

5 Gulf of Maine haddock

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*This assessment of the Gulf of Maine haddock (*Melanogrammus aeglefinus*) stock is an operational assessment of the existing 2014 benchmark assessment (NEFSC 2014). Based on the previous assessment, the stock was not overfished, and overfishing was not occurring. This assessment updates commercial and recreational fishery catch data, research survey indices of abundance, and the analytical ASAP assessment model and reference points through 2014. Additionally, stock projections have been updated through 2018*

State of Stock: Based on this updated assessment, the Gulf of Maine haddock (*Melanogrammus aeglefinus*) stock is not overfished and overfishing is not occurring (Figures 26-27). Retrospective adjustments were not made to the model results (see Special Comments section of this report). Spawning stock biomass (SSB) in 2014 was estimated to be 10,325 (mt) which is 223% of the biomass target ($SSB_{MSY} proxy = 4,623$; Figure 26). The 2014 fully selected fishing mortality was estimated to be 0.257 which is 55% of the overfishing threshold proxy ($F_{MSY} proxy = F_{40\%} = 0.468$; Figure 27).

Table 18: Catch and status table for Gulf of Maine haddock. All weights are in (mt) recruitment is in (000s) and F_{Full} is the fully selected fishing mortality. Model results are from the current updated ASAP assessment.

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
<i>Data</i>										
Recreational discards	36	66	46	72	24	19	11	54	250	371
Recreational landings	538	447	573	537	409	314	229	251	299	314
Commercial discards	25	32	47	10	12	3	6	18	32	22
Commercial landings	978	622	678	543	500	623	499	417	212	314
Foreign landings	0	0	0	0	0	0	0	0	0	0
Catch for Assessment	1,577	1,167	1,343	1,162	946	958	744	739	793	1,021
<i>Model Results</i>										
Spawning Stock Biomass	8,848	8,219	7,271	6,369	5,735	4,877	4,086	4,551	6,907	10,325
F_{Full}	0.264	0.226	0.322	0.298	0.247	0.287	0.26	0.337	0.296	0.257
Recruits <i>age</i> 1	451	1,325	1,541	279	438	1,345	11,547	3,930	18,186	26,457

Table 19: Comparison of reference points estimated in an earlier assessment and from the current operational assessment. The overfishing threshold is the F_{MSY} proxy ($F_{40\%}$). The biomass target, (SSB_{MSY} proxy) was based on long-term stochastic projections of fishing at the F_{MSY} proxy. Median recruitment reflects the median estimated age-1 recruitment from 1977 - 2012. Intervals shown reflect the 5th and 95th percentiles.

	2014	Current
F_{MSY} proxy	0.46 (0.36 - 0.54)	0.468 (0.391 - 0.547)
SSB_{MSY} (mt)	4,108 (1,774 - 7,861)	4,623 (2,036 - 9,283)
MSY (mt)	955 (421 - 1,807)	1,083 (489 - 2,148)
Median recruits (age 1) (000s)	1,121 (205 - 6,500)	1,335 (253 - 8,198)
<i>Overfishing</i>	No	No
<i>Overfished</i>	No	No

Projections: Short term projections of median total fishery yield and spawning stock biomass for Gulf of Maine haddock were conducted based on a harvest scenario of fishing at the F_{MSY} proxy between 2016 and 2018. Catch in 2015 has been estimated at 885 mt. Recruitment was sampled from a cumulative distribution function of model estimated age-1 recruitment from 1977-2012. The age-1 estimate in 2015 was generated from the geometric mean of the 1977-2014 recruitment series. The annual fishery selectivity, maturity ogive, and mean weights at age used in the projections were estimated from the most recent 5 year averages; retrospective adjustments were not applied in the projections. Given the uncertainty in the size of the 2012 and 2013 year classes and the model's tendency to overestimate large terminal year classes, the 2015 assessment review panel recommended that a sensitivity projection scenario which constrains terminal recruitment ('Constrain terminal R') be brought forward to the New England Fishery Management Council's Scientific and Statistical Committee (NEFMC SSC) for consideration when setting catch advice; these sensitivity projections are provided in the Supplemental Information Report ([SASINF](#)).

Table 20: Short term projections of total fishery catch and spawning stock biomass for Gulf of Maine haddock based on a harvest scenario of fishing at F_{MSY} proxy ($F_{40\%}$) between 2016 and 2018. Catch in 2015 was assumed to be 885 (mt).

