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TRAC

Transboundary Resources Assessment Committee

Proceedings 2010/02

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

Report of Meeting held 20-23 July 2010

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

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FOREWARD

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

AVANT-PROPOS

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

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ABSTRACT

The Transboundary Resources Assessment Committee (TRAC) met during 20-23 July 2010 in Woods Hole, Massachusetts, USA, to review updated assessments (through 2009) 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 2011 fishing year for these transboundary resources.

RÉSUMÉ

Le Comité d'évaluation des ressources transfrontalières (CERT) s'est réuni du 20 au 23 juillet à Woods Hole (Massachusetts), aux États-Unis, pour examiner les évaluations actualisées (jusqu'en 2009) 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 2011.

INTRODUCTION

The Transboundary Resources Assessment Committee (TRAC) co-chairs, L. O'Brien and T. Worcester, welcomed participants (Appendix 1) to the July 2010 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 US / 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 / US 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 via a conference call, however, no minutes from this meeting are included. The US scientists were unable to meet with fishermen prior to the TRAC meeting this year.

Draft ToR for the 2011 TRAC are provided in Appendix 4.

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

TRAC Presentation: Discards from the Canadian Scallop Fishery

Working Paper: Discards of Atlantic Cod, Haddock and Yellowtail Flounder from the 2009 Canadian Scallop Fishery on Georges Bank. TRAC Working Paper 2010/13.

Presenter: L. Van Eeckhaute

Rapporteur: J. Nieland

Presentation Highlights

Discards of Atlantic cod, haddock, and yellowtail flounder from the 2009 Canadian scallop fishery on Georges Bank were estimated from 22 observed trips. Data were insufficient to determine spatial differences in discard rates per hour but temporal trends were accounted for using a 3-month moving window calculation. Discards were estimated by applying the monthly discard rate per hour obtained by the 3-month moving window calculation to the total monthly effort in hours of the scallop fleet. Total annual estimated discards in 2009 were highest for

yellowtail flounder, at 84 mt, while those for Atlantic cod and haddock were 69 mt and 54 mt, respectively.

Discussion

Fishing activity in 5Zm (552) was low in 2009. Observer coverage in this management area was limited, particularly in calender quarters 1, 3, and 4. The Department of Fisheries and Oceans (DFO) is working toward allocating more observer coverage for the southern management area.

A few gear changes were made in 2009 to reduce bycatch. Closed areas were established in 2005 to decrease bycatch. Specific areas are closed to the scallop fleet in February and March to avoid bycatch of cod and in June to avoid bycatch of yellowtail flounder.

Discards of cod, haddock, and yellowtail flounder were estimated by applying a three-month moving window. Discards in January were estimated as the average of January and February and discards in December were estimated as the average of November and December. A three-month moving window was adopted to smooth estimates, especially for one year (2006) when there was one trip with very high discards of yellowtail flounder, and to show seasonal patterns.

A study at the Northeast Fisheries Science Center (NEFSC) confirmed that using a moving window to estimate discard/kept (d/k) ratios can result in biased discard estimates at some levels of observer coverage. In the study, discards estimated using month specific effort were compared to discards estimated using a thirty-five day moving window of effort. Discard values were biased when estimated using the moving average d/k ratio with month specific effort values but were not biased when estimated using a 35-day moving average of effort. The study showed that one realization might not be very biased, but bias could be large over many realizations.

TRAC recommended that next year the three-month moving window estimates be compared to monthly estimates to check for bias, and the variance of the ratio estimator also be estimated.

Estimates of discards in 2009 were based on observed discards from twenty-two observed trips. This number of observations is low, and annual discard estimates were proposed as an alternative to monthly estimates. The 2009 annual estimates for cod, haddock, and yellowtail flounder were 70 mt, 56 mt, and 79 mt, respectively. The annual estimates are close to the three-month moving window estimates, so the three-month moving window estimates will be used for the assessments this year. TRAC recommended that annual estimates be calculated next year for comparison.

In conclusion, the TRAC panel recommended using the three-month moving window for the estimation of discards of cod, haddock, and yellowtail flounder to include in the respective assessments this year, but monthly averages, bias calculations, variance estimates, and annual estimates should be calculated, along with the three-month moving window estimates next year.

TRAC Presentation: Calibration Study of *FSV Henry B. Bigelow* and *FRV Albatross IV*

Working Paper: Determining Length-Based Calibration Factors for Cod, Haddock and Yellowtail Flounder. TRAC Working Paper 2010/14.

Presenter: L. Brooks

Rapporteur: J. Nieland

Presentation Highlights

Calibration study results were analyzed for Atlantic cod, haddock, and yellowtail flounder to determine appropriate factors to adjust survey data between the new NEFSC *FSV Henry B. Bigelow* and the retired *FRV Albatross IV*. While some general protocols were in place, guidelines for approaching length-based calibration were lacking. A pre-TRAC working group approached the estimation of length based calibration factors for all three species together so that the criteria, and the considerations, that led to decisions on the method were consistent. After thorough evaluation of the data and comparisons of the proposed estimators, beta-binomial based estimates of length-specific calibration factors were estimated for cod, haddock, and yellowtail flounder. Data were examined for differences in seasonal (fall, spring) and site-specific calibration factors, but it was determined that all data could be pooled. Data were sparse at the smallest and the largest lengths, and calibration factors were estimated only for lengths greater than 20 cm in cod and yellowtail founder, and lengths greater than 18 cm in haddock. All lengths less than these cut-offs were assumed to have the same calibration factor. The best fit to the length data for all three species was obtained using segmented regressions where the right endpoint was estimated; all lengths greater than or equal to the right endpoint were assumed to have the same calibration factor. Numbers at length from *Bigelow* tows should be divided by the length specific calibration factors to obtain survey values on a scale that are consistent with *Albatross IV* tows.

Discussion

Some of the vessel and gear differences in Table 1 were questioned. Did the *FRV Albatross IV* have 4" cookies? This seems small compared to the 14" rockhoppers on the *FSV Henry B. Bigelow*. Was the wing end to door distance on the *Albatross IV* only 9 m? The wing end to door distance on the *Bigelow* is 36.5 m. Is the listed headrope height from the cookies or from the bottom for the *Albatross IV* and the *Bigelow*? These values were checked with staff in the survey branch and confirmed to be accurate.

Other questions were asked about the differences between the *Albatross IV* and *Bigelow*, specifically about the catch. The *Bigelow* catches more small fish than the *Albatross IV*, but the *Bigelow* data cannot be used as an index of recruitment. The *Bigelow* has only collected one year of data. Eventually, the *Bigelow* data will be a separate index from the *Albatross IV* data, but for now, the conversion factor is a way to bridge the two data sets so that they can both be used in the assessments.

Many details about the length conversions from the *Bigelow* to *Albatross IV* were discussed. X2, the maximum length to use for the calibration coefficient estimation, was estimated, but X1, the minimum length to use for the calibration coefficient estimation, was not estimated. Estimating X1 might be useful, but X1 does not contribute a lot of information to the coefficient. Hence, even if X1 was estimated, the results might not be much different from the X2 results.

A question was asked about how much information the site-specific tows contributed to the calibration coefficient versus the random tows conducted during the NEFSC spring and fall bottom trawl surveys. Most of the data for the small-size fish come from the NEFSC spring and fall survey tows. The ratio of survey tows to site-specific tows for yellowtail flounder was below one for the smallest half of the specified length range (20 – 29 cm), whereas for cod and haddock, the ratio was close to one. The yellowtail flounder data will be rerun using survey data only, instead of using both survey and site-specific data, to compare the results.

