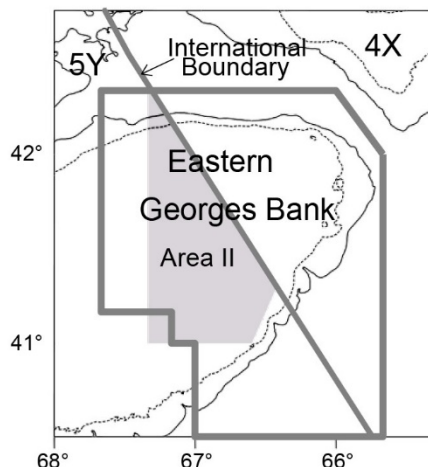




EASTERN GEORGES BANK HADDOCK UPDATE

[5Zjm; 551,552,561,562]



Summary

- Combined Canada and United States of America (USA) catches were 16,577 mt in 2015.
- The 2015 National Marine Fisheries Service (NMFS) fall and 2016 Fisheries and Oceans Canada (DFO) survey total biomass indices are the highest values for their respective time series, while the 2016 NMFS spring value is the third highest value in the time series (1968-2016).
- The average survey adult biomass (as of January 2016) is 27% lower than the biomass predicted by the Virtual Population Analysis (VPA).
- The measured weights at age from the DFO survey continue to exhibit a declining trend since 2000, especially for ages 3 to 6.
- The beginning of year weights-at-age used in projecting the 2016 biomass were comparable with the 2016 DFO survey weights-at-age, but did under-estimate the weight of fish aged 5 and 9+. Considering the 2010 and 2013 year-classes are expected to contribute 46% and 41% of the catch biomass, an under-estimation of the weight of age 5 (2011 year-class) and 9+ fish would have little effect on the projected 2016 biomass.
- In 2015, the Transboundary Management Guidance Committee (TMGC) agreed on a quota of 37,000 mt for 2016. Based on the information presented, Transboundary Resources Assessment Committee (TRAC) continues to recommend catch at neutral risk (45,000-81,000 mt).

Context

Since 1998, the Transboundary Resources Assessment Committee (TRAC) has reviewed Eastern Georges Bank Haddock stock assessments and projections necessary to support management activities for shared resources across the United States of America (USA)-Canada international Hague Line in the Gulf of Maine-Georges Bank region. These assessments have been conducted annually to advise the Transboundary Management Guidance Committee (TMGC) about the status of the resource and likely consequences of policy choices.

Eastern Georges Bank Haddock is a stock that has increased tremendously from a very low state in the 1990s, and is showing improved recruitment with the production of 5 strong year-classes in the last 13 years. In the most recent stock assessment (TRAC 2015) adult biomass at the beginning of 2015 was estimated to be the second highest in the time series. Because the stock was perceived to be doing well, it was proposed in 2014 by TRAC and TMGC that the assessments would move to a 2-year cycle with an interim report produced in the intervening year.

In 2015, the Terms of Reference for the TRAC haddock assessment included the request for 2 years of catch advice (2016 and 2017) corresponding to low (25%), neutral (50%), and high (75%) probability that the fishing mortality (F) would exceed the reference level ($F_{ref} = 0.26$). In 2016, the TRAC was tasked with preparing an interim report for Eastern Georges Bank Haddock focusing on selected indicators of stock status to ensure that the 2016 advice from the 2015 assessment was still appropriate and, if not, to revise the advice.

Fishery

Combined catches for USA and Canada increased from 14,243 mt in 2014 to 16,577 mt in 2015, against a quota of 37,000 mt (Table 1). **Canadian catches** increased to 14,631 mt in 2015, with 25 mt of discards from the scallop fishery and negligible discards from the groundfish fishery. 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 is a low quota.

USA catches also increased from 1,182 mt in 2014 to 1,921 mt in 2015 (USA calendar year), with 415 mt of discards estimated from the otter trawl and scallop dredge fisheries. As in other years, otter trawl gear accounted for nearly all of USA 2015 landings. USA catch in fishing year 2015 was 6.2% of its 17.8 mt quota.

Table 1. Catches and Biomass (thousands mt) of haddock; recruits are in millions.