Year	Catch (mt)	SSB (mt)	F_{Full}
2015	885	18,026	0.131
2016	4,717	25,352	0.468
2017	5,614	24,623	0.468
2018	5,642	20,371	0.468

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 largest source of uncertainty in the assessment is the estimated size of the 2012 and 2013 year classes. Based on the estimated selectivity patterns, these year classes are projected to be 30% selected to the fishery in 2016 and 2017 respectively. However, recent changes to the commercial and recreational minimum retention size may result in these year classes recruiting to the fishery sooner than projected. The abundance and growth of the 2012 and 2013 year classes should be monitored and frequent model updates would be expected to improve the estimates of year class size and validate projection assumptions.

- 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} lie outside of the approximate joint confidence region for SSB and F_{Full}).

This assessment does not exhibit a retrospective pattern and therefore no retrospective adjustments were made to the terminal model results or the short-term catch projections. The 7-year Mohn's rho values on SSB (-0.04) and F (0.03) are small and there were no consistent patterns in the directionality of the retrospective 'peels' (see the Supplemental Information Report, [SASINF](#)).

- Based on this stock assessment, are population projections well determined or uncertain?

Population projections for Gulf of Maine haddock are reasonably well determined. The projected biomass from the last assessment is below the confidence bounds of the biomass estimated in the current assessment; however, this is primarily due to the positive rescaling of the population size that occurred from turning the ASAP model likelihood constants option off (see next Special Comment).

- Describe any changes that were made to the current stock assessment beyond incorporating additional years of data, and the affect these changes had on the assessment and stock status.

Recreational catch estimates from 2004-2014 were re-estimated as part of this update to account for updates to the MRIP data. Additionally, the ASAP model was revised by turning the likelihood constants off; sensitivity runs on SAW/SARC 59 model suggest minor positive rescaling of recruitment and SSB, negative rescaling of F (sensitivity results are provided in the Supplemental Information Report, [SASINF](#)).

- If the stock status has changed a lot since the previous assessment, explain why this occurred.

There has been no change in stock status since the previous SAW/SARC 59 assessment (2014).

- Indicate what data or studies are currently lacking and which would be needed most to improve this stock assessment in the future.

Currently the assessment assumes 50% survival of haddock discarded in the recreational fishery - directed field research would improve this estimate. Additionally, a better understanding of recruitment processes may help to improve recruitment forecasting.

- Are there other important issues?

None.

5.1 Reviewer Comments: Gulf of Maine haddock

Recommendation: The Panel concluded that the updated assessment was acceptable as a scientific basis for management advice. The minor revisions to the recreational catch statistics are justified. The Assessment Oversight Panel recommended that the likelihood function should be revised. The assessment results are somewhat sensitive to the revised likelihood function, but the revision is reasonable. There was no retrospective pattern in the update assessment.

Alternative Assessment Approach: Not Applicable

Sources of Uncertainty: The major source of uncertainty is the estimation of recent recruitment; the abundance of the 2012 and 2013 year classes is not well estimated. A sensitivity analysis of the SAW59 benchmark method that includes a constraint on the estimate of recruitment in the last year of the assessment, which limits the abundance estimate of the 2013 year class, was also provided in the update assessment. The method was performance tested in SAW59 but the Panel noted that the model does not fit the surveys well in the last two years. Although density-dependent growth has not been observed for this stock, there have been strong density-dependent effects for haddock in other areas from dominant year classes. Recreational discard mortality is also uncertain.

Research Needs: The Panel recommends that abundance of 2012 and 2013 year classes should be monitored. Model updates are expected to improve the estimates of abundance. As noted for Georges Bank haddock, a better understanding of recruitment process may help to improve the estimation and projection of recruitment. Importantly, the estimation of MSY reference points for a stock with episodic recruitment should be reconsidered. When experimental results become available, estimates of recreational discard mortality should be considered in future assessments. Projections from the sensitivity analysis with recruitment constraints should be considered for catch advice.

