

3 Georges Bank Atlantic cod

Chris Legault

*This assessment of the Georges Bank Atlantic cod (*Gadus morhua*) stock is an operational assessment of the existing 2015 operational update assessment (NEFSC 2015). Based on the previous assessment the stock status could not be quantitatively determined but was qualitatively determined to be overfished based on poor stock condition, while overfishing status remained unknown (see Table 13 Legend). This 2017 assessment updates commercial fishery catch data through 2016 (Table 12, Figure 17) and updates research survey indices of abundance and the PlanBsmooth assessment model through 2017 (Figure 18).*

State of Stock: Based on this updated assessment, the Georges Bank Atlantic cod (*Gadus morhua*) stock status cannot be quantitatively determined due to a lack of biological reference points associated with the PlanBsmooth approach but is recommended to be overfished due to poor stock condition, while recommended overfishing status is unknown (Table 13). Retrospective adjustments were not made to the model results. The survey biomass in 2017 (the arithmetic average of the 2017 NEFSC spring and 2016 NEFSC fall surveys smoothed using a loess) was estimated to be 7.237 (kg/tow) (Figure 15). The 2016 relative exploitation rate (2016 catch divided by 2016 smoothed survey biomass) was estimated to be 0.174 (Figure 16).

Table 12: Catch and model results for Georges Bank Atlantic cod. Catch weights are in (mt), Biomass is the average survey biomass in (kg/tow) smoothed using a loess, and Rel. Exploit. Rate is the relative exploitation rate (catch/smoothed survey). Model results are from the PlanBsmooth assessment.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
<i>Data</i>										
Commercial landings	3,699	3,255	2,999	2,688	3,387	2,007	1,312	1,514	1,300	1,109
Commercial discards	728	309	385	253	122	120	83	19	31	33
Recreational landings	11	69	48	153	177	56	6	88	124	369
Recreational discards	3	1	5	23	17	1	1	2	15	30
CA landings	1,107	1,390	1,003	748	702	395	384	430	472	428
CA discards	117	140	206	94	43	75	39	28	20	12
Catch for Assessment	5,665	5,164	4,646	3,959	4,449	2,653	1,824	2,081	1,962	1,982
<i>Model Results</i>										
Biomass	3.27	3.223	3.227	3.107	3.13	3.175	3.022	2.474	3.144	4.696
Rel. Exploit. Rate	0.716	0.662	0.595	0.526	0.587	0.345	0.249	0.347	0.258	0.174

Table 13: Comparison of reference points estimated in the previous assessment and from the current assessment update. Note: based on NOAA’s policy, the Agency decided after the 2015 assessment that the stock status would remain as overfishing occurring and overfished based on an earlier benchmark assessment.

	2015	2017
F_{MSY} proxy	NA	NA
SSB_{MSY} (kg/tow)	NA	NA
MSY (mt)	NA	NA
Overfishing	Unknown	Unknown
Overfished	Yes	Yes

Projections: Short term projections cannot be computed using the PlanBsmooth approach. The PlanBsmooth approach estimates the rate of change in the recent three years of the smoothed survey biomass to be 1.517. This multiplier is applied to the average of the recent three years of catch (2,008 mt) to produce the catch advice for 2018 of 3,047 mt. The PlanBsmooth approach is fully described in NEFSC (2015) and available as an [R package](#).

Special Comments:

- What are the most important sources of uncertainty in this stock assessment? Explain, and describe qualitatively how they affect the assessment results (such as estimates of biomass, F, recruitment, and population projections).
The major source of uncertainty is the cause of the retrospective pattern that led to the analytical assessment of this stock not being accepted during the 2015 operational update meeting.
- Does this assessment model have a retrospective pattern? If so, is the pattern minor, or major? (A major retrospective pattern occurs when the adjusted SSB or F_{Full} lies outside of the approximate joint confidence region for SSB and F_{Full}).
No retrospective adjustment of spawning stock biomass or fishing mortality was required.
- Based on this stock assessment, are population projections well determined or uncertain? If this stock is in a rebuilding plan, how do the projections compare to the rebuilding schedule?
Population projections for Georges Bank Atlantic cod are not computed. Catch advice is derived from applying an estimate of recent change in the smoothed survey biomass to the average of the recent three years of catch and thus is influenced by uncertainty in survey estimates. The smoothed survey biomass is increasing, but without a biomass reference point it is not known if rebuilding is on schedule.
- Describe any changes that were made to the current stock assessment, beyond incorporating additional years of data and the effect these changes had on the assessment and stock status.
No major changes, other than the addition of recent years of data, were made to the Georges Bank Atlantic cod assessment for this update.