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Avg ¹	Min ¹	Max ¹
Canada ²	Quota	14.5	12.7	15.0	18.9	17.6	12.5	9.1	6.4	16.5	19.2				
	Landed	12.0	11.9	14.8	17.6	16.6	11.2	5.0	4.6	13	14.6		6.0	0.5	17.6
	Discard	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0		0.1	<0.1	0.2
USA ²	Quota ³	7.5	6.3	8.1	11.1	12.0	9.5	6.9	4.0	10.5	17.8				
	Catch ³	0.7	0.3	1.6	1.6	1.8	1.1	0.4	0.6	1.5	1.1				
	Landed	0.3	0.3	1.1	2.2	2.2	1.3	0.4	0.3	1.2	1.5		2.0	<0.1	9.1
	Discard	0.3	0.3	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.4		0.5	0.0	7.6
Total ²	Quota ³	22.0	19.0	23.0	30.0	29.6	22.0	16.0	10.4	27.0	37.0	37.0			
	Catch ^{4,5}	12.7	12.3	16.5	19.2	18.4	12.3	5.5	5.2	14.5	15.7				
	Catch	12.6	12.5	16.0	19.9	18.8	12.7	5.6	5.1	14.2	16.6		8.5	2.1	23.3
Adult Biomass (Jan 1 st)		88.8	104.2	101.0	102.0	74.3	47.5	29.9	99.5	125.7	117.0	455.8	46.9	4.9 ¹	125.7 ¹
Age 1 Recruits		9.8	3.6	4.8	3.1	5.4	274.7	33.9	14.5	1300.0	12.9		45.6	0.2 ¹	1,300 ¹
Fishing Mortality ⁶		0.35	0.20	0.13	0.22	0.31	0.33	0.37	0.22	0.23			0.31	0.10	0.57
Exploitation Rate ⁶		27%	16%	11%	18%	24%	26%	28%	18%	19%			24%	9%	40%

¹1969 – 2015²unless otherwise noted, all values reported are for calendar year³for fishing year from May 1st – April 30th⁴for Canadian calendar year and USA fishing year May 1st – April 30th⁵sum of Canadian landed, Canadian discard, and USA catch (includes discards)⁶ages 5-8 for 2003 – 2014; from the 2015 assessment

Indicators and Recommendations

The 2015 National Marine Fisheries Service (NMFS) fall and 2016 DFO survey total biomass indices are the highest values for their respective time series, with the 2016 NMFS spring value being the third highest of its time series from 1968-2016 (Figure 1).

The bias adjusted **adult biomass** from the 2015 haddock assessment was projected to increase from 117,019 mt in 2015 to 455,806 mt in 2016 (Table 1), assuming the 2015 quota of 37,000 mt was caught. The survey catchability (q) adjusted **survey biomass** showed an increase in the recent spring (2016) and fall (2015) surveys. In order to smooth inter-survey variation whilst still providing information on incoming year-classes, the three surveys (2015 NMFS fall, 2016 DFO, and 2016 NMFS spring) were averaged to give an estimate that could be considered close to that of the start of the calendar year (Figure 2). The average survey biomass for January 2016 is approximately 27% lower than that predicted by the virtual population analysis (VPA) model in the 2015 haddock assessment (334,966 mt, Figure 2)

Consistent with the trend reported in 2015, the measured **weights-at-age** (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 were comparable with the 2016 DFO survey WAA for many ages, but did under-estimate the weight of fish aged 5 (2011 year-class) and fish aged 9+ (Table 2). Considering the 2010 and 2013 year-classes are expected to contribute 46% and 41% of the catch biomass, respectively, an under-estimation of the weight of aged 5 (2011 year-class) and aged 9+ fish would have little effect on the projected 2016 biomass.

Quotas for catch years 2010-2012 were set using a neutral risk of exceeding $F_{ref}=0.26$, yet resulted in estimates of **fishing mortality** (F) that exceeded F_{ref} in these years despite the fact

that 35%-65% of quotas were caught. In 2013 and 2014, neutral and low risk quotas were adopted by TMGC and only about half of the quotas were landed. The estimated F for these years was 0.22 and 0.23, respectively, which is close to F_{ref} despite not achieving quotas and selecting low risk quota in 2014. In 2015, a neutral risk quota of 37,000 mt was adopted by TMGC and only about 45% of the quota was landed (Table 1). This trend of positive bias in the projected quota, and underestimated risk of exceeding F_{ref} is a consequence of the retrospective pattern which has emerged and increased in the last two assessments.

