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CERT | *TRAC*

Comité d'évaluation des ressources transfrontalières

Transboundary Resources Assessment Committee

Comptes rendus 2015/01

Proceedings 2015/01

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

Report of Meeting held
7-9 July 2015

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

Meeting Chairpersons

K.J. Curran[1] and E.N. Brooks[2]

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

[2] National Marine Fisheries Service
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 7-9 July 2015 in St. Andrews, New Brunswick, Canada, to review updated assessments (through 2014) of Eastern Georges Bank Atlantic Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder, and to consider a number of other related scientific issues. Results of these assessments will be used by the Transboundary Management Guidance Committee (TMGC) in developing management guidance for the 2016 fishing year for these transboundary resources.

RÉSUMÉ

Le Comité d'évaluation des ressources transfrontalières (CERT) s'est réuni du 7 au 9 juillet 2015 à St. Andrews, Nouveau-Brunswick, Canada, pour examiner les évaluations actualisées (jusqu'en 2014) concernant la morue de l'est du banc Georges, l'aiglefin de l'est du banc Georges et la limande à queue jaune du banc Georges, et pour étudier diverses questions scientifiques connexes. Les résultats de ces évaluations seront utilisés par le Comité l'orientation de la gestion des stocks transfrontaliers (COGST) pour formuler un avis sur l'orientation à donner à la gestion de ces ressources transfrontalières pour l'année de pêche 2016.

INTRODUCTION

The Transboundary Resources Assessment Committee (TRAC) co-chairs, Kristian Curran and Liz Brooks, welcomed participants (Appendix 1) to the 7-9 July 2015 TRAC assessment of Eastern Georges Bank (EGB) Atlantic Cod (*Gadus morhua)*, EGB Haddock (*Melanogrammus aeglefinus*), and Georges Bank (GB) Yellowtail Flounder (*Limanda ferruginea)*. The TRAC was established in 1998 to undertake joint Canada / United States of America (U.S.) assessments of resources on Georges Bank. Cod, Haddock and Yellowtail Flounder were the first species to be assessed by the TRAC, followed by Atlantic Herring (*Clupea harengus)*, Spiny Dogfish (*Squalus acanthias)* and Atlantic Mackerel (*Scomber scombrus)*. The 2015 TRAC Terms of Reference (ToR) received approval from the Canada / U.S. Steering Committee, Canada / U.S. Transboundary Management Guidance Committee (TMGC), U.S. Northeast Regional Coordinating Council, and Canadian Gulf of Maine Advisory Committee.

Meeting participants were reminded that the TRAC review process is two-tiered, with assessment updates typically undertaken between more intensive benchmark reviews. A new benchmark for GB Yellowtail Flounder was established in April 2014; the benchmark for EGB Cod was established in April 2013; and the benchmark for EGB Haddock was established in 1998. Assessments are conducted annually for these three species. The ToR and agenda for the meeting are provided in Appendix 2 and Appendix 3, respectively. The co-chairs briefly reviewed the roles and responsibilities of meeting participants and provided guidance on how agreement would be achieved on decisions. During the meeting, each working paper was presented by one of the science authors, followed by a plenary discussion of that paper. There were additional presentations for which working papers were not prepared. This proceeding provides a record of discussion of all presentations.

Three peer reviewers were invited to participate in the review of the assessments: Heather Bowlby (Canada), Daphne Themelis (Canada), and Alexei Sharov (U.S.). A draft ToR for the 2016 TRAC meeting was not finalized prior to adjournment of the 2015 meeting, and will be discussed further via email. The 2016 TRAC assessment meeting will be held in Woods Hole, Massachusetts. U.S.A.

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

TRAC PRESENTATION: ALLOCATION SHARES

Working Paper: Update of Allocation Shares for Canada and the USA of the Transboundary Resources of Atlantic Cod, Haddock, and Yellowtail Flounder on Georges Bank through Fishing Year 2016 (TRAC WP 2015/01)

Science Lead: D. Busawon (Working Paper)
Science Lead: K. Clark (Presentation)
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

Development of consistent management by Canada and the U.S. for the transboundary resources of Atlantic Cod, Haddock and Yellowtail Flounder on Georges Bank led to a sharing allocation agreement. For Atlantic Cod and Haddock the agreement is limited to the eastern Georges Bank management unit (Fisheries and Oceans Canada (DFO) Statistical Unit Areas 5Zj and 5Zm; United States of America (USA) Statistical Areas 551, 552, 561 and 562). The management unit for Yellowtail Flounder encompasses the entire Georges Bank east of the Great South Channel (DFO Statistical Unit Areas 5Zh, 5Zj, 5Zm and 5Zn; USA Statistical Areas 522, 525, 551, 552, 561 and 562). Two principles are incorporated into the sharing formulae to account for both historical utilization (based on reported landings from 1967 to 1994) and temporal changes in resource distributions (determined from U.S. National Marine Fisheries Service (NMFS) and DFO survey results that are updated annually). From 2010 onward, utilization will account for 10% and distribution for 90% of the allocation. This working paper used the 2014 NMFS and DFO survey results to update the calculation for the 2016 fishing year allocations.

The resource distributions in 2014 were: 20% U.S. and 80% Canada for Atlantic Cod; 41% U.S. and 59% Canada for Haddock; and 73% U.S. and 27% Canada for Yellowtail Flounder. The 2016 fishing year allocations (calendar year for Canada; May 1, 2016, to April 30, 2017, for the U.S.), updated with the revised 2014 resource distributions, resulted in shares for Atlantic Cod of 22% U.S. and 78% Canada, for Haddock of 41% U.S. and 59% Canada, and for Yellowtail Flounder of 76% U.S. and 24% Canada.

Discussion

The discussion focused on the ‘resource distribution’ component of the allocation formula; specifically, clarifying the role of surveys. It was noted that only research surveys were used to quantify the resource distribution component, with the following being observed: 1) Yellowtail Flounder was observed primarily in U.S. waters; and 2) and Cod and Haddock were observed primarily in Canadian waters.

There were questions regarding calibration of data and catchability between the surveys given differences in survey timing and vessels, etc. In terms of data calibration, it was clarified that the NFMS surveys were not calibrated to *Albatross* units for the percent distribution, although this does not matter given the formula is based on the proportion of biomass (analysis regarding effects of switching to the survey vessel *Bigelow* did not yield any concern beyond sampling noise). In terms of catchability, it was asked if this may differ between surveys. It was clarified that all three surveys sample the same general locations in both Canadian and U.S. waters at different times of year (winter, spring and fall), so any differences in catchability of a survey are assumed to apply equally in Canadian and U.S. waters for a given survey. It was again noted that the formulae are based on the proportions of biomass, so catchability is not a factor or of concern.

A reviewer inquired if any problem existed with incoming year classes affecting the allocation applied in year *t+2*. The presenter noted that a 33-year smooth is applied, and that it is expected the overall trend would reflect the appropriate distribution, so this would not be an issue. The reviewer further inquired if each survey was weighted by season and/or biomass (has there been any analysis looking into survey representativeness). The presenter noted that for Atlantic Cod the DFO and NMFS spring surveys in each year were averaged to characterize the distribution during the winter-spring period. This result was averaged with the NMFS fall survey distribution percentage, thereby giving equal weight to the winter-spring and summer-fall periods. Prior to initiation of the DFO survey in 1987, the NMFS spring survey was used alone to characterize the winter-spring period. For Haddock and Yellowtail Flounder, the results from all three surveys in each year were averaged to represent the annual distribution pattern. Prior to 1987, only the NMFS spring and fall surveys were averaged for these two species. The reviewer then asked if the two-year delay in survey data (2014 in this instance) to allocation output (2016 in this instance) resulted in any bias. A meeting participant noted that this would be problematic if species migration patterns differed between years, but given the ages 1-3+ fish have been observed to behave in a general way this has not presented any obvious problem to date. Further, the adult fish drive the long term average, as they constitute the majority of the biomass. Last, it was noted that although changes to the allocation formulae cannot be made by TRAC, there is opportunity to identify issues/propose changes to TMGC, although there were no issues or proposed changes provided by the TRAC regarding this topic discussed at this year's meeting.

Working Paper Revisions

Revisions to the working paper were proposed: 1) revisit methodology section in the document for possible clarification in the description (e.g. characterization of surveys) 2); truncate data in Table 1 consistent with the formulae input criteria; and 3) verify if data may be missing from Table 5.

TRAC PRESENTATION: GEORGES BANK YELLOWTAIL FLOUNDER ASSESSMENT

Working Paper: Stock Assessment of Georges Bank Yellowtail Flounder for 2015 (TRAC WP 2015/04)

Science Lead: C. Legault
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

The GB Yellowtail Flounder *(Limanda ferruginea)* stock is a transboundary resource in Canadian and U.S. jurisdictions. The working paper updated the last stock assessment of Yellowtail Flounder on Georges Bank, which was completed by Canada and the U.S. in 2014. The assessment takes into account advice from the 2014 Diagnostic and Empirical Approach Benchmark (hereafter 2014 Diagnostic Benchmark). During the June 2014 TRAC assessment, it was decided to abandon the Virtual Population Analysis (VPA) model, which had previously provided stock condition and catch advice. This assessment followed that decision and did not provide any stock assessment model results. The combined Canada/U.S. Yellowtail Flounder catch in 2014 was 159 mt, with neither country filling its portion of the quota. This is the lowest catch in the time series, which began in 1935. Despite the low catch, the mean of the three bottom trawl surveys remained essentially unchanged from last year. All three bottom trawl surveys indicate recent low recruitment.