Length-based and constant coefficient estimates of catch per tow at age were compared. The differences between these two estimates were minimal for yellowtail flounder and haddock. The estimates for haddock exhibited small differences at young ages. Length-based and constant coefficient estimates need to be compared for cod.

The TRAC panel agreed to use the length-based conversions for this assessment of cod, haddock, and yellowtail flounder. A sensitivity analysis should be run with the constant coefficient for length. Number-based, weight-based, and length-based conversions should also be compared.

TRAC Presentation: Eastern Georges Bank Cod Assessment

Working Paper: Assessment of Eastern Georges Bank Atlantic Cod for 2010. TRAC Working Paper 2010/11.

Presenter: K. Clark

Rapporteur: S. Cadrin

Presentation Highlights

Commercial Fishery

Catches in 2009 were 1,858 mt, including 425 mt of discards. Canadian catches declined to 1,209 mt in 2009 from 1,529 mt in 2008. The majority of the cod landings occurred in the third quarter, which is consistent with previous years. Discards were estimated to be 22 mt in the mobile gear fleet and 115 mt in the fixed gear fleet. Estimated discards of cod by the Canadian scallop fishery were 69 mt in 2009.

USA catches increased to 649 mt in 2009 from 253 mt in 2008. USA landings are usually taken in the first and second calendar quarter; in 2009, however, the highest catches occurred in quarters 2 and 3. Estimated discards of cod for 2009 were 217 mt in the USA groundfish fishery and 1 mt in the USA sea scallop fishery.

Size and Age Composition

Size and age compositions of the 2009 landings by the Canadian groundfish fishery were derived from port and at-sea samples from all principal gears. A comparison of port and at-sea length frequencies showed no discrepancies for otter trawlers but longline observer samples tended to have more small fish than the port samples.

Catches have declined substantially for all ages since 1995, and only ages 3 to 6 now contribute significantly to the catch. The combined Canada/USA 2009 fishery age composition was

dominated by the 2006 year class (33% by number, 20% by weight) and the 2003 year class (25% by number, 38% by weight) followed by the 2005 year class (20% by number, 21% by weight). The contribution to the catch by fish older than age 7 remains small (4% by number, 9% by weight in 2009).

Fishery weights at age have showed a declining trend since the early 1990s. In 2009 weight at age decreased in all age groups except ages 2 and 4.

Abundance Indices

Calibration factors by length were calculated in 2010 for Atlantic cod for the data collected on the 2009 and 2010 NMFS spring and 2009 NMFS autumn surveys by the *FSV Henry B Bigelow* to make the data comparable to previous surveys conducted by *FRV Albatross IV*. The calibrated survey data for the 2009 and 2010 NMFS spring surveys and 2009 NMFS autumn surveys were included in the 2010 assessment.

With the exception of the 2003 and 2006 year classes, survey abundance at age indices showed poor recruitment since the 1990 year class. The 2003 year class appeared strong over several ages in all surveys, and the 2006 year class appeared promising in the DFO survey but not in the NMFS spring and autumn surveys. Survey biomass indices in recent years have fluctuated without clear trend. The DFO survey showed an increase in biomass in 2010, but the NMFS spring and autumn surveys were low. There was improvement for some ages in beginning-of-year weights at age calculated from the 2010 NMFS spring and 2010 DFO survey size at age data, but these values were still low compared to the 1980s.

The numbers of age 7+ fish in the surveys remained low and the weights at age for these ages were very variable. The 2003 year class was consistently smaller at age than other recent year classes. As a result, cohort regression analysis was used to predict beginning of year weights for ages 7+ in the projections.

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. All 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 was fixed at 0.5 for ages 6+ during 1994-2008. Fishing mortality on Age 9 for 1978 to 2008 was assumed to be the weighted average fishing mortality on ages 7 and 8.

Results

Biomass for ages 3+ at the beginning of 2010 was estimated to be 6,394 mt from the “split M 0.2” model and 9,260 mt from the “split M 0.5” model. The estimated 2009 fishing mortalities, F=0.33 (“split M 0.2”) and F=0.20 (“split M 0.5”), were the lowest in the assessment time series but still above the F_{ref} of 0.18. 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 2009, yield exceeded surplus production.

Recruitment at age 1 of 3.6 million for the 2003 year class from the “split M 0.2” model was similar to the 1996 year class at age 1. Recruitment at age 1 of 5.0 million for the 2003 year class from the “split M 0.5” model was the highest since the 1990 year class but was still lower

than the pre-1990 average level (10 million). The 2002 and 2004 year classes remain the lowest on record.

Projections

Catch in 2010 was assumed to be equal to the 1,350 mt quota. From the "split M 0.2" model, a combined Canada/USA catch of about 1,000 mt in 2011 will result in a neutral risk (50%) that the fishing mortality rate in 2011 will exceed F_{ref}, whereas a catch of 1,850 mt will result in a neutral risk (50%) that the 2012 adult biomass (4+) will be lower than the 2011 adult biomass. A catch of about 1,100 mt will result in a neutral risk (50%) that 2011 adult biomass will not increase by 10%. From the "split M 0.5" model, a combined Canada/USA catch of about 1,400 mt in 2011 will result in a neutral risk (50%) that the fishing mortality rate in 2010 will exceed F_{ref} whereas a catch of 1,350 mt will result in a neutral risk (50%) that the 2012 adult biomass will be lower than the 2011 adult biomass. A catch of about 450 mt will have a high risk (75%) that 2012 adult biomass will not increase by 10%.

Discussion

Update of Eastern Georges Bank Cod Data Inputs – Commercial Fishery

The TRAC discussed the 2003 year class and declining average size at age. The 2003 year class was strong in the updated catch at age. Since the late 1980s, mean size at age (weight at age and length at age) has been decreasing for all age groups. In other cod stocks, reductions in weight at age have generally resulted from decreased condition (i.e. weight at length), but the condition of Eastern Georges Bank cod has remained stable. Participants discussed why size at age should be decreasing when the stock size is low, and questioned if there are trophic interactions with the abundant haddock stock. Although there may be some diet overlap between cod and haddock, temperate cod stocks are more opportunistic feeders than sub-boreal cod stocks and can shift to lower-energy food sources.

Update of Eastern Georges Bank Cod Data Inputs – Surveys

The NEFSC *Bigelow* survey series was not used in the 2009 TRAC update, so the last two years of NEFSC survey data were included in the current assessment. Different recent signals in DFO and NEFSC surveys were noted. The 2003 year class continued to be strong in the DFO survey, but not in recent NEFSC surveys. Mean size at age for age groups 3-10 has decreased since the early 1990s.

Application of the Benchmark Formulations for Eastern Georges Bank Cod

The two benchmark formulations using ADAPT ('split M 0.2' and 'split M 0.5') were updated. The justification for assuming an increase in natural mortality (M) at older ages in recent years was discussed. Although there is some evidence for increase in M in other cod stocks (M=0.6 in 4TVn and M4+=0.7 in 4X), there is no direct evidence of an increase in M of Eastern Georges Bank cod. The TRAC noted that the 'split M=0.2' formulation is consistent with the USA 5Z+6 cod assessment. The benchmark assessment found that the data supported an M of approximately 0.5 through model selection methods (AIC). Although the 'split M=0.5' model had no retrospective pattern in the benchmark assessment, a retrospective pattern emerged in the update; however, the magnitude of this pattern was less pronounced than in the 'split M=0.2' model.

Statistical comparisons showed that Mohn's rho, residual mean square, and CVs were slightly less for the 'split M=0.5' model than in the 'split M=0.2' model. The TRAC requested that the magnitude of retrospective difference be evaluated using Mohn's rho, and that the approximate magnitude be communicated to managers in the transboundary status review (TSR).