References:

Northeast Fisheries Science Center. 2014. 59th Northeast Regional Stock Assessment Workshop (59th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-09; 782 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. [CRD14-09](#)

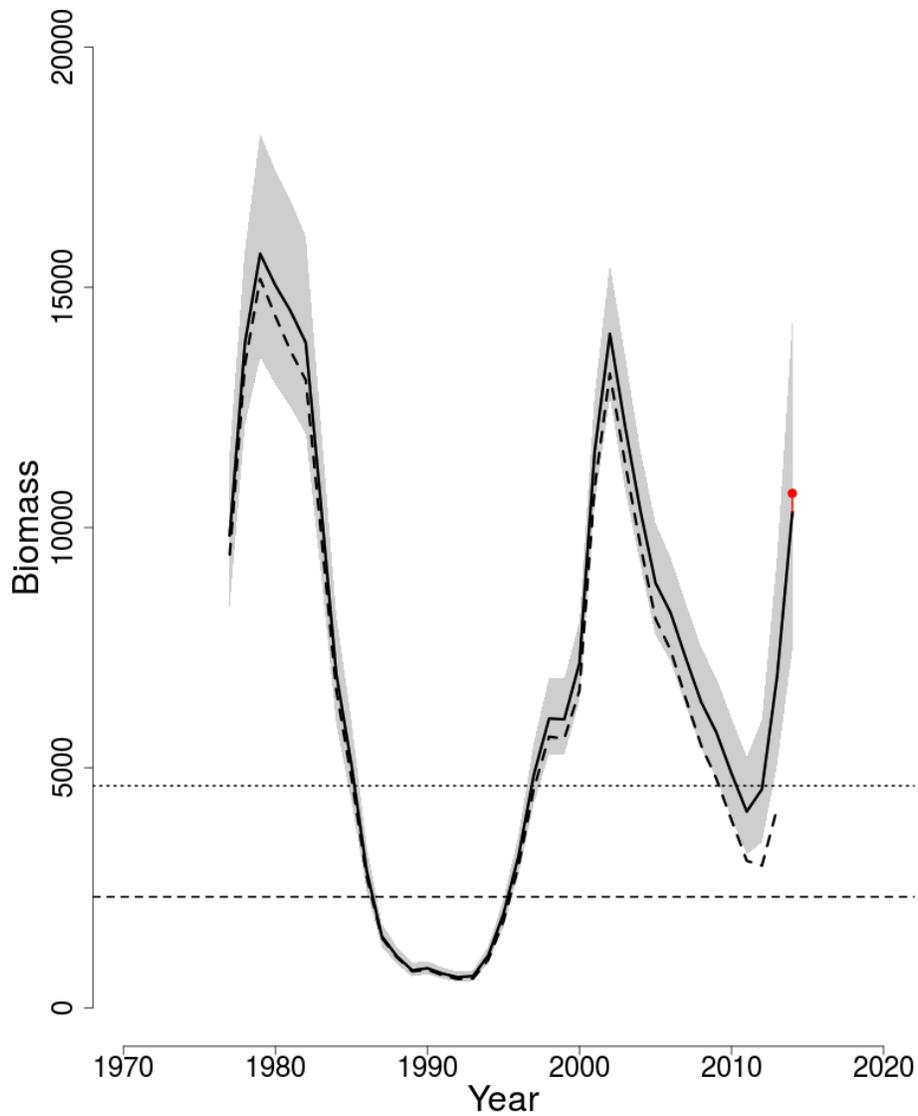


Figure 26: Trends in spawning stock biomass (SSB) of Gulf of Maine haddock between 1977 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{Threshold}$ ($\frac{1}{2} SSB_{MSY}$ proxy; horizontal dashed line) as well as SSB_{Target} (SSB_{MSY} proxy; horizontal dotted line) based on the 2015 assessment. The approximate 90% lognormal confidence intervals are shown. The red dot indicates the rho-adjusted SSB values that would have resulted had a retrospective adjustment been made to either model (see Special Comments section).

