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Transboundary Resource Assessment Committee

Reference Document 2017/05

Evaluation of the 2016 Eastern Georges Bank Haddock Interim Report

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ABSTRACT

At the 2016 TRAC, an interim update was provided in lieu of a full assessment for haddock. This interim update evaluated several indicators in an attempt to provide advice as to whether the 2015 projections were likely to be well informed or if there was evidence that projections needed to be adjusted. This working paper looks back at the interim update and compares it with the information that would have been available if an assessment had been performed at the 2016 TRAC. Differences in fisheries catch, beginning of year weight-at-age (WAA), fisheries WAA, model (VPA) estimated catch-at-age, model estimated numbers-at-age, partial recruitment, fishing mortality at age, retrospective analysis, projected biomass, risk, and the performance of the survey index were evaluated. The main drivers of differences were the overestimate of WAA for large year classes (both beginning of year and fishery weights at age) and the observed retrospective pattern, causing an overestimated biomass and underestimated F. Several methods of how to incorporate knowledge gained from this evaluation were put forth by the authors for further consideration at TRAC.

Introduction

At the 2015 TRAC, a VPA with fishery catch data through 2014 and survey data updated to 2015 was performed for Eastern Georges Bank haddock and projections were performed from 2015 through 2017. The projections were longer than previous projections by one year, and were intended to allow multi-year quota setting for Eastern Georges Bank haddock by TMGC. Based on 2015 TRAC multi-year projections, a quota for 2016 was set and an upper threshold was proposed for quota in 2017. The following year, at the 2016 TRAC, an interim update was provided in lieu of a full assessment for haddock. This interim update evaluated several indicators in an attempt to provide advice as to whether the 2015 projections were likely to be well informed or if there was evidence that projections needed to be adjusted. This working paper looks back at the interim update and compares it with the information that would have been available if a VPA had been performed at the 2016 TRAC. We compare the 2015 projection assumptions with what was estimated with the VPA with catch data through 2015. We do not provide a full research document for the 2015 VPA application, as all of those tables will be found in this year's VPA application (with catch data through 2016).

Methods and Results

The projection assumptions made at the 2015 TRAC are given in Table 27 of Stone et al. (2015). We compare the assumed values with updated estimate values (using the same calculation methods) with data that would have been available for conducting a full assessment at TRAC 2016. Specifically, we compare the following assumed values used in projections at the 2015 TRAC with the updated estimated values.

Perception of the Stock

Catch

Combined catches for USA and Canada were 16,408 mt, 44% of the 37,000 mt quota in 2015. The full Canadian quota of 19,240 mt was not caught in 2015, due mostly to difficulties in avoiding bycatch of cod for which there was a low quota.

Beginning of Year Population Weights-At-Age (WAA)

Consistent with the trend reported in 2015, the measured WAA from the DFO survey exhibit a declining trend from 2000 to present, especially for ages 3 to 6. Interestingly, WAA for fish ages 7 and older are showing an increase in 2016. The beginning of year WAA used in projecting the 2016 biomass in 2015 were comparable with the 2016 DFO survey WAA for many ages, but did underestimate the weight of fish aged 5, 7 and 9+ and overestimated fish aged 1, 2, 3 (2013 yc), and 6 (2010 yc) (Figures 1 and 2). Considering the 2010 and 2013 year-classes are expected to contribute to the majority of the population biomass and catch biomass in 2016, an overestimation of the weight of aged 3 (2013 year class) and 6 (2010 year class) might be expected to affect the projected 2016 and 2017 biomass. The WAA for ages 9+ in the 2016 DFO survey was calculated using a numbers weighted average of ages 9 to 13. The proportion of aged 9+ fish was variable, 23% in 2013 to 4% in 2015, this is reflective of the NAA 9+ caught in the DFO survey. A total of 299 fish from 2016 DFO survey were aged, 2% of which were ages 9+. Therefore, it is unknown if the higher WAA observed for 2016 were reflective of the population or due to low sample size.

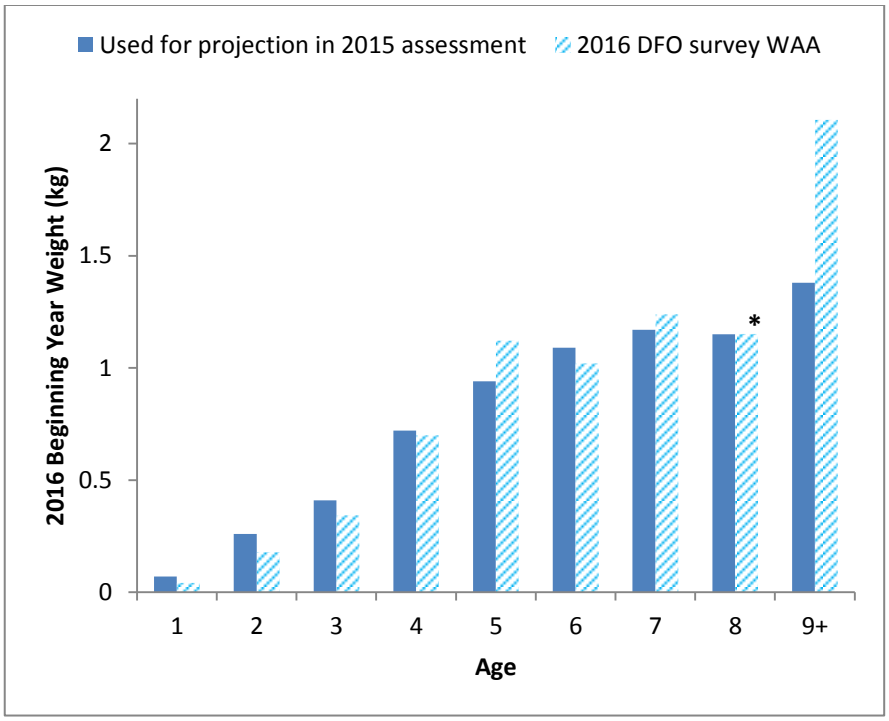

*Figure 1. Comparison of beginning weight-at-age projection inputs from the 2015 assessment (2013-2015 average) and updated 2016 DFO survey data. * Weight for age 8 in 2016 was derived by taking the average of weights in years 2013-2015 as data were not available for this age group in the 2016 DFO survey.*

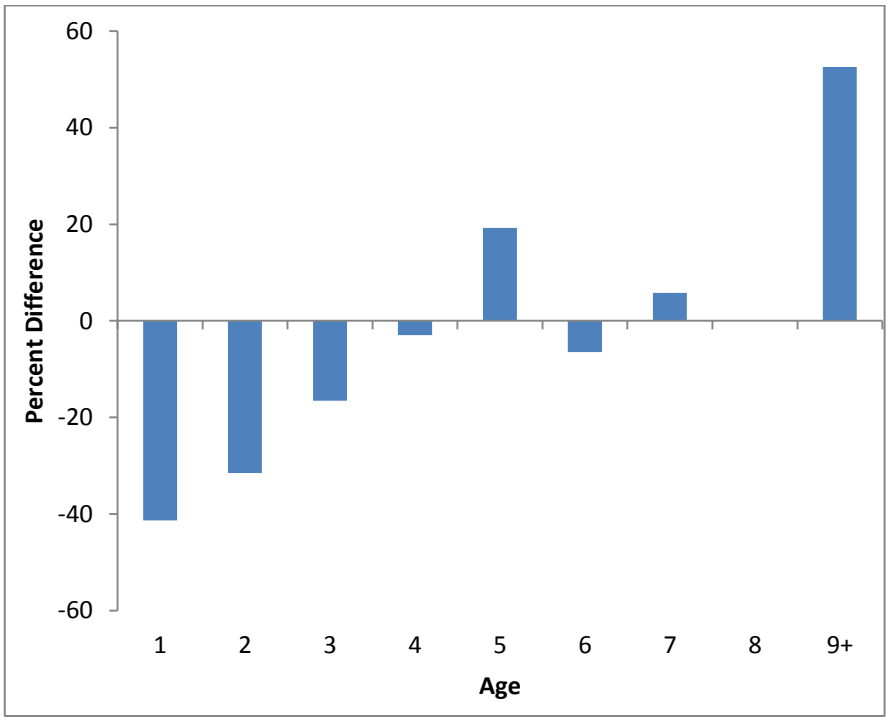

Figure 2. Percent differences of beginning weight-at-age projection inputs from the 2015 assessment and updated 2016 DFO survey data. Percent differences were calculated using '(Measured in 2016 - Estimated in 2015 assessment)/ (Estimated in 2015 assessment) x 100'.