Table 2. Average weights-at-age (kg) of Eastern Georges Bank haddock used in the 2015 TRAC haddock assessment projection (for 2016) and observed 2016 DFO surveys average weights-at-age (kg). These weights are used to represent beginning of year population weights. Weights for 9+ are population weighted averages.

Year	Age Group								
	1	2	3	4	5	6	7	8	9+
2015 Projection	0.07	0.26	0.41	0.72	0.94	1.09	1.17	1.15	1.38
2016 Observed	0.04	0.18	0.34	0.70	1.12	1.02	1.24	1.15 ¹	2.11

¹Weight 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.

Conclusions

In 2015, the TMGC agreed on a quota of 37,000 mt for 2016. Based on the information presented, TRAC continues to **recommend catch** at neutral risk (45,000-81,000 mt, Tables 3 and 4). The TRAC acknowledges that there are several reasons for considering both the standard projection and the sensitivity projection (rho adjusted) for catch advice. Given this, the TRAC has agreed to provide both projections for TMGC consideration. If the retrospective pattern continues and the total quota is caught then there is a greater potential of exceeding F_{ref} .

Special Considerations

The 2016 NMFS spring survey was delayed by about a month. Spatial distribution maps were not examined for haddock on eastern Georges Bank in this interim report because it is not obvious how that could be used to interpret the appropriateness of catch projections made in 2015.

Table 3. Indicators derived from the 2015 NMFS fall, 2016 DFO, and 2016 NMFS spring surveys either supporting the catch advice from the 2015 assessment or supporting a reduction in the advice to a lower risk level.

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.
The 2015 NMFS fall and 2016 DFO survey total biomass indices are at the highest level observed for the time series.	

Table 4. The levels of catch projected in 2015 for which there is a 12.5%, 25%, 50% and 75% percent risk of the fishing mortality in 2016 and 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.

Probability of Exceeding F_{ref}	12.5%	25%	50%	75%
2016 Catch	29,000 mt	32,000 mt	37,500 mt	43,500 mt
2016 Catch (rho adjusted)	14,000 mt	16,000 mt	19,500 mt	22,500 mt
2017 Ccatch	58,000 mt	66,000 mt	81,000 mt	97,000 mt
2017 Catch (rho adjusted)	32,000 mt	37,000 mt	45,000 mt	55,000 mt

Source Documents

Brooks, E.N., and K.J. Curran, editors. 2016. Proceedings of the Transboundary Resources Assessment Committee (TRAC): Eastern Georges Bank Cod and Haddock, and Georges Bank Yellowtail Flounder: Report of Meeting held 12-14 July 2016. TRAC Proceedings 2016/01.

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. 2015. Eastern Georges Bank Haddock. TRAC Status Report 2015/02.