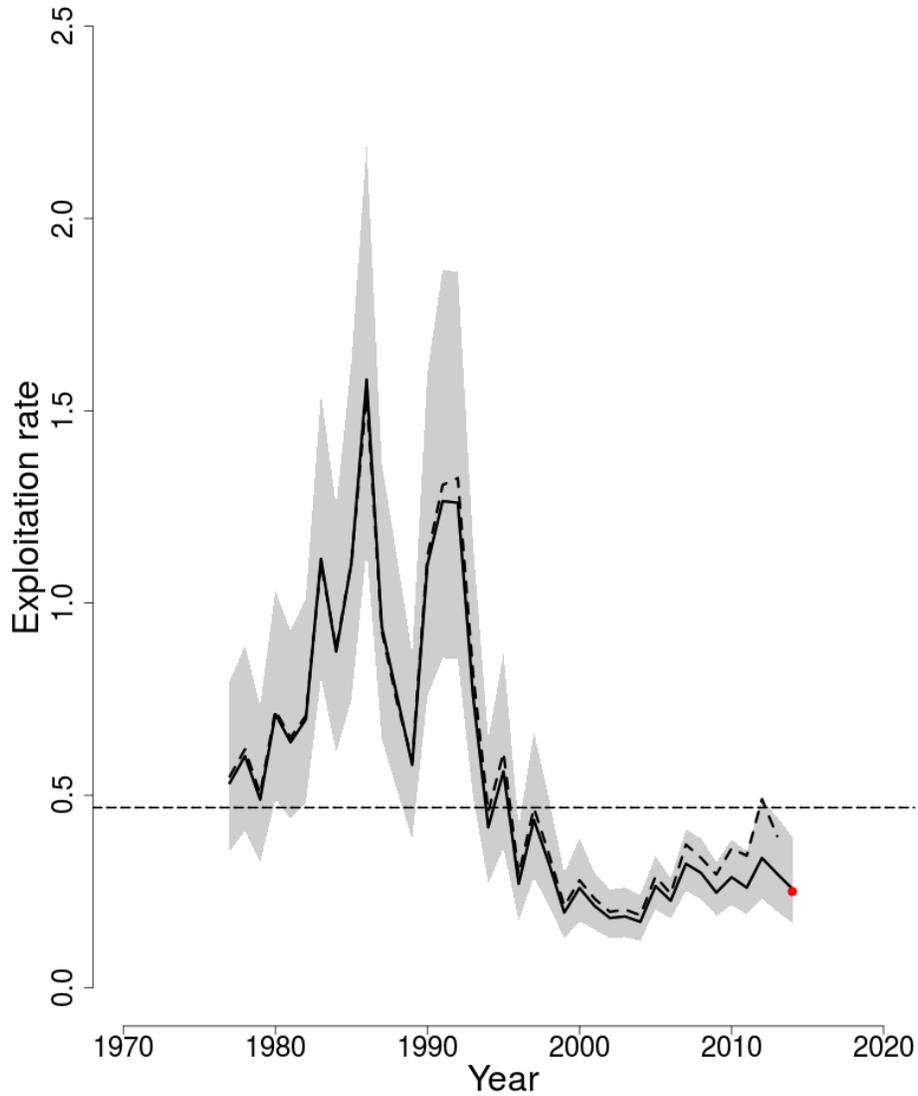


Figure 27: Trends in the fully selected fishing mortality (F) of Gulf of Maine haddock between 1977 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{Threshold}$ (F_{MSY} proxy=0.468; horizontal dashed line) from the 2015 assessment model. The approximate 90% lognormal confidence intervals are shown. The red dot indicates the rho-adjusted F values that would have resulted had a retrospective adjustment been made to either model (see Special Comments section).