Fisheries Weights-at-Age (WAA)

The average fishery WAA used in projecting the 2016 fishery catch in 2015 were comparable with the weights at age calculated from the 2015 catch for many ages, but did underestimate for ages 4, 8 and 9+, and overestimated ages 1, 2, 3, and 5 to 7 (Figures 3 and 4). Most of the differences were within +/- 10%, except ages 1 and 8, which account for a very small fraction of the catch in numbers. Fishery weights at age 5 (2010 year class) were overestimated by 3.3%; given the expected dominance of this year class in the catch and the population, if the full quota was caught it could result in additional risk.

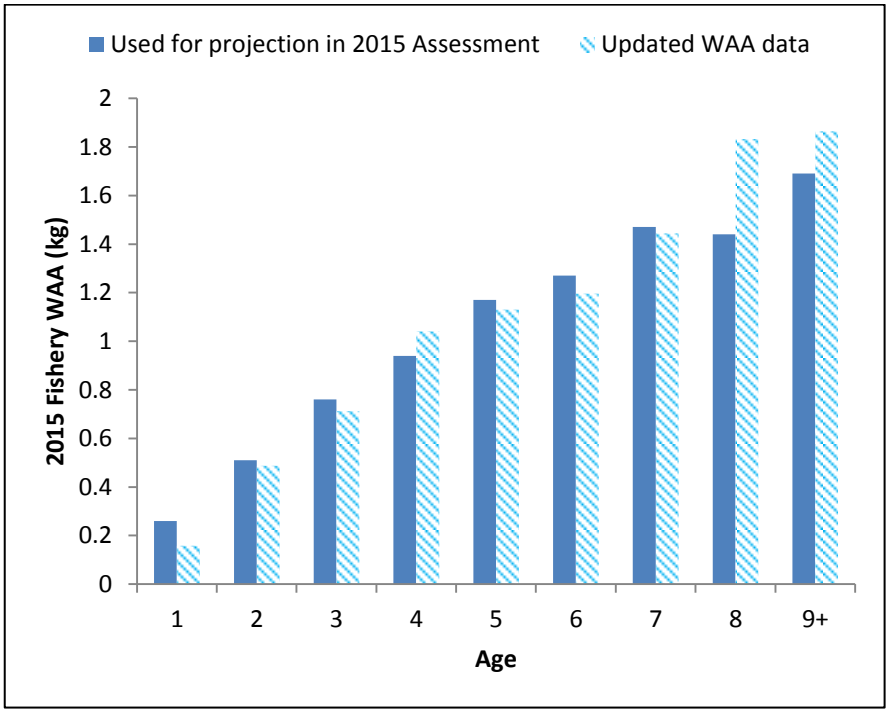

Figure 3. Comparison of fishery weight-at-age projection inputs from the 2015 VPA and updated WAA based on 2015 catch data.

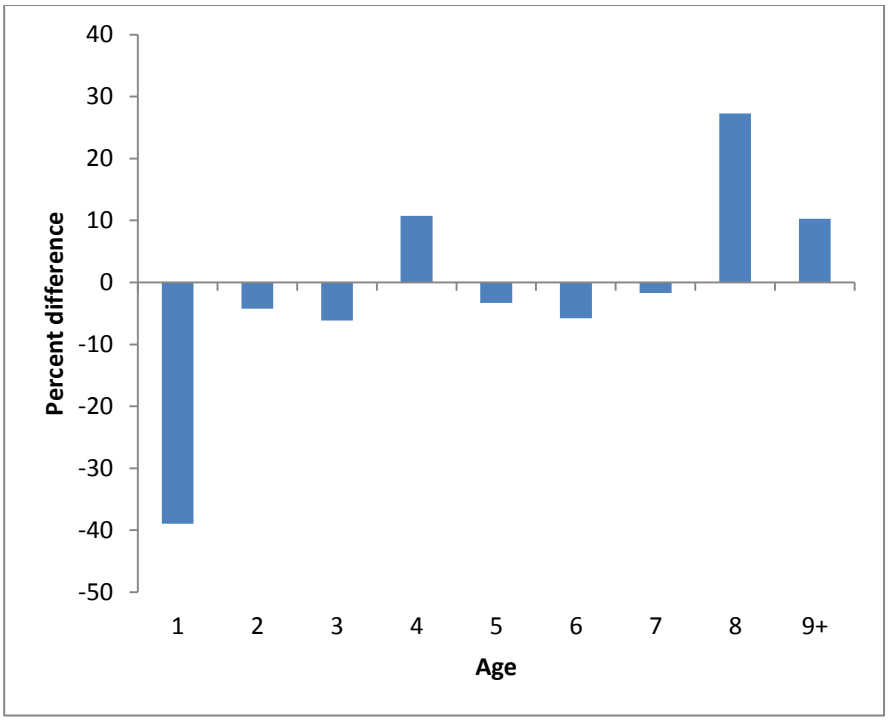

Figure 4. Percent differences of fishery weight-at-age for projection inputs from the 2015 VPA and updated 2015 catch data. Percent differences were calculated using '(Measured in 2015 - Estimated in 2015 assessment)/ (Estimated in 2015 assessment) x 100.

VPA Inputs, Estimates, and Performance

A VPA was run with catch data through 2015, the 2015 NMFS Fall survey data, and 2015/2016 NMFS and DFO Spring survey data. The VPA estimates obtained were used to compare with a variety of metrics from the assessment conducted in 2015 (TRAC 2015/02). To distinguish these two VPAs in the text that follows, we refer to the models as "updated VPA" and "2015 VPA", for the assessment with data updated through 2015 and the TRAC 2015 assessment, respectively.

Catch-At-Age (CAA)

The 2010 year class (Age 5) made up a majority of the catch in 2015 for both the projected 2015 catch (from the 2015 VPA) and the updated VPA. It was projected that Age 5 would contribute 81% to the 2015 total catch in numbers, but the updated VPA estimated that it only contributed 62% (Figures 5 and 6). Catch-at-ages 3 and 4 contributed more than projected for 2015 catch, and this is reflected in the slightly higher estimate of partial recruitment at these ages (Figure 10).