Discussion

The discussion began with inquiry into the Empirical Approach used in the assessment. A reviewer requested brief review of the calculation of catch advice. The science lead noted that a 16% exploitation rate is applied; however, realized exploitation in previous years has been 7% or less and the stock has continued to decline (although it is worth noting that the model in previous years was not the "empirical method", so an exploitation rate was not used to set previous quotas). The reviewer then asked what natural mortality (M) was used in the age structure. The science lead indicated that a range of values was considered and provided in last year's TRAC Status Report (TSR) and TRAC Research Document. The reviewer supplemented the question by noting that evidence suggests M has recently increased. The science lead responded that each combination of M and fishing mortality (F) would have a different selectivity pattern, and this has resulted in a decision to use exploitation rates between 2-16%. Another reviewer noted that the abundance of fish is low, but with the reduction in fishing there appears to be some improvement of the proportion of larger fish in the survey. In contrast, the science lead felt that an expansion of age structure is not being observed relative to past age structures observed in the stock, and that the low catch rates are not driving any change to population dynamics with respect to age structure. Further, the science lead noted that when the stock was declared collapsed in the past catch was reduced and the stock responded positively almost immediately; however, the same thing is not being observed at the current low levels, as supported by no observed increase in survival of older fish or recruitment.

It was noted that discussion in the working paper regarding management of catches of Yellowtail Flounder should clarify that Canada's quota is not allocated to a directed fishery, rather it is set aside for bycatch (the fishery cannot be licensed to target Yellowtail Flounder, nor use gear to target Yellowtail Flounder). In practice, once a Yellowtail Flounder quota is set, the Canadian Gulf of Maine Advisory Committee discusses whether there is enough quota to justify having a directed fishery. In 2012, 3-4 vessels tried to harvest Yellowtail Flounder, but since then there has not been an active fishery (with separator trawls being used to exclude Yellowtail Flounder from the catch). The science lead noted terminology on this in the working paper would be revised for clarity. As follow-up, a meeting participant asked if the separator trawl was effectively-used to separate Yellowtail Flounder, and it was noted that separator trawls are somewhat different between Canada and the U.S. That is, the panel used in Canada can be switched to retain Cod and release Haddock or to retain Haddock and Pollock but release Cod, Yellowtail Flounder, and Monkfish. In the U.S., harvesters use Rhule trawls and separator trawls but, given Rhule trawls require greater horsepower to operate, they are not used that often in the fishery. It was noted that a presentation on how separator trawls work was previously presented at TRAC, but that a follow-up “reminder” presentation might be worth pursuing at a future meeting.

The discussion turned to instantaneous total mortality (Z) and relative F. A reviewer asked if the drop in Z for the most recent cohort was because it is only starting to enter the fishery and has only two observations (ages 3 and 4). The science lead confirmed that this is the case. The reviewer then asked if one could split it between directed versus non-directed trips for relative F, and the science lead responded that this is not a Catch Per Unit Effort (CPUE), and given there is no directed fishery at the moment the directed relative F would be zero. The science lead further noted that a 2% exploitation rate corresponds to 45 mt and that a realized exploitation rate from 2010-2014 has ranged from 4-16% (with an average of 8%). Some meeting participants (i.e. resource managers) requested a range of exploitation rates be included in the working paper, and it was agreed additional information would be added to the document in tabular format. Meeting participants agreed that including a range of exploitation rates in the document would be helpful, as it would help avoid any suggestion that TRAC supported 16% as the best or most appropriate exploitation rate.

A reviewer asked if there are any management measures in place that might be preventing the fishery's ability to attain quota. It was clarified that in the U.S., allocation is divided amongst the groundfish fishery, scallop fishery, and small mesh fishery. Groundfish harvesters caught 24% of the quota, although industry indicated that the price was so low that it was not worth fishing. A meeting participant further indicated that there is a restriction to gear that can be used in some areas, which would reduce flatfish catch. Last, market conditions do not support a fishery with such a low quota (it is not an active fishery). This was followed by a brief discussion on closed areas in the fishery, and that text in the working paper on this topic required further clarification. It was noted by the science lead that Closed Area 2 does not allow groundfish fishing (except under special acess programs), as it is thought to be a refuge for Yellowtail Flounder (although other fishing can occur in the area, including Scallop and Lobster). A meeting participant supplemented this by indicating there is a proposal in the U.S. for making changes to closed areas in the fishery. It is being proposed that Closed Area 2 include more seasonal closures although, to date, no spatial management changes have been implemented. Last, minor points of clarification on the assessment were pursued, including: a brief discussion on the size of swept area biomass as a measure of performance (i.e., catchability) and the inclusion of an appendix in the working paper that outlined the fishery's management history (similar to that found in the Cod and Haddock working papers).

Working Paper Revisions

Minor revisions to the working paper were proposed: 1) revise characterization of Canadian fisheries management within the text of the document; 2) add a column to Table 17 outlining the actual quota (it was decided that a secondary table would be included instead); 3) add an Appendix outlining the history of management performance measures (similar to that in working papers for Cod and Haddock); and 4) add additional exploitation rates to the catch advice (similar to Table 3 from the 2014 Yellowtail Flounder TSR).

TRAC PRESENTATION: HARVEST CONTROL RULES FOR GEORGES BANK YELLOWTAIL FLOUNDER

Powerpoint PPT: Harvest Control Rules and Yellowtail Flounder (see: Appendix 4)

Science Lead: C. Legault
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

Harvest Control Rules (HCR) were discussed. An HCR describes how harvest is intended to be controlled by management in relation to the state of some indicator of stock status (NOAA 2006). The rule is measurable in some manner and supported by a pre-determined management response(s). The TMGC Yellowtail Flounder HCR for 2015 is average biomass from the DFO, NMFS spring, and NMFS fall surveys with an applied 2-16% exploitation rate to determine catch. The advantages of this HRC include: easy to compute; easy to understand; and has a direct response to perceived stock changes. Disadvantages of this HCR include: no target biomass (can track population down to origin); single large tow could be problematic; not predictive (only responsive); ignores a lot of information; and relies on an accurate catchability (q) and appropriate exploitation rate.

A range of alternative HCR was described, including the advantages and disadvantages of each alternative. Alternative HCRs included: smoothing biomass estimates; drawing upon other information available about the stock (e.g., recruitment indicators, spatial distribution, etc.); change in exploitation rate as a function of the survey biomass; and/or use of a constant catch. In order to determine the approach moving forward, a management strategy evaluation (MSE) could be used. The 2014 Diagnostic Benchmark provided a significant amount of information on MSE, but also outlined several disadvantages to pursuing an MSE at this time. Given GB Yellowtail Flounder is currently a discard fishery, with further consideration that a significant amount of time would be required to pursue MSE without much benefit, it was concluded that the TRAC continue to provide advice for the stock consistent with the current HCR.

Discussion

A reviewer asked how the fishery was managed in 1995 when the stock was considered collapsed. The science lead noted that closed areas were implemented and effort restrictions, trip limits, and mesh sizes were imposed. It was noted that in the past there were many management efforts that could be implemented, although absence of a fishery currently limits further tracking of the stock. A meeting participant asked if the terminology in the working paper "constant catch" was intentional or if "constant quota" would be more appropriate, and the science lead responded that "constant quota" was correct (and would be updated in the presentation). It was clarified that there was no intent to imply that a specific amount of fish must be constantly caught each year. Another meeting participant noted that with a constant quota one could build in clauses for "if we see X, then we can do Y". As an example, the constant quota could be "until we see A or B, then quota is to remain constant at amount C." The science lead clarified that what was intended in the presentation was strictly constant quota without any clauses, although adding clauses would be more sensible and could be considered as an alternative HCR for the stock.

A meeting participant inquired as to what level of biomass could allow separation of signal to noise, in order to determine when the stock was at a point whereby it would be useful to invest in a management strategy. The science lead responded that there is likely not any identifiable threshold that could be used rather it is more of a gradient. The science lead also noted the three surveys generally agree in trend, adding confidence that the signal does exhibit the correct trend. Further, observing recruitment increase, an expanded age structure, and an expanded range, would provide additional signals the stock is moving in the right direction. Another meeting participant wondered what the overfished threshold would be if there is no modeled assessment. The science lead acknowledge the importance of this question, responding that for U.S. management the status remains unknown because reference points have not been calculated – this is a limitation of the current approach. The participant followed up inquiring if any attempt would be made to develop such a threshold, including any timeline if one were to be calculated. The science lead noted that it is not within the TRAC's purview to specify biomass reference points.