The models that split the survey series imply a change in survey catchability (q). In the recent period some catchability estimates are greater than 2 for swept area biomass, indicative of potential problems with scale. The TRAC decided that swept area estimates of biomass should be reported along with model estimates of biomass in the TSR. The description of model evaluations from the TRAC 2009 proceedings was reviewed to justify modeling decisions. The reason for the split in 1993/1994 was justified through inspection of annual calculations of q from model estimates of abundance and survey indices. The fishing mortality metric of average F for ages 4-9 was discussed and justified because estimates of recent F at age suggest that age-3 fish are only partially recruited.

The TRAC discussed the approach of accounting for retrospective patterns through splitting survey time series and alternative M assumptions. A suggestion was made to estimate 'unaccounted mortality' as a more direct way of modeling the inconsistencies in the assessment, rather than attributing differences to changes in survey catchability or natural mortality. In summary of all discussions on alternative benchmark methods, the TRAC decided that there is no strong evidence to support one model over the other, and both model updates were used as a basis for the assessment. The range of stock perceptions and outlooks from the two models reflect the substantial uncertainty in the assessment. Despite these uncertainties all perceptions of historical and recent fishing mortalities are greater than F_{ref}.

Projections and Assessment Advice for Eastern Georges Bank Cod

Decreasing weights at age, possible sampling problems at older ages, and the growth patterns of the 2003 year class were thoroughly considered. Sample estimates of weight at age were noisy for ages 7+. Given the importance of the 2003 year class for short-term forecasts of catch and stock size and variations in recent growth patterns, size at age was derived from regressions of weight on age by year-classes to predict weight at ages 7+. Weight at ages for age groups 1-6 were based on the recent 3-year average.

The TRAC noted that fishing mortality exceeded F_{ref} in recent years despite TACs that were expected to produce $F<F_{ref}$. Potential reasons for overfishing were catch exceeding catch associated with F_{ref} in 2009, retrospective error in estimates of stock size and the addition of two years of NEFSC survey data in the 2010 update.

The TRAC noted that the value of F_{ref} was derived from F_{MSY} analyses that assumed M=0.2. Therefore comparisons between F estimates from the 'split M=0.5' model and F_{ref}=0.18 are complicated by the inconsistent natural mortality assumptions. The TRAC agreed that alternative reference point estimates from the 2009 benchmark should be reported in the Proceedings to communicate the relationship between M and F_{ref}.

Comparison of F reference points from three models for cod on eastern Georges Bank (from TRAC Reference Document 2009/07).

	F0.1	F40%	Fmsy
no split M 0.7	0.43	0.45	0.08
split M 0.2	0.27	0.23	0.18
split M 0.5	0.39	0.40	0.13

The TRAC may need to consider other needs of Canadian management. In April 2010, COSEWIC (Committee on the Status of Endangered Wildlife in Canada) divided Canadian Atlantic cod populations into six designatable units (DUs): Arctic Lakes, Arctic, Newfoundland and Labrador, Laurentian North, Laurentian South, and Southern. COSEWIC designated Atlantic cod in four out of the six DUs as endangered. Eastern Georges Bank cod (NAFO Division 5Zjm) was grouped with cod from NAFO Division 4X and the Canadian portion of 5Yb and labeled as the Southern DU and designated as endangered (COSEWIC, 2010).

TRAC Presentation: Eastern Georges Bank Haddock Assessment

Working Paper: Assessment of Eastern Georges Bank Haddock for 2010. TRAC Working Paper 2010/15.

Presenter: L. Van Eeckhaute

Rapporteur: J.Blaylock

Presentation Highlights

Fishery

The total catch of eastern Georges Bank (EGB) haddock in 2009 was 19,707 mt from a total combined Canada/USA quota of 30,000 mt. The 2009 Canadian catch increased from 14,814 mt in 2008 to 17,648 mt while the USA catch increased from 1,181 mt in 2008 to 2,058 mt. Estimated discards from the Canadian scallop fishery were 54 mt. USA groundfish fishery regulated discards were 47 mt in 2009.

Canadian landings were highest in January, followed by August, September, and June. The Canadian winter fishery took place from January 1 to February 7, 2009. Most Canadian landings were made by otter trawlers; longliners landed a much smaller portion of the Canadian total. Catch from gillnet gear was very low. The Canadian landings were well sampled, by both port and at-sea observers.

The USA catch was almost all by otter trawlers. The majority of the USA catch occurred in the second half of the year, with the “scrod” size category accounting for most of the landings. Sampling was low, and lengths were augmented from adjacent areas.

Catch at Age

A new DFO age reader provided ages for the Canadian fishery and survey. Inter-reader age testing was conducted between the previous DFO reader and the new DFO reader and between

the DFO and NMFS labs for both the previous and new DFO readers. Intra-reader testing was conducted at both labs. Agreement on most tests was high. But, because there was low agreement with the new DFO reader on some commercial samples, the previous DFO reader read those otoliths that the new DFO reader had difficulty with.

The 9+ group used in previous assessments was expanded to 9 to 16+ so that fishing mortality (F) and partial recruitment (PR) on older ages could be investigated. (See below for further details.) Some revisions were made to the catch at age to account for changes in the US discard estimation methodology (introduced in the previous assessment but not carried through to the catch at age) as well as to correct some other elements. Most of these revisions were minor, except for a large increase in the 1994 US discards that represented about a third of the combined catch for that year.

The 2003 year class dominated the landings for both countries. Older ages now contribute more to the catch than during the 1990s. The observed catch composition (in percent) was very similar to what was predicted in 2008 and 2009.

Indices

The NMFS 2009 spring and fall and the 2010 spring surveys were conducted with the new fisheries survey vessel, the *Henry B. Bigelow*, and a new net (4 seam, 3 bridle). Length-based catch conversion factors were used to adjust the *Bigelow* survey data to *Albatross IV* equivalents. All three NMFS groundfish surveys had low catches of the 2007, 2008, and 2009 cohorts. Adult haddock, however, were caught in abundance in all of these surveys (especially in the spring surveys) and the adults were widespread throughout the survey area. An unusual distribution pattern occurred in the 2009 fall survey, where several large tows of haddock were taken in the middle of the Bank on the USA side. Normally, haddock are found in the deeper slope waters at this time of year. Since about 2003, the adult biomass indices have been fluctuating without trend at a high level. The age 0, 1 and 2 recruitment index values indicate that the 2008 and 2009 cohorts are comparable to the 2004, 2006 and 2007 cohorts.

Size at Age

The 2010 survey weights at age all declined, except for age 5 which decreased and age 2 which remained stable. This is in contrast the fishery weights at age in 2009, which all increased except for age 6 (2003 year class). Survey sizes at age for the younger age groups show an increasing trend, but are still below the time series average. Older ages have shown little recovery from the downward trend in weights at age. Weights at length (condition) for representative lengths decreased from 2009 to 2010, and are below the series average. There is a trend towards lower condition in recent years. The growth rate for the 2003 year class, which is smaller at age than earlier cohorts, is similar to the 2000 year class growth rate at the same age. The 2005 year class at age 1 was the same size at age as the 2003 year class, but has been larger at age than the 2003 year class from age 3 onward.

ADAPT formulation

The benchmark formulation was applied with the minor changes reported in previous assessments. An expanded catch at age was used encompassing ages 0 to 14, with ages 9 to 14 summed to a 9+ group as in previous assessments. Ages 15 and 16+ were omitted from the catch at age as ageing inconsistencies occurred at these ages. Diagnostics and results were consistent with the 2009 assessment. A retrospective analysis showed no patterns of concern.