- If the stock status has changed a lot since the previous assessment, explain why this occurred.
The stock status for Georges Bank Atlantic cod remains overfished based on a qualitative evaluation of poor stock condition.
- Provide qualitative statements describing the condition of the stock that relate to stock status.
The Georges Bank Atlantic cod continues to show a truncated age structure. Despite an increase in the smoothed survey biomass the last two years, the most recent survey values remain below the mean of their time series. The 2013 year class is larger than recent year classes, but still below the average from the 1970s at ages 1-3 in both surveys.
- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.
The Georges Bank Atlantic cod assessment could be improved with additional studies on natural mortality, the potential for missing catch, and other possible sources of retrospective patterns in analytical assessments.
- Are there other important issues?
The differences in modeling approaches between the full Georges Bank cod assessment (reported here) and the TRAC cod assessment of eastern Georges Bank (a portion of the whole bank) remain a potential problem.

3.1 Reviewer Comments: Georges Bank Atlantic cod

Assessment Recommendation:

The panel concluded that the operational assessment was acceptable as a scientific basis for management advice. However, a relatively large increase in catch advice results from this approach, and this should be approached with caution, because previous recruitment events were not always realized in the fishery. The Scientific and Statistical Committees (SSCs) approach to buffering catch advice in determining an acceptable biological catch should consider this uncertainty.

Alternative Assessment Approach:

Not applicable

Status Recommendation:

Based on this operational assessment, the panel supports the conclusion that the Georges Bank Atlantic cod stock is in poor condition. The assessment approach is not able to provide quantitative values and biological reference points on which a stock status determination could be made; however, current stock status is considered overfished with overfishing occurring based on the previous benchmark assessment. The panel agrees with the 2015 operational assessment that the stock remains overfished. For instance, the Georges Bank Atlantic cod continues to show a truncated age structure. Despite an increase in the smoothed survey biomass the last two years, the most recent survey values remain below the mean of their time series. The 2013 year class appears larger than recent year classes, but concurrent increases in ages 4-6 suggest the increase in the 2013 year class may be artificial and the results should be treated with caution.

Key Sources of Uncertainty:

The major source of uncertainty with this stock is the cause of the retrospective pattern that led to the analytical assessment of this stock not being accepted during the 2015 operational update meeting.

Research Needs:

The panel recommends additional studies to address potential causes of the severe retrospective pattern, including studies on natural mortality, the potential effects of missing catch data, and other possible sources of retrospective patterns in analytical assessments.

References:

Northeast Fisheries Science Center. 2015. Operational Assessment of 20 Northeast Groundfish Stocks, Updated Through 2014. Northeast Fisheries Science Center Reference Document 15-24; 251 p. [CRD15-24](#)