Revisiting the meeting ToR, a reviewer pondered whether the objectives pertaining to HCR and MSE for Yellowtail Flounder had been met. The reviewer noted that moving towards MSE is perhaps premature approach given the status of the stock. From a biological point of view, finding out whether the selected exploitation rate is sustainable is advisable. With respect to stock status, there is no ability to develop reference points for biomass (no true understanding of what the population is capable of), but with U.S. law requiring this, an idea of what can be done in this regard will need to be pursued. In general, discussing any rebuilding of the stock is difficult given the only control is to manage F. It was suggested there be a focus on the existing control rule to make sure it makes sense. It was agreed that there is a need to identify what can currently be done, in order to determine if the population is more influenced by the environment or the fishery. It was suggested that one way to look at the appropriateness of the exploitation rate is to revisit it to see what realized exploitation rate has been in the past and what the trend in the surveys was. It was noted that this still would not provide insight into whether the environment or fisheries were largely contributing to changes in the stock. A meeting participant noted that using a very simple HCR, such as a constant quota, makes sense until signs of rebuilding (or any response) are observed. In both Canada and the U.S., management decisions regarding scallop and groundfish are considered at the same time. A meeting participant noted that if a constant quota was pursued there could be a management discussion that takes into account impacts of other fisheries on the Yellowtail Flounder stock.

It was agreed by all meeting participants there is no need to conduct MSE at this time given the current state of the yellowtail flounder stock. It was further agreed that HCR for the stock should remain simple. Again, two approaches were proposed: constant exploitation rate and constant quota. It was noted that in 2014 TMGC chose the constant exploitation rate approach, but for only one year. Last, it was agreed that the HCR presentation would be included in the meeting proceeding (see: Appendix 4).

TRAC PRESENTATION: COMPARISON OF COD LIFE-HISTORY PARAMETERS

Background Paper: A Comparison of Cod Life-history Parameters Inside and Outside of Four Year-round 1 Groundfish Closed Areas in New England, USA

Science Lead: G. Sherwood
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

The presentation provided an update to research undertaken on Cod life-history parameters observed between closed and non-closed areas to groundfish fishing in the Gulf of Maine and on Georges Bank west of the Hague Line. The five major closed areas were established to reduce groundfish mortality; particularly for Cod, Haddock and Yellowtail Flounder. Recently, there has been pressure to reduce the closed areas given mortality is also managed by quotas. Thus, central to all discussions of closed areas is the evaluation of how well they are achieving their goals.

The science lead reviewed some unpublished work that compared survey catches inside and outside of the closed areas, with some evidence that for select species the closed areas have increased catches per tow. The science lead noted that historically the most productive Cod stocks are migratory; there was some question as to whether implementing closed areas was favouring resident and less productive Cod stocks. The science lead further noted that morphometrics can be used to differentiate between residents and migrants amongst Cod. With this in mind, body type differences between Cod inside and outside closed areas were evaluated. In general, findings suggested that Cod outside of closed areas were found to have a more streamlined body shape versus Cod inside closed areas. Further, Cod were consistently one year older inside closed areas versus outside closed areas, with an order of magnitude of older fish being found inside closed areas versus outside closed areas. Last, Cod inside closed areas exhibited a broader feeding strategy and achieved higher trophic positions.

In summary, the presenter noted: 1) closed areas may be selecting for sedentary Cod (perhaps this difference existed prior to closed areas, but it is interesting nonetheless that closed areas appear to harbor resident fish); 2) age and length are enhanced inside closed areas (ten times more old Cod greater than five years of age were found inside closed areas); 3) closed areas appear to provide refuge for old, resident Cod; and 4) trophic relationships appear to be more complete/diverse inside closed areas. The study could not conclude if observed differences in Cod inside versus outside closed areas were a habitat or closed area effect. Further, the study could not be determined how widespread the results might apply, as sampling was not completed across all closed areas (i.e., possible habitat/scale bias). The science lead did note, however, that a new Saltonstall-Kennedy research grant would support further exploration of these questions.

Discussion

It was noted by meeting co-chairs that the presentation should be viewed as background information for the following discussion on Cod – it was clarified that the presentation did not fall within the ToR for the meeting. The science lead was supportive of a discussion of the findings. A reviewer asked how a connection was drawn between fish being collected in closed areas to fish that are resident, and the science lead noted that this goes back to the body shape analysis (morphometrics) and behavior, including a look at other known sedentary Cod species (e.g., Red Cod). The reviewer followed up inquiring how variability relates to condition, and the science lead noted that one of the landmarks for morphometrics was dropped since it was thought to be sensitive to gut contents, spawning condition, etc. Dropping this landmark was thought to reduce likelihood that differences in body shape would be influenced by time of spawning. Another reviewer noted that one could envision a lot of situations in which differences may be resultant of a fishing effect and not a closed area effect. The science lead agreed, further noting that there might even be potential for genetic isolation at small scales due to different spawning times.

A meeting participant asked if information on habitat type was available when sampling inside versus outside of closed areas. The science lead indicated this was not available, but that it could be explored. Another meeting participant inquired as to why the northern portion of the Western Gulf of Maine Closed Area was selected for study compared to the southern portion (e.g., near Stellwagen Bank). The science lead noted this was a function of study logistics, but that the southern portion of the closed area could be explored in the future. The meeting participant further asked if similar information exists for the northeast peak of Georges Bank, and it was noted that similar information does not exist, although in Canada there are seasonal closures for spawning (typically the fifth Sunday of the new year until the end of May). It was asked if the study could look at open areas that are not fished versus open areas that are fished, in order to identify differences, and the science lead acknowledged that it would be difficult to tease apart any differences. Further, it was noted by the Canadian assessment scientist for Cod that her examination of average age from survey data inside and outside closed areas did not yield any differences. The science lead noted that improved fecundity inside versus outside closed areas could not be determined given the study was undertaken in the summer. Last, the U.S. assessment scientist for Cod noted the study results regarding age classes were more represented in the closed areas. She noted that fish like structure, so the older fish are more likely to be present in the closed areas. She further noted that the study used gear over hard bottom, which is not easy to survey using normal trawl gear.

The presentation was greatly appreciated by all meeting participants. Sincere appreciation was given to the science lead Graham Sherwood and the Gulf of Maine Research Institute (GMRI).

Working Paper Revisions

Not applicable – no working paper was presented at the meeting on this topic. This presentation was provided for background purposes.

TRAC PRESENTATION: EASTERN GEORGES BANK COD ASSESSMENT

Working Paper:	Assessment of Eastern Georges Bank Atlantic Cod for 2015 (TRAC WP 2015/02)
Science Leads:	Y. Wang and L. O’Brien
Rapporteur:	A. Newbould and L. Brooks

Surveys, VPA Calibration, VPA Formulation and Projections

Presentation Highlights

The combined 2014 Canada/U.S. catches were 574 mt, which included 30 mt of discards, of a quota of 700 mt. It was the second lowest fishery catch in the time series since 1978. Ages 3-5 made major contributions (90% in number; 94% in weight) to the 2014 fishery, and there was no catch at ages 9 and 10+. Catch per tow from the two NMFS surveys decreased significantly from last year, with all three surveys generally showing similar trends. The current survey biomass is among the lowest in the time series, with all three surveys exhibiting poor recruitments since the mid-1990s. The DFO and NMFS spring survey exhibited downward trends of fish condition (Fulton's K), although condition has slightly increased since 2010. Both the fishery and the survey have exhibited truncated age structure in recent years.

The VPA "M 0.8" model from the 2013 benchmark was used to provide catch advice. Due to no fishery catch of age 9 in 2014, the benchmark model could not be exactly followed. Specifically, the population number at age 9 in 2014 was estimated rather than being based on an assumed relationship of fishing mortality of age 9 with adjacent age groups. The estimated adult population biomass at the beginning of 2015 was 10,048 mt, which remains a very low level (approximately 20% of biomass in 1978). Fishing mortality was high prior to 1994 and was estimated at 0.04 in 2014. Both the 2010 and 2003 year classes were estimated at 4.4 million, well below the pre-1990 average level (10 million). The bias-adjusted estimate of the 2013 year class is 2.6 million, with other year classes being weak. The continued poor recruitment and low weights-at-age since the early 1990s, and the assumed high natural mortality on ages 6+ since 1995, are important factors for lower productivity.

Compared to the 2012 assessment, there is still retrospective bias in spawning stock biomass (SSB) and F from the 2013-2015 assessments, which is caused by the substantial reduction in the estimated size of the 2003 year class. Sensitivity analyses conducted in the 2013 and 2014 assessments suggested that this low estimate of the 2003 year class may be an outlier due to uncertainties in the estimation of the 2003 year class at age 9. By checking the 2003 year class residuals in the 2013-2015 assessments, it was shown that the 2003 year class was under-estimated. Rho adjustment would further under-estimate the biomass, hence rho adjustment was not considered appropriate. Removing the impact of the uncertain estimate of the 2003 year class via a sensitivity run ("est 2003yc") would produce similar estimates of the terminal year population number as the 2015 VPA "M 0.8" model. One would also expect these uncertainties to have little impact on catch advice.

For the 2016 projection, a neutral (50%) risk of not exceeding F = 0.11 corresponds to catches less than 675 mt. In 2017, a 50% risk of not exceeding F = 0.11 corresponds to catches less than 725 mt.