Results

Improved recruitment in the 1990s, reduced exploitation, lower harvests of small fish, and a strong 2000 year class allowed adult population biomass (ages 3+) to increase from a near record low of 10,300 mt in 1993 to 82,400 mt in 2003. Adult biomass decreased to 58,600 mt in 2005, but increased to 157,300 mt in 2009 and was 125,100 at the beginning of 2010 (80% confidence interval: 101,500 mt – 153,300 mt), higher than the 1931-1955 maximum biomass of about 90,000 mt. Biomass tripled after 2005 because of the exceptional 2003 year class, estimated at 293 million age 1 fish, the largest in the assessment time series (1931-1955 and 1969-2009). The 2001, 2002, 2004, 2006, 2008 and 2009 (initial estimate) cohorts are below the 10 million (age 1) average from 1995 to 2010 (excluding the 2000 and 2003 cohorts). The 2005 year class (24.3 million age 1 fish) is above average, and the 2007 cohort (10.3 million age 1 fish) is average. The high spawning stock biomass observed since 2006 has generally produced below-average cohorts. Fishing mortality for ages 4+ fluctuated between 0.25 and 0.46 during the 1980s, but markedly increased in 1992 and 1993 to about 0.5, the highest observed since 1971. The age at full recruitment to the fishery increased in 2003 from age 4 to age 5 because of reduced growth. 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, declined to below F_{ref} in 2007 and 2008, and was 0.13 in 2009 (80% confidence interval: 0.11 – 0.17). The determination of F_{ref} was based on analyses that assumed full recruitment to the fishery at ages 4 and older.

Projection

Weight at age and partial recruitment projection inputs for the 2003 and 2005 cohorts were based on growth specific to these two cohorts, the method employed in recent assessments. Inputs for other cohorts/ages were either based on averages of previous years or on recent survey and fishery observations, whichever was most appropriate. Assuming a 2010 catch equal to the 29,600 mt total quota, a combined Canada/USA catch of 22,000 mt in 2011 results in a neutral risk (50%) that the 2011 fishing mortality rate would exceed F_{ref} = 0.26. Under this scenario, 3+ biomass at the beginning of 2012 would be 67,800 mt. The 2003 year class is expected to compose 75% of the 2011 catch biomass. A catch of 19,000 mt in 2011 would result in a low risk (25%) of exceeding F_{ref} in 2011.

Expansion of Catch at Age 9+ Group

In 2012, the 2003 year class will be part of the 9+ group but will still account for a large part of the catch. Inclusion of this cohort in the plus group may confound fishing mortality estimation, and estimation of partial recruitment (PR). To evaluate F and PR on age 9, the 9+ group was expanded as described above. Except for the increase in the 1994 US discards, the revisions introduced to the expanded catch at age had little effect on the results. Several model formulations were explored using a catch at age spanning ages 0 to 14. When the model was estimated F on age 8 (or 6), PR was domed after age 8. When the model estimated F on the oldest true age group (*i.e.,* age 14), the PR was flat. The 2000 year class was considered to be of a sufficient size to provide reliable estimates of age 9 fishing mortality and PR. A model formulation that allowed the 2000 year class to be estimated in the terminal year (age 10 in 2010) produced a PR at age 9 of 0.5. This model was considered the most appropriate as it deviated only slightly from the benchmark formulation. The change in PR will have a large effect on the projected catch in 2012 in next year's assessment.

Discussion

Update of EGB Haddock Data Inputs – Commercial Fishery

Recruitment remains low despite the fact that EGB haddock was underfished in 2009. In the past (1970's, 2003) large cohorts were not produced by large spawning stock biomasses.

Anecdotal accounts from the 2010 fishery indicate an increased abundance of small haddock (~2 inches) in US and Canadian waters as evidenced by the numbers of young-of-the-year haddock in the stomachs of adult haddock.

Update of EGB Haddock Data Inputs – Surveys

Survey weights-at-age are currently based on the DFO survey only. In the future, including NMFS surveys weights-at-age might be informative for estimation of recruitment and biomass because of the difference in timing between the two surveys.

Predictions of weight-at-age are made based on length; different effects (including the low growth rate in the winter, and the presence of roe in January-February) are factored in the calculations.

Haddock caught in the Canadian fishery in 2010 appear skinny. The lengths of fish caught are similar to those in last year's fishery, but the corresponding yield is less. Although weights-at-age have generally declined since 2003 indicating a decrease in condition, the survey does not show a large drop in weights-at-age for 2010 in particular. Canadian fishermen (fishing on Georges Bank since June 1st) have observed an absence of sand lance in haddock stomachs, and have reported instead the presence of haddock in haddock stomachs.

Partial recruitment changed after 2002, shifting from full recruitment at age 4 to full recruitment at older ages. This change reflected decreased growth rates and lower sizes at age.

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Application of the Benchmark Formulation for EGB Haddock

There was some concern about whether projections could be improved to better match the realized landings. Although only 2/3 of the 2009 TAC was caught (total catch was 19,707 mt from a quota of 30,000 mt), biomass at the beginning of 2010 (127,000 mt) was below what had been predicted assuming the 2009 TAC would be fully harvested (131,000 mt). In other words, the 2010 beginning of the year biomass was lower than that projected, even though less fish than assumed was caught in 2009. While some reviewers indicated that a 10% difference from the projections was not bad, the group agreed that further investigation of this discrepancy was needed (*i.e.,* by examining 2009 projected versus realized abundance, partial recruitment, weights-at-age, and mean weights). This evaluation was presented by one of the reviewers. The 2003 year class had the most influence on the projections, and differences between assumed and realized weight at age and partial recruitment were magnified by the dominance of this year class.

Expansion of EGB Haddock Plus Group

This ToR was reviewed at a pre-TRAC meeting in April 2010. The partial recruitment of the 2003 year class in 2012 is a major concern, as this cohort will still dominate the fishery when it moves into the age 9 plus group.

There was consensus that this large year class should not be included in a plus group because this would confound estimation of F and PR. There was also concern about how a domed PR will affect spawning stock estimates with a large year class in the older ages.

Concerning the PR, there was some discussion on the causes for the dome. Hypotheses included movement of older fish to US waters where fishing pressure is lower, and increased natural mortality on older ages.

Another consideration related to the assessment formulation is that the survey tuning indices only include ages up to age 8, so the 2003 year class in 2012 would be excluded from calibration within ADAPT.

Following these discussions, the group suggested that a benchmark assessment for EGB haddock be conducted. The last EGB haddock benchmark was in 1998. If such a benchmark cannot occur in 2011, the recommendation is to include age 9 in the survey indices for calibration purposes and to expand the catch at age structure to at least age 9 and use a 10+ group.

Projections and Assessment Advice for EGB Haddock

There was consensus to accept the assessment.

TRAC Presentation: Georges Bank Yellowtail Flounder Assessment

Working Paper: Stock Assessment of Georges Bank Yellowtail Flounder for 2010 TRAC Working Paper 2010/18.