Correct Citation

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

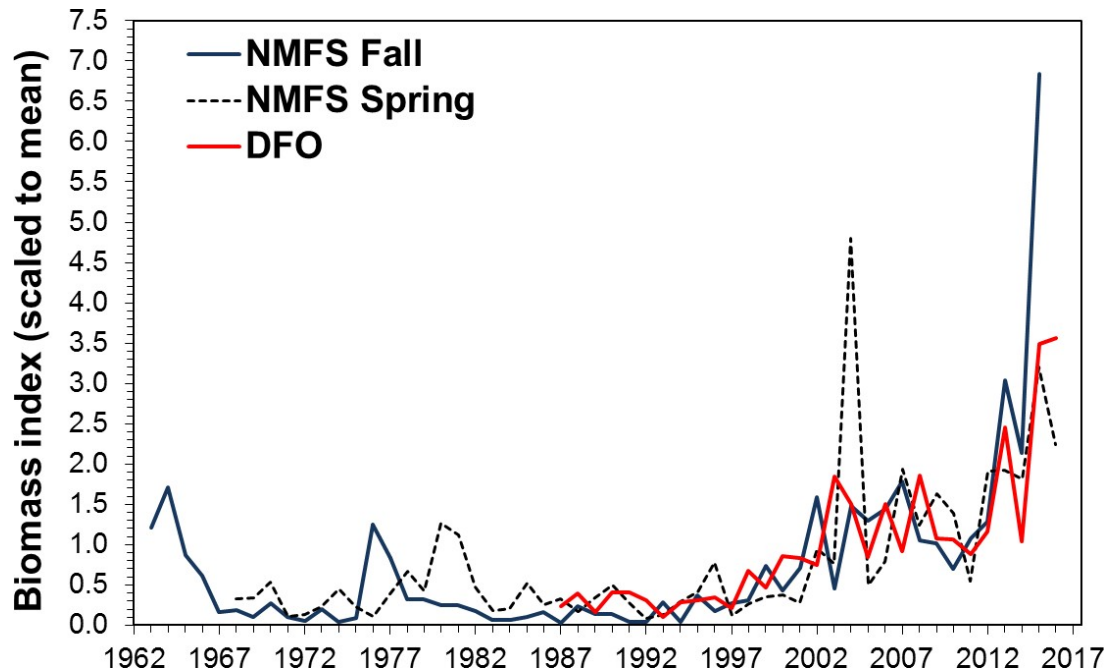


Figure 1. Scaled total biomass indices from NMFS fall (1963-2015), NMFS spring (1968-2016) and DFO (1987-2016) research surveys for eastern Georges Bank. Biomass conversion coefficients have been applied to the NMFS surveys to adjust for changes in door type (BMV vs Polyvalent; 1968-1984), vessel (Delaware II vs Albatross IV; 1968-2008) and vessel/net (Albatross IV vs Henry B. Bigelow; Yankee 36 vs 4 seam-3 bridle; 2009-2016). Biomass was scaled using the mean index value from 1987 to 2016.

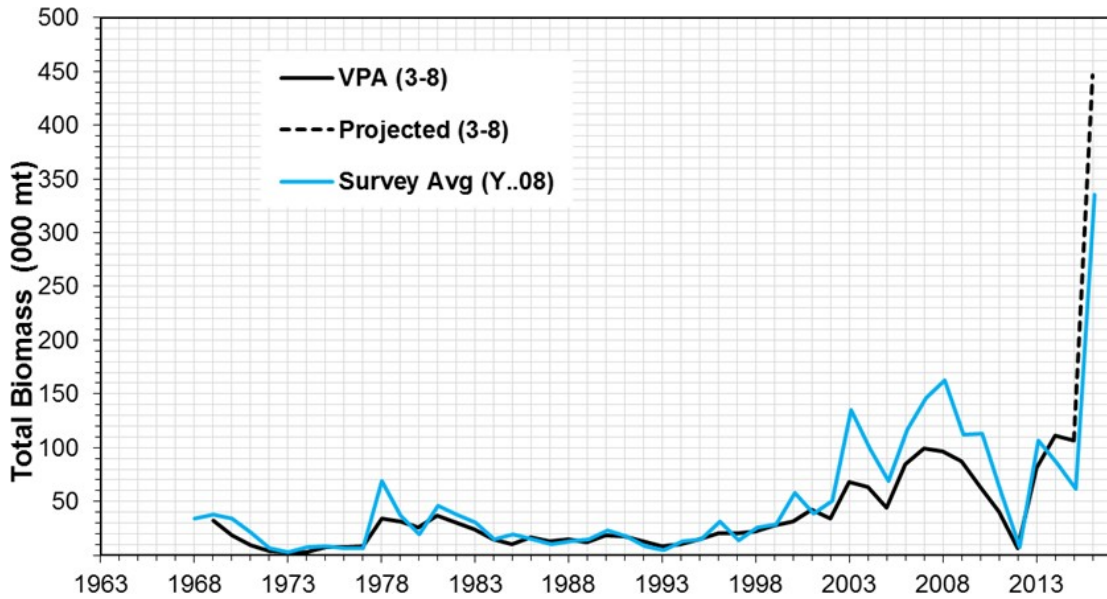


Figure 2. The 1969 to 2016 eastern Georges Bank adult haddock (ages 3-8) biomass from VPA compared with the average of the NMFS spring and DFO (age 3-8) and NMFS fall (age 2-7) survey biomass (scaled with catchability, q). Weight for age 8 in 2016 was derived by taking the average of weights in years 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 455,806 mt.