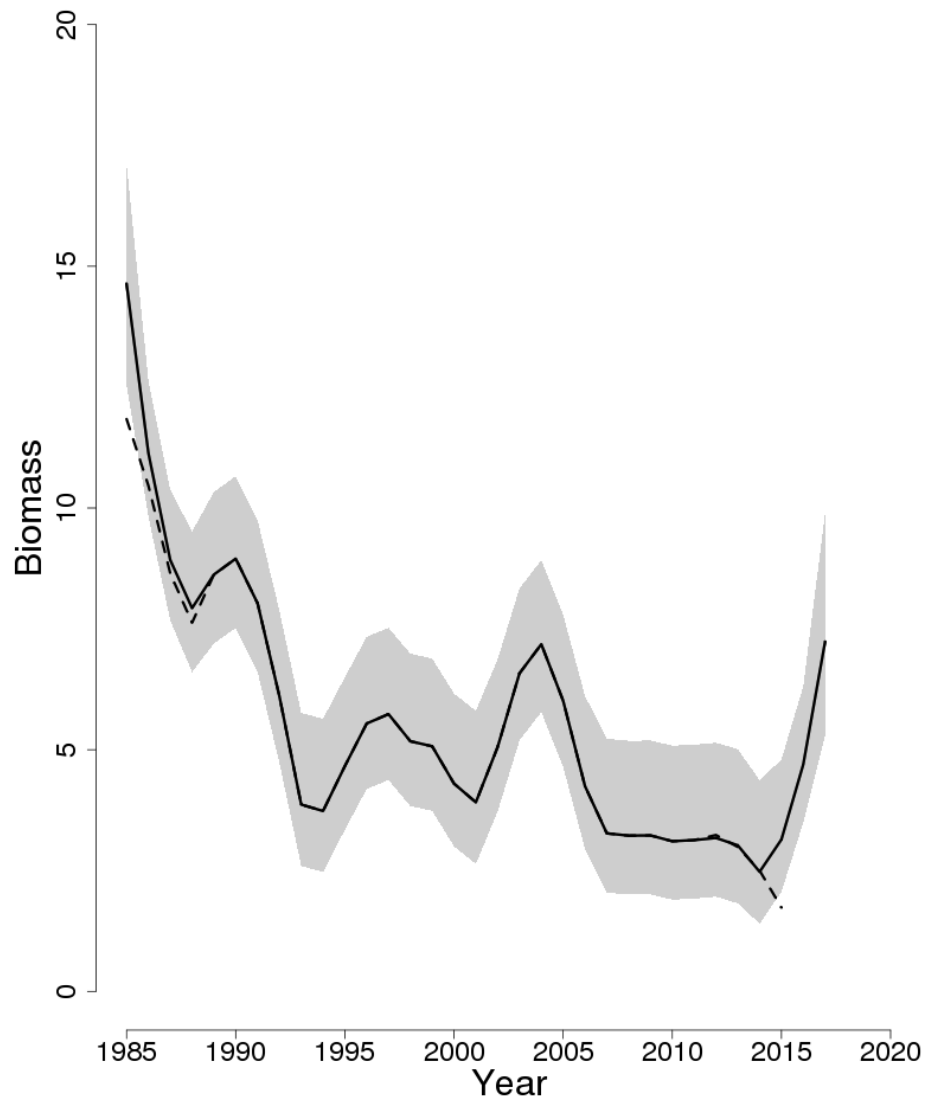


Figure 15: Trends in smoothed survey biomass (kg/tow) of Georges Bank Atlantic cod between 1985 and 2017 from the current (solid line) and previous (dashed line) assessment based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown.