Presenter: C. Legault

Rapporteur: J. Deroba

Presentation Highlights

The combined Canada/US yellowtail flounder (*Limanda ferruginea*) catch increased from 2008 (1,275 mt) to 2009 (1,778 mt), primarily reflecting an increase in quota. The 2005 year class did not appear strong in any of the recent surveys, and has not dominated the catches; the assessment model now estimates the 2005 year class to be only average. In the 2009 assessment, the 2005 year class had been estimated as one of the largest since the mid-1970s. This change in perception results in a lower spawning stock biomass than previously estimated. Nevertheless, spawning stock biomass shows an increasing trend with SSB in 2009 estimated at 14,000 mt (although still well below the US rebuilding target of 43,200 mt). The 2005 and 2006 cohorts are estimated to be about average at 23.9 million and 22.2 million fish at age 1, respectively. The 2007 year class is well below average, and the 2008 year class is estimated to be the lowest in the time series at 6.1 million fish. Fishing mortality rates for fully recruited ages 4+ were estimated to be 0.15 in both 2008 and 2009, below the F_{ref} of 0.25. Assuming the 2010

catch equals the 1,956 mt quota and F in 2011 is F_{ref} = 0.25, a combined Canada/US yield of about 3,400 mt is predicted for 2011. The current US rebuilding strategy cannot be achieved even with a fishing mortality rate of zero. Examination of a range of alternative rebuilding strategies resulted in median catches in 2011 ranging from 600 mt to 2,700 mt.

The 2010 assessment results are based on a single model formulation, denoted Split Series, as opposed to the 2009 assessment which provided results from two model formulations. The previous assessment treated the single unusually large tows in both the 2008 and 2009 DFO surveys as either the same values in the assessment (i*.e.,* "Including") or removed them from the tuning (*i.e.,* "Excluding") - as a way to bracket the uncertainty associated with the surveys. The 2010 assessment down-weights the DFO 2008 and 2009 surveys, as recommended by the TRAC last year, to produce results approximately half way between the two previous formulations.

Despite splitting the survey time series to eliminate the retrospective pattern, the 2010 assessment results now show a moderate retrospective pattern in SSB (caused by the marked change in the estimated abundance of the 2005 year class). Alternative projections which adjust the starting population abundance to account for the retrospective pattern lead to lower catch advice than the standard projections. For example, fishing at F_{ref} = 0.25 in 2011 generates a median catch of approximately 2,100-2,300 mt depending on the method used to adjust for the retrospective pattern. Additionally, projections which use only recent recruitment levels in the forecasts have lower rebuilding probabilities and lower expected catches in the medium term—although the 2011 catch advice is essentially unaffected.

Discussion

Surveys

Although aging error was not considered a cause of any problems in the assessment, some TRAC members wondered if changes in age readers (or protocols) had occurred in recent years. If such changes had occurred, these might potentially explain the "disappearance" of the 2005 year class. The current yellowtail age reader has been in the position for two years. Furthermore, age comparison studies suggest that precision is good and no significant aging errors occur for yellowtail until after age 6. The presenter noted that "disappearances" have occurred before, with retrospective patterns generally implicated as the cause. Consequently, changes in aging protocols and aging error are unlikely to be responsible for the reduced estimate of abundance of the 2005 year class.

Some TRAC members noted that DFO survey catches were clustered in one area, while NMFS spring survey catches were more evenly dispersed across Georges Bank. The reason for this could be that the timing of these two surveys differs by 1-2 months. Some TRAC members also noted that the locations where DFO survey catches were highest were not sampled by the NMFS survey. Consequently, resolving the issue of why DFO catches were clustered but NMFS survey catches were spread out may be difficult. Observations from commercial catches suggested that yellowtail were present at locations other than where the DFO survey catches were clustered. Why these fish were not also caught by the DFO survey is unknown. Some TRAC members suggested overlaying a plot of commercial CPUE catch locations on the survey catch sites to help determine the spatial range of the stock during each of the surveys. Although this topic was noted as interesting, some TRAC members wondered how such an evaluation would affect the assessment. The annual indices provided by each of the surveys are consistent. The spatial patterns of the catch locations from each of the surveys are not consistent, but this is to be expected given the stratified random design of the surveys, and

hence should not be overanalyzed. The TRAC agreed to leave this matter unresolved as the results of any such analysis would have little consequence for the assessment.

Split Series VPA

The 2010 age-5 and age-6+ stock size estimates are among the highest in the VPA time series, likely due to the low Fs (page 35; table 12 of WP). These contrasting estimates suggest that biomass may be accumulating at older ages in recent years. Furthermore, the relatively strong 2005 and 2006 cohorts will soon enter the age-6+ group. Consequently, future assessments may wish to extend the age range used in the model to age-8 (or some other older age) and consider a 9+ (or older) plus group category. Extending the ages explicitly modeled is important so that proper weights at ages are assigned, and older age groups are adequately represented.

Some TRAC members noted that the temporal changes in catchability suggested by the split series were misleading as there is no explanation why changes should have occurred. The split series was initially introduced as an alias for unknown mortality (*e.g.,* M, missing catch). Some members also suggested exploring whether changing the natural mortality rate might reduce the retrospective pattern, just as well as using a split series. The presenter noted that sensitivity runs were done with different natural mortality rates or added catch to address this issue directly.

Sensitivities

Someone suggested that the degree to which the catch increased during the sensitivity run of the assessment in which catch multipliers were used could be indicative of the degree of unaccounted mortality (e.g., M). Consequently, one could increase natural mortality by an amount commensurate with that suggested by the catch multiplier sensitivity run. Increasing natural mortality (rather than using a split series or catch multiplier) has "international acceptance" (*e.g.,* with cod). Conversely, splitting survey series has "local acceptance" and is supported by previous simulation research. However, because the source of retrospective patterns is often unknown, choosing among the alternatives (*e.g.,* increase M, split series) for reducing the retrospective patterns can be problematic. The TRAC therefore agreed that pursuing this topic further was not worthwhile at this time. In closing, a TRAC member requested that the presenter see if estimating catch multipliers improved model fit over alternative ways of reducing the retrospective pattern. The presenter agreed.

Very few old fish (e.g., > age 5) are present in the commercial catches. One explanation is that the fishing mortality rates have been so high that most fish did not survive to old age. In recent years, however, fishing mortality has been much lower but older fish are still scarce in the commercial catch. Why? The reason for the general absence of older fish in the commercial catch is unknown. Possible causes might include increased natural mortality, changes in catchability, misreported catches, or a combination of these factors. Additionally, fishing mortality might be underestimated or not as low as perceived, as suggested by the retrospective patterns.

The split series worked well to reduce the retrospective pattern in previous assessments. Unfortunately, the retrospective pattern has reappeared in the 2010 assessment, and so the split series is no longer a sufficient solution. Some TRAC members wondered whether the re-emerging retrospective pattern suggested that the split series assessment was no longer adequate for projections and stock status determination. The presenter noted that the remaining retrospective was troubling, but suggested that the current projection results be used but be accompanied by a note indicating that the medians may not accurately portray 50%

probabilities, and other caveats as necessary. Alternatively, terminal year estimates could be adjusted for the retrospective pattern using Mohn's Rho and new projections conducted. Other TRAC members suggested examining survey swept area biomass estimates and use an "envelope" method to help ground truth the assessment (*i.e.,* not rely solely on Mohn's Rho adjustments). It was then noted that a decision to adjust for Mohn's Rho and conduct new projections (or no projections) would be inconsistent with the cod assessment and might be considered too drastic a change for an 'update' assessment. Furthermore, given that projections and status determinations were conducted last year, not performing these activities this year during an update assessment would create credibility issues. The suggestion was made to use the current projections (*i.e.,* not adjusted using Mohn's Rho) and caveat the results, as appropriate, in the stock status report. Such an approach would be within the acceptable limits of an update assessment and consistent with the cod assessment. The TRAC agreed to this suggestion; use the current projections and caveat the results. The TRAC also agreed that projections with Mohn's Rho adjusted values, swept area biomass estimate, etc., should also be provided. A benchmark assessment should also be recommended to address the issues identified in this update.