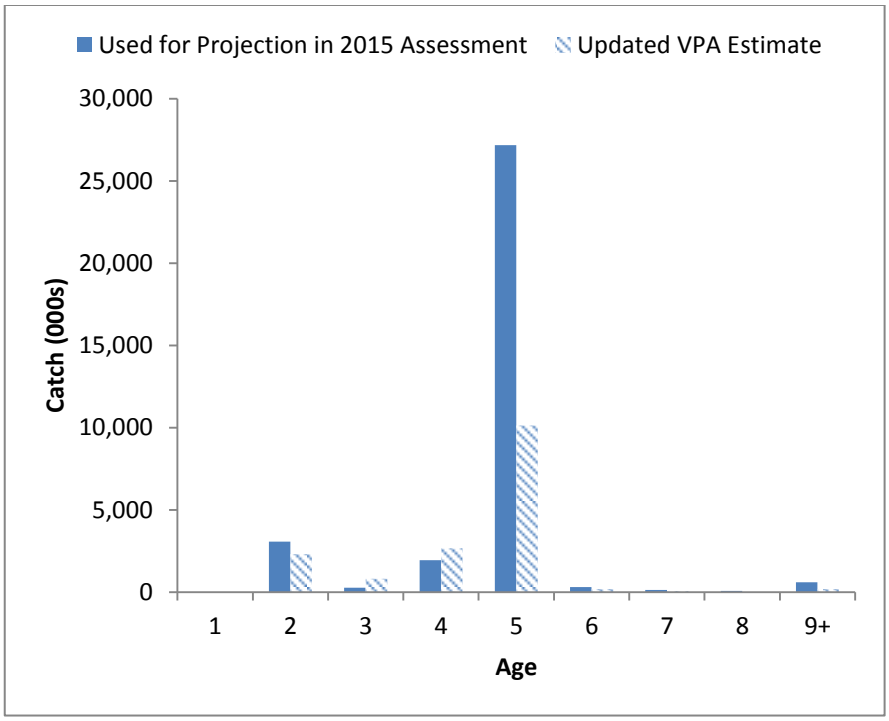

Figure 5. Comparison of catch-at-age for projection inputs from the 2015 VPA assessment and the estimated 2015 catch-at-age in the updated VPA.

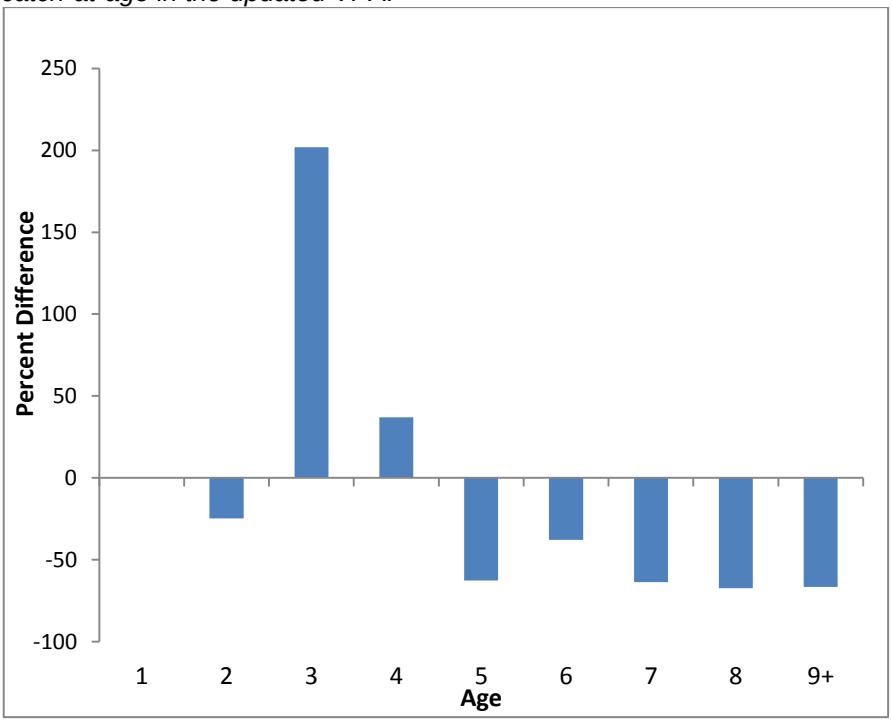

Figure 6. Percent differences of catch-at-age for projection inputs from the 2015 VPA assessment and the estimated 2015 catch-at-age in the updated VPA. Percent differences were calculated using '(Measured in 2015 - Estimated in 2015 assessment)/ (Estimated in 2015 assessment) x 100.

Numbers-at-age (NAA)

The estimated population numbers-at-age from the 2015 VPA assessment were compared to the 2015 NAA from the updated VPA model run (Figure 7). Overall, the contribution of each age class remains similar; however, the updated NAA for the 2013 year class (age 2) is estimated to be 10% lower.

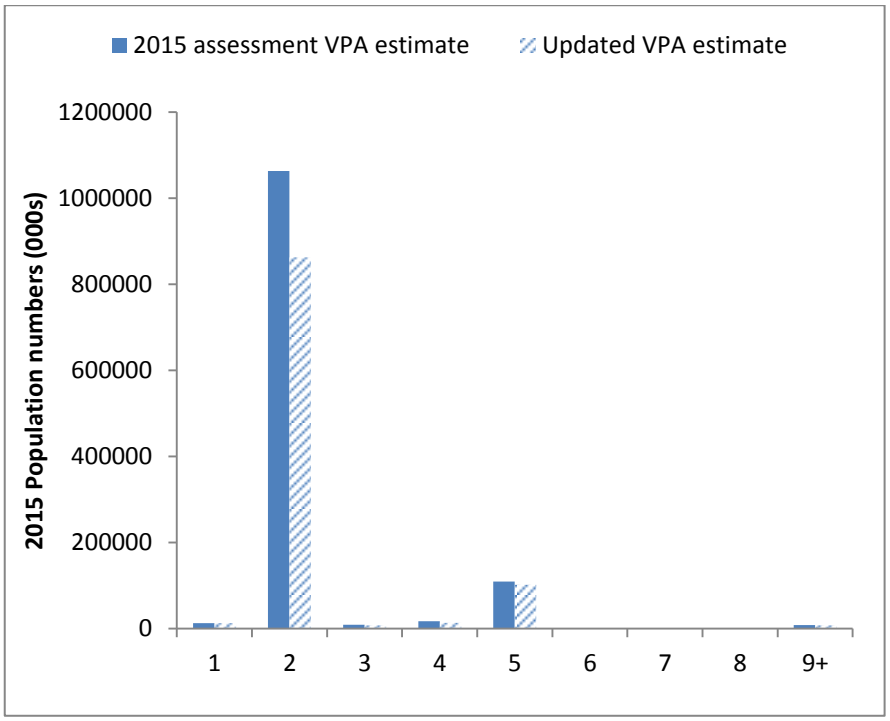

Figure 7. Comparison of 2015 population numbers-at-age from the 2015 VPA and updated VPA model runs.

The population numbers-at-age that were projected for 2016 in the 2015 assessment were compared to the updated VPA model run (Figure 8). Overall the contribution of each age class remains similar; however, the updated NAA for the 2013 year class (Age 3) is estimated to be 9% lower.