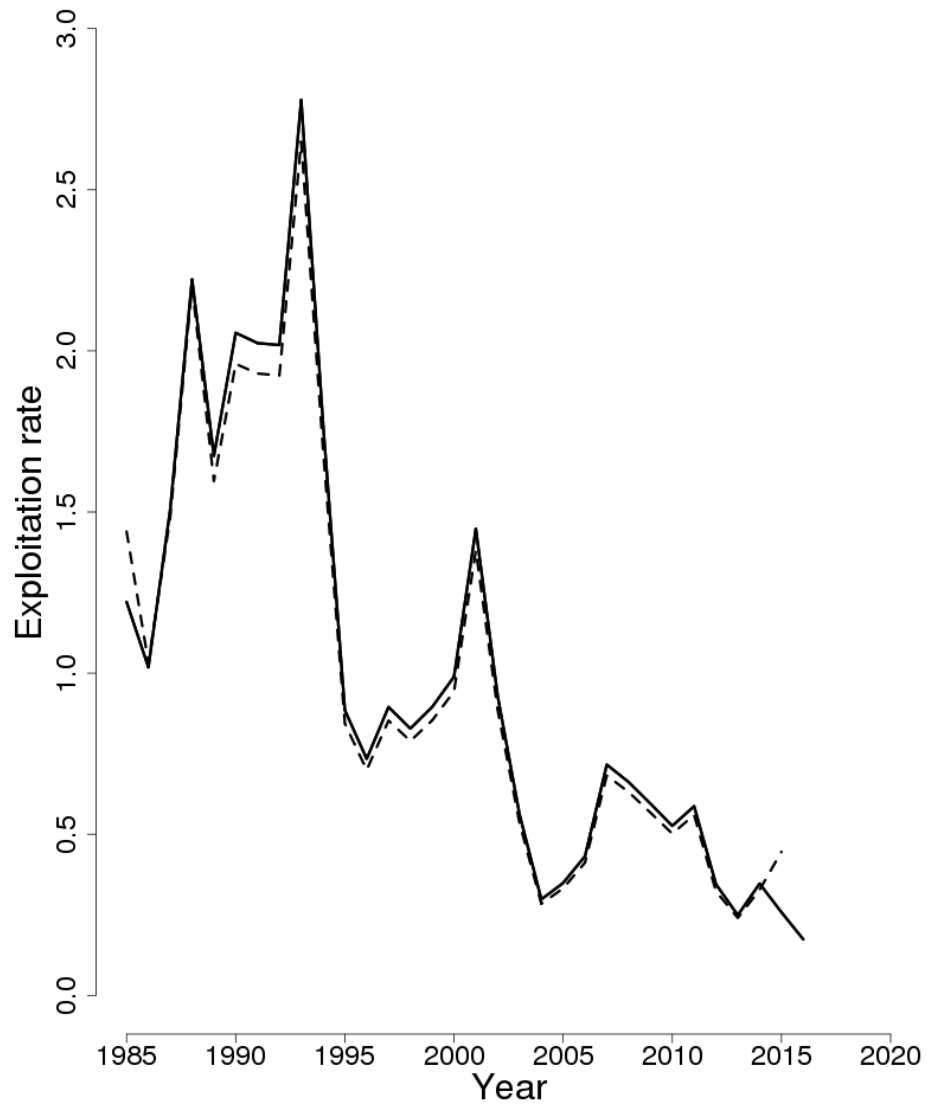


Figure 16: Trends in the relative exploitation rate (catch/smoothed survey) of Georges Bank Atlantic cod between 1985 and 2017 from the current (solid line) and previous (dashed line) assessment based on the 2017 assessment.

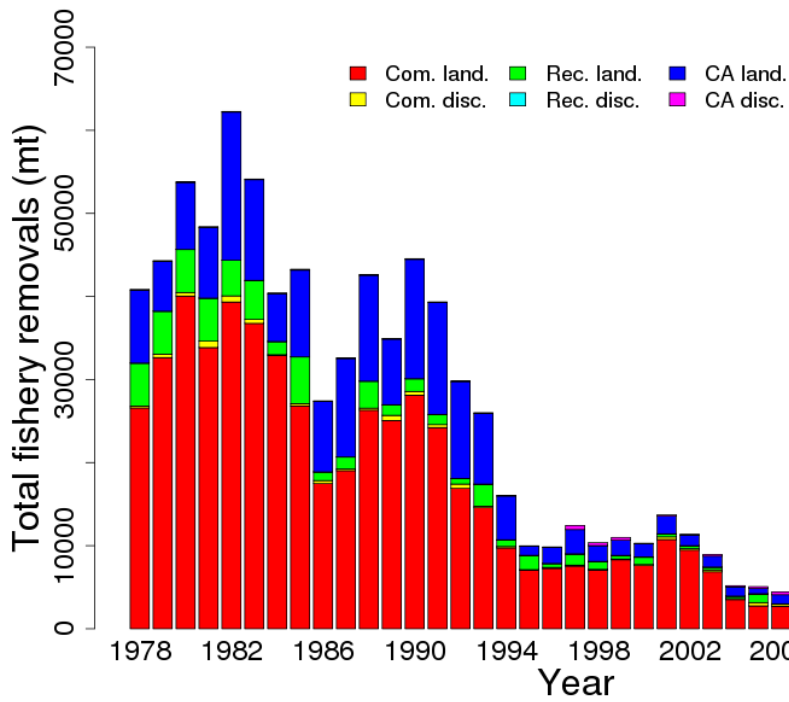


Figure 17: Total catch of Georges Bank Atlantic cod between 1978 and 2016 by fleet (US commercial, US recreational, or Canadian) and disposition (landings and discards).