Discussion

A meeting participant noted that discard estimates are generally the same between Canada and the U.S., so inquired as to why they appeared to differ this year. A science lead replied that Canada's discards are considered to have a 100% mortality rate, whereas the U.S. has started to apply a mortality rate that is not 100%, varying by gear type (e.g., otter trawl is 75%). It was further noted that discard estimates in Canada were missing for a few years, and it was asked if these could be computed. It was clarified that values were not missing for these years rather they were estimated to be zero, as the fishery is not permitted to discard and observer coverage has been very high (up to 100% in some years). It was requested that Table 1 of the working paper be updated to distinguish between years with no estimate of discards and estimates of zero discards in years with high observer coverage. Observer coverage was then discussed. It was noted that for most recent years in the Canadian fishery, observer coverage for the longline fishery has been 20-30%, although longline gear appears to catch more than half of the landings. It was further noted that the Canadian mobile gear fleet would prefer additional coverage. In contrast, it was noted that observer coverage in the U.S. changes year-to-year, but all gear types generally have 25-30% coverage. It was agreed that Table 1 in the working paper would add zeros where discards were nil.

The discussion turned to fish condition (i.e., Fulton's K), which appears to be low. A meeting participant active in the fishery noted that since the middle of last year Cod appear healthier than they have over the past 8-10 years. Similarly, another meeting participant noted that gillnetters have mentioned there appears to be a lot of Cod on Georges Bank this year, and of good condition (fishing on the northern edge of the Bank). A reviewer noted that the lower observed fish condition during the surveys could be attributed to timing of the surveys, which might be reflective of post-spawning condition (which is typically less favorable). The science lead noted that monthly samples are available for the most recent two years, with fish condition showing a seasonal cycle. Also, it was noted that the DFO survey is closer to when spawning occurs, and with some variability of the survey timing, you might expect lower condition in this survey versus the NMFS surveys (as fish will have a chance to start feeding again by the time the NMFS surveys occur). There is a clear trend in condition in the DFO and NMFS spring survey, but little trend in the NMFS fall survey. If there is a continuous shift in spawning this should be reflected in spring versus fall survey results. No investigation into this has been pursued to date; however, DFO closes the winter fishery when at-sea observers see that the proportion mature is 30%, with the timing of the stoppage not varying much in recent years.

A meeting participant asked why there is still emphasis on the 2003 year class in the VPA, since they are now aged 11 and do not show up in the catch or surveys. The science lead replied that this is included due to its large impact on the retrospective analysis. A reviewer asked why the survey q-value is greater than unity for age 8 fish, and the science lead noted that it could be due to a higher M for those ages (although some conversation has taken place whether wing or door-spread should be used for the surveys – it is good to remember that it is a swept area q-value). It was suggested input of a small arbitrary value in the catch at age 9 should be tested in place of the benchmark formulation. There was discussion regarding various elements of the VPA formulation and projections. A reviewer inquired as to why there is such a large difference between the deterministic projections and risk plots for the stochastic projections, and it was suggested this might be related to the larger coefficient of variation for the 2013 year class. A presentation of homework results was pursued to help address this question.

Presentation of Homework Results

Homework included additional runs to understand differences in the deterministic versus stochastic projections, including a look at the bootstrap of the 2010 and 2013 year class to see how much asymmetry may exist (given the large difference between the deterministic projections and risk plots for the stochastic projections). Looking at the bootstrap results for the 2010 and 2013 year class offered reassurance that the asymmetric distribution for the estimate of the two stronger year classes probably is not the main reason causing the large difference between the deterministic and stochastic projections.

By checking the programing code in ADAPT, it was found that the stochastic projections have been undertaken in terms of an exploitation rate reference point on older (ages 6+) fish; this has always been the case. If the M is constant across ages, there is no difference when an exploitation rate reference (U_{ref}) or fishing mortality reference point (F_{ref}) is used. It is problematic now because of the difference in M between younger and older ages, and also the differences in partial recruitment (PR). M = 0.8 for ages 6+ is assumed, while M=0.2 for ages less than 6. In summary, stochastic projections were undertaken in terms of exploitation rate on old fish; this has always been the case. For the working paper, it was suggested that the issue be clearly described, with U_{ref} in terms of younger fish or U_{ref} in terms of older fish being presented (due to the PR pattern). It was proposed that results of the homework analysis be highlighted in the working paper; the difference in M and selectivity pattern on old versus young fish would indicate whether the U_{ref} had been too high or too low. Despite this identified error, it is to be emphasized that there is no concern of this error influencing the deterministic projections, and that this issue only pertains to the stochastic projections (i.e., risk analysis).

Discussion (Continued)

Following presentation of the homework, there was discussion on U_{ref} associated with the F_{ref} in context of the risk analysis. Last year's U_{ref} was 7%, based on F = 0.11 and M = 0.8, and this is the value the assessment results are based on. During presentation of the homework results, the TRAC learned that the risk analysis software did not account for the shift in M from 0.2 for the younger ages to 0.8 for ages 6 and older. Differences in PR for these two age groups further complicated the calculation of U_{ref}. A reviewer suggested exploring this further as a research recommendation, and it was agreed that this year's assessment should not attempt re-analysis but that describing the outcome of a sensitivity run in the working paper would be appropriate. It was asked if this would have an impact on the reference F = 0.11. The science lead indicated that it would not. This results in F = 0.11 being appropriate for the old fish, but underestimates the exploitation rate for the young fish. It was noted that this difference was not noticed in last year's assessment due to the flat PR but, given differences in the fishery PR between younger and older fish this year, the mis-accounting of the two U_{ref} values has become more apparent.

It was agreed the working paper should highlight the discovery of the error in the stochastic risk projection, and there was discussion of what this might look like. Rather than documenting the details of what happened last year, perhaps the working paper should simply note that a coding error had been discovered in this year's assessment, which did not appear to have an impact on last year's assessment results (but would be evaluated and addressed moving forward beyond the 2015 assessment). A reviewer suggested pointing out in the working paper that it is not that the software code is incorrect rather that when M was changed for older ages this was not incorporated in the software.

In terms of the 2015 assessment, it was agreed that the upper bound of advice for this model should be 675 mt (which is likely conservative) and the error, including what it may mean for the 2015 catch advice, would be clearly described in the working paper. The importance of capturing this point correctly in the working paper was reinforced by meeting participants, so as not to cause any misunderstanding or misinterpretation by resource managers in their review of the 2015 status report. Last, it was noted the science lead would be in attendance at TMGC this year, so would be available to describe the effect of this error on the catch advice in person (see: *Presentation of Homework Results* section above).

Given the size of the 2013 year class, a meeting participant expressed concern about using a recent five year average for recruitment, considering two large year classes would influence this average (suggesting that the average be lowered). A reviewer asked why the retrospective analysis was not characterized by Mohn's rho, indicating it would be useful to show what the values are. The science lead referred to a previous explanation on residuals, and that one year of catch-at-age information causes the sensitivity to result in the current estimate of the 2003 year class being under-estimated. A meeting co-chair suggested adding a table to the working paper to explain this effect (similar to the table on page 9 of the 2015 Haddock working paper). This was considered a good compromise; that is, include a table of the values and then explain why the Mohn's rho adjustment is not made. A meeting participant further added that it might help to put a table of raw numbers next to the Mohn's rho table to show that the missing age 9 class is the primary determinant. A reviewer noted that there could be other sensitivities that explain the retrospective results, and this should also be kept in mind.

At the 2009 benchmark, the fate of the 2003 year class was believed to provide insight into the uncertainty of the natural mortality estimate but in the end the age class disappeared and it remains unknown as to why; VPA resolves the resulting retrospective with an assumption of high M and the ASAP remains at M=0.2, but resulting in a high F. As the 2003 year class was so important to benchmark assessments over the past 10 years, it is important to specifically include it here. The science lead responded that 10 fish were added to the catch-at-age for age 9 in the 2014 sensitivity run. This created a large change in results and impacted the estimate of the 2005 year class, decreasing it from 3.7 to 1.2 million fish. The result demonstrated how sensitive VPA is to age 9. Concern was raised over using an “around the corner” approach given it is not the benchmark formulation. As an alternative, it was suggested a drop back to age 8+ be pursued instead of using an age 10+ model formulation. A co-chair noted that movement away from the benchmark formulation is permissible under the meeting ToR provided that any departure was clearly documented in the TRAC advice.

A meeting participant indicated this highlights the impact of estimation performance at low abundances; that is, small changes can have large effects (highlighting that both models imply there is low abundance). The science lead further noted that this is even more important for the older fish. It was agreed that text would be added to the working paper addressing concern of the benchmark formulation, including guidance on how to proceed moving forward.

Working Paper Revisions

Revisions to the working paper were proposed: 1) add text outlining that the upper bound of advice should be 675 mt, with the stochastic projection error in mind, and clearly describe what this may mean for the 2015 advice.