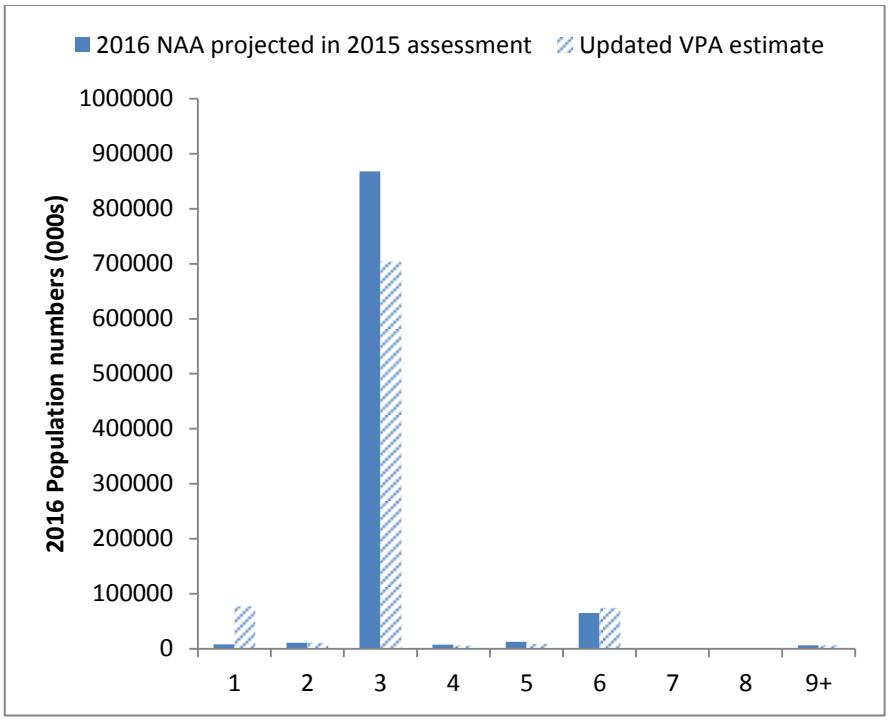

Figure 8. Comparison of 2016 population numbers-at-age from the 2015 VPA assessment projection and updated VPA model run. Age 1 for the 2016 NAA, projected in the 2015 VPA, is an assigned value (8,150).

Biomass at Age

The updated VPA estimated the 2016 3+ population biomass (biased adjusted) to be 344,426 mt, 25% less than the 455,806 mt projected in the 2015 VPA assessment. Of importance is the overestimate of the 2013 year class (Age 3 in 2016) and the underestimate of the 2010 year class (Age 6 in 2016; Figure 9). The overestimate of projected 2016 biomass is the combined result of age 3 and age 6 survey WAA being overestimated (~ 20% and 7%, respectively), while age 6 numbers at age were underestimated (~13%) and age 3 numbers were overestimated (~23%).

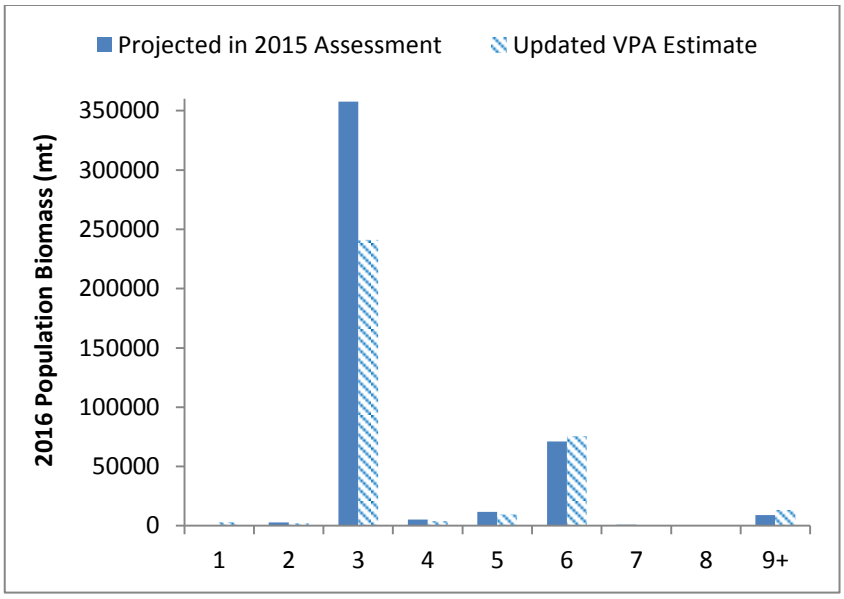

Figure 9. Comparison of 2016 population biomass at age from the 2015 VPA assessment projection results and the updated VPA assessment.

Partial Recruitment

The 2015 partial recruitment pattern assumed for the 2015 VPA assessment projections and estimated in the updated VPA were quite similar (Figure 10).

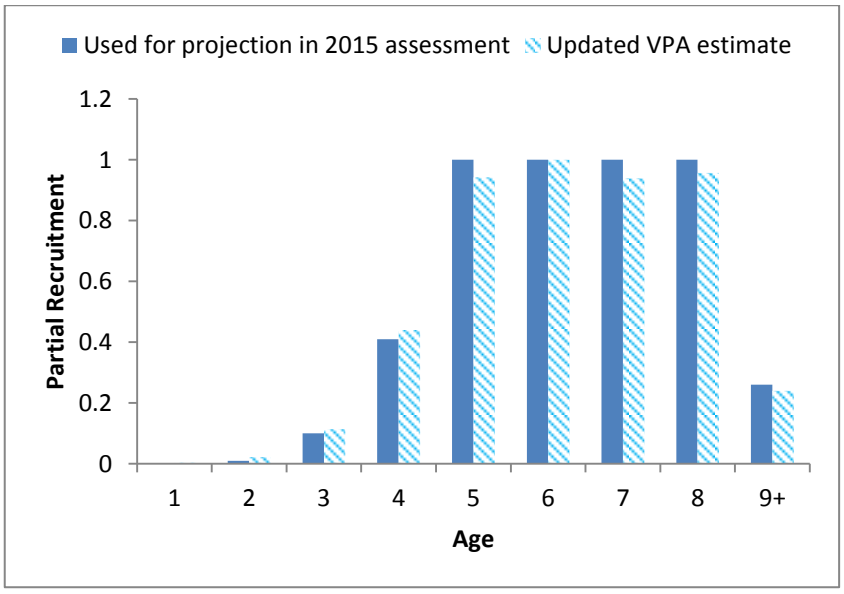

Figure 10. Comparison of partial recruitment that was assumed in the 2015 VPA assessment projections and the estimated PR from the updated VPA. Blue columns are PR values using the 10 year weighted average from 2005 to 2014 from the 2015 VPA assessment. Hatched columns are PR values using the 10 year weighted average from 2006 to 2015 if a full VPA run would have been conducted.

Fishing Mortality at Age (FAA)

The 2015 FAA estimated in the updated VPA was lower than the projected values from the 2015 assessment (Figure 11). The updated VPA estimate for the age 5 to 8 population weighted average F was 0.11 for 2015. The projection had been made with F_{ref}=0.26. Only 44% of the total quota was caught, so it is not surprising that the estimated F is less than the F that was assumed for the projection.

