not used in the 2005 assessment since it was close to 1 and had little impact. It was, therefore, not used in the present assessment. It was agreed that the Base Case and the Major Change 6+ VPA formulations would be presented in the TSR and the Research Document, along with the explanation of why the Major Change 6+ formulation is most appropriate; it matches the downturn observed in the surveys more closely. Only the Major Change 6+ VPA formulation will be used for projections and outlook, and no risk analysis will be done because of the uncertainty. Since only a point estimate is being provided, it is very important to emphasize that there is too much uncertainty to do a risk analysis.

Discussion (June 15, 2006)

There was discussion as to how the Base Case and Major Change VPA data should be presented in the TSR. Yesterday's decision was to present both models in full detail but only show the projection for the Major Change 6+ formulation. When the TSR is set up this way, then it makes things less clear. It would be better to show the trend in biomass for the two VPA formulations in a separate graph and to explain the two VPA cases in the text and the decision to go with the Major Change 6+ formulation.

The decision was made that risk plots are required, along with a discussion of the uncertainty.

Discussion (June 16, 2006)

Chris Legault presented the adjustments to the TSR that were requested on June 15. The decision was made that a full risk analysis will not be made because of software limitations.

APPENDICES

Appendix 1. List of Participants

Participant	Affiliation/Address	Telephone	Fax	E-mail
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Appendix 2. Meeting Terms of Reference

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.

- Document the size compositions of catches (both landings and discards) in the USA and Canadian fisheries. Describe how landings and discards in these fisheries are sampled for size composition, and summarize the amount of sampling (number of samples and number of length measurements) by year. Compare the USA and Canadian size compositions, identify any differences, and discuss possible reasons for these differences.

- For a range of values for total catch in 2007, estimate the risk that:
    - the 2007 fishing mortality rate would exceed 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder), respectively; and
    - the biomass at the beginning of 2008 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2007.

- Conduct medium term forecasts assuming that the stocks are exploited at constant fishing mortalities of 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder) during 2007-2010, and provide the catches and beginning year biomasses (total and spawning stock) in 2007, 2008, 2009 and 2010, and also the beginning year biomasses in 2011.

- Review the merits and drawbacks of:
    - summarizing annual fishing mortality using un-weighted average versus population weighted average of age specific fishing mortalities; and
    - adjusting for bias when reporting stock status and risk analyses for catch projections
    - establish a consistent practice for reporting to TMGC.

- Review the biomass distribution relative to the USA/Canada boundary, updating results with the 2005 survey information, and apply the allocation shares formula.

- Other matters.

Appendix 3. Meeting Agenda

13 June 2006 – Tuesday

08:30 – 09:00 Welcome and Introduction (Co-chairs)
10:00 – 12:00 Catch Size Composition in USA and Canadian Fisheries (Gavaris, Mayo)

12:00 – 13:00 Lunch

13:00 – 15:00 Eastern Georges Bank Cod (O'Brien, Hunt)
15:00 – 17:00 Eastern Georges Bank Haddock (Brodziak, Van Eeckhaute)

14 June 2006 – Wednesday

08:30 – 10:30 Georges Bank Yellowtail Flounder (Legault, Stone)
10:30 – 11:30 Reporting Practices to TMGC (Fishing Mortality & Projections)
11:30 – 12:00 Biomass Distribution

12:00 – 13:00 Lunch

13:00 – 14:00 Report Preparation
14:00 – 15:00 Report Preparation
15:00 – 17:00 Report Preparation

15 June 2006 – Thursday

08:30 – 12:00 Report Review

12:00 – 13:00 Lunch

13:00 – 17:00 Report Review

16 June 2006 – Friday

08:30 – 12:00 Report Review
12:00 Adjournment