ASAP and Consequence Analysis

Presentation Highlights

The statistical catch-at-age model ‘Age Structured Assessment Program’ (ASAP) reviewed at the April 2013 EGB Cod benchmark model meeting was updated through 2014. The ASAP model was not chosen by the TRAC as a benchmark model for stock status; however, the TRAC agreed to apply the ASAP model results in a consequence analysis of projection results to be provided to managers for catch advice. The ASAP model for EGB Cod is formulated as closely as possible to the NEFSC Georges Bank Cod assessment with an assumption of M = 0.2 for all ages and years (NEFSC 2013). ASAP derived estimates of instantaneous fishing mortality and stock size in 2014, and a retrospective analysis was performed for terminal year fishing mortality, SSB, and age 1 recruitment. Stochastic projections from model results provide estimated landings and SSB from 2016-2018.

A comparison of the 2015 assessment results of the two models indicates that while the two models have similar trends the magnitude of the January 1 biomass (ages 1+) is estimated to be higher in the VPA model and lower in the ASAP model.

At the 2013 benchmark, the TRAC agreed that although the VPA 0.8 model would be used for catch advice a consequence analysis would be undertaken to understand the risks associated with assumptions of the VPA and the ASAP models. This would be provided to managers for their consideration in discussing quota. Results of the consequence analysis demonstrated: 1) projected catch (ages 1+) at F_{ref} = 0.18 and F = 0.11 and the percent change in biomass, as if each model represented the “true state” of the resource; and 2) consequences to fishing mortality and expected biomass (ages 3+) when ‘true state’ catch levels are removed under the assumptions of the other “alternate state” model.

Discussion

A reviewer inquired if M was switched from 0.2 to 0.8 in ASAP, and the science lead responded no, clarifying that the formulation used in the 2015 assessment is the same formulation as the NEFSC Georges Bank Cod assessment (with M=0.2 for all ages in all years). The reviewer responded by noting the ASAP model uses flat-topped fishery selectivity while the VPA model uses dome-shaped, so it is very difficult to compare. The science lead responded that the intent of the consequence analysis is to evaluate such differences. A meeting participant further noted that the ASAP model does not include 2015 spring survey data.

A reviewer noted it seems inconsistent that the biomass estimate could be low with a high F, leading to a conclusion there is low productivity (it was questioned where the finding of low productivity came from). The science lead clarified that age structure is really truncated and spawner numbers are low. The science lead noted that scientific publications exist demonstrating a need for 3-5 times spawners to increase productivity, and that in this instance this is not being observed.

It was agreed that looking into AIC for the M = 0.8 case would be a good research recommendation to be pursued next year. A meeting participant inquired as to why SSB increases each year in the projection. The science lead noted that the ASAP model uses a more optimistic recruitment value than the VPA model. Last, it was recommended in 2014 to compare the AIC of the ASAP M = 0.2 with an ASAP with M = 0.8 for ages and years as in the VPA; however, this was not in the 2015 meeting ToR so was not completed for the 2015 assessment.

TRAC PRESENTATION: BIAS ADJUSTMENT IN ADAPT

Powerpoint PPT: Bias Adjustment in ADAPT

Science Lead: Y. Wang
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

The ‘DFO Gavaris’ version of ADAPT is used for the TRAC EGB Cod and Haddock stock assessments. In this software, the bias caused by non-linear behavior of the assessment model is considered and corrected in the point estimate of model parameters, as well as in the projections and risk analysis. The practice of bias correction has been debated and discussed at previous TRAC meetings (O’Boyle 1998; Overholtz and O’Boyle 2006), and the practice was adopted in Canadian-led assessments (EGB cod and haddock), but not in U.S.-led assessments (GB Yellowtail Flounder), based on these past deliberations. However, in the 2013 and 2014 TRAC meeting, a reviewer expressed concern about the rationale of bias adjustment due to a possible increase of variance following bias correction.

A Monte Carlo simulation analysis was conducted by applying log-normal random error to survey abundance indices, with no error in fishery catch-at-age, which is consistent with an assumption in ADAPT. The operating model structure is identical to that of the estimating model. The purpose of simulation was to compare the variance and bias of the point estimate of terminal year population number as well as the accuracy of confidence intervals for the SSB and terminal+1 year total allowable catch (TAC). The simulation results demonstrated that for terminal population numbers, the point estimate was improved in terms of bias, with no increase in the relative estimation error after bias correction. Accuracy of confidence intervals derived from bootstrap bias corrected percentile distributions, as measured by coverage, was improved both for the TAC and SSB, upon which the risk analyses are based for catch advice. The analytical results agreed with previous studies (ICES 1999; Restrepo et al. 2000). In general, both theoretical and simulation studies have established the superiority of the bootstrap bias corrected percentile method over the simple percentile method for confidence intervals and risk analysis.

Discussion

A meeting co-chair questioned whether the analysis based on simulated data is in fact representative of actual stock dynamics. It was clarified that the simulation assumes independent error, with no model misspecification, so this is a 'best case scenario' in terms of how a bias adjustment could perform. It was further noted that both bias and unbiased corrected values are reported upon in the status report. There was no identified need to include this presentation in the meeting proceedings, so it has not been included as an appendix below.

Working Paper Revisions

Revisions to the presentation were proposed: 1) correct table summarizing SSB coverage; and 2) fix the bias table for TAC.

TRAC PRESENTATION: COMPARISON OF COD-END MESH STUDIES

Background Paper: Testing the Effect of Alternative Codend Mesh Sizes on the Size and Age Composition of Haddock in the 2014 Trawl Fishery on Eastern Georges Bank

Science Lead: R. Morin
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

With permission of the author R. Morin[1], the following presentation summary was adopted almost verbatim from the Abstract of the background paper presented at the meeting.

The Georges Bank Haddock stock is currently dominated by the 2010 year class. On eastern Georges Bank (NAFO 5Zjm) Canadian regulations require trawlers to use codends of 130-mm square mesh and to have catches with no more than 15% of the number of Haddock under 43 cm in length. The Canadian otter trawl fleet requested permission to test alternative codend meshes (145-mm diamond mesh and 125-mm square mesh) to improve catch rates, monitor the catch of small Haddock, and to reduce the capture of Cod. Sampling was obtained from onboard observers on all trips until the end of August and then with observers on 25% of all trips from September to December. All codend meshes caught Haddock less than 43 cm above the 15% limit in all months, except in November with the 130-mm mesh (14%). The highest percent less than 43 cm (% <43cm) occurred in the spring (June) fishery for all meshes (65-73%) and the lowest percentage in the first and fourth quarters (October-February; 21-37%). The 145-mm diamond mesh retained more Haddock below 43 cm than the 130-mm mesh by 2-5% in the first three quarters, and by 15% in the fourth quarter. The 125-mm mesh retained 3-12% less Haddock below 43 cm than the 130-mm mesh in the second and third quarters, and 16% more in the fourth quarter. The length composition of Haddock catches in the fourth quarter may not be representative due to reduced observer coverage and increased use of the 145-mm diamond mesh in favour of the other two codend meshes. The catch at age was dominated by age-4 Haddock varying between 78% and 91% of monthly catches, with no clear relationship to period or codend mesh size.

[1] Morin, R. 2015. Testing the Effect of Alternative Codend Mesh Sizes on the Size and Age Composition of Haddock in the 2014 Trawl Fishery on Eastern Georges Bank. Roderick Morin for the Groundfish Enterprise Allocation Council (GEAC), April 2015. 30pp. (unpublished manuscript).

Catch rate analyses contrasted the catch per unit effort (CPUE; kg Haddock per 1-hour tow) of the 130-mm mesh with the two alternative codend meshes. Statistical models accounting for four factors (boat, month, depth, and codend mesh size) indicated the CPUE of the 145-mm diamond mesh is 1.16-2.09 times the CPUE of the 130-mm mesh, depending on the month, 1.42 times without a mesh size-month interaction. A similar analysis contrasting CPUE of the 125-mm and 130-mm meshes estimated the CPUE of the 125-mm mesh at 1.76 times that of the 130-mm mesh. A simulated fishery with all three codend meshes in the January to August fishery examined the catch weights of Haddock less than 43 cm and 43 cm+. Assuming uniform fishing effort between mesh sizes and estimated CPUE relative to the 130-mm mesh, most of the gain in yield from using the alternative mesh sizes was made for commercially-sized Haddock (43 cm+). The exception was the June fishery and the July fishery with the 145-mm diamond mesh when most of the gain in yield was made for Haddock less than 43 cm.

Observer data recorded more Pollock than Cod caught in the 2014 Haddock fishery, but with Cod bycatch more prevalent than Pollock bycatch. Cod bycatch appeared in 89% of Haddock catches; Pollock bycatch appeared in 73%. The 145-mm diamond mesh captured less Cod bycatch relative to Haddock catches than the 130-mm mesh in all quarters except in quarter 4. For the 2014 fishery, the Cod bycatch ratio with the 145-mm diamond mesh was 24% less than the ratio observed with the 130-mm mesh. Pollock bycatch, as a ratio of Haddock catch, was lower with the 145-mm mesh than the 130-mm mesh in all quarters, and 71% lower for the 2014 fishery. Similar results were found with the 125-mm mesh for Pollock bycatch relative to the 130-mm mesh; however, the Cod bycatch ratio was lower with the 125-mm mesh than the 130-mm mesh only in quarter 2 and equal between the two meshes for the 2014 fishery.