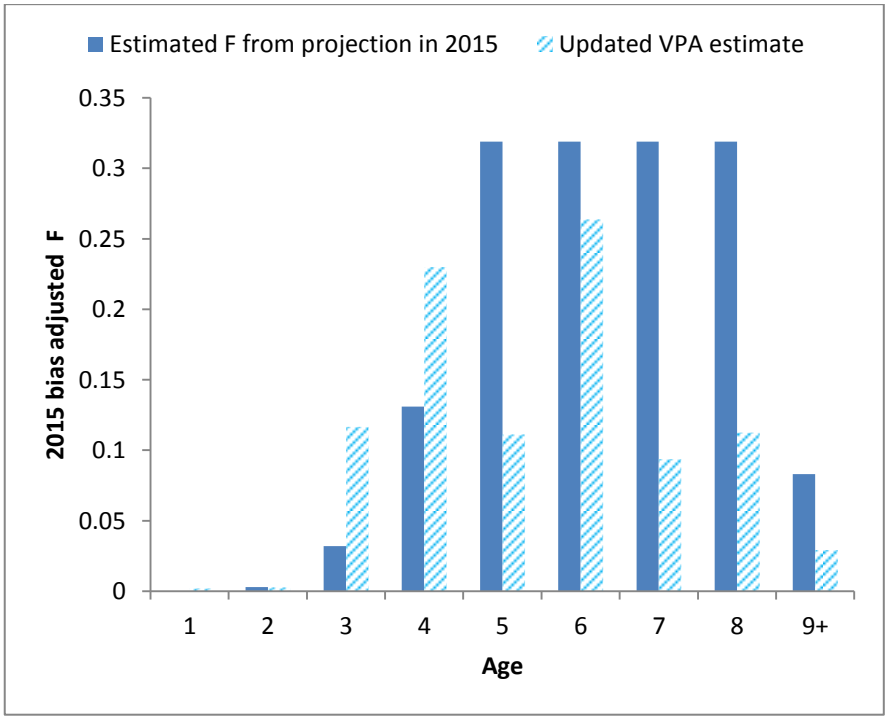

Figure 11. Comparison of fishing mortality (F) at age that was assumed in the 2015 VPA projections (F_{ref}=0.26) and the estimated F at age from the updated VPA.

Retrospective pattern and Mohn's rho

A retrospective analysis was conducted on the 2015 VPA assessment for the 2008-2015 time series to detect any trends that consistently overestimate or underestimate age 3-8 biomass, age 5-8 population number weighted average fishing mortality, and age 1 recruitment relative to the terminal year estimates. The same analyses were completed for the 2009-2016 time series in the update VPA (Figure 12). The bias observed in previous assessments is present in the updated VPA as well. Retrospective analyses show lower biomass, higher F, and lower recruitment for several years of the analysis, consistent with previous assessments.

Estimates of the relative change in age 3-8 biomass, age 5-8 F and age 1 recruits (Figure 12) were used to calculate Mohn's rho values for the 2009-2016 time series, and those rho values were compared to the 2008-2015 time series (2015 assessment; Table 1). The updated age 3-8 biomass rho and percent adjustment were similar to the 2015 assessment values (Table 1).

The retrospective adjustment (denoted rho adjustment) based on the observed retrospective bias was applied to the terminal year estimates for comparisons of status determination following the methodology in Legault et al. (2010). For the updated sensitivity projection (2009-2016 time series), the age 3-8 biomass rho of 0.682 was used to adjust age specific stock abundance (for all

ages) at the start of 2016, which in turn was used to calculate 3+ biomass at the beginning of 2016.

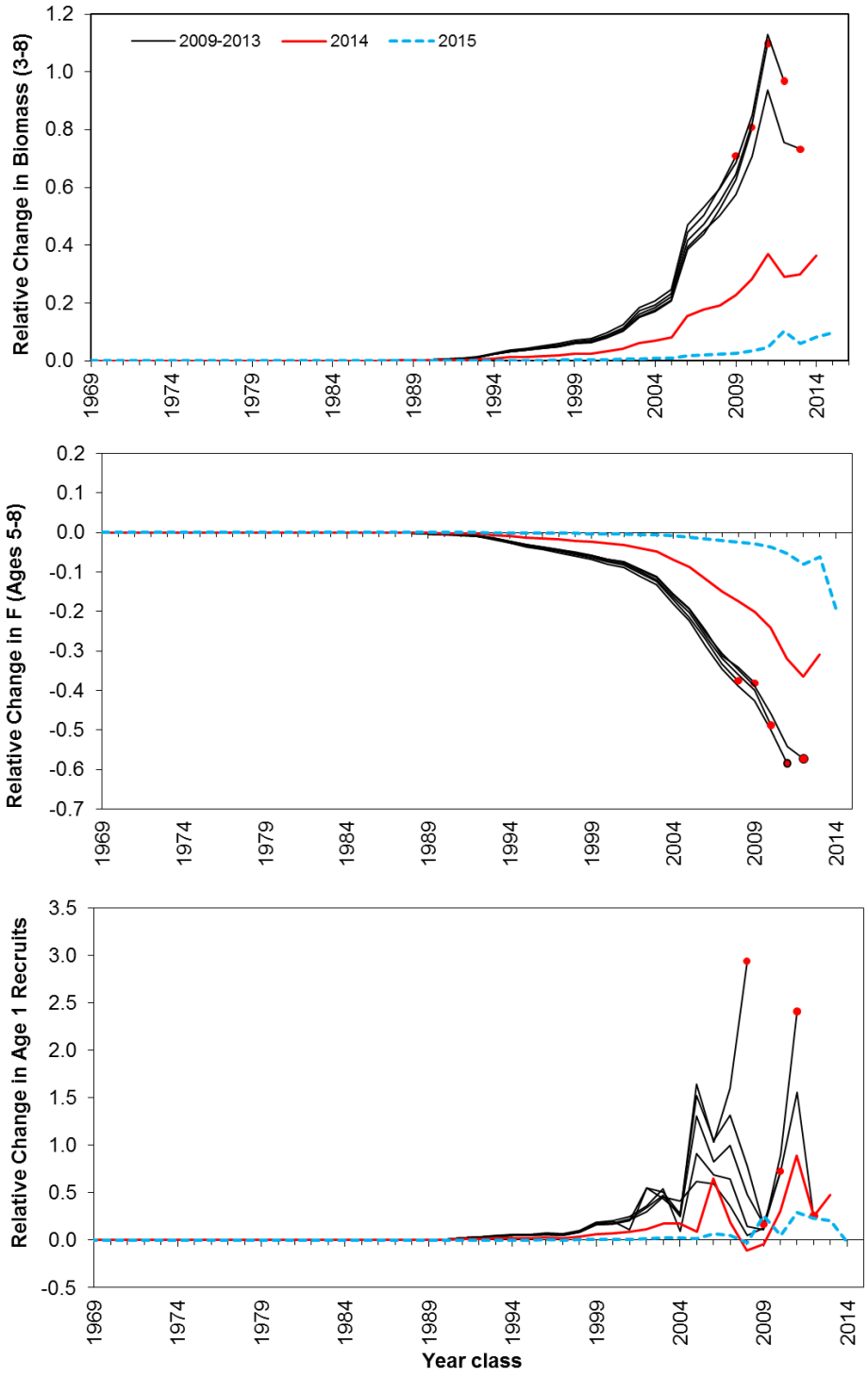

Figure 12. Relative retrospective results from the updated VPA for EGB haddock for biomass (ages 3-8), fishing mortality, (ages 5-8) and recruitment (age 1), as successive years of data are removed from the assessment. Changes are relative to the updated VPA model run.

Table 1. Calculated values of rho and percent adjustment for retrospective analysis for the 2015 VPA (left) and updated VPA (right) of.