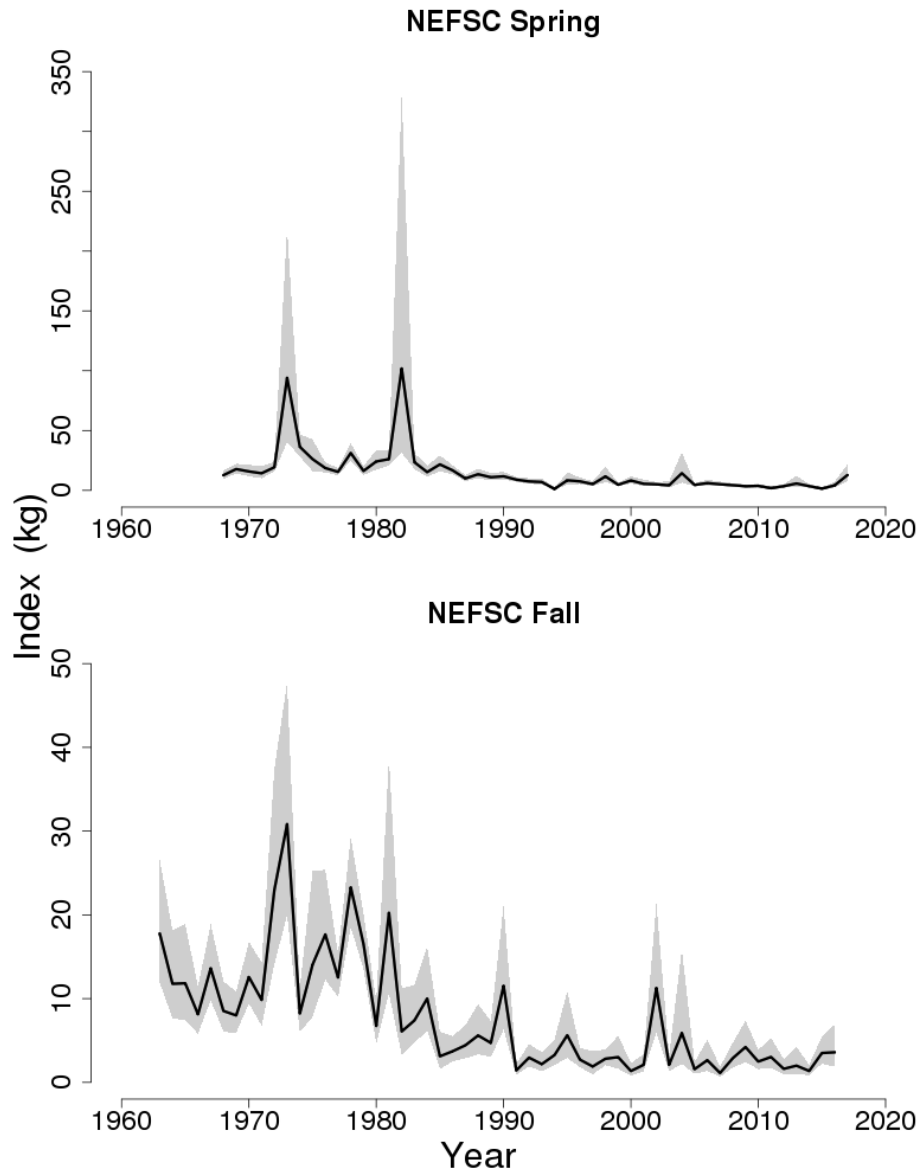


Figure 18: Indices of biomass for the Georges Bank Atlantic cod between 1963 and 2017 for the Northeast Fisheries Science Center (NEFSC) spring and fall trawl surveys. The approximate 90% lognormal confidence intervals are shown.