Discussion

It was noted by meeting co-chairs that the presentation should be viewed as background information for the proceeding discussion on Haddock – it was clarified that the presentation did not fall within the ToR for the meeting. The science lead was supportive of a discussion of the findings. The science lead clarified that there were three data components used: 1) catch-at-length and catch-at-age; 2) catch rate for 1-hour tow duration; and 3) bycatch of Cod and Pollock relative to Haddock. In addition, age-length keys for 2007 were used until the 2014 keys became available; the science lead noted that this was expected to yield similar probabilities at age for the 2003 year class as for the 2010 year class. A meeting participant inquired as to how the nine boats selected for the GLM were identified, and it was noted that boats with high catches and many sets was the underlying criteria. Another meeting participant inquired if the 1-hour tow duration was representative of the catch rate, as the boxplots suggested that tow rates of 3-4 hours is standard. The science lead replied that catch rate was standardized for tow length because vessel captains were allowed to vary tow duration according to their normal fishing practice. In early analyses, no improvement to model fit was achieved by treating absolute catch as the dependent variable. The science lead noted that the GLMs accounted for only 18-28% of the variability in catch rate, depending on the mesh comparison.

A meeting participant inquired if Canadian fishery regulations were changed as a result of the study. The Canadian resource manager in attendance clarified this was not the case, but for 2015 Canada was allowing harvesters to use 125-mm or 130-mm meshes, but not the 145-mm diamond mesh, via licence condition. The size classes being landed in 2015 were being monitored weekly. It was again highlighted that study results suggested a small change in mesh size increased landings without really changing the catch-at-age. A reviewer noted it is difficult to get a sense of the precision of results and that estimates of variance moving forward would be helpful (especially given the dramatic difference in sample size among mesh sizes over the last half of the year). In addition, the reviewer noted it would be helpful to see an analysis of residuals or diagnostics of the regression assumptions, as well as model selection. Based on the study results, the Canadian resource manager inquired if scientists had the information they need to account for any gear changes in the Haddock science assessment. The science lead indicated that only two boats employed the 125-mm mesh in the study, so it would be good to pursue the study for another year, if possible, to acquire more data on this.

The presentation was greatly appreciated by all meeting participants. Sincere appreciation was given to the science lead Rod Morin and the Groundfish Enterprise Allocation Council (GEAC).

Working Paper Revisions

Not applicable – no working paper was presented at the meeting on this topic. A background paper was circulated to participants before the meeting. This presentation was provided for background purposes.

TRAC PRESENTATION: EASTERN GEORGES BANK HADDOCK ASSESSMENT

Working Paper: Assessment of Eastern Georges Bank Haddock for 2015 (TRAC WP 2015/03)

Science Lead: H. Stone (Working Paper)
Science Lead: K. Clark (Presentation)
Rapporteur: A. Newbould and L. Brooks

Presentation Highlights

The total catch of EGB Haddock in 2014 was 14,243 mt of the 27,000 mt combined Canada/U.S. quota. The 2014 Canadian catch increased from 4,631 mt in 2013 to 12,936 mt, while the U.S. catch in 2014 was 1,182 mt; an increase from the 2013 catch of 435 mt. Haddock discards from the Canadian scallop fishery and the U.S. groundfish fishery were estimated at 17 mt and 108 mt, respectively.

The 2015 beginning of year adult population biomass (ages 3+) is estimated at 117,000 mt. The current estimate of the 2013 year class is 1,300 million fish, which is the highest in the time series (1931-1955 and 1969-2014). The exceptional 2003 and 2010 year classes, estimated at 210 million and 275 million age-1 fish, respectively, are the second and third largest. Except for the strong 2000 and 2011 year classes, and the exceptional 2003, 2010 and 2013 year classes, recruitment has fluctuated between 2.1-27.3 million since 1990. Fully-recruited fishing mortality increased to levels above F_{ref} = 0.26 from 2010-2012 before dropping off again in 2013. In 2014, F was estimated at 0.23. Positive signs of productivity include expanded age structure, broad spatial distribution, large biomass, and three exceptional year classes and two strong year classes since 2000. On the negative side, condition has decreased substantially and size at age has declined.

Assuming a 2015 catch equal to the 37,000 mt total quota and F = 0.26 (F_{ref}) in 2016 and 2017, a combined Canada/U.S. catch of 37,500 mt in 2016 results in a neutral risk (50%) that the 2016 fishing mortality rate would exceed F_{ref} = 0.26. A catch of 32,000 mt in 2016 results in a low risk (25%) that the 2016 fishing mortality rate will exceed F_{ref}. The 2010 year class at age 6 is expected to contribute 46% of the catch biomass and the 2013 year class at age 3 is expected to contribute the next highest percentage at 41%. The probability that the 2017 biomass will not increase by 10% is negligible. Adult biomass is projected to be 522,000 mt, at the beginning of 2017 at the F_{ref} catch level. A combined Canada/U.S. catch of 81,000 mt in

2017 results in a neutral risk (50%) that the 2017 fishing mortality rate would exceed F_{ref} = 0.26. A catch of 66,000 mt in 2017 results in a low risk (25%) that the 2017 fishing mortality rate will exceed F_{ref}. The 2010 year class at age 7 is expected to contribute 16% of the catch biomass and the 2013 year class at age 4 is expected to contribute 78%. The probability that the 2018 biomass will not increase by 10% is high because population biomass is expected to decline from 2017 to 2018. Adult biomass is projected to be 464,000 mt at the beginning of 2018 at the F_{ref} catch level.

Retrospective analyses indicated that the framework model has a tendency to underestimate F and overestimate biomass and age 1 recruitment when additional years of data are added. A sensitivity forecast using the rho adjusted 2015 population numbers (ages 0-9+) for deterministic projections and risk assessments was conducted to beginning year 2018. Assuming a 2015 catch equal to the 37,000 mt total quota and F = 0.26 (F_{ref}) in 2016 and 2017, a combined Canada/U.S. catch of 19,500 mt in 2016 results in a neutral risk (50%) that the 2016 fishing mortality rate would exceed F_{ref} = 0.26. A catch of 16,000 mt in 2016 results in a low risk (25%) that the 2016 fishing mortality rate will exceed F_{ref}. The 2010 year class at age 6 is expected to contribute 40% of the catch biomass and the 2013 year class at age 3 is expected to contribute 47%. The probability that the 2017 biomass will not increase by 10% is negligible. Adult biomass is projected to be 299,000 mt at the beginning of 2017 at the F_{ref} catch level. A combined Canada/U.S. catch of 45,000 mt in 2017 results in a neutral risk (50%) that the 2017 fishing mortality rate would exceed F_{ref} = 0.26. A catch of 37,000 mt in 2017 results in a low risk (25%) that the 2017 fishing mortality rate will exceed F_{ref}. The 2010 year class at age 7 is expected to contribute 13% of the catch biomass and the 2013 year class at age 4 is expected to contribute 82%. The probability that the 2018 biomass will not increase by 10% is high because population biomass is expected to decline from 2017 to 2018. Adult biomass is projected to be 268,000 mt at the beginning of 2018 at the F_{ref} catch level.

Discussion

There were brief questions of clarification regarding aspects of the fishery, survey, growth, and model calibration, which were addressed by the presenter and other meeting participants. It was noted that there are two very strong year classes, and they are showing up throughout the eastern Georges Bank area. The discussion turned to the 2016/2017 projections. A reviewer inquired if it would be more appropriate to use a rho adjustment based on numbers-at-age rather than an adjustment based on SSB. A research recommendation was made to look into this further, especially when there are large year classes.

A reviewer noted that the PR pattern was odd in that the PR was near unity for ages 6-8 and then dropped to 0.26 for ages 9+ fish; the reviewer questioned whether this was a consequence of how the plus group is estimated. The presenter noted that the PR of age 9+ fish is calculated, but realistically it is difficult to envision a PR of unity for ages 6, 7, 8 and then 0.26 for ages 9+, so there might be something going on with the calculation. Further, the presenter noted that the assessment has flipped back and forth on whether to use a flat-topped or dome-shaped PR, and that the large year class moving through flipped to dome-shaped resulting in the 0.26 value. It was suggested that exploring this as a potential research topic for next year be considered.

Concerns were expressed that, based on the retrospective analysis, the estimated and reported stocks appear to differ significantly. That is, while it is thought the stock is doing fine, it needs to be tracked more closely given biomass has consistently been over-estimated by 40% when comparing the adjusted and unadjusted values (which could lead to quick changes in the overall stock dynamic if the wrong values are used for management purposes). It was further noted that for two years now the assessment has shown a strong retrospective pattern leading to an overestimate of the projected biomass, but since the stock is considered to be healthy this has not been a cause for concern – perhaps it is now time to look into this further. A reviewer inquired as to how large the rho adjustment is compared to other stocks, and it was clarified that it is small compared to other stocks such as GB Yellowtail Flounder. A meeting participant asked if the rho adjusted values could be evaluated relative to confidence interval estimates (e.g. plotted together), and a discussion followed on how this could be done.