	2015 assessment				Updated 2016 rho			
Peel		Age 1 Recruits	Age 3-8 Biomass	Age 5-8 F	Peel		Age 1 Recruits	Age 3-8 Biomass	Age 5-8 F
	1	0.212176	0.259844	-0.33828		1	-0.01768	0.097053	-0.19662
	2	0.024397	0.635385	-0.52487		2	0.473366	0.362902	-0.30847
	3	1.633772	0.787811	-0.55826		3	0.259612	0.732731	-0.57286
	4	0.637191	1.008665	-0.46865		4	2.408929	0.968705	-0.58436
	5	-0.06977	0.747664	-0.36216		5	0.726336	1.098849	-0.48828
	6	3.052361	0.664057	-0.3596		6	0.165968	0.807758	-0.38082
	7	1.971094	0.699258	-0.26101		7	2.937157	0.708965	-0.37534
Mohn's Rho		1.065888	0.686098	-0.4104	Mohn's Rho		0.993383	0.682423	-0.41525
% Adjustment		0.483092	**0.591716**	1.694915	% Adjustment		0.50166	**0.594381**	1.710136

Projections and Risk

Projection Inputs

The new projection inputs used for comparison with the 2015 VPA Assessment (TRAC 2015/02, Table 27) report can be found in Table 2.

Table 2. Inputs for projections and risk analyses of eastern Georges Bank haddock from the updated VPA in 2016. A catch of 37,000 mt in 2016 and natural mortality = 0.2 were assumed. The 2013 year class weights are highlighted.

	Age group								
Year	1	2	3	4	5	6	7	8	9+
Population Numbers (000s)									
2016	77410	10736	704022	5462	8615	74102	508	427	6293
2017	11376	63327	8738	558849	3968	5461	46253	322	5097
2018	11376	9307	51552	6945	407980	2542	3448	29665	4127
Partial Recruitment to the Fishery[1]									
2016-2018	0.003	0.022	0.114	0.441	0.943	1.000	0.939	0.957	0.240
Weight at beginning of year for population (kg)[2]									
2016[3]	0.04	0.18	0.34[4]	0.70	1.12	1.02	1.24	1.15[6]	2.11
2017	0.06	0.23	0.43	0.65[4]	0.95	1.11	1.22	1.15	1.59
2018	0.06	0.23	0.43	0.68	0.81[4]	1.11	1.22	1.15	1.59
2019	0.06	0.23	0.43	0.68	0.95	1.02[4]	1.22	1.15	1.59
Weight at age for catch (kg)[5]									
2016-2018	0.16	0.49	0.73	0.94	1.13	1.21	1.44	1.44	1.69
Maturity									
2015-2017	0	0	1	1	1	1	1	1	1

[1]Based on 2006 to 2015 weighted average; used for 2016 2017 and 2018.

[2]2014-2016 average weights at age from the DFO survey unless indicated otherwise.
[3]2016 average weights at age from DFO survey.
[4]2010 year class average weights at age from DFO survey used for 2013 year class.
[5]Lowest values in the time series (1969-2015); used for 2016, 2017 and 2018.

Fisheries Weights-At-Age

The lowest fisheries WAA values in the time series (1969-2014) were used in the 2015 assessment for projection. The updated projection values include the 2015 calculated fisheries WAA. Due to the continued declining trend in WAA, many of the fisheries WAA in 2015 were the lowest in the time series. Consequently, the weights-at-age used in the 2015 VPA assessment projection for 2016-2018 were greater than if the projection had been re-run in the update year (Figure 13).

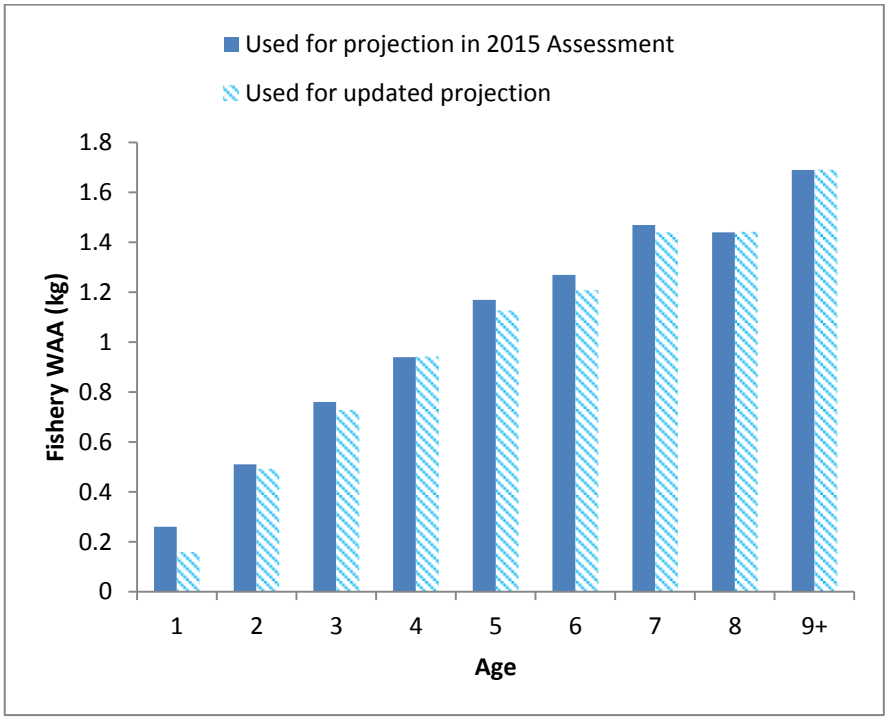

Figure13. Comparison of fishery weight-at-age for projection inputs from the 2015 VPA assessment (1969-2014) and updated VPA (including 2015 data) projection inputs.

Projection Results

Projected Biomass

Using the inputs in Table 2, biomass was re-projected for 2017. The updated projection estimated the 2017 3+ population biomass to be 440,479 mt, 16% less than the 521,978 mt projected from the 2015 assessment. Of importance is the overestimate of the 2013 year class (age 4 in 2017) and the underestimate of the 2010 year class (age 7 in 2017).

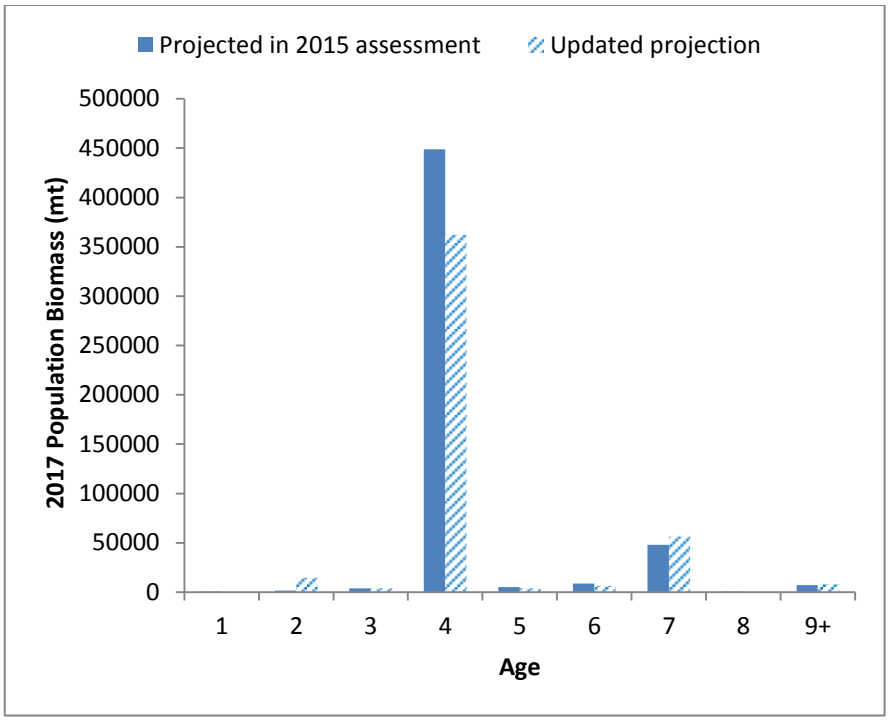

Figure 14. Comparison of 2017 population biomass at age from the 2015 VPA assessment projection results and updated VPA projection results.