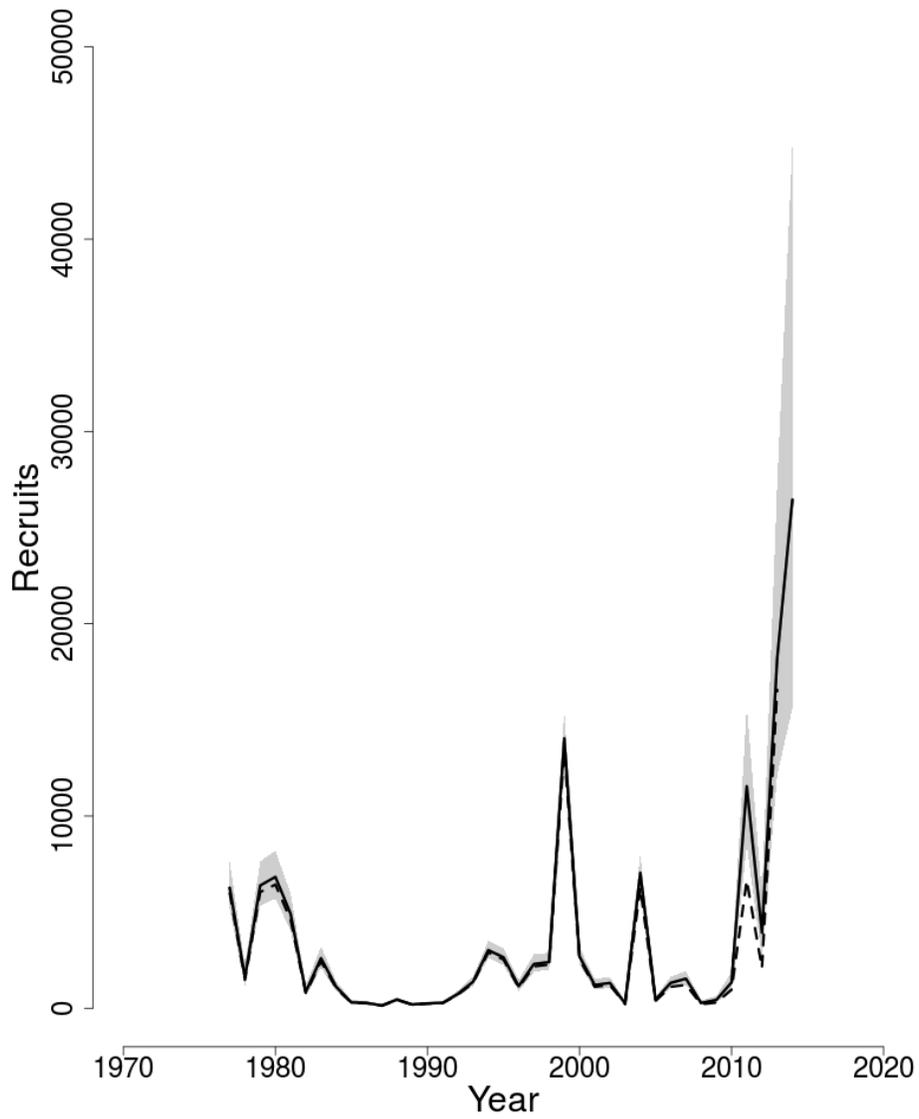


Figure 28: Trends in Recruits (age 1) (000s) of Gulf of Maine haddock between 1977 and 2014 from the current (solid line) and previous (dashed line) assessment. The approximate 90% lognormal confidence intervals are shown.

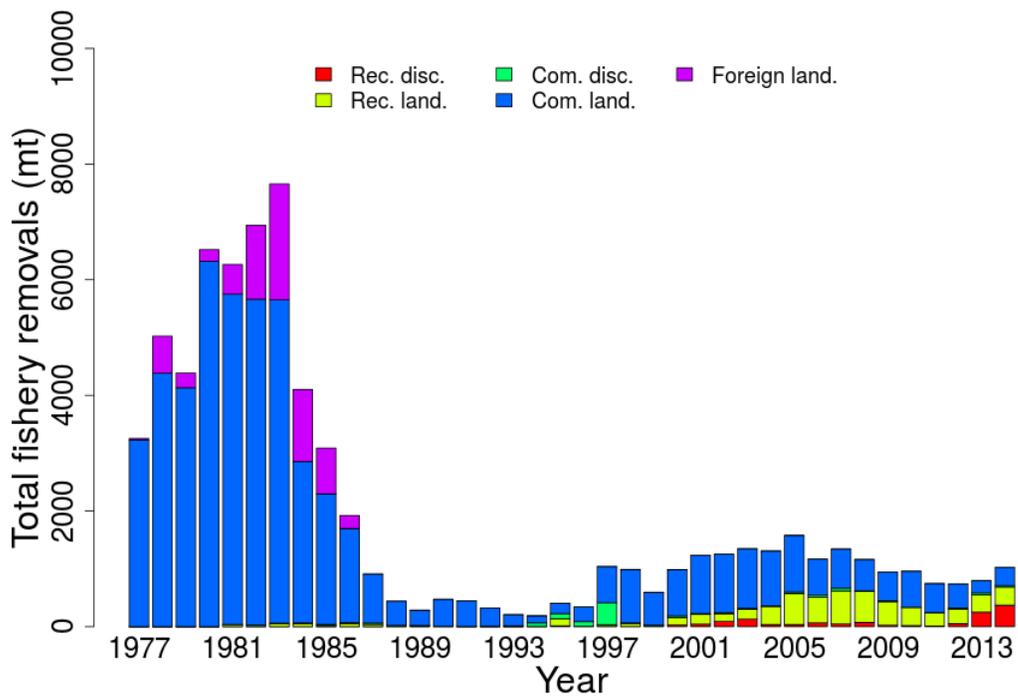


Figure 29: Total catch of Gulf of Maine haddock between 1977 and 2014 by fleet (commercial, recreational, or foreign) and disposition (landings and discards).