A TRAC member noted that defining rebuilding targets based on medium term projections was not in the Terms of Reference, and suggested that this not be done. US law, however, requires rebuilding targets, and such projections were done last year. Consequently, not doing these simulations would leave this work for some other unspecified group, be inconsistent, and create a void in meeting the requirements of US law. If these projections are going to be done, however, then the TRAC must agree on how to deal with making adjustments for the retrospective pattern using Mohn's Rho. The TRAC agreed to conduct both age-specific adjustments and adjustments on total biomass.

Projections

Concern was expressed that truncating the projections at age-6 might not sufficiently account for growth after this age. Currently, however, there are few fish older than age 6 in the stock, and the available growth curves suggest that yellowtail do not grow much after this age. Consequently, this issue does not really matter right now, but could in future assessments if a larger proportion of the population accrues at older ages.

A TRAC member suggested preparing for a question like, "Knowing what we know now, was rebuilding in 10 years even possible?" Simulations with no fishing mortality suggest that the stock rebuilds relatively quickly even with low recruitment, although this result depends on using values unadjusted for the retrospective pattern. So, yes, rebuilding was/is possible.

All projections done to this point used recruitments from all years, including hindcasted values. The method used to hindcast recruitments was criticized as being potentially flawed because the years in the hindcast calculations contained all of the highest recruitments, and this may be inappropriate. The suggestion was made to put "significant effort and thought" into how recruitments are hindcast in future analyses and reference point calculations.

Recruitment has generally been lower in recent decades. Do these lower recruitments represent a permanent or long-term change in productivity? If so, should the projections only use recent recruitments? Furthermore, the 2007 and 2008 cohorts are among of the poorest in the assessment time series and, although these year class estimates are uncertain, the low values are of concern. The TRAC agreed that projections should be done using only recent recruitment values. More specifically, recruitments should be sampled from the cumulative distribution function of recruitments from 1982 onward. In the projections, care should be taken

to use fishing mortality reference points that do not rely on recruitment assumptions; this will help ensure consistency between the calculated reference points and the projection results. These 'new' projections should not adjust for the retrospective pattern because methods for adjusting recruitment estimates for non-terminal years have not been established. The TRAC agreed that these new projections will be included only as sensitivity runs to help convey the degree of uncertainty in the results, and these findings will also be captured in the "uncertainty" section of the status report using text and figures. Tables will not be included to help avoid misinterpretation of the actual numbers

Management Implications

Some TRAC members noted that when citing the consistent lack of older fish in the DFO and NMFS surveys and also in the commercial catches, a caveat should be added noting that the Canadian commercial fishery is not allowed to target yellowtail and, because observer coverage is low, some older fish may have been missed. Conversely, since so few older fish have been caught in the Canadian DFO survey (and other surveys as well), the argument that 'lots' of older aged fish would have been detected in the Canadian commercial catch had sampling been intensive is weak.

TRAC Presentation: Allocation Shares

Working Paper: Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank Through Fishing Year 2011. TRAC Working Paper 2010/12.

Presenter: L. Van Eeckhaute

Presentation Highlights

Development of consistent management by Canada and the US 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, principles upon which allocation shares would be determined, and computational formulae. For the purposes 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; NAFO Statistical Areas 551, 552, 561,and 562). The management unit for yellowtail flounder would include Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; NAFO 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 effect of the very large catch of yellowtail flounder in Canadian waters in both the 2008 and 2009 DFO surveys was investigated. Leaving out the tow had a greater impact in 2008 than in 2009, where the effect was negligible. After combining the three survey distributions and then applying the smoothing algorithm, there was no change in the allocation for the 2011 fishing year.

The resource distributions in 2009, integrated over the NMFS and DFO surveys, were, for Atlantic cod: 83% Canada, 17% USA, for haddock: 57% Canada, 43% US and for yellowtail flounder: 50% Canada, 50% US. The allocations for the 2011 fishing year, updated with these resource distributions, resulted in shares for Atlantic cod of 81% Canada and 19% US, shares for haddock of 57% Canada and 43% US, and shares for yellowtail flounder of 45% Canada and 55% US.

No Discussion

TRAC Presentation: Catchability of Yellowtail Flounder in Survey and Commercial Scallop Dredges

Working Paper: Yellowtail Flounder Catch at Length by Scallop Dredges: A Comparison Between Survey and Commercial Gear. TRAC Working Paper 2010/09.

Presenter: C. Legault

Rapporteur: J. Deroba

Presentation Highlights

An index of age-1 recruitment of yellowtail flounder derived from the US sea scallop research vessel survey on Georges Bank has traditionally been used in the Georges Bank yellowtail flounder assessment. The possibility of using indices of older ages of yellowtail caught in the US sea scallop survey was explored during the 2009 TRAC meeting. One concern was that larger, older yellowtail may not be fully selected by the sea scallop survey dredge, and thus not provide representative indices of abundance over time. A paired tow scallop dredge comparison study, using both a NEFSC scallop survey dredge and a standard commercial dredge, was conducted by the Virginia Institute of Marine Science. The study collected length frequency data from yellowtail flounder, in addition to the main species of interest (sea scallops). A beta-binomial estimator was applied to the yellowtail catches at length to determine any differences in catchability between the two gears for large (and thus older) fish. Small yellowtail flounder were caught at a higher rate in the survey dredge than in the commercial dredge. This difference is a function of the different configurations of the dredges; the survey dredge is constructed with 2" rings (50.8 mm) in the chain bag, and has a 1.5" liner (38.1 mm), while the commercial dredge has a chain bag constructed of 4" (101.6 mm) rings and no liner. At yellowtail sizes greater than about 35 mm, the catchabilities of the two gears are roughly equivalent. The experimental finding of similar catchability between the survey and commercial dredges for larger yellowtail supports the use of catch per tow indices of older age groups of yellowtail derived from the NEFSC sea scallop survey.

Discussion

Discussion of this working paper began with a question, "How are the results of this analysis intended for use in the assessment?" The answer provided by the presenter was that a combined spring and fall survey age-length key would be applied to the US sea scallop survey data to generate age-specific indices that could be used in the assessment. Using data for all ages would differ from the previous practice of using the scallop survey data to derive just an age-1 index of abundance. The TRAC agreed that deriving indices of abundance for yellowtail older than age 1 was supported by the experimental analysis, but discussion took place about how best to develop these indices. Some members were concerned because the scallop

survey is conducted during the summer when yellowtail growth is relatively fast. However, no summer specific age-length keys are available. Therefore, applying a combined spring-fall age-length key may induce unnecessary noise and "smear" cohorts. Several comments and suggestions were put forth in regards to this topic: (1) The scallop survey is generally conducted closer in time to the spring survey, especially in recent years, and therefore just using the spring age-length key may be the most appropriate; (2) An age-length key developed from commercial catches that overlap temporally with the scallop survey might work well; (3) Continue the use of an age-1 index, but rather than age-specific indices for ages greater than age-1, use an age-2+ aggregate index; and (4) Request that yellowtail scales be sampled for a year or two during the sea scallop survey and compare the age-length key generated from these samples to the age-length keys mentioned above. If one of the alternative age-length keys mentioned above is "sufficiently consistent" with the age-length key generated from the samples from the scallop survey, use that age-length key in the future. These options were not compared to one another, and no one option was identified as preferable to any other.

TRAC Presentation: Percentage of Yellowtail Population in Experimental Study Area

Working Paper: What Percent of the Yellowtail Flounder Population is in the Petersen Tag Experiment Study Area? TRAC Working Paper 2010/10.

Presenter: C. Legault

Rapporteur: J. Deroba

Presentation Highlights

A Petersen tagging experiment was conducted in the southern portion of Closed Area II in June 2008 resulting in an estimate of 17.96 million yellowtail flounder ages 2 and older located in the study area. If the proportion of yellowtail within the study area could be estimated from other data, e.g. survey catches, an absolute estimate of the entire Georges Bank stock could be derived. Initial attempts using individual surveys were too imprecise (i.e., too few survey tows in the study area), so a smoothing process similar to that used for the quota allocation of cod, haddock, and yellowtail was attempted using the US spring and fall surveys. Both the annual and smoothed estimates of percent yellowtail in the study area are too inconsistent (i.e., inter-annually variable) to be used to expand the Petersen estimate of abundance to the entire Georges Bank.

Discussion

The TRAC agreed that these data could not be used to reliably estimate the abundance of yellowtail on Georges Bank, but that the Petersen estimate for the study area would be relevant as a point of comparison to the scale of the assessment estimates of total abundance.

Movement was considered negligible, particularly outside the study area, during the eight day period of the study, so results are likely robust to movement. Although that may be true, the location of recaptures outside the study area might still be useful to infer something about movement rates of yellowtail, especially as it relates to fish moving between US and Canadian waters. Based on recapture data to date, 97% of marked fish remained on Georges Bank while 3% were found on the Scotian Shelf. Beyond that, the recapture data have not yet been analyzed for movement rates. In summary, some recaptures have occurred outside the study

area but no additional analysis has been conducted to permit conclusions beyond such qualitative statements.

During the study, lengths were taken on all yellowtail sampled, but no age structures. The sampling methods targeted only age-2+ sized fish. At this time, the data have not been analyzed to determine whether seasonal movements of yellowtail are age dependent.

Any probable recaptures in the long-term (e.g., >4 years) may serve to better inform age structure of the population, however; 't-bar' tags were used as the tagging method and they are not designed for long-term recapture studies. Consequently, tag loss may preclude any possibility of long-term recaptures.

TRAC Presentation: Vertical Distribution Analyses of Yellowtail Flounder on Georges Bank

Presenter: L. Alade

Rapporteur: J. Deroba

Presentation Highlights

With observed increases in catchability estimates of Georges Bank yellowtail flounder in recent assessments, it was hypothesized whether there has been a change in depth distribution of the species in recent years. A generalized additive model (GAM), using a negative binomial error structure, was explored to determine the patterns of yellowtail flounder catch distribution by depth on Georges Bank. The NEFSC spring and fall bottom trawl survey data during 1963-2010 were input to the model and the explanatory variables were year, month, season, and depth. Catch weight (kg) per tow was the response variable. Survey data show that highest densities of yellowtail were found between 20-100 m and the best fit model based on AIC and percent deviation explained suggested that there was a strong year and depth effect in the survey catches. This is possibly related to interannual variability in the depth that could be related to temperature and prey availability. Overall, it was concluded that the depth range of yellowtail flounder were fairly limited and they habit shallow waters (≤ 100m).

Discussion

Vertical distribution was defined as the mean depth at which yellowtail flounder were caught, not the location of yellowtail in the water column. The analysis focused solely on Georges Bank.

Plots of mean depth of positive tows by year could be confounded with changes in the timing of the survey. This point, however, was not addressed and not resolved.

Because the analysis was intended to examine trends in the mean depth of yellowtail across years, a question was asked as to whether the GAM included a year*depth interaction. The presenter noted that this interaction was not included, but could be. Some years, however, would have few observations, and so the parameters associated with a year*depth interaction might not be well estimated and therefore should not be over-interpreted. Furthermore, the range of depths sampled each year may be narrow and so detecting a year*depth interaction might not be feasible.

TRAC Presentation: Exploratory Analysis of Fishery Data for Georges Bank Yellowtail Flounder

Working Paper: Exploratory Analysis of Fishery Data for Georges Bank Yellowtail Flounder. TRAC Working Paper 2010/17.

Presenter: Saang-Yoon Hyun

Rapporteur: J. Deroba

Presentation Highlights

Data on yellowtail flounder catches in the Georges Bank otter trawl fishery during 2000-2010 indicated no trend by depth (*i.e.,* neither deeper nor shallower) in catch per unit effort (CPUE) over years, although there was annual and seasonal variability in CPUE. Depth, bottom water temperature, their interaction term, and the quadratic terms of depth and water temperature were explanatory variables in the best linear model where the CPUE was the response variable. The significant interaction of depth and bottom water temperature means that the effect of one of these factors on CPUE is not independent of the effect of the other. It also implies that other factors, such as prey, should also interact with bottom water temperature.

Discussion

This study was initiated because reports from fishermen indicated that yellowtail flounder were being caught deeper than ever before. Although these reports may be true, the results of this analysis suggest that the bulk of yellowtail resided at the same depths during 2001-2009 and that the mean depth occupied by yellowtail did not exhibit a trend across years. Some TRAC members suggested that temperature was the likely driver of the depth occupied by yellowtail.

TRAC Presentation: Discard Mortality Estimates for Georges Bank Yellowtail Flounder

Working Paper: Sensitivity of the Georges Bank Yellowtail Flounder Stock Assessment to Alternative Estimates of Discard Mortality Including Gear Dependent Sensitivity. TRAC Working Paper 2010/16.

Presenter: A. Barkley

Rapporteur: J. Deroba

Presentation Highlights

Survival of discarded fish is unknown in many fisheries, posing a source of uncertainty in stock assessments and fisheries management. Lacking quantitative information on discard survival, most assessment models assume a discard mortality rate of 100% as an upper bound. Analyses were conducted to evaluate the sensitivity of the Georges Bank yellowtail flounder stock assessment to alternative discard mortality assumptions. Recent stock assessment results were the basis for initial input data and analyses. A range of discard mortality assumptions (0%, 25%, 50%, 75% and 100%) were used to simulate different dead-catch estimates for the Virtual Population Analysis (VPA) and reference point calculations. Abundance at age, spawning stock biomass (SSB) and fishing mortality rate at age (F), were estimated by the VPA. Yield and spawner-per-recruit analyses were used to calculate the

reference point $F_{40\%}$ as a proxy for F_{MSY}, while projection analyses were used to characterize long-term maximum sustainable yield (MSY) and the associated spawning stock biomass at MSY (SSB_{MSY}). Sensitivity of the assessment to differing assumptions of discard mortality by capture method was also analyzed. Results from the 100% mortality analyses represent the assumption used in the current stock assessment. Results indicated nonlinear, positive relationships between discard mortality rate, abundance estimates and F estimates. However, relative stock status (e.g., estimates of SSB and F relative to MSY reference points) had only subtle changes relative to the current assumption. Therefore, these analyses indicate that alternative discard mortality assumptions do not substantially affect determination of stock status for Georges Bank yellowtail flounder.

Discussion

Discussion of this working paper began with a question, "How long was the tow duration during sampling?" The presenter noted that in the discard mortality study conducted by Carr (1995) multiple tow durations were evaluated ranging from about 1-3 hours.

Although stock status was insensitive to discard mortality in this case, the absolute values for the results did change and this could affect TACs. Some TRAC members therefore wondered what discard mortality rate the presenter would recommend to be used in the assessment. The presenter deferred, noting that examining the effect of different discard mortality rates might be useful as a sensitivity analysis to the final assessment model chosen. Beyond that recommendation, the analysis did not provide a strong basis for using one discard mortality rate over another. The presenter also pointed out that the results of this study (*i.e.,* general insensitivity to discard mortality) may not be general, especially for fisheries with more extensive discards.