Risk Analyses

In 2016, the Transboundary Resources Assessment Committee (TRAC) recommended a 2017 catch at neutral risk (50%), with a range of 45,000 mt (rho adjusted) to 81,000 mt (Table 3, Figure 15) (TRAC 2016/02). The updated risk analyses resulted in a decrease to the neutral range catch recommendation, 39,000 mt (rho adjusted) to 71,000 mt (Table 3, Figure 15). The quota for 2017 was set at 50,000 mt, within the neutral range for both the 2015 assessment risk analyses and the updated stochastic projections.

Table 3. The levels of catch projected in 2015 and 2016 for which there is a 12.5%, 25%, 50% and 75% percent risk of the fishing mortality in 2017 exceeding F_{ref} = 0.26 for both the standard and the rho adjusted projections. Catches in 2017 at each risk level are conditional on $F=F_{ref}=0.26$ in 2016. Evaluation year indicates whether the analysis came from the 2015 VPA or the updated VPA.

Probability of exceeding F_{ref}	Evaluation Year	12.50%	25%	50%	75%
2017 catch	2015	58,000 mt	66,000 mt	81,000 mt	97,000 mt
2017 catch	2016	54,000 mt	61,000 mt	71,000 mt	85,000 mt
2017 catch (rho adjusted)	2015	32,000 mt	37,000 mt	45,000 mt	55,000 mt
2017 catch (rho adjusted)	2016	29,000 mt	33,000 mt	39,000 mt	46,000 mt

Survey Index

The TRAC Status Report (2016/02) utilized an average of the three surveys (2015 NMFS fall, 2016 DFO, and 2016 NMFS spring) as an index of biomass for the start of the 2016 calendar year. An average was used in order to smooth inter-survey variation whilst still providing information on incoming year-classes. The average survey biomass for January 2016 (334,866

mt) was approximately 25% lower than that predicted by the 2015 VPA assessment (446,877 mt, ages 3-8), however, the average survey biomass was very similar to that estimated by the updated VPA (331,175 mt, ages 3-8). This appears to suggest that the average survey biomass is a good model-free estimate of population biomass. However, if a Mohn's rho adjustment was applied to the 2015 VPA, the projected 2016 biomass from a rho 59% adjustment was 251,516 mt, which would be 26% less compared to the surveys, even with an assumption of overestimated WAA of the 2013 year class.

Discussion

In light of the comparisons reviewed in this document (Table 5), all of the indicators in Table 4, which summarized reasons to maintain or reduce catch advice, are still valid. This document highlights the continued challenges with the decreasing trend in WAA for this stock and the observed retrospective pattern causing an overestimated biomass and underestimated F.

Table 4. Indicators derived from the 2015 NMFS fall, 2016 DFO, and 2016 NMFS spring surveys either supporting the catch advice from the 2015 VPA assessment or supporting a reduction in the advice to a lower risk level. (Reprinted from Table 3 in TSR 2016-02).

Maintain Existing Catch Advice	Reduce Catch Advice
In 2016, DFO and NMFS spring survey indices of abundance for 2013 year-class are at the highest levels observed for the time series.	Average biomass from the surveys was 27% lower than the biomass predicted in the VPA for 2016.
VPA estimated adult biomass in 2015 is the highest in the time series.	Recent quotas selected for neutral risk have not been fully caught, yet $F>F_{ref}$ (2010-2012). Risk is being underestimated and catch is being overestimated.
Less than half of the 2015 quota was caught.	A retrospective pattern has been observed in the 2015 TRAC haddock assessment. The pattern leads to overestimated biomass and underestimated F.
2015 NMFS fall and 2016 DFO survey total biomass indices are at the highest level observed for the time series.	

Declining WAA

Current methods for WAA inputs base the 2013 year class WAA on the 2010 year class for survey WAA and the minimum time-series value for fishery WAA, however, information from the updated survey and fishery indicates that haddock WAA has changed in the last decade. Therefore, the continued decline in WAA was not captured sufficiently by taking the minimum time-series value or assuming similar growth rates among strong year classes. This suggests that there is a requirement to adjust large year classes differently in the future. Several alternatives were put forth by the authors for consideration, they include:

1. Use current weight differences to adjust model and projection input WAA. For example, the 2010 year class, future weights for projections could assume that the trajectory for ages > 6 continues to be 7% or 5% lower for beginning of year and fishery weights at age, respectively. For the 2013 year class, future weights for projections could assume that that the 20% and 8% lower trajectory continues for older ages. Alternatively, as growth in length

slows, one may expect that the difference of 20% from previous time series does not persist at that same rate.

2. Use a regression analysis to estimate the WAA for the strong year classes to use for future projections. Although WAA were close between the most recent 3 strong year classes at young ages (<2), older ages (>3) differ with survey WAA (Figure 15B). A linear regression was fit to WAA of ages 1-4 of the 2010 year class (Figure 15A). Predicted WAA (red circles) from the regression for the 2010 year class were consistent with the measured values (red diamonds) for ages 5-6. If this same approach is applied to the 2013 year class, the weight at ages 5-6 could be projected, which are smaller than the time series low values (orange circles). Considering fish growth rate slows down after age 6(Figure 15B), and the 2010 year class at age 7 was smaller than weight at age 6, using the predicted value from the regression would be limited up to age 6. For age 7, we would suggest to use the same weight as age 6.

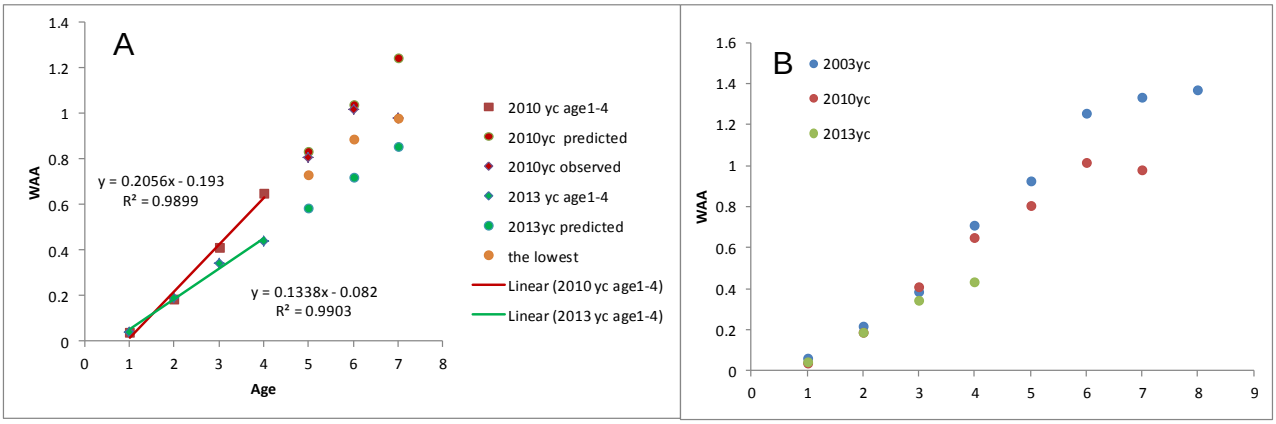

Figure 15. A regression of survey weights-at-age (A) and scatter plot (B) for strong year classes (2003, 2010 and 2013). A linear regression was fit to the measured data for Ages 1 to 4 to predict future WAA(A).