Presentation of Homework Results

Analysis of Mohn's rho adjusted values compared to the point estimate confidence intervals (CI) demonstrated that the rho adjustment is outside both 80% and 95% CI, with rho adjusted biomass ranging from 116,970 mt to 69,012 mt and rho adjusted F ranging from 0.23 to 0.39. It was agreed an additional figure and discussion on this analysis would be added to the working paper.

Discussion (Continued)

Given continued differences between adjusted and unadjusted assessment results, it was strongly encouraged by meeting participants that the TRAC consider a benchmark assessment for EGB Haddock to explore model formulation (current benchmark formulation adopted in 1998). It was noted that a lot of discussion and fixes to the current formulation have occurred over the years, and that now particular attention needs to be paid to the 117,000 mt SSB estimate for 2015. Further, it was noted that the fishery has not been catching its quota in either jurisdiction despite the 117,000 mt value. Thus, in absence of a new benchmark formulation, concern remains that biomass is not being captured correctly in the assessment, which may have implications particularly in future year projections. It was generally felt by many meeting participants that if this was an unhealthy stock then differences such as those observed in the Haddock assessment would be of strong concern.

Working Paper Revisions

Revisions to the work paper were proposed: 1) revise figure outlining Canadian Haddock catches in U.S. jurisdiction, as there is either an error in plotting or in logbook entries; 2) verify if tonnage presented are in metric units; 3) include NMFS Fulton's K values; 4) verify that predictions versus observations presented are correct (figure appears inaccurate); 5) F_{2014} should be rho adjusted and reported (in Table 9); and 6) include a plot of the rho adjusted values against the confidence interval estimates.

OTHER BUSINESS

Following discussion of the three status reports, there was limited time to discuss other business of the TRAC. Other business items briefly discussed included:

Terms of Reference for 2016

Terms of Reference for consideration in 2016, as well as potential research topics and further assessment needs, were documented by meeting co-chairs prior to adjournment of the meeting. It was agreed that ToR for the 2016 assessment meeting would be discussed and finalized via email in the months following the 2015 meeting. Topics of discussion/research recommendations for further consideration included:

- For Yellowtail Flounder, report on catchability studies for flatfish (if available).

- For Cod, resolve the coding error in the risk analysis and document the risk analysis methodology for background reference. Once the code is corrected, re-visit the catch advice since 2009. In addition, explore M = 0.8 case for ASAP and document AIC (objective function value). The objective is to evaluate M = 0.2 versus M = 0.8. Last, revisit the plus age group used in the VPA (currently uses 10+; should it be reduced to 9+). This might require a follow-up benchmark.
- For Haddock, explore opportunity for a benchmark/framework. In addition, develop an interim advice reporting template that could be applied to Haddock for further discussion.

Approach for Interim Status Report

An approach for characterizing components of an interim status report (in lieu of an assessment) was discussed by the TRAC within its intercessional meeting, although discussion on this topic was not expanded upon at the 2015 assessment meeting. It remained unclear to the TRAC as to what TMGC's expectation of an interim status report might contain, and the TMGC representative in attendance at the meeting indicated that further direction from the TMGC to the TRAC on this topic is warranted before a more complete discussion can occur on this topic. There was a commitment by the meeting co-chairs to follow-up with the TMGC on this matter prior to the 2016 TRAC meeting.

Publication Timelines

Co-chairs committed to finalizing the TSRs by late-July prior to the pre-TMGC meeting with industry on July 29, 2015. Revised draft TSRs were circulated for review only to those meeting participants in attendance on day 3 of the meeting, with opportunity to provide comment within a defined period of time. All comments received were considered within the final TSRs that were approved by Canada and the U.S. on July 22, 2015. Copies of the final, English language TSRs were made available to all meeting participants via email on July 23, 2015. Last, the co-chairs committed to finalizing all working papers and a meeting proceeding within two months of the meeting, continuing to communicate with meeting participants if this timeline could not be met.

CONCLUSIONS

The co-chairs of the meeting thanked participants for attending this year's TRAC assessment of EGB Cod, EGB Haddock, and GB Yellowtail Flounder. The TSRs for each of these species would be finalized by mid- to late-July 2015 (finalized July 23, 2015), based on discussion at the meeting, and they would be made available to participants in French and English on the TRAC website: http://www.bio.gc.ca/info/intercol/trac-cert/index-en.php and on the NEFSC website: http://www.nefsc.noaa.http://www.nefsc.noaa.gov/saw/trac/gov/saw/trac/. The TSRs are to be presented at the September 2015 TMGC meeting. Working papers are to be revised, as recommended at the meeting, and published on the website as TRAC Reference Documents in the coming months.

SOURCES OF INFORMATION

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APPENDICES

APPENDIX 1. LIST OF PARTICIPANTS JULY 7-9, 2015

7th	8th	9th	Name	Affiliation
X	X	X	Alexander, Terry	New England Fisheries Management Council (NEFMC) / TMGC
X	X	X	Bowlby, Heather	DFO Maritimes - Population Ecology Division (BIO)
X	X	X	Brooks, Liz	NOAA - NMFS - NEFSC
X	X	X	Cadrin, Sean (WebEx)	Academic - University of Massachusetts
X	X	X	Clark, Kirsten	DFO Maritimes - Population Ecology Division (SABS)
X	X	X	Cournane, Jamie	New Englad Fisheries Management Council (NEFMC)
X	X		Couture, John	Unama'ki Institute of Natural Resources (UINR)
X	X	X	Curran, Kristian	DFO Maritimes - Centre for Science Advice
X	X	X	d'Entremont, Alain	Scotia Harvest Seafoods Inc. - O'Neil Fisheries Ltd.
X	X	X	Decelles, Greg	Academic - University of Massachusetts
X		X	Etrie, Libby (WebEx)	Industry
X	X	X	Ford, Jennifer	DFO Maritimes - Resource Management / TMGC
X	X	X	Heil, Sarah	NOAA - GARFO / TMGC
X	X	X	Kennedy, Adam	Atlantic Policy Congress (APC)
X	X	X	Legault, Chris	NOAA - NMFS - NEFSC
X	X		Maxwell, Judith	Scotia-Fundy Inshore Fishermen's Assn. (SFIFA)
X	X		Minkiewicz, Drew	Industry
	X		Morin, Rod (Telephone)	Consultant (with GEAC)
X	X	X	Newbould, Andrew	DFO Maritimes - Centre for Science Advice
X	X	X	Nies, Tom (WebEx)	New England Fisheries Management Council (NEFMC)
X	X	X	O'Brien, Loretta	NOAA - NMFS - NEFSC
X	X	X	O'Connor, Michael	Transboundary Mgmt. Guidance Committee (TMGC)
X	X	X	Peros, Jonathon (WebEx)	New England Fisheries Management Council (NEFMC)
		X	Rowley, Joyce (WebEx)	Industry
X	X	X	Sharov, Alexi	NEFMC - SSC
X			Sherwood, Graham	Academic- Gulf of Maine Research Institute (GMRI)
X	X	X	Themelis, Daphne	DFO Maritimes - Population Ecology Division (BIO)
X	X	X	Tooley, Mary Beth	New England Fisheries Management Council (NEFMC) / TMGC
X	X	X	Vascotto, Kris	NS Dept. Fisheries & Aquaculture - Marine Fish
X	X	X	Wang, Yanjun	DFO Maritimes - Population Ecology Division (SABS)

X – Attend meeting on that day

APPENDIX 2. TERMS OF REFERENCE

Transboundary Resources Assessment Committee

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

July 7-9, 2015

St. Andrews, NB

TERMS OF REFERENCE

Context

The TRAC annually obtains requests for harvest advice on transboundary resources from the Transboundary Management Guidance Committee (TMGC).

For the following resources: Eastern Georges Bank Cod, Eastern Georges Bank Haddock, and Georges Bank Yellowtail Flounder:

- Apply the benchmark assessments (VPA for cod and haddock and empirical approach for yellowtail) to report on the status of the stocks, updating results for the latest information from fisheries, including discard estimates and research surveys, and characterize the uncertainty of estimates.
- Describe any adjustments to benchmark assessment models applied during the TRAC including impacts on advice given to TMGC.
- Evaluate and quantify, if possible, scientific uncertainty of the assessment output (stock status determination and catch projection), discussing current practices of characterization and alternative methods of evaluation.
- Provide sensitivity analyses to account for retrospective bias on stock biomass and fishing mortality estimates for cod and haddock, if appropriate.
- For a range of total catch values in 2016 and 2017, estimate the risk that the respective fishing mortality rate would exceed F_{ref} = 0.26 for haddock and F = 0.11 for cod. Include a table showing the 2016 and 2017 catches corresponding to low (25%), neutral (50%), and high (75%) probability that the F would exceed F_{ref} = 0.26 for haddock and F = 0.11 for cod.
- For a range of total catch values in 2016 and 2017, estimate the risk that the biomass at the beginning of 2017 and 2018 would not achieve a 0%, 10% or 20% increase compared to the beginning of 2016 and 2017 for cod and haddock.
- For yellowtail flounder, provide catch advice for 2016 based on the empirical approach for a range of exploitation rates and, if appropriate, any other approach (e.g., constant quota) that includes catch advice for 2016 and 2017. Catch advice based on the empirical approach should consider information on survey catchability, if available.
- Review the biomass distribution relative to the U.S./Canada boundary, updating results with the 2014 survey information, and apply the allocation shares formula.
- For yellowtail flounder, develop a range of harvest control rules for determining the effectiveness of potential harvest strategies (i.e., constant quota or constant exploitation rate) and initiate an exploration of Management Strategy Evaluation
- Draft terms of reference for the 2016 TRAC assessment of eastern Georges Bank Atlantic Cod, eastern Georges Bank Haddock and Georges Bank Yellowtail Flounder.
- Other matters.