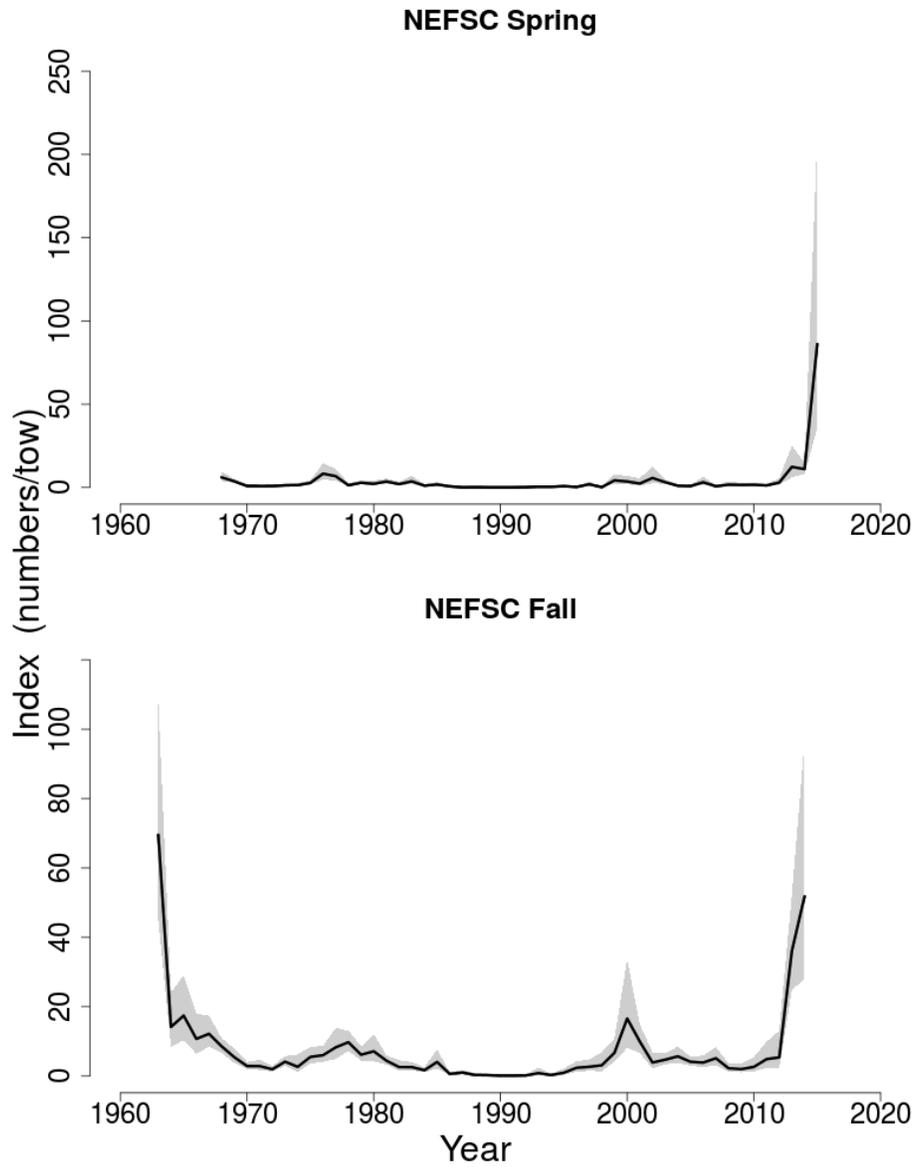


Figure 30: Indices of biomass for the Gulf of Maine haddock between 1963 and 2015 for the Northeast Fisheries Science Center (NEFSC) spring and fall bottom trawl surveys. The approximate 90% lognormal confidence intervals are shown.