Retrospective Pattern and Biomass Overestimate

The continued retrospective pattern leads to optimistic projections. If the entire quota was caught and the retrospective pattern continues it is possible that an update year may result in higher F than anticipated. The authors discussed, but did not reach consensus on methods to deal with this challenge. The suggestions include:

1. Rho adjusted to form the basis for catch advice.

   For: Current VPA estimates and projections are an overestimate.

   Against: When compared to the survey index the Mohn's rho adjusted 2016 biomass was 26% less, even with an assumption of overestimated WAA of the 2013 year class. This suggests that the rho adjusted estimates are likely to be an underestimate; however, it is still important to include rho adjustment as a sensitivity run.

2. Using updated survey and fishery information, and incorporating the possible changes of WAA, especially the strong year classes, into the projections for the interim year reports. If beginning of year WAA was available in an update year it could be used to re-calculate

population biomass (projected NAA multiplied by updated beginning of year WAA; Figure 16). Additionally, if fisheries WAA was available then the projected catch biomass could be updated.

For: The fishery WAA is an important component during the interim year. Even if it is available late it is still very useful.

Against: The interim report was intended to reduce work load during a time when the stock was doing well. This would result in a similar workload to completing the entire assessment. This method only addresses the portion of the overestimate caused by the underestimate in WAA, not the overestimate of NAA.

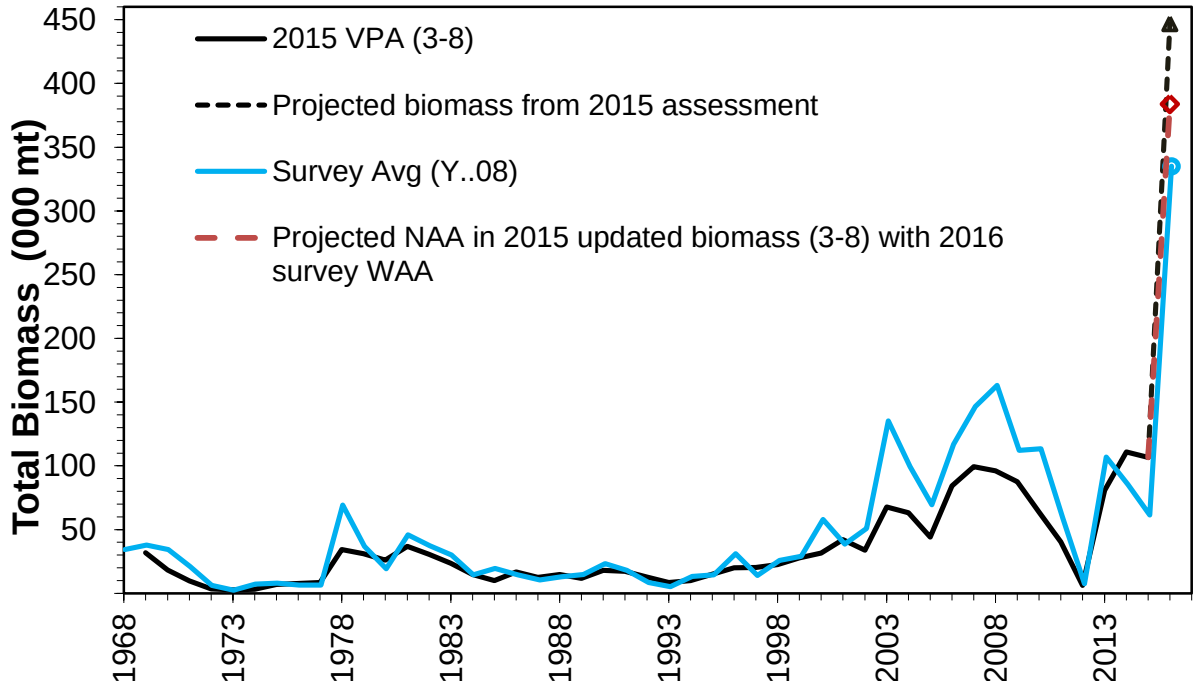

Figure 16. The 1969 to 2016 eastern Georges Bank adult haddock (ages 3-8) biomass from VPA compared with the average of the NMFS spring and DFO (age 3-8) and NMFS fall (age 2-7) survey biomass (scaled with catchability, q). Weight for age 8 in 2016 was derived by taking the average of weights in years 2013-2015; if instead the average of age 7 and age 9 was used, biomass would increase by 16 mt in 2016. The haddock VPA does not estimate q for fall ages 6 and 7, so the value was assumed equal to NMFS fall age 5 q (i.e., catchability asymptotes). If catchability declines at ages 6 and 7, rather than reaching an asymptote at these ages, then the calculated fall biomass would be an underestimate. However, even if the fall q at ages 6 and 7 was 10% of the q at age 5 (very sharply domed), the resulting biomass in 2016 would only increase from 334,966 mt to 336,613 mt, which is far below the projected biomass of 446,877 mt. The red diamond symbol represents the updated biomass; the projected 2016 NAA (from 2015 VPA) multiplied by the 2016 DFO survey WAA.

Conclusions and Recommendations

- The calculated range is lower for projected catch at neutral risk, from 45,000 to 81,000 mt in the interim report (2015 VPA projections) compared to 39,000 to 71,000 mt calculated from the 2015 VPA projections. The quota agreed upon at TMGC 2016 still falls within this range.

- The driver of these differences were from the overestimate of WAA for large year classes (both beginning of year and fishery weights at age) and the retrospective pattern

- The average survey index was a good indicator of 3+ biomass.

- Discussion around the continuation of the interim report and any additional indicators that should be included in future years will be discussed at the upcoming TRAC meeting.

Table 5. Summary of comparisons for metrics assessed.

Metric for 2015	**Used/Available for Interim Report**	**Used/Available for VPA**	**Projected vs Estimated value**
Partial recruitment	No (requires running VPA)	Yes	Similar result
Beginning year WAA	Yes	Yes	Projection underestimated ages 5, 7 and 9+; overestimated ages 1, 2, 3, and 6
Fisheries WAA	No (requires computing landings and discards at age)	Yes	Projection underestimated ages 4, 8 and 9+; overestimated ages 1, 2, 3, and 5-7
Total Catch	Yes	Yes	44% of quota caught in 2015
CAA	No (requires running VPA)	Yes	Projection underestimated ages 3 and 4; overestimated ages 2 and 5-9+
FAA	No (requires running VPA)	Yes	Projection overestimated ages 5-9+ (assumed full quota could be caught)
NAA	No (requires running VPA)	Yes	2013 year class overestimated in 2015 assessment
Mohn's rho	No (requires running VPA)	Yes	Similar bias between 2015 VPA and updated VPA
Projected Biomass	No (requires running VPA)	Yes	3+ population biomass 25% less than projected

			in assessment
Risk Analyses	No (the 2016 update used risk plots from the 2015 assessment, no new information was incorporated)	Yes	Values lower than projected in 2015 assessment but quota set for 2017 still within the neutral risk range
Average Survey Biomass	Yes	Yes, could be calculated, but typically report VPA estimates of biomass instead	Similar result (27% compared to 25%)

Literature Cited

Stone H.H., E.N. Brooks, D. Busawon, and Y. Wang. 2015. Assessment of Haddock on Eastern Georges Bank for 2015. TRAC Ref. Doc 2015/02.

TRAC. 2016. Eastern Georges Bank Haddock Status Update. TRAC Status Report 2016/02.