Some TRAC members pointed out that a discussion of reasons for discarding and methods that could mitigate discarding might be worthwhile. Trip limits were highlighted as a cause of discarding, including the discard of legal sized fish. One TRAC member pointed out that the scallop fleet does not consider landing yellowtail to be "worthwhile", but new regulations may soon require yellowtail to be landed.

OTHER BUSINESS

Alternate Assessment Cycles

The TRAC discussed the possibility of conducting assessments on an alternative schedule rather than the current annual assessment cycle. The issue was brought forward because of the concern that the quality of the TRAC assessments may be hindered by increased workloads of the scientists, the narrow window available for analyzing the data, partly due to the extension of the NMFS spring survey, and changes in management reviews.

The TRAC agreed that a letter would be drafted by several TRAC members and presented to the TMGC requesting that we explore the advantages and consequences of conducting the assessments other than on an annual cycle. The letter was drafted and presented to the TMGC and is presented in Appendix 5.

RECOMMENDATIONS

- For DFO estimation of discards of cod, haddock, and yellowtail flounder in the Canadian scallop fleet, estimate monthly averages, bias calculations, variance estimates, and annual estimates in addition to the three-month moving window estimates for 2011 assessment.

- For the NEFSC calibration analysis conduct a sensitivity analysis with the constant coefficient for length then compare the number-based, weight-based, and length-based conversions.

- A benchmark assessment for GB yellowtail flounder was recommended to address the issues identified in this update.

- A benchmark assessment was suggested for EGB haddock given the length of time since the previous benchmark and the recent expanding age structure that includes dominant cohorts.

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. 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 Transboundary Management Guidance Committee. Working papers were expected to be modified as recommended by this meeting, and published as TRAC Reference Documents in the coming months.

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APPENDICES

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Appendix 2. Terms of Reference.

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

July 20-23, 2010

NEFSC Woods Hole Laboratory
Stephen H. Clark Conference Room

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, including recently estimated calibration coefficients for the NOAA *FSV Henry B. Bigelow* and *FRV Albatross IV*, and characterize the uncertainty of estimates.

- Given that the 2000 and 2003 year-classes of haddock will represent a larger component of the plus group than previous cohorts, investigate how this impacts the calculation of fishing mortality. A workshop prior to the July TRAC may be required.

- Evaluate temperature and depth preference of yellowtail flounder on Georges Bank and any associated temporal and spatial trends.

- 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 2011, estimate the risk that the 2011 fishing mortality rate would exceed 0.18 (cod), 0.26 (haddock) and 0.25 (yellowtail flounder) respectively. Include a table showing the 2011 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.

- If stock condition is poor, for a range of total catch values in 2011, estimate the risk that the biomass at the beginning of 2012 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2011.

- Review the biomass distribution relative to the USA/Canada boundary, updating results with the 2009 survey information, and apply the allocation shares formula.

- Draft terms of reference for the 2011 TRAC assessment of cod, haddock and yellowtail.

- Other matters.

Outputs

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 US fishing industry
US 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

Stephen H. Clark Conference Room
NEFSC Woods Hole Laboratory

20-23 July 2010

DRAFT AGENDA (subject to drift)

20 July 2010 – Tuesday

9:00 – 9:15	Welcome and Introduction (Chairs)
9:15 – 9:30	Discards from the 2009 Canadian Scallop Fishery
9:30 – 10:00	NEFSC *FSV Henry B. Bigelow – FRV Albatross IV* Length Conversion
10:00 – 10:30	Update of EGB Cod Data Inputs – commercial fishery
10:30 – 10:45	*Break*
10:45 – 11:15	Update of EGB Cod Data Inputs –surveys
11:15 - 12:30	Application of the Benchmark Formulations for EGB Cod Projections and Assessment Advice for EGB Cod Discussion
12:30 – 1:30	*Lunch*
1:30 – 2:00	Expansion of EGB Haddock Plus Group
2:00 – 2:30	Update of EGB Haddock Data Inputs – commercial fishery
2:30 – 3:00	Update of EGB Haddock Data Inputs – surveys
3:00 – 3:15	*Break*
3:15 – 3:45	Application of the Benchmark Formulation for EGB Haddock
3:45 – 4:15	Projections and Assessment Advice for EGB Haddock
4:00 – 5:00	Discussion Allocation Shares for 2011

21 July 2010 – Wednesday

9:00 – 10:30	Evaluation of GB Yellowtail Depth and Temperature Preference Yellowtail Selectivity in Scallop Dredges Yellowtail Abundance in Closed Area II (3 other potential working papers to be presented)
10:30 – 10:45	*Break*
10:45 – 11:30	Continue Yellowtail working papers
11:30 – 12:00	Update of GB Yellowtail Data Inputs – commercial fishery
12:00 – 1:00	*Lunch*
1:00 - 1:30	Update of GB Yellowtail Data Inputs – surveys
1:30 – 2:00	Application of the Benchmark Formulation for GB Yellowtail
2:30 – 3:00	Projections and Assessment Advice for GB Yellowtail
3:00 – 3:15	*Break*
3:15 – 4:00	Discussion

4:00 – 5:00 EGB Cod Report Preparation

22 July 2010 – Thursday

9:00 – 11:00 EGB Cod Report Preparation
EGB Haddock Report Preparation
EGB Yellowtail Report Preparation

11:00 – 1:00 Lunch

1:00 – 3:00 Report Review
3:00 – 3:15 Break
3:15 – 5:00 Report Review

23 July 2010 – Friday

9:00 – 12:00 Development of 2011 TRAC cod/haddock/yellowtail Terms of Reference
Other Business (as required)

Appendix 4. 2011 Draft Terms of Reference.

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

June 20-24, 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 USA/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.

Outputs

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 US fishing industry
US State and Canadian Provincial representatives (NB and NS)
NEFMC representatives
Scientific and Statistical Committee (SSC) representatives

Appendix 5. Alternate Assessments: TRAC letter to TMGC.

Fisheries and Oceans Canada | Pêches et Océans Canada

NOAA FISHERIES
NATIONAL MARINE FISHERIES SERVICE

CERT

Comité d'évaluation des ressources transfrontalières

TRAC

Transboundary Resources Assessment Committee

August 13, 2010

To: TMGC

From: TRAC

At the July 2010 TRAC, participants briefly discussed planning for future assessments. There is concern that increased workloads for both Canadian and U.S. scientists, the extended NEFSC spring survey, and changes in management reviews are all severely hindering the quality of our TRAC assessments. These time constraints affect not only the timely completion of the assessments, but also the development and testing of new methods in TRAC.

One change that might improve the TRAC process would be to alter the assessment cycle. The three management units of Eastern Georges Bank cod, Eastern Georges Bank haddock, and Georges Bank yellowtail flounder are currently assessed annually. Changing some, or all, of these management units to a less-frequent assessment cycle would provide more time to investigate the causes for the uncertainties in the assessment results. For example, a healthy stock could be assessed less frequently than a stock in poor condition, or one stock could be assessed each year on a rotating schedule.

Such a change has implications and questions that need to be explored in detail before being implemented. For example: what are the risks to the management units if assessments are performed less frequently? How does the change affect catch advice? Under what conditions would an annual assessment not be necessary? What would the time savings be? What conditions could trigger an assessment when one was not scheduled?

If the TMGC agrees that this concept is worth exploring, TRAC will prepare a white paper that discusses the options for changing the assessment cycle and the advantages and disadvantages of a change. It would be helpful for TMGC to relay any concerns with this proposal that TRAC needs to explore.

We look forward to your response regarding this issue.