Expected Publications

TRAC Transboundary Status Reports for the eastern Georges Bank Atlantic Cod and Haddock, and Georges Bank Yellowtail Flounder management units.

TRAC Reference Documents for eastern Georges Bank Atlantic Cod and Haddock, Georges **Bank yellowtail flounder management units, and the allocation shares.**

TRAC Proceedings of meeting discussion.

Participants

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

APPENDIX 3. MEETING AGENDA

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

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

7-9 July 2015

DRAFT AGENDA

Note: Agenda order may have been modified to accommodate meeting needs, although all topics below were discussed/presented at the meeting unless striked out

DAY 1 (Tuesday; July 7, 2015)

Time	Topic	Leads
09:00 – 09:30	Welcome & introduction (co-chairs)	Liz Brooks (US) Kristian Curran (Cdn)
09:30 – 10:00	Allocation shares	Heath Stone (Cdn) Loretta O'Brien (US)
10:00 – 10:45	GB Yellowtail Flounder Assessment Update: 1. Inputs: commercial fishery and surveys 2. Application of the benchmark formulation 3. Catch advice	Chris Legault (US) Dheeraj Busawon (Cdn)
10:45 – 11:00	***Break***	
11:00 – 11:30	GB Yellowtail Flounder Assessment Update: 1. Harvest Control Rule/Management Strategy Evaluation – summary of progress	Chris Legault (US)
11:30 – 12:00	A comparison of cod life-history parameters inside and outside of four year-round groundfish closed areas in New England	Graham Sherwood (US, GMRI)
~~12:00 – 12:30~~	~~Potential bounds on the scale of cod consumption by seals~~ **ANALYSIS NOT AVAILABLE**	~~Loretta O'Brien (US)~~
12:30 – 13:30	***Lunch***	
13:30 – 14:00	Bias adjustment in ADAPT	Yanjun Wang (Cdn)
14:00 – 15:00	EGB Cod Assessment Update: 1. Inputs: commercial fishery and surveys 2. Application of the VPA Formulation and VPA Projections for EGB Cod 3. Application of the ASAP Formulation and Projections for EGB Cod 4. Consequence Analysis and Assessment Advice	Yanjun Wang (Cdn) Loretta O'Brien (US)
15:00 – 15:15	***Break***	
15:15 – 17:00	EGB Cod Assessment Update (cont)	Yanjun Wang (Cdn) Loretta O'Brien (US)

DAY 2 (Wednesday; July 8, 2015)

Time	Topic	Leads
09:00 – 09:30	Review of previous day (co-chairs)	Liz Brooks (US) Kristian Curran (Cdn)
09:30 – 10:30	Homework from previous day	All (US) All (Cdn)
10:30 – 10:45	***Break***	
10:45 – 11:15	GEAC Mesh Size Experimental Results	Rod Morin (GEAC)
11:15 – 12:30	EGB Haddock Assessment Update: 1. Inputs: commercial fishery and surveys 2. Application of the benchmark formulation 3. Projections and assessment advice	Heath Stone (Cdn) Liz Brooks (US)
12:30 – 13:30	***Lunch***	
13:30 – 14:00	EGB Haddock Assessment Update (Cont'd)	Heath Stone (Cdn) Liz Brooks (US)
14:00 – 15:00	GB Yellowtail Flounder status report	Chris Legault (US) Dheeraj Busawon (Cdn)
15:00 – 15:15	***Break***	
15:15 – 16:00	GB Yellowtail Flounder status report (Cont'd)	Chris Legault (US) Dheeraj Busawon (Cdn)
16:00 – 17:00	EGB Cod status report	Yanjun Wang (Cdn) Loretta O'Brien (US)

DAY 3 (Thursday; July 9, 2015)

Time	Topic	Leads
09:00 – 09:30	Review of previous day (co-chairs)	Liz Brooks (US) Kristian Curran (Cdn)
09:30 – 10:30	Homework from previous day	All (US) All (Cdn)
10:30 – 10:45	***Break***	
10:45 – 11:30	EGB Cod status report (cont'd)	Yanjun Wang (Cdn) Loretta O'Brien (US)
11:30 – 12:30	EGB Haddock status report	Heath Stone (Cdn) Liz Brooks (US)
12:30 – 13:30	***Lunch***	
13:30 – 14:15	EGB Haddock status report (cont'd)	Heath Stone (Cdn) Liz Brooks (US)
14:15 – 15:00	Conclusions of report reviews	All (US) All (Cdn)
15:00 – 15:15	***Break***	
15:15 – 16:15	Conclusions of report reviews (cont'd)	All (US) All (Cdn)
16:15 – 17:00	Other business and close: 1. Terms of Reference for 2016 2. Approach for Interim Assessments 3; Other business (as necessary) 4. Meeting adjournment	Liz Brooks (US) Kristian Curran (Cdn)

APPENDIX 4. HARVEST CONTROL RULES (YELLOWTAIL FLOUNDER)

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GBYT HCR MSE PDQ

Chris Legault
TRAC
7 July 2015

Slide 2 of 18

TOR

- For yellowtail flounder, develop a range of harvest control rules for determining the effectiveness of potential harvest strategies (i.e., constant quota or constant exploitation rate) and initiate an exploration of Management Strategy Evaluation

Slide 3 of 18

HCR

- What is it?
- What makes a good one?
- What is the current one for GBYT?
- How could it be changed?
- How should one be selected?

Slide 4 of 18

HCR Definition

- Describes how harvest is intended to be controlled by management in relation to the state of some indicator of stock status. (NOAA Fisheries Glossary)
- Measure something, management response pre-determined

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Desirable Features

- High yield to fishery
- Low inter-annual catch variability
- Safe for stock
- Many other possibilities
  - Need managers to decide these

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Current GBYT HCR

- Average biomass from 3 surveys and apply 16% exploitation rate to determine catch
- Advantages
  - Easy to compute
  - Easy to understand
  - Direct response to perceived stock changes
- Disadvantages
  - No target biomass, can track population down to origin
  - Single large tow could cause problem
  - Not predictive, only responsive
  - Ignores a lot of information
  - Relies on accurate q and appropriate exploitation rate

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Possible Changes

- Smooth biomass estimates over time
  - Allocation uses 33 year Loess smooth
  - Kalman filter accounts for measurement and process errors
- Advantages
  - Reduces annual variability
  - Limits influence of single large tows
- Disadvantages
  - Harder to explain
  - No basis to select any particular smoother over other options
  - Smoothers sometimes do strange things

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Possible Changes II

- Add elements to HCR (e.g. recruitment indicator, harvest indicator, spatial distribution indicator, etc.)
- Advantages
  - Use more information
- Disadvantages
  - More complex decision framework
  - Difficult to determine importance of different elements

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Possible Changes III

- Change exploitation rate as a function of directional change in survey biomass
- Advantages
  - Allows increased fishing opportunities when stock increases
  - More protection for yellowtail population when stock decreases
- Disadvantages
  - Hard to determine amount of change allowed
  - Increases annual variability

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Possible Changes IV

- Constant quota
- Advantages
  - Simple to understand
  - No annual variability
  - No assessment needed
- Disadvantages
  - Not responsive to stock changes
  - Determining the constant catch amount difficult
    - If set too high, will drive stock down
    - If set too low, will forgo fishing opportunities

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Possible Changes V

- Lots more ways to change HCR
- Best if define goals and objectives first
  - What do we want?
  - What trade-offs are we willing to make?
  - What limits/boundaries do we have?

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HCR

- What is it?
- What makes a good one?
- What is the current one for GBYT?
- How could it be changed?
- How should one be selected?
  - MSE

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MSE

- Management Strategy Evaluation
  - aka Management Procedure
- Simulation testing of different harvest control rules over a range of possible realities
  - Performance metrics defined in advance
  - Operating models agreed in advance
  - Big exercise!

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GBYT MSE Thoughts

- 2014 Diagnostic Benchmark provided wide range of information to define widely different operating models
  - This meeting identified a lot of uncertainties
  - Many models will be required to span possibilities
  - None expected to perform well with real data
  - Large amount of time required to build and agree upon the operating models

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GBYT MSE Thoughts II

- Performance metrics not obvious for this stock
  - Currently discard fishery
  - Low catch does not appear to be causing rebuilding
  - Is commercial extinction or maximum yield more important?

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GBYT MSE Thoughts III

- Major time commitment by managers and scientists in both countries required if MSE is to be pursued
  - What other work would have to be sacrificed to conduct an MSE?

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Summary of Progress

- None
  - Done some thinking, but unclear if TRAC and TMGC are committed to giving up something to pursue this idea
  - Cost/benefit of this exercise relative to current catch and ability to influence stock